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Report on
Remediation Action Plan

UNSW HTH, Randwick Campus Redevelopment
High and Botany Streets, Randwick

Prepared for
University of New South Wales

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## Executive Summary

This report comprises a Remediation Action Plan (RAP) developed for the proposed University of New South Wales Health Translation Hub (UNSW HTH) development, part of the larger Randwick Campus Redevelopment (RCR) located at High and Botany Streets, Randwick.

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

In this regard, this RAP:

- Establishes an appropriate remedial strategy so as to render the site suitable, from a contamination perspective, for the proposed development;
- Establishes 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;
- Establishes appropriate environmental safeguards required to complete the remediation works in an environmentally acceptable manner;
- Establishes 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.

Given that the proposed development is understood to comprise bulk excavation across much of the site with minimal retention of soils, this RAP primarily details the management of excavated soils for disposal off-site under a formal waste classification and / or beneficial re-use under an appropriate resource recovery order. For soils being retained on site under the proposed development, the RAP details specific assessment of suitability, and subsequent management options. Further detail is provided within this document, including management strategies, validation, responsibilities and reporting requirements.

Overall, it is considered that UNSW HTH site can be rendered suitable for the proposed development subject to proper implementation of the recommended data gap investigation, remediation procedures, unexpected finds protocols and completion of the validation assessment detailed in this RAP.

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## 1. Introduction

This report presents the results of a Remediation Action Plan (RAP) undertaken for the proposed University of New South Wales Health Translation Hub (UNSW HTH) development (the "site", as shown in Drawings 1 and 2, Appendix A), part of the larger Randwick Campus Redevelopment (RCR) located at High and Botany Streets, Randwick. Preparation of the RAP was commissioned by the University of New South Wales (UNSW) and was undertaken in accordance with the Douglas Partners Pty Ltd (DP) proposal SYD200971.P.001.Rev0 dated 11 September 2020 and email correspondence dated 3 December 2020.

This RAP has been prepared to address the Planning Secretary's Environmental Assessment Requirements (SEARs) for the proposed development as a part of the State Significant Development Application (SSDA).

It is understood that the larger RCR project comprises multiple projects and sub-areas (as shown in Drawing 1, Appendix A) which includes the current development of an Integrated Acute Services Building (IASB) addition located to the south and south-east of the current site, and the future planned Sydney Children's Hospital Stage 1 and the Children's Comprehensive Cancer Clinic (SCH Stage 1 and the CCCC) immediately to the east (and south).

DP has previously completed a PSI (DP, 2018) and Detailed Site Investigation (DSI) for the Stage 1 and Stage 2 RCR areas (DP, 2019a) which established the basis of the recommendations of a Remediation Action Plan (RAP) (DP, 2019b), and subsequent site validation report (DP, 2019c) for the Stage 1 IASB development, which included a stormwater easement along the western and northern boundary of Stage 2 (refer Drawing 1, Appendix A), which is largely within the current site boundary. A supplementary DSI was undertaken for the IASB addition area outside of Stage 1 (DP, 2019d) which informed a revision to the RAP (DP, 2019b). PSI (DP, 2020b), DSI (DP, 2020c) and RAP (DP, 2019d) reports were recently prepared for the SCH Stage 1 and the CCCC development to the east (and partially south) of the site. These reports are summarised, as relevant, in Section 5.

Additionally, a PSI was recently prepared for the current UNSW HTH site (DP, 2020e) comprising a desktop review of available information and past reports. In conclusion DP (2020e) recommended the development of a RAP in addition to an intrusive data gap investigation.

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* (NSW EPA, 1995);
- NSW EPA, Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Land (NSW EPA, 2020);

- NSW EPA (2017) *Contaminated Sites Guidelines for the NSW Site Auditor Scheme* 3rd Edition (NSW EPA, 2017);
- NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (NSW EPA, 2014);
- NSW EPA Waste Classification Guidelines Part 2: Immobilisation of Waste (NSW EPA, 2014);
- State Environmental Planning Policy 55 (SEPP 55) - Remediation of Land (NSW DUAP/EPA, 1998); and
- WA DOH, Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia (WA DoH, 2009).

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.

“It is understood that UNSW will be leasing the land from Health Infrastructure. Under the Agreement for Lease, the landlord accepts responsibility for and associated with the contamination to a depth of one metre, as part of the early works package with an agreed capital contribution from UNSW. UNSW is responsible for the remaining remediation works below the remediated one metre level that is to be delivered as part of the early works by the landlord.

## 2. Scope of Works

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

The primary 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 Identification

The site is located approximately 6 km south-east of the Sydney CBD (refer to locality on Drawing 1, Appendix A). The site comprises the north western portion of the RCR development site.

Table 1 below presents site identification details.

**Table 1: Site Identification**

| Item | Details |
|---|---|
| Allotment Identification | Lots 3-14, Deposited Plan 12909<br>Lots 1-7, Deposited Plan13997<br>Lot 1, Deposited Plan 300666<br>Lots A & B, Deposited Plan 439756<br>Lots A-D, Deposited Plan 440501<br>Lots X & Y, Deposited Plan 445567<br>Lots 1 & 2, Deposited Plan 590480<br>Lot 32, Deposited Plan 667518 |
| Street Address | Botany and High Streets, Randwick |
| Site Coordinates (centroid) | 337012 m East, 6245623 m North (GDA 94 Zone 56) |
| Site Area (approximately) | 7875 $m^2$ |
| Local Government Area | Randwick City Council |
| Zoning | SP2 - Health Services Facilities<br>(previous SP2 and residential) |
| Current Land-use | Construction site compound |
| Proposed Land-use | Hospital Infrastructure / Educational |

Based on aerial photography (dated 29 October 2020) the site was observed to being used as a construction site compound associated with the IASB construction works further south. The bulk of the site was used for materials and equipment storage, and limited construction staff parking. The general layout of the site is shown on Drawing 1, Appendix A and Figure 1 below.

The land uses surrounding the site include:

- *North* - High Street, then residential and commercial properties;
- *East* - Part of the IASB construction site compound;
- *South* - IASB development area; and
- *West* - Botany Street, then UNSW campus.

**Figure 1: Site locality. Parts as follows: red boundary- current site, green boundary - SCH Stage 1 and the CCCC assessment boundary, pink boundary- IASB boundary, pink shaded - IASB addition area, yellow shaded- Stage 1 RCR area, blue shaded - Stage 2 RCR area, orange - stormwater easement. Refer to Drawing 1, Appendix A for further detail.**

Drawing DA0020, Appendix A outlines the boundary of the proposed development in further detail, Drawing 20084_SSDA-001, Appendix A provides further details of the proposed development including the building footprint and landscaping areas. It is noted both of these drawings that the southern portion of the site (i.e., the southern logistics area) whilst within the site boundary is to be undertaken as a part of the SCH Stage 1 and the CCCC project scope, but nonetheless remains a part of the current assessment.

## 4. Proposed Development

It is understood that the proposed development includes:

- Relevant site preparation, excavation and enabling works;
- Construction and use of a new, 15-storey building accommodating research and education uses, comprising:
  - One basement level; and
  - A total gross floor area of 35,600 $m^2$, including health-related research, education and administrative floor space;
- Pedestrian link bridges connecting the UNSW Kensington campus to the Randwick Hospital Campus (RHC), via the Wallace Wurth building to the UNSW HTH and through to the SCH Stage 1 and the CCCC redevelopment;
- Landscaping and public domain works, including the creation of 2500 $m^2$ of new publicly accessible open space within the eastern portion of the site, sitting between the UNSW HTH and the SCH Stage 1 and the CCCC redevelopment;
- Building Signage;
- Stratum subdivision; and
- Services and utilities augmentation as required.

It is understood that the UNSW HTH will be an expansion of the RHC to accommodate new health related education, research, and administrative facilities. It will include:

- Purpose-built spaces for health educators and researchers to work alongside clinicians;
- Floor plates for health translation research focused work with physical connections to the SCH Stage 1 and the CCCC and wider RHC;
- Dedicated facility for the CC directly linking the UNSW HTH with the SCH 1 Stage 1 and the CCCC;
- An education hub, including education and training rooms allowing hospital staff to educate and train UNSW medical students;
- Facilities for education, training, research, seminars and industry events;
- Clinical schools for the Women's and Children's Health, Psychiatry and Prince of Wales Hospital;
- Ambulatory care clinics including in neurosciences, public and population health; and
- Supporting facilities including retail premises.

## 5. Review of Previous Reports

The preliminary site investigation report for the site (DP, 2020e) included a review of relevant previous investigation reports within the larger RCR development area. Reference should be given to Drawing 1, Appendix A for the sub-sections of the larger RCR project as relevant to the previous investigations. It is noted that whilst Stage 1 and 2 of the RCR are no longer in use as terminology, reference has been retained to describe the parts of the larger RCR project to which previous investigations applied.

In general, it is noted that the Stage 1 RCR area includes the majority of the IASB, and parts of the SCH Stage 1 and the CCCC. A separate investigation area was later included to the east of Stage 1, for the remainder of the IASB area. The Stage 2 RCR area includes the UNSW HTH, SCH Stage 1 and the CCCC, and the stormwater easement.

The reports previously reviewed comprised the following:

- Stage 1 and 2 RCR PSI (DP, 2018);
- Stage 1 and 2 RCR DSI (DP, 2019a);
- IASB Addition DSI (DP, 2019d);
- Stage 1 and IASB Remediation Action Plan (DP, 2019b);
- Stage 1 Validation Report (DP, 2019c);
- Stage 2 In-Situ Waste Classification Assessment (DP, 2019e);
- "Tear Drop" Area Assessment (DP, 2020b);
- SCH1 / CCCC Preliminary Site Investigation (DP, 2020a); and
- SCH1 / CCCC Detailed Site Investigation (DP, 2020c).

A summary of results presented in the PSI are further summarised below in the following Sections 5.1 to 5.4. All previous test locations are shown on Drawing 2, Appendix A, and test locations within the current site are shown on Drawing 3, Appendix A. Previous test results within and / or applicable to the assessment of contamination at the site are summarised on Tables C1 to C3, Appendix C.

## 5.1 Site History Summary

A review of relevant historical information indicated that the majority of the site has been previously occupied with residential dwellings and limited low-density commercial operations since at least 1930. Nearby land-uses have been predominately residential, with the progressive upgrading / expansion of the Prince of Wales hospital further to the east, and the University of New South Wales to the west (opposite side of Botany Street).

More recently, the residential dwellings within the site have been demolished as a part of the greater RCR development. The site has then largely been used as a construction site compound (i.e., site sheds and storage) in support of the construction works within the IASB site, with a new stormwater easement constructed along the western and northern boundaries, as shown on Drawing 1, Appendix A.

Potential areas of environmental concern (AEC) identified through the site history review, previous site walkovers, and review of previous investigations included:

- Imported fill;
- Demolition of dwellings containing asbestos and / or lead paint;
- Construction support activities; and
- Neighbouring or nearby commercial activities including the operational hospital, former butcher / medical practice / orthodontist and an EPA notified dry cleaning business located 300 m to the north-east.

## 5.2 Topography, Geology and Hydrogeology

### 5.2.1 Topography

Local topography is relatively flat across the site, ranging from approximately 56 - 58 m AHD. Regional topography gently slopes downwards to the west and south-west to approximately 48 m AHD near Magill Street to the south.

### 5.2.2 Geology and Soil Landscape

Reference to the Sydney 1:100,000 Soil and Geology mapping indicates that the majority of the site is within the Newport group whereas the south eastern part is located within the Tuggerah group. These soil groups generally comprise aeolian (wind-blown) and marine sands overlying Hawkesbury sandstone at depth.

### 5.2.3 Surface Water and Groundwater

Groundwater levels across the larger RCR development area have previously been measured from 5.6 m to 5.96 m below ground level (bgl) which was previously interpreted to indicate a flow direction to the west and south west, as also indicated by the topography. Recent monitoring during the SCH1 / CCCC DSI (DP, 2020c) measured levels of 49.6 m AHD (3.28 m bgl), 48.6 m AHD (3.36 m bgl) and 49.8 m AHD (5.88 m bgl) respectively.

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.

### 5.2.4 Acid Sulfate Soils

Reference to acid sulfate soils risks mapping indicates that the site is within an area of no known acid sulfate risk. The nearest likely area is located approximately 1 km to the east. Based on the mapping information and observations from previous intrusive investigations the PSI considered that an acid sulfate soils management plan is not required.

### 5.2.5 Subsurface Profile

The subsurface profile across the site as detailed in previous investigations, can be summarised as follows:

- **PAVEMENT / SLAB**: A 30 - 70 mm thick asphaltic concrete surfacing overlying roadbase gravel to depths of up to 0.4 m was encountered in within roadways. Brick pavement or concrete pavers / slab up to 0.1 m thick were observed in and nearby previous residential properties;
- **FILLING:** (topsoil): Dark brown, fine to medium slightly silty sand topsoil was encountered to depths of 0.05 - 0.3 m; Some locations contained sandstone boulders, terracotta, glass, brick fragments and some slag and tile fragments;
- **FILLING:** Sandy filling with fine to medium gravel to depths of between 0.2 m and 1.4 m. Sandy filling and / or ripped sandstone was encountered into depths of between 0.2 m and 2.3 m. 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 in the majority of test locations. Asbestos containing materials were noted at select locations in both of the fill profiles as summarised on Drawing 4, Appendix A and discussed in Section 9.1;

- **SAND / Clayey SAND:** At the majority of test locations fine to medium sand, ranging from yellow to grey-brown in colour, 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 (BH6, 5.5 m and clay (BH9, 5.2 m) was noted at two locations. Trace quantities of charcoal was observed at BH207 and BH208; and
- **BEDROCK:** Sandstone encountered from 2.6 m bgl (51.9 m AHD) in the north to 4.12 m bgl (50.28 m AHD) in the south and 3.5 m bgl (48.4 m AHD) in the south eastern part of the site. Encountered sandstone generally very low to low strength initially, with increasing strength at depth.

## 5.3 Summary of Identified Contamination

Table 2 below presents a summary of previously identified contamination within the site exceeding a Residential - B land-use scenario (refer Section 8 for relevant criteria). Section 9.1 provides a summary of these results in relation to the adopted site assessment criteria (SAC) / remediation acceptance criteria (RAC) and their significance. Previous reported summary tables for soil, groundwater and waste classification are attached in Appendix C.

**Table 2: Previously Identified Contamination**

| Location | Depth Range (m) | Contaminants |
|---|---|---|
| S2-TP4 | 0-0.2 | Nickel |
| S2-TP4 | 0.9-1.0 | Nickel |
| S2-TP5 | 0.4-0.6 | Nickel, B(a)P |
| S2-TP6 | 0-0.2 | Nickel, B(a)P |
| S2-TP6 | 0.9-1.0 | Nickel |
| S2-TP7 | 0.8-1.0 | Nickel |
| S2-TP8 | 0-0.2 | Nickel |
| S2-TP8 | 0.8-1.0 | Nickel |
| S2-TP9 | 0.8-1.0 | Nickel |
| S2-TP12 | 0-0.2 | Nickel, B(a)P |
| S2-TP12 | 0.8-1.0 | Nickel |
| S2-TP13 | 0.5-0.7 | Nickel |
| S2-TP14 | 0-0.2 | Nickel, B(a)P |
| S2-TP14 | 0.3-0.5 | Nickel |
| S2-TP27 | 0-0.2 | Nickel |
| TP315 | 0-0.2 | B(a)P |
| TP315 | 1.0-1.1 | B(a)P |

| Location | Depth Range (m) | Contaminants |
|---|---|---|
| TP318 | 0-0.2 | B(a)P, Asbestos |
| TP318 | 0.4-0.5 | B(a)P |
| TP319 | 0-0.2 | B(a)P |
| TP319 | 0.4-0.5 | B(a)P |
| BH206 | 0.3-0.4 | B(a)P, PCB |
| BH207 | 0.1-0.2 | B(a)P |
| BH208 | 0.3-0.4 | Copper, B(a)P, B(a)P TEQ |
| BH215 | 0.1-0.2 | B(a)P, B(a)P TEQ |
| BH105 | 0.3-0.5 | B(a)P |
| BH105 | 0.3-0.5 | Zinc, B(a)P |
| BH106 | 0-0.2 | B(a)P |
| BH106 | 0.5-0.7 | B(a)P |
| BH107 | 0-0.2 | B(a)P |
| BH108 | 0-0.2 | B(a)P |

Additional surficial asbestos was noted in-between test locations, as summarised on the attached Drawing 4, Appendix A. It is noted that surficial asbestos was understood to have been removed as a part of the Stage 1 remedial works, however with the exception of the stormwater easement the current site is outside of the Stage 1 remediation boundary and associated validation report, SAR and SAS. Overall, these areas are generally considered to be indicative of the risk for further asbestos to be present in fill, particularly within the tear drop shaped area.

## 5.4 Waste Classification

All contaminant concentrations for the analysed samples from the previous investigations were within the contaminant thresholds (CT1s) for General Solid Waste (GSW) with the exception of lead and B(a)P at select locations, further toxicity characteristic leaching procedure (TCLP) testing on these samples for both lead and B(a)P resulted in combined SCCC and TCLP results within both SCC1 and TCLP1 respectively

On this basis the fill soils across the site were given a preliminary classification of General Solid Waste (non-putrescible) - Special Waste (asbestos). Subject to further *ex-situ* testing to confirm or otherwise the presence of asbestos and potentially elevated levels of lead and B(a)P in fill, it is possible that some of the fill may be re-classified as General Solid Waste (non-putrescible).

It was noted that OCP (scheduled chemicals, present as aldrin and dieldrin) was detected at one location (BH206), further detections were noted within the SCH Stage 1 and the CCCC area to east, with concentrations exceeding 2 mg/kg at one test location (outside of the current site). Any further detected concentrations above 2 mg/kg within the current site would require management as per the Scheduled Chemical Waste Control Order (NSW EPA, 2004), which enforces limitations on the re-use / processing of scheduled wastes. However, the detected concentrations to date are not expected to pose a restriction on the transport of the material for off-site disposal to landfill.

# 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).

## 6.1 Known and Potential Contamination Sources and Contaminants of Potential Concern

Based on the CSM developed as part of the PSI (DP, 2020e) potential sources of contamination and associated contaminants of potential concern (CoPC) have been identified in Table 3 below. Identified contamination from previous investigations is summarised in Table 2.

**Table 3: Potential Additional Contamination Sources and Contaminants of Concern**

| Potential Source | Description of Potential Contaminating Activity | Contaminants of Potential Concern |
|---|---|---|
| Imported fill of unknown origin (S1) | Filling: Associated with disturbed terrain in the local area and from building of roads and demolition of structures. Previous investigations have identified an average fill thickness of about 0.5 m across the RCR development. | Heavy metals, TPH, BTEX, PAH, phenols, PCB, OCP, and asbestos.<br><br>Previous investigations have identified the presence of the above contaminants to varying degrees, with the exception of most metals, BTEX, OCP and phenols. Exceedances of SAC are shown on Table 2. |

| Potential Source | Description of Potential Contaminating Activity | Contaminants of Potential Concern |
|---|---|---|
| Previous site structures (S2) | The majority of the site was previously occupied by residential structures, some of which were confirmed to have hazardous building materials including asbestos and lead based paint. | Lead, asbestos, PCB, PAH, and TRH<br><br>Previous investigations have identified the presence of the above contaminants to varying degrees, with the exception of most metals, BTEX, OCP and phenols. Exceedances of SAC are shown on Table 2. |
| Construction activities (S3) | The site has largely been used for the storage of materials and equipment associated with construction activities in the neighbouring ASB and IASB areas. There is a low potential for impacts from stockpiling and equipment maintenance. | Heavy metals, TRH, BTEX, PAH, asbestos. |
| Industrial / commercial activities, neighbouring and nearby (S4) | Operation of hospital.<br>Storage of chemicals or equipment associated with former medical practices / orthodontist. | Heavy metals, TRH, BTEX, PAH, phenols, VOC, ammonia and asbestos. |

The potential contamination sources (S) on the site, in addition to the known locations of contamination (Table 2) are therefore as follows:

- S1: Fill of unknown origin;
- S2: Previous site structures;
- S3: Construction activities; and
- S4: Industrial / commercial activities, neighbouring and nearby.

Whilst source S4 is still considered to exist the measurable impacts were considered in the PSI to be negligible and more representative of general urban conditions (e.g., elevated metal concentrations in groundwater) rather than posing a risk for the proposed development. No measurable impacts were previously detected from the notified dry-cleaning business (VOC) or the nearby hospital.

## 6.2 Potential Receptors

### 6.2.1 Human Health Receptors

R1 Current site users (site workers);

R2 Construction and maintenance workers;

R3 Final end users (health workers, university staff, students and visitors); and

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

### 6.2.2 Environmental Receptors

R5 Groundwater;

R6 Surface water (Botany Bay); and

R7 Terrestrial ecosystems (neighbouring areas of conservations such as Centennial Park, Queens Park and Eastlakes).

### 6.2.3 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).

## 6.3 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 potential sources (S1 to S4) and receptors (R1 to R7) are provided in Table 4 below.

**Table 4: Potential Complete Pathways**

| Source | Pathway | Receptor |
|---|---|---|
| S1 Fill of unknown origin<br><br>S2 Previous site structures<br><br>S3 Construction Activities | P1: Ingestion and dermal contact | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users |
| | P2: Inhalation of dust and/or vapour | R1: Current site users<br>R2: Construction and maintenance workers<br>R3: Final end users (educational / hospital)<br>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<br>P5: Lateral migration of 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 provided in Appendix B, Schedule B2 of NEPC (2013) will be implemented. 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 Administration Corporation);
- The tenant, i.e., the Principal (UNSW);
- The Principal's representative (TBC);
- The planning authority (Randwick City 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; and
- Guidelines cited in Section 1.

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 / RAC for the UNSW HTH site, refer Section 8;
- 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 High Street and Botany Streets to the west and north and is situated within the larger RCR development area, as shown on the attached Drawings 1 & 2, Appendix A.

### (e) Develop a Decision Rule

The successful implementation of the RAP is assessed on the basis of 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 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 5.

**Table 5: 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.

## 8.1 Soil and Groundwater

The SAC / RAC for the identified CoPC are based on the health investigation levels (HIL), health screening levels (HSL), ecological investigation levels (EIL) and ecological screening levels (ESL) in accordance with Schedule B1 of NEPC (2013). Petroleum based health screening levels for direct contact have been adopted from the CRC CARE Technical Report no.10 (CRC CARE, 2011) as referenced by NEPC (2013).

A hospital generally has numerous potential soil exposure scenarios, and therefore does generally fit solely within one generic land use scenario as listed in NEPC (2013). Given the potential proposed development and based on the CSM the applicable land use scenarios are:

- **Residential B** - Residential end use scenario with minimal access to underlying soils which is considered generally representative of the proposed hospital usage for patients;
- **Recreational C** - Representative of land-use in open, land-scaped areas such as the proposed shared plaza between the UNSW HTH and SCH Stage 1 and the CCCC developments; and
- **Commercial and Industrial D** - Commercial and industrial end use for roads. This is also considered to screen for hospital workers, shorter stay patients / visitors, and as a conservative screen for intrusive maintenance workers (also representing construction workers).

Given the mixed land-use the Residential B criteria will be applied as an initial more conservative screen.

Appendix B outlines in more detail the relevant investigation and screening levels adopted for soil and groundwater. All site specific and / or theoretical assumptions relevant to the selection of the investigation and screening levels have been outlined in each sub-section as required.

## 8.2 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 virgin excavated natural material (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.

## 8.3 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 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[1]. 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

[1] http://www.epa.nsw.gov.au/waste/virgin-material.htm, titled 'Virgin Excavated Natural Material'

- 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.

Imported VENM will also be required to be compared against the RAC as listed in Section 8. Sampling requirements for imported materials are outlined in Section 13.7.

Assessment of soils off-site disposal or of VENM will be conducted in accordance with either Section 13.5 (*in-situ*) or as per Section 13.3 (stockpile assessment).

### 8.5 Imported Material under a Resource Recovery Order

As stated in Section 13.7, all proposed imported materials (including road forming materials such as 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.

## 9. Remedial Action Plan

### 9.1 Contamination Status

Table 6 below includes a summary of identified contamination exceeding the adopted SAC for a Residential-B land-use scenario. The adopted RAC / SAC for this report are summarised in Section 8 and Appendix F. Previous reported summary tables for soil, groundwater and waste classification are attached in Appendix C.

It is again noted that areas within the previous Stage 1 Validation boundary (refer Drawing 1, Appendix A) have previously been remediated and as such no longer contain any previously identified contamination. Any additional finds within this area may be managed under the unexpected finds protocol as detailed in Section 12.

**Table 6: Summary Identified Exceedances of SAC / RAC (Residential B Criteria)**

| Sample ID | EIL / ESL B Exceedances | HIL / HSL B Exceedances |
|---|---|---|
| **Stage 2 In-Situ Waste Classification (DP, 2019e)** | | |
| S2-TP4/0-0.2 | Nickel – 18 (EIL 9) | - |
| S2-TP4/0.9-1.0 | Nickel – 14 (EIL 9) | - |
| S2-TP5/0.4-0.6 | Nickel – 19 (EIL 9)<br>*B(a)P – 0.81 (ESL 0.7)* | - |
| S2-TP6/0-0.2 | Nickel – 31 (EIL 9)<br>*B(a)P – 1.2 (ESL 0.7)* | - |
| S2-TP6/0.9-1.0 | Nickel – 39 (EIL 9) | - |
| S2-TP7/0.8-1.0 | Nickel – 37 (EIL 9) | |
| S2-TP8/0-0.2 | Nickel – 48 (EIL 9) | - |
| S2-TP8/0.8-1.0 | Nickel – 42 (EIL 9) | - |
| S2-TP9/0.8-1.0 | Nickel – 27 (EIL 9) | |
| S2-TP12/0-0.2 | Nickel – 41 (EIL 9)<br>*B(a)P – 1.2 (ESL 0.7)* | - |
| S2-TP12/0.8-1.0 | Nickel – 10 (EIL 9) | - |
| S2-TP13/0.5-0.7 | Nickel – 23 (EIL 9) | - |
| S2-TP14/0-0.2 | Nickel – 100 (EIL 9)<br>*B(a)P – 2.7 (ESL 0.7)* | - |
| S2-TP14/0.3-0.5 | Nickel – 83 (EIL 9) | - |
| S2-TP27/0-0.2 | Nickel – 11 (EIL 9) | - |
| **Stage 1 and 2 RCR DSI (DP, 2019a)** | | |
| TP315/0-0.2 | *B(a)P – 1.3 (ESL 0.7)* | - |
| TP315/1.0-1.1 | *B(a)P – 1.5 (ESL 0.7)* | - |
| TP318/0-0.2 | *B(a)P – 1.4 (ESL 0.7)* | Asbestos detected ** |
| TP318/0.4-0.5 | *B(a)P – 0.9 (ESL 0.7)* | - |
| TP319/0-0.2 | *B(a)P – 2.1 (ESL 0.7)* | - |
| TP319/0.4-0.5 | *B(a)P – 2.2 ESL 0.7)* | - |
| BH206/0.3-0.4 | *B(a)P –1.7 (ESL 0.7)* | PCB – 1.6 (HIL 1) |
| BH207/0.1-0.2 | *B(a)P – 1.2 (ESL 0.7)* | - |
| BH208/0.3-0.4 | Copper - 85 (EIL 65)<br>*B(a)P – 2.9 (ESL 0.7)* | B(a)P TEQ – 4.3 (HIL 4) |
| *BH215/0.1-0.2* | *B(a)P – 3.2 (ESL 0.7)* | B(a)P TEQ – 4.5 (HIL 4) |
| **Stage 1 and 2 RCR PSI (DP, 2018)** | | |
| *BH105/0.3-0.5* | *B(a)P – 0.77 (ESL 0.7)* | - |
| *BH105/0.3-0.5* | Zinc – 310 (EIL 240) | - |

| Sample ID | EIL / ESL B Exceedances | HIL / HSL B Exceedances |
|---|---|---|
| | *B(a)P – 1.1 (ESL 0.7)* | |
| BH106/0-0.2 | *B(a)P – 0.73 (ESL 0.7)* | - |
| BH106/0.5-0.7 | *B(a)P – 0.91 ESL 0.7)* | - |
| BH107/0-0.2 | *B(a)P –1.8 (ESL 0.7)* | - |
| BH108/0-0.2 | *B(a)P – 1.5 (ESL 0.7)* | - |

Note: Locations in italics are located within the previous Stage 1 validation boundary (DP, 2019c) and therefore have been previously remediated.

It is also noted that further surficial asbestos was previously identified within parts of Stage 1 and 2 of the RCR area, including the 'tear drop' shaped area. These areas are summarised in Drawing 4, Appendix A.

The elevated levels of B(a)P (in italics) are not considered to be significant when compared against the higher reliability CRC CARE (2017) guidelines which provides 95% confidence intervals of 21-135 mg/kg (33 mg/kg mean value) for urban, residential and public open space land-use.

The exceedance of metals above the EIL are not considered to be significant given the minor elevated levels, and that they may appropriately managed by using suitability appropriate landscaping materials which meet both the SAC / RAC and any other horticultural requirements, and / or relocation within the site to areas not exposed to ecological risks (e.g., building and road footprints). The relative impact of these exceedances is also considered minor given much of the development will comprise building footprints, roads and pathways with limited landscaping areas.

Statistical analysis of B(a)P TEQ results for all test locations (current and previous) within fill (excluding roadbase samples) using ProUCL Statistical software (refer Appendix C) resulted in a calculated 95% Upper Confidence Limit (UCL) of 1.83 mg/kg which is within the adopted HIL of 4 mg/kg.

The previously detected exceedance of PCB at BH206 is not considered to pose a significant health risk given the minor exceedance (1.6 mg/kg, HIL 1 mg/kg). A 95% UCL of 0.47 mg/kg was calculated for all fill samples with the current site (excluding roadbase) which is within the SAC. Therefore, it is considered that the impact at BH206 is likely to be relatively localised.

It is noted that this RAP should be updated pending the results of the recommended data gap investigation (refer Section 9.4) which may include additional locations and contaminants to those summarised in Table .

## 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

The overall remediation strategy for the site is:

- To ensure that all soils removed from the site are disposed in accordance with an appropriate waste classification or exemption; and
- That all soils remaining within the site as part of the development are assessed as being suitable, from a contamination perspective, for the intended land use.

On the basis of the summary outlined in Section 9.1, and the fact that the bulk of the fill soils will be removed from site under the proposed development (refer Section 4), the remediation strategy outlined in this section applies to the following:

- Contamination that may be identified through the data gap investigation designed to identify changes in site conditions since the previous intrusive investigations;
- Waste classification for surplus soils (e.g., basement excavation and levelling) and / or soils requiring off-site disposal due to contamination and / or other factors;
- Further assessment and / or management of asbestos impacts in soils, as summarised in Table and Drawing 4, Appendix A, if these soils are to be retained on site;
- Assessment and management of fill in relation to any isolated potential health impacts (PCB and carcinogenic PAH), if these soils are to be retained on site;
- Assessment and management of fill in relation to potential ecological impacts, if being retained on site in areas of landscaping. An isolation and delineation process has not been considered due to the distribution of EIL and ESL exceedances across 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 Data Gap Investigation

The PSI (DP, 2020e) recommended conducting a data gap investigation primarily to characterise potential changes in site conditions since conducting the previous intrusive investigations. This may have included disturbance of soils by plant and general earthmoving associated with the use as a construction site compound, which may have changed the distribution of previously identified contaminants e.g., heterogeneously distributed asbestos in soil may have been moved outside of areas shown in Drawing 4, Appendix A. There also exists the potential for impacts from the ongoing construction activities themselves e.g., fuel / oil leaks and from stockpiling, however, these are anticipated to be relatively minor and lower risk.

The data gap investigation is recommended to comprise sampling from a minimum of four test locations within the site, with locations selected to provide adequate spatial coverage and target any higher risk areas.

The outcomes of the data gap investigation as reported in a separate supplementary contamination report may require revision of (or an addendum to) this document to update the contamination status of the site and appropriate adopted remediation approaches.

## 9.5 Typical Remedial Options Available

A number of remedial options were reviewed based on the soil contaminants identified to date (i.e., asbestos, PCB, PAH and EIL/ESL exceedances for nickel, copper, zinc and PAH). 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); 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.

### 9.5.1 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.

This option is however considered applicable in areas where the previous Stage 1 validation report and associated SAS / SAR apply, subject to the outcomes of the data gap investigation.

### 9.5.2 Further Assessment for On-site Re-use

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

#### 9.5.2.1 Asbestos

To assess the suitability of fill impacted (or potentially impacted) with asbestos, an assessment of asbestos concentrations in accordance with 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 and Appendix F 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). Relocation of soils to less sensitive areas of the site is also possible using this process.

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.

#### 9.5.2.2 EIL / ESL Exceedances

At the completion of 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.

### 9.5.3 On-site Treatment of Contaminated Material

On-site treatment of contaminated material within the site may comprise the following:

#### 9.5.3.1 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 assessed for being retained on-site or otherwise as through the process outlined in Section 9.5.2.

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.

#### 9.5.3.2 EIL / ESL Exceedances and Other Contaminants

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

### 9.5.4 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, including excavation for a one level basement, all fill within the basement footprint will be excavated and removed from the site. As such, any materials from these areas that are proposed for on-site burial will most likely have to be planned for burial outside of these areas e.g., in the proposed plaza area.

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

### 9.5.5 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.

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. However, this may be considered an option where retaining impacted fill may not be practicable (i.e., as discussed in Section 9.4.5).

## 9.6 Remediation Approach

### 9.6.1 Hazardous Building Materials

There are currently no structures within the site which are known or are likely to contain asbestos materials. However, should hazardous building materials be identified in structures (e.g., temporary site structures), these will be removed and managed under relevant codes of practices (refer Section 11) and an asbestos removal control plan (ACRP). Any asbestos removal during this process will be documented to be included in the validation reporting requirements as set out in this document.

### 9.6.2 Preferred Remediation Approach

On the basis of the discussion of remediation options above, and taking into account the likely removal of all or most fill from the site due to planned basement excavation, the adopted remediation approach is as follows:

- Conduct a data gap investigation (Section 9.4) to assess potential impacts from recent land uses (i.e., construction site compound);
- Prior to excavation commencing and / or after removal of a sealed surface (e.g., asphaltic concrete), a qualified occupational hygienist will inspect the surface for potential bonded ACM and issue a clearance certificate once clear of visible ACM; and
- Where bonded ACM is observed on the ground surface, e.g., in higher risk areas shown on Drawing 4, Appendix A, a licensed asbestos contractor will remove and double bag the bonded ACM and a qualified occupational hygienist will prepare a clearance report.

In areas of bulk excavation:

- Excavate and dispose existing fill from areas of proposed bulk excavation, under a formal waste classification (not presented within the RAP). Fill across the site has a preliminary waste classification of General Solid Waste - Special Waste (Asbestos), unless further testing shows otherwise; and
- Validate the natural soils / bedrock following fill removal, confirming a VENM classification for those soils requiring further excavation.

In areas outside of bulk excavation:

- Fill in the vicinity of the following locations (as outlined in Section 9.1) is to be delineated, excavated and assessed for off-site disposal under a formal waste classification, due to elevated contaminant concentrations:
  - BH206 (0.3-0.4 m bgl) for PCB; and
  - BH208 (0.3-0.4 m bgl) for PAH.

- Identify areas of higher risk of asbestos in soil, as shown on Drawing 4, Appendix A (including the tear drop area), which have not been removed through bulk excavation. Delineate, excavated and dispose the fill from these areas as General Solid Waste - Special Waste (Asbestos);
- In the remining areas of the site, outside of the bulk excavations, conduct an assessment in accordance with WA DoH (2009) for asbestos concentrations (gravimetric analysis), with the outcome as follows:
- If asbestos concentrations meet the RAC, the soils will be found to be suitable, in terms of asbestos concentrations, to be retained within the site;
- If asbestos concentrations exceed the RAC, but no friable (AF/FA) asbestos is found, the process of "emu picking" may be undertaken as detailed in Section 10.4. The soils will then be re-assessed in accordance with WA DoH (2009); and
- If significant asbestos is found the impacted soils will be removed to landfill under a waste classification.

As discussed in Section 9.1, ecological investigation levels were exceeded for some metals and B(a)P across much of the fill soils. However, the elevated levels of B(a)P are not considered to be significant when compared against the higher reliability CRC CARE (2017) guidelines which provides 95% confidence intervals of 21-135 mg/kg (33 mg/kg mean value) for urban, residential and public open space land-use. Furthermore, the exceedance of metals above the EIL are not considered to be significant given the relatively minor elevated levels.

The reported levels may appropriately be managed by using suitability appropriate landscaping materials which meet both the SAC / RAC and any other horticultural requirements. Alternatively, the shallow fill in landscaping areas can be excavated and removed from site under a formal waste classification.

# 10. Remediation Procedures and Sequence

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 any demolition, excavation 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 9.5.2.

## 10.1 Bulk Excavation Areas

In areas of proposed excavation such as the building footprint, the following waste classification and RRO assessment process will be undertaken.

### 10.1.1 Roadbase

The follow process will apply to roadbase materials:

- Asphalt materials are to be removed separately and disposed of under the assigned pre-classification of General Solid Waste (non-putrescible);
- Roadbase materials and mixtures thereof are to be assessed preferentially under the recovered aggregate RRO (NSW EPA, 2014). Materials complying with the RRO may then be beneficially re-used on site subject to assessment against the SAC / RAC, or alternatively transported off-site for re-use under the RRO and associated resource exemption. In short, this assessment will comprise:
  - Collection of 10 composite samples per every 4,000 tonnes of material; and
  - Analysing of recovered samples for a suite of chemicals and tests as set out in the order including metals, electrical conductivity and foreign materials;
- Alternatively, roadbase materials and mixtures thereof may be tested for disposal under a formal waste classification (refer Section 10.1.2 below), noting that previous testing of similar materials indicated elevated levels of PAH and TRH such that a classification of Restricted Solid Waste or higher may be anticipated.

### 10.1.2 Waste Classification of Fill Materials

If no further assessment of fill materials is to be undertaken (as instructed by the Principal, or Principals representative), such as in areas where stockpiling is not practicable, excavated material will be disposed directly off-site under the preliminary *in-situ* waste classification of General Solid Waste - Special Waste (Asbestos), which will be documented in a formal waste classification report. Visual checks during excavation will be undertaken to confirm the material is consistent with the previously described material (refer Section 5.2.5).

Otherwise fill materials will be stockpiled in manageable quantities to avoid potential cross-contamination, i.e., from identified contamination set out in Section 9.1 and from any un-identified contamination. Assessment of the formed stockpiles will comprise:

- Determine the volume of the stockpile requiring investigation, noting that if survey data is available this will enable more accurate assessment of volume and therefore sampling requirements;
- Visually inspect the surface of the stockpile for bonded ACM;
- Identify the source of the stockpile and conduct a walkover that area;
- Excavate test pits into the stockpile at a rate of 1 per 70 m3 or a minimum of three per stockpile, to assess for the potential presence of asbestos within the stockpile and other risk indicators (i.e., building materials). Noting that if asbestos was previously observed within the source area or on the surface of the stockpile this step may be redundant as a single confirmed fragment will classify the stockpile as Special Waste (asbestos), if so this process may skip to the next bullet point;
- Assessing of recovered samples for chemical contaminants (as identified in the CSM and per waste classification guidelines) using a combination of previous in-situ data and additional recovered samples collected from test pitting into the stockpile at the following rates:
- For stockpiles < 250 m3: 1 sample per 25-50 m3 of material, or minimum of 3; and

- For stockpiles > 250 m3, 1 sample per 100-250 m3, a minimum of 3 or as per the above rate (whichever is the lesser). For large stockpiles it is also recommended to collect and analyse a minimum 3 additional check samples if there is sufficient in-situ data.

Preparation of a letter report by the environmental consultant providing a formal waste classification for with reference to the NSW EPA (2014) *Waste Classification Guidelines*.

If any stockpiled materials are considered for beneficial re-use on-site the same process will apply (as outlined above) in addition to:

- Assessing recovered samples for chemical analytes identified in the CSM against the SAC / RAC at the same rates as outlined above;
- Excavate test pits into the stockpile at a rate of 1 per 70 $m^3$ or a minimum of three per stockpile for analysis of asbestos including:
- 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);
- QA / QC analysis as per industry standards; and
- Preparation of a memorandum by the environmental consultant assessing the suitability of the stockpiled materials for re-use on-site

### 10.1.3 VENM

Following removal of all overlying fill materials the exposed natural materials will be assessed as follows:

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;
- Asbestos (identification only); and
- Inclusion of industry standard QA / QC (refer Section 13.9).

Preparation of VENM classification reports (as required for off-site disposal) as required, or otherwise to be documented in the validation process.

## 10.2 Remaining Areas (Outside Bulk Excavations)

### 10.2.1 Delineation and Remediation of Hot Spots

Identified exceedances of health-based criteria as set out in Sections 9.1 will be managed as follows in areas where bulk excavation is not planned:

- Excavation of soils around the identified location to a nominal 5 x 5 m extent and 0.5 - 1.0 m below the identified depth of contamination (or otherwise advised by the environmental consultant);
- Excavated soils will be stockpiled (where practicable) and assessed for off-site disposal, or otherwise directly disposed of as per Section 10.1.2;
- Visual inspection of the excavation by the environmental consultant;
- Collection of samples from the walls and base of the excavation at a rate of 1 sample per side wall or per 20-25 m, and 1 sample from the base or per 25 m. Noting that larger excavations will require assessment as per sampling rates indicated by NSW EPA sampling design guidelines (NSW EPA, 1995);
- Analysis of recovered samples for a range of contaminants identified in the CSM and / or as per the identified contaminants exceeding the SAC / RAC; and
- QA / QC analysis as per industry standards.

If asbestos is identified as a contaminant of concern (e.g., previously excavated from an area of identified asbestos contamination or as an unexpected find):

- 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).

If recovered samples exceed the SAC / RAC the excavation will be expanded as advised by the environmental consultant and the above steps repeated as necessary.

### 10.2.2 Management of EIL / ESL Exceedances

Locations with exceedances of environmental based SAC / RAC (as outlined in Section 9.1) are currently not considered to pose a significant risk and may be managed in landscaped areas using suitability appropriate landscaping materials which meet both the SAC / RAC and any other horticultural requirements.

Preference should be given to any beneficial re-use of materials outside of these areas / soil strata where practicable.

Alternatively, the shallow fill in landscaping areas can be excavated and removed from site under a formal waste classification as per the process outlined in Section 10.1.2.

### 10.2.3 Retained Fill

Validation of the suitability of the fill remaining within the site will be carried out as follows:

- Test pits will be excavated on a nominal 20 m grid across the fill area, or as required under WA DoH (2009) i.e., in areas with elevated risk of asbestos;
- Samples of fill will be recovered from the surface and at regular depth intervals not exceeding 3 m or a minimum of 0.5 m into natural soils (whichever the lesser);
- Samples will be analysed at minimum for metals, PAH and asbestos (10L sieve and / or gravimetric analysis), and / or as otherwise informed by previous test results;
- The analytical data will be assessed against the RAC, with statistics applied where appropriate; and
- 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 fill will be excavated and removed off site under an assigned waste classification (as detailed in Section 10.1), or, if exceeding only EIL / ESL to be managed as per Section 10.2.2

## 10.3 Additional Asbestos Finds

If suspected asbestos materials are encountered during works:

- 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 e.g., “Danger Asbestos - Do Not Enter”;
- Licensed asbestos assessor (LAA) / environmental consultant to inspect / sample the material to confirm if asbestos or not;
- If asbestos; the Asbestos Contractor will continue to remove the ACM (once all hazards & risks assessed) e.g. as outlined in section 10.2.1 , decontaminate area, obtain clearance certificate from LAA and dispose of material to a licensed landfill facility (refer Section 13.6) , in accordance with an ARCP;
- LAA to inspect the area confirm that no other unidentified asbestos present;
- Environmental consultant to inspect area and / or review documentation to assess if additional targeted delineation and validation is required; and
- Following issue of a clearance certificate and the recommendations of the environmental consultant, workers can resume work under normal conditions.

## 10.4 Emu Picking

If emu picking of bonded ACM is determined by the Environmental Consultant to be an appropriate process to adopt to allow for fill soils to be retained, the emu picking process (if adopted) and validation will be as set out below. This process may be applicable in areas where assessment of fill to be retained exceeds the SAC / RAC for asbestos.

a) Designation by the client of a location for the spreading and treatment of the impacted soils or otherwise the demarcation of an *in-situ* area, with appropriate signage and isolation from nearby work areas. 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 (if to be relocated);

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 (if stockpiled) 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 or *in-situ* area in accordance with Section 10.1 or 10.2.3.

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

## 10.5 Burial and Capping

It is highly unlikely that any contaminated soils will be retained on-site under a burial and capping scenario. The process outlined in this section is considered only as a contingency if such a process is deemed viable.

Any soils identified to require on-site retention beneath the physical barrier (capping) system may 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 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.

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.

Figures 2 and 3 below illustrate generic capping designs for asbestos contaminated materials under hardstand areas or for deeper service trenches. If burial and capping is adopted more detailed and site specific designs will need to be developed.

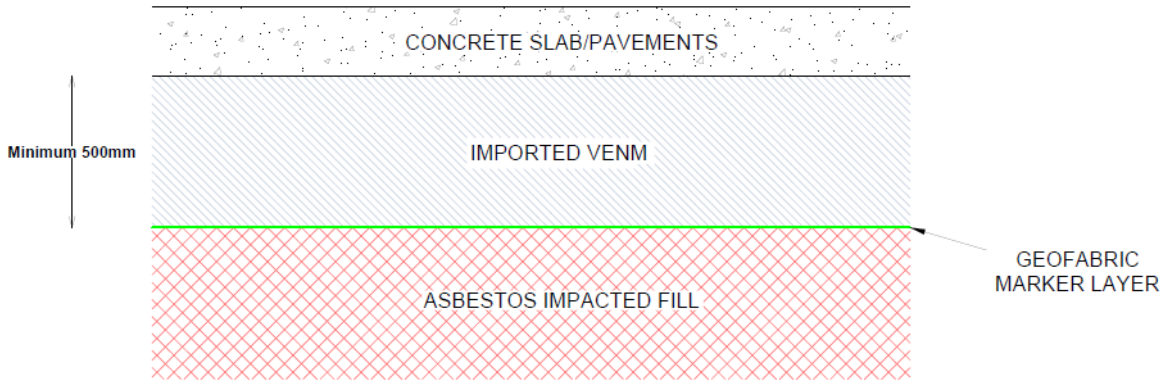



**Figure 2. Typical capping cross section for asbestos impacted materials**

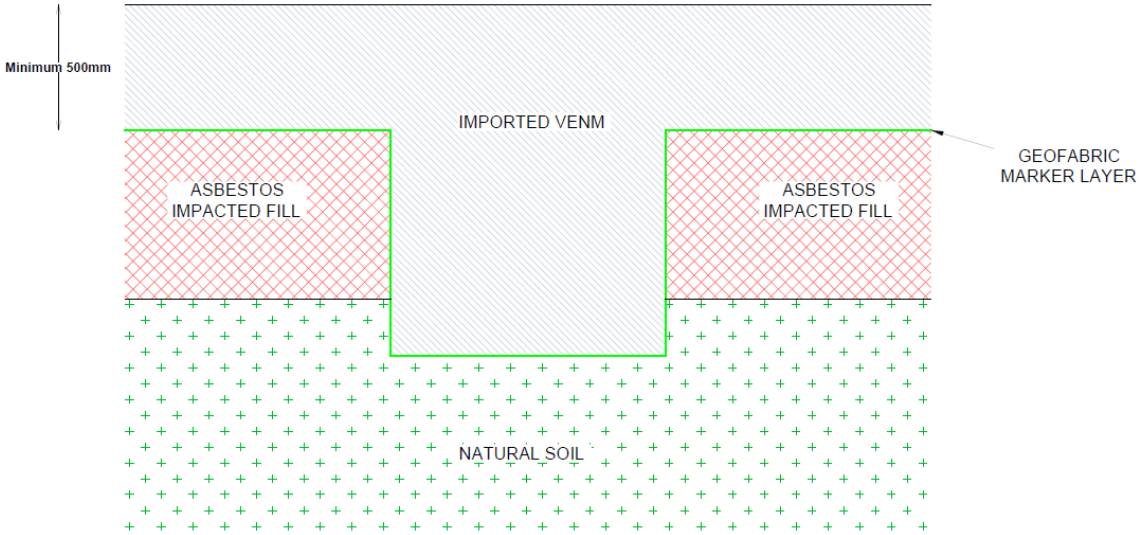



**Figure 3. Typical capping cross section for deeper services trenches with asbestos impacted materials. Noting that further civil design requirements are likely to apply to the design.**

## 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;
- The entity / person who commissioned the asbestos removal work; and
- 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 SafeWork 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

Asbestos air monitoring during the remediation and civil works is recommended given the finds of ACM during previous investigations, the prevalence of asbestos in the former buildings on site and the sensitivity of nearby receptors (residential and hospital).

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 hot spots of identified contaminated soil or an unexpected find of contaminated fill is removed from the site, systematic validation samples are to be collected from the remedial excavations as set out in Section 10.2.1.

## 13.3 Stockpiles

Validation of the suitability of stockpiles to be retained within the site will be conducted as per Section 10.1.

## 13.4 Fill to be Retained

Given the disturbance of soils during ongoing construction works any fill remaining within the site will be assessed for suitability to be retained in the landscaped areas outside the excavation areas (HRL and basements). Validation of the suitability of the fill remaining within the site will be carried out as per Section 10.2.3.

## 13.5 Virgin Excavated Natural Material Assessment

A VENM classification of natural materials will be required in areas where fill has been removed and deeper excavation is proposed (such as for basements, Hospital Road excavation or services). The

Environmental Consultant will conduct an assessment of the natural soils for VENM classification compliance as per Section 10.1.3.

## 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 set out in Section 10.1.

## 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:

- VENM; or
- Materials complying with a RRO allowing land application; and
- Meeting the site acceptance criteria.

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

- Contractor 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 (check) samples of the material either on site or at the source site, at a rate of two samples (minimum) per source site or as otherwise advised based on the supplied documentation;
- 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, analysed at minimum for metals and PAH or otherwise for the same suite of contaminants as the primary sample;
- 5% Inter-laboratory replicate samples, analysed at minimum for metals and PAH or otherwise for the same suite of contaminants 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 13.8.

### 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;
- 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; and
- Any other records of relevant works as set out in this document such as air monitoring reports, asbestos clearance records, unexpected finds documentation, etc.;

### 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, including *inter alia*:

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

- Source site documentation and testing data for imported materials;
- Notifications, licences and qualifications associated with the works;
- Asbestos air monitoring results;
- Asbestos clearance certificates;
- Water disposal (post treatment) monitoring results;
- Material tracking for imported materials and those disposed off-site as well as (i) classification of any exported wastes and or (ii) classification of any imported materials under RROs;
- Survey documentation;
- General site management documentation associated with implementation of the environmental management plans; 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 EPA *Consultants reporting on contaminated Land: Contaminated land guidelines* (NSW EPA, 2020) 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. Roles and Responsibilities

**Principal**

The Principal (i.e. the tenant - UNSW) 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 (TBC), 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 (i.e. the Principals representative) 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 SafeWork NSW. 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.

**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 SafeWork 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 9;
- Undertake all validation assessment work, including inspections, sampling and reporting outlined in Section 10 & 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 or updated as relevant personnel are appointed to the project.

**Table 7: Contact Details**

| Role | Personnel / Contact | Contact Details (phone) |
|---|---|---|
| Principal | UNSW | |
| Principal Contractor | TBC | |
| Site Manager | | |
| Environmental Consultant | Douglas Partners | Paul Gorman (0427 949 878) |
| 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.

## 15. Conclusions

It is considered that UNSW HTH 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.

## 16. References

CRC CARE. (2011). *Health screening levels for petroleum hydrocarbons in soil and groundwater.* Parts 1 to 3, Technical Report No. 10: Cooperative Research Centre for Contamination Assessment and Remediation of the Environment.

CRC CARE. (2017). *Risk-based Management and Remediation Guidance for Benzo(a)pyrene.* Technical Report no. 39: Cooperative Research Centre for Contamination Assessment and Remediation of the Environment.

DP. (2018). *Report on Preliminary Site Investigation for Contamination. Randwick Campus Redevelopment, Hospital Road and High, Magill and Botany Streets Randwick.*

DP. (2019a). *Report on Detailed Site Investigation. Randwick Campus Redevelopment. Bound by High, Magill Hospital and Botany Streets, Randwick. Ref: 72505.14.R.001.Rev1.*

DP. (2019b). *Remediation Action Plan. Randwick Campus Development, Stage 1 and IASB Additional. Botany and Magill Streets, and Hospital Road, Randwick. Ref 72505.14.R.002.Rev9.*

DP. (2019c). *Report on Stage 1 Validation. Randwick Campus Redevelopment, Botany Street, Randwick. Ref 72505.15.R.039.Rev0.*

DP. (2019d). *Report on Detailed Site Investigation. IASB Addition - Randwick Campus Redevelopment, Hospital Road, Randwick. Ref 72505.16.R.001.Rev0.*

DP. (2019e). *Stage 2 In-Situ Waste Classification Assessment, Prince of Wales Hospital Redevelopment, Randwick Bounded by High Street and Hospital Road, Randwick.*

DP. (2020a). *Report on Preliminary Site Investigation for Contamination. SCH / CCCC, Randwick Campus Redevelopment Hight Street and Hospital Road, Randwick.*

DP. (2020b). *Assessment of Central "Tear Drop" Area. Randwick Campus Redevelopment Project, Prince of Wales Hospital, Randwick.*

DP. (2020b). *Report on Preliminary Site Investigation for Contamination. SCH / CCCC Randwick Campus Redevelopment, Hight Street and Hospital Road, Randwick.*

DP. (2020c). *Report on Detailed Site Investigation for Contamination, SCH / CCCC Randwick Campus Redevelopment, Hospital Road, Randwick. Ref 72505.19.R.002.Rev0.*

DP. (2020c). *Report on Detailed Site Investigation for Contamination. SCH / CCC Randwick Campus Redevelopment, High Street and Hospital Road Randwick.*

DP. (2020e). *Report on Preliminary Site Investigation for Contamination, HTH, Randwick Campus Redevelopment, High and Botany Streets, Randwick.*

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) [NEPM].* Australian Government Publishing Services Canberra: National Environment Protection Council.

NSW DUAP/EPA. (1998). *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land .* NSW Department of Urban Affairs and Planning / Environment Protection Authority.

NSW EPA. (1995). *Contaminated Sites, Sampling Design Guidelines.* NSW Environment Protection Authority.

NSW EPA. (2004). *Chemical Control Order in Relation to Scheduled Chemical Wastes.*

NSW EPA. (2014). *Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, The recovered aggregate order 2014.* NSW Environment Protection Authority.

NSW EPA. (2014). *Waste Classification Guidelines, Part 1: Classifying Waste.* NSW Environment Protection Authority.

NSW EPA. (2014). *Waste Classification Guidelines, Part 2: Immobilisation of Waste.* NSW Environment Protection Authority.

NSW EPA. (2017). *Guidelines for the NSW Site Auditor Scheme (3rd Edition).* NSW Environment Protection Authority.

NSW EPA. (2020). *Consultants reporting on contaminated Land: Contaminated land guidelines.*

NSW EPA. (2020). *Guidelines for Consultants Reporting on Contaminated Land.* Contaminated Land Guidelines: NSW Environment Protection Authority.

Olszowy, H., Imray P, P., & Torr, P. (1995). Trace element concentrations in soils from rural and urban areas of Australia. . *Contaminated Sites Monograph No. 4.*

WA DoH. (2009). *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.* WA Department of Health.

## 17. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for the Health Translation Hub Project at High and Botany Streets, Randwick in accordance with DP's proposal (SYD200971.P.001.Rev0 dated 11 September 2020 and email correspondence 3 December 2020 ) and acceptance received from University of New South Wales (email by Amber Greenhalgh, dated 1 October 2020 and 3 December 2020). The work was carried out under an agreement with University of New South Wales, dated 30 October 2020). This report is provided for the exclusive use of University of New South Wales for this project only and for the purposes as described in the report. It should not be used for other projects 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.
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. Building demolition materials, such as concrete, brick, tile were, however, located in previous below-ground filling within the RCR area and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

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. It is therefore considered possible that HBM, 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.

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 Comments 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 (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

**Douglas Partners Pty Ltd**

# Appendix A

Notes About this Report

Drawings

# About this Report

Douglas Partners

## Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

## Copyright



## Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

## Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

## Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# *About this Report*

## Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

## Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

## Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.


LOCALITY MAP

Notes:
1. Basemap from nearmap.com (dated 02/08/2020)

Legend

- UNSW HTH Boundary (the site)
- SCH Stage 1 and the CCCC Assessment Boundary
- IASB Boundary
- IASB Addition Area
- RCR Stage 1 Area
- RCR Stage 2 Area
- Stormwater Easement

0 20 40 60 80 100 m

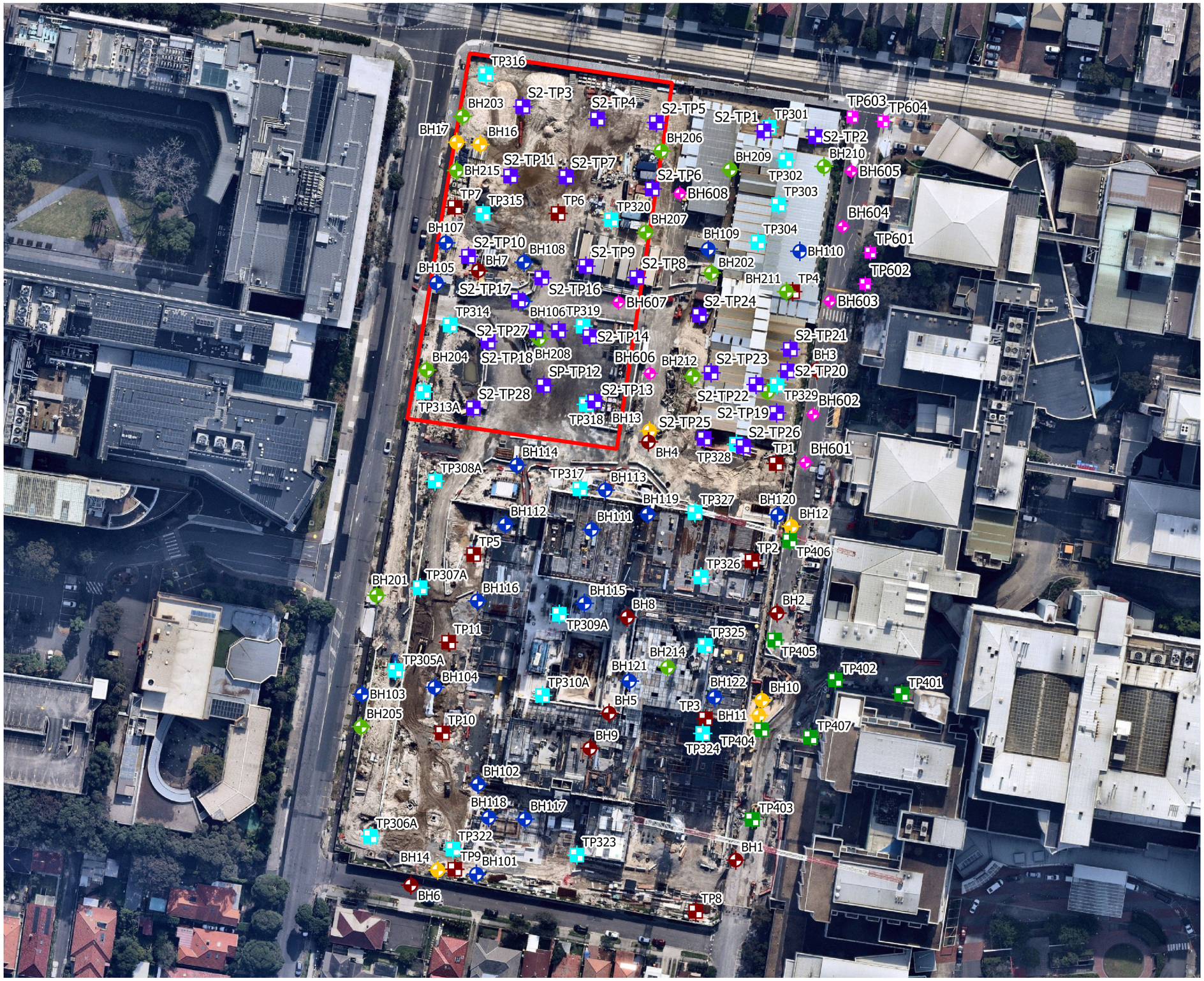
Douglas Partners
Geotechnics / Environment / Groundwater

| | | | |
|---|---|---|---|
| CLIENT: | University of New South Wales | | |
| OFFICE: | Sydney | DRAWN BY: | JJH |
| SCALE: | 1:1500 @A3 | DATE: | 02.02.2021 |

TITLE: **Site Locality**
**UNSW HTH - Randwick Campus Redevelopment**
**Hospital Road and High, Magill and Botany Streets, Randwick, NSW**

N

| | |
|---|---|
| PROJECT No: | 99852.01 |
| DRAWING No: | 1 |
| REVISION: | 1 |





Notes:
1. Basemap from nearmap.com (dated 08/02/2020)

## Legend

- UNSW HTH Boundary (the site)
- DP Environmental borehole (PSI, DP 2018)
- DP borehole location (PSI,DP 2018)
- DP borehole location (DSI, DP 2019a)
- DP test pit location (DSI, DP 2019a)
- Post Demolition Test Pit (DSI, DP 2019)
- IASB Addition Sample Locations (DP 2019d)
- Existing Groundwater Wells
- Stage 2 Waste Classification Test Pits (DP 2019e)
- Hospital Road Test Pits (DP 2020b)
- Current SCH Stage 1 and the CCCC boreholes (DP 2020b)

0 25 50 75 m

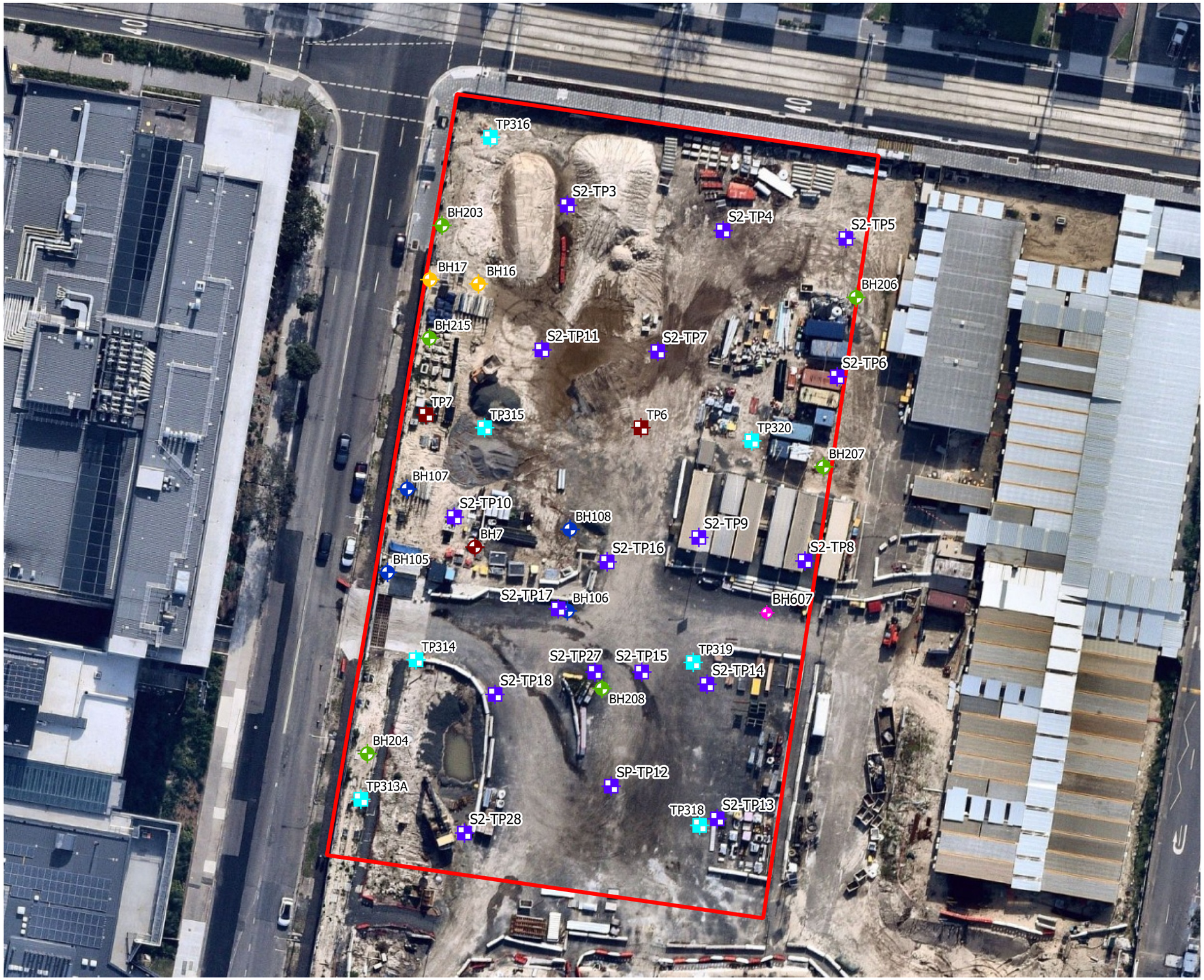
Douglas Partners
Geotechnics / Environment / Groundwater

| | | | |
|---|---|---|---|
| CLIENT: | University of New South Wales | | |
| OFFICE: | Sydney | DRAWN BY: | JJH |
| SCALE: | 1:1250 @ A3 | DATE: | 02.02.2021 |

TITLE: **Previous Test Locations**
**UNSW HTH - Randwick Campus Redevelopment**
**Hospital Road, High and Magill Streets, Randwick NSW**

N

| | |
|---|---|
| PROJECT No: | 99852.01 |
| DRAWING No: | 2 |
| REVISION: | 1 |




LOCALITY MAP

Notes:
1. Basemap from nearmap.com (dated 08/02/2020)

## Legend

- UNSW HTH Boundary (the site)
- Current SCH Stage 1 and the CCCC Boreholes (DP 2020b)
- DP Environmental borehole (PSI, DP 2018)
- DP borehole location (PSI,DP 2018)
- DP borehole location (DSI, DP 2019a)
- DP test pit location (DSI, DP 2019a)
- Post Demolition Test Pit (DSI, DP 2019)
- Existing Groundwater Wells
- Stage 2 Waste Classification Test Pits (DP 2019e)

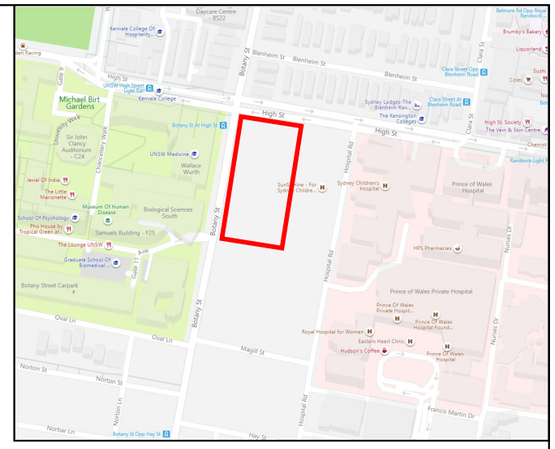
0 10 20 30 40 m

**Douglas Partners**
*Geotechnics / Environment / Groundwater*

| | | | |
|---|---|---|---|
| CLIENT: | University of New South Wales | | |
| OFFICE: | Sydney | DRAWN BY: | JJH |
| SCALE: | 1:600 @ A3 | DATE: | 02.02.2021 |

TITLE: **Previous Test Locations (within the site only)**
**UNSW HTH - Randwick Campus Redevelopment**
**Hospital Road, High and Magill Streets, Randwick NSW**

| | |
|---|---|
| PROJECT No: | 99852.01 |
| DRAWING No: | 3 |
| REVISION: | 1 |


LOCALITY MAP

Notes:
1. Basemap from nearmap.com (dated 02/08/2020)

## Legend

- UNSW HTH Boundary (the site)
- Stormwater Easement
- Remediated Asbestos Hot Spot (DP 2019b)
- Previous Surficial ACM Finds (DP 2019a)
- "Tear drop" area (soils may contain asbestos)
- DP Environmental borehole (PSI, DP 2018)
- DP test pit location (DSI, DP 2019)
- Post Demolition Test Pit (DSI, DP 2019)
- ACM observed at test location/during seiving (0 - 0.2 m depth) (DP 2019a)
- ACM observed at test location/during seiving (0.4 - 0.5 m depth) (DP 2019a)

0 10 20 30 40 50 m

Douglas Partners
Geotechnics / Environment / Groundwater

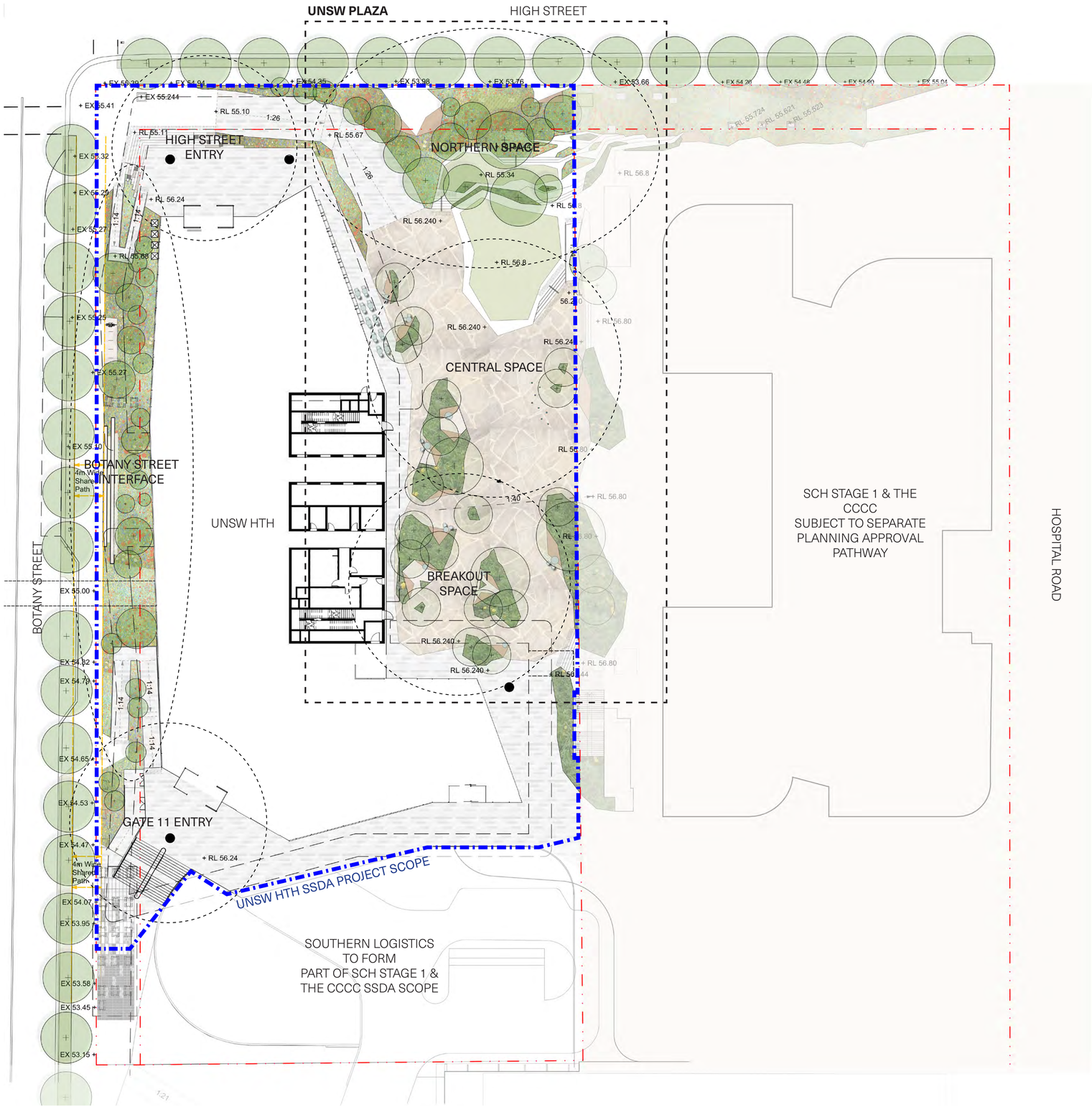
| | | | |
|---|---|---|---|
| CLIENT: | University Of New South Wales | | |
| OFFICE: | Sydney | DRAWN BY: | JJH |
| SCALE: | 1:750 @A3 | DATE: | 02.02.2021 |

TITLE: **Previous Asbestos Finds**
**UNSW HTH - Randwick Campus Redevelopment**
**Hospital Road and High, Magill and Botany Streets, Randwick, NSW**

N

| | |
|---|---|
| PROJECT No: | 99852.01 |
| DRAWING No: | 4 |
| REVISION: | 1 |

# Site Plan




# Drawing List

| Drawing Number | Drawing Name | Scale | Revision |
|---|---|---|---|
| 20084_SSDA-001 | Site Plan | 1:300 @A1 | Draft |
| 20084_SSDA-002 | Northern Space Plan | 1:150 @A1 | Draft |
| 20084_SSDA-003 | Northern Space Sections | 1:200 @A1 | Draft |
| 20084_SSDA-004 | Northern Space Perspective | NTS | Draft |
| 20084_SSDA-005 | Central Space Plan | 1:150 @A1 | Draft |
| 20084_SSDA-006 | Central Space Sections | 1:200 @A1 | Draft |
| 20084_SSDA-007 | Central Space Perspective | NTS | Draft |
| 20084_SSDA-008 | Breakout Space Plan | 1:150 @A1 | Draft |
| 20084_SSDA-009 | Breakout Space Sections | 1:200 @A1 | Draft |
| 20084_SSDA-010 | Breakout Space Perspective | NTS | Draft |
| 20084_SSDA-011 | High Street Entry Plan | 1:150 @A1 | Draft |
| 20084_SSDA-012 | High Street Entry Sections | 1:200 @A1 | Draft |
| 20084_SSDA-013 | High Street Entry Perspective | NTS | Draft |
| 20084_SSDA-014 | Botany St Plan | 1:150 @A1 | Draft |
| 20084_SSDA-015 | Botany St Sections | 1:200 @A1 | Draft |
| 20084_SSDA-016 | Gate 11 Entry Plan | 1:150 @A1 | Draft |

0 3 4 6 8 10 M

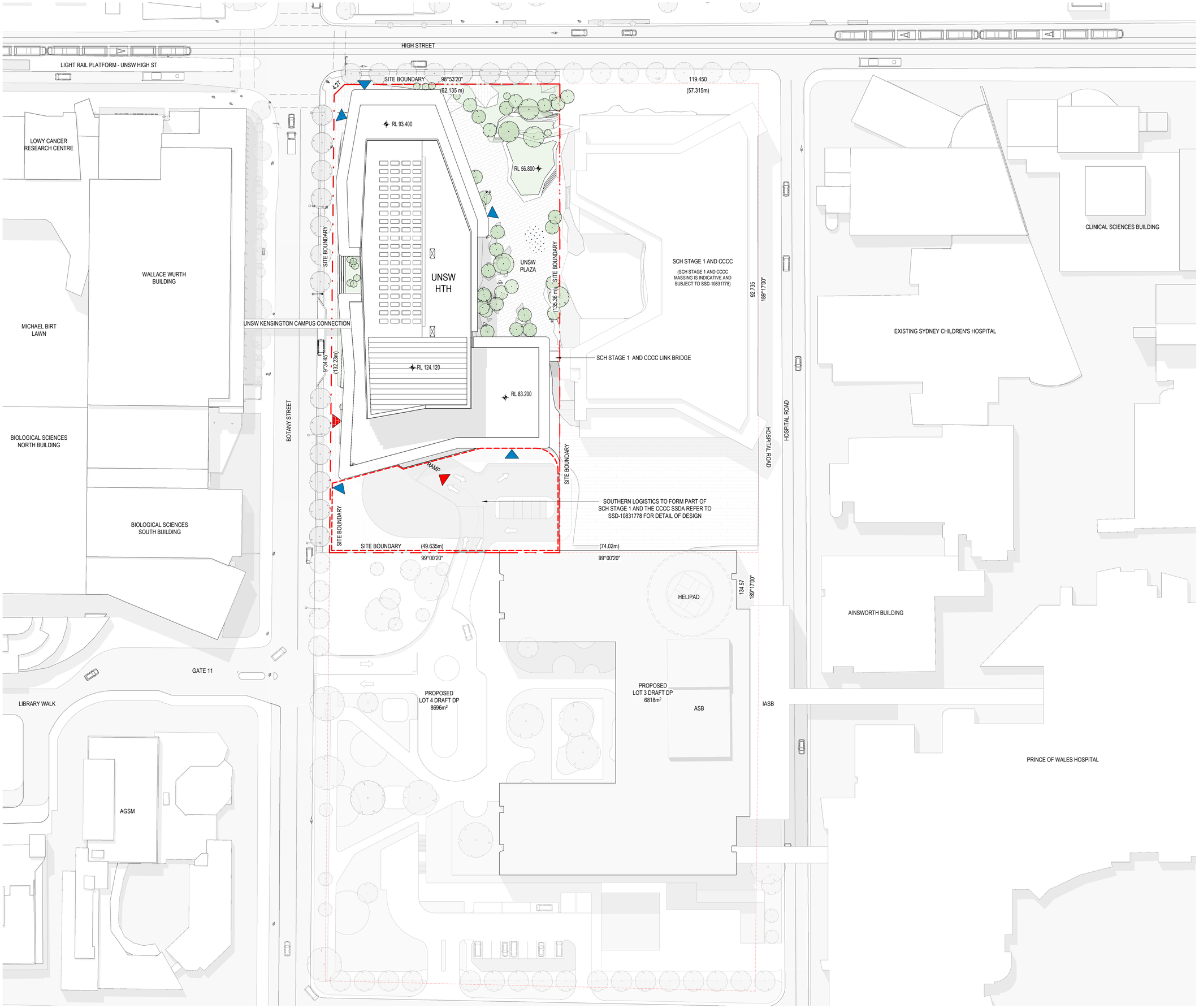
# UNSW Health Translation Hub Public Domain

State Significant Development Application | DRAFT

UNSW SYDNEY

ASPECT Studios™

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Client | UNSW | Drawn | DB \| GK | Scale | 1:300 | Dwg. | 20084_SSDA-001 |
| Architect | Architectus | Checked | AW | Date | 01.03.21 | Rev. | F |






Nominated Architect
Ray Brown, NSWARB 6359

**Do not scale drawings. Verify all dimensions on site**

| issue | amendment | date |
|---|---|---|
| A | ISSUED FOR STATE SIGNIFICANT DEVELOPMENT APPLICATION | 18.02.21 |

GENERAL NOTES:

- DO NOT SCALE FROM THE DRAWINGS, USE ONLY FIGURED DIMENSIONS.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
- REDUCED LEVELS (RL) ARE TO AUSTRALIAN HEIGHT DATUM (AHD). COORDINATES ARE TO MAP GRID AUSTRALIA (MGA).
- THE ARCHITECTURAL DOCUMENTATION IS ONLY ALLOWED TO BE USED FOR THE PURPOSE FOR WHICH IT WAS COMMISSIONED. UNAUTHORISED USE OF THE DOCUMENTATION IS PROHIBITED.

ROAD INFRASTRUCTURE LEGEND

- SOUTHERN LOGISTICS TO FORM PART OF SCH STAGE 1 AND THE CCCC SSDA REFER TO SSD-10831778 FOR DETAIL OF DESIGN

GROUND ENTRY POINT

BASEMENT ENTRY POINT

**Scale:**
1:500 @ A1
1:1000 @ A3

0 5 10 15

architectus™

UNSW SYDNEY

**ABN 90 131 245 684**

project

UNSW Health Translation Hub

drawing

Site Plan

| | | | |
|---|---|---|---|
| scale | 1 : 500@A1 | drawing no. | **DA0020** |
| drawn | TH | | |
| checked | JC | issue | **A** |
| project no | 190551.00 | | |

**22/02/2021 6:28:48 PM**

# Appendix B

Site Assessment Criteria / Remediation Acceptance Criteria

# Site Assessment Criteria / Remediation Acceptance Criteria

## S1. Soil Investigation Levels

### S1.1 Health Investigation 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. Site-specific conditions may determine the depth to which HILs 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.

The generic HIL and HSL are considered to be appropriate for the assessment of contamination at the site. Given the proposed land use and based on the CSM the adopted HIL and HSL are:

- **HIL-B & HSL-B** – Residential (hospital)
- **HIL-D & HSL D** – Commercial Industrial (proposed roads)

Health screening levels for the vapour intrusion pathway have been conservatively adopted.

Table S1 shows the HILs that have been adopted by NEPC (2013) Schedule B1, Table 1A(1). Table S1 only includes contaminants to be analysed during the current investigations and contaminants adopted as initial screening indicators, not the full list provided in NEPC (2013).

**Table S1: Health Investigation Levels**

| Contaminant | HIL B (mg/kg) | HIL D (mg/kg) |
|---|---|---|
| **Metals and Inorganics** | | |
| Arsenic | 500 | 3,000 |
| Cadmium | 150 | 900 |
| Chromium (IV) | 500 | 3,600 |
| Copper | 30,000 | 240,000 |
| Lead | 1,200 | 1,500 |
| Mercury (inorganic) | 120 | 730 |
| Nickel | 1,200 | 6,000 |
| Zinc | 60,000 | 400,000 |

| Contaminant | HIL B (mg/kg) | HIL D (mg/kg) |
|---|---|---|
| **PAH** | | |
| Carcinogenic PAH (as benzo(a)pyrene TEQ) [1] | 4 | 40 |
| Total PAH | 400 | 4,000 |
| **Phenols** | | |
| Pentachlorophenol (used as an initial screen) | 130 | 660 |
| **OCP** | | |
| DDT + DDD + DDE | 600 | 3,600 |
| Aldrin + Dieldrin | 10 | 45 |
| Chlordane | 90 | 530 |
| Endosulfan (total) | 400 | 2,000 |
| Endrin | 20 | 100 |
| Hepatchlor | 10 | 50 |
| HCB | 15 | 80 |
| Methoxychlor | 500 | 2,500 |
| **Other Pesticides** | | |
| Chlorpyrifos | 340 | 2,000 |
| **Other Organics** | | |
| PCB [2] | 1 | 7 |

Notes:

1 Sum of carcinogenic PAH.

2 Non dioxin-like PCBs only.

Table S2 shows petroleum hydrocarbon compounds adopted from NEPC (2013) Schedule B1, Table 1A(3). The HSLs are based on overlying soil type and depth. Vapour intrusion HSLs for sand) have been used based on the fill encountered at the site (refer to borehole logs, Appendix E). Given the general depth of fill encountered in the investigation during the intrusive works, and using the most conservative values, the depth range of 0 m to <1 m has been used.

**Table S2: Soil Health Screening Levels for Vapour Intrusion**

| Contaminant | Soil Type | HSL A & B – Vapour Intrusion (mg/kg) | HSL D – Vapour Intrusion (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 | 3 |
| TRH $C_6$-$C_{10}$ less BTEX [F1] | | 40 | 260 |
| TRH >$C_{10}$-$C_{16}$ less naphthalene [F2] | | 230 | NL |

Notes: NL Not limiting

Direct contact HSL have been adopted from the CRC Care Technical Report No. 10 (Friebel and Nadebaum 2019) and are summarised in below Table S3.

**Table S3: Soil Health Screening Levels for Direct Contact**

| Contaminant | HSL B – Direct Contact (mg/kg) | HSL D – Direct Contact (mg/kg) |
|---|---|---|
| Toluene | 21,000 | 99,000 |
| Ethylbenzene | 5,900 | 27,000 |
| Xylenes | 17,000 | 81,000 |
| Naphthalene | 2,200 | 11,000 |
| Benzene | 140 | 430 |
| $C_6$ – $C_{10}$ | 5,600 | 26,000 |
| $C_{10}$-$C_{16}$ | 4,200 | 20,000 |
| $C_{16}$-$C_{34}$ | 5,800 | 27,000 |
| $C_{34}$-$C_{40}$ | 8,100 | 38,000 |

## S1.2 Ecological Investigation and Screening Levels

Ecological Investigation Levels (EIL) have been derived for selected metals and organic compounds and are applicable for assessing risk to terrestrial ecosystems (NEPC, 2013). EIL depend on specific soil physiochemical properties and land use scenarios and generally apply to the top 2 m of soil, which corresponds to the root zone and habitation zone of many species. The EIL is determined for a contaminant based on the sum of the ambient background concentration (ABC) and an added

contaminant limit (ACL). The ABC of a contaminant is the soil concentration in a specific locality that is the sum of naturally occurring background levels and the contaminants levels that have been introduced from diffuse or non-point sources (e.g., motor vehicle emissions). The ACL is the added concentration (above the ABC) of a contaminant above which further appropriate investigation and evaluation of the impact on ecological values is required.

The EIL is calculated using the following formula:

EIL = ABC + ACL

The ABC is determined through direct measurement at an appropriate reference site (preferred) or through the use of methods defined by Olszowy et al *Trace element concentrations in soils from rural and urban areas of Australia*, Contaminated Sites monograph no. 4, South Australian Health Commission, Adelaide, Australia 1995 (Olszowy, 1995) or Hamon et al, *Geochemical indices allow estimation of heavy metal background concentrations in soils*, Global Biogeochemical Cycles, vol. 18, GB1014, (Hamon, 2004). ACL is based on the soil characteristics of pH, CEC and clay content.

EIL (and ACLs where appropriate) have been derived in NEPC (2013) for only a short list of contaminants comprising As, Cu, Cr (III), DDT, naphthalene, Ni, Pb and Zn. An *Interactive (Excel) Calculation Spreadsheet* may be used for calculating site-specific EIL for these contaminants, and has been provided in the ASC NEPM Toolbox available on the NEPC website (http://www.nepc.gov.au/nepms/assessment-site-contamination/toolbox).

The adopted EIL, derived from the *Interactive (Excel) Calculation Spreadsheet* are shown in the following Table S4. 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 2.1 $cmol_c$/kg and pH of 6.1 with high traffic and clay content of 15%

**Table S4: Ecological Investigation Levels (EIL) in mg/kg**

| Analyte | | EIL (Urban residential and public open space) | EIL (Commercial Industrial) | Comments |
|---|---|---|---|---|
| **Metals** | Arsenic | 100 | 160 | Adopted averaged pH of 6.1 and CEC of 2.1 $cmol_c$/kg based on current and previous results; approximate clay content 1% (refer to borehole logs, Appendix E), high traffic area (NSW). |
| | Chromium III | 470 | 770 | |
| | Copper | 65 | 80 | |
| | Lead | 1,100 | 1800 | |
| | Nickel | 9 | 10 | |
| | Zinc | 240 | 300 | |

| Analyte | | EIL (Urban residential and public open space) | EIL (Commercial Industrial) | Comments |
|---|---|---|---|---|
| **PAH** | Naphthalene | 170 | 370 | |
| **OCP** | DDT | 180 | 640 | |

Ecological Screening Levels (ESL) are used to assess the risk of selected petroleum hydrocarbon compounds, BTEX and benzo(a)pyrene to terrestrial ecosystems. ESL apply to the top 2 m of the soil profile as for EIL.

ESL have been derived in NEPC (2013) for petroleum fractions F1 to F4 as well as BTEX and Benzo(a)pyrene. Site specific data and assumptions as summarised in Table S5 have been used to determine the ESL. The adopted ESL, from Table 1B(6), Schedule B1 of NEPC (2013) are shown in Table S6.

**Table S5: Inputs to the Derivation of ESL**

| Variable | Input | Rationale |
|---|---|---|
| Depth of ESL application | Top 2 m of the soil profile | The top 0 - 1 m depth below ground level corresponds to the root zone and habitation zone of many species. |
| Land use | Commercial / Industrial | Site is proposed/used for a road, loading docks and associated infrastructure for the adjacent hospital |
| Soil Texture | Coarse | Based on findings noted in the borehole logs (refer to Appendix E). |

**Table S6: Ecological Screening Levels (ESL) in mg/kg**

| Analyte | | ESL (urban residential and public open space) | ESL (commercial and industrial) | Comments |
|---|---|---|---|---|
| **TRH** | C6 – C10 (less BTEX) [F1] | 180* | 215* | All ESLs are low reliability apart from those marked with * which are moderate reliability |
| | >C10-C16 (less Naphthalene) [F2] | 120* | 170* | |
| | >C16-C34 [F3] | 300 | 1,700 | |
| | >C34-C40 [F4] | 2,800 | 3,300 | |
| **BTEX** | Benzene | 50 | 75 | |
| | Toluene | 85 | 135 | |
| | Ethylbenzene | 70 | 165 | |
| | Xylenes | 105 | 180 | |
| **PAH** | Benzo(a)pyrene | 0.7 | 1.4 | |

In addition, given the low reliability of the benzo(a)pyrene ESL in NEPC (2013) reference has been made to Table 11 of the CRC Care Technical Report No.39 *Risk-Based Remediation Guidance for Benzo(a)pyrene* March 2017 (CRC, 2017). CRC (2017) indicates a high reliability ecological guideline for fresh B(a)P of 33 mg/kg (and 95% confidence interval range of 21 mg/kg to 135 mg/kg) for urban residential and public open space.

## S1.3 Management Limits

NEPC (2013) Table 1B(7) provides 'management limits' for TRH fractions, which are applied after consideration of relevant HSLs. The management limits have been adopted to avoid or minimise the following potential effects of petroleum hydrocarbons:

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

The presence of site TRH contamination at the levels of the management limits does not imply that there is no need for administrative notification or controls in accordance with jurisdictional requirements. The adopted management limits are presented in Table S7 based upon the CSM and encountered subsurface conditions. Coarse texture management limits have been adopted based on findings noted in the borehole logs (refer to Appendix E).

**Table S7: Management Limits for TRH Fractions in Soil in mg/kg**

| TRH Fraction | Soil Texture | Management Limits (residential, parkland and public open space) | Management Limits (commercial and industrial) |
|---|---|---|---|
| $C_6$-$C_{10}$ [F1] | Coarse | 700 | 700 |
| >$C_{10}$-$C_{16}$ [F2] | Coarse | 1,000 | 1,000 |
| >$C_{16}$-$C_{34}$ [F3] | Coarse | 2,500 | 3,500 |
| >$C_{34}$-$C_{40}$ [F4] | Coarse | 10,000 | 10,000 |

## S1.4 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;
- Commonly occurring in historical fill containing unsorted demolition materials; and

- Importation of asbestos contaminated building products from China.

Mining, manufacturing or distribution of asbestos products may result in sites being contaminated by friable asbestos including free fibres. Severe weathering or damage to bonded ACM may also result in the formation of friable asbestos comprising fibrous asbestos (FA) and / or asbestos fines (AF).

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.

NEPC (2013) Table 7 provides health screening levels for asbestos in soil which are based on scenario-specific likely exposure levels, adopted from the WA DoH (2007) guidelines, summarised below in Table **S8**.

**Table S8: Health screening levels for asbestos in soil (w/w %)**

| Form of asbestos | Health Screening Level (Residential B) | Health Screening Level (Commercial/Industrial D) |
|---|---|---|
| Bonded ACM | 0.04 % | 0.05 % |
| FA and AF | 0.001 % | |
| All forms of asbestos | No visible asbestos for surface soil | |

In the event limited sample quantity is available due to sampling methods, access restrictions and / or due to the relatively lower risk of asbestos being present (e.g. natural soils), the presence of asbestos will be adopted at the laboratory reporting limit of 0.1 g/kg as an initial screen.

## S1.5 Groundwater

The potential receptors of impacted groundwater from the site include:

- Workers conducting excavations, construction or maintenance works within the site or nearby the site; and
- Receiving down-gradient groundwater body (freshwater)

### S1.5.1 Groundwater Investigation Levels

Groundwater investigation levels (GIL) adopted in NEPC (2013) are based on the ANZECC & ARMCANZ (2000) water quality guidelines, however, it is noted that the ANZECC & ARMCANZ (2000) guidelines have since been superseded by the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). Accordingly, groundwater analytical results have been assessed against the ANZG (2018) guidelines for this investigation. The 95% Level of Protection (LOP) has been

adopted with the exception of contaminants with the potential to bioaccumulate, which have been assessed with reference to the 99% LOP.

The adopted GIL for the analytes included in the assessment (where applicable), and the corresponding source documents, are shown in Table S9 below.

**Table S9: Groundwater Investigation Levels**

| Contaminant | GIL, Marine Waters (mg/L) ANZG (2018) |
|---|---|
| **Metals** | |
| Arsenic (III/IV) | 24/42 |
| Cadmium | 0.2 |
| Chromium (III/IV) | 3.3/1 |
| Copper | 1.4 |
| Lead | 3.4 |
| Mercury (inorganic) | 0.06 |
| Nickel | 11 |
| Zinc | 8 |
| **BTEX** | |
| Benzene | 950 |
| Toluene | 180 |
| Ethylbenzene | 80 |
| m- / p-Xylene | 75 / 200 |
| o Xylene | 350 |
| **PAH** | |
| benzo(a)pyrene | 0.0001 |
| naphthalene | 0.016 |
| **Phenols** | |
| Pentachlorophenol (used as an initial screen) | 0.0036 |
| **OCP** | |
| Aldrin (used as an initial screen) | 0.000001 |
| **OPP** | |
| Chlorpyrifos(used as an initial screen) | 0.00001 |
| **Other Organics** | |
| PCB (Aroclor 1242 as conservative screen) | 0.0003 |
| **VOC** | |
| 1,1,2-Trichloroethane | 0.0065 |
| 1,2,3-Trichlorobenzene | 0.003 |

| Contaminant | GIL, Marine Waters (mg/L) ANZG (2018) |
|---|---|
| 1,2,4-Trichlorobenzene | 0.085 |
| 1,2-Dichlorobenzene | 0.16 |
| 1,4-Dichlorobenzene | 0.06 |

### S1.5.1 Health Screening Levels - Petroleum Hydrocarbons

The generic groundwater HSL for vapour intrusion are published in NEPC (2013). Table S9 summarises the adopted HSL along with the relevant assumptions used in selecting the appropriate limits.

**Table S10: Groundwater HSL for Vapour Intrusion (mg/L)**

| Analyte | HSL A & HSL B | HSL D | Comments |
|---|---|---|---|
| Toluene | NL | NL | Depth of groundwater encountered 2 - 4 m<br>Sand chosen as the most conservative value given variability of fill encountered |
| Ethylbenzene | NL | NL | |
| Xylenes | NL | NL | |
| Naphthalene | NL | NL | |
| Benzene | 0.8 | 5 | |
| $C_6$-$C_{10}$ [F1] | 1 | 6 | |
| >$C_{10}$-$C_{16}$ [F2] | 1 | NL | |

# Appendix C

Previous Results

Douglas Partners
Geotechnics / Environment / Groundwater

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

| Sample ID | Depth | Sampling Date | Soil Type[a] | Metals | | | | | | | | PAH | | | | Phenols | TRH | | | | | | BTEX | | | | Organochlorine Pesticides (OCP) | | | | | | | | OPP | PCB | Asbestos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Arsenic | Cadmium | Chromium (VI)[b] | Copper | Lead | Mercury | Nickel | Zinc | Naphthalene | Benzo(a) Pyrene (BaP) | BaP TEQ | Total PAH | Total Phenols | TRH $C_6$-$C_{10}$ | TRH >$C_{10}$-$C_{16}$ | $C_{16}$ - $C_{34}$ (F3) | $C_{34}$ - $C_{40}$ (F4) | C6 - C10 less BTEX (F1) | $C_{10}$-$C_{16}$ less Naphthalene (F2) | Benzene | Toluene | Ethylbenzene | Total xylenes | DDT + DDD + DDE | Aldrin and Dieldrin | Chlordane | Endosulfan | Endrin | Heptachlor | HCB | Methoxychlor | Chlorpyrifos | Total PCB | Asbestos ID | AF / FA |
| Practical Quantitation Limit (PQL) | | | | 4 | 0.4 | 1 | 1 | 1 | 0.1 | 1 | 1 | 0.1 | 0.05 | 0.5 | 0.05 | 5[d] | 25 | 50 | 100 | 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 | 0.1g/kg | 0.001 % w/w |
| Site Assessment Criteria (SAC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HIL B & HSL B (direct contact) | | | | 500 | 150 | 500 | 30000 | 1200 | 120 | 1200 | 60000 | 2200 | - | 4 | 400 | 130 | 5600 | 4200 | 5800 | 8100 | - | - | 140 | 21000 | 5900 | 17000 | 600 | 10 | 90 | 400 | 20 | 10 | 15 | 500 | 340 | 1 | - | |
| HSL A&B - vapour intrusion (Sand) | | | | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 45 | 110 | 0.5 | 160 | 55 | 40 | - | - | - | - | - | - | - | - | - | - | NAD | |
| EIL (Res/Open Space , coarse) | | | | 100 | - | 470 | 65 | 1100 | - | 9 | 240 | 170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 180[e] | - | - | - | - | - | - | - | - | - | - | |
| ESL (Urban Res) | | | | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | 300 | 2800 | 180 | 120 | 50 | 85 | 70 | 105 | - | - | - | - | - | - | - | - | - | - | - | |
| Management Limits (Res, Parkland) | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | 700 | 1000 | 2500 | 10000 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| SCH / CCCC Investigation (DP 2020c) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH607 | 0.5 | 31/08/2020 | Fill | <4 | <0.4 | 4 | 8 | 73 | <0.1 | 3 | 24 | <0.1 | <0.05 | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <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 | - |
| BH607 | 1 | 31/08/2020 | Natural Sand | <4 | <0.4 | 1 | 1 | 7 | <0.1 | <1 | 4 | <0.1 | <0.05 | <0.5 | <0.05 | - | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| Stage 2 Waste Classification (DP 2019e) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S2-TP3 | 0-0.2 | 5/12/2019 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP3 | 0.4-0.5 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 2 | <0.1 | 2 | 6 | 14 | <0.1 | <0.05 | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | <0.1 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - |
| S2-TP4 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 4 | 3 | <0.1 | 1 | 18 | 30 | <0.1 | <0.05 | <0.5 | 0.51 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP4 | 0.9-1.0 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 2 | <0.1 | 1 | 14 | 24 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP5 | 0.4-0.6 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 6 | <0.1 | 1 | 19 | 62 | <0.1 | 0.81 | 1.2 | 8.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP6 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 2 | 4 | <0.1 | <1 | 31 | 28 | <0.1 | 1.2 | 1.8 | 19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP6 | 0.9-1.0 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 7 | <0.1 | 1 | 39 | 39 | <0.1 | 0.63 | 0.9 | 7.4 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | 0.5 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - |
| S2-TP7 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 2 | <0.1 | 2 | 8 | 19 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP7 | 0.8-1.0 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 5 | <0.1 | 1 | 37 | 53 | <0.1 | 0.5 | 0.7 | 6.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP7 | 1.1-1.3 | 5/12/2019 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP8 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 7 | 0.5 | <1 | 48 | 30 | <0.1 | 0.1 | <0.5 | 1.3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP8 | 0.8-1.0 | 5/12/2019 | **Natural** | <4 | <0.4 | 2 | 6 | 0.3 | <1 | 42 | 30 | <0.1 | 0.3 | <0.5 | 3.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP8 | 2.5-2.7 | 5/12/2019 | **Natural** | <4 | <0.4 | 6 | <1 | <0.1 | <1 | 5 | 14 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP9 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 1 | <0.1 | <1 | 4 | 5 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP9 | 0.8-1.0 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 4 | <0.1 | 1 | 27 | 35 | <0.1 | 0.1 | <0.5 | 1.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP10 | 0-0.1 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 3 | <0.1 | 1 | 8 | 10 | <0.1 | 0.1 | <0.5 | 0.58 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | <0.1 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | <0.001 |
| S2-TP10 | 1.5-1.7 | 5/12/2019 | **Fill** | <4 | <0.4 | 4 | <1 | <0.1 | 1 | 7 | 6 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP10 | 2.2 | 5/12/2019 | **Natural** | <4 | <0.4 | 1 | <1 | <0.1 | <1 | <1 | <1 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP11 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 2 | <1 | <0.1 | <1 | 3 | 3 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP12 | 0.0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 2 | 7 | <0.1 | 1 | 41 | 64 | <0.1 | 1.2 | 1.8 | 11 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | **2.5** | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | <0.001 |
| S2-TP12 | 0.3-0.5 | 5/12/2019 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | 2.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP12 | 0.8-1.0 | 5/12/2019 | **Natural** | <4 | <0.4 | 3 | 1 | <0.1 | 1 | 10 | 17 | <0.1 | 0.2 | <0.5 | 2.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP13 | 0.5-0.7 | 5/12/2019 | **Fill** | <4 | <0.4 | 1 | 3 | <0.1 | <1 | 23 | 57 | <0.1 | 0.2 | <0.5 | 1.2 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | <0.1 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | <0.001 |
| S2-TP14 | 0.3-0.5 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 8 | 0.1 | 2 | 83 | 86 | <0.1 | 0.57 | 0.8 | 5.1 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | <0.1 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | <0.001 |
| S2-TP14 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 4 | 13 | 0.1 | 2 | 100 | 170 | 0.1 | 2.7 | 3.7 | 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP14 | 1.2-1.5 | 5/12/2019 | **Natural** | <4 | <0.4 | 2 | <1 | <0.1 | <1 | 3 | 170 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP15 | 0-0.1 | 5/12/2019 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP15 | 8.2 | 5/12/2019 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP15 | 0.8-1.0 | 5/12/2019 | **Fill** | <4 | <0.4 | 3 | 17 | 0.2 | 1 | 100 | 140 | <0.1 | 0.60 | 0.9 | 6.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP15 | 1.8-2.0 | 5/12/2019 | **Natural** | <4 | <0.4 | 2 | 5 | <0.1 | <1 | 11 | 10 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP16 | 0-0.2 | 5/12/2019 | **Fill** | <4 | <0.4 | 5 | 11 | <0.1 | 2 | 9 | 12 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |

| Sample ID | Depth | Sampling Date | Soil Type[a] | Metals | | | | | | | | PAH | | | | Phenols | TRH | | | | | | BTEX | | | | Organochlorine Pesticides (OCP) | | | | | | | | OPP | PCB | Asbestos | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Arsenic | Cadmium | Chromium (VI)[b] | Copper | Lead | Mercury | Nickel | Zinc | Naphthalene | Benzo(a) Pyrene (BaP) | BaP TEQ | Total PAH | Total Phenols | TRH $C_6$-$C_{10}$ | TRH >$C_{10}$-$C_{16}$ | $C_{10}$-$C_{16}$ (F3) | $C_{17}$-$C_{34}$ (F4) | C6 - C10 less BTEX (F1) | $C_{10}$-$C_{16}$ less Naphthalene (F2) | Benzene | Toluene | Ethylbenzene | Total xylenes | DDT + DDD + DDE | Aldrin and Dieldrin | Chlordane | Endosulfan | Endrin | Heptachlor | HCB | Methoxychlor | Chlorpyrifos | Total PCB | Asbestos ID | AF/FA |
| Practical Quantitation Limit (PQL) | | | | 4 | 0.4 | 1 | 1 | 1 | 0.1 | 1 | 1 | 0.1 | 0.05 | 0.5 | 0.05 | 5[d] | 25 | 50 | 100 | 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 | 0.1g/kg | 0.001 % w/w |
| Site Assessment Criteria (SAC) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| HIL B & HSL B (direct contact) | | | | 500 | 150 | 500 | 30000 | 1200 | 120 | 1200 | 60000 | 2200 | - | 4 | 400 | 130 | 5600 | 4200 | 5800 | 8100 | - | - | 140 | 21000 | 5900 | 17000 | 600 | 10 | 90 | 400 | 20 | 10 | 15 | 500 | 340 | 1 | - | |
| HSL A&B - vapour intrusion (Sand) | | | | - | - | - | - | - | - | - | - | 3 | - | - | - | - | - | - | - | - | 45 | 110 | 0.5 | 160 | 55 | 40 | - | - | - | - | - | - | - | - | - | - | NAD | |
| EIL (Res/Open Space , coarse) | | | | 100 | - | 470 | 65 | 1100 | - | 9 | 240 | 170 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 180[e] | - | - | - | - | - | - | - | - | - | - | |
| ESL (Urban Res) | | | | - | - | - | - | - | - | - | - | - | 0.7 | - | - | - | - | - | 300 | 2800 | 180 | 120 | 50 | 85 | 70 | 105 | - | - | - | - | - | - | - | - | - | - | - | |
| Management Limits (Res, Parkland) | | | | - | - | - | - | - | - | - | - | - | - | - | - | - | 700 | 1000 | 2500 | 10000 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| S2-TP16 | 1.0-1.2 | 5/12/2019 | Fill | <4 | <0.4 | 2 | <1 | <0.1 | <1 | 5 | 6 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP18 | 0.3-0.5 | 5/12/2019 | Fill | <4 | <0.4 | 4 | 7 | <0.1 | 1 | 8 | 8 | <0.1 | <0.05 | <0.5 | <0.05 | - | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP27 | 0-0.2 | 5/12/2019 | Fill | <4 | <0.4 | 5 | 6 | <0.1 | 1 | 11 | 13 | <0.1 | 0.1 | <0.5 | 0.2 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <2 | <0.1 | <0.1 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | - |
| S2-TP27 | 0.3-0.5 | 5/12/2019 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | <0.001 |
| S2-TP28 | 0.02 | 5/12/2019 | Fill | <4 | <0.4 | 4 | 16 | <0.1 | 1 | 8 | 10 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP28 | 0.6-0.8 | 5/12/2019 | Natural | <4 | <0.4 | 2 | <1 | <0.1 | <1 | 2 | 6 | <0.1 | <0.05 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| DSI (DP 2019a) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *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 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP314 | 0.0-0.2 | 13/02/2019 | Fill | <4 | <0.4 | 3 | 6 | 22 | <0.1 | 1 | 28 | <1 | 0.55 | 0.8 | 4.2 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 1.5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.1 | NAD | - |
| TP315 | 0.0-0.2 | 11/02/2019 | Fill | <4 | <0.4 | 5 | 10 | 100 | <0.1 | 2 | 99 | <1 | 1.3 | 1.8 | 11 | <5 | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP315 | 1.0-1.1 | 11/02/2019 | Fill | <4 | <0.4 | 4 | 13 | 82 | <0.1 | 2 | 68 | <1 | 1.5 | 2.1 | 12 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| *TP316* | 0.0-0.2 | 11/02/2019 | Fill | <4 | <0.4 | <1 | <1 | 2 | <0.1 | <1 | <1 | <1 | <0.05 | <0.5 | <0.05 | <5 | <25 | <50 | <100 | <25 | <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 | - |
| TP318 | 0.0-0.2 | 11/02/2019 | Fill | <4 | <0.4 | 3 | 6 | 43 | <0.1 | 1 | 63 | <1 | 1.4 | 1.9 | 12 | <5 | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 0.5 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | **YES **** | - |
| TP318 | 0.4-0.5 | 11/02/2019 | Fill | <4 | <0.4 | 2 | 6 | 42 | <0.1 | 1 | 57 | <1 | 0.9 | 1.3 | 8.8 | | <25 | <50 | <100 | <100 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP319 | 0.0-0.2 | 11/02/2019 | Fill | <4 | <0.4 | 6 | 49 | 210 | 0.7 | 3 | 160 | <1 | 2.1 | 2.9 | 19 | <5 | <25 | <50 | 120 | <25 | <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 | - |
| TP319 | 0.4-0.5 | 11/02/2019 | Fill | <4 | <0.4 | 6 | 45 | 220 | 0.7 | 3 | 150 | <1 | 2.2 | 3 | 18 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| TP319 | 1.1-1.2 | 11/02/2019 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BD1/20190213[a] | 0.0-0.2 | 13/02/2019 | Fill | <4 | <0.4 | 3 | 7 | 85 | 0.1 | 1 | 80 | <1 | 0.2 | <0.5 | 2.7 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| TP320 | 0.0-0.2 | 13/02/2019 | Fill | <4 | <0.4 | 3 | 8 | 96 | 0.1 | 1 | 80 | <1 | 0.4 | 0.6 | 4.4 | <5 | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | <0.1 | 2 | 0.5 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | - | <0.1 | NAD | - |
| TP320 | 0.6-0.7 | 13/02/2019 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD | - |
| *BH204* | 0.3-0.4 | 27/06/2018 | Fill | <4 | <0.4 | 2 | 7 | 30 | <0.1 | 1 | 26 | <0.1 | 0.2 | <0.5 | 1.6 | <5 | <25 | <50 | <100 | <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 | 0.4 | NAD | - |
| BH206 | 0.3-0.4 | 25/06/2018 | Fill | <4 | <0.4 | 4 | 13 | 140 | 0.1 | 2 | 49 | <0.1 | 1.7 | 2.5 | 16 | <5 | <25 | <50 | <100 | <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 | 1.6 | NAD | - |
| BH207 | 0.1-0.2 | 25/06/2018 | Fill | <4 | <0.4 | 4 | 12 | 98 | <0.1 | 2 | 93 | <0.1 | 1.2 | 1.7 | 17 | <5 | <25 | <50 | <100 | <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 | - |
| BH208 | 0.3-0.4 | 25/06/2018 | Fill | 7 | 0.6 | 7 | 85 | 270 | 0.2 | 3 | 160 | 0.1 | 2.9 | 4.3 | 31 | <5 | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | 0.6 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.5 | NAD | - |
| *BH215* | 0.1-0.2 | 29/06/2018 | Fill | <4 | <0.4 | 6 | 21 | 190 | <0.1 | 4 | 56 | 0.1 | 3.2 | 4.5 | 28 | <5 | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <3 | 0.2 | <0.2 | <0.2 | <0.3 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | NAD | - |
| TP6 | 0.4-0.5 | 08/08/2018 | Fill | <4 | <0.4 | 2 | 13 | 91 | 0.1 | <1 | 27 | <0.1 | 0.2 | <0.5 | 2.1 | <5 | <25 | <50 | <100 | <25 | <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 | - |
| BD1/20180808 | | 08/08/2018 | Fill | <4 | <0.4 | 1 | 12 | 55 | 0.1 | <1 | 24 | <0.1 | <0.1 | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <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 | - | - |
| TP6 | 1.4-1.5 | 08/08/2018 | Natural | <4 | <0.4 | 2 | <1 | 2 | <0.1 | <1 | 11 | <0.1 | <0.1 | <0.5 | <0.05 | - | <25 | <50 | <100 | <25 | <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 | - | - |
| *TP7* | 0.3-0.4 | 08/08/2018 | Fill | - | - | - | - | 20 | - | - | - | <0.1 | <0.1 | <0.5 | 1.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| *TP7* | 0.7-0.8 | 08/08/2018 | Natural | - | - | - | - | <1 | - | - | - | <0.1 | <0.1 | <0.5 | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| PSI (DP 2018) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH7 | 0.1 | 6/10/2017 | Fill | <4 | <0.4 | 4 | 14 | 94 | <0.1 | 2 | 72 | <0.1 | 0.3 | 0.394 | 2.8 | <5 | <25 | <50 | <100 | <25 | <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 | - |
| BH7 | 0.5 | 6/10/2017 | Natural Sand | <4 | <0.4 | 2 | <1 | 6 | <0.1 | 1 | 12 | <0.1 | <0.05 | <0.172 | <0.05 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | - | - |
| *BH105* | 0.3-0.5 | 9/01/2018 | Fill | <4 | <0.4 | 4 | 16 | 130 | <0.1 | 2 | 140 | <0.1 | 0.77 | 0.993 | 7.2 | <5 | <25 | <50 | <100 | <25 | <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 | - |
| *BH105* | 0.5-0.7 | 9/01/2018 | Natural Sand | <4 | <0.4 | 3 | 10 | 130 | <0.1 | 2 | 310 | <0.1 | 1.1 | 1.387 | 12 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| BH106 | 0-0.2 | 9/01/2018 | Fill | <4 | 0.7 | 5 | 32 | 180 | 0.1 | 3 | 230 | <0.1 | 0.73 | 0.932 | 6.7 | <5 | <25 | <50 | 130 | <25 | <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 | - |
| BH106 | 0.5-0.7 | 9/01/2018 | Natural Sand | <4 | <0.4 | 4 | 16 | 90 | <0.1 | 2 | 100 | <0.1 | 0.91 | 1.144 | 7.1 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |
| *BH107* | 0-0.2 | 9/01/2018 | Fill | <4 | <0.4 | 7 | 25 | 270 | 0.2 | 4 | 160 | <0.1 | 1.8 | 2.278 | 16 | <5 | <25 | <50 | 110 | <25 | <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 | - |
| BH108 | 0-0.2 | 9/01/2018 | Fill | <4 | 0.5 | 6 | 26 | 280 | 0.2 | 4 | 200 | <0.1 | 1.5 | 1.953 | 14 | <5 | <25 | <50 | 100 | <25 | <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 | - |
| BH108 | 0.7-0.8 | 9/01/2018 | Natural Sand | <4 | <0.4 | 3 | 3 | 230 | <0.1 | 2 | 96 | <0.1 | 0.54 | 0.668 | 4.4 | - | <25 | <50 | <100 | <25 | <25 | <50 | <0.2 | <0.5 | <1 | <1 | - | - | - | - | - | - | - | - | - | - | NAD | - |

**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 | Refer to laboratory reports for individual quantification limits for the explosive compounds |
| d | Pentechlorophenol listed as intial screening level |
| e | EIL given for DDT |
| NAD | No asbestos detected |
| - | Not Analysed |
| * | Asbestos detected below the laboratory limit of reporting 0.1g/kg |
| ** | Suspected asbestos detected during field screening (DP 2019a) |

***Results in italics correpond to areas within the Stage 1 Validation Works which have already been remediated for the proposed land use***

Table C2 - Previous 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 / 0.042 | 0.0002 | 0.0033/ 0.001 | 0.0014 | 0.0034 | 0.00006 | 0.011 | 0.008 | - | - | 0.95 | 0.08 | 0.18 | 0.075 / 0.20 | 0.35 | - | 0.0065 | - | - | - | - | | - | - | 0.003 | 0.085 | 0.16 | 0.26 | 0.06 | - | 0.0001 | 0.016 | 0.0036 |
| **Field ID** | **Sampled Date** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **DP (2020c)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH12 | 08/09/2020 | <0.001 | <0.0001 | <0.001 | <0.002 | <0.001 | <0.00005 | <0.002 | <0.001 | 0.075 | <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 | <0.0002 | <0.05 |
| BH608 | 08/09/2020 | <0.001 | <0.0001 | <0.001 | 0.009 | <0.001 | <0.00005 | 0.006 | 0.017 | <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 | 0.0002 | <0.0002 | <0.05 |
| BD1/20200908 | 08/09/2020 | <0.001 | <0.0001 | <0.001 | 0.001 | <0.001 | <0.00005 | 0.005 | 0.016 | <0.05 | <0.01 | <0.001 | <0.001 | <0.001 | <0.002 | <0.001 | <0.001 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0003 | <0.0002 | - |
| **DP (2019a)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | <0.0001 | <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 |

Douglas Partners
Geotechnics | Environment | Groundwater

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 | 0.03 mg/L | 0.1 | 1 | 0.05 | 0.001 mg/L | 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 |
| **SCH / CCCC Investigation (DP2020c)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| BH607 | 0.5 | Fill | <4 | <0.4 | 4 | 73 | - | <0.1 | 3 | <0.05 | - | <0.05 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.3 | <0.1 | <0.1 | NAD |
| BH607 | 1 | Natural Sand | <4 | <0.4 | 1 | 7 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | - | - | - | NAD |
| **Stage 2 Waste Classification (DP 2019e)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| S2-TP3 | 0-0.2 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP3 | 0.4-0.5 | **Fill** | <4 | <0.4 | 3 | 6 | - | <0.1 | 2 | <0.05 | - | <0.05 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | |
| S2-TP4 | 0-0.2 | **Fill** | <4 | <0.4 | 4 | 18 | - | <0.1 | 1 | <0.05 | - | 0.51 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP4 | 0.9-1.0 | **Fill** | <4 | <0.4 | 3 | 14 | - | <0.1 | 1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP5 | 0-0.2 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP5 | 0.4-0.6 | **Fill** | <4 | <0.4 | 3 | 19 | - | <0.1 | 1 | 0.81 | <0.001 | 8.1 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP6 | 0-0.2 | **Fill** | <4 | <0.4 | 2 | 31 | - | <0.1 | <1 | 1.2 | <0.001 | 19 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP6 | 0.4-0.6 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP6 | 0.9-1.0 | **Fill** | <4 | <0.4 | 3 | 39 | - | <0.1 | 1 | 0.63 | - | 7.4 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | - |
| S2-TP7 | 0-0.2 | **Fill** | <4 | <0.4 | 3 | 8 | - | <0.1 | 2 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP7 | 0.8-1.0 | **Fill** | <4 | <0.4 | 3 | 37 | - | <0.1 | 1 | 0.5 | - | 6.2 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP7 | 1.1-1.3 | **Fill** | | | | | - | | | | - | | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP8 | 0-0.2 | **Fill** | <4 | <0.4 | 3 | 48 | - | 0.5 | <1 | 0.1 | - | 1.3 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP8 | 0.8-1.0 | **Natural** | <4 | <0.4 | 2 | 42 | - | 0.3 | <1 | 0.3 | - | 3.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP8 | 2.5-2.7 | **Natural** | <4 | <0.4 | 6 | 5 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP9 | 0-0.2 | **Fill** | <4 | <0.4 | 3 | 4 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP9 | 0.8-1.0 | **Fill** | <4 | <0.4 | 3 | 27 | - | <0.1 | 1 | 0.1 | - | 1.4 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP10 | 0-0.1 | **Fill** | <4 | <0.4 | 3 | 8 | - | <0.1 | 1 | 0.1 | - | 0.58 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | NAD |
| S2-TP10 | 1.5-1.7 | **Fill** | <4 | <0.4 | 4 | 7 | - | <0.1 | 1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP10 | 2.2 | **Natural** | <4 | <0.4 | 1 | <1 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP11 | 0-0.2 | **Fill** | <4 | <0.4 | 2 | 3 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP12 | 0.0-0.2 | **Fill** | <4 | <0.4 | 2 | 41 | - | <0.1 | 1 | 1.2 | <0.001 | 11 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | NAD |
| S2-TP12 | 0.3-0.5 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP12 | 0.8-1.0 | **Natural** | <4 | <0.4 | 3 | 10 | - | <0.1 | 1 | 0.2 | - | 2.1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP13 | 0.5-0.7 | **Fill** | <4 | <0.4 | 1 | 23 | - | <0.1 | <1 | 0.2 | - | 1.2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | NAD |
| S2-TP14 | 0.3-0.5 | **Fill** | <4 | <0.4 | 4 | 100 | - | 0.1 | 2 | 2.7 | <0.001 | 25 | - | - | - | - | - | - | - | - | - | - | - | | - |
| S2-TP14 | 0-0.2 | **Fill** | <4 | <0.4 | 3 | 83 | - | 0.1 | 2 | 0.57 | - | 5.1 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | NAD |
| S2-TP14 | 1.2-1.5 | **Natural** | <4 | <0.4 | 2 | 3 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | | - |
| S2-TP15 | 0-0.2 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP15 | 0.8-1.0 | **Fill** | <4 | <0.4 | 3 | 100 | - | 0.2 | 1 | 0.60 | - | 6.4 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP15 | 1.8-2.0 | **Natural** | <4 | <0.4 | 2 | 11 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP16 | 0-0.2 | **Fill** | <4 | <0.4 | 5 | 9 | - | <0.1 | 2 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP16 | 1.0-1.2 | **Fill** | <4 | <0.4 | 2 | 5 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP18 | 0.3-0.5 | **Fill** | <4 | <0.4 | 4 | 8 | - | <0.1 | 1 | <0.05 | - | <0.05 | | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | | | | - |
| S2-TP27 | 0-0.2 | **Fill** | <4 | <0.4 | 5 | 11 | - | <0.1 | 1 | 0.1 | - | 0.2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <3 | <0.1 | <0.1 | <0.1 | - |
| S2-TP27 | 0.3-0.5 | **Fill** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| S2-TP28 | 0.02 | **Fill** | <4 | <0.4 | 4 | 8 | - | <0.1 | 1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S2-TP28 | 0.6-0.8 | **Natural** | <4 | <0.4 | 2 | 2 | - | <0.1 | <1 | <0.05 | - | <0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **DSI (DP 2019a)** | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 |
| TP314 | 0.0-0.2 | Fill | <4 | <0.4 | 3 | 22 | - | <0.1 | 1 | 0.55 | - | 4.2 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | - | <0.1 | NAD |
| TP314A | 0.6-0.7 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| TP315 | 0.0-0.2 | Fill | <4 | <0.4 | 5 | 100 | - | <0.1 | 2 | 1.3 | - | 11 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP315 | 1.0-1.1 | Fill | <4 | <0.4 | 4 | 82 | - | <0.1 | 2 | 1.5 | - | 12 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP316 | 0.0-0.2 | Fill | <4 | <0.4 | <1 | 2 | - | <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 |
| TP318 | 0.0-0.2 | Fill | <4 | <0.4 | 3 | 43 | - | <0.1 | 1 | 1.4 | - | 12 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP318 | 0.4-0.5 | Fill | <4 | <0.4 | 2 | 42 | - | <0.1 | 1 | 0.9 | - | 8.8 | | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP319 | 0.0-0.2 | Fill | <4 | <0.4 | 6 | 210 | - | 0.7 | 3 | 2.1 | - | 19 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | <0.1 | <0.1 | NAD |
| TP319 | 0.4-0.5 | Fill | <4 | <0.4 | 6 | 220 | - | 0.7 | 3 | 2.2 | - | 18 | - | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | - | - | - | NAD |
| TP319 | 1.1-1.2 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |
| TP320 | 0.0-0.2 | Fill | <4 | <0.4 | 3 | 96 | - | 0.1 | 1 | 0.4 | - | 4.4 | <5 | <25 | <50 | <100 | <100 | <0.2 | <0.5 | <1 | <1 | <0.1 | - | <0.1 | NAD |
| TP320 | 0.6-0.7 | Fill | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | NAD |

## UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.17/12/2020 11:53:51 AM |
| From File | WorkSheet.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**BaP TEQ**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 49 | Number of Distinct Observations | 22 |
| | | Number of Missing Observations | 0 |
| Minimum | 0.394 | Mean | 1.179 |
| Maximum | 4.5 | Median | 0.5 |
| SD | 1.046 | Std. Error of Mean | 0.149 |
| Coefficient of Variation | 0.888 | Skewness | 1.742 |

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.712 | **Shapiro Wilk GOF Test** |
| 5% Shapiro Wilk Critical Value | 0.947 | Data Not Normal at 5% Significance Level |
| Lilliefors Test Statistic | 0.252 | **Lilliefors GOF Test** |
| 5% Lilliefors Critical Value | 0.126 | 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 | 1.429 | 95% Adjusted-CLT UCL (Chen-1995) | 1.464 |
| | | 95% Modified-t UCL (Johnson-1978) | 1.435 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 4.522 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.764 | Data Not Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.289 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.128 | Data Not Gamma Distributed at 5% Significance Level |

**Data Not Gamma Distributed at 5% Significance Level**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.868 | k star (bias corrected MLE) | 1.767 |
| Theta hat (MLE) | 0.631 | Theta star (bias corrected MLE) | 0.667 |
| nu hat (MLE) | 183.1 | nu star (bias corrected) | 173.2 |
| MLE Mean (bias corrected) | 1.179 | MLE Sd (bias corrected) | 0.887 |
| | | Approximate Chi Square Value (0.05) | 143.8 |
| Adjusted Level of Significance | 0.0451 | Adjusted Chi Square Value | 143 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL (use when n>=50)) | 1.42 | 95% Adjusted Gamma UCL (use when n<50) | 1.428 |

### Lognormal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.792 | **Shapiro Wilk Lognormal GOF Test** |
| 5% Shapiro Wilk Critical Value | 0.947 | Data Not Lognormal at 5% Significance Level |
| Lilliefors Test Statistic | 0.294 | **Lilliefors Lognormal GOF Test** |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 5% Lilliefors Critical Value | | | | | 0.126 | Data Not Lognormal at 5% Significance Level | | | | | |
| 56 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | **Lognormal Statistics** | | | | | | | | | | | |
| 59 | Minimum of Logged Data | | | | | -0.931 | Mean of logged Data | | | | | -0.127 |
| 60 | Maximum of Logged Data | | | | | 1.504 | SD of logged Data | | | | | 0.721 |
| 61 | | | | | | | | | | | | |
| 62 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 63 | 95% H-UCL | | | | | 1.414 | 90% Chebyshev (MVUE) UCL | | | | | 1.52 |
| 64 | 95% Chebyshev (MVUE) UCL | | | | | 1.694 | 97.5% Chebyshev (MVUE) UCL | | | | | 1.936 |
| 65 | 99% Chebyshev (MVUE) UCL | | | | | 2.412 | | | | | | |
| 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 | | | | | 1.424 | 95% Jackknife UCL | | | | | 1.429 |
| 72 | 95% Standard Bootstrap UCL | | | | | 1.421 | 95% Bootstrap-t UCL | | | | | 1.482 |
| 73 | 95% Hall's Bootstrap UCL | | | | | 1.468 | 95% Percentile Bootstrap UCL | | | | | 1.43 |
| 74 | 95% BCA Bootstrap UCL | | | | | 1.473 | | | | | | |
| 75 | 90% Chebyshev(Mean, Sd) UCL | | | | | 1.627 | 95% Chebyshev(Mean, Sd) UCL | | | | | 1.83 |
| 76 | 97.5% Chebyshev(Mean, Sd) UCL | | | | | 2.112 | 99% Chebyshev(Mean, Sd) UCL | | | | | 2.666 |
| 77 | | | | | | | | | | | | |
| 78 | **Suggested UCL to Use** | | | | | | | | | | | |
| 79 | 95% Chebyshev (Mean, Sd) UCL | | | | | 1.83 | | | | | | |
| 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 | **PCB** | | | | | | | | | | | |
| 88 | | | | | | | | | | | | |
| 89 | **General Statistics** | | | | | | | | | | | |
| 90 | Total Number of Observations | | | | | 26 | Number of Distinct Observations | | | | | 4 |
| 91 | | | | | | | Number of Missing Observations | | | | | 0 |
| 92 | Minimum | | | | | 0.1 | Mean | | | | | 0.2 |
| 93 | Maximum | | | | | 1.6 | Median | | | | | 0.1 |
| 94 | SD | | | | | 0.31 | Std. Error of Mean | | | | | 0.0608 |
| 95 | Coefficient of Variation | | | | | 1.549 | Skewness | | | | | 4.056 |
| 96 | | | | | | | | | | | | |
| 97 | **Normal GOF Test** | | | | | | | | | | | |
| 98 | Shapiro Wilk Test Statistic | | | | | 0.375 | **Shapiro Wilk GOF Test** | | | | | |
| 99 | 5% Shapiro Wilk Critical Value | | | | | 0.92 | Data Not Normal at 5% Significance Level | | | | | |
| 100 | Lilliefors Test Statistic | | | | | 0.473 | **Lilliefors GOF Test** | | | | | |
| 101 | 5% Lilliefors Critical Value | | | | | 0.17 | 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 | | | | | 0.304 | 95% Adjusted-CLT UCL (Chen-1995) | | | | | 0.352 |
| 107 | | | | | | | 95% Modified-t UCL (Johnson-1978) | | | | | 0.312 |
| 108 | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 109 | **Gamma GOF Test** | | | | | | | | | | | |
| 110 | | | | | A-D Test Statistic | 6.97 | **Anderson-Darling Gamma GOF Test** | | | | | |
| 111 | | | | | 5% A-D Critical Value | 0.765 | Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 112 | | | | | K-S Test Statistic | 0.511 | **Kolmogorov-Smirnov Gamma GOF Test** | | | | | |
| 113 | | | | | 5% K-S Critical Value | 0.175 | Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 114 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 115 | | | | | | | | | | | | |
| 116 | **Gamma Statistics** | | | | | | | | | | | |
| 117 | | | | | k hat (MLE) | 1.364 | | | k star (bias corrected MLE) | 1.232 | | |
| 118 | | | | | Theta hat (MLE) | 0.147 | | | Theta star (bias corrected MLE) | 0.162 | | |
| 119 | | | | | nu hat (MLE) | 70.93 | | | nu star (bias corrected) | 64.08 | | |
| 120 | | | | | MLE Mean (bias corrected) | 0.2 | | | MLE Sd (bias corrected) | 0.18 | | |
| 121 | | | | | | | | | Approximate Chi Square Value (0.05) | 46.66 | | |
| 122 | | | | | Adjusted Level of Significance | 0.0398 | | | Adjusted Chi Square Value | 45.68 | | |
| 123 | | | | | | | | | | | | |
| 124 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 125 | | | | 95% Approximate Gamma UCL (use when n>=50)) | | 0.275 | | | 95% Adjusted Gamma UCL (use when n<50) | 0.281 | | |
| 126 | | | | | | | | | | | | |
| 127 | **Lognormal GOF Test** | | | | | | | | | | | |
| 128 | | | | | Shapiro Wilk Test Statistic | 0.46 | **Shapiro Wilk Lognormal GOF Test** | | | | | |
| 129 | | | | | 5% Shapiro Wilk Critical Value | 0.92 | Data Not Lognormal at 5% Significance Level | | | | | |
| 130 | | | | | Lilliefors Test Statistic | 0.501 | **Lilliefors Lognormal GOF Test** | | | | | |
| 131 | | | | | 5% Lilliefors Critical Value | 0.17 | Data Not Lognormal at 5% Significance Level | | | | | |
| 132 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 133 | | | | | | | | | | | | |
| 134 | **Lognormal Statistics** | | | | | | | | | | | |
| 135 | | | | | Minimum of Logged Data | -2.303 | | | Mean of logged Data | -2.019 | | |
| 136 | | | | | Maximum of Logged Data | 0.47 | | | SD of logged Data | 0.713 | | |
| 137 | | | | | | | | | | | | |
| 138 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 139 | | | | | 95% H-UCL | 0.233 | | | 90% Chebyshev (MVUE) UCL | 0.246 | | |
| 140 | | | | | 95% Chebyshev (MVUE) UCL | 0.28 | | | 97.5% Chebyshev (MVUE) UCL | 0.329 | | |
| 141 | | | | | 99% Chebyshev (MVUE) UCL | 0.423 | | | | | | |
| 142 | | | | | | | | | | | | |
| 143 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 144 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 145 | | | | | | | | | | | | |
| 146 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 147 | | | | | 95% CLT UCL | 0.3 | | | 95% Jackknife UCL | 0.304 | | |
| 148 | | | | | 95% Standard Bootstrap UCL | N/A | | | 95% Bootstrap-t UCL | N/A | | |
| 149 | | | | | 95% Hall's Bootstrap UCL | N/A | | | 95% Percentile Bootstrap UCL | N/A | | |
| 150 | | | | | 95% BCA Bootstrap UCL | N/A | | | | | | |
| 151 | | | | | 90% Chebyshev(Mean, Sd) UCL | 0.382 | | | 95% Chebyshev(Mean, Sd) UCL | 0.465 | | |
| 152 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 0.579 | | | 99% Chebyshev(Mean, Sd) UCL | 0.805 | | |
| 153 | | | | | | | | | | | | |
| 154 | **Suggested UCL to Use** | | | | | | | | | | | |
| 155 | | | | | 95% Chebyshev (Mean, Sd) UCL | 0.465 | | | | | | |
| 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 | | | | | | | | | | | | |