Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Remediation Action Plan

Randwick Campus Redevelopment
Stage 1 and IASB Addition
Botany and Magill Streets, and Hospital Road,
Randwick

Prepared for
LendLease Building Pty Limited

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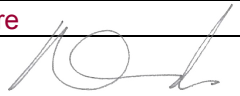
Author		18 September 2019
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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666

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Randwick Campus Redevelopment – Stage 1 and IASB Addition
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1. Introduction

Douglas Partners Pty Ltd (DP) was commissioned by LendLease Building Pty Ltd to prepare a remediation action plan (RAP) for the Randwick Campus Redevelopment (RCR) project – Stage 1 and IASB Addition, bound by Hospital Road, Botany Street and Magill Street (as shown on Drawing 1, Appendix A – labelled "Stage 1 Boundary" and "IASB Addition Boundary"). The RAP was prepared in accordance with DP's initial proposal SYD180227 dated 4 June 2018, and subsequent proposal SYD181172 dated 18 January 2019.

It is understood that the RCR project will be undertaken in two stages (Stage 1 and Stage 2). Stage 1 is proposed to include development of a new multi-storey Acute Services Building (ASB) with associated landscaping. The core elements of the IASB Addition include the University of New South Wales (UNSW) Eastern Extension (base building only), associated modifications within the ASB, lowering of Hospital Road and Delivery Drive, and limited landscaping. Further details of the proposed development are provided in Section 4.

At the time of preparing this RAP, the development details associated with Stage 2 of the campus redevelopment (refer Drawing 1, Appendix A – labelled "Stage 2 Boundary") were not finalised. As such, this RAP focusses on the Stage 1 and IASB Addition works only, as detailed in the State Significant Development applications. Remediation requirements for Stage 2 will need to be documented in a separate RAP once the development details are known.

For ease of reference, from herein the terms "site" refers to the combined Stage 1 and IASB Addition, whilst the whole of the RCR project is referred to as "RCR Project Area".

The site is being audited by Jason Clay, a NSW Environment Protection Authority (EPA) accredited site auditor. It is understood that this RAP will be used to facilitate the issue of a site audit statement (SAS) Part B, confirming the Stage 1 and IASB Addition areas can be made suitable for the proposed development.

In the preparation of this RAP, reference has been made to the following guidelines:

- National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (as amended in 2013), (NEPC, 2013);
- NSW EPA, *Sampling Design Guidelines* (EPA, 1995);
- NSW OEH, *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011);
- NSW EPA (2017) *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* 3rd Edition (EPA, 2017);

- NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA, 2014a);
- NSW EPA *Waste Classification Guidelines Part 2: Immobilisation of Waste* (EPA, 2014b);
- State Environmental Planning Policy 55 (SEPP55) - Remediation of Land; and
- WA DOH (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia*.

The overall objective of the remediation programme outlined in the RAP is to render the site suitable, from a contamination perspective, for the proposed development. The objectives of the RAP are listed in Section 2.

2. Scope of Works

The scope of the RAP has been established on the basis of the findings of the previous investigations, site observations and proposed development details.

The objective of the RAP is to remove and/or to mitigate associated risks of potential environmental and human health impacts posed by identified contamination and contamination uncovered during earthworks (as unexpected finds) such that the site can be rendered suitable for the proposed development.

In this regard, the objectives of this RAP are to:

- Establish an appropriate remedial strategy so as to render the site suitable, from a contamination perspective, for the proposed development;
- Establish the remediation acceptance criteria to be adopted for the remediation of the site and the validation requirements to verify the successful implementation of the remediation strategy;
- Establish appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner;
- Establish appropriate occupational, health and safety (OH&S) procedures required to complete the remediation works in a manner that would not pose a threat to the health of site workers or users; and
- Establish a framework to minimise environmental risk on the site and the surrounding environment.

3. Site Information

3.1 Site Identification

The site is located approximately 7 km southeast of the Sydney CBD (Drawing 1, Appendix A). The site is bordered by the remainder of the RCR Development Area to the north, Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue

runs through the centre of Stage 1 of the site, extending north through the remainder of the RCR Development Area to High Street.

To the east of Hospital Road is the existing Randwick Hospital Campus (the Hospital), currently occupied by numerous multi-storey buildings, a number of car parks, and open space and courtyard areas. Buildings across the Hospital include the Sydney Children's Hospital and Ronald McDonald House, The Prince of Wales Public and Private Hospitals including patient wings, operating theatres and palliative care, and campus services such as staff residences, ambulance station, and childcare facilities. The existing hospital occupies a total area of approximately 13.5 hectares (ha).

General site information is provided in Table 1 below.

Table 1: General Site Information

Item	Description
Site Name/ Occupier:	Health Infrastructure
Site Address	Bordered by Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue runs through the centre of the site (Drawing 1, Appendix A).

Item	Description
Deposited Plans	Refer Drawing U1-XX-03, Appendix B for Stage 1 lots. Lot 35 DP7745; Lot 1 DP12909; Lot 2 DP12909; Lot A P102029 Lot B DP102029; Lot B DP303478; Lot A DP303478; Lot D DP304806; Lot C DP304806; Lot B DP304806; Lot A DP304806 Lot 1 DP13995; Lot 2 DP13995; Lot 3 DP13995; Lot 4 DP13995; Lot 5 DP13995; Lot 6 DP13995; Lot 7 DP13995; Lot 8 DP13995; Lot 9 DP13995; Lot 10 DP13995; Lot 11 DP13995; Lot 12 DP13995; Lot Y DP445567; Lot X DP445567; Lot A DP439756; Lot B DP439756; Lot 1 DP300666; Lot 32 DP667518; Lot 3 P667518; Lot 4 DP667518; Lot 5 DP667518; Lot 6 DP667518; Lot 7 DP667518; Lot 4 DP667518; Lot 9 DP667518; Lot 10 DP667518; Lot 11 DP667518; Lot 12 DP667518; Lot 13 P667518; Lot 14 DP667518; Lot B DP6441943; Lot A P6441943; Lot 1 DP1182570; Lot 2 DP1182570; Lot 23A P434935; Lot 23B DP434935; Lot 1 DP522586; Lot 2 DP522586; Lot 1 DP501682; Lot 2 DP501682; Lot 3 DP513339; Lot 4 DP513339; Lot 19 DP7745; Lot 18 DP7745; Lot 11 DP806091; Lot 1 DP74860; Lot 7 DP 975640; Lot 1 DP307266; Lot 12 DP806091; Lot 1 DP11351; Lot 2 DP11351; Lot 3 DP11351; Lot 1 DP590480; Lot 2 DP590480; Lot A DP440501; Lot B DP440501; Lot C DP440501; Lot D DP440501; Lot 1 DP13997; Lot 2 DP13997; Lot 3 DP13997; Lot 4 DP13997; Lot 5 DP13997; Lot 6 DP13997; Lot 7 DP13997; Lot A DP167106; Lot B DP167106; Lot C DP167106; Lot D DP167106; Lot A DP33161; Lot B DP33161; Lot C DP33161; Lot D DP33161; Lot E DP33161; Lot F DP33161; Lot 1 DP741639; Lot 2 DP1134643; Lot A DP439101; Lot B DP439101; Lot 3 DP302329. The IASB Addition covers part Lots 6-11 DP 13995 and part Lot 1 DP870720 (Prince of Wales Hospitals Campus), Hospital Road, Randwick.
Geographical Co-ordinates (SSD Area (Stage 1), refer Drawing RCR-BVN-ARC-00-DRW-01A-NL00011B, Appendix B))	NW corner 336970.92 m E, 6245569.83 m S NE corner 337087.17 m E, 6245551.42 m S SW corner 336949.89 m E, 6245437.09 m S SE corner 337066.14 m E, 6245418.68 m S IASB Addition Coordinates not shown.
Local Government Authority	Randwick City Council
County/Parish	Parish of Alexandria and the County of Cumberland
Total Site Area	Approximately 2.1 ha
Current Zoning (Stage 1)	R2 – Low density residential; and R3 – Medium density residential

Item	Description
Current Zoning (IASB Addition)	SP2 – Health Services Facility
Recent Site Use	Stage 1 - Multiple single dwelling urban residential allotments, undergoing demolition and early civil works at the time of preparing this RAP. IASB Addition – Existing Hospital Road, part existing hospital buildings and car parking spaces.
Proposed Future Land Use	Acute Services Buildings (part of the existing hospital expansion). IASB Addition (part of the hospital redevelopment)

The land uses surrounding the site include:

- *North* – The remainder of the RCR Development Area, currently occupied by some remaining dwellings (in the process of demolition), some vacant lots where demolition has been completed, and the site compound in the north east corner;
- *East* – Hospital Road and Randwick Hospital (described above) followed by Avoca Street located to the east. Beyond this is open space parkland, located at the junction of Avoca Street and Belmore Road. Residential properties are also located to the east of Avoca Street. Further east is Brigidine College, comprising a number of multi-storey buildings and open space areas;
- *South* – Magill Street located to the south of the site is predominantly residential; and
- *West* – Botany Street is located to the west followed by the University of NSW, Biomedical Campus which has been the subject of previous investigations by DP and was previously part of the larger university site which had previously been quarried for igneous clays from a dyke/ diatreme previously identified at the site. The quarry was subsequently backfilled. The historical aerial photographs indicated that the quarry/landfill extends beyond the boundary of the current development. Following completion of quarrying (to depths of approximately 4.5 m to 9.0 m based on field observations), the area appears to have been backfilled in an uncontrolled manner and has since been used for internal roadways and parking by the university. To DP's knowledge, the quarry was backfilled with inert solid wastes and soil, with variable anthropogenics. There were no known organics buried in the quarry. As such, the backfilled quarry is not considered to be a source of hazardous ground gases.

3.2 Topography, Geology and Hydrogeology

Reference to the Sydney 1:250,000 Series Geological Sheet indicates that the Randwick area is located mainly on Quaternary aged alluvium, gravel, sand silt and clay, with some areas also being located on Triassic aged Hawkesbury Sandstone, comprising sandstone and quartz with some shale.

The Tasman Sea lies to the east of the site. Eastlakes and Mill Pond lie to the south west of the site, leading into Botany Bay. The anticipated groundwater flow direction from the site, on this basis, is west to south west. However, previous investigations by DP in the vicinity of the site suggest that a south-easterly groundwater flow direction is also possible.

Drillers logs supplied indicated that the lithology across the area was generally comprised of topsoil or fill, followed by either sand or clay, and sandstone. Coffee rock and peat was noted at some locations. DP has previously undertaken works on the adjacent UNSW site to the west. The general finding close to the site is that the depth to rock varied from 0.7 m to >5 m bgl. While no free groundwater was observed in these bores, DP expects that this observation may be dependent on the drilling method used during fieldwork.

A groundwater bore search of the Department of Water and Energy website database (previously held by the Department of Natural Resources) was conducted on 11 September 2017. Forty-seven groundwater bores were located within a 1 km radius of the site. The bores were used for monitoring, remediation, recreation, domestic, commercial, and industrial. The standing water levels for the majority of groundwater wells were found to range from 2.5 to 5 metres below ground level (bgl), with measurements of 8.6,10, 16.5, 20 and 27 m bgl also recorded.

In the investigation conducted by DP in the Randwick Hospital site to the east, groundwater was observed at depths of 3.7 m (RL 40.5 m) and 4.7 m (RL 44.4 m) in two boreholes. No groundwater was observed during auger drilling in the remaining boreholes. The use of water for rock coring purposes precluded any further observation of groundwater.

Measured groundwater levels in wells installed previously by DP, in relation to the RCR Development Area, showed groundwater levels generally between 3 m and 6 m bgl. In relation to the site, the following groundwater levels were measured in the wells:

Topographic up-gradient of Stage 1:	BH202 – 4 m bgl; BH204 – 6 m bgl;
Topographic cross gradient of Stage 1:	BH11 – 5.2 m bgl; and
Topographic down-gradient of Stage 1:	BH14 – 3.5 m bgl.

The groundwater flow direction at the site (and the RCR Development Area) is generally towards the south.

3.3 Site Description

At the time of conducting the initial investigations in 2017, then in 2018, the RCR Development Area comprised a collection of about 92 urban residential properties and a public road (Eurimbla Avenue), part of which is shown on Drawing 1, Appendix A.

As of early 2019, the RCR Development Area has undergone significant demolition works with the majority of the low-density residential houses in the area being demolished and removed. All previous residents within the site have relocated and the entire RCR Development Area declared a construction area.

At the time of preparing this report, several parts of the RCR Development Area had been stripped of surface soils for waste classification and disposal, and the site compound was under construction in the north-eastern portion of the site.

At the time of preparing this report, the site was similarly largely cleared of former structures, with some demolition continuing on the eastern side, and Eurimbla Avenue still intact.

The IASB Addition area had not been subject to any changes under the redevelopment at the time of preparing this report. The area comprised part of Hospital Road, portions of several existing hospital buildings, car parking spaces and landscaping, as shown on the aerial photograph base of Drawing 1, Appendix A.

4. Proposed Development

It is understood that the proposed Randwick Campus Redevelopment will include:

Stage 1 (State Significant Development):

- A new multi-storey ASB within Stage 1, with two basement levels (Level 02 extending to RL 47 m), requiring excavations to depths of around 8 m. The outline of the proposed building and basement is shown on Drawing RCR-ENS-STR-50-DRW-002, Appendix B; and
- Surrounding the building will be pedestrian footpaths and general landscaping, as shown on Drawing 01A-NL00013 in Appendix B.

IASB Addition:

The core elements of the IASB Addition are as follows:

- University of New South Wales (UNSW) Eastern Extension (base building only);
- Associated modifications within the ASB;
- Lowering of Hospital Road; and
- Landscaping.

Stage 2:

It is understood that a future expansion area, located immediately north of the proposed ASB site and extending up to High Street (Stage 2), is also being considered. No details of this future development are known at this stage. However, it is likely that the future development may include multi-storey buildings, new internal roads and utilities. It is also understood that the north-western part of Stage 2 is likely to be utilised for educational purposes (UNSW) whist the north east portion is likely to include a hospital expansion.

5. Review of Previous Reports

Previous reports reviewed as part of this RAP include:

- Douglas Partners *Report on Preliminary Geotechnical Investigation, Randwick Campus Redevelopment* Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Health Infrastructure, Project 72505.11 dated February 2018 (DP, 2018a);

- Douglas Partners *Report on Preliminary Site Investigation for Contamination, Randwick Campus Redevelopment,* Hospital Road and High, Magill and Botany Streets, Randwick, Project 72505.12.R.001.Rev2 dated February 2018 (DP, 2018b);
- Douglas Partners *Report on Supplementary Geotechnical Investigation*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.13 dated June, 2018 (DP, 2018c);
- Douglas Partners *Groundwater Monitoring Round 2,* Randwick Campus Redevelopment Project No. 72505.13 R.002.Rev0 dated 20 June 2018 (DP, 2018d);
- Douglas Partners *Sampling and Analysis Quality Plan (SAQP)*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.15 dated February, 2019 (DP, 2019a);
- Douglas Partners *Spoil Management Plan*, Randwick Campus Redevelopment Hospital Road and High, Magill and Botany Streets, Randwick Prepared for Lendlease Building Pty Ltd Project 72505.15 dated February, 2019 (DP, 2019b);
- Douglas Partners *Report on Detailed Site Investigation for Contamination, Randwick Campus Redevelopment,* Hospital Road and High, Magill and Botany Streets, Randwick, Project 72505.14.R.001.Revision 2 dated February 2019 (DP, 2019c);
- Douglas Partners *Report on Detailed Site Investigation, IASB Addition - Randwick Campus Redevelopment, Hospital Road, Randwick* Project 72505.16.R.001.DftA dated 4 September 2019 (DP, 2019d)*;* and
- Various Hazardous Building Materials reports prepared by Property Risk Australia.

5.1 DP, 2018a

A preliminary geotechnical investigation was undertaken by DP in February 2018 and included the drilling of nine boreholes, installation of one groundwater monitoring well and laboratory testing for geotechnical purposes. The geotechnical investigation was conducted in conjunction DP (2018b).

5.2 DP, 2018b

DP (2018b) was carried for the RCR Development Area (referred to as *the site* in this section only).

DP undertook a preliminary site investigation (PSI) which included a review of site history information, a site walkover, intrusive investigation, laboratory analysis and reporting. Due to access restrictions, it was not possible to complete all proposed bore locations.

Aerials photographs from 1943 to 2014 were reviewed to provide an indication of past land uses and identify possible sources of contamination. The review indicated that the residential properties along Eurimbla Ave, Botany Street and Hospital Road were built during or prior to 1943, with little change observed over the years. In 1991, a number of properties on the site were extended to the rear, with more extensions observed in the 2000 aerial. The overall layout however remained much the same as in previous years.

With regards to the surrounding land, in the 1943 aerial, residential properties were evident to the north and south of the site. To the west, the UNSW site appeared to be vacant, and the large quarried areas to the west of Botany Street appeared to have been filled. To the east, parts of the hospital site were undeveloped. In 1955, an increased density of housing was observed to the south of the site, and construction works were noted within the UNSW site in 1961. Over the years 1970 to 2014, further commercial/ industrial development was evident throughout the surrounding subdivision, notably the continued development of the hospital and UNSW sites.

A historical title deeds search was conducted on selected lots within the site, which were selected based on having potential for commercial / retail land use. Records dating as far back as 1910 indicated that the potential land activities were predominately residential, with some commercial / medical, education and health institution land use.

A number of state and local heritage items were listed in the vicinity of the site, the closest being:

- The Cotswold, late Victorian cottage – 50 m South of the site; and
- Blenheim House and outbuilding - 82 m North East of the site.

The closest dry cleaners and motor garages, considered to be high risk in terms of contamination were more than 180 m from the site, and therefore were not considered to be a source of contamination to the site.

A search of the NSW EPA website on 5 October 2018 indicated that:

- No notices or orders made under the CLM Act have been issued for the site or adjacent properties; and
- No licences under Schedule 1 of the POEO Act have been issued for the site or adjacent properties.

Full access was not possible to the various residences at the time of the DP (2018b) investigation; therefore, observations were limited to the property exteriors from street view. The walkover was undertaken by a DP environmental scientist on 10 October 2017. In summary, the properties were mainly single storey with a few double storey and bungalow-style properties. The structures were generally constructed of brick / rendered brick with terracotta roofing. Possible fibro eaves / fibro carport were observed in some properties. A commercial-style building with aluminium roofing and consolidated commercial medical rooms (orthodontics) were also noted during the walkover.

Intrusive investigations as part of DP (2018b) were undertaken in two stages. The initial fieldwork (undertaken in September and October 2017) in conjunction DP 2018a and as such, the bore locations were positioned primarily for geotechnical investigation purposes in areas where access was available. A total of seven boreholes (BH1 to BH7) were drilled in the initial round, with one of the bores (BH7) converted into a groundwater monitoring well. Bores were drilled to depths of between 16 m and 20.5 m bgl using a bobcat-mounted or truck- mounted drilling rig using solid flight auger and rotary drilling. Bores were located within the existing roads, except BH7 which was drilled within a residential property and a groundwater sample was taken and analysed.

A second round of fieldwork was undertaken on 9 – 11 January 2018 and involved hand augering of 22 boreholes (BH101 to BH122) across 11 properties. Two boreholes were augured at each property,

one in the front yard and one in the backyard, to depths of 1.5 m or the top of natural. In addition, two boreholes (BH8 and BH9) were drilled and sampled.

The following exceedances were registered:

Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the LOR and/or less than the adopted SAC with the exception of:

- *Nickel in BH3/0.1-0.2 (79 mg/kg) and BH110/0-0.2 (26 mg/kg) which exceeded the EIL for commercial industrial (10mg/kg) and residential/open space (9 mg/kg);*
- *Copper in BH102/0-0.3 m (83 mg/kg) and BH112/0-0.2 (110 mg/kg) which exceeded the EIL for commercial industrial (80mg/kg) and residential/open space (65 mg/kg); and*
- *Zinc in BH104/0-0.3 (250 mg/kg), BH105/ 0.5-0.7 (310 mg/kg), BH111/0-0.2 (390 mg/kg), BH115/0.5-0.7 (310 mg/kg) and BH118/0.5-0.6 (510 mg/kg) which exceeded the EIL for residential/open space (240 mg/kg) and/or commercial / industrial (300 mg/kg).*

A number of exceedances of ESL were noted for B(a)P in samples BH102/0-0,3, BH103/0-0.3, BH105/0.3-0.5, BH105/0.5-0.7, BH106/0-0.2, BH106/0.5-0.7, BH107/0-0.2, BH108/0-0.2, BH109/0-0.2, BH110/0-0.2, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2.

There was also an exceedance of BaP TEQ in sample BH111 (8.197 mg/kg) which exceeded the HIL B (4 mg/kg) and HIL C (3 mg/kg).

Exceedances were noted for various contaminants in the roadbase sample taken from BH4/0.07-0.15 (noted as having a strong hydrocarbon odour) and BH8/0.4-0.5. Exceedances included:

- *Copper – 100 mg/kg in BH4 exceeded EILs for commercial / industrial (80 mg/kg) and residential/open space (65 mg/kg);*
- *TRH C10-C16 – 1700 mg/kg in BH8 exceeded management limits (1000 mg/kg);*
- *TRH C16-C34 – 6600 mg/kg in BH4 and 11,000 mg/kg in BH8 exceeded ESLs for urban residential (300 mg/kg) and industrial / commercial (1700 mg/kg) and management limits (10000 mg/kg);*
- *TRH F2-naphthalene – 170 mg/kg in BH4 and 1600 mg/kg in BH8 exceeded NEPM (2013) Table 1A(3) Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg) and NEPM (2013) Table 1B(6) ESLs for Urban Res, Coarse Soil (120 mg/kg);*
- *Benzo(a)pyrene – 57 mg/kg in BH4 exceeded ESLs for urban residential (0.7 mg/kg) and industrial / commercial (1.4 mg/kg);*
- *Total PAH – 740 mg/kg in BH4 exceeded the HIL B (400 mg/kg) and HIL C (300 mg/kg); and*
- *Carcinogenic PAH – 77 mg/kg in BH4 exceeded HIL B (4 mg/kg), HIL C (3 mg/kg) and HIL D (40 mg/kg), Naphthalene of 150 mg/kg in BH8 exceeded the HSL A & B – vapour intrusion (3 mg/kg).*

The fragment of fibreboard discovered during hand-augering in BH106 was analysed and Chrysotile asbestos was confirmed in laboratory testing to be present in this material.

Based on the desktop study, field and analytical results reported in DP (2018b), it was considered that the site in general has a low potential for contamination with respect to the proposed hospital development.

DP (2018b) recommended the following:

- Further testing on properties located within the site and owned by Health Infrastructure and/or UNSW to determine if there are any hazardous substances which may influence waste classification (explosives, gases, flammable solids, oxidising agents, organic peroxides, toxic substances or corrosive substances);
- Pre-demolition hazardous building materials survey of the building structures which comprise the site. It is noted that many of the premises appear to contain some asbestos and other hazardous materials;
- Post demolition clearance for surface asbestos containing materials (ACM) by an experienced occupational hygienist;
- Additional soil and groundwater sampling and testing across the site to more thoroughly:
  - Assess the presence of complete source-pathway-receptor linkages under the CSM;
  - Assess the suitability of any fill/natural material to remain under the proposed development. DP notes the majority of the fill at the site will be removed during excavation works to reach final levels;
  - To remain under the proposed development;
  - Determine the need for any soil or groundwater remediation; and
  - Assess the re-use potential and/or waste classification of roadbase, filling and natural soils.

Apart from additional groundwater monitoring bores, DP (2018b) recommended that the post-demolition investigations be undertaken using test pits rather than bores to enable a more thorough visual assessment of the potential for the existence and spread of asbestos impact in the soils.

All bore locations referred to above are shown on Drawing 1, Appendix A.

5.3 DP, 2018c

DP (2018c) was carried for the RCR Development Area (referred to as *the site* in this section only).

The geotechnical investigation included a desktop study, drilling of 16 boreholes across the site (where access was readily available to drilling rigs) and installation of 11 groundwater monitoring wells to monitor the groundwater levels, permeability tests in soil and rock, and laboratory tests for geotechnical purposes.

No environmental sampling was undertaken as part of this investigation.

All bore locations referred to above are shown on Drawing 1, Appendix A.

5.4 DP, 2018d

The results of the groundwater levels obtained from the dataloggers between 1 May 2018 and 17 June 2018 were provided in this report, together with a plot of daily rainfall records. No environmental sampling was undertaken as part of this investigation.

5.5 DP, 2019a

DP (2019a) was carried for the RCR Development Area (referred to as *the site* in this section only).

A *Sampling, Analysis and Quality Plan (SAQP)* was issued to document the sampling and testing protocols to address the data gaps identified in the PSI and early version of the DSI (Rev0). In addition, the SAQP outlines a progressive waste classification process for soils to be removed from the site, the assessment of virgin excavated natural material (VENM), the assessment of road materials in Eurimbla Avenue, and the assessment of imported materials.

The SAQP reconsidered the proposed land use scenarios (i.e. hospital and education) and adopted site assessment criteria comprising:

- Health Investigation Levels – Residential B;
- Health screening levels– Residential B and Intrusive Maintenance Worker;
- Ecological Investigation Levels Ecological Screening Levels for urban residential / public open space; and
- Management Limits for residential / public open space.

These site assessment criteria are provided in Section 8.

5.6 DP, 2019b

DP (2019b) was carried for the RCR Development Area (referred to as *the site* in this section only).

A *Spoil Management Plan* was prepared by DP to address the following objectives:

- Document the protocol for finds of asbestos in or on soil;
- Document the protocol for when soils showing signs of other forms of contamination are identified;
- Provide the inspection, sampling and laboratory testing requirements to determine the waste classification of soil for off-site disposal as well as to assess for potential re-use of soil at the site from a contamination perspective; and
- List control measures to be employed to minimise environmental effects from spoil management.

The protocols outlined in DP (2019d) have largely been adopted in this RAP.

5.7 DP, 2019c

DP (2019c) was carried for the RCR Development Area (referred to as *the site* in this section only).

Intrusive investigations were undertaken in various stages throughout 2018 and 2019. Earlier versions of the DSI report have not been reviewed as the Updated DSI dated February 2019 is a compendium of the previous versions.
Table A of NSW EPA (1995) *Sampling Design Guidelines* recommends a minimum of 43 sampling points for a site of 3.3 ha for site characterisation based on the detection of circular hot spots using a systemic grid sampling pattern. This updated DSI report provides the results for DP investigations including 82 sample locations across the site viz:

- DP (2018a): BH1 to BH9 – 9 boreholes;
- DP (2018a): BH101 to BH122 – 22 boreholes;
- DP (2018b): BH201, BH205 to BH215 – 12 boreholes;
- DP (2018b): BH202, BH204 (hand augers) – two boreholes;
- DP (2018b): TP1 to TP11 – 11 test pits; and
- DP (2019): BH301- TP304, BH305A- TP310A, TP313A, TP314, TP314A, TP315-TP320, TP322-TP329 - 26 test pits.

In addition, an assessment of compliance of the asphalt and road base in Eurimbla Avenue, with the recovered aggregate order 2014. Ten test pits (EA1 to EA10) were excavated into Eurimbla Avenue for that purposes.

The subsurface profile encountered in the bores and test pits across the site (excluding Eurimbla Avenue) are summarised below:

- PAVEMENT/SLAB: A 30 – 70 mm thick asphaltic concrete surfacing overlying roadbase gravel to depths of between 0.2 m and 0.4 m was encountered in BH1 to BH6, BH8 and BH9. In the current investigation, brick pavement was encountered in BH201, and concrete pavers/slab was observed in BH202, BH204, BH205, BH208, BH212, BH214 and TP3 to depths of up to 0.1 m;
- FILLING: (topsoil): dark brown, fine to medium slightly silty sand topsoil was encountered in BH101, BH113, BH121, BH207, BH209, TP1- TP3 and TP7 to depths of between 0.05 m and 0.3 m; In some test pits (TP301-304) this dark grey sand filling contained sandstone boulders, terracotta, glass, brick fragments and some slag and tile fragments;

  FILLING: Sandy filling with fine to medium gravel and trace of rootlets was encountered in BH101 to BH122 and TP1 to TP11, to depths of between 0.2 m and 1.4 m. Sandy filling and/or ripped sandstone was encountered in BH1 to BH9 to depths of between 0.2 m and 2.3 m. Sandy filling was observed in all boreholes at depths of up to 1.0 m in June/August 2018 investigations. A trace of charcoal, clinker/slag was observed in BH201, BH213 and TP10, and anthropogenic material including brick, terracotta and glass fragments, metal sheeting, and asphaltic gravels were noted in BH201, BH202, BH205, BH207 to BH209, BH211, TP1, TP4, TP6, TP8, TP9, TP301-TP304. Two distinct sandy fill layers were observed in BH201, BH202, BH207 to BH209, and BH215;
- SAND: In DP (2018), fine to medium dense yellow sand was encountered in all boreholes and test pits. Clayey sand was encountered in BH117 and BH118 at depths of 1.4 m and 1.0 m

respectively. Dense clayey sand or possibly extremely low strength sandstone was encountered in BH6 below a depth of 5.2 m. A 0.5 m thick band of stiff silty clay/clay was encountered in BH9 below a depth of 5.5 m. In the current investigation, sand varying from grey/brown and yellow, fine to medium grained, was encountered in BH201 - BH207, BH209 – BH215 at depths of 0.35 to 4.7 m. A trace of charcoal was observed in BH211. Sandy silt/silty sand with a trace of charcoal was observed in BH207 and BH208 at depths of 0.9 m and 0.7 m, respectively, to borehole termination; and

- BEDROCK: In boreholes BH1 to BH9, the top of bedrock ranged between depths of 1.5 m (RL 53.1 m) and 6.9 m (RL 40.7 m). The upper rock profile included variably extremely low to low strength sandstone. More consistent medium and high strength sandstone was encountered in all boreholes at depths ranging between 3.9 m (RL 44.6 m) and 8.8 m (RL 38.8 m). Some very low and low strength siltstone and laminite bands were interbedded within the sandstone in BH1, BH2, BH5, BH6, BH8 and BH9. The rock discontinuities were predominantly along bedding planes dipping between 0° and 20° below the horizontal with the occasional rock joint dipping between 30° and 70°. In the current investigation, very low to low strength sandstone was encountered in BH202 and BH204 at depths of 3.0 m and 4.7 m, respectively, to borehole termination.

Field Observations

- Individual suspected asbestos containing material (ACM) fragments were located in BH106, TP 315, 318, 326, 329 at a depth of 0.0 – 0.2 m and TP10 at a depth of 0.0 - 0.1 m. Additionally, ACM was observed in TP9 and TP319 at a depth of 0.4 - 0.5 m. The locations where ACM was located either through visual observation or during sieving of 10L samples is indicated on Drawing 2 (Appendix A);
- The recovered potential ACM fragments and additional 500ml soil samples from each of the locations were sent to the laboratory for analysis for ACM and Asbestos Fines (AF) and Fibrous Asbestos (FA). Chrysotile asbestos was confirmed in laboratory testing to be present in the material collected from BH106, whilst chrysotile, amosite and crocidolite were detected in the fragments collected from TP9 and TP10;
- Surficial ACM was observed at multiple locations in between test locations as indicated on Drawing 2 (Appendix A);
- All PID readings were <3 ppm; and
- Refusal was met at BH 120 due to limited access to soil.

Soil

Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the laboratory limit of reporting LOR and/or less than the adopted SAC with the exception of:

- Nickel in BH3/0.1-0.2 (79 mg/kg) and BH110/0-0.2 (26 mg/kg) which exceeded the EIL for residential/open space (9 mg/kg);
- Copper in BH208/0.3-0.4 (85 mg/kg), BH102/0-0.3 m (83 mg/kg) and BH112/0-0.2 (110 mg/kg) which exceeded the EIL for residential/open space (65 mg/kg);

- Zinc in BH213/0.1-0.2 (300 mg/kg), BH104/0-0.3 (250 mg/kg), BH105/ 0.5-0.7 (310 mg/kg), BH111/0-0.2 (390 mg/kg), BH115/0.5-0.7 (310 mg/kg) and BH118/0.5-0.6 (510 mg/kg) which exceeded the EIL for residential/open space (240 mg/kg);
- Lead in TP9/0-0.1 (890 mg/kg) which exceeded the HIL for residential (600 mg/kg); and
- PCB in BH206 (1.6 mg/kg) which exceeded the HIL B (1 mg/kg).

A number of exceedances of ESL (urban residential) (0.7 mg/kg) were noted including:

- B(a)P in samples TP302/0.5-0.6, TP309A/0.0-0.2, TP309A/0.5-0.0.6, TP315/0.0-0.2, TP315/1.0-1.1, TP318/0.0-0.2, TP319/0.0-0.2. TP319/0.4-0.0.5, BH201/0.2-0.3, BH202/0.3-0.4, BH205/0.1-0.2, BH206/0.3-0.4, BH207/0.1-0.2, BH208/0.3-0.4, BH209/0.1-0.2, BH210/0.2-0.3, BH215/0.1-0.2, TP9/0-0.1, BH102/0-0,3, BH103/0-0.3, BH105/0.3-0.5, BH105/0.5-0.7, BH106/0-0.2, BH106/0.5-0.7, BH107/0-0.2, BH108/0-0.2, BH109/0-0.2, BH110/0-0.2, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2 which exceeded the ESL for urban residential (0.7 mg/kg); and
- TRH (C16 -C34) in sample TP310A/0.0-0.2 (410 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

The exceedance of Health based investigation Levels (Residential B) were noted in the following samples:

- Carcinogenic PAH at TP302/0.5-0.6 (6.3 mg/kg), BH208/0.3-0.4 (4.3 mg/kg), BH215/0.1-0.2 (4.5 mg/kg), BH4/0.07-0.15 (77 mg/kg) and BH111/0-0.2 (8.2 mg/kg) which exceeded the Health Based Investigation Guideline for Residential B of 4 mg/kg.

As evident in the results, much of the polycyclic aromatic hydrocarbon (PAH) and total recoverable hydrocarbon (TRH) exceedances are associated with the roadbase material, which was recommended to be managed separately as Recovered Aggregate.

The statistical assessment of the data was undertaken for two main fill horizons (0 – 0.3 m and 0.3 m to the natural soil) to determine the upper 95% confidence level of mean concentrations. Statistics were run in excel for all contaminants with the exception of copper, lead, nickel, zinc, B(a)P, B(a)P TEQ and total PAH which were run in ProUCL.

Results for roadbase and asphalt were not included in the statistical calculations.

The results for the fill horizons included:

- 0-0.3 m depth – statistical calculations (95% UCL of the mean concentration) for all chemical analytics results (not including asbestos) for fill from 0-0.3 m are below the SAC with the exception of B(a)P in the top 0.3 m which is 1.066 mg/kg and exceeds the ESL (urban residential) of 0.7 mg/kg; and
- Below 0.3 m to top of natural – the statistical calculations (95% UCL of the mean concentration) for all chemical analytics results for fill below 0.3m and to the top of natural are below the assessment criteria for the site with the exception of B(a)P in the fill which is 0.818 mg/kg and marginally exceeds the ESL (urban residential) of 0.7 mg/kg.

The observed asbestos impacts are shown on Drawing 2, Appendix A, whilst the benzo(a)pyrene impacts are shown on Drawing 3, Appendix A.

Groundwater

Groundwater results revealed no phase separated hydrocarbons (PSH) were observed or detected by the interface meter during well development or sampling. Concentrations of all contaminants were either below the detection limit or the SAC, with the exception of the following:

- Cadmium in sample BH14 (0.006 mg/L) which exceeded the GIL of 0.005 mg/L;
- Copper in samples BH14 (0.007 mg/L), GW7 and the duplicate (0.007 mg/L), BH202 (0.002 mg/L), BH204 (0.008 mg/L), BH11 (0.005 mg/L), BH14 (0.007 mg/L), and BH17 (0.003 mg/L) which exceeded the GIL of 0.0014 mg/L; and
- Zinc in sample GW7 (0.022 mg/L) and the duplicate (0.024mg/L), BH202 (0.031 mg/L), BH204 (0.028 mg/L), BH11 (0.013 mg/L), BH14 (0.055 mg/L) and BD1 (0.026 mg/kg) which exceeded the GIL of 0.008 mg/L.

These results are however considered to be typical of groundwater conditions in urban settings.

Preliminary Waste Classification

The preliminary waste classification results are presented in the DSI (2019c). In summary, based on the results, the filling encountered in the bores at the site is preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas:

- Asphalt and roadbase from Eurimbla Avenue, which are assessed in accordance with the recovered aggregate order 2014 (Order); and
- Fill in the vicinity of TP9, TP10, BH106, TP315, TP318, TP319, TP326, TP329 and four areas (depicted in Drawing 2 with yellow shading) which have been confirmed or suspected to contain asbestos. Other fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

Furthermore, natural sand samples in some of the bores (BH105, BH106, BH108, BH110, BH112, BH113, BH115 and BH117) had concentrations of lead and/or PAH falling within the general solid waste (non-putrescible) classification.

Recovered Aggregate Order

The results for the asphalt and roadbase of Eurimbla Avenue were assessed for compliance with the recovered aggregate order 2014 (Order). In total 10 composite samples were recovered and analysed for heavy metals, electrical conductivity, metal, plaster, other foreign material and coal tar.

All results were found to be within the average and maximum criteria and all coal tar results were below the practical quantitative limit for the laboratory.

Based on these results, DP considers the asphalt and roadbase of Eurimbla Avenue are suitable to be processed for re-used in land application as described under the Order.

Results specific to Stage 1 and the IASB Addition are discussed in detail in Section 9.1.

5.8 DP, 2019d

DP (2019d) was carried for the IASB Addition area only. The IASB Addition (addition to Stage 1) component of the RCR sits adjoining and to the east of Stage 1.

DP carried out the following scope of work as part of DP (2019d):

- Review of previous DP reports (see references in Section 13) and relevant site history documents associated with the Prince of Wales (POW) hospital site;
- Concrete coring to remove the concrete slab and/or asphaltic concrete in all locations;
- Excavation of seven test pits (TP401 to TP407) to a minimum depth of 0.5 m into natural soil or prior refusal using a combination of non-destructive drilling and hand auger;
- Collection of soil samples from the test pits at regular depth intervals and Laboratory analysis of selected soil samples by a National Association of Testing Authorities (NATA) accredited laboratory for contaminants of potential concern (COPC);
- Inclusion of industry standard QA/QC including replicates, trip spike and trip blank samples;
- Interpretation of results in accordance with current NSW Environment Protection Authority (EPA) endorsed guidelines; and
- Preparation of a DSI report.

Site History

A review of land titles from Lot 1 DP 870720 - Randwick Hospital site revealed the site was appropriated as a site for Destitute Children's Asylum in 1854 and in 1916 was transferred to the Crown to be used as a hospital for invalided and wounded soldiers and sailors or such other purposes as the Governor may determine. In 1917 the site was requisitioned by Commonwealth for Hospitals & Convalescent accommodation from 25 August 1915 until 12 months after the termination of the war and has been used as a hospital since this time.

DP reviewed the Safework NSW search document for the Randwick Hospital site, dated 12 May 2015 and the following were located in Building 16, off-site and adjacent to Delivery Drive (to the southeast):

- DG03 – diesel generator / above ground tank (10,600L) in Building 16 basement dock 5;
- GM01 – roofed cylinder store (5400L) in Building 16 basement; and
- GM02 – roofed cylinder store (1800L) in Building 16 basement.

Aerial photographs were reviewed with the following general observations:

- 'Zig-zag shaped features' were noted on the 1943 image indicating air raid bunker/shelters may have been present on site. Similar shaped features were also evident at nearby High Cross Park. These were confirmed as air raid shelters uncovered during south east light rail construction works in 2017 by archaeologists;

- Between 1961 and 1970 the western boundary of the site was developed into a road with additional development of the building that partly covered the eastern side of the site. The area directly south east of the site was developed for hospital/commercial use;
- Between 1986 and 2005, major developments across the hospital to the east, although there appeared to be no significant changes to the site. The building adjacent to the north east part of the site were demolished and converted into a car parking area within the hospital which was later developed as an additional building to the Children's hospital; and
- The new building (Building 1C) adjacent to the IASB Addition area appears to have been constructed following October 2011. Prior to this time the site appears to have been used as a carpark associated with the Sydney Children's Hospital. The high-rise hospital building (Building 1C – extension of Sydney Children's Hospital) was constructed between October 2011 and October 2012.

The subsurface profile encountered in the bores (BH1, BH2, BH10, BH11) and test pits (TP401 to TP407) across the IASB Addition have been summarised below:

- **PAVEMENT/SLAB**: A 30 – 70 mm thick asphaltic concrete surfacing; overlying
- **FILL (ROADBASE):** dark brown medium grained sand with fine to coarse igneous gravel and medium grained sandstone gravel from 0.2-0.3 or 0.45 m in BH1, BH2, BH10, BH11, TP401, TP402, TP403, TP404, TP405, and TP406. In test pits TP401, TP405 and TP406 fill (roadbase) was encountered directly above natural sand. No roadbase was encountered in TP407;
- **FILL:** yellow fine to medium grained sand with fine to coarse sandstone gravel and igneous gravel with plastic, crushed cement, crushed brick to depths of between 0.45 and 0.95m depth; A hydrocarbon odour was noted in TP402. Trace ash and charcoal were noted in TP407 at 0.35-0.4m depth. At a depth below 0.55m in TP407, large sandstone cobbles were observed with cement gravel inclusions;
- **SAND:** yellow and orange and white fine to medium sand with some fine to coarse sandstone gravel (some igneous gravel), becoming mottled white in TP402; roots and organic staining were noted in TP405; yellow sand with some coffee rock noted in TP406 at 0.4m depth; medium dense sand encountered in BH1, BH2, BH10 and BH11; and
- **BEDROCK**: Sandstone encountered in TP401 at 0.7m depth and at depths of between 3.4 m and 6 m in BH1, BH2, BH10 and BH11.

Hydrocarbon odour was noted in TP402. Ash and charcoal were noted in TP407. Asbestos was not observed during fieldwork however the presence of building rubble was considered a possible indicator or potential asbestos in fill at the site.

Soil

Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TRH were below laboratory limits of reporting (LOR) for all soil samples. Metal concentrations were either less than the limit of reporting (LOR) and/or less than the adopted SAC for all samples tested.

The exceedance of Health based investigation Levels (Residential B) were noted in the following roadbase (fill) samples:

- Carcinogenic PAH at TP401/0.2 (5.2 mg/kg), TP402/0.2-0.25 (4.2 mg/kg) and BD1/20190823 (4.2 mg/kg) which exceeded the HSL B of 4 mg/kg.

A number of exceedances of ESL (urban residential) were noted in roadbase samples including:

- B(a)P in samples TP401/0.2 (3.6 mg/kg), TP402/0.2-0.25 (2.9 mg/kg) and BD1/20190823 (2.8 mg/kg) which exceeded the ESL (urban residential) of 0.7 mg/kg; and
- TRH (C16 -C34) in samples TP401/0.2 (370 mg/kg), TP402/0.2-0.25 (400 mg/kg) and BD1/20190823 (400 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

Chrysotile, amosite and crocidolite asbestos was detected in the roadbase sample from TP402/0.2-0.25 and AF/FA results were 0.0328 %w/w which exceeded the HSL (B) of 0.001%w/w. The asbestos is likely to be associated with building rubble in roadbase at this location.

Delineation samples were analysed to delineate the vertical and lateral extent of the asbestos detected. No further asbestos was detected in the samples at 0.5 and 1.0m in TP402 or the surrounding surficial samples at TP401, TP407, TP404 and TP405.

Results for selected explosive analytes were below detected in all samples analysed. Ammonia was above detection in one sample (TP407/0.35) however the level did not exceed the screening level adopted for the site (50 mg/kg).

Preliminary Waste Classification

Based on the analytical results (including TCLP), the filling encountered in the test pits at the site was preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas:

- Roadbase in the vicinity of TP402 (confirmed to contain asbestos). Other roadbase or fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

DP stated that this classification of soils was preliminary only and subject to further waste classification confirmation prior to disposal, as detailed in the RAP.

5.9 Hazardous Materials Surveys

The hazardous materials survey reports prepared by Property Risk Australia have identified various hazardous materials in the 92 properties that comprised the RCR Development Area. The following is a summary of the finds as a percentage of the 92 properties surveyed:

- 69% of the houses contain bonded ACM;
- 19% contain friable ACM;
- 90% contain bonded Synthetic Mineral Fibre (SMF);
- 1% contain un-bonded SMF;
- 14% contain PCBs;

- 66% contain lead paint;
- 77% contain lead dust; and
- 17% contain ozone depleting substances.

6. Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present of in the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

Based on the previous investigations, the following potential sources of contamination and associated contaminants of concern have been identified (Table 2).

Table 2: Potential Contamination Sources and Contaminants of Concern

Potential Source	Description of Potential Contaminating Activity	Contaminants of Concern
Imported fill of unknown origin (S1)	Uncontrolled filling: Associated with disturbed terrain in the local area and from the demolition of former buildings/structures on site. Previous investigations have identified an average fill thickness of about 0.5 m across the site.	Heavy metals, TPH, BTEX, PAH, phenols, PCB, OCP, and asbestos. Previous investigations have identified the presence of the above contaminants to varying degrees, with the exception of most metals, BTEX, OCP and phenols.
Hazardous building materials in existing buildings (S2)	Presence of hazardous building materials within the building fabric of the some of the existing buildings.	Asbestos, synthetic mineral fibre (SMF), lead and PCB
Industrial/commercial activities at the site or nearby (S3)	Storage of chemicals or equipment associated with former butcher/ medical practices and orthodontist.	Heavy metals, TRH, BTEX, PAH, phenols, PFAS, VOCs, ammonia and asbestos.
Neighbouring sites (S4)	Potential migration of contamination associated with the backfilled quarry at the UNSW site. Current operations at the new Biomed building at UNSW.	Asbestos, metals, hydrocarbons (TPH/BTEX) and pharmaceutical solvents (VOCs).

Notes: TRH - total petroleum hydrocarbon
BTEX - benzene, toluene, ethylbenzene, xylene

PAH - polycyclic aromatic hydrocarbons
PCB - polychlorinated biphenyls
OCP - organochlorine pesticides
OPP - organophosphorus pesticides
VOC - volatile organic compounds
PFAS- Perfluorinated Alkylated Substances

The potential contamination sources (S) on the site are therefore as follows:

S1 Fill of unknown origin;

S2 Hazardous building materials;

S3 Previous industrial/commercial activities at the site; and

S4 Neighbouring sites (hospital and UNSW).

6.1 Potential Receptors

6.1.1 Human Health Receptors

R1 Current site users (residents, site workers and visitors);

R2 Construction and maintenance workers;

R3 Final end users (site workers and visitors); and

R4 Land users in adjacent areas (university / hospital / residential / commercial).

6.1.2 Environmental Receptors

R5 Groundwater;

R6 Surface water (Botany Bay); and

R7 Terrestrial ecosystems (neighbouring areas of conservation such as Centennial Park, Queens Park and Eastlakes, and landscaped areas under the future development).

6.1.3 Potential Pathways

Potential pathways for the identified contamination to impact on the receptors include the following:

P1 Ingestion and dermal contact;

P2 Inhalation of dust and/or vapour;

P3 Leaching of contaminants and vertical migration into groundwater (Eastlakes/Botany Bay);

P4 Surface water run-off (Centennial Park/Coogee);

P5 Lateral migration of groundwater; and

P6 Contact with terrestrial ecology (Centennial Park).

6.2 Summary of Preliminary CSM

A ‘source – pathway – receptor’ approach has been used to assess the potential risks of harm being caused to human, water or environmental receptors from contamination sources on or in the vicinity of the site, via exposure pathways. The possible pathways between the above sources (S1 to S4) and receptors (R1 to R7) are provided in Table 3 below.

Table 3: Potential Complete Pathways

Source	Pathway	Receptor
S1 Fill of unknown origin S3 Previous industrial/commercial activities at the site (road, delivery dock, possible air raid bunker/shelter within IASB Addition) S3 Vehicles and cars within the building footprint S4	P1: Ingestion and dermal contact	R1: Current site users R2: Construction and maintenance workers R3: Final end users
	P2: Inhalation of dust and/or vapour	R1: Current site users R2: Construction and maintenance workers R3: Final end users (educational/hospital) R4: Land users in adjacent areas (educational/hospital/ residential/commercial/industrial)
	P3: Leaching of contaminants and vertical migration into groundwater	R5: Groundwater
	P4: Surface water run-off P5: Lateral migration of groundwater	R6: Surface water
	P6: Contact with terrestrial ecology	R7: Terrestrial ecology
S2 Hazardous building materials	P1: Ingestion and dermal contact P2: Inhalation of dust and/or vapour	R1: Current site users R2: Construction and maintenance workers R3: Final end users
S4 Neighbouring sites (hospital and UNSW)	P2: Inhalation of vapour generated by contaminated groundwater.	R1: Current site users R2: Construction and maintenance workers R3: Final end users R4: Land users in adjacent areas
	P3: Lateral migration of contaminated groundwater from up-gradient sites	R5: Groundwater R6: Surface water
	P6: Contact with terrestrial ecology	R7: Terrestrial ecology

7. Data Quality Objectives

In order to attain the remediation objective as set out in Section 2 the following seven step data quality objective (DQO) process, as defined in Australian Standard *Guide to the investigation and sampling of sites with potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1 – 2005) has been adopted. The DQO process is outlined as follows:

(a) State the Problem

The 'problem' under consideration is the implementation of an appropriate remediation action plan to ensure any previously identified contamination and unexpected finds and waste classification/disposal procedures are managed appropriately to ensure that the remediated site will be suitable for the proposed development and that the remedial works pose no unacceptable risks to human health or to the environment.

The various parties involved in this decision process, include:

- The site owner (Health Infrastructure);
- The principal's representative (Lendlease);
- The planning authority (Randwick Council); and
- The environmental consultant (DP) for the investigation and remediation planning works.

(b) Identify the Decision

Based on the findings of the previous assessments, site observations and the proposed development details, the principal decision is to adopt an appropriate remediation strategy to address the problem. The proposed strategy needs to be developed following the consideration of viable options. Assessment and classification requirements for imported soil will also be outlined in this RAP.

(c) Identify Inputs to the Decision

Inputs to the decision include:

- Previous reports cited in Section 5;
- Guidelines cited in Section 1;
- Australian Water Quality Guidelines 2000 (AWQG);
- Australian Drinking Water Guidelines 2017 (ADWG, for reference only as the groundwater at the site is not considered a drinking water source); and
- National water quality management strategy. Australia and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC and ARMCANZ).

The primary inputs in adopting a remediation strategy are as follows:

- The areas of potential contamination derived from known historical site activities identified from the site history review outlined in previous DP reports;
- The investigation findings reported previously, as outlined in Sections 5 and 9;
- The adopted SAC for Stage 1 and IASB Addition;

- The limitations associated with the construction site (e.g. available space and timing); and
- Proposed land use and design of the proposed development.

(d) Define the Boundary of the Assessment

The site is bordered by Hospital Road and the existing hospital to the east, Magill Street to the south and Botany Street to the west. Eurimbla Avenue runs through the centre of the Stage 1 part of the site. The Stage 1 and IASB Addition boundaries are shown on Drawing 1, Appendix A.

(e) Develop a Decision Rule

The successful implementation of the RAP is assessed on the basis of the remediation acceptance criteria (RAC) provided in Section 8. The decision rule is the comparison of the analytical results against the relevant guidelines and background concentrations where relevant.

(f) Specify Acceptable Limits on Decision Errors

Specific limits for this project will generally be in accordance with the appropriate guidelines from NEPC (2013) for the collection of environmental samples. In order that the results are accurate and reproducible, appropriate and adequate quality assurance and quality control (QA/QC) measures and evaluations will be incorporated into the validation sampling and testing regime.

(g) Optimize the Design for Obtaining Data

In order to ensure the collection of representative data as part of the validation process, the sampling regime is based on the areas and their extent of environmental concern. In addition, in order to attain an acceptable level of data quality, QA/QC procedures will be adopted as part of the RAP requirements.

If the DQOs are not met, then the reasons as to why they were not achieved will be critically examined. If the situation cannot be easily rectified or is unique to the site, then consultation with the Site Auditor will take place, and assessment of future actions required will be discussed and implemented where applicable.

7.1 Data Quality Indicators

DP's quality assurance (QA) and quality control (QC) procedures will be adopted throughout the field sampling programme (validation) to ensure sampling precision and accuracy and prevent cross contamination.

The quality controls of documentation completeness, data completeness, data comparability, data representativeness, precision and accuracy for sampling and analysis, if required, are described in Table 4.

Table 4: Data Quality Indicators

Quality Control	Achievement Evaluation Procedure
Documentation completeness	Completion of field and laboratory chain of custody documentation, completion of validation sample plans.
Data completeness	Sampling density according to provisions in the approved RAP, and analysis of appropriate determinants based on site history and on-site observation.
Data comparability and representativeness	Use of NATA accredited laboratories, use of consistent sampling technique.
Precision and accuracy for sampling and analysis	Achievement of 30-50% RPD for heavy metals and organics respectively for replicate analysis, acceptable levels for laboratory QC criteria.

8. Remediation Acceptance Criteria

The remediation works will be validated as meeting an acceptable standard for the proposed land use. The validation will be undertaken by the environmental consultant by means of visual inspection, field screening, recovery and analysis of samples and review of any available plans, as discussed below.

This section provides remediation acceptance criteria (RAC), which will be used to judge the success or otherwise of the remediation by the consultant.

Analytical results from laboratory testing will be assessed against the (Tier 1) investigation and screening levels sourced from Schedule B1 of NEPC (2013). This guideline has been endorsed by the NSW EPA under the *Contaminated Land Management* (CLM) *Act* 1997. Schedule B of NEPC (2013) provides investigation and screening levels for commonly encountered contaminants which are applicable to generic land uses and include consideration of, where relevant, the soil type and the depth of contamination. The investigation and screening levels are not intended to be used as clean up levels. They establish concentrations above which further appropriate investigation (e.g. Tier 2 or Tier 3) should be undertaken.

Stage 1 is proposed for the new ASB, whilst the IASB Addition comprises works associated with the hospital redevelopment. This land use does not fall within the generic land uses established in NEPC (2013). However, for the purpose of the investigation a land use scenario of “B” (residential within minimal opportunities for soil access) has been adopted for the following reasons:

- The proposed development will be substantially covered in a multi-level building, with basement levels, similar to the existing adjacent hospital;
- There are likely to be pockets of open space (paved or lawn - landscaping) within the development footprint, primarily on the peripheries;
- There is likely to be frequent visiting to the hospital by sensitive receptors such as children and the elderly, however access to open space areas would be minimal; and
- At this stage there is no proposed child care facility as part of the development.

8.1 Soils

8.1.1 Health Investigation and Screening Levels

The health investigation levels (HIL) and health screening levels (HSL) are scientifically-based generic assessment criteria designed to be used in the first stage (Tier 1) of an assessment of potential human health risk from chronic exposure to contaminants.

HIL are applicable to assessing health risk arising via all relevant pathways of exposure for a range of metals and organic substances. The HIL are generic to all soil types and apply generally to a depth of 3 m below the surface for residential use. Site-specific conditions may determine the depth to which HIL apply for other land uses.

HSL are applicable to selected petroleum compounds and fractions to assess the risk to human health via inhalation and direct contact pathways. HSL have been developed for different land uses, soil types and depths to contamination.

Given the assumed land use scenario the adopted HIL and HSL are:

- **HIL-B and HSLA/ B**; and
- **HSL – Intrusive Maintenance Worker** (shallow trench).

The following table shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A(1) for the investigation.

Table 5: Health Investigation Levels

Contaminant	HIL B (mg/kg)
Metals and Inorganics	
Arsenic	500
Cadmium	150
Chromium (IV)	500
Copper	30,000
Lead	1200
Mercury (inorganic)	120
Nickel	1200
Zinc	60,000
PAH	
Carcinogenic PAH (as benzo(a)pyrene TEQ) [1]	4
Total PAH	400
Phenols	
Pentachlorophenol (used as an initial screen)	130
OCP	600
DDT + DDD + DDE	10
Aldrin + Dieldrin	90
Chlordane	400
Endosulfan (total)	20
Endrin	10
Hepatchlor	15
HCB	500
Methoxychlor	
Other Pesticides	
Chlorpyrifos	340
Other Organics	
PCB [2]	1

Notes:

1 sum of carcinogenic PAH

2 non dioxin-like PCBs only

The table below shows the HSLs that have been adopted by NEPC (2013) Schedule B1, Table 1A(3) for the investigation. Based on previous investigations, the dominant soil type encountered at the site is sands, therefore the HSL criteria for sand has been selected. Furthermore, given the general depth of fill encountered in the previous investigations, the depth range of 0 m to <1 m has been applied. The vapour intrusion pathway is considered to be applicable to the proposed development and is the most conservative of the exposure scenarios. The adopted HSLs are also therefore protective of the direct contact exposure scenario.

Table 6: Soil Health Screening Levels for Vapour Intrusion

Contaminant	Soil Type	HSL A / B (mg/kg)	Intrusive Maintenance Worker (mg/kg)
		Depth 0 m to <1m	Depth 0 m to <1m
Toluene	Sand	160	NL
Ethylbenzene		55	NL
Xylenes		40	NL
Naphthalene		3	NL
Benzene		0.5	77
TRH C_6-C_{10} less BTEX [F1]		45	NL
TRH >C_{10}-C_{16} less naphthalene [F2]		110	NL

NL = Not Limiting

8.1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EIL) and Ecological Screening Levels (ESL) will apply to areas of Stage 1 outside of the building basement footprint, where landscaping will be established.

The EILs listed in the DSI are shown in the following Table 7. The following site specific data and assumptions have been used to determine the EILs:

- The EILs will apply to the top 2 m of the soil profile;
- Given the likely source of soil contaminants (i.e. historical site use/fill) the contamination is considered as “aged” (>2 years) and
- ABCs have been derived using the *Interactive (Excel) Calculation Spreadsheet* using input parameters of aged soil, CEC of 2.4 $cmol_c$/kg (site average) and pH of 7 with high traffic and clay content of 15%.

Table 7: Ecological Investigation Levels (EIL) in mg/kg

Analyte		EIL Residential Open Space	Comments
Metals	Arsenic	100	Adopted pH of 7 and CEC of 2.4 $cmol_c$/kg]; assumed clay content 15% High traffic area (NSW)
	Chromium III	200	
	Copper	65	
	Lead	1100	
	Nickel	9	
	Zinc	240	
PAH	Naphthalene	170	

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and Benzo(a)pyrene. The inputs into the ESL derivation are presented in Table 8 below, and the adopted ESL values based on Table 1B(6) of NEPM (2013) are shown in Table 9.

Table 8: Inputs to the Derivation of ESL

Variable	Input	Rationale
Depth of ESL application	Top 2 m of the soil profile	The top 2 m depth below ground level corresponds to the root zone and habitation zone of many species.
Land use	Residential B	As discussed in Section 10
Soil Texture	Coarse	Based on dominant soil type at the site (sand)

Table 9: Ecological Screening Levels (ESL) in mg/kg

Analyte		ESL (Residential and open space)	Comments
TRH	C6 – C10 (less BTEX) [F1]	180*	All ESLs are low reliability apart from those marked with * which are moderate reliability
	>C10-C16 (less Naphthalene) [F2]	120*	
	>C16-C34 [F3]	300	
	>C34-C40 [F4]	2800	
BTEX	Benzene	50	
	Toluene	85	
	Ethylbenzene	70	
	Xylenes	105	
PAH	Benzo(a)pyrene	0.7	

8.1.3 Management Limits

In addition to the application of HSL and ESL, a further screening measure is applicable to petroleum hydrocarbons, which takes into account policy considerations and reflect the nature and properties of petroleum hydrocarbons, including:

- Formation of observable light non-aqueous phase liquids (LNAPL),
- Fire and explosive hazards and
- Effects on buried infrastructure e.g. penetration of, or damage to, in-ground services.

Management Limits have been adopted in NEPC (2013) as interim Tier 1 guidance to avoid or minimise these potential effects. The criteria have been developed for petroleum fractions F1 to F4. The adopted Management Limits, extracted from Table 1B(7), Schedule B1 of NEPC (2013) are

shown in Table 10 below. The following site specific data and assumptions have been used to determine the Management Limits:

- The Management Limits will apply to any depth within the soil profile; and
- A sand (i.e. coarse texture) has been adopted, based on the dominant soil type at the site.

Table 10: Management Limits for TRH Fractions in Soil

TRH Fraction	Soil Texture	Management Limit: Residential / Open Space (mg/kg)
C_6-C_{10} [F1]	Coarse	700
>C_{10}-C_{16} [F2]	Coarse	1,000
>C_{16}-C_{34} [F3]	Coarse	2,500
>C_{34}-C_{40} [F4]	Coarse	10,000

8.1.4 Asbestos in Soil

Bonded asbestos-containing material (ACM) is the most common form of asbestos contamination across Australia, generally arising from:

- Inadequate removal and disposal practices during demolition of buildings containing asbestos products;
- Widespread dumping of asbestos products and asbestos containing fill on vacant land and development sites; and
- Importation of asbestos contaminated building products from China.

Asbestos only poses a risk to human health when asbestos fibres are made airborne and inhaled. If asbestos is bound in a matrix such as cement or resin, it is not readily made airborne except through substantial physical damage. Bonded ACM in sound condition represents a low human health risk, whilst both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres. Consequently, FA and AF must be carefully managed to prevent the release of asbestos fibres into the air.

Where an assessment of asbestos to NEPC (2013) is undertaken, the RAC will be as shown on the following Table 11.

Table 11: Asbestos HSLs

Health Screening levels (w/w)	
	HSL B
Bonded ACM	0.04%
FA and AF (friable asbestos)	0.001%
All Forms of Asbestos	No visible asbestos in surface soil

Bonded ACM: Asbestos containing material which is in sound condition, bound in a matrix of cement or resin, and cannot pass a 7 mm x 7 mm sieve.

FA: Fibrous asbestos material including severely weathered cement sheet, insulation products and woven asbestos material. This material is typically unbonded or was previously bonded and is now significantly degraded and crumbling.

AF: Asbestos fines including free fibres, small fibre bundles and also small fragments of bonded ACM that pass through a 7 mm x 7 mm sieve.

8.1.5 Classification Assessment for Off-Site Disposal

All wastes will be assessed in accordance with the POEO Act (1997).

For disposal to landfill, this will comprise assessment in accordance with the NSW Environment Protection Authority (EPA) *Waste Classification Guidelines* (2014).

For re-use off-site, soil will be assessed in accordance with other EPA guidance or licences under the POEO Act, and may include:

- Resource recovery orders issued by EPA under the *Protection of the Environment Operations (Waste) Regulation* 2014; and
- Guidance on assessment of VENM.

It is also noted that recycling facilities with an appropriate Environment Protection License (EPL) may accept some of the soils that comply with their EPL conditions.

8.2 Groundwater

8.2.1 Groundwater Investigation Levels

The Groundwater Investigation Levels (GIL) are the freshwater default guideline values (DGV) for a slightly to moderately disturbed system from Australian and New Zealand Governments (ANZG), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, 2018 (ANZG, 2018).

Table 12: Groundwater Investigation Levels (DGV)

Contaminant		GIL for Freshwater (µg/L)
Metals	Arsenic (III)	24
	Arsenic (V)	13
	Cadmium	0.5 #
	Chromium (III)	8.2 #
	Chromium (VI)	0.4
	Copper	1.4
	Lead	14 #
	Mercury	0.06
	Nickel	28 #
	Zinc	21 #
PAH	Anthracene	0.4
	Naphthalene	16
	Fluoranthene	1
	Benzo(a)pyrene	0.1
	Phenanthrene	0.6
BTEX and VOC	Benzene	950
	Toluene	180
	Ethylbenzene	80
	m-xylene	75
	o-xylene	350
	p-xylene	200
	Isopropylbenzene	30
	Tetrachloroethene	70
	Trichloroethene	330
	1,1-Dichloroethene	700
	1,3-Dichloropropene	0.1
	Chloroethene (vinyl chloride)	100
	Chlorobenzene	55
	1,2,3-Trichlorobenzene	3
	1,2,4-Trichlorobenzene	85
	1,2-Dichlorobenzene	160
	1,3-Dichlorobenzene	260
	1,4-Dichlorobenzene	60
	1,1,2,2-Tetrachloroethane	400
	1,1,2-Trichloroethane	6500
	1,2-Dichloroethane	1900
	Carbon tetrachloride	240
	Chloroform	370
	Dibromochloromethane	4000
	1,2-Dichloropropane	900
	1,3-Dichloropropane	1100

Contaminant		GIL for Freshwater (µg/L)
OCP	Andrin	0.001
	Chlordane	0.03
	DDE	0.03
	DDT	0.006
	Dieldrin	0.01
	Endosulfan	0.03
	Endrin	0.01
	Heptachlor	0.01
	Lindane	0.2
	Methoxychlor	0.005
OPP	Azinphos methyl	0.01
	Chlorpyrifos	0.01
	Diazinon	0.01
	Dimethoate	0.15
	Fenitrothion	0.2
	Malathion	0.05
PCB	Aroclor 1242	0.3
	Aroclor 1254	0.01

Note: #Adjusted for a hardness which is the lowest (most conservative) hardness value obtained from groundwater sampling in DP (2018b).

8.2.2 Health Screening Levels and Volatile Contaminants

The generic HSLs published in NEPC (2013) and CRC CARE (2011) are considered to be appropriate for the assessment of contamination in groundwater at the site in general. Given the proposed land use the adopted HSL are:

- **HSL B** – high density residential; and
- **HSL** - Intrusive Maintenance Worker (shallow trench).

The inputs to the derivation of the HSL are given in Table 13.

Table 13: Inputs to the Derivation of HSLs

Variable	Input	Rationale
Potential exposure pathway	Vapour intrusion (inhalation) with contaminated groundwater as the source	The basement level is expected to intercept groundwater, which may be perched.
Soil Type	Sand	The intrusive investigations on site, as shown in the logs, show a subsurface comprised predominantly of sand
Depth to contamination	2 m to <4 m	Used as an initial screen. The detection of volatile contaminants in the groundwater may trigger the need for a site-specific risk assessment given the proposed basement depths at the location of the proposed building.

The adopted groundwater HSL for vapour intrusion, from Table 1A(4), Schedule B1 of NEPC (2013) are shown in the following Table 14.

Table 14: Groundwater Health Screening Levels (HSL) for Vapour Intrusion (mg/L)

Analyte		HSL-B	HSL – Intrusive Maintenance Worker
TRH	C_6 – C_{10} (less BTEX) [F1]	1	NL
	>C_{10}-C_{16} (less Naphthalene) [F2]	1	NL
BTEX	Benzene	0.8	NL
	Toluene	NL	NL
	Ethylbenzene	NL	NL
	Xylene	NL	NL
PAH	Naphthalene	NL	NL

Note: *NL – Not limiting.*

8.3 Aesthetics

Clause 3.6, Schedule B1 of NEPC (2013) outlines aesthetic considerations when undertaking a site assessment. Some examples of characteristics or situations that may need to be considered in the assessment outcome include odorous soils, hydrocarbon sheen (e.g. surface water), soil staining and putrescible refuse.

The assessment of such finds at the site will be as stated in the unexpected finds protocol in Section 12. If the assessment identified no real human health or ecological risk, the find might be removed on the grounds of aesthetics or relocated (e.g. at depth).

8.4 Imported VENM

The POEO Act defines virgin excavated natural material (VENM) as:

'*natural material (such as clay, gravel, sand, soil or rock fines):*

(a) that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities and

(b) that does not contain any sulfidic ores or soils or any other waste

and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved for the time being pursuant to an EPA Gazettal notice.'

VENM is a waste that has been pre-classified as general solid waste (non-putrescible) under EPA (2014).

Additional advice is provided on the EPA web site [http://www.epa.nsw.gov.au/waste/virgin-material.htm] entitled 'Virgin Excavated Natural Material'. This advice states:

- Generators of VENM must assess the past and present activities on the site. The possibility that a previous land use has caused contamination of a site must be considered when assessing whether an excavated material is VENM. Land uses that could result in contaminants being present in an excavated material are listed on the web site. The list is not exhaustive and an excavated material may still be contaminated even where none of these activities have previously occurred on a site. Activities not directly related to a site may also lead to contamination, including diffuse sources of pollution such as contaminated groundwater that migrates under a site, or dust settling out from industrial emissions. Generators of VENM must consider these factors;
- Generators of excavated material should review the applicable Acid Sulfate Soil Risk Maps to determine the probability of acid sulfate soils being present at the site at which VENM excavation is proposed. The waste cannot be classified as VENM if the Acid Sulfate Soil Risk Maps identify a high probability of occurrence of acid sulfate soils or potential acid sulfate soils, unless it has undergone chemical assessment in accordance with the *Acid Sulfate Soils Assessment Guidelines* and the updated *Acid Sulfate Soils Laboratory Method Guidelines Version 2.1* - June 2004;
- By definition, VENM cannot contain any other waste, or be 'made' from processed soils. Excavated material that has been processed in any way cannot be classified as VENM; and
- Classification of excavated material as VENM requires certainty that all aspects of the definition are met. Chemical testing may be required to ascertain whether an excavated material is contaminated with manufactured chemicals or process residues, or whether it contains sulfidic ores or soils.

As a means of assessing the presence of manufactured chemicals or process residues, the analytical data for samples of natural soils are typically compared against published background concentrations, including Olszowy et al (1995) - Urban Soils (0-150mm), and Berkman 4th Edition (2001) - Field Geologists Manual 5.

Imported VENM will also be required to meet the RAC as listed in Section 8.1. It is noted that natural soils with organics concentrations exceeding the limit of reporting, and/or metals concentrations exceeding background concentrations would not classify as VENM. A process for confirming the VENM classification of natural soils is outlined in Section 13.5.

Sampling requirements for imported material are outlined in Section 13.7.

8.5 Imported Material under a Resource Recovery Order

As stated in Section 13.6, all proposed imported materials (including DGB, landscaping and temporary filling for platforms) will be assessed as being legally able to be imported to the site, and suitable

under the proposed development. Material proposed to be imported to the site must comprise one of the following:

- VENM; or
- Materials complying with a Resource Recovery Order (RRO) allowing land application.

Materials meeting an appropriate RRO must also meet the RAC as listed in Section 8.1.

9. Remedial Action Plan

9.1 Stage 1 and IASB Addition Contamination Status

Based on the site history information provided in DP (2018b and 2019d) and the field and laboratory results (DP 2019c), it is considered that the site in general has a low to moderate potential for contamination with respect to the proposed development.

Exceedances of health investigation and screening levels (HIL/HSL) and management limits from the previous investigations, for Stage 1 and IASB Addition, are provided in the following Table 15.

Table 15: Exceedances of HILs/HSL in Stage 1 and IASB Addition

Location	Contaminant	Concentration	Guideline exceeded
TP401/0.2	Carcinogenic PAH	5.2 mg/kg	HIL B (4 mg/kg)
TP402/0.2-0.25	Carcinogenic PAH	4.2 mg/kg	HIL B (4 mg/kg)
TP402/0.2-0.25	Chrysotile, amosite and crocidolite asbestos	0.0328%	HSL B (0.001%)
BH4/0.07-0.15 (roadbase)	TRH F2-naphthalene	170 mg/kg	Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg) and hydrocarbon odour
BH4/0.07-0.15 (roadbase)	TRH C16-C34	6600 mg/kg	Management Limits for residential parkland (2500 mg/kg)
BH4/0.07-0.15 (roadbase)	carcinogenic PAH	77 mg/kg	HIL B (4 mg/kg)
BH4/0.07-0.15 (roadbase)	Total PAH	740 mg/kg	HIL B (400 mg/kg)
BH8/0.4-0.5 (roadbase)	TRH C10-C16	1700 mg/kg	Management limit residential parkland (1000 mg/kg)
BH8/0.4-0.5 (roadbase)	TRH F2-naphthalene	1600 mg/kg	Res A/B Soil HSL for vapour intrusion, Sand (0-1m) (110 mg/kg)
BH8/0.4-0.5 (roadbase)	Total PAH	11,000 mg/kg	HIL B (400 mg/kg)

Location	Contaminant	Concentration	Guideline exceeded
BH8/0.4-0.5 (roadbase)	naphthalene	150 mg/kg	HSL A/B – vapour intrusion (3 mg/kg)
BH111/0-0.2	carcinogenic PAH	8.2 mg/kg	HIL B (4 mg/kg)
TP9/0.0–0.2 m	asbestos	present	fragments
TP10/0–0.2 m	asbestos	present	fragments
TP326/0.0–0.2 m	asbestos	present	fragments

Areas of asbestos contamination requiring remediation are shown on Drawing 2, Appendix A.

A number of exceedances of ESL (urban residential) / EIL (residential/open space) were noted within the site including:

- B(a)P in samples TP401/0.2 (3.6 mg/kg), TP402/0.2-0.25 (2.9 mg/kg) and BD1/20190823 (2.8 mg/kg), TP309A/0.0-0.2, TP309A/0.5-0.0.6, BH201/0.2-0.3, BH205/0.1-0.2, TP9/0-0.1, BH102/0-0,3, BH103/0-0.3, BH111/0-0.2, BH113/0.5-0.7, BH114/0.5-0.7, BH115/0.5-0.7, BH116/0-0.2 which exceeded the ESL for urban residential (0.7 mg/kg); and
- TRH (C16 -C34) in sample TP401/0.2 (370 mg/kg), TP402/0.2-0.25 (400 mg/kg), BD1/20190823 (400 mg/kg) and TP310A/0.0-0.2 (410 mg/kg) which exceeded the ESL (urban residential) of 300 mg/kg.

Given the identification of ACM in surface soils, and the higher risk of ACM being present in shallow soils (given the number of dwellings demolished) it was considered that the surface soils (to a nominal depth of 0.3 m) and deeper fill could be separated for assessment and remediation purposes.

The analytical data for soils within the site are included on Table C1, Appendix C, along with the SAC and statistics on the soil horizons 0-0.3 m and 0.3 m to the top of natural soils. The results show:

- Concentrations of BTEX, phenols, OCP, OPP, PCB and light fraction TPH were below LOR;
- Metal concentrations were either less than the LOR and/or less than the adopted SAC with the exception of those listed in Table 15;
- With the exception of BH111, TP401 (including duplicate sample) and TP402 the PAH and TRH exceedances (Table 15) are associated with the roadbase material, which is recommended to be managed separately as recovered aggregate;
- Statistical calculations (95% UCL of the mean concentration) for all chemical analytical results (not including asbestos) for fill from 0-0.3 m are below the SAC with the exception of B(a)P in the top 0.3 m which exceeds the ESL; and
- Statistical calculations (95% UCL of the mean concentration) for all chemical analytics results for fill below 0.3 m and to the top of natural are below the SAC for the site.

As noted in DP (2019c) the preliminary waste classification for the filling encountered in the bores and test pits at the site is preliminarily classified for off-site disposal purposes as General Solid Waste (non-putrescible), with the exception of the following areas (as applicable to Stage 1):

- Asphalt and roadbase from Eurimbla Avenue and Hospital Road, which are to be assessed in accordance with the recovered aggregate order 2014 (Order); and
- Fill in the vicinity of TP402, TP9, TP10, TP326 and areas (depicted in Drawing 2 with yellow shading) which have been confirmed or suspected to contain asbestos. Other fill soils, particularly in the surface, may be impacted with ACM not observed during this current investigation. As a minimum, soils impacted with asbestos would be classified as Special Waste – Asbestos for off-site disposal purposes.

The analytical data relevant to the preliminary waste classification assessment for fill in Stage 1 and IASB Addition are shown on Table C3, Appendix C.

It is noted that natural soils with organics concentrations exceeding the limit of reporting, and/or metals concentrations exceeding background concentrations would not classify as VENM. A process for confirming the VENM classification of natural soils is outlined in Section 13.5.

With regards to groundwater, based on the results reported in DP (2019c), it is considered that further investigation and/or remediation of groundwater is not required. However, it is likely that ongoing monitoring of groundwater quality will be required under a dewatering management plan and/or license. The groundwater data relevant to Stage 1 and IASB Addition (i.e. just up-gradient, cross-gradient and down-gradient) are presented in Table C2, Appendix C.

As also noted in DP (2019c) the Eurimbla Avenue pavement materials are considered to comply with the recovered aggregate order (2014) and may therefore be processed and applied to land outside of the site, in accordance with the conditions of the recovered aggregate order. The analytical data relevant to Stage 1 and IASB Addition is presented in Table C4, Appendix C, including previous sample locations.

9.2 Remediation Goal

The remediation goal is to remove and/or to mitigate associated risks of potential environmental and human health impacts posed by identified contamination and contamination uncovered during earthworks (as unexpected finds) such that the site can be rendered suitable for the proposed development.

9.3 Extent of Remediation

On the basis of the summary outlined in Section 9.1, the remediation strategy outlined in this section applies to the following:

- Further assessment and management of asbestos impacts in soils, which applies to the whole of the site. An isolation and delineation process has not been considered due to the sporadic distribution and the potential for ACM to be present between sampled locations;
- Management of fill in relation to potential ecological impacts. An isolation and delineation process has not been considered due to the distribution of EIL and ESL exceedances across the site;

- Waste classification protocols for surplus soils (e.g. basement excavation) and/or soils requiring off-site disposal due to contamination and/or other factors;
- The management of the existing asphalt and road base in Eurimbla Avenue and Hospital Road, within the site;
- The assessment of materials proposed for import to the site; and
- Materials tracking processes both within the site and off-site.

An unexpected finds protocol has also been developed to manage finds not falling into the above categories.

9.4 Typical Remedial Options Available

A number of remedial options were reviewed based on the soil contaminants identified to date (i.e. asbestos and EIL/ESL exceedances for PAH and TRH). The suitability of the remedial options was examined in accordance with a number of relevant documents, including, *inter alia*, the following:

- NSW EPA, *Contaminated Land Management, Guidelines for the NSW Site Auditor Scheme (3rd edition)*;
- NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure (as amended 2013)*; and
- NSW Department of Environment and Climate Change (DECC) *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2008 (UPSS Regulation)*.

Possible remedial options to achieve the remedial objectives are identified as follows:

- No action;
- Further assessment of material for on-site re-use;
- On-site treatment of contaminated material for on-site re-use;
- On-site burial of contaminated material under a suitable physical barrier (cap); and
- Removal of contaminated material to landfill.

9.4.1 No Action

The “No Action” option involves no remedial response to the contamination identified on the subject site. This option was not considered appropriate for the following reasons:

- The proposed development will include basement excavations and therefore a management strategy for excavated soils is required; and
- Appropriate management arrangements and procedures would be required to manage/alleviate the impacts due to asbestos contamination, as a minimum.

9.4.2 Further Assessment for On-site Re-use

Further assessment of fill soils at the site can be undertaken as below.

It is understood that approval for further assessment is required from Health Infrastructure prior to proceeding.

Asbestos

To assess the suitability of fill impacted (or potentially impacted) with asbestos, an assessment of asbestos concentrations WA Department of Health (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* can be conducted. The guideline is recognised in NEPC (2013) as an appropriate approach for the assessment of asbestos contamination.

Soils sampled, screened and analysed in accordance with WA DoH (2009), and meeting the HSLs listed in Section 8.1.4 of this RAP, could be assessed as being suitable to retain within the site, either with no additional management, or beneath a nominal surface layer of topsoil or fill (as the HSL requires no visible asbestos in the surface).

Unless fill soils are to be removed from site to landfill under an assigned waste classification, the above process is documented in Section 13 (validation) and will apply for any such soils proposed to be retained at the site.

EIL / ESL Exceedances

At the completion of basement excavation, existing soils retained in areas of proposed landscaping may be re-assessed for suitability through additional sampling and assessment against the EILs and ESLs. If found to be suitable, the soils could remain without any further action. Otherwise the soils could be removed and relocated to other areas of the site not subject to landscaping.

Alternatively, a horticulturalist will be consulted to advise on suitable plant species or soil mixes that can be used to manage potential impacts on plant growth.

9.4.3 On-site Treatment of Contaminated Material

On-site treatment of contaminated material within the site could involve the following.

Asbestos

Provided no friable asbestos is present in the soils, material impacted with bonded asbestos can be treated through a process of “emu picking” in the presence of an occupational hygienist or environmental consultant to removed observed fragments of bonded ACM. The materials would then be validated through the process outlined in Section 9.3.2.

This process has the benefit of retaining suitable soils on site, rather than adding to the landfill volumes and transporting asbestos impacted soils on public roads.

This process has limitations including:

- Available space on site to spread soils (in batches) for the emu picking process;
- Available space for stockpiling treated soils (in batches);

- The potential for dust generation carrying asbestos fines, noting residential, hospital and educational receptors nearby, in addition to pedestrians at the site boundary and workers within the site;
- The requirement for asbestos air monitoring and reporting; and
- The additional time required to implement the process.

EIL / ESL Exceedances

There is no treatment process that could reduce the relatively low levels of PAH and TRH identified in the fill at the site.

9.4.4 On-site Burial and Capping

Physical barrier (or encapsulation) systems involve the placement/installation of a layer of suitable capping material such as validated soils or permanent pavement over the contaminated filling that would limit the exposure of site users to the contaminants.

This option is considered to be viable given the following:

- Physical, non-leaching contamination (e.g. asbestos, low level PAH); and
- Generally low level contamination.

However, this option requires available space at depth (accounting for final design levels that need to accommodate the capping thickness) for placement of the impacted material, and the excavation and management of the material removed to accommodate the impacted material.

The process also requires diligent tracking of material to avoid cross-contamination, and the accurate surveying of the burial area and final capping construction.

On the basis of the proposed development details for Stage 1 and IASB Addition, being excavation to depths of up to 8 m, all fill within the IASB basement footprint and Hospital Road will be excavated and removed from Stage 1 and the IASB Addition. As such, any materials from these areas that are proposed for on-site burial will most likely have to be planned for burial within Stage 2. This encumbrance on the future development of Stage 2 needs to be considered if this option is to be undertaken.

This option requires a long-term environmental management plan and notation on title.

9.4.5 Removal of Contaminated Material to Landfill

Off-site disposal of contaminated material is considered a suitable option for managing human health and environmental impacts from the contaminated materials, particularly in view of the extent of bulk excavation required for the construction of basement car park and the lowering of Hospital Road as part of the IASB Addition.

The removal of material to landfill would involve a formal waste classification and transport of contaminated material to an EPA licensed landfill. Tracking and disposal records would need to be retained for inclusion in the site validation report.

This option is viable for all soils at the site.

This option general has higher cost implications, fills available landfill space, and requires the transporting of contaminated materials on public roads.

9.5 Remediation Approach

9.5.1 Hazardous Building Materials

The proposed works within the IASB Addition area will include the re-working of some of the existing hospital building to accommodate connectivity with the ASB building. Prior to undertaking any such works a hazardous building materials survey will be conducted and reported. Should hazardous building materials be identified, these will be removed and managed under the procedure outlined in Section 10.1.

9.5.2 Preferred Remediation Approach

On the basis of the discussion of remediation options above, and taking into considered instructions from the end client in terms of soil management, requiring the retention of soils on site where possible, and the preference to dispose surplus soils as virgin excavated natural material (VENM), the adopted remediation approach is as follows:

- At the completion of building demolition, a licensed asbestos removal contractor will remove and double bag any observed bonded ACM on the ground surface;
- A qualified occupational hygienist will inspect the surface for potential bonded ACM and issue a clearance certificate;
- Where bonded ACM is observed on the ground surface elsewhere (e.g. as shown on Drawing 2, Appendix A), a licensed asbestos contractor will remove and double bag the bonded ACM and a qualified occupational hygienist will prepare a clearance report;
- Stripping initially of the upper 0.3 m of fill soil in zones across the site and stockpiling for re-assessment. Deeper fill will also be stripped and stockpiled separately for the same assessment;
- Where sufficient *in situ* test data (chemical analysis) exists, assessment of the stockpile in accordance with WA DoH (2009) for asbestos concentrations (gravimetric analysis) and for waste classification purposes as detailed in Section 10.1:
  - If asbestos concentrations meet the RAC, the stockpile will be relocated for on-site re-use (Lendlease will keep the tracking records;
  - If asbestos concentrations exceed the RAC, but no friable (AF/FA) asbestos is found, the process of “emu picking” will be undertaken as detailed in Section 10.3. The stockpile will be re-assessed in accordance with WA DoH (2009) and relocated as above;
  - If friable (AF/FA) asbestos is found in the stockpile, the stockpile will either be:
    - Disposed off-site under a formal waste classification; or
    - Relocated within the site for burial and capping, as detailed in Section 10.4.

- Where insufficient *in situ* test data exists, assessment of the soils against the WA DoH (2009) guidelines and appropriate testing for contaminants of concern identified in the CSM, to aid in the waste classification process.

EIL and ESL exceedances in retained soil will be assessed at the areas of proposed landscaping in accordance with Section 13.4.

Fill materials below a depth of 0.3 m will be stripped and assessed for either re-use within the site, or disposed off-site under a waste classification. Any observed bonded ACM during this process will be managed under the UFP in Section 12.

At the completion of fill removal, the exposed natural soils or bedrock will be assessed against the VENM criteria as listed in Section 13 of this RAP.

Asphalt and road-base in Eurimbla Avenue and Hospital Road will be stripped and processed for land application either on-site or off-site in accordance with the requirements of the recovered aggregate order 2014.

10. Remediation Procedures and Sequence

The proposed development is declared to be an SSDA as a "hospital" in accordance with Clause 14 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development*) 2011 (SRD SEPP) Part 4, Division 4.7 of the EP&A Act which establishes an assessment framework for SSDAs. As such, the remediation works as part of the Randwick Campus Redevelopment are considered to be Category 1 in accordance with Clause 4.4.1 of the *Managing Land Contamination Planning Guidelines, SEPP 55 – Remediation of Land*, which defines Category 1 works as works which require consent under another SEPP or a regional environmental plan (as one of a number of possible triggers).

The detailed procedures and sequence for the remediation work will rest with the Contractor and will depend upon the equipment to be used and the overall sequence of the demolition and development.

The Principal and/ or Contractor must obtain all required approvals, licences and permissions prior to commencement of remediation works, and implement relevant conditions.

The requirements for the management of asbestos are detailed in Section 11.

The following sub-sections provide the details for each of the steps outlined in Section 9.4, as well as the steps to be implemented (and as implemented to date) to manage hazardous building materials in structures being demolished.

10.1 Management of Hazardous Building Materials

Hazardous materials identified in buildings will be management and removed under the control of the Randwick Campus Redevelopment – Acute Services Building Demolition Control Plan (DCP). The

DCP has been prepared by the Demolition Contractor, Demolition Environmental Civil Contractors (DECC) and is approved by the Principal Contractor (Lendlease).

The DCP incorporates the following:

- Management Plans;
- Installation and maintenance of silt controls;
- Hazardous materials removal;
- Salvage of some items and materials for resale or use;
- Strip out; and
- Structural demolition.

An Asbestos Removal Control Plan (ARCP) has been prepared in accordance with Safe Work Australia *How to Safely Remove Asbestos Code of Practice* 2016; Safe Work Australia *How to manage and Control Asbestos in the Workplace Code of Practice* 2016 of friable and non-friable asbestos material. Similarly, a Lead Removal Control Plan (LRCP) was prepared by Asbestos Solutions Professional Pty Ltd (ASP) for the demolition and describes the technical requirements for the safe remediation of lead contaminated dust to a number of areas within the RCR Development Area.

A notice of intent to commence demolition work was issued and accepted by SafeWork NSW. A licenced asbestos removal company holding a Class A asbestos removal license, issued by SafeWork NSW, will remove friable asbestos material as required by NSW WHS Regulations. As required by the NSW WHS Regulations, a Licensed Asbestos Assessor (LAA) will undertake air monitoring and clearance inspections.

Hazardous materials removal will involve the following:

- Prior to the commencement of works, a walkthrough inspection shall be undertaken with the asbestos register with ASP's nominated LAA;
- All items within the register shall be visually confirmed as to its status of containing asbestos or not; where it is unclear as to its status, or where items likely to contain asbestos this shall be brought to the attention of DECC Pty Ltd;
- Some salvage and loose item strip out may take place before the hazardous materials removal where it is possible without disturbing the hazardous materials;
- Hazardous materials removal to be undertaken as further outlined in the ARCP and LRCP. The ceiling, flooring and any other lining will be removed by the hazmat contractor to access the hazardous materials where applicable. Daily air monitoring will be implemented during asbestos and lead dust removal work;
- A clearance certificate confirming the removal of asbestos based materials will be received from the occupational hygienist prior to further demolition work;
- Normal demolition practices for the salvage and removal of building materials;
- A final visual inspection of the containment area is to be carried out by SWE at completion of lead remediation works. The visual clearance will certify whether the containment area is free from dust and to document the lead remediation work. The visual clearance will allow general access

to the containment area. The clearance certificate must state the extent of the lead removal meaning either a full removal or partial removal;

- Surface swabs will be collected to assess if there has been a significant impact on the removal area and surrounding areas and if normal use of the area is permissible. The sample is then sent to a NATA accredited analytical laboratory for determination of the amount of lead by AAS or ICP; and
- Clearance Certificate to be issued for lead removal, asbestos, unexpected finds & post demolition handover to remediation contractor.

Unexpected finds:

If suspected asbestos materials are encountered during works not associated within the asbestos removal area, workers are to follow the following procedures:

- Immediately stop work and notify the Site Supervisor;
- Move away (minimum 10 m) from the suspicious materials, and leave all tools;
- Site supervisor to create exclusion zone around the suspicious materials and erect signage “Danger Asbestos – Do Not Enter”;
- Licensed asbestos assessor to inspect/sample the material to confirm if asbestos or not. LAA can instruct works to continue in a different area of the building if deemed safe to do so;
- If asbestos; ASP will continue to remove the ACM (once all hazards & risks assessed), decontaminate area, obtain clearance certificate from LAA and dispose of material to a licensed landfill facility, in accordance with this ARCP;
- LAA to inspect building for other “similar” areas throughout (i.e. wet areas, risers) to confirm that no other unidentified asbestos present; and
- Following issue of a clearance certificate, workers can resume work under normal conditions.

In addition to the above, JBS&G Australia Pty Ltd (JBS&G) was engaged by Health Infrastructure, care of Pricewaterhouse Coopers Australia (PwC) to undertake an audit of the hazardous materials process currently being implemented to clean-up the houses prior to demolition, including identification, removal, control measures and monitoring. JBS&G stated that “*the removal methodologies implemented by the hazardous removal contractors at the time of the inspection appeared to be compliant with regulatory requirements and standard industry practices*”, as documented in their Hazardous Materials Audit 01 Report (Ref: 55357-117764), dated 11 December 2018.

10.2 Stockpile Assessment

Following the stripping of the upper 0.3 m of soil (and deeper soils separately where present) from a zone nominated by Lendlease (usually determined by the demolition and occupational hygienist clearance progress), the following assessment process will apply for the resultant stockpile:

- Determine the volume of the stockpile requiring investigation;
- Visually inspect the surface of the stockpile for bonded ACM;

- Identify the source of the stockpile and conduct a walkover that area;
- Determine the appropriate number of samples in accordance with WA DoH (2009), which is typically a sampling density of one sample per 70 m^3, or a minimum of three samples per single stockpile. Select sample locations from within the test pits, with an intentional bias towards areas with observed bonded ACM;
- Excavate test pits into the stockpile to visually assess the homogeneity of the soils and the presence or spread of bonded ACM;
- Collect ~10 L bulk samples from each sampling location;
- Manual on-site screening of each ~10 L bulk sample through a 7 mm sieve, and weighing recovered ACM retained on the sieve;
- Calculate the asbestos %w/w for each 10 L bulk sample, and compare against the RAC;
- Collect a 500 ml sub-sample for each ~10 L sample for laboratory analysis of AF and FA to calculate the asbestos %w/w and compare against the RAC. This sample may only be analysed where ACM is found in the bulk sample and/or there is a suspicion of potential AF or FA (at the discretion of the environmental consultant); and
- Collect additional samples (three per stockpile) for confirmatory chemical testing of contaminants identified in DP (2019c) as exceeding health or ecological based investigation or screening levels (i.e. metals, TRH, PAH).

The environmental consultant will produce a report (or memorandum) following the completion of the investigation of each stockpile. The report will incorporate *in situ* test results applicable to the source of the stockpile. The report will include an assessment of the stockpile against the RAC, and will provide recommendations for management of the stockpile on the basis of this RAP.

The report will also include a waste classification for the event that the stockpile requires off-site disposal. The waste classification will be conducted with reference to the NSW EPA (2014) *Waste Classification Guidelines*.

The report will not include details of where the stockpile should be placed, but will include details of any conditions or requirements on the relocation. Determination of the actual area for relocation rests with Lendlease.

The report will be submitted to the Site Auditor for review and comment prior to any action being taken with respect to that stockpile.

No soils will leave the site without a formal waste classification.

10.3 Emu Picking

The emu picking process (if adopted) and validation will be as follows:

a) Designation by Lendlease of a location for the spreading and treatment of the impacted soils. The area must have sufficient space for stockpiling and treatment of the asbestos impacted filling as described below;

b) It is preferable for the treatment area to be hardstand. Otherwise, the surface soils beneath would need to be stripped at the end of the process and managed in the same way as the treated materials;

c) The treatment area must be managed in accordance with the general site management requirements, including fencing to prevent unauthorised access, implementation of a dust management system, suitable locations selected for asbestos air monitoring, and provision of an asbestos decontamination area (if considered warranted by the occupational hygienist or environmental consultant);

d) Progressive excavation of manageable volumes from the stockpile by the asbestos contractor and spreading in the treatment area to a nominal thickness of 0.1 m;

e) The licensed asbestos contractor will inspect the layered soil by walking on a 1 m transect grid. Observed ACM will be removed by hand, double bagged and stored on site in the secure designated ACM waste storage area;

f) The occupational hygienist / asbestos assessor will inspect the soil and mark any observed ACM. The marked ACM will be removed by the asbestos contractor;

g) Steps (e) and (f) will be repeated until no ACM is observed during three consecutive inspections / passes;

h) All ACM collected will be disposed off site at a licensed landfill facility, with disposal records retained for confirmation and inclusion in the site validation report;

i) The asbestos contactor will stockpile the treated material in a designated area separate from the treatment area for later re-assessment; and

j) The environmental consultant will undertake validation assessment of each stockpile in accordance with Section 10.1.

In addition, the footprint of the treatment area, at the completion of all treatment works, will be validated in accordance with Section 13.

10.4 Burial and Capping

Any soils identified to require on-site retention beneath the physical barrier (capping) system will most likely require temporary stockpiling prior to creation of the burial area(s). Such stockpiles will be covered with a durable geofabric and surrounded with sediment control measures.

A specific capping design is not provided in this RAP given that any such requirements are likely to be associated with the Stage 2 area, for which the development design is not yet known. The physical barrier system design may be developed for areas of:

- New building slabs;
- Paved areas (including service trenches);
- Landscaped areas (including service trenches);
- Trees to be retained; and/or
- New trees and shrubs.

The various physical barrier system designs will need to be included as either an addendum to this RAP, or a stand-alone RAP for Stage 2.

In general, the formation of the physical barrier system will entail the following:

- Excavation or placement of the existing contaminated fill to a nominal depth of 500 mm below the design final ground level (or less if a concrete slab or hardstand will form the cap);
- The exposed materials will be compacted as required;
- The contaminated materials will be placed and compacted as required;
- A marker layer will be placed over the area containing the contaminated fill. The marker layer will comprise a durable matted material which permits soil infiltration, and acts as a warning layer if there is any excavation in the future;
- The capping material(s) will be placed over the contaminated materials;
- The plan and vertical dimensions / locations of the contained and capped soils will be surveyed; and
- A long term EMP will be prepared by the environmental consultant to manage the integrity of the physical barrier system into the future.

11. Asbestos Management

11.1 Regulatory Framework

In New South Wales (NSW), occupational health and safety is regulated under the NSW Work Health and Safety Act 2011 (WHS Act) and the NSW Work Health and Safety Regulation 2017 (WHS Regulation).

The WHS Act and the WHS Regulation place a broad range of responsibilities on key stakeholders to promote and secure the safety and health of persons in the workplace. The WHS Regulation also outlines an array of requirements pertaining to the identification, assessment and control of asbestos and ACM in the workplace.

In addition to the WHS Act and WHS Regulation there are a range of National Codes of Practice and Guidance Notes, Australian Standards and other guidelines relating to the management of asbestos and ACM in the workplace.

Safe Work Australia (SWA) has issued the following codes of practice that have been adopted in NSW:

- Code of Practice: *How to Safely Remove Asbestos*, Safe Work Australia, 2016 (SWA, 2016a);
- Code of Practice: *How to Manage and Control Asbestos in the Workplace*, Safe Work Australia, 2016 (SWA, 2016b); and
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres* 2nd Edition [NOHSC:3003(2005)].

These codes and guidance note detail the requirements for the identification, assessment and management of ACM in the workplace, including the specific controls required for asbestos and ACM removal. Electronic copies of these documents are available on the SWA website (www.safeworkaustralia.gov.au).

Asbestos waste is regulated under the *Protection of the Environment Operations* (POEO) Act 1997 and POEO (Waste) Regulation 2014, which are administered by the Environment and Protection Authority (EPA).

Wastes, including those containing asbestos, must be classified for disposal in accordance with the NSW EPA *Waste Classification Guidelines, Part 1: Classifying Waste,* November 2014 (EPA, 2014)

The Dangerous Goods (Road and Rail Transport) Regulation 2008 adopts uniform national requirements for the transport of dangerous goods (e.g. asbestos) including the requirements of the Australian Dangerous Goods Code.

Asbestos transporters and facilities receiving asbestos waste must report the movement of asbestos waste to the EPA. Entities involved with the transport or disposal of asbestos waste in NSW, or arranging the transport of asbestos waste in NSW, must use the EPA's online tool, WasteLocate.

All works must be conducted in accordance with the development consent conditions.

All works must be also undertaken in accordance with the relevant regulatory criteria, including *inter alia*;

- NSW *Work Health and Safety Act* 2011 (WHS Act);
- NSW *Work Health and Safety Regulation* 2011 (WHS Regulation);
- NSW *Environmental Planning and Assessment Act* 1979;
- NSW *Environmental Protection and Biodiversity Conservation Act* 1999;
- NSW *Environmental Offences and Penalties Act* 1996;
- NSW *Environmentally Hazardous Chemicals Act* 1985;
- NSW *Protection of the Environment Operations Act* 1997 (POEO Act);
- NSW *Contaminated Land Management Act* 1997;
- NSW *Dangerous Goods (Road and Rail Transport) Act 2008; and*
- NSW *Dangerous Goods (Road and Rail Transport) Regulation* 2009.

Reference to relevant Codes of Practice, Australian Standards and industry standards should also be made in determining appropriate safe work practices. These include, *inter alia:*

- National Occupational Health and Safety Commission (NOHSC) *Code of Practice for the Safe Removal of Asbestos* [2002(2005)];
- NOHSC *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres 2nd Edition* [NOHSC:300392005)];

- NOHSC *Code of Practice for the Management and Control of Asbestos in the Workplace* [NOHSC:2018(2005)];
- NOHSC *Guidance Note on the Interpretation of Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:3008 (1995)] 3rd edition;
- AS/NZS 1715:2009 *Selection, Use and Maintenance of Respiratory Protective Devices;*
- AS/NZS 1716:2012 *Respiratory Protective Devices;*
- AS/NZS 1716:2003/Amdt 1:2005: *Respiratory protective devices;*
- WorkCover NSW: *Working with Asbestos: Guide 2008;*
- WorkCover NSW: *How to manage and control asbestos in the workplace: Code of practice; and*
- WorkCover NSW: *How to safely remove asbestos: Code of practice.*

11.2 Notification

SafeWork NSW must be notified 5 days in advance of any asbestos works.

The asbestos contractor must, before commencing the licensed asbestos removal work, inform the following people that asbestos removal works are to be conducted and the date the work will commence:

- The person with management or control of the workplace and any adjacent occupied buildings; and
- The entity/person who commissioned the asbestos removal work.

The person with management of control of the workplace must inform workers and any other persons in the workplace.

11.3 WHS Plans

The asbestos contractor will prepare the following plans complying with regulatory requirements, including the WHS Regulation and WorkCover NSW requirements:

- Safe Work Method Statements (SWMS); and
- Asbestos Removal Control Plan (ARCP). The ARCP must:
  - Be provided to the person who commissioned the work;
  - Include details of how the asbestos removal will be carried out, including the method to be used and the tools, equipment and personal protective equipment to be used;
  - Include details of the asbestos to be removed, including the location, type and condition of the asbestos; and
  - Be kept by the licensed asbestos contractor in accordance with the WHS Regulations.

11.4 Licensed Contractor Training

All asbestos workers at the site must be appropriately trained in asbestos works and in the Asbestos Removal Control Plan. The training must include information on health risks associated with asbestos, and the rights of asbestos workers under the WHS Regulation.

The licensed asbestos removalist must keep records of all training works.

11.5 Restriction of Access

Access to the asbestos works area will be restricted to:

- Workers engaged in asbestos removal work;
- Other persons associated with the asbestos removal work; and
- Anyone allowed under the WHS Regulation or another law to be in the asbestos removal area.

11.6 Airborne Asbestos Monitoring

Monitoring for airborne asbestos fibres is to be carried out by the independent competent person or licenced asbestos assessor during asbestos removal works, as required, to meet WHS (2011) and SafeWork NSW requirements. The competent person or licensed asbestos assessor will be responsible for determining when air monitoring is required, and an appropriate scope of monitoring for the works.

11.7 Personal Protection Equipment

The following personal protective equipment (PPE), in addition to standard construction PPE, should be worn during works involving the handling and/or removal of soils impacted by asbestos (e.g. emu picking):

- Half-face P1/P2 respirator;
- Disposable coveralls (Tyvek suit or equivalent);
- Gloves; and
- Safety glasses or safety goggles.

11.8 Decontamination and Asbestos Clearance

At the direction of the competent person or licenced asbestos assessor, facilities must be provided to decontaminate:

- The asbestos removal area;
- Any plant used in the asbestos removal area;

- Workers carrying out asbestos removal work; and
- Other persons who have access to the asbestos removal area.

12. Unexpected Finds Protocol

12.1 General Unexpected Finds

An "Unexpected Finds Protocol" has been established to deal with unexpected findings and/or unplanned situations. This protocol is also applicable to any unexpected finds relating to potentially contaminated soils with a historical uncertainty that may be encountered during excavation works with the site. The protocol is as follows:

1. The contractor(s) undertaking any remediation, civil or construction works will be provided with a copy of the RAP (plus any amendment or addendum), including this UFP. The contractor(s) will nominate their site (project) manager who will be responsible for implementing the UFP;
2. Upon discovery of suspected (unexpected) contaminated material, the site (project) manager is to be notified and the affected area closed off by the use of barrier tape and warning signs (if appropriate) and sediment controls. Warning signs shall be specific to the findings and potential hazards and shall comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;
3. A qualified environmental consultant is to be notified by the site manager to inspect the area and confirm the presence or otherwise of hazards or contamination, and to determine the method and extent of investigation or remediation works to be undertaken. A report detailing this information will be compiled by the environmental consultant and provided to the site manager, who will disseminate to the Principal (or their representative);
4. All work associated with the contaminated soil will be undertaken by an appropriately licensed contractor, as stipulated by the environmental consultant;
5. All works must comply with the provisions of the relevant legislation and guidelines;
6. Documentary evidence (weighbridge dockets) of appropriate disposal of the material is to be provided to the Principal (or their representative) if disposal occurs;
7. Details of all relevant activities are to be recorded in the site record system; and
8. Details of the remediation and validation works undertaken with respect to the unexpected find must be incorporated into the final validation report as prepared by the environmental consultant.

12.2 Underground Storage Tanks

In the event that an underground storage tank (UST) is unexpectedly discovered during site remediation or excavation works the following procedure will be followed:

1. Works in the area will cease and the Site Manager informed;
2. The area will be closed off by the use of barrier tape and warning signs that comply with the Australian Standard 1319-1994 – Safety Signs for the Occupational Environment;

3. Prior to the removal of the UST, any residual product (liquid/vapour) will be removed from the tank and disposed of appropriately in accordance with Australian Standard (AS 4976 – 2008 *The Removal and Disposal of Petroleum Underground Storage Tanks*). Records of disposal will be provided for the validation report;
4. The UST will be exposed and examined for potential leaks and general condition. The environmental consultant will be engaged to inspect the UST prior to its removal;
5. The UST will be removed and the structures disposed of by a qualified contractor in accordance with AS 4976 – 2008. Disposal records will be provided to the environmental consultant for inclusion in the validation report;
6. All associated infrastructure (i.e. the remnants including fuel lines etc) will be removed and disposed in a similar manner if present;
7. Excavate and stockpile impacted materials (based on field observations) as directed by the environmental consultant. Once stockpiled, the material will be sampled and tested by the environmental consultant for either on-site re-use or off-site disposal (i.e. waste classification);
8. Land farming of impacted soils may be considered upon further advice from the environmental consultant based on the nature and extent of impacted soils;
9. Collect validation samples from the tank pit at a minimum rate of one location per side wall or one sample per soil type and at the depth of observed groundwater, whichever is the greater and at least one sample in the excavation base. Note that the actual number of samples may vary depending on the size of the tank pit excavation and the degree of contamination, the soil profile encountered and the presence of groundwater;
10. Collect validation samples below the fuel lines (following removal). Validation samples will be collected at a rate of one sample per 5 m linear metres of the fuel lines;
11. The validation samples will be analysed at a NATA accredited laboratory for lead, TRH, BTEX, PAH. Additional analysis may be required as advised by the environmental consultant based on the contents of the tank;
12. If evidence of leaks is observed in the tank and/or tank pit then groundwater monitoring wells may be required. Groundwater samples will be tested for TRH, BTEX, PAH, heavy metals and VOC. Additional analysis may be required subject to the determination of the product stored in the tank; and
13. The above works will be documented in the site validation report.

13. Validation

13.1 Site Inspections

The Environmental Consultant is to conduct periodic site inspections during remediation works, when any issue of concern is identified under the UFP, and to assess the progress of remediation. A record of the inspections and observations, including a photographic record, will be provided as part of the validation assessment report.

13.2 Remedial Excavation Testing Requirements

Where an unexpected find of contaminated fill is removed from the site and either disposed off-site or relocated to Stage 2 for containment and capping, systematic validation samples are to be collected from the exposed surface of remedial excavations and analysed at the frequencies shown below:

- Base of excavation – One sample should be collected from the floor of the excavation for small excavations, or at a minimum of 1 sample per 25 m for large excavations;
- Side walls of excavation – samples must be collected from the excavation walls at a minimum rate of one location per side wall or one sample per 20-25 m, whichever is the greater. Note that the actual number of samples may vary depending on the size of the it excavation and the degree of contamination, the soil profile encountered and the presence of groundwater (to be determined by the environmental consultant);
- Every sample will be analysed for the contaminants of concern at that location;
- Testing to include gravimetric analysis given that friable asbestos and asbestos fines have been identified on Hospital Road, i.e.
  - Collect ~10 L bulk samples from each sampling location;
  - Manual on-site screening of each ~10 L bulk sample through a 7 mm sieve, and weighing recovered ACM retained on the sieve;
  - Calculate the asbestos %w/w for each 10 L bulk sample, and compare against the RAC; and
  - Collect a 500 ml sub-sample for each ~10 L sample for laboratory analysis of AF and FA to calculate the asbestos %w/w and compare against the RAC. This sample may only be analysed where ACM is found in the bulk sample and/or there is a suspicion of potential AF or FA (at the discretion of the environmental consultant).
- QA / QC analysis as per industry standards;

13.3 Stockpiles

Validation of the suitability of stockpiles to be retained within the site will be conducted as per Section 10.2.

13.4 Fill to be Retained

Given the disturbance of soils through the demolition, stripping of fill, the ASB building excavation, and Hospital Road excavation, any fill remaining within the site will be assessed for suitability to be retained in the landscaped areas outside the building excavation (noting that all fill will be removed from the building footprint due to the basement excavation). Validation of the suitability of the fill remaining within the site will be carried out as follows:

- Remaining fill will be identified by the environmental consultant;
- Test pits will be excavated on a nominal 20 m grid across the fill area, or as required under WA DoH (20092);

- Samples of fill will be recovered from the surface and at regular depth intervals not exceeding 1 m;
- Samples will be analysed for metals, TRH, PAH and asbestos (10L sieve and gravimetric analysis); and
- The analytical data will be assessed against the RAC, with statistics applied where appropriate.

If the concentrations fall within the RAC the fill will be deemed suitable to be retained *in situ*.

If the concentrations exceed the RAC, the following actions will be considered / enacted:

- The fill will be excavated and removed off site under an assigned waste classification; or
- If exceeding only EILs or ESLs, either:
    - A horticulturalist will be consulted to propose tolerant plant species and/or imported soil mixes to allow establishment of the proposed landscaping; or
    - The fill will be partially removed as above, with validated soil imported to form a suitable surface layer (nominally 0.5 m thickness, to be advised by a horticulturalist) for the establishment of the proposed landscaping.

13.5 Virgin Excavated Natural Material Assessment

A virgin excavated natural material (VENM) classification of natural materials will be required in areas where fill has been removed and deeper excavation is proposed (such as the ASB basement, Hospital Road excavation or services). The Environmental Consultant will conduct an assessment of the natural soils for VENM classification compliance through the following scope:

- Inspect the surface of the area to be assessed (ONLY AFTER FILL REMOVAL) to confirm the absence of formerly overlying fill;
- Recover samples on a grid of 1 per 30 m;
- Submit the soil samples (plus QC samples) for analysis of the chemical contaminants identified in the overlying fill (even if at low concentrations), comprising as a minimum the following:
    - Eight priority metals (arsenic, cadmium, chromium, copper lead, mercury, nickel, zinc);
    - TRH / BTEX;
    - PAH; and
    - Asbestos (identification only).
- Inclusion of industry standard QA/QC (refer Section 13.9); and
- Preparation of VENM classification reports (as required for off-site disposal).

13.6 Waste Classification

The Environmental Consultant will classify all soil and rock to be disposed off-site in accordance with the POEO Act.

Waste classification will be undertaken in general accordance with the EPA *Waste Classification Guidelines* 2014.

The scope of works for general waste classification purposes is as follows:

- Review of previous applicable results which will be included in the waste classification process;
- If considered necessary due to insufficient data, sampling from across the subject materials at various depths / locations to ensure collection of characteristic samples;
- Analysis of primary samples at a rate considered appropriate to classify the materials; and
- Quality assurance/ quality control (QA/QC) sampling and analysis in accordance with Section 13.9.

The analytical regime adopted will depend on the previous results available for the material, but should include the following approximate frequencies (including previous testing results):

- Asbestos for all samples collected, unless asbestos is clearly present, and the material is assumed to be Special Waste (asbestos);
- Heavy metals, TRH, BTEX and PAH for all samples collected;
- Phenols, PCB, OCP and OPP from a third of the number of samples collected;
- Additional analysis for any specific issues of concern (e.g. odorous or stained material); and
- Toxicity characteristic leaching procedure (TCLP) analysis as required based on total concentration results.

13.7 Imported Material Assessment

All proposed imported materials (including DGB, landscaping and temporary filling for platforms) will be assessed as being legally able to be imported to the site, and suitable under the proposed development. Material proposed to be imported to the site must comprise one of the following:

- Virgin excavated natural material (VENM); or
- Materials complying with a Resource Recovery Order (RRO) allowing land application; and
- Meeting the site acceptance criteria.

The scope of works for the assessment of imported materials is as follows:

- Lendlease to provide certification / reports confirming compliance with one of the above, prior to the materials being imported to the site;
- The Environmental Consultant will review the information made available for compliance with one of the above, prior to the materials being imported to the site;
- If the Environmental Consultant determines compliance, they will recover confirmatory samples of the material either on site or at the source site, at a rate of two samples (minimum) per source site;

- Analysis of the samples for a range of potential contaminants including metals, TRH, BTEX, PAH, OCP, OPP, PCB, Phenols and Asbestos (gravimetric analysis method);
- The Environmental Consultant will inspect the materials upon delivery to site for compliance with the information provided;
- The Environmental Consultant will flag any concerns once identified; and
- The Environmental Consultant will issue an email or memorandum confirming acceptance (or otherwise) of the materials, prior to any materials being included in the works. The validation process will be documented in the final site validation report.

13.8 Sample Collection and Handling

Appropriate sampling procedures will be undertaken to ensure that cross contamination does not occur, these will include:

- Use of standard operating procedures to ensure consistency between samples;
- The use of stainless steel or disposable sampling equipment;
- Decontamination of sampling equipment prior to the collection each sample;
- Labelling of the sample containers with individual and unique identification;
- The use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory;
- Samples are stored under secure, temperature controlled conditions;
- The use of chain-of-custody documentation so that sample tracking and custody can be cross-checked at any point in the transfer of samples from the field to hand-over to the laboratory; and
- Recording field observation, including location and dimensions of excavations and stockpiles, sample locations and descriptions, and signs of potential concern.

13.9 Quality Assurance Plan

Quality assurance (QA) and quality control (QC) procedures will be integral to the validation assessment and will include those detailed in the following sections.

13.9.1 Data Quality Indicators

Field and laboratory procedures will be assessed against the following data quality indicators (DQIs):

- Completeness – a measure of the amount of usable data from a data collection activity;
- Comparability – the confidence (qualitative) that data may be considered to be equivalent for each sampling and analytical event;
- Representativeness – the confidence (qualitative) of data representativeness of media present on-site;
- Precision – a measure of variability or reproducibility of data; and

- Accuracy – a measure of closeness of the data to the 'true' value.

13.9.2 Quality Assurance and Quality Control Samples

The following QA/QC samples will be collected and analysed:

- 5% Intra-laboratory replicate samples (for the same suite of analytes as the primary sample);
- 5% Inter-laboratory replicate samples (for the same suite of analytes as the primary sample);
- Rinsate samples (1 per day where re-usable sampling equipment used) (for the same suite of analytes as the primary samples); and
- Trip spikes and trip blanks for each batch of samples requiring analysis for volatile or semi-volatile contaminants (analysed for BTEX).

13.9.3 Field Quality Assurance and Quality Control

QA/QC procedures will be adopted throughout the field sampling program to ensure sampling precision and accuracy and prevent cross contamination.

This will comprise using sampling methods and collection and analysis of QA/QC samples in accordance with Section 13.7.2.

13.9.4 Laboratory Quality Assurance and Quality Control

NATA accredited laboratories will be used to conduct analysis where possible.

The laboratories will undertake in-house QA/QC procedures involving the routine testing of:-

- Reagent blanks;
- Spike recovery analysis;
- Laboratory duplicate analysis;
- Analysis of control standards;
- Calibration standards and blanks; and
- Statistical analysis of QC data including control standards and recovery plots.

13.10 Documentation and Reporting

The following documents will be prepared/ obtained by the relevant party, and provided to other parties (the Principal, Contractor, Environmental Consultant and/ or Asbestos Assessor) as required. Documentation should be provided by the relevant parties in a timely manner to allow the works to be conducted efficiently.

13.10.1 Principal

The Principal will prepare/ obtain the following documents:

- Any licences and approvals required for the works which are not the responsibility of the Contractor to provide.

13.10.2 Contractor

The Contractor will prepare/ obtain the following documents:

- Any licences and approvals required for the works which are the responsibility of the Contractor to provide;
- Excavation and stockpiling records (i.e. tracking records): these will record the source of any stockpiled material, the date of excavation and any issues of concern;
- Transportation record: this will comprise a record of all truck loads of soil entering or leaving the site, including truck identification (e.g. registration number), date, time, load characteristics (i.e. classification, on-site source, destination);
- Tip dockets: these comprise dockets of receipt provided by the receiving waste facility. Where the receiving site is not a waste facility (e.g. if VENM from the site is accepted for re-use on another site), a record of receipt from the receiving site will be supplied; and
- Incident reports: any WHS or environmental incidents which occur during the works will be documented and the PR and appropriate regulatory authority will be informed in accordance with regulatory requirements.

13.10.3 Environmental Consultant

The Environmental Consultant will prepare the following documents:

- Stockpile site suitability reports;
- Waste classification reports (as required);
- Advice on the suitability of soil proposed to be imported onto the site (if required); and
- Validation report, including records the remediation and validation work undertaken, and the results of the work.

13.10.4 Asbestos Assessor/ Occupational Hygienist

The Asbestos Assessor – occupational hygienist will prepare the following documents:

- Airborne asbestos monitoring records; and
- Visual clearance of asbestos removal.

13.11 Validation Reporting

In addition to those listed in Section 13.7, the following documents will need to be reviewed as part of the validation assessment by the environmental consultant at the completion of all remediation works. These are to include and be provided to the environmental consultant by the relevant parties:

- Records relating to any unexpected finds and contingency plans implemented;

- Laboratory certificates and chain-of-custody documentation; and
- Letters/ memos as required which provide instruction or information to the principal or contractor.

The purpose of the documentation is to ensure the works are conducted in accordance with all applicable regulations and that appropriate records of the works are kept for future reference. Documentation should be provided by the relevant parties in a timely manner to allow the works to be conducted efficiently.

A validation assessment report will be prepared for the site by the environmental consultant in accordance with NSW Office of Environment and Heritage (OEH) *Contaminated Sites Guidelines for Consultants Reporting on Contaminated Sites* (reprinted 2011) and other appropriate guidance documentation. The validation report shall detail the methodology, results and conclusion of the assessment and make a clear statement regarding the suitability of the site for the proposed land use.

14. General Environmental Management Plan

General environmental management at the site will be undertaken in accordance with the following documents:

- Lendlease Randwick Campus Redevelopment, Project EHS Management Plan, Issue No.4, dated 16 July 2018;
- Lendlease Randwick Campus Redevelopment, Management Plan - Contamination, Issue No.2.2, dated 4 December 2018; and
- Lendlease Randwick Campus Redevelopment, Management Plan - Waste, Issue No.2.3, dated 4 December 2018.The Contractors will undertake the work with due regard to the minimisation of environmental effects and to meet regulatory and statutory requirements.

15. Roles and Responsibilities

Principal

The Principal (Health Infrastructure) is responsible for the environmental performance of the proposed remediation works, including implementation of acceptable environmental controls during all site works. The Principal will retain the overall responsibility for ensuring this RAP is appropriately implemented. The Principal is to nominate a representative (Lendlease), who is responsible for overseeing the implementation of this RAP. The actual implementation of the RAP will, however, be conducted by the Contractor on behalf of the Principal.

The Principal will also be responsible for acquiring all necessary approvals for the remediation works proposed, including approval from the consent authority.

Contractor and Site Manager

The Contractor (Lendlease) is foreseen to be the party responsible for the day to day implementation of this RAP and shall fulfil the responsibilities of the Principal Contractor as defined by WorkCover. It is noted that the Contractor may appoint appropriately qualified sub-contractors or sub-consultants to assist in fulfilling the requirements of the procedures.

The Contractor will nominate a Site Manager who will be responsible for day to day site management and first response to any unexpected finds encountered during works.

Site Auditor

The site auditor will be responsible for the preparation of interim audit advice notices as required during the works and review of reports produced by the Environmental Consultant and submitted to the auditor for review. The auditor will be responsible for the preparation of a Site Audit Statement (if required) for works under the development consent conditions.

Asbestos Contractor

The Asbestos Contractor will be responsible for undertaking all asbestos works and will hold either a Class A or B licence (issued by WorkCover NSW) as appropriate. For friable (Class A) works a certified supervisor must be present at all times, for bonded works > 10 m^2 (Class B) a certified supervisor must be readily available to the certified removalist workers.

The Asbestos Contractor and Contractor can be the same entity.

Environmental Consultant (EC)

The Environmental Consultant will provide advice on implementing this RAP and validate that the site has been appropriately remediated. In general terms, the Environmental Consultant will:

- Provide advice to their client as required for the remediation works;
- Identify the extents of remediation areas, as outlined in Section 7;
- Undertake all validation assessment work, including inspections, sampling and reporting outlined in Section 13;
- Provide advice and recommendations arising from inspections/observations;
- Notify their client with the results of any assessments and any observed non-conformances in a timely manner;
- Undertake the required waste classification assessments for disposal of liquid and solid wastes;
- Attend to unexpected finds as outlined in Section 12; and
- Validate and approve the use on any imported materials used in the civil works.

Occupational Hygienist

The Occupational Hygienist will provide advice on WHS issues related to the asbestos works. The Occupational Hygienist will be suitably qualified / licenced in accordance with the WHS Regulations 2011.

The Occupational Hygienist will:

- Prepare any WHS plans and advice requested by the Contractor;
- Undertake airborne asbestos monitoring (as required);
- Undertake visual clearance inspections;
- Provide advice and recommendations arising from monitoring and/or inspections;
- Notify their client with the results of any assessments and any observed non-conformances in a timely manner; and
- Issue clearance certification.

The Environmental Consultant and Occupational Hygienist can be the same entity.

Contact Details

The following table provides a list of personnel and contact details relevant to the remediation. The list should be filled in as relevant personnel are appointed to the project.

Table 16: Contact Details

Role	Personnel / Contact	Contact Details (phone)
Principal	Health Infrastructure	
Principal Contractor	Lendlease Building	Danny Finn (0439 369 749)
Site Manager		
Environmental Consultant	Douglas Partners	Paul Gorman (0427949878)
Regulator	NSW EPA (pollution line)	131 555
	NSW EPA (general enquiries)	131 555
Consent Authority	Randwick City Council	(02) 9093 6000
Utility Provider	Sydney Water	13 20 92
Utility Provider	Power	
Utility Provider	Gas	

Note: Table to be completed when the contact details are known.

16. Conclusions

It is considered that Stage 1 and the IASB Addition site can be rendered suitable for the proposed development subject to proper implementation of the remediation procedures, unexpected finds protocols and completion of the validation assessment detailed in this RAP.

It is understood that a Groundwater Management Plan will be prepared at the direction of Lendlease for inclusion in a dewatering license application to NSW Water.

17. Limitations

Douglas Partners (DP) has prepared this report for the proposed Randwick Campus Redevelopment in accordance with DP's proposal and acceptance received from Lendlease Building Pty Ltd. This report is provided for the exclusive use of Lendlease Building Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the discussions section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Asbestos has not been detected by observation or by laboratory analysis, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Although the sampling plan

adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints. It is therefore considered possible that hazardous building materials, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

Douglas Partners Pty Ltd

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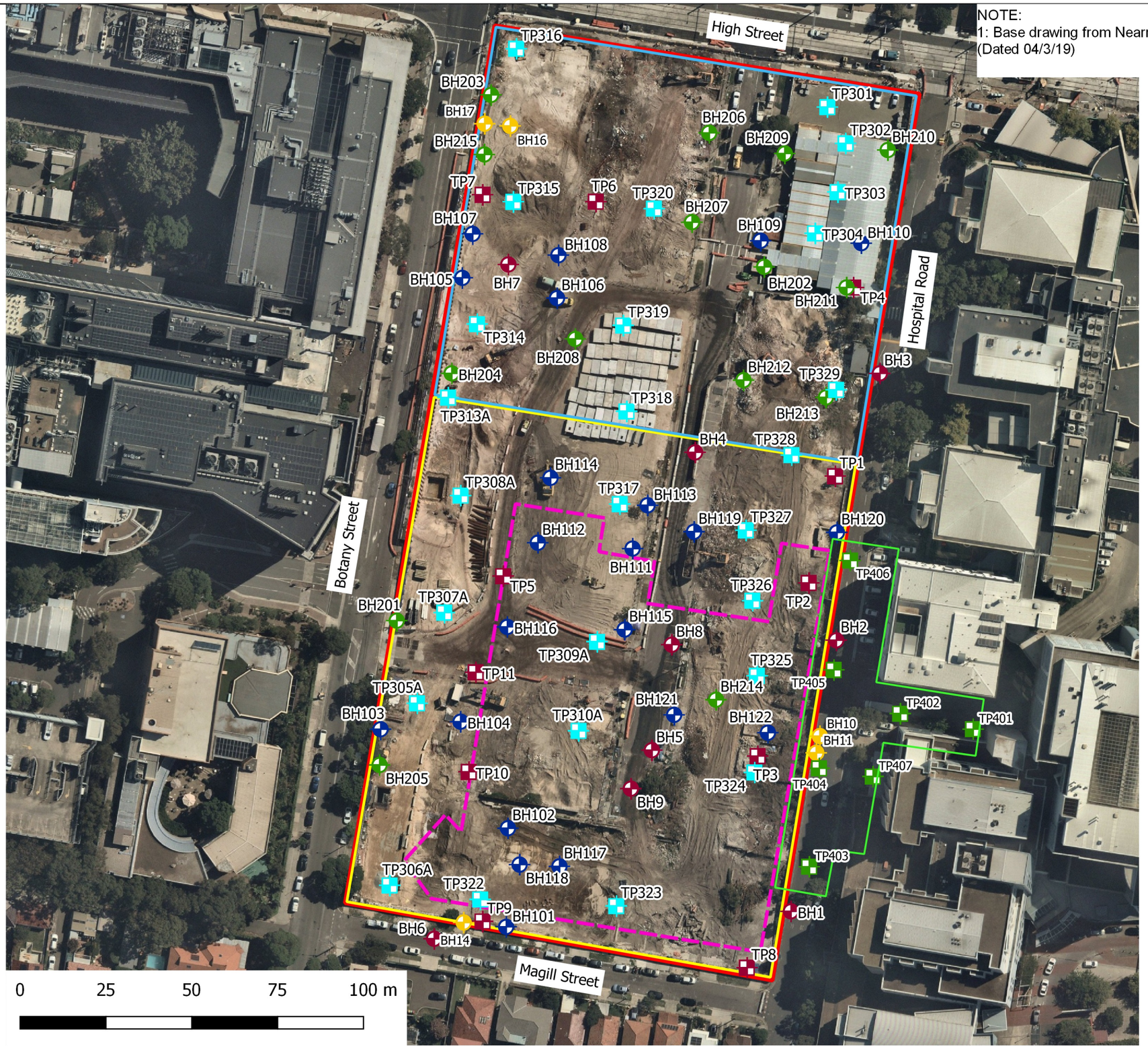
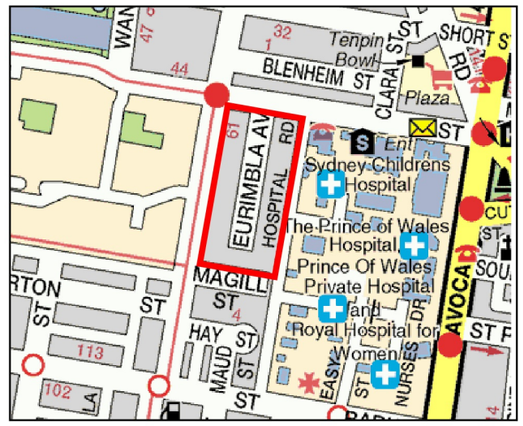
NOTE:
1: Base drawing from Nearmap.com (Dated 04/3/19)





Locality Plan

Legend

- RCR Project Area Boundary
- Acute Services Building
- IASB Addition Boundary
- Stage 1 Boundary
- Stage 2 Boundary

Test Locations

- Post Demolition Test Pit (Current Investigation)
- DP Borehole Location (June, 2018)
- DP Borehole Location (Oct. 2017)
- DP Environmental Borehole (Jan. 2018)
- DP Test Pit Location (Aug. 2018)
- IASB Addition Test Pits (Aug. 2019)
- Existing Groundwater Wells

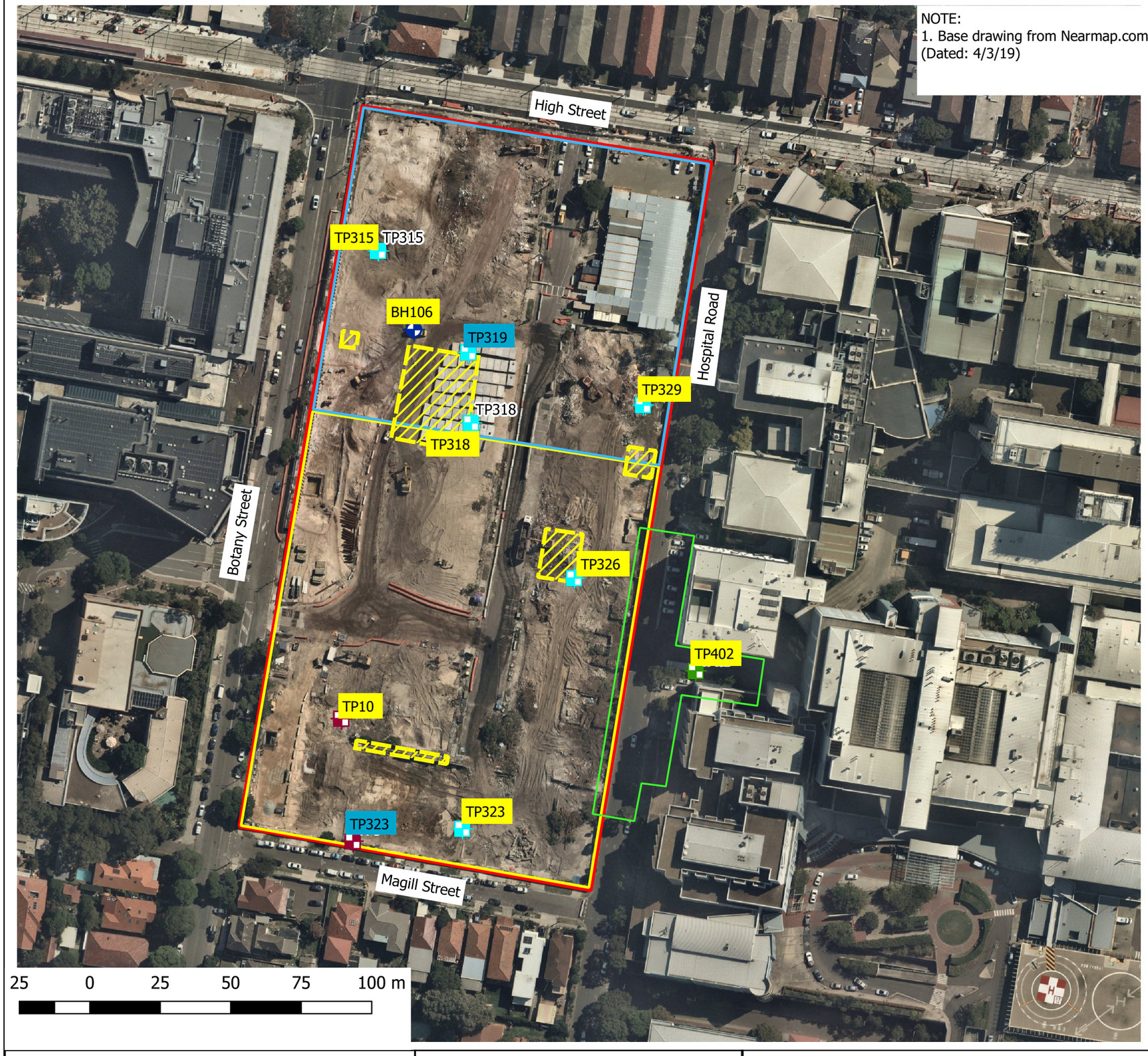
Douglas Partners
Geotechnics / Environment / Groundwater

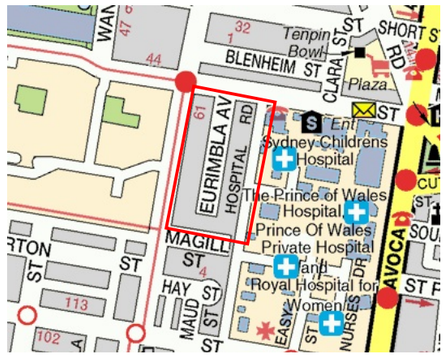
CLIENT:	Lend Lease Building Pty Ltd		
OFFICE:	Sydney	DRAWN BY:	AD
SCALE:	As shown	DATE:	4/9/2019

TITLE: **Sample Locations**
Randwick Campus Redevelopment
Randwick, NSW

PROJECT No:	72505.14
DRAWING No:	1
REVISION:	0

NOTE:
1. Base drawing from Nearmap.com (Dated: 4/3/19)





Legend

- Greater RCR Boundary
- Stage 1 Boundary
- Stage 2 Boundary
- Approximate Observed Surface ACM Areas
- IASB Addition

Test Locations in which ACM was observed

- Post Demolition Test Pit (Current Investigation)
- DP Environmental Borehole (Jan. 2018)
- DP Test Pit Location (Aug. 2018)
- IASB Addition Test Pit Location (Aug. 2019)

- ACM observed at test location/during seiving (0-0.25m depth), between 9/1/2018 and 13/2/2019
- ACM observed at test location/during seiving (0.4-0.5m depth), between 8/8/2018 and 11/2/2019

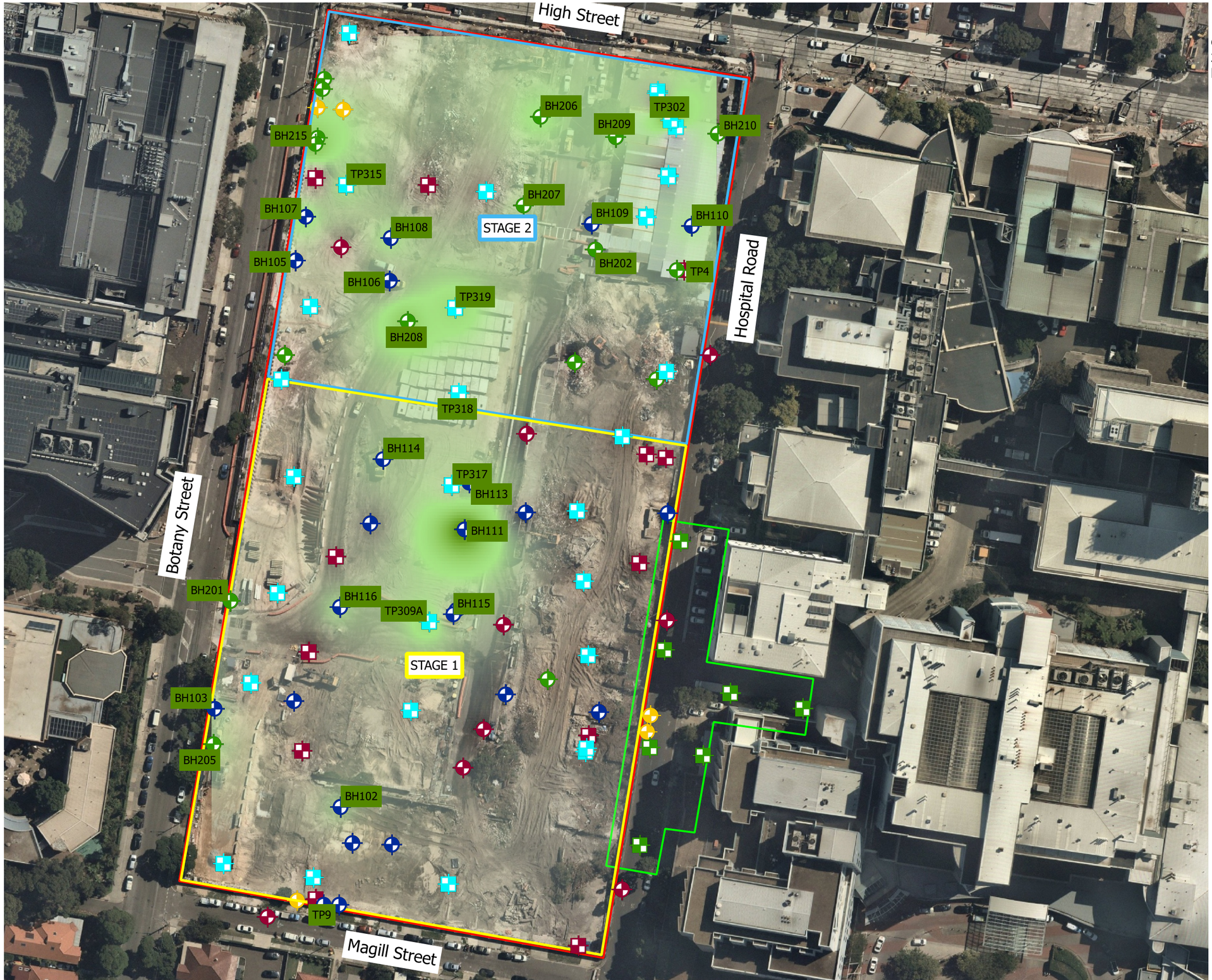
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Lend Lease Building	
OFFICE:	Sydney	DRAWN BY: AD
SCALE:	1:1250	DATE: 4/9/2019

TITLE: **Asbestos Containing Material Finds**
Randwick Campus Redevelopment
Randwick, NSW

N

PROJECT No:	72505.14
DRAWING No:	2
REVISION:	0



NOTE:
1: Detected B(a)P concentrations for soils up to 1 m depth
2: Interpolation of concentrations between test locations is approximate only

Legend

- RCR Project Area Boundary
- Acute Services Building
- IASB Addition Boundary
- Stage 1 Boundary
- Stage 2 Boundary

B(a)P Concentration (mg/kg)

- 0
- 1.60
- 3.25
- 4.90
- 6.50

Test Locations

- Post Demolition Test Pit (Current Investigation)
- DP Test Tit Location (Aug. 2018)
- DP Environmental Borehole (Jan. 2018)
- DP Borehole Bocation (Oct. 2017)
- DP Borehole Location (June, 2018)
- IASB Addition Test Pit Locations (Aug.2019)
- Existing Groundwater Well
- B(a)P Detected Above 0.7 mg/kg

0 25 50 75 m

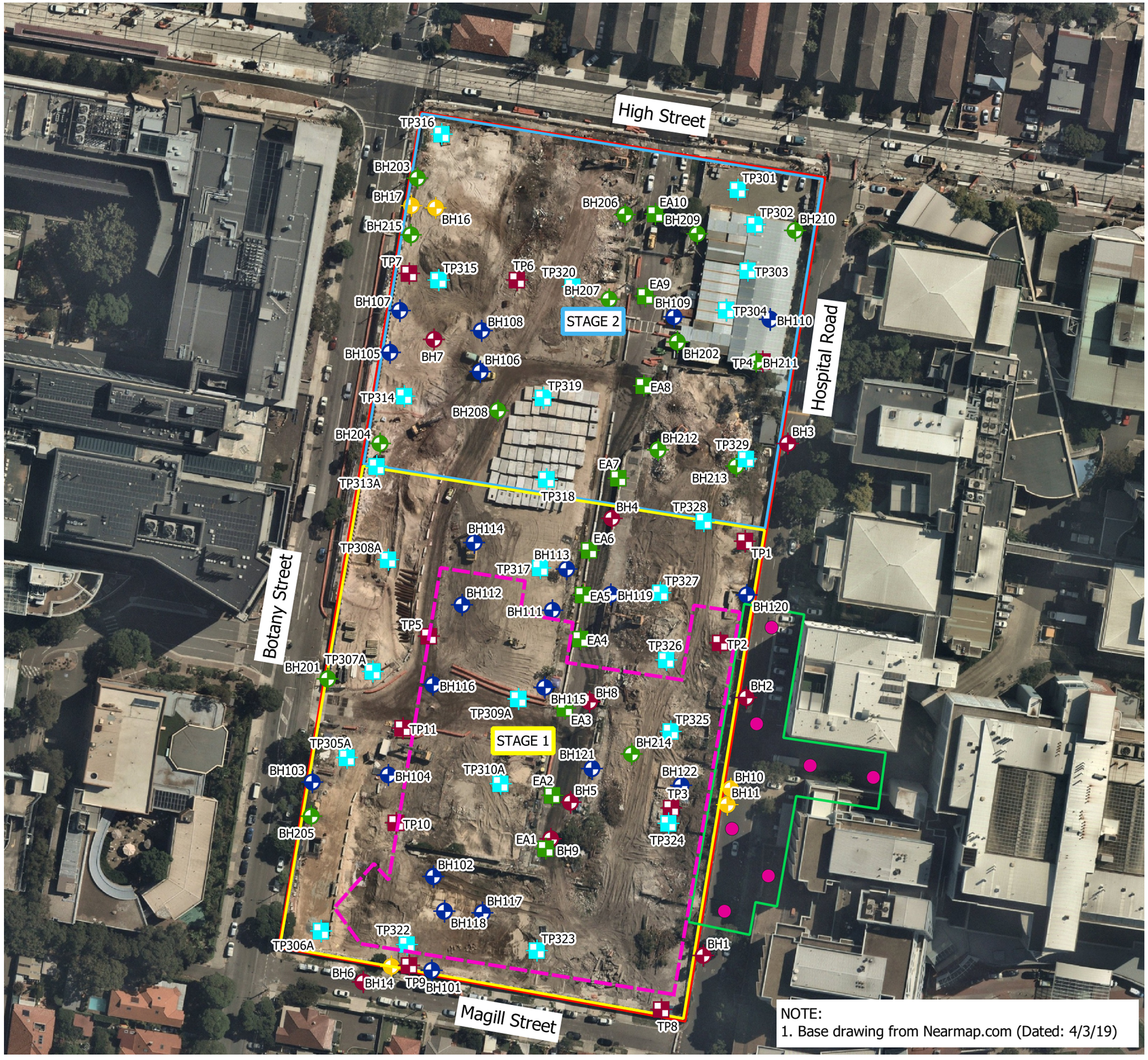
Douglas Partners
Geotechnics / Environment / Groundwater

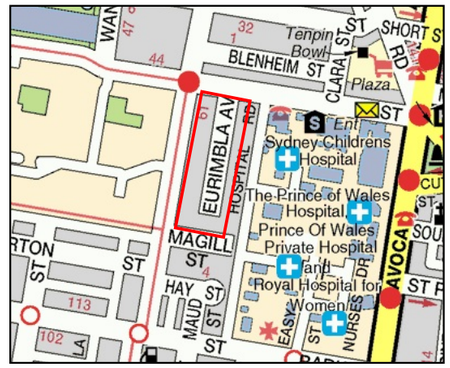
CLIENT:	Lend Lease Building		
OFFICE:	Sydney	DRAWN BY:	AD
SCALE:	1:1250	DATE:	4/9/2019

TITLE: **Benzo(a)Pyrene In Soils**
Randwick Campus Development
Randwick, NSW

N

PROJECT No:	72505.14
DRAWING No:	3
REVISION:	0





Locality Plan

Legend

- RCR Project Area Boundary
- Stage 1 Boundary
- Stage 2 Boundary
- Proposed Acute Services Building
- IASB Addition Boundary
- Aggregrate Sampling Test Pits (Feb. 2019)
- Post Demolition Test Pit (Feb. 2019)
- DP test pit location (Aug. 2018)
- DP Environmental borehole (Jan. 2018)
- DP borehole location (Oct. 2017)
- DP borehole location (Jun. 2018)
- Existing Groundwater Well
- Proposed Sampling Locations

0 25 50 75 100 m

Douglas Partners
Geotechnics / Environment / Groundwater

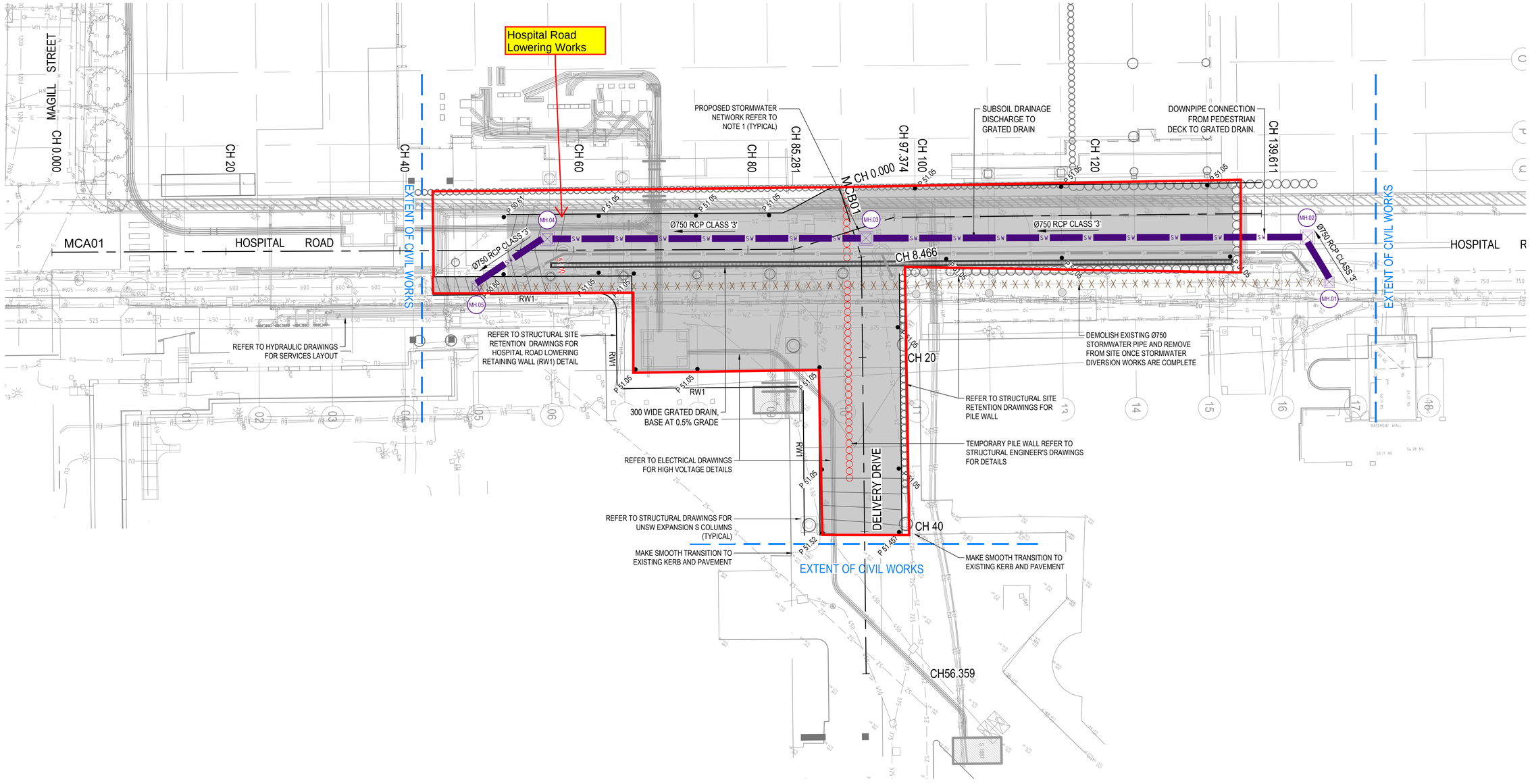
CLIENT:	Lend Lease Building		
OFFICE:	Sydney	DRAWN BY:	LT
SCALE:	1:1250	DATE:	14.08.2019

TITLE: **Proposed Sampling Locations**
Randwick Campus Development - IASB Addition
Hospital Road, High, Magill and Botany Streets, Randwick, NSW

PROJECT No:	72505.14
DRAWING No:	4A
REVISION:	0

NOTE

1. REFER TO STORMWATER STANDARD DETAILS DRAWING RCR-ACR-CV-00-DWG-00-602 AND STORMWATER LONGSECTION AND PIT SCHEDULE DRAWING RCR-ACR-CV-00-DWG-00-950.



CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

CONSULTANT
Suite 2, Level 1
33 Herbert Street
St Leonards
NSW 2065
T +61 2 9438 5098

NOTE
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ISSUE	DATE	FOR
A	23.11.18	SCHEMATIC DESIGN
B	20.12.18	ISSUE FOR PRICING
C	15.05.19	DRAFT SSDA
D	04.07.19	ISSUE FOR SSDA
E	11.09.19	ISSUE FOR COORDINATION

PROJECT MANAGEMENT
PWC

STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
FREDON AIR

ELECTRICAL ENGINEERING
FREDON

HYDRAULIC ENGINEERING
CP CONSULTANTS

CLIENT
NSW GOVERNMENT Health Infrastructure

PROJECT
HOSPITAL ROAD
LOWERING
RANDWICK NSW AUSTRALIA

ACOR PROJECT NUMBER
SY180053

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 4 10

SCALE
1:200 @ B1 DO NOT SCALE

STATUS
DESIGN

DRAWING
GENERAL ARRANGEMENT
SHEET 1

DRAWING NUMBER	ISSUE
RCR-ACR-CV-00-DWG-00-101	E

About this Report

Douglas Partners

Introduction

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Borehole and Test Pit Logs

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Groundwater

[illegible]

Reports

[illegible]

About this Report

Site Anomalies

[illegible]

Information for Contractual Purposes

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Site Inspection

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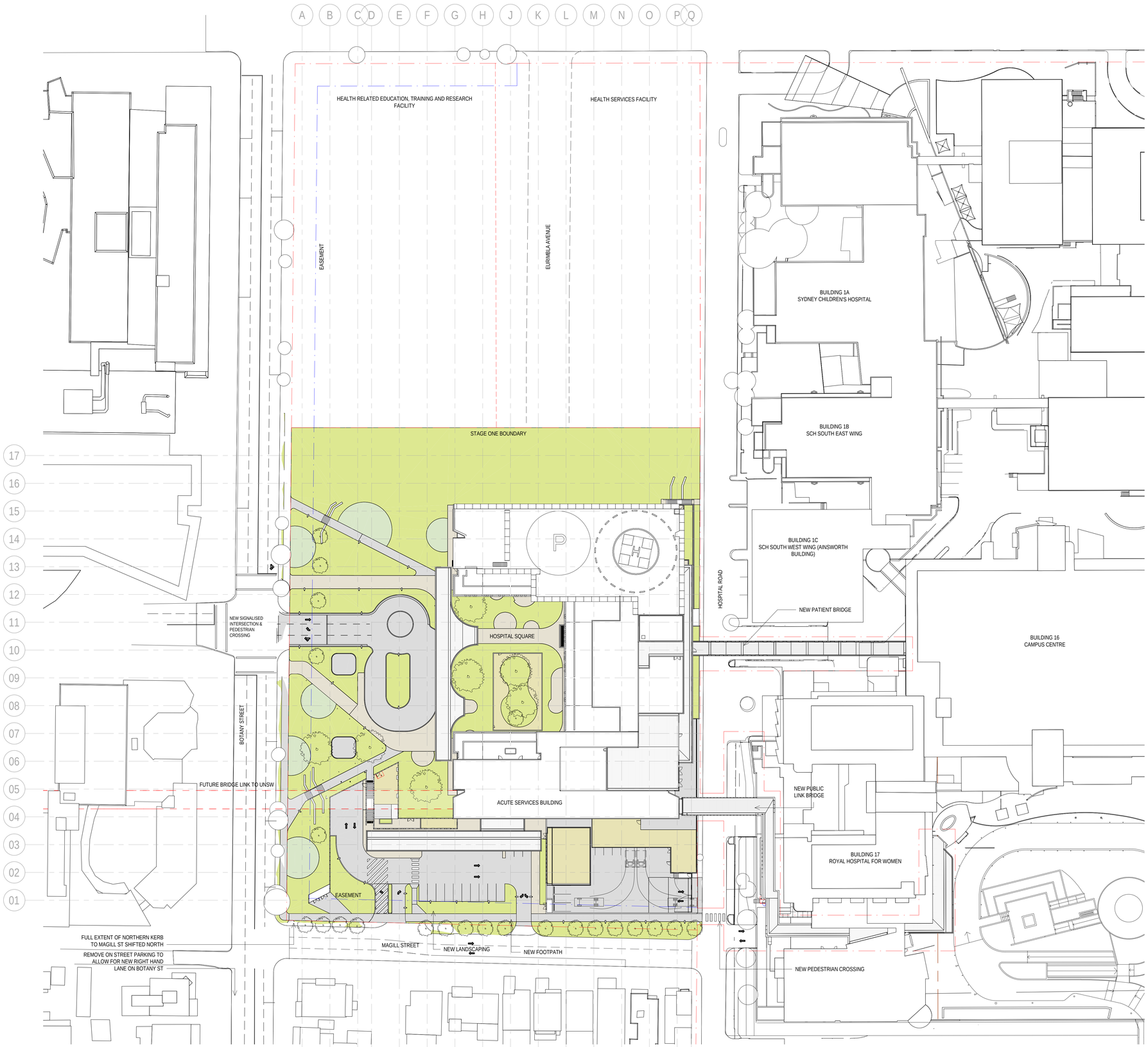

BVN TERROIR

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

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C	10/05/18	FOR INFORMATION
D	16/05/18	FOR INFORMATION
E	09/09/18	FOR INFORMATION
F	14/09/18	DD 100% UPDATE

PROJECT MANAGEMENT
PWC

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSTRUCTION MANAGER
lendlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER

130487
PROJECT
RANDWICK CAMPUS REDEVELOPMENT

BARKER ST
RANDWICK NSW 2031
AUSTRALIA
BVN PROJECT NUMBER

s1606008
DRAWING KEY

TRUE NORTH PROJECT NORTH

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SCALE

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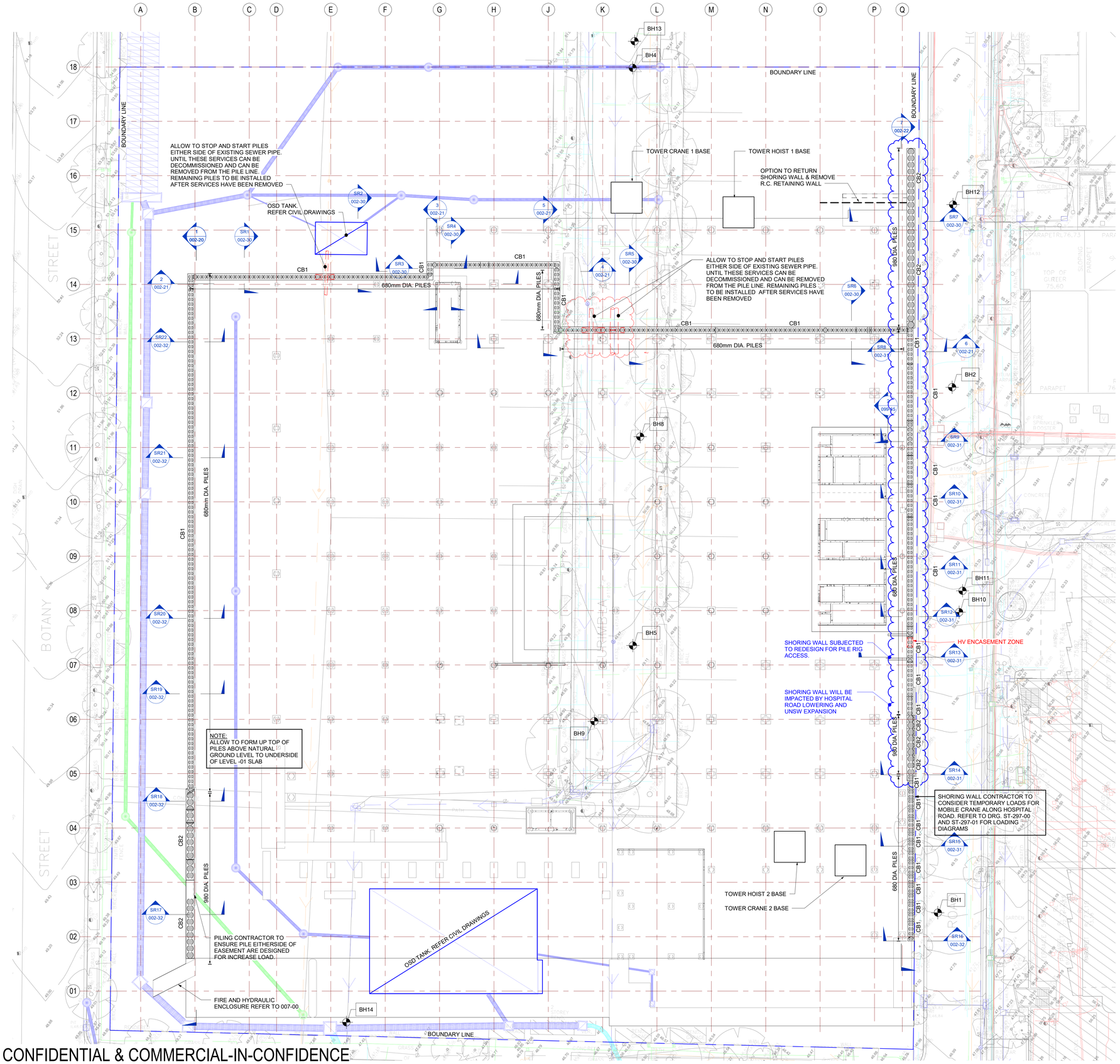
STATUS

FOR INFORMATION
DRAWING

SITE PLAN

RCR-BVN-ARC-00-DRW-01A-NL00013 ISSUE F

FOR GENERAL NOTES REFER TO DRAWING RCR-ENS-STR-50-DRW-001-01



SHORING NOTES

GEOTECHNICAL REPORT
- THE CONTRACTOR SHALL OBTAIN A COPY OF THE GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 AND SUPPLEMENTARY REPORT 72505.13.R.001 JUNE 18 BY DOUGLAS PARTNERS AND ADHERE TO THE RECOMMENDATIONS CONTAINED THEREIN.
- REFER TO GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED JUNE 2017 AND SUPPLEMENTARY REPORT 72505.13.R.001 REVISION A DATED MAY 2018 FOR ALL GROUND CONDITIONS

SITE SURVEY
- SURVEY INFORMATION PROVIDED AS REFERENCE ONLY. PLEASE REFER TO LATEST SURVEY INFORMATION.

SPECIFICATION
- THESE NOTES ARE TO BE READ IN CONJUNCTION WITH THE STRUCTURAL AND OTHER SPECIFICATIONS.

DUST CONTROL
- THE CONTRACTOR IS TO ENSURE THAT THE DUST PREVENTION METHODS HE ADOPTS ARE SUFFICIENT TO MEET THE REQUIREMENTS OF THE SYDNEY CITY COUNCIL. IT IS THE CONTRACTORS' RESPONSIBILITY TO ACQUAINT HIMSELF WITH THE REQUIREMENTS.

SITE SETOUT
- REFER TO THE ARCHITECTS DRAWINGS FOR THE ACCURATE SETOUT OF ALL BUILDINGS, DRIVEWAYS, PARKING AREAS ETC. NOTE BULK EARTHWORKS PLAN IS INDICATIVE ONLY. CALCULATE AND CUT BATTERS FROM ARCHITECT'S PLANS AND SURVEY. CROSSOVER PROFILES TO COUNCIL REQUIREMENTS.

GENERALLY
- PROCEED WITH BULK EARTHWORKS AND SHORING TO PROVIDE A STABLE SUBGRADE AND WORK SPACE FOR THE CONSTRUCTION OF THE PROPOSED DEVELOPMENT. REDUCE SITE TO LEVELS INDICATED AND DISPOSE OF ALL UNWANTED MATERIAL LEGALLY.

SITE RETENTION
- RETAINING WALLS HAVE NOT BEEN DESIGNED FOR HYDROSTATIC PRESSURE. HYDRAULIC ENGINEER AND CONTRACTOR TO PROVIDE STRIP DRAINS TO PREVENT ANY WATER PRESSURE BUILD UP.

SUPERVISION
- A GEOTECHNICAL ENGINEER IS TO PROVIDE LEVEL 1 SUPERVISION (AS3798) FOR ALL EARTHWORKS DURING THE COURSE OF CONSTRUCTION. AT THE COMPLETION OF THE BULK EXCAVATION CONTRACT, THE GEOTECHNICAL ENGINEER IS TO PROVIDE CERTIFICATION THAT THE WORKS HAVE BEEN CARRIED OUT IN ACCORDANCE WITH BULK EARTHWORKS SPECIFICATION.
- GEOTECHNICAL SUPERVISION AND ROCK MAPPING OF ALL EXCAVATION FACES IS TO BE UNDERTAKEN

DRAINAGE DURING CONSTRUCTION
- PROVIDE ADEQUATE DRAINAGE DURING CONSTRUCTION TO ENSURE MINIMUM DISRUPTION FROM RAIN.

SERVICES
- DURING EXCAVATION COORDINATE WITH ALL SERVICES INCLUDING SEWER, GAS AND POWER.
- THE CONTRACTOR IS TO OBTAIN A COPY OF SERVICES LOCATOR DRAWINGS AND ENSURE ALL ANCHORS AVOID ALL SERVICES.

BULK EARTHWORKS PROCEDURE AND SPECIFICATION
- AT THE COMPLETION OF THE BULK EARTHWORKS, THE CONTRACTOR SHALL PROVIDE TEMPORARY OR PERMANENT DRAINAGE TO ENSURE NO SURFACE WATER IS RETAINED ON THE SITE, OR THAT SURFACE WATER FLOW DETRIMENTALLY SCOURS THE PREPARED BASE.

GEOTECHNICAL ENGINEER NOTES:
- EXCAVATION TO BE CARRIED OUT UNDER GEOTECHNICAL ENGINEER'S SUPERVISION.
- GEOTECHNICAL ENGINEER TO COMMENT ON SUITABILITY OF THE SUBCONTRACTOR'S METHOD OF EXCAVATION AS REMOVAL PROCEEDS.

HYDRAULICS ENGINEER
- DURING EXCAVATION COORDINATE WITH ALL HYDRAULIC ENGINEERS REQUIREMENTS FOR SEWER, GAS AND STORMWATER LINES.

AS-BUILT DRAWING
- PROVIDE AN AS-BUILT DRAWING PREPARED BY A REGISTERED SURVEYOR TO CONFIRM BULK EARTHWORKS IS COMPLETED TO REQUIRED DIMENSIONS AND LEVELS.

DILAPIDATION REPORT
- THE APPROVED SHORING WALL CONTRACTOR SHALL PREPARE A DILAPIDATION REPORT OF STREET, FOOTPATH AND ROAD FEATURES PRIOR TO INSTALLATION OF SHORING WALL.

COMPACTION NOTES
- COMPACTION BEHIND INTERNAL FORMED RETAINING WALL BY EXCAVATION CONTRACTOR USING HAND HELD RAMMERS TO ACHIEVE 98% MODIFIED DENSITY.
- COMPACT IN MAXIMUM 300mm THICK LAYERS AT OPTIMUM MOISTURE CONTENT OF ±3%.

CONTRACTORS NOTES
- INFERRED SUBSURFACE CONDITIONS HAVE BEEN ASSUMED OR PREPARED BY INTERPOLATION AND/OR EXTRAPOLATION FROM DISCRETE TEST HOLE DATA AND AS SUCH THE CONDITIONS SHOWN ARE AN INTERPRETATION AND MUST BE CONSIDERED AS A GUIDE ONLY. LOCAL VARIATIONS OR ANOMALIES IN GROUND CONDITIONS CAN OCCUR IN THE NATURAL ENVIRONMENT, PARTICULARLY BETWEEN DISCRETE TEST HOLE LOCATIONS.
- SPECIFIC SUPPORT REQUIREMENTS CAN ONLY BE ASSESSED DURING EXCAVATION. VERIFICATION OF THE GEOTECHNICAL ASSUMPTIONS AND/OR MODEL AND SITE RETENTION SYSTEM IS AN INTEGRAL PART OF THE DESIGN PROCESS. THE CONTRACTOR SHALL MAKE ALLOWANCE TO ENGAGE THE ABOVE MENTIONED GEOTECHNICAL ENGINEER TO CARRY OUT FULL TIME INSPECTIONS AS THE EXCAVATION PROGRESSES FOR THE PURPOSE OF INVESTIGATION, CONSTRUCTION VERIFICATION AND PERFORMANCE MONITORING.
- DESIGN OF GROUND ANCHORS TO BE D&C BY THE CONTRACTOR. DETAILS AND CALCULATIONS TO BE SUBMITTED FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- SOIL/ROCK RL'S ARE BASED ON DOUGLAS PARTNERS INVESTIGATION REPORT, REFER TO ABOVE MENTIONED DOCUMENT. THIS MAY VARY FROM ACTUAL SITE CONDITIONS
- CONTRACTOR TO LOCATE ALL SERVICES ON AND AROUND THE SITE AND ENSURE ALL GROUND ANCHORS AND ROCK BOLTS AVOID ALL SERVICES.
- CONTRACTOR TO DEVELOP SEQUENCING OF WORKS ALLOWING FOR ALL SERVICES RELOCATION REQUIREMENTS AND SUBMIT SEQUENCING METHODOLOGY FOR APPROVAL PRIOR TO COMMENCEMENT OF WORKS.
- ALL GROUND ANCHORS TO BE LOCATED TO AVOID NEW BUILD FLOOR AND COLUMN STRUCTURES SHOWN ON THE ELEVATIONS.
- REFER TO GEOTECHNICAL ADVICE FOR EXCAVATION AND METHODOLOGY AND MONITORING REQUIREMENTS.

LEGEND

DENOTES BORE HOLE LOCATIONS

REFER TO DRG. ST-002-10 FOR TYPICAL SITE RETENTION DETAILS

REFER TO DRG. ST-003-00 TO ST-003-01 FOUNDATION GENERAL ARRANGEMENTS

SHORING DESIGN & DETAILS BY CONTRACTOR

REFER TO GEOTECHNICAL REPORT 72505.11.R.001 REVISION 2 BY DOUGLAS PARTNERS DATED NOVEMBER 2017 AND SUPPLEMENTARY REPORT 72505.13.R.001 DATED JUNE 2018 FOR ALL GROUND CONDITIONS

SITE RETENTION - GENERAL ARRANGEMENT

SCALE 1 : 250

CONFIDENTIAL & COMMERCIAL-IN-CONFIDENCE

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enstruct

enstruct group pty ltd

Level 4, 2 Glen Street
Milsons Point NSW 2061
Australia

Telephone (02) 8904 1444
Facsimile (02) 8904 1555
http: //www.enstruct.com.au

NOTE
CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

ISSUE	DATE	FOR
A	11.10.17	70% SD ISSUE
B	13.11.17	DRAFT 95% SD ISSUE
C	30.11.17	95% SD ISSUE
D	31.01.18	100% SD ISSUE
E	01.02.18	100% SD ISSUE UPDATE
F	05.02.18	100% SD ISSUE UPDATE
G	16.02.18	100% SD ISSUE UPDATE
H	01.06.18	ISSUED FOR COORDINATION
I	05.06.18	ISSUED FOR COORDINATION
J	28.06.18	50% DD ISSUE
K	03.08.18	ISSUED FOR COODINATION
L	20.08.18	100% DD ISSUE
M	31.08.18	100% DD UPDATES
N	07.09.18	100% DD UPDATES
O	14.09.18	100% DD UPDATES
1	11.12.18	ISSUED FOR CONSTRUCTION
2	21.12.18	ISSUED FOR CONSTRUCTION

DRAWINGS DO NOT INCLUDE ANY ALLOWANCE FOR UNSW EXPANSION

PROJECT MANAGEMENT
PWC

ARCHITECTS
BVN / TERROIR

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSTRUCTION MANAGER
lendlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE

CLIENT NUMBER
130487

PROJECT
RANDWICK CAMPUS REDEVELOPMENT

BAKER ST
RANDWICK NSW 2031
AUSTRALIA

ENSTRUCT PROJECT NUMBER
5385

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000

SCALE
As indicated@B1 DO NOT SCALE

STATUS
FOR CONSTRUCTION

DRAWING
BUILDING 50
SITE RETENTION GENERAL ARRANGEMENT

DRAWING NUMBER | ISSUE
RCR-ENS-STR-50-DRW-002-00 | 2

DEVELOPMENT APPLICATION
208/2018
Randwick City Council
18 April 2018
Records Received

- REMOVE ALL TREES WITHIN SITE (NOT DRAWN)
- EXISTING SITE BOUNDARIES
- EXISTING STRUCTURES TO BE DEMOLISHED
- TREES TO BE REMOVED - LOCATED ON EXISTING HOSPITAL CAMPUS
- EXISTING TREES

NOTE 1: DEVELOPMENT APPLICATION COVERS AREA SHOWN GREY AND TREES SHOWN IN ORANGE.

NOTE 2: SURVEY INFORMATION BASED ON SURVEY RECEIVED FROM ARCADIS (SEPTEMBER 2016)

BVN TERROIR

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

INTELLECTUAL PROPERTY

NOTE

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ISSUE	DATE	FOR
A	14.03.2018	FOR INFORMATION

PROJECT MANAGEMENT
AURECON

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
AECOM AUSTRALIA

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSULTANT
PROJECT MANAGER

CLIENT
NSW GOVERNMENT | Health Infrastructure
HEALTH INFRASTRUCTURE

CLIENT NUMBER
130487

PROJECT
POW REDEVELOPMENT
BAKER ST
RANDWICK NSW
AUSTRALIA

BVN PROJECT NUMBER
s1606008

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000

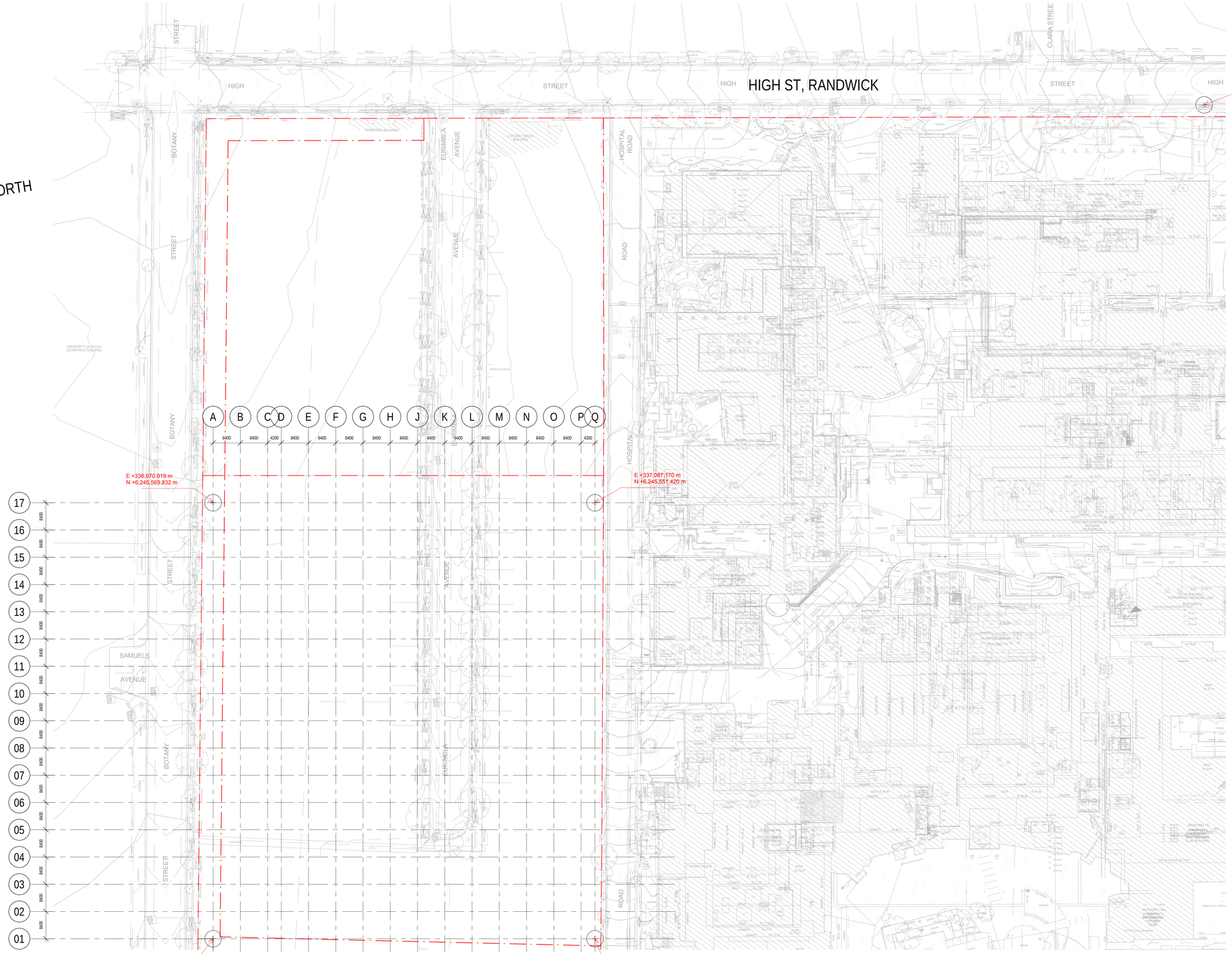
SCALE
1 : 500@B1 DO NOT SCALE

STATUS

DRAWING
DEMOLITION PLAN - DEVELOPMENT APPLICATION

RCR-BVN-AR-00-DWG-U1-XX-03

ISSUE
A



BVN TERROIR

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
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NOTE
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ISSUE	DATE	FOR
A	21/03/18	FOR INFORMATION
B	14/09/18	DD 100% UPDATE

PROJECT MANAGEMENT
PWC

CIVIL AND STRUCTURAL ENGINEERING
ENSTRUCT GROUP

MECHANICAL ENGINEERING
LEHR CONSULTANTS INTERNATIONAL

ELECTRICAL ENGINEERING
WOOD & GRIEVE ENGINEERS

HYDRAULIC ENGINEERING
ACOR CONSULTANTS

CONSTRUCTION MANAGER
lendlease

CLIENT
NSW GOVERNMENT Health Infrastructure

HEALTH INFRASTRUCTURE
CLIENT NUMBER

130487
PROJECT
RANDWICK CAMPUS REDEVELOPMENT

BARKER ST
RANDWICK NSW 2031
AUSTRALIA
BVN PROJECT NUMBER

s1606008
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 10000 25000
SCALE
1 : 500@B1 DO NOT SCALE
STATUS
FOR INFORMATION
DRAWING

GRID SETOUT

RCR-BVN-ARC-00-DRW-01A-NL00011 ISSUE B

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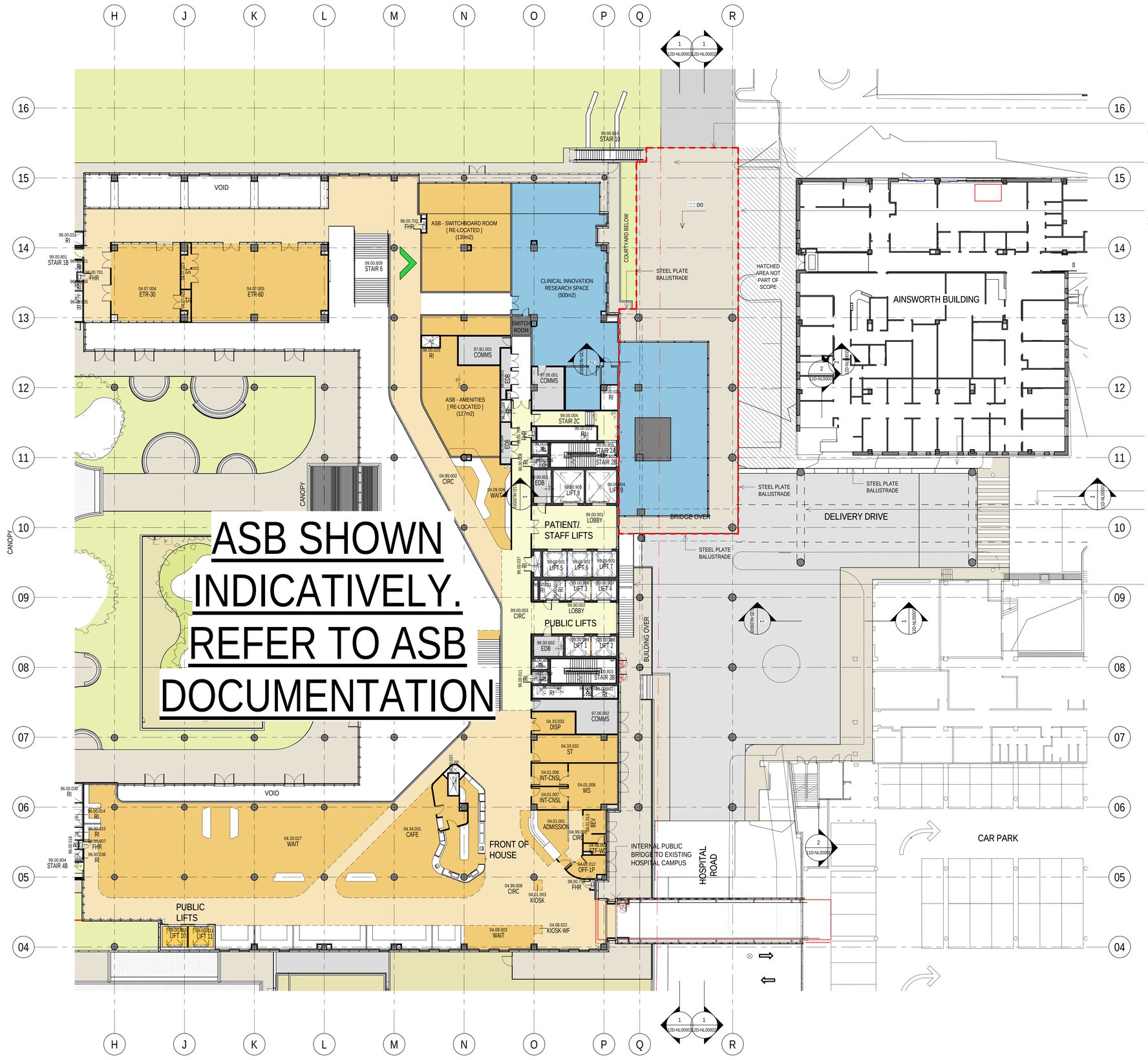

ASB SHOWN INDICATIVELY. REFER TO ASB DOCUMENTATION

Legend:

Exclusions

The following areas are excluded from the Stage 1 Hospital Road lowering works:

- Landscaping to public deck
- Interface zone between new public deck and existing Ainsworth Building
- Future lowering works north of Stair 10

Associated documents

Read inconjunction with

- UNSW East Integration drawings
- Services and structural engineer's drawings

Key

Fire separation wall. 2hr Fire rating assumed

BVN TERROIR

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

NOTE

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ISSUE	DATE	FOR
A	20/12/18	FOR INFORMATION

CLIENT

NSW GOVERNMENT Health Infrastructure

CONSTRUCTION MANAGER

lendlease

PROJECT

ASB/UNSW EAST INTEGRATION
e.g. 255 PITT STREET,
SYDNEY NSW
AUSTRALIA

BVN PROJECT NUMBER

s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 200@B1 DO NOT SCALE

STATUS

DESIGN DEVELOPMENT

DRAWING

HOSPITAL ROAD WORKS - LEVEL 00

RCR-BVN-ARC-00-DRW-11B-0000001 ISSUE A

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Legend:

Exclusions

The following areas are excluded from the Stage 1 Hospital Road lowering works:

- Landscaping to public deck
- Interface zone between new public deck and existing Ainsworth Building
- Future lowering works north of Stair 10

Associated documents

Read inconjunction with

- UNSW East Integration drawings
- Services and structural engineer's drawings

Key

Fire separation wall. 2hr Fire rating assumed

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NOTE

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ISSUE	DATE	FOR
A	20/12/18	FOR INFORMATION

CLIENT

NSW Government Health Infrastructure

CONSTRUCTION MANAGER

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PROJECT

ASB/UNSW EAST INTEGRATION
e.g. 255 PITT STREET,
SYDNEY NSW
AUSTRALIA

BVN PROJECT NUMBER

s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 200@B1 DO NOT SCALE

STATUS

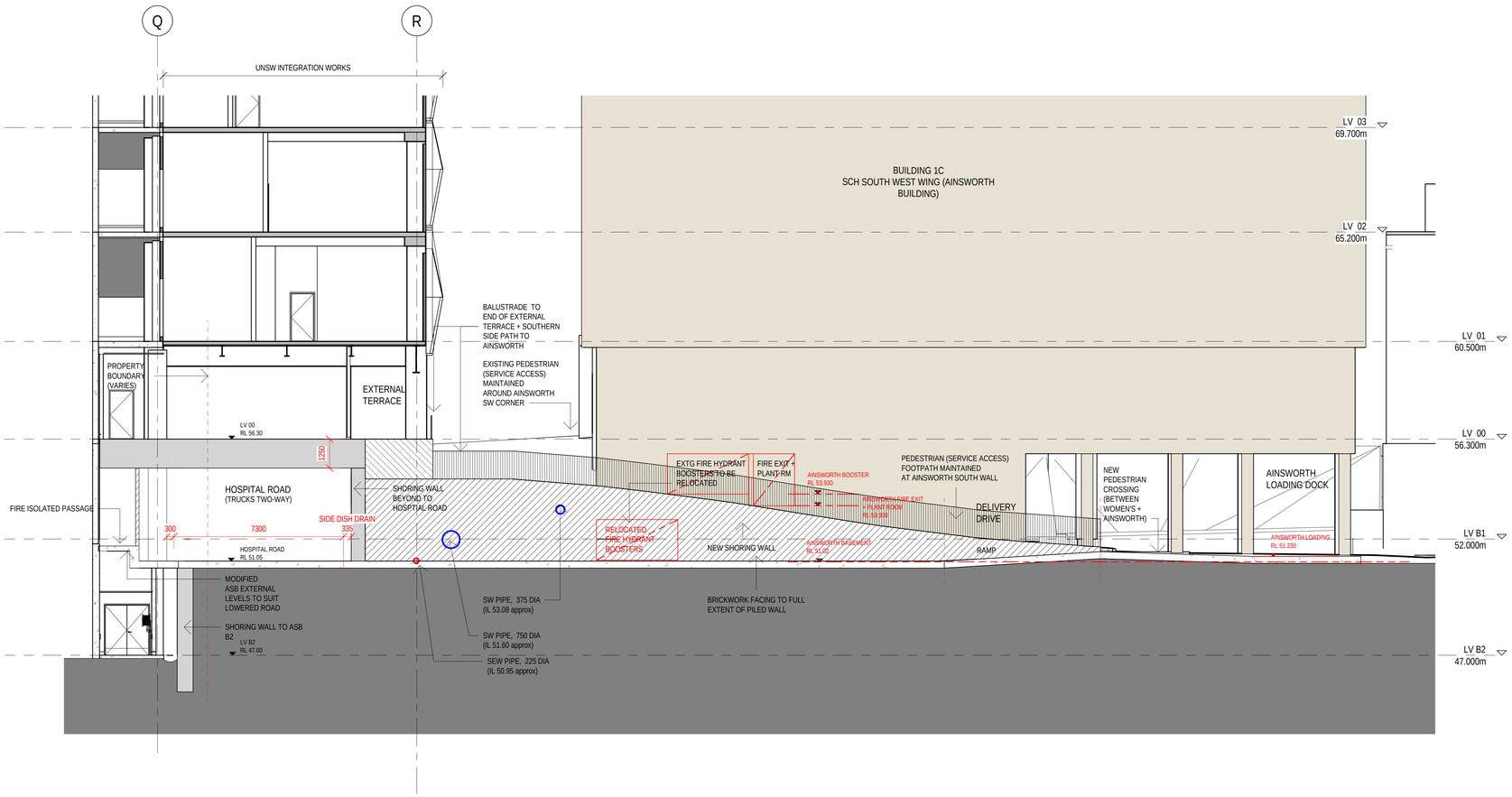
DESIGN DEVELOPMENT

DRAWING

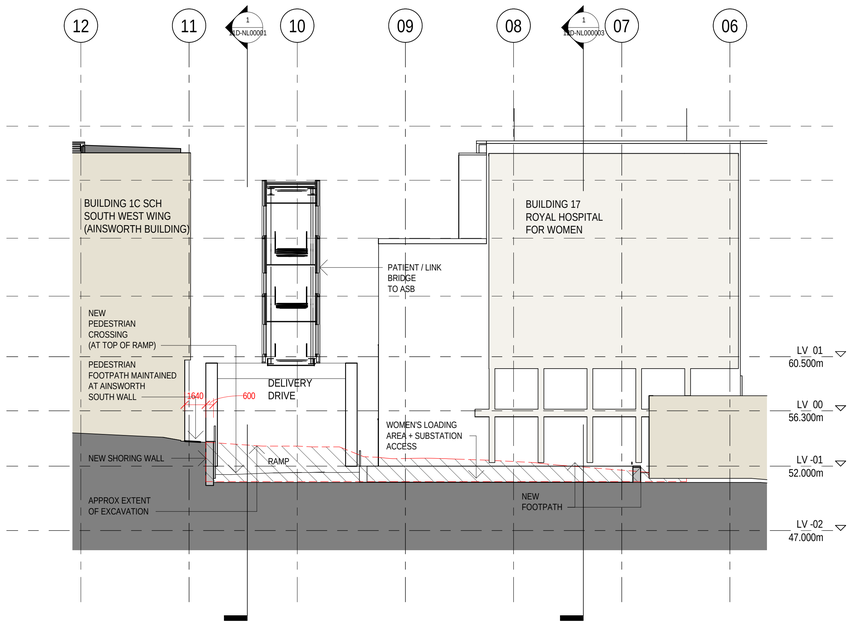
HOSPITAL ROAD WORKS - LEVEL -01

RCR-BVN-ARC-00-DRW-11B-B100001

ISSUE A



1 HOSPITAL ROAD - SECTION_AINSWORTH SOUTH ELEVATION
11B-0000001 1 : 100



2 DELIVERY DRIVE - SECTION_AINSWORTH + WOMEN'S
11B-0000001 1 : 200

BVN TERROIR

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

NOTE
CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

ISSUE	DATE	FOR
A	23/11/18	FOR INFORMATION
B	20/12/18	FOR INFORMATION

CLIENT
NSW GOVERNMENT Health Infrastructure

CONSTRUCTION MANAGER
lendlease

PROJECT
RANDWICK CAMPUS
REDEVELOPMENT
BARKER ST
RANDWICK NSW 2031
AUSTRALIA

BVN PROJECT NUMBER
s1606008

KEYPLAN

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 4000 10000

SCALE
As indicated@B1 DO NOT SCALE

STATUS
DESIGN DEVELOPMENT

DRAWING
HOSPITAL ROAD WORKS - SECTIONS - SHEET 1

RCR-BVN-ARC-00-DRW-11D-NL00001 ISSUE B

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Douglas Partners
Geotechnics • Environment • Groundwater

Table C1 - Summary of Soil Laboratory Analysis - Stage 1 (All results in mg/kg unless otherwise stated)

Test Pit/ Sample ID	Depth	Sampling Date	Soil Type*	Metals																PAH						Phenols	Total Recoverable Hydrocarbons					BTEX					Organochlorine Pesticides (OCP)								OPP	PCB	Asbestos	
				Arsenic	Arsenic TCLP	Cadmium	Cadmium TCLP	Chromium (VI)	Chromium (VI) TCLP	Copper	Copper TCLP	Lead	Lead TCLP	Mercury	Mercury TCLP	Nickel	Nickel TCLP	Zinc	Zinc TCLP	Naphthalene	Benzo(a)Pyrene (BaP)	Benzo(b)Fluoranthene (BaP) TCLP	BaP TEQ	Total PAH	Phenol	TRH C_6-C_9	TRH C_{10}-C_{14}	C_{15}-C_{28}	C_{29}-C_{36}	F2 - Naphthalene	Benzene	Toluene	Ethylbenzene	Total xylenes	DDT + DDD + DDE	Aldrin and Dieldrin	Chlordane	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Chlorpyrifos	PCB	Asbestos ID	FA and AF % w/w
Practical Quantitation Limit (PQL)				4	0.1	0.4	0.1	1	0.1	1	0.1	1	0.1	0.1	0.1	1	0.1	1	0.2	0.1	0.05	0.005	0.5	0.05	5	25	50	100	25	50	0.2	0.5	1	3	0.3	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.7		0.001
Site Assessment Criteria (SAC)																																														
HILs (Res B)				500		150				30000		1200		120		1200		60000					4	400	130									600	10	90	400	20	10	15	500	340	1		
HSL A&B - vapour intrusion (Sand)																				3										45	110	0.5	160	55	40											
EIL (Res/Open Space)				100				200		65		1100				9		240		170																										
ESL (Urban Res)																					0.7								300	180	120	50	85	70	105										
Management Limits (Res, Parkland)																										700	1000	2500																		
IA&B Addition																																														
TP401	0.2-0.25	23/08/2019	Roadbase	4	-	<0.4	-	9	-	24	-	240	<0.03	0.3	-	6	-	130	-	<0.1	3.6	<0.001	5.2	33	<5	<25	<50	370	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	-	<0.001
BD1/20190823	-	23/08/2019	Roadbase	<4	-	<0.4	-	11	-	42	-	170	<0.03	0.3	-	7	-	270	-	<0.1	2.8	<0.001	4.2	27	-	<25	<50	400	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP401	0.65-0.7	23/08/2019	Natural	<4	-	<0.4	-	3	-	1	-	2	-	<0.1	-	<1	-	<1	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP402	0.2-0.25	23/08/2019	Roadbase	<4	-	<0.4	-	12	-	47	-	150	<0.03	0.2	-	7	-	120	-	<0.1	2.9	<0.001	4.2	28	<5	<25	<50	400	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	-	0.0328
TP402	0.45-0.55	23/08/2019	Roadbase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
TP402	0.95-1.05	23/08/2019	Natural	<4	-	<0.4	-	1	-	<1	-	1	-	<0.1	-	<1	-	<1	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP403	0.6-0.65	23/08/2019	Fill	<4	-	<0.4	-	1	-	2	-	16	-	<0.1	-	<1	-	11	-	<0.1	0.05	-	<0.5	0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP403	1.0-1.1	23/08/2019	Natural	<4	-	<0.4	-	<1	-	<1	-	<1	-	<0.1	-	<1	-	<1	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP404	0.45-0.55	23/08/2019	Fill	<4	-	<0.4	-	1	-	<1	-	6	-	<0.1	-	<1	-	9	-	<0.1	<0.05	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP404 1.0	1.0-1.1	23/08/2019	Natural	<4	-	<0.4	-	1	-	<1	-	<1	-	<0.1	-	<1	-	<1	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP405 0.5	0.4-0.5	24/08/2019	Natural	<4	-	<0.4	-	<1	-	<1	-	1	-	<0.1	-	<1	-	5	-	<0.1	<0.05	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.001
TP405 1.0	1.0-1.1	24/08/2019	Natural	<4	-	<0.4	-	5	-	1	-	3	-	<0.1	-	5	-	15	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP406 0.35	0.35-0.45	24/08/2019	Natural	<4	-	<0.4	-	1	-	2	-	12	-	<0.1	-	1	-	17	-	<0.1	<0.05	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP406 0.5	0.55-0.65	24/08/2019	Natural	<4	-	<0.4	-	2	-	<1	-	1	-	<0.1	-	1	-	2	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
TP407 0.35	0.35-0.4	24/08/2019	Natural	<4	-	<0.4	-	8	-	6	-	11	-	<0.1	-	5	-	20	-	<0.1	0.2	-	<0.5	1.5	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.3	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.001
TP407 1.0	1.0-1.1	24/08/2019	Natural	<4	-	<0.4	-	3	-	<1	-	4	-	<0.1	-	<1	-	4	-	<0.1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	-	-	-	-	-	-	-	-	-	-	-	-
Stage 1 Remediation Works																																														
TP305A	0.0-0.2	12/02/2019	Fill	<4	-	<0.4	-	5	-	6	-	40	-	<0.1	-	2	-	56	-	<1	0.2	-	<0.5	1.4	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP305A	0.5-0.6	12/02/2019	Fill	<4	-	<0.4	-	2	-	<1	-	3	-	<0.1	-	<1	-	4	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP305A	1.0-1.1.1	12/02/2019	Natural	<4	-	<0.4	-	1	-	<1	-	2	-	<0.1	-	<1	-	3	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
TP306A	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	<1	-	1	-	11	-	0.1	-	<1	-	10	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP307A	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	1	-	1	-	10	-	<0.1	-	<1	-	9	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP308A	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	1	-	1	-	8	-	<0.1	-	<1	-	2	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP309A	0.0-0.2	12/02/2019	Fill	<4	-	0.4	-	4	-	7	-	45	-	<0.1	-	1	-	72	-	<1	2.1	-	2.8	15	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	0.2	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.5	NAD	-
BD1/20190212	0.0-0.2	12/02/2019	Fill	<4	-	<0.4	-	4	-	26	-	51	-	<0.1	-	2	-	110	-	<1	1.9	-	2.7	17	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
TP309A	0.5-0.6	12/02/2019	Fill	<4	-	<0.4	-	3	-	9	-	24	-	<0.1	-	1	-	61	-	<1	0.76	-	1.1	5.3	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP310A	0.0-0.2	11/02/2019	Fill	<4	-	<0.4	-	4	-	7	-	47	-	<0.1	-	2	-	73	-	<1	0.4	-	0.6	3.5	<5	<25	<50	410	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP310A	0.5-0.6	11/02/2019	Fill	<4	-	<0.4	-	1	-	<1	-	4	-	<0.1	-	<1	-	5	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP313A	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	<1	-	<1	-	<1	-	<0.1	-	<1	-	4	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP317	0.0-0.2	11/02/2019	Fill	<4	-	<0.4	-	4	-	14	-	60	-	<0.1	-	2	-	65	-	<1	1	-	1.4	8.6	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	NAD	-
BD1/20190211*	0.0-0.2	11/02/2019	Fill	<4	-	<0.4	-	5	-	18	-	180	-	<0.1	-	3	-	92	-	<1	2.2	-	3	22	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
TP317	0.5-0.6	13/02/2019	Fill	<4	-	<0.4	-	1	-	<1	-	1	-	<0.1	-	<1	-	3	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP322	0.0-0.2	13/02/2019	Fill	<4	-	0.5	-	4	-	38	-	45	-	0.3	-	1	-	120	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP323	0.0-0.2	13/02/2019	Fill	4	-	<0.4	-	7	-	22	-	130	-	0.7	-	2	-	130	-	<1	0.4	-	0.6	3.6	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	NAD	-
TP323	0.5-0.6	13/02/2019	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NAD	-
TP324	0.1-0.2	13/02/2019	Fill	<4	-	<0.4	-	1	-	5	-	21	-	<0.1	-	<1	-	30	-	<1	0.4	-	0.6	3.5	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	NAD	-
TP324	0.5-0.6	13/02/2019	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NAD	-
TP325	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	1	-	<1	-	1	-	<0.1	-	<1	-	<1	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP326	0.0-0.2	12/02/2019	Fill	<4	-	<0.4	-	1	-	2	-	7	-	<0.1	-	<1	-	12	-	<1	<0.05	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP326	0.5-0.6	12/02/2019	Natural	<4	-	<0.4	-	1	-	1	-	2	-	<0.1	-	<1	-	12	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
TP327	0.0-0.2	12/02/2019	Fill	<4	-	<0.4	-	2	-	1	-	7	-	<0.1	-	<1	-	21	-	<1	<0.05	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	0.3	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP327	0.6-0.7	12/02/2019	Fill	<4	-	<0.4	-	1	-	<1	-	1	-	<0.1	-	<1	-	2	-	<1	<0.05	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
TP328	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	2	-	5	-	35	-	<0.1	-	<1	-	47	-	<1	0.05	-	<0.5	0.2	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.2	0.3	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	NAD	-
BD2/20190211*	0.0-0.2	13/02/2019	Fill	<4	-	<0.4	-	3	-	8	-	58	-	<0.1	-	2	-	76	-	<1	0.98	-	1.4	7.7	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
TP328	0.5-0.6	12/02/2019	Fill	<4	-	<0.4	-	2	-	1	-	30	-	<0.1	-	<1	-	18	-	<1	0.06	-	<0.5	0.3	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-

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Test Pit/ Sample ID	Depth	Sampling Date	Soil Type*	Metals																PAH						Phenols	Total Recoverable Hydrocarbons					BTEX				Organochlorine Pesticides (OCP)									OPP	PCB	Asbestos	
				Arsenic	Arsenic TCLP	Cadmium	Cadmium TCLP	Chromium (III)*	Chromium (VI)* TCLP	Chromium (VI)*	Copper	Copper TCLP	Lead	Lead TCLP	Mercury	Mercury TCLP	Nickel	Nickel TCLP	Zinc	Zinc TCLP	Naphthalene	Benzo(a)Pyrene (BaP)	Benzo(b)Pyrene (BeP) TCLP	BaP TEQ	Total PAH	Phenol	TRH C_6-C_{10}	TRH $>C_{10}$-C_{16}	C_{10}-C_{16}	C_6 - C_{10} less BTEX (F1)	$>C_{16}$-C_{34} Naphthalene +	$>C_{16}$-C_{34}	Benzene	Toluene	Ethylbenzene	Total xylenes	BHC + DDD + DDE	Aldrin and Dieldrin	Chlordane	Endosulfan	Endrin	Heptachlor	HCB	Methoxychlor	Chlorpyrifos	PCB	Asbestos ID	FA and AF (% w/w)
Practical Quantitation Limit (PQL)				4	0.1	0.4	0.1	1	0.1	1	1	0.1	1	0.1	0.1	0.1	1	0.1	1	0.2	0.1	0.05	0.005	0.5	0.05	5	25	50	100	25	50	0.2	0.5	1	3	0.3	0.2	0.2	0.3	0.1	0.1	0.1	0.1	0.1	0.7		0.001
Site Assessment Criteria (SAC)																																														
HILs (Res B)				500		150					30000		1200		120		1200		60000					4	400	130									600	10	90	400	20	10	15	500	340	1		
HSL A&B - vapour intrusion (Sand)																				3										45	110	0.5	160	55	40												
EIL (Res/Open Space)				100				200			65		1100				9		240	170																										
ESL (Urban Res)																					0.7								300	180	120	50	85	70	105											
Management Limits (Res, Parkland)																										700	1000	2500																		
DP DID (2018)																																														
BH201	0.2-0.3	26/06/2018	Fill	<4	-	<0.4	-	4	-	17	-	130	-	<0.1	-	3	-	88	-	<0.1	0.83	-	1.3	6.9	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH205	0.1-0.2	25/06/2018	Fill	<4	-	<0.4	-	3	-	11	-	67	-	<0.1	-	2	-	52	-	<0.1	1.3	-	2	10	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH214	0.1-0.2	26/06/2018	Fill	<4	-	<0.4	-	3	-	4	-	29	-	<0.1	-	1	-	15	-	<0.1	0.07	-	<0.5	0.2	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP1	0.3-0.4	07/08/2018	Fill	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-	<0.1	0.1	-	<0.5	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP1	1.1-1.2	07/08/2018	Natural	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP2	0-0.1	07/08/2018	Fill	-	-	-	-	-	-	-	-	-	91	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP2	1.3-1.4	07/08/2018	Natural	-	-	-	-	-	-	-	-	-	<1	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP3	0.1-0.2	07/08/2018	Fill	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP3	1.0-1.1	07/08/2018	Natural	-	-	-	-	-	-	-	-	-	<1	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP5	0.1-0.2	07/08/2018	Fill	-	-	-	-	-	-	-	-	-	140	-	-	-	-	-	-	<0.1	0.5	-	0.9	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP5	0.9-1.0	07/08/2018	Natural	-	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP8	0.5-0.6	08/08/2018	Fill	<4	-	<0.4	-	<1	-	4	-	19	-	0.4	-	<1	-	26	-	<0.1	<0.1	-	<0.5	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP8	1.3-1.4	08/08/2018	Natural	<4	-	<0.4	-	2	-	<1	-	2	-	<0.1	-	<1	-	22	-	<0.1	<0.1	-	<0.5	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-
TP9	0-0.1	08/08/2018	Fill	<4	-	<0.4	-	8	-	37	-	890	0.54	0.2	-	4	-	200	-	<0.1	0.8	<0.001	1.7	10	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<3	<0.1	1.6	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
TP10	0.4-0.5	08/08/2018	Fill	-	-	-	-	-	-	-	-	-	110	-	-	-	-	-	-	<0.1	0.2	-	<0.5	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP10	0.9-1.0	08/08/2018	Natural	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP10	0-0.1	08/08/2018	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NAD	-
TP11	0-0.1	08/08/2018	Fill	-	-	-	-	-	-	-	-	-	180	-	-	-	-	-	-	<0.1	0.1	-	<0.5	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP11	0.4-0.5	08/08/2018	Natural	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	<0.1	<0.1	-	<0.5	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DP (2019)																																														
BH1	0.5-0.6	18/09/2017	Fill	<4	-	<0.4	-	2	-	4	-	25	-	<0.1	-	1	-	28	-	<0.1	0.06	-	0.121	0.3	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH2	0.3-0.4	18/09/2017	Fill	<4	-	<0.4	-	4	-	2	-	16	-	<0.1	-	2	-	37	-	<0.1	<0.05	-	<0.172	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH4	0.07-0.15	18/09/2017	Roadbase	<4	-	<0.4	-	<1	-	100	-	1	-	<0.1	-	3	-	10	-	<1 - 0.4	57	-	77	740	<5	<25	170	6600	<25	170	<0.2	<0.5	<1	<1	<1	<2	<2	<3	<1	<1	<1	<1	<1	<1	NAD	-
BH4	0.5-0.6	18/09/2017	Fill	<4	-	<0.4	-	3	-	2	-	10	-	<0.1	-	2	-	10	-	<0.1	0.52	-	0.647	4.5	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH5	0.4-0.5	19/09/2017	Fill	<4	-	<0.4	-	<1	-	<1	-	2	-	<0.1	-	<1	-	1	-	<0.1	<0.05	-	<0.172	0.2	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH5	0.9-1	19/09/2017	Natural Sand	<4	-	<0.4	-	<1	-	<1	-	<1	-	<0.1	-	<1	-	<1	-	<0.1	<0.05	-	<0.172	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
BH5	1.3-1.4	19/09/2017	Natural Sand	<4	-	<0.4	-	3	-	<1	-	2	-	<0.1	-	1	-	2	-	<0.1	<0.05	-	<0.172	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	-	-
BH101	0.5-0.7	9/01/2018	Fill	<4	-	<0.4	-	4	-	5	-	34	-	0.1	-	<1	-	30	-	<0.1	0.1	-	0.1665	0.94	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH101	1.4-1.6	9/01/2018	Natural Sand	<4	-	<0.4	-	9	-	<1	-	4	-	<0.1	-	2	-	22	-	<0.1	<0.05	-	<0.172	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH102	0.3	9/01/2018	Fill	<4	-	0.5	-	9	-	83	-	450	-	0.2	-	3	-	150	-	<0.1	1.2	-	1.59	12	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH103	0-0.3	9/01/2018	Fill	<4	-	<0.4	-	5	-	25	-	220	-	0.1	-	3	-	99	-	<0.1	1.2	-	1.59	11	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH103	0.5-0.7	9/01/2018	Natural Sand	<4	-	<0.4	-	3	-	14	-	20	-	<0.1	-	2	-	29	-	<0.1	0.63	-	0.759	4.8	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH104	0-0.3	9/01/2018	Fill	<4	-	0.5	-	4	-	24	-	110	-	0.1	-	2	-	250	-	<0.1	0.3	-	0.395	2.6	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH111	0-0.2	10/01/2018	Fill	7	-	0.8	-	18	-	50	-	470	-	0.2	-	5	-	390	-	<1 - 0.3	6.4	-	8.197	61	<5	<25	<50	480	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	NAD	-
BH112	0-0.2	10/01/2018	Natural Sand	6	-	2	-	20	-	110	-	440	-	0.2	-	5	-	230	-	<0.1	0.5	-	0.628	4.2	<5	<25	<50	110	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	NAD	-
BH112	0.6-0.7	10/01/2018	Fill	<4	-	<0.4	-	1	-	4	-	8	-	<0.1	-	<1	-	58	-	<0.1	<0.05	-	<0.172	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH113	0.1-0.3	10/01/2018	Fill	<4	-	<0.4	-	2	-	7	-	28	-	<0.1	-	<1	-	31	-	<0.1	0.2	-	0.284	2.1	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH113	0.5-0.7	10/01/2018	Natural Sand	<4	-	<0.4	-	14	-	37	-	350	-	0.1	-	4	-	130	-	<0.1	1.2	-	1.588	11	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH114	0.5-0.7	10/01/2018	Fill	<4	-	<0.4	-	5	-	19	-	130	-	0.1	-	2	-	38	-	<0.1	1.1	-	1.478	11	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH115	0-0.2	10/01/2018	Fill	<4	-	<0.4	-	2	-	4	-	10	-	<0.1	-	1	-	53	-	<0.1	0.09	-	0.151	0.4	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH115	0.5-0.7	10/01/2018	Natural Sand	<4	-	<0.4	-	9	-	30	-	360	-	0.2	-	4	-	310	-	<0.1	0.89	-	1.124	7.9	-	<25	<50	100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH116	0-0.2	10/01/2018	Fill	<4	-	<0.4	-	7	-	26	-	360	-	0.2	-	4	-	160	-	<0.1	1.4	-	1.851	16	<5	<25	<50	110	<25	<50	<0.2	<0.5	<1	<1	0.1	2.05	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH117	0.6-0.8	10/01/2018	Fill	<4	-	<0.4	-	11	-	<1	-	6	-	<0.1	-	2	-	220	-	<0.1	<0.05	-	<0.172	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH117	1.5-1.6	10/01/2018	Natural Sand	<4	-	<0.4	-	4	-	14	-	270	-	0.3	-	2	-	220	-	<0.1	0.52	-	0.657	5.3	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH118	0.5-0.6	10/01/2018	Fill	<4	-	0.8	-	9	-	43	-	350	-	0.2	-	3	-	510	-	<0.1	0.6	-	0.739	5.5	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH119	0.5-0.6	10/01/2018	Fill	<4	-	<0.4	-	6	-	12	-	100	-	<0.1	-	3	-	72	-	<0.1	0.3	-	0.395	2.5	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH119	1-1.1	10/01/2018	Natural Sand	<4	-	<0.4	-	2	-	4	-	13	-	<0.1	-	1	-	12	-	<0.1	<0.05	-	<0.172	<0.05	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH120	0-0.1	10/01/2018	Fill	13	-	<0.4	-	13	-	35	-	21	-	0.2	-	4	-	85	-	<0.1	0.07	-	0.131	0.3	<5	<25	<50	210	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
BH121	0-0.05	10/01/2018	Fill	4	-	<0.4	-	9	-	31	-	290	-	<0.1	-	4	-	160	-	<0.1	0.2	-	0.294	2.2	8	<25	63	520	<25	63	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	NAD	-
BH122	0-0.1	10/01/2018	Fill	<4	-	<0.4	-	6	-	9	-	69	-	<0.1	-	1	-	31	-	<0.1	0.1	-	0.161	0.63	-	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	-	-	-	-	-	-	-	-	-	-	NAD	-
BH122	0.5-0.6	10/01/2018	Natural Sand	<4	-	<0.4	-	3	-	3	-	15	-	<0.1	-	1	-	7	-	<0.1	<0.05	-	<0.172	<0.05	<5	<25	<50	<100	<25	<50	<0.2	<0.5	<1	<1	<0.1	<0.2	<0.2	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NAD	-
Statistical Analysis																																														
Fill to depths of 0.3 m (excluding roadbase)			Number of Samples	29	0	29	0	29	0	29	0	33	1	29	0	29	0	29	0	32	33	1	33	33	19	29	29	29	29	29	29	29	29	19	19	19	19	19	19	19	17	19	-	-
			Mean	4.00	-	0.43	-	3.40	-	9.85	-	63.27	-	0.13	-	1.50	-	64.65	-	0.35	0.25	-	0.54	2.13	5.00	25.00	50.00	100.00	25.00	50.00	0.20	0.50	1.00	1.30	0.13	0.19	0.19	0.29	0.10	0.10	0.10	0.10	0.10	-	-
			Std. Deviation	1.74	-	0.08	-	3.77	-	13.54	-	175.09	-	0.12	-	1.18	-	78.49	-	0.45	1.21	-	1.49	11.48	0.00	0.00	0.00	90.65	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.53	0.06	0.10	0.00	0.03	0.00	0.00	0.00	0.14	-	-
			95% UCL	4.66	-	0.45	-	4.84	-	19.80	-	163.40	-	0.17	-	2.85	-	108.10	-	0.51	1.62	-	2.29	6.20	-	-	-	134.48	-	-	0.20	-	-	1.57	0.13	0.45	0.22	0.34	0.10	0.12	0.10	0.10	0.10	0.17	-	-
Fill from depths of 0.3 m to top of natural soils (excluding roadbase)			Number of Samples		0	20	0	20	0	20	0	22	0	20	0	20	0	20	0	22	22	0	22	22	14	20	20	20	20	20	20	20	20	14	14	14	14	14	14	14	14	14	-	-
			Mean	4.00	-	0.43	-	3.40	-	9.85	-	63.27	-	0.13	-	1.50	-	64.65	-	0.35	0.25	-	0.54	2.13	5.00	25.00	50.00	100.00	25.00	50.00	0.20	0.50	1.00	1.30	0.13	0.19	0.19	0.29	0.10	0.10	0.10	0.10	0.10	-	-
			Std. Deviation	0.00	-	0.09	-	3.10	-	19.84	-	115.99	-	0.07	-	0.76	-	118.22	-	0.41	0.35	-	0.39	3.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.07	0.03	0.03	0.05	0.00	0.00	0.00	0.00	0.00	-	-
			95% UCL	-	-	0.47	-	4.85	-	29.18	-	122.00	-	0.16	-	1.79	-	124.70	-	0.53	0.58	-	0.91	3.69	-	-	-	-	-	-	0.20	-	-	1.64	0.17	0.21	0.21	0.32	-	-	-	-	-	-	-

Notes

<PQL	Concentration comprises of sum of a number of individual analytes. All individual analytes below reported PQL
a	Replicate of sample directly below
b	All Chromium are assumed to exist in the stable Cr(III) oxidation state, as Cr(VI) will be too reactive and unstable under the normal environment
c	95% UCL Caclulated using ProUCL
HIL/HSL	HIL / HSL for soil contaminants - NEPC 2013, Schedule B1
EIL / ESL	EIL / ESL soil for soil contaminant - NEPC 2013, Schedule B1.
NAD	No asbestos detected
-	Not Analysed

Douglas Partners
Geotechnics | Environment | Groundwater

Table C2 - Groundwater results

		Metals								TRH		MAH						VOCs																PAH		Phenols
		Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Lead (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	F2-NAPHTHALENE	C6-C10 less BTEX (F1)	Benzene	Ethylbenzene	Toluene	Xylene (m&p)	Xylene (o)	Styrene	1,1,2-trichloroethane	1,1-dichloroethene	1,2-dichloroethane	Carbon tetrachloride	Chloroform	Hexachlorobutadiene	Tetrachloroethene	Vinyl chloride	1,2,3-trichlorobenzene	1,2,4-trichlorobenzene	1,2-dichlorobenzene	1,3-dichlorobenzene	1,4-dichlorobenzene	Chlorobenzene	Benzo(a) pyrene	Naphthalene	Phenol
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.0001	0.001	0.001	0.001	0.00005	0.001	0.001	0.05	0.01	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.001	0.001	0.001	0.001	0.0001	0.0002	0.05
NEPM 2013 Table 1A(4) Res HSL A & B GW for Vapour Intrusion, Sand																																		
2-4m										1	1	0.8	NL	NL																			NL	
ANZG 2018 DGV GILs, Freshwater, slightly to moderately disturbed system		0.024	0.0005	0.0004	0.0014	0.0014	0.00006	0.028	0.021	-	-	0.95	-	-	0.075	0.35	-	6.5	-	-	-	-		-	-	0.003	0.085	0.16	0.26	0.06	-	0.0001	0.016	-
Field ID	**Sampled Date**																																	
DP (2019)																																		
BH14	12/02/2019	<0.001	0.0006	<0.001	0.007	<0.001	<0.00005	0.002	<0.001	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05
BH10	12/02/2019	<0.001	<0.1	<0.001	<0.001	<0.001	<0.00005	<0.001	0.008	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05
DP (2018b)																																		
BH202		<0.001	0.0001	<0.001	0.002	<0.001	<0.00005	0.005	0.031	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH204		<0.001	<0.0001	<0.001	0.008	<0.001	<0.00005	0.002	0.028	<0.05	0.039	<0.001	0.001	<0.001	0.009	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH11		<0.001	<0.0001	<0.001	0.005	<0.001	<0.00005	<0.001	0.013	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH14		<0.001	0.0001	<0.001	0.007	<0.001	<0.00005	<0.001	0.055	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH16		<0.001	<0.0001	<0.001	0.012	<0.001	<0.00005	0.001	0.007	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BH17		<0.001	<0.0001	<0.001	0.003	<0.001	<0.00005	<0.001	0.008	0.074	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
BD1/20180706		<0.001	0.0001	<0.001	0.001	<0.001	<0.00005	0.004	0.026	<0.05	<0.01	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
DP (2018)																																		
BD13102017	13/10/2017	<0.001	<0.0001	<0.001	0.007	<0.001	<0.00005	0.002	0.022	<0.05	0.012	<0.001	<0.001	0.001	<0.002	<0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0001	<0.0002	<0.05
GW7	13/10/2017	<0.001	<0.0001	<0.001	0.007	<0.001	<0.00005	0.002	0.024	<0.05	0.013	<0.001	<0.001	0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0002	<0.05

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Table C3 - Waste Classification Table (All results in mg/kg unless otherwise stated)

Test Pit/ Sample ID[a]	Sampling Depth	Soil Type	Metals							PAH			Phenols	Total Petroleum Hydrocarbons				BTEX				OCP	OPP	PCB	Asbestos
			Arsenic	Cadmium	Chromium (VI)[b]	Lead	Lead (TCLP)	Mercury	Nickel	Benzo(a) Pyrene (BaP)	BaP (TCLP)	Total PAH	Phenol	C6 - C9	C10 - C14	C15-C28	C29 - C36	Benzene	Toluene	Ethylbenzene	Xylenes	Endosulfan	Chlorpyrifos	PCB *	Asbestos
PQL			4	0.4	1	1		0.1	1	0.05	0.04	0.05	5	25	50	100	100	0.2	0.5	1	3	0.3	0.1	0.7	0.1g /kg
Site Assessment Criteria (SAC)																									
NSW EPA (2014) CT1 (mg/kg) General Solid Waste			100	20	100	100	-	4	40	0.8	-	200	288	650	10 000			10	288	600	1000	60	4	<50	NAD
NSW EPA (2014) SCC1 with TCLP			500	100	1900	1500	5	50	1050	10	0.04	200	518	650	10 000			18	518	1080	1800	108		<50	NAD
NSW EPA (2014) CT2 (mg/kg) Restricted Solid Waste			400	80	400	400	-	16	160	3.2	-	800	1152	2600	40 000			40	1152	2400	4000	240	16	<50	NAD
NSW EPA (2014) Restricted Solid Waste with TCLP			2000	400	7600	6000	20	200	4200	23	0.16	800	2073	2600	40 000			72	2073	4320	7200	432	30	<50	NAD
Current Investigation																									
TP305A	0.0-0.2	Fill	<4	<0.4	5	40	-	<0.1	2	0.2	-	1.4	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
TP305A	0.5-0.6	Fill	<4	<0.4	2	3	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP305A	1.0-1.1.1	Natural	<4	<0.4	1	2	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	
TP309A	0.0-0.2	Fill	<4	0.4	4	45	-	<0.1	1	2.1	-	15	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.5	NAD
BD1/20190212	0.0-0.2	Fill	<4	<0.4	4	51	-	<0.1	2	1.9	-	17	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
TP309A	0.5-0.6	Fill	<4	<0.4	3	24	-	<0.1	1	0.76	-	5.3	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP310A	0.0-0.2	Fill	<4	<0.4	4	47	-	<0.1	2	0.4	-	3.5	<5	<25	<50	190	270	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
TP310A	0.5-0.6	Fill	<4	<0.4	1	4	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP317	0.0-0.2	Fill	<4	<0.4	4	60	-	<0.1	2	1	-	8.6	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	0.4	NAD
BD1/20190211[a]	0.0-0.2	Fill	<4	<0.4	5	180	-	<0.1	3	2.2	-	22	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
TP317	0.5-0.6	Fill	<4	<0.4	1	1	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP326	0.0-0.2	Fill	<4	<0.4	1	7	-	<0.1	<1	<0.05	-	<0.05	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
TP326	0.5-0.6	Natural	<4	<0.4	1	2	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
TP327	0.0-0.2	Fill	<4	<0.4	2	7	-	<0.1	<1	<0.05	-	<0.05	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
TP327	0.6-0.7	Fill	<4	<0.4	1	1	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP328	0.0-0.2	Fill	<4	<0.4	2	35	-	<0.1	<1	0.05	-	0.2	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BD2/20190211[a]	0.0-0.2	Fill	<4	<0.4	3	58	-	<0.1	2	0.98	-	7.7	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
TP328	0.5-0.6	Fill	<4	<0.4	2	30	-	<0.1	<1	0.06	-	0.3	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
TP306A	0.0-0.2	Fill	<4	<0.4	<1	11	-	0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP307A	0.0-0.2	Fill	<4	<0.4	1	10	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP308A	0.0-0.2	Fill	<4	<0.4	1	8	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP313A	0.0-0.2	Fill	<4	<0.4	<1	<1	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP322	0.0-0.2	Fill	<4	0.5	4	45	-	0.3	1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
TP323	0.0-0.2	Fill	4	<0.4	7	130	-	0.7	2	0.4	-	3.6	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	-	<0.1	NAD
TP323	0.5-0.6	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NAD
TP324	0.1-0.2	Fill	<4	<0.4	1	21	-	<0.1	<1	0.4	-	3.5	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	-	<0.1	NAD
TP324	0.5-0.6	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NAD
TP325	0.0-0.2	Fill	<4	<0.4	1	1	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
DP (August 2018)																									
TP1	0.3-0.4	Fill	-	-	-	47	-	-	-	0.1	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-
TP1	1.1-1.2	Natural Sand	-	-	-	1	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP2	0-0.1	Fill	-	-	-	91	-	-	-	0.1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
TP2	1.3-1.4	Natural Sand	-	-	-	<1	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP3	0.1-0.2	Fill	-	-	-	22	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP3	1.0-1.1	Natural Sand	-	-	-	<1	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP4	0.4-0.5	Fill	-	-	-	180	-	-	-	1.5	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-
BD2/20180807	-	Fill	-	-	-	220	-	-	-	0.4	-	3.9	-	-	-	-	-	-	-	-	-	-	-	-	-
TP4	0.6-0.7	Natural Sand	-	-	-	<1	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP5	0.1-0.2	Fill	-	-	-	140	-	-	-	0.63	-	5.6	-	-	-	-	-	-	-	-	-	-	-	-	-
TP5	0.9-1.0	Natural Sand	-	-	-	14	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP7	0.3-0.4	Fill	-	-	-	20	-	-	-	0.1	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-
TP7	0.7-0.8	Natural Sand	-	-	-	<1	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP8	0.5-0.6	Fill	<4	<0.4	<1	19	-	0.4	<1	<0.05	-	<0.05	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
TP8	1.3-1.4	Natural Sand	<4	<0.4	2	2	-	<0.1	<1	<0.05	-	<0.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<3	-	-	-	-
TP9	0-0.1	Fill	<4	<0.4	8	890	-	0.2	4	1.2	-	10	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
TP9	0.4-0.5	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
TP9	0.4-0.5A	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Chrysotile, Amosite & Crocidolite detected
TP10	0.4-0.5	Fill	-	-	-	110	-	-	-	0.3	-	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-
TP10	0.9-1.0	Natural Sand	-	-	-	2	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
TP10	0-0.1	Fill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.001
TP10	0-0.1A	Material	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Chrysotile, Amosite & Crocidolite detected
TP11	0-0.1	Fill	-	-	-	180	-	-	-	0.2	-	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-
TP11	0.4-0.5	Natural Sand	-	-	-	3	-	-	-	<0.05	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
DP (June, 2018)																									
BH201	0.2-0.3	Fill	<4	<0.4	4	130	0.1	<0.1	3	0.83	<0.001	6.9	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
BH205	0.1-0.2	Fill	<4	<0.4	3	67	-	<0.1	2	1.3	<0.001	10	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
BH206	0.3-0.4	Fill	<4	<0.4	4	140	0.1	0.1	2	1.7	<0.001	16	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	1.6	NAD
BH207	0.1-0.2	Fill	<4	<0.4	4	98	-	<0.1	2	1.2	<0.001	17	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
BH208	0.3-0.4	Fill	7	0.6	7	270	0.38	0.2	3	2.9	<0.001	31	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.5	NAD
BH214	0.1-0.2	Fill	<4	<0.4	3	29	-	<0.1	1	0.07	-	0.2	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<3	<0.3	<0.1	<0.1	NAD
DP (Oct 2017, Jan 2018) Investigation																									
BH1	0.5-0.6	Fill	<4	<0.4	2	25	-	<0.1	1	0.06		0.81	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH2	0.3-0.4	Fill	<4	<0.4	4	16	-	<0.1	2	<0.05	-	<1.35	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH4	0.07-0.15	Roadbase	<4	<0.4	<1	1	-	<0.1	3	57	<0.001	634.3	<5	<25	66	4400	3000	<0.2	<0.5	<1	<1	<1	<1	<1	NAD
BH4	0.5-0.6	Fill	<4	<0.4	3	10	-	<0.1	2	0.52	-	3.82	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH5	0.4-0.5	Fill	<4	<0.4	<1	2	-	<0.1	<1	<0.05	-	0.775	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH5	0.9-1	Natural Sand	<4	<0.4	<1	<1	-	<0.1	<1	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
BH5	1.3-1.4	Natural Sand	<4	<0.4	3	2	-	<0.1	1	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	-
BH8	0.4-0.5	Roadbase	<4	<0.4	5	12	-	<0.1	4	-	-	150	<5	<25	860	8500	3800	<0.2	<0.5	<1	<1	<1	<1	<1	NAD
BH8	0.6-0.7	Fill	<4	<0.4	1	<1	-	<0.1	<1	0.2	-	3.45	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH9	0.6-0.7	Fill	<4	<0.4	<1	8	-	<0.1	<1	<0.05	-	<1.35	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH9	1.4-1.5	Fill	<4	<0.4	<1	<1	-	<0.1	<1	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH101	0.5-0.7	Fill	<4	<0.4	4	34	-	0.1	<1	0.1	-	1.15	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH101	1.4-1.6	Natural Sand	<4	<0.4	9	4	-	<0.1	2	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD

Test Pit/ Sample ID[a]	Sampling Depth	Soil Type	Metals							PAH			Phenols	Total Petroleum Hydrocarbons				BTEX				OCP	OPP	PCB	Asbestos
			Arsenic	Cadmium	Chromium (VI)[b]	Lead	Lead (TCLP)	Mercury	Nickel	Benzo(a) Pyrene (BaP)	BaP (TCLP)	Total PAH	Phenol	C6 - C9	C10 - C14	C15-C28	C29 - C36	Benzene	Toluene	Ethylbenzene	Xylenes	Endosulfan	Chlorpyrifos	PCB *	Asbestos
BH102	0.3	Fill	5	<0.4	6	53	1.4	0.2	2	0.2	<0.001	2.7	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH103	0-0.3	Fill	<4	0.5	9	450	0.3	0.2	3	1.2	<0.001	9.85	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH103	0.5-0.7	Natural Sand	5	<0.4	26	77	-	0.1	26	1.4	-	11.45	-	<25	<50	100	110	<0.2	<0.5	<1	<1	-	-	-	NAD
BH104	0-0.3	Fill	<4	<0.4	3	20	0.1	<0.1	2	0.63	-	4.03	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH111	0-0.2	Fill	7	0.8	18	470	0.3	0.2	5	6.4	<0.001	50.75	<5	<25	<50	280	260	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.5	NAD
BH112	0-0.2	Natural Sand	6	2	20	440	0.1	0.2	5	0.5	<0.001	3.8	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	0.2	NAD
BH112	0.6-0.7	Fill	<4	<0.4	1	8	-	<0.1	<1	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH113	0.1-0.3	Fill	<4	<0.4	2	28	-	<0.1	<1	0.2	-	2	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH113	0.5-0.7	Natural Sand	<4	<0.4	14	350	0.2	0.1	4	1.2	<0.001	9.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH114	0.5-0.7	Fill	<4	<0.4	5	130	0.2	0.1	2	1.1	<0.001	9.75	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH115	0-0.2	Fill	<4	<0.4	2	10	-	<0.1	1	0.09	-	0.84	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH115	0.5-0.7	Natural Sand	<4	<0.4	9	360	0.1	0.2	4	0.89	<0.001	6.59	-	<25	<50	<100	100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH116	0-0.2	Fill	<4	<0.4	7	360	0.2	0.2	4	1.4	-	14.3	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH117	0.6-0.8	Fill	<4	<0.4	11	6	-	<0.1	2	<0.05	-	<1.35	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH117	1.5-1.6	Natural Sand	<4	<0.4	4	270	0.32	0.3	2	0.52	<0.001	4.72	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH118	0.5-0.6	Fill	<4	0.8	9	350	0.39	0.2	3	0.6	<0.001	4.75	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH119	0.5-0.6	Fill	<4	<0.4	6	100	0.08	<0.1	3	0.3	-	2.4	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH119	1-1.1	Natural Sand	<4	<0.4	2	13	-	<0.1	1	<0.05	-	<1.35	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH120	0-0.1	Fill	13	<0.4	13	21	-	0.2	4	0.07	-	0.82	<5	<25	<50	<100	180	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD
BH121	0-0.05	Fill	4	<0.4	9	290	0.06	<0.1	4	0.2	-	1.95	8	<25	<50	270	410	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.5	NAD
BH122	0-0.1	Fill	<4	<0.4	6	69	-	<0.1	1	0.1	-	1.05	-	<25	<50	<100	<100	<0.2	<0.5	<1	<1	-	-	-	NAD
BH122	0.5-0.6	Natural Sand	<4	<0.4	3	15	-	<0.1	1	<0.05	-	<1.35	<5	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<0.1	<0.1	<0.1	NAD

Notes

NSW EPA (2014) Waste Classification Guidelines - Part 1: Classifying Waste

[a] Duplicate sample is listed below primary sample

NAD Not detected at the laboratory reporting limit of 0.1g/kg

* PCBs must be managed in accordance with the EPA's PCB Chemical Control Order 1997.

Table C4 - Summary of Recovered Aggregate Results (All results in mg/kg unless otherwise stated)

			Metals								Foreign Materials					Coal Tar
			Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	Metal	Plaster	Rubber, plastic, paper, cloth, paint, wood and other vegetable matter	Electrical conductivity	pH (aqueous extract)	
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	µS/cm	pH_Units	mg/filter
EQL			4	0.4		1	1	0.1	1	1						
Recovered Aggregate Order (2014) Maximum Average Concentration for Characterisation			20	0.5	60	60	75	0.5	40	200	1	0.25	0.2	1500		-
Recovered Aggregate Order (2014) Maximum Average Concentration for Routine Testing				0.5	60	60	75			200	1	0.25	0.2	1500		-
Recovered Aggregate Order (2014) Absolute Maximum Concentration			40	1.5	120	150	150	1	80	350	2	0.5	0.3	3000		
Field_ID	**Sample_Depth_Range**	**Sampled_Date-Time**														
Current Investigation - Stage 1 only																
EA1	0.1-0.3	12/02/2019	<4	<0.4	5	52	13	<0.1	6	37	<0.1	<0.1	<0.1	35	8.1	<0.5
EA2	0.1-0.3	12/02/2019	<4	<0.4	4	51	15	<0.1	5	31	<0.1	<0.1	<0.1	29	9.3	<0.5
EA3	0.1-0.3	12/02/2019	<4	<0.4	5	66	21	<0.1	6	54	<0.1	<0.1	<0.1	69	9.1	<0.5
EA4	0.1-0.3	12/02/2019	<4	<0.4	10	28	22	<0.1	10	40	<0.1	<0.1	<0.1	290	10.6	<0.5
EA5	0.1-0.3	12/02/2019	<4	<0.4	8	49	56	<0.1	7	67	<0.1	<0.1	<0.1	470	9	<0.5
EA6	0.1-0.3	12/02/2019	<4	<0.4	8	110	10	<0.1	5	32	<0.1	<0.1	<0.1	58	9.4	<0.5
Previous Investigations - Stage 1 only																
BH4	0.07-0.15	18/09/2017	<4	<0.4	<1	100	1	<0.1	3	10	-	-	-	-	-	-

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.13/09/2019 2:59:30 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Copper

General Statistics

Total Number of Observations	20	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	1	Mean	9.85
Maximum	83	Median	2
SD	19.84	Std. Error of Mean	4.436
Coefficient of Variation	2.014	Skewness	3.153

Normal GOF Test

Shapiro Wilk Test Statistic	0.509	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.347	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.52	95% Adjusted-CLT UCL (Chen-1995)	20.49
		95% Modified-t UCL (Johnson-1978)	18.04

Gamma GOF Test

A-D Test Statistic	1.981	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.797	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.249	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.204	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.564	k star (bias corrected MLE)	0.513
Theta hat (MLE)	17.45	Theta star (bias corrected MLE)	19.2
nu hat (MLE)	22.58	nu star (bias corrected)	20.52
MLE Mean (bias corrected)	9.85	MLE Sd (bias corrected)	13.75
		Approximate Chi Square Value (0.05)	11.24
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	10.7

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.99	95% Adjusted Gamma UCL (use when n<50)	18.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.837	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Lognormal at 5% Significance Level

56	**Data Not Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59						Minimum of Logged Data	0			Mean of logged Data	1.183	
60						Maximum of Logged Data	4.419			SD of logged Data	1.36	
61												
62	**Assuming Lognormal Distribution**											
63						95% H-UCL	22.3			90% Chebyshev (MVUE) UCL	15.77	
64						95% Chebyshev (MVUE) UCL	19.47			97.5% Chebyshev (MVUE) UCL	24.6	
65						99% Chebyshev (MVUE) UCL	34.69					
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data do not follow a Discernible Distribution (0.05)**											
69												
70	**Nonparametric Distribution Free UCLs**											
71						95% CLT UCL	17.15			95% Jackknife UCL	17.52	
72						95% Standard Bootstrap UCL	16.85			95% Bootstrap-t UCL	36.96	
73						95% Hall's Bootstrap UCL	46.38			95% Percentile Bootstrap UCL	17.75	
74						95% BCA Bootstrap UCL	20.95					
75						90% Chebyshev(Mean, Sd) UCL	23.16			95% Chebyshev(Mean, Sd) UCL	29.18	
76						97.5% Chebyshev(Mean, Sd) UCL	37.55			99% Chebyshev(Mean, Sd) UCL	53.98	
77												
78	**Suggested UCL to Use**											
79						95% Chebyshev (Mean, Sd) UCL	29.18					
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86												
87	**Lead**											
88												
89	**General Statistics**											
90						Total Number of Observations	22			Number of Distinct Observations	19	
91										Number of Missing Observations	0	
92						Minimum	1			Mean	63.27	
93						Maximum	450			Median	17.5	
94						SD	116			Std. Error of Mean	24.73	
95						Coefficient of Variation	1.833			Skewness	2.67	
96												
97	**Normal GOF Test**											
98						Shapiro Wilk Test Statistic	0.57			**Shapiro Wilk GOF Test**		
99						5% Shapiro Wilk Critical Value	0.911			Data Not Normal at 5% Significance Level		
100						Lilliefors Test Statistic	0.329			**Lilliefors GOF Test**		
101						5% Lilliefors Critical Value	0.184			Data Not Normal at 5% Significance Level		
102	**Data Not Normal at 5% Significance Level**											
103												
104	**Assuming Normal Distribution**											
105	**95% Normal UCL**									**95% UCLs (Adjusted for Skewness)**		
106						95% Student's-t UCL	105.8			95% Adjusted-CLT UCL (Chen-1995)	119	
107										95% Modified-t UCL (Johnson-1978)	108.2	
108												
109	**Gamma GOF Test**											
110						A-D Test Statistic	0.831			**Anderson-Darling Gamma GOF Test**		

111				5% A-D Critical Value	0.805	Data Not Gamma Distributed at 5% Significance Level						
112				K-S Test Statistic	0.189	**Kolmogorov-Smirnov Gamma GOF Test**						
113				5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level						
114	**Detected data follow Appr. Gamma Distribution at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117				k hat (MLE)	0.495	k star (bias corrected MLE)	0.458					
118				Theta hat (MLE)	127.9	Theta star (bias corrected MLE)	138.3					
119				nu hat (MLE)	21.77	nu star (bias corrected)	20.13					
120				MLE Mean (bias corrected)	63.27	MLE Sd (bias corrected)	93.54					
121						Approximate Chi Square Value (0.05)	10.95					
122				Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	10.44					
123												
124	**Assuming Gamma Distribution**											
125			95% Approximate Gamma UCL (use when n>=50)		116.3	95% Adjusted Gamma UCL (use when n<50)	122					
126												
127	**Lognormal GOF Test**											
128				Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**						
129				5% Shapiro Wilk Critical Value	0.911	Data appear Lognormal at 5% Significance Level						
130				Lilliefors Test Statistic	0.0761	**Lilliefors Lognormal GOF Test**						
131				5% Lilliefors Critical Value	0.184	Data appear Lognormal at 5% Significance Level						
132	**Data appear Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											
135				Minimum of Logged Data	0	Mean of logged Data	2.861					
136				Maximum of Logged Data	6.109	SD of logged Data	1.711					
137												
138	**Assuming Lognormal Distribution**											
139				95% H-UCL	300.2	90% Chebyshev (MVUE) UCL	154.7					
140				95% Chebyshev (MVUE) UCL	195.1	97.5% Chebyshev (MVUE) UCL	251					
141				99% Chebyshev (MVUE) UCL	361							
142												
143	**Nonparametric Distribution Free UCL Statistics**											
144	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
145												
146	**Nonparametric Distribution Free UCLs**											
147				95% CLT UCL	103.9	95% Jackknife UCL	105.8					
148				95% Standard Bootstrap UCL	103.6	95% Bootstrap-t UCL	176					
149				95% Hall's Bootstrap UCL	281.5	95% Percentile Bootstrap UCL	104.6					
150				95% BCA Bootstrap UCL	118.7							
151				90% Chebyshev(Mean, Sd) UCL	137.5	95% Chebyshev(Mean, Sd) UCL	171.1					
152				97.5% Chebyshev(Mean, Sd) UCL	217.7	99% Chebyshev(Mean, Sd) UCL	309.3					
153												
154	**Suggested UCL to Use**											
155				95% Adjusted Gamma UCL	122							
156												
157	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
158	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
159												
160	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
161	Recommendations are based upon data size, data distribution, and skewness.											
162	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
163	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
164												
165												

	A	B	C	D	E	F	G	H	I	J	K	L
166	**Nickel**											
167												
168	**General Statistics**											
169					Total Number of Observations	20			Number of Distinct Observations			3
170									Number of Missing Observations			0
171					Minimum	1			Mean			1.5
172					Maximum	3			Median			1
173					SD	0.761			Std. Error of Mean			0.17
174					Coefficient of Variation	0.507			Skewness			1.195
175												
176	**Normal GOF Test**											
177					Shapiro Wilk Test Statistic	0.67			**Shapiro Wilk GOF Test**			
178					5% Shapiro Wilk Critical Value	0.905			Data Not Normal at 5% Significance Level			
179					Lilliefors Test Statistic	0.394			**Lilliefors GOF Test**			
180					5% Lilliefors Critical Value	0.192			Data Not Normal at 5% Significance Level			
181	**Data Not Normal at 5% Significance Level**											
182												
183	**Assuming Normal Distribution**											
184					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
185					95% Student's-t UCL	1.794			95% Adjusted-CLT UCL (Chen-1995)			1.828
186									95% Modified-t UCL (Johnson-1978)			1.802
187												
188	**Gamma GOF Test**											
189					A-D Test Statistic	3.163			**Anderson-Darling Gamma GOF Test**			
190					5% A-D Critical Value	0.745			Data Not Gamma Distributed at 5% Significance Level			
191					K-S Test Statistic	0.408			**Kolmogorov-Smirnov Gamma GOF Test**			
192					5% K-S Critical Value	0.194			Data Not Gamma Distributed at 5% Significance Level			
193	**Data Not Gamma Distributed at 5% Significance Level**											
194												
195	**Gamma Statistics**											
196					k hat (MLE)	5.061			k star (bias corrected MLE)			4.335
197					Theta hat (MLE)	0.296			Theta star (bias corrected MLE)			0.346
198					nu hat (MLE)	202.4			nu star (bias corrected)			173.4
199					MLE Mean (bias corrected)	1.5			MLE Sd (bias corrected)			0.72
200									Approximate Chi Square Value (0.05)			143.9
201					Adjusted Level of Significance	0.038			Adjusted Chi Square Value			141.8
202												
203	**Assuming Gamma Distribution**											
204					95% Approximate Gamma UCL (use when n>=50))	1.807			95% Adjusted Gamma UCL (use when n<50)			1.834
205												
206	**Lognormal GOF Test**											
207					Shapiro Wilk Test Statistic	0.673			**Shapiro Wilk Lognormal GOF Test**			
208					5% Shapiro Wilk Critical Value	0.905			Data Not Lognormal at 5% Significance Level			
209					Lilliefors Test Statistic	0.404			**Lilliefors Lognormal GOF Test**			
210					5% Lilliefors Critical Value	0.192			Data Not Lognormal at 5% Significance Level			
211	**Data Not Lognormal at 5% Significance Level**											
212												
213	**Lognormal Statistics**											
214					Minimum of Logged Data	0			Mean of logged Data			0.303
215					Maximum of Logged Data	1.099			SD of logged Data			0.441
216												
217	**Assuming Lognormal Distribution**											
218					95% H-UCL	1.822			90% Chebyshev (MVUE) UCL			1.938
219					95% Chebyshev (MVUE) UCL	2.143			97.5% Chebyshev (MVUE) UCL			2.427
220					99% Chebyshev (MVUE) UCL	2.986						

221												
222	**Nonparametric Distribution Free UCL Statistics**											
223	**Data do not follow a Discernible Distribution (0.05)**											
224												
225	**Nonparametric Distribution Free UCLs**											
226				95% CLT UCL		1.78			95% Jackknife UCL		1.794	
227				95% Standard Bootstrap UCL		N/A			95% Bootstrap-t UCL		N/A	
228				95% Hall's Bootstrap UCL		N/A			95% Percentile Bootstrap UCL		N/A	
229				95% BCA Bootstrap UCL		N/A						
230				90% Chebyshev(Mean, Sd) UCL		2.01			95% Chebyshev(Mean, Sd) UCL		2.242	
231				97.5% Chebyshev(Mean, Sd) UCL		2.563			99% Chebyshev(Mean, Sd) UCL		3.193	
232												
233	**Suggested UCL to Use**											
234				95% Student's-t UCL		1.794			or 95% Modified-t UCL		1.802	
235												
236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
237	Recommendations are based upon data size, data distribution, and skewness.											
238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
240												
241												
242	**Zinc**											
243												
244	**General Statistics**											
245				Total Number of Observations		20			Number of Distinct Observations		20	
246									Number of Missing Observations		0	
247				Minimum		1			Mean		64.65	
248				Maximum		510			Median		27	
249				SD		118.2			Std. Error of Mean		26.43	
250				Coefficient of Variation		1.829			Skewness		3.212	
251												
252	**Normal GOF Test**											
253				Shapiro Wilk Test Statistic		0.555			**Shapiro Wilk GOF Test**			
254				5% Shapiro Wilk Critical Value		0.905			Data Not Normal at 5% Significance Level			
255				Lilliefors Test Statistic		0.325			**Lilliefors GOF Test**			
256				5% Lilliefors Critical Value		0.192			Data Not Normal at 5% Significance Level			
257	**Data Not Normal at 5% Significance Level**											
258												
259	**Assuming Normal Distribution**											
260	**95% Normal UCL**								**95% UCLs (Adjusted for Skewness)**			
261				95% Student's-t UCL		110.4			95% Adjusted-CLT UCL (Chen-1995)		128.4	
262									95% Modified-t UCL (Johnson-1978)		113.5	
263												
264	**Gamma GOF Test**											
265				A-D Test Statistic		0.566			**Anderson-Darling Gamma GOF Test**			
266				5% A-D Critical Value		0.797			Detected data appear Gamma Distributed at 5% Significance Level			
267				K-S Test Statistic		0.16			**Kolmogorov-Smirnov Gamma GOF Test**			
268				5% K-S Critical Value		0.204			Detected data appear Gamma Distributed at 5% Significance Level			
269	**Detected data appear Gamma Distributed at 5% Significance Level**											
270												
271	**Gamma Statistics**											
272				k hat (MLE)		0.556			k star (bias corrected MLE)		0.506	
273				Theta hat (MLE)		116.3			Theta star (bias corrected MLE)		127.8	
274				nu hat (MLE)		22.24			nu star (bias corrected)		20.24	
275				MLE Mean (bias corrected)		64.65			MLE Sd (bias corrected)		90.89	

276							Approximate Chi Square Value (0.05)					11.03
277					Adjusted Level of Significance	0.038					Adjusted Chi Square Value	10.49
278												
279					**Assuming Gamma Distribution**							
280				95% Approximate Gamma UCL (use when n>=50)		118.7					95% Adjusted Gamma UCL (use when n<50)	124.7
281												
282					**Lognormal GOF Test**							
283					Shapiro Wilk Test Statistic	0.989	**Shapiro Wilk Lognormal GOF Test**					
284					5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level					
285					Lilliefors Test Statistic	0.103	**Lilliefors Lognormal GOF Test**					
286					5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level					
287					**Data appear Lognormal at 5% Significance Level**							
288												
289					**Lognormal Statistics**							
290					Minimum of Logged Data	0					Mean of logged Data	3.045
291					Maximum of Logged Data	6.234					SD of logged Data	1.61
292												
293					**Assuming Lognormal Distribution**							
294					95% H-UCL	292.2					90% Chebyshev (MVUE) UCL	155.8
295					95% Chebyshev (MVUE) UCL	195.8					97.5% Chebyshev (MVUE) UCL	251.2
296					99% Chebyshev (MVUE) UCL	360.2						
297												
298					**Nonparametric Distribution Free UCL Statistics**							
299					**Data appear to follow a Discernible Distribution at 5% Significance Level**							
300												
301					**Nonparametric Distribution Free UCLs**							
302					95% CLT UCL	108.1					95% Jackknife UCL	110.4
303					95% Standard Bootstrap UCL	107.6					95% Bootstrap-t UCL	191.6
304					95% Hall's Bootstrap UCL	259.8					95% Percentile Bootstrap UCL	111.5
305					95% BCA Bootstrap UCL	133.2						
306					90% Chebyshev(Mean, Sd) UCL	144					95% Chebyshev(Mean, Sd) UCL	179.9
307					97.5% Chebyshev(Mean, Sd) UCL	229.7					99% Chebyshev(Mean, Sd) UCL	327.7
308												
309					**Suggested UCL to Use**							
310					95% Adjusted Gamma UCL	124.7						
311												
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
313	Recommendations are based upon data size, data distribution, and skewness.											
314	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
315	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
316												
317												
318	**B(a)P**											
319												
320					**General Statistics**							
321					Total Number of Observations	22					Number of Distinct Observations	10
322											Number of Missing Observations	0
323					Minimum	0.05					Mean	0.255
324					Maximum	1.2					Median	0.06
325					SD	0.354					Std. Error of Mean	0.0754
326					Coefficient of Variation	1.389					Skewness	1.81
327												
328					**Normal GOF Test**							
329					Shapiro Wilk Test Statistic	0.648	**Shapiro Wilk GOF Test**					
330					5% Shapiro Wilk Critical Value	0.911	Data Not Normal at 5% Significance Level					

331				Lilliefors Test Statistic	0.351	**Lilliefors GOF Test**						
332				5% Lilliefors Critical Value	0.184	Data Not Normal at 5% Significance Level						
333	**Data Not Normal at 5% Significance Level**											
334												
335	**Assuming Normal Distribution**											
336	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
337				95% Student's-t UCL	0.384	95% Adjusted-CLT UCL (Chen-1995)						0.41
338						95% Modified-t UCL (Johnson-1978)						0.389
339												
340	**Gamma GOF Test**											
341				A-D Test Statistic	2.64	**Anderson-Darling Gamma GOF Test**						
342				5% A-D Critical Value	0.781	Data Not Gamma Distributed at 5% Significance Level						
343				K-S Test Statistic	0.31	**Kolmogorov-Smirnov Gamma GOF Test**						
344				5% K-S Critical Value	0.192	Data Not Gamma Distributed at 5% Significance Level						
345	**Data Not Gamma Distributed at 5% Significance Level**											
346												
347	**Gamma Statistics**											
348				k hat (MLE)	0.798	k star (bias corrected MLE)						0.72
349				Theta hat (MLE)	0.319	Theta star (bias corrected MLE)						0.354
350				nu hat (MLE)	35.12	nu star (bias corrected)						31.66
351				MLE Mean (bias corrected)	0.255	MLE Sd (bias corrected)						0.3
352						Approximate Chi Square Value (0.05)						19.8
353				Adjusted Level of Significance	0.0386	Adjusted Chi Square Value						19.1
354												
355	**Assuming Gamma Distribution**											
356	95% Approximate Gamma UCL (use when n>=50))				0.407	95% Adjusted Gamma UCL (use when n<50)						0.422
357												
358	**Lognormal GOF Test**											
359				Shapiro Wilk Test Statistic	0.759	**Shapiro Wilk Lognormal GOF Test**						
360				5% Shapiro Wilk Critical Value	0.911	Data Not Lognormal at 5% Significance Level						
361				Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**						
362				5% Lilliefors Critical Value	0.184	Data Not Lognormal at 5% Significance Level						
363	**Data Not Lognormal at 5% Significance Level**											
364												
365	**Lognormal Statistics**											
366				Minimum of Logged Data	-2.996	Mean of logged Data						-2.112
367				Maximum of Logged Data	0.182	SD of logged Data						1.158
368												
369	**Assuming Lognormal Distribution**											
370				95% H-UCL	0.481	90% Chebyshev (MVUE) UCL						0.419
371				95% Chebyshev (MVUE) UCL	0.507	97.5% Chebyshev (MVUE) UCL						0.628
372				99% Chebyshev (MVUE) UCL	0.867							
373												
374	**Nonparametric Distribution Free UCL Statistics**											
375	**Data do not follow a Discernible Distribution (0.05)**											
376												
377	**Nonparametric Distribution Free UCLs**											
378				95% CLT UCL	0.379	95% Jackknife UCL						0.384
379				95% Standard Bootstrap UCL	0.376	95% Bootstrap-t UCL						0.471
380				95% Hall's Bootstrap UCL	0.409	95% Percentile Bootstrap UCL						0.38
381				95% BCA Bootstrap UCL	0.419							
382				90% Chebyshev(Mean, Sd) UCL	0.481	95% Chebyshev(Mean, Sd) UCL						0.583
383				97.5% Chebyshev(Mean, Sd) UCL	0.725	99% Chebyshev(Mean, Sd) UCL						1.005
384												
385	**Suggested UCL to Use**											

386				95% Chebyshev (Mean, Sd) UCL		0.583						
387												
388	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
389	Recommendations are based upon data size, data distribution, and skewness.											
390	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
391	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
392												
393												
394	**B(a)P TEQ**											
395												
396	**General Statistics**											
397				Total Number of Observations		22			Number of Distinct Observations		10	
398									Number of Missing Observations		0	
399				Minimum		0.121			Mean		0.542	
400				Maximum		1.59			Median		0.5	
401				SD		0.393			Std. Error of Mean		0.0838	
402				Coefficient of Variation		0.725			Skewness		1.572	
403												
404	**Normal GOF Test**											
405				Shapiro Wilk Test Statistic		0.781			**Shapiro Wilk GOF Test**			
406				5% Shapiro Wilk Critical Value		0.911			Data Not Normal at 5% Significance Level			
407				Lilliefors Test Statistic		0.315			**Lilliefors GOF Test**			
408				5% Lilliefors Critical Value		0.184			Data Not Normal at 5% Significance Level			
409	**Data Not Normal at 5% Significance Level**											
410												
411	**Assuming Normal Distribution**											
412				**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**			
413				95% Student's-t UCL		0.686			95% Adjusted-CLT UCL (Chen-1995)		0.71	
414									95% Modified-t UCL (Johnson-1978)		0.691	
415												
416	**Gamma GOF Test**											
417				A-D Test Statistic		1.276			**Anderson-Darling Gamma GOF Test**			
418				5% A-D Critical Value		0.754			Data Not Gamma Distributed at 5% Significance Level			
419				K-S Test Statistic		0.232			**Kolmogorov-Smirnov Gamma GOF Test**			
420				5% K-S Critical Value		0.188			Data Not Gamma Distributed at 5% Significance Level			
421	**Data Not Gamma Distributed at 5% Significance Level**											
422												
423	**Gamma Statistics**											
424				k hat (MLE)		2.301			k star (bias corrected MLE)		2.018	
425				Theta hat (MLE)		0.236			Theta star (bias corrected MLE)		0.269	
426				nu hat (MLE)		101.3			nu star (bias corrected)		88.78	
427				MLE Mean (bias corrected)		0.542			MLE Sd (bias corrected)		0.382	
428									Approximate Chi Square Value (0.05)		68.05	
429				Adjusted Level of Significance		0.0386			Adjusted Chi Square Value		66.7	
430												
431	**Assuming Gamma Distribution**											
432				95% Approximate Gamma UCL (use when n>=50))		0.707			95% Adjusted Gamma UCL (use when n<50)		0.721	
433												
434	**Lognormal GOF Test**											
435				Shapiro Wilk Test Statistic		0.885			**Shapiro Wilk Lognormal GOF Test**			
436				5% Shapiro Wilk Critical Value		0.911			Data Not Lognormal at 5% Significance Level			
437				Lilliefors Test Statistic		0.266			**Lilliefors Lognormal GOF Test**			
438				5% Lilliefors Critical Value		0.184			Data Not Lognormal at 5% Significance Level			
439	**Data Not Lognormal at 5% Significance Level**											
440												

	A	B	C	D	E	F	G	H	I	J	K	L
441	**Lognormal Statistics**											
442					Minimum of Logged Data	-2.112				Mean of logged Data		-0.845
443					Maximum of Logged Data	0.464				SD of logged Data		0.713
444												
445	**Assuming Lognormal Distribution**											
446					95% H-UCL	0.782				90% Chebyshev (MVUE) UCL		0.813
447					95% Chebyshev (MVUE) UCL	0.934				97.5% Chebyshev (MVUE) UCL		1.102
448					99% Chebyshev (MVUE) UCL	1.433						
449												
450	**Nonparametric Distribution Free UCL Statistics**											
451	**Data do not follow a Discernible Distribution (0.05)**											
452												
453	**Nonparametric Distribution Free UCLs**											
454					95% CLT UCL	0.68				95% Jackknife UCL		0.686
455					95% Standard Bootstrap UCL	0.683				95% Bootstrap-t UCL		0.757
456					95% Hall's Bootstrap UCL	0.773				95% Percentile Bootstrap UCL		0.676
457					95% BCA Bootstrap UCL	0.702						
458					90% Chebyshev(Mean, Sd) UCL	0.793				95% Chebyshev(Mean, Sd) UCL		0.907
459					97.5% Chebyshev(Mean, Sd) UCL	1.065				99% Chebyshev(Mean, Sd) UCL		1.375
460												
461	**Suggested UCL to Use**											
462					95% Chebyshev (Mean, Sd) UCL	0.907						
463												
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
465	Recommendations are based upon data size, data distribution, and skewness.											
466	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
468												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.13/09/2019 2:56:40 PM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Copper

General Statistics

Total Number of Observations	29	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	1	Mean	13.41
Maximum	50	Median	7
SD	13.54	Std. Error of Mean	2.514
Coefficient of Variation	1.009	Skewness	1.176

Normal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.214	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.161	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	17.69	95% Adjusted-CLT UCL (Chen-1995)	18.14
		95% Modified-t UCL (Johnson-1978)	17.78

Gamma GOF Test

A-D Test Statistic	0.543	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.777	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.168	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.919	k star (bias corrected MLE)	0.847
Theta hat (MLE)	14.6	Theta star (bias corrected MLE)	15.84
nu hat (MLE)	53.31	nu star (bias corrected)	49.12
MLE Mean (bias corrected)	13.41	MLE Sd (bias corrected)	14.58
		Approximate Chi Square Value (0.05)	34.03
Adjusted Level of Significance	0.0407	Adjusted Chi Square Value	33.28

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	19.36	95% Adjusted Gamma UCL (use when n<50)	19.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.144	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.161	Data appear Lognormal at 5% Significance Level

56	**Data appear Approximate Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	0				Mean of logged Data		1.962
60					Maximum of Logged Data	3.912				SD of logged Data		1.283
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	32.21				90% Chebyshev (MVUE) UCL		28.79
64					95% Chebyshev (MVUE) UCL	34.84				97.5% Chebyshev (MVUE) UCL		43.23
65					99% Chebyshev (MVUE) UCL	59.73						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	17.55				95% Jackknife UCL		17.69
72					95% Standard Bootstrap UCL	17.44				95% Bootstrap-t UCL		18.56
73					95% Hall's Bootstrap UCL	18.11				95% Percentile Bootstrap UCL		17.69
74					95% BCA Bootstrap UCL	18.17						
75					90% Chebyshev(Mean, Sd) UCL	20.96				95% Chebyshev(Mean, Sd) UCL		24.37
76					97.5% Chebyshev(Mean, Sd) UCL	29.11				99% Chebyshev(Mean, Sd) UCL		38.43
77												
78	**Suggested UCL to Use**											
79					95% Adjusted Gamma UCL	19.8						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86												
87	**Lead**											
88												
89	**General Statistics**											
90					Total Number of Observations	33				Number of Distinct Observations		26
91										Number of Missing Observations		0
92					Minimum	1				Mean		105.6
93					Maximum	890				Median		45
94					SD	175.1				Std. Error of Mean		30.48
95					Coefficient of Variation	1.658				Skewness		3.333
96												
97	**Normal GOF Test**											
98					Shapiro Wilk Test Statistic	0.588				**Shapiro Wilk GOF Test**		
99					5% Shapiro Wilk Critical Value	0.931				Data Not Normal at 5% Significance Level		
100					Lilliefors Test Statistic	0.28				**Lilliefors GOF Test**		
101					5% Lilliefors Critical Value	0.152				Data Not Normal at 5% Significance Level		
102	**Data Not Normal at 5% Significance Level**											
103												
104	**Assuming Normal Distribution**											
105					**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**		
106					95% Student's-t UCL	157.2				95% Adjusted-CLT UCL (Chen-1995)		174.6
107										95% Modified-t UCL (Johnson-1978)		160.2
108												
109	**Gamma GOF Test**											
110					A-D Test Statistic	0.608				**Anderson-Darling Gamma GOF Test**		

111				5% A-D Critical Value	0.798	Detected data appear Gamma Distributed at 5% Significance Level						
112				K-S Test Statistic	0.15	**Kolmogorov-Smirnov Gamma GOF Test**						
113				5% K-S Critical Value	0.16	Detected data appear Gamma Distributed at 5% Significance Level						
114	**Detected data appear Gamma Distributed at 5% Significance Level**											
115												
116	**Gamma Statistics**											
117				k hat (MLE)	0.634	k star (bias corrected MLE)	0.597					
118				Theta hat (MLE)	166.4	Theta star (bias corrected MLE)	176.9					
119				nu hat (MLE)	41.87	nu star (bias corrected)	39.4					
120				MLE Mean (bias corrected)	105.6	MLE Sd (bias corrected)	136.6					
121						Approximate Chi Square Value (0.05)	26.02					
122				Adjusted Level of Significance	0.0419	Adjusted Chi Square Value	25.46					
123												
124	**Assuming Gamma Distribution**											
125			95% Approximate Gamma UCL (use when n>=50)		159.9	95% Adjusted Gamma UCL (use when n<50)	163.4					
126												
127	**Lognormal GOF Test**											
128				Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk Lognormal GOF Test**						
129				5% Shapiro Wilk Critical Value	0.931	Data appear Lognormal at 5% Significance Level						
130				Lilliefors Test Statistic	0.0952	**Lilliefors Lognormal GOF Test**						
131				5% Lilliefors Critical Value	0.152	Data appear Lognormal at 5% Significance Level						
132	**Data appear Lognormal at 5% Significance Level**											
133												
134	**Lognormal Statistics**											
135				Minimum of Logged Data	0	Mean of logged Data	3.693					
136				Maximum of Logged Data	6.791	SD of logged Data	1.549					
137												
138	**Assuming Lognormal Distribution**											
139				95% H-UCL	318.2	90% Chebyshev (MVUE) UCL	253					
140				95% Chebyshev (MVUE) UCL	311.4	97.5% Chebyshev (MVUE) UCL	392.6					
141				99% Chebyshev (MVUE) UCL	551.9							
142												
143	**Nonparametric Distribution Free UCL Statistics**											
144	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
145												
146	**Nonparametric Distribution Free UCLs**											
147				95% CLT UCL	155.7	95% Jackknife UCL	157.2					
148				95% Standard Bootstrap UCL	155.1	95% Bootstrap-t UCL	209.3					
149				95% Hall's Bootstrap UCL	351.7	95% Percentile Bootstrap UCL	157.7					
150				95% BCA Bootstrap UCL	184							
151				90% Chebyshev(Mean, Sd) UCL	197	95% Chebyshev(Mean, Sd) UCL	238.4					
152				97.5% Chebyshev(Mean, Sd) UCL	295.9	99% Chebyshev(Mean, Sd) UCL	408.8					
153												
154	**Suggested UCL to Use**											
155				95% Adjusted Gamma UCL	163.4							
156												
157	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
158	Recommendations are based upon data size, data distribution, and skewness.											
159	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
160	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
161												
162												
163	**Nickel**											
164												
165	**General Statistics**											

166	Total Number of Observations				29	Number of Distinct Observations						5
167						Number of Missing Observations						0
168	Minimum				1	Mean						1.897
169	Maximum				5	Median						1
170	SD				1.175	Std. Error of Mean						0.218
171	Coefficient of Variation				0.62	Skewness						1.205
172												
173	**Normal GOF Test**											
174	Shapiro Wilk Test Statistic				0.765	**Shapiro Wilk GOF Test**						
175	5% Shapiro Wilk Critical Value				0.926	Data Not Normal at 5% Significance Level						
176	Lilliefors Test Statistic				0.294	**Lilliefors GOF Test**						
177	5% Lilliefors Critical Value				0.161	Data Not Normal at 5% Significance Level						
178	**Data Not Normal at 5% Significance Level**											
179												
180	**Assuming Normal Distribution**											
181	**95% Normal UCL**					**95% UCLs (Adjusted for Skewness)**						
182	95% Student's-t UCL				2.268	95% Adjusted-CLT UCL (Chen-1995)						2.308
183						95% Modified-t UCL (Johnson-1978)						2.276
184												
185	**Gamma GOF Test**											
186	A-D Test Statistic				2.688	**Anderson-Darling Gamma GOF Test**						
187	5% A-D Critical Value				0.752	Data Not Gamma Distributed at 5% Significance Level						
188	K-S Test Statistic				0.321	**Kolmogorov-Smirnov Gamma GOF Test**						
189	5% K-S Critical Value				0.164	Data Not Gamma Distributed at 5% Significance Level						
190	**Data Not Gamma Distributed at 5% Significance Level**											
191												
192	**Gamma Statistics**											
193	k hat (MLE)				3.279	k star (bias corrected MLE)						2.963
194	Theta hat (MLE)				0.578	Theta star (bias corrected MLE)						0.64
195	nu hat (MLE)				190.2	nu star (bias corrected)						171.8
196	MLE Mean (bias corrected)				1.897	MLE Sd (bias corrected)						1.102
197						Approximate Chi Square Value (0.05)						142.5
198	Adjusted Level of Significance				0.0407	Adjusted Chi Square Value						140.9
199												
200	**Assuming Gamma Distribution**											
201	95% Approximate Gamma UCL (use when n>=50))				2.287	95% Adjusted Gamma UCL (use when n<50)						2.312
202												
203	**Lognormal GOF Test**											
204	Shapiro Wilk Test Statistic				0.782	**Shapiro Wilk Lognormal GOF Test**						
205	5% Shapiro Wilk Critical Value				0.926	Data Not Lognormal at 5% Significance Level						
206	Lilliefors Test Statistic				0.323	**Lilliefors Lognormal GOF Test**						
207	5% Lilliefors Critical Value				0.161	Data Not Lognormal at 5% Significance Level						
208	**Data Not Lognormal at 5% Significance Level**											
209												
210	**Lognormal Statistics**											
211	Minimum of Logged Data				0	Mean of logged Data						0.48
212	Maximum of Logged Data				1.609	SD of logged Data						0.556
213												
214	**Assuming Lognormal Distribution**											
215	95% H-UCL				2.326	90% Chebyshev (MVUE) UCL						2.486
216	95% Chebyshev (MVUE) UCL				2.764	97.5% Chebyshev (MVUE) UCL						3.148
217	99% Chebyshev (MVUE) UCL				3.904							
218												
219	**Nonparametric Distribution Free UCL Statistics**											
220	**Data do not follow a Discernible Distribution (0.05)**											

221												
222	**Nonparametric Distribution Free UCLs**											
223					95% CLT UCL	2.256				95% Jackknife UCL	2.268	
224					95% Standard Bootstrap UCL	2.254				95% Bootstrap-t UCL	2.363	
225					95% Hall's Bootstrap UCL	2.317				95% Percentile Bootstrap UCL	2.276	
226					95% BCA Bootstrap UCL	2.241						
227					90% Chebyshev(Mean, Sd) UCL	2.551				95% Chebyshev(Mean, Sd) UCL	2.848	
228					97.5% Chebyshev(Mean, Sd) UCL	3.26				99% Chebyshev(Mean, Sd) UCL	4.068	
229												
230	**Suggested UCL to Use**											
231					95% Chebyshev (Mean, Sd) UCL	2.848						
232												
233	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
234	Recommendations are based upon data size, data distribution, and skewness.											
235	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
236	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
237												
238												
239	**Zinc**											
240												
241	**General Statistics**											
242					Total Number of Observations	29				Number of Distinct Observations	28	
243										Number of Missing Observations	0	
244					Minimum	1				Mean	73.59	
245					Maximum	390				Median	56	
246					SD	78.49				Std. Error of Mean	14.58	
247					Coefficient of Variation	1.067				Skewness	2.556	
248												
249	**Normal GOF Test**											
250					Shapiro Wilk Test Statistic	0.762				**Shapiro Wilk GOF Test**		
251					5% Shapiro Wilk Critical Value	0.926				Data Not Normal at 5% Significance Level		
252					Lilliefors Test Statistic	0.178				**Lilliefors GOF Test**		
253					5% Lilliefors Critical Value	0.161				Data Not Normal at 5% Significance Level		
254	**Data Not Normal at 5% Significance Level**											
255												
256	**Assuming Normal Distribution**											
257	**95% Normal UCL**									**95% UCLs (Adjusted for Skewness)**		
258					95% Student's-t UCL	98.38				95% Adjusted-CLT UCL (Chen-1995)	105	
259										95% Modified-t UCL (Johnson-1978)	99.53	
260												
261	**Gamma GOF Test**											
262					A-D Test Statistic	0.273				**Anderson-Darling Gamma GOF Test**		
263					5% A-D Critical Value	0.777				Detected data appear Gamma Distributed at 5% Significance Level		
264					K-S Test Statistic	0.102				**Kolmogorov-Smirnov Gamma GOF Test**		
265					5% K-S Critical Value	0.168				Detected data appear Gamma Distributed at 5% Significance Level		
266	**Detected data appear Gamma Distributed at 5% Significance Level**											
267												
268	**Gamma Statistics**											
269					k hat (MLE)	0.939				k star (bias corrected MLE)	0.865	
270					Theta hat (MLE)	78.39				Theta star (bias corrected MLE)	85.11	
271					nu hat (MLE)	54.44				nu star (bias corrected)	50.14	
272					MLE Mean (bias corrected)	73.59				MLE Sd (bias corrected)	79.14	
273										Approximate Chi Square Value (0.05)	34.89	
274					Adjusted Level of Significance	0.0407				Adjusted Chi Square Value	34.12	
275												

276	**Assuming Gamma Distribution**											
277					95% Approximate Gamma UCL (use when n>=50)		105.8		95% Adjusted Gamma UCL (use when n<50)			108.1
278												
279	**Lognormal GOF Test**											
280					Shapiro Wilk Test Statistic		0.921		**Shapiro Wilk Lognormal GOF Test**			
281					5% Shapiro Wilk Critical Value		0.926		Data Not Lognormal at 5% Significance Level			
282					Lilliefors Test Statistic		0.17		**Lilliefors Lognormal GOF Test**			
283					5% Lilliefors Critical Value		0.161		Data Not Lognormal at 5% Significance Level			
284	**Data Not Lognormal at 5% Significance Level**											
285												
286	**Lognormal Statistics**											
287					Minimum of Logged Data		0		Mean of logged Data			3.679
288					Maximum of Logged Data		5.966		SD of logged Data			1.372
289												
290	**Assuming Lognormal Distribution**											
291					95% H-UCL		219		90% Chebyshev (MVUE) UCL			186
292					95% Chebyshev (MVUE) UCL		226.8		97.5% Chebyshev (MVUE) UCL			283.5
293					99% Chebyshev (MVUE) UCL		394.8					
294												
295	**Nonparametric Distribution Free UCL Statistics**											
296	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
297												
298	**Nonparametric Distribution Free UCLs**											
299					95% CLT UCL		97.56		95% Jackknife UCL			98.38
300					95% Standard Bootstrap UCL		97.82		95% Bootstrap-t UCL			108.7
301					95% Hall's Bootstrap UCL		206.2		95% Percentile Bootstrap UCL			99.14
302					95% BCA Bootstrap UCL		106.9					
303					90% Chebyshev(Mean, Sd) UCL		117.3		95% Chebyshev(Mean, Sd) UCL			137.1
304					97.5% Chebyshev(Mean, Sd) UCL		164.6		99% Chebyshev(Mean, Sd) UCL			218.6
305												
306	**Suggested UCL to Use**											
307					95% Adjusted Gamma UCL		108.1					
308												
309	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
310	Recommendations are based upon data size, data distribution, and skewness.											
311	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
312	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
313												
314												
315	**B(a)P**											
316												
317	**General Statistics**											
318					Total Number of Observations		33		Number of Distinct Observations			18
319									Number of Missing Observations			0
320					Minimum		0.05		Mean			0.706
321					Maximum		6.4		Median			0.2
322					SD		1.207		Std. Error of Mean			0.21
323					Coefficient of Variation		1.711		Skewness			3.564
324												
325	**Normal GOF Test**											
326					Shapiro Wilk Test Statistic		0.581		**Shapiro Wilk GOF Test**			
327					5% Shapiro Wilk Critical Value		0.931		Data Not Normal at 5% Significance Level			
328					Lilliefors Test Statistic		0.294		**Lilliefors GOF Test**			
329					5% Lilliefors Critical Value		0.152		Data Not Normal at 5% Significance Level			
330	**Data Not Normal at 5% Significance Level**											

331												
332	**Assuming Normal Distribution**											
333	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
334				95% Student's-t UCL		1.062				95% Adjusted-CLT UCL (Chen-1995)		1.191
335										95% Modified-t UCL (Johnson-1978)		1.084
336												
337	**Gamma GOF Test**											
338				A-D Test Statistic		1.721	**Anderson-Darling Gamma GOF Test**					
339				5% A-D Critical Value		0.803	Data Not Gamma Distributed at 5% Significance Level					
340				K-S Test Statistic		0.233	**Kolmogorov-Smirnov Gamma GOF Test**					
341				5% K-S Critical Value		0.161	Data Not Gamma Distributed at 5% Significance Level					
342	**Data Not Gamma Distributed at 5% Significance Level**											
343												
344	**Gamma Statistics**											
345				k hat (MLE)		0.589				k star (bias corrected MLE)		0.556
346				Theta hat (MLE)		1.197				Theta star (bias corrected MLE)		1.269
347				nu hat (MLE)		38.91				nu star (bias corrected)		36.7
348				MLE Mean (bias corrected)		0.706				MLE Sd (bias corrected)		0.946
349										Approximate Chi Square Value (0.05)		23.84
350				Adjusted Level of Significance		0.0419				Adjusted Chi Square Value		23.3
351												
352	**Assuming Gamma Distribution**											
353				95% Approximate Gamma UCL (use when n>=50))		1.087				95% Adjusted Gamma UCL (use when n<50)		1.112
354												
355	**Lognormal GOF Test**											
356				Shapiro Wilk Test Statistic		0.875	**Shapiro Wilk Lognormal GOF Test**					
357				5% Shapiro Wilk Critical Value		0.931	Data Not Lognormal at 5% Significance Level					
358				Lilliefors Test Statistic		0.213	**Lilliefors Lognormal GOF Test**					
359				5% Lilliefors Critical Value		0.152	Data Not Lognormal at 5% Significance Level					
360	**Data Not Lognormal at 5% Significance Level**											
361												
362	**Lognormal Statistics**											
363				Minimum of Logged Data		-2.996				Mean of logged Data		-1.399
364				Maximum of Logged Data		1.856				SD of logged Data		1.488
365												
366	**Assuming Lognormal Distribution**											
367				95% H-UCL		1.68				90% Chebyshev (MVUE) UCL		1.39
368				95% Chebyshev (MVUE) UCL		1.704				97.5% Chebyshev (MVUE) UCL		2.138
369				99% Chebyshev (MVUE) UCL		2.992						
370												
371	**Nonparametric Distribution Free UCL Statistics**											
372	**Data do not follow a Discernible Distribution (0.05)**											
373												
374	**Nonparametric Distribution Free UCLs**											
375				95% CLT UCL		1.051				95% Jackknife UCL		1.062
376				95% Standard Bootstrap UCL		1.051				95% Bootstrap-t UCL		1.351
377				95% Hall's Bootstrap UCL		2.481				95% Percentile Bootstrap UCL		1.07
378				95% BCA Bootstrap UCL		1.213						
379				90% Chebyshev(Mean, Sd) UCL		1.336				95% Chebyshev(Mean, Sd) UCL		1.622
380				97.5% Chebyshev(Mean, Sd) UCL		2.018				99% Chebyshev(Mean, Sd) UCL		2.797
381												
382	**Suggested UCL to Use**											
383				95% Chebyshev (Mean, Sd) UCL		1.622						
384												
385	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

386	Recommendations are based upon data size, data distribution, and skewness.											
387	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
388	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
389												
390												
391	**B(a)P TEQ**											
392												
393	**General Statistics**											
394					Total Number of Observations	33			Number of Distinct Observations	17		
395									Number of Missing Observations	0		
396					Minimum	0.131			Mean	1.163		
397					Maximum	8.197			Median	0.5		
398					SD	1.486			Std. Error of Mean	0.259		
399					Coefficient of Variation	1.279			Skewness	3.596		
400												
401	**Normal GOF Test**											
402					Shapiro Wilk Test Statistic	0.588			**Shapiro Wilk GOF Test**			
403					5% Shapiro Wilk Critical Value	0.931			Data Not Normal at 5% Significance Level			
404					Lilliefors Test Statistic	0.284			**Lilliefors GOF Test**			
405					5% Lilliefors Critical Value	0.152			Data Not Normal at 5% Significance Level			
406	**Data Not Normal at 5% Significance Level**											
407												
408	**Assuming Normal Distribution**											
409					**95% Normal UCL**				**95% UCLs (Adjusted for Skewness)**			
410					95% Student's-t UCL	1.601			95% Adjusted-CLT UCL (Chen-1995)	1.761		
411									95% Modified-t UCL (Johnson-1978)	1.628		
412												
413	**Gamma GOF Test**											
414					A-D Test Statistic	2.048			**Anderson-Darling Gamma GOF Test**			
415					5% A-D Critical Value	0.77			Data Not Gamma Distributed at 5% Significance Level			
416					K-S Test Statistic	0.274			**Kolmogorov-Smirnov Gamma GOF Test**			
417					5% K-S Critical Value	0.157			Data Not Gamma Distributed at 5% Significance Level			
418	**Data Not Gamma Distributed at 5% Significance Level**											
419												
420	**Gamma Statistics**											
421					k hat (MLE)	1.251			k star (bias corrected MLE)	1.157		
422					Theta hat (MLE)	0.929			Theta star (bias corrected MLE)	1.004		
423					nu hat (MLE)	82.56			nu star (bias corrected)	76.39		
424					MLE Mean (bias corrected)	1.163			MLE Sd (bias corrected)	1.081		
425									Approximate Chi Square Value (0.05)	57.26		
426					Adjusted Level of Significance	0.0419			Adjusted Chi Square Value	56.4		
427												
428	**Assuming Gamma Distribution**											
429					95% Approximate Gamma UCL (use when n>=50))	1.551			95% Adjusted Gamma UCL (use when n<50)	1.574		
430												
431	**Lognormal GOF Test**											
432					Shapiro Wilk Test Statistic	0.912			**Shapiro Wilk Lognormal GOF Test**			
433					5% Shapiro Wilk Critical Value	0.931			Data Not Lognormal at 5% Significance Level			
434					Lilliefors Test Statistic	0.228			**Lilliefors Lognormal GOF Test**			
435					5% Lilliefors Critical Value	0.152			Data Not Lognormal at 5% Significance Level			
436	**Data Not Lognormal at 5% Significance Level**											
437												
438	**Lognormal Statistics**											
439					Minimum of Logged Data	-2.033			Mean of logged Data	-0.3		
440					Maximum of Logged Data	2.104			SD of logged Data	0.91		

441												
442	**Assuming Lognormal Distribution**											
443					95% H-UCL	1.633			90% Chebyshev (MVUE) UCL	1.696		
444					95% Chebyshev (MVUE) UCL	1.965			97.5% Chebyshev (MVUE) UCL	2.338		
445					99% Chebyshev (MVUE) UCL	3.071						
446												
447	**Nonparametric Distribution Free UCL Statistics**											
448	**Data do not follow a Discernible Distribution (0.05)**											
449												
450	**Nonparametric Distribution Free UCLs**											
451					95% CLT UCL	1.588			95% Jackknife UCL	1.601		
452					95% Standard Bootstrap UCL	1.587			95% Bootstrap-t UCL	1.987		
453					95% Hall's Bootstrap UCL	3.335			95% Percentile Bootstrap UCL	1.626		
454					95% BCA Bootstrap UCL	1.861						
455					90% Chebyshev(Mean, Sd) UCL	1.939			95% Chebyshev(Mean, Sd) UCL	2.291		
456					97.5% Chebyshev(Mean, Sd) UCL	2.779			99% Chebyshev(Mean, Sd) UCL	3.737		
457												
458	**Suggested UCL to Use**											
459					95% Chebyshev (Mean, Sd) UCL	2.291						
460												
461	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
462	Recommendations are based upon data size, data distribution, and skewness.											
463	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
464	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
465												