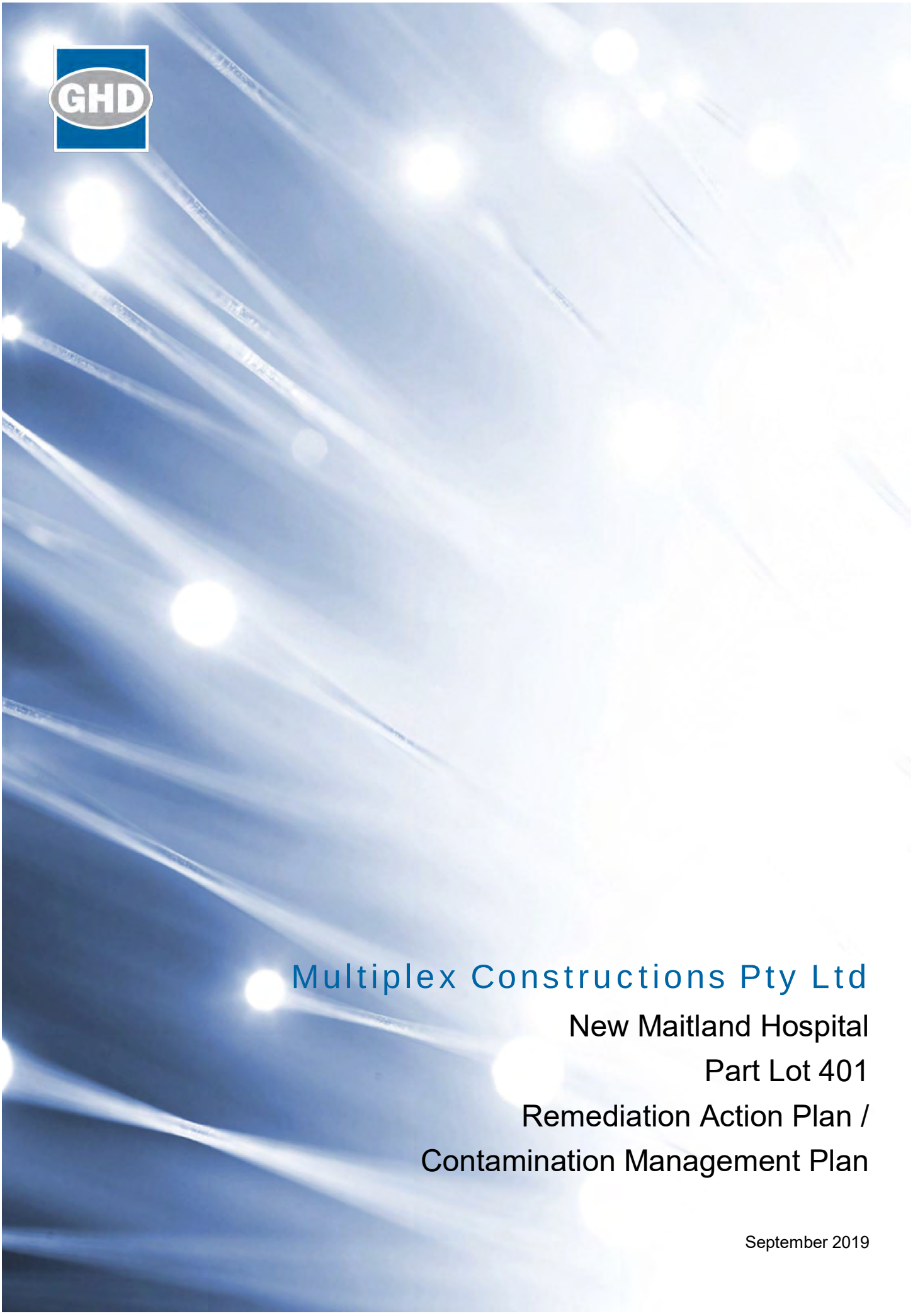

Multiplex Constructions Pty Ltd

New Maitland Hospital

Part Lot 401

Remediation Action Plan / Contamination Management Plan

September 2019

Executive summary

GHD Pty Ltd (GHD) was engaged by Multiplex Construction Pty Ltd (Multiplex) to prepare a Remediation Action Plan (RAP) / Contamination Management Plan (CMP) (herein referred to as the RAP) for Part Lot 401 DP 755237, Metford Road, Metford, NSW (the site). Part Lot 401 forms a portion of the overall development area for the New Maitland Hospital (NMH), and is proposed to be developed as a car park.

This RAP provides a summary of identified site contamination issues, and description of the proposed remediation and soil management programs, procedures and standards which are to be followed during the course of the redevelopment, to ensure the successful remediation of the site and consequently the protection of the environment and human health, so that the site can be made suitable for the nominated land uses by implementation of this RAP.

Redevelopment of the site is proposed to involve construction of the North Carpark. It is evident that significant earthworks will be required to achieve the landform required for the proposed development, including excavation, relocation and re-compaction of existing fill materials. It is understood that bulk excavation is likely to be required to level the site to approximately RL 17 m AHD, resulting in up to 4 m cut into existing fill material on site.

On the basis of previous investigations carried out at the site, potential “contamination” (this term is used for convenience to indicate any materials presenting a health or environmental risk, including naturally occurring materials) at the site is considered to comprise the following:

- Filling at various locations across the site containing demolition wastes and ACM.
- Naturally occurring carbonaceous soils and shale oils (source of TRH and PAH contamination).

The findings of the investigations to date are based on lines of evidence including historical site use, site observations and sampling and analysis from discrete locations. While the site history indicates previous site use was predominantly quarrying activities, and remediation works are understood to have been undertaken, it is possible that contaminated fill may be encountered during redevelopment of the site. There is also a possibility that unexpected contamination could be encountered during earthworks for redevelopment of the site.

A review of remediation options has been carried out giving consideration to the nature of contamination identified at the site, and to relevant technical and policy considerations, resulting in the following preferred approach.

As a general principle in redevelopment of the site, NSW Health Infrastructure (HI) has committed to using best endeavours to manage contamination on site, where appropriate. The types of contaminants identified at the Site (primarily TRH, PAH, asbestos-containing materials and aesthetic impacts) cannot readily be destroyed, and soil treatment methods that reduce contaminant concentrations are not considered suitable for the contamination at the site. Therefore, the following remediation methods are considered appropriate for the Site:

- ACM contamination - Physical removal and disposal of potential ACM contamination associated with illegally dumped materials (if identified) that may be disturbed by the site works is the preferred strategy and consistent with regulatory requirements for asbestos. Any remediated areas will then be cleared by a licenced contractor and validated by an environmental consultant

- Visual screening and segregation of unacceptable materials (foreign inclusions, aesthetic impacts, ACM, hydrocarbon contaminated materials, potentially combustible materials) to address contamination impacts within stockpiles and across the general site area.
- Capping and containment as a conservative soil management option for segregated materials (as above) where contamination will not be subject to exposure under normal foreseeable use of the site (eg. burial at depths greater than 2 m below design structure levels or beneath permanent infrastructure as part of the redevelopment).
- Re-use of uncontaminated materials (VENM, screened overburden and fill) for bulk fill subject to geotechnical requirements or constraints.

The particular methods to be used for each material / source should be agreed with HI and the Principal Contractor (and their designers) for the development in conjunction with finalisation of design, to account for any particular geotechnical requirements, optimise earthmoving and minimise the potential for future disturbance of contaminated or problematic materials. It is anticipated this will take the form of a “material re-use schedule”, to be prepared as part of final design and consistent with the principles described in this RAP. A CQA plan will be required as a basis for verifying and documenting the appropriate implementation of this RAP and final design documentation. These documents (including relevant aspects of the final design, specifications, material re-use schedule and CQA plan) shall be reviewed by the Environmental Consultant and Site Auditor prior to the commencement of remediation to confirm that they are consistent with the principles of this RAP.

A Long Term Site Management Plan (LTSMP) will be required to record the placement of any contaminated material on site, and provide procedures to be used in the event that it should be disturbed.

GHD considers that the site can be made suitable for the proposed use (hospital car park) by implementation of this RAP during earthworks undertaken for development of the site.

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Appendices

List of abbreviations

ACM	Asbestos Containing Material
ANZECC	Australia and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BaP	Benzo(a)pyrene
bgl	Below ground level
BTEXN	Benzene, toluene, ethyl benzene and xylenes plus naphthalene
CLM Act	Contaminated Land Management Act 1997(incorporating amendments made by the Contaminated Land Management Amendment Act 2003)
COC	Chain of Custody
CoPC	Contaminant of Potential Concern
CQA	Construction Quality Assurance
DP	Deposited Plan
DQO	Data quality objectives
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESL	Ecological Screening Level
GIL	Groundwater Investigation Level
HIL	Health Investigation Level (relating to defined land use scenario)
HI	NSW Health Infrastructure
HSL	Health Screening Level
LOR	Limit of reporting
NATA	National Association of Testing Authorities of Australia
NEHF	National Environmental Health Forum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NSW EPA	New South Wales Environmental Protection Authority
NSW DEC	Former New South Wales Department of Environment and Conservation
OCP	Organochlorine Pesticide
OEH	Office of Environment and Heritage
OPP	Organophosphate Pesticide
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PID	Photo-ionisation detector
QA/QC	Quality assurance / quality control
RAP	Remediation Action Plan

RPD	Relative percentage difference
SAQP	Sampling, Analytical and Quality Plan
SWL	Standing water level
TCLP	Toxicity Characteristics Leaching Procedure
TEQ	Toxicity equivalent quotient (in reference to BaP)
TPH	Total petroleum hydrocarbons
TRH	Total recoverable hydrocarbons
UCL	Upper Confidence Limit
UST	Underground storage tank
VENM	Virgin Excavated Natural Material
VOC	Volatile organic compounds

1. Introduction

1.1 Introduction

GHD Pty Ltd (GHD) was engaged by Multiplex Construction Pty Ltd (Multiplex) to prepare a Remediation Action Plan (RAP) / Contamination Management Plan (CMP) (herein referred to as the RAP) for Part Lot 401 DP 755237, Metford Road, Metford, NSW (the site). Part Lot 401 forms a portion of the overall development area for the New Maitland Hospital (NMH), and is proposed to be developed as a car park. The location and extent of Part Lot 401 is shown on Figure 1 in Appendix A.

This RAP provides discussion of remediation or management methods to address potential contamination scenarios at the site including:

- Isolated instances of asbestos-containing material (ACM)
- Areas of anthropogenic wastes
- Presence of natural carbonaceous materials
- Potential for “unexpected finds” of contamination to occur during earth works

This RAP should be read in conjunction with the *Part Lot 401 Site Investigation report* (GHD, 2019) (key findings reproduced in Section 2) and the limitations presented in Section 12.

A supplementary contamination investigation of the site is currently being completed by GHD, in order to address data gaps and provide more specific information to facilitate implementation of this RAP.

1.2 Proposed development

Multiplex is currently contracted to NSW Health Infrastructure (HI) for construction of the NMH development. HI has advised that the site is to be remediated and handed back to the Crown by CSR (the current lease holder).

Redevelopment of the site is proposed to involve construction of the North Carpark, as shown in the “Site Plan” drawing BVN-ARH-01A-AX0-002 Issue 7 (presented in Appendix A). It is evident that significant earthworks will be required to achieve the landform required for the proposed development, including excavation, relocation and re-compaction of existing fill materials.

It is understood that bulk excavation is likely to be required to level the site to approximately RL 17 m AHD, resulting in up to 4 m cut into existing fill material on site.

1.3 Purpose of the RAP

This document presents the management and remediation strategies that may be required to manage any contamination that may be encountered during the redevelopment of the site and to ensure no unacceptable contamination is subject to exposure during the proposed future use of the site.

The purpose of this RAP is to provide a description of the potential contamination management and remediation programs, procedures and standards, which may be required during the course of the project, to ensure the successful management or remediation at the site and consequently the protection of the environment and human health, so that the site will be suitable for the proposed land use (carpark).

1.4 Objectives

The objectives of the RAP are to:

- Set soil management and remediation goals so that the site can be made suitable for the nominated land uses, and will pose no unacceptable risk to human health or the environment under those uses.
- Evaluate the range of management or remediation options available to address the potential site contamination scenarios, and thereby reduce risks to acceptable levels.
- Establish a framework for interim management of the site prior to the commencement of development.
- Document the preferred / most suitable contamination management or remediation techniques and procedures for the contamination scenarios that may occur on site.
- Establish the various safeguards required to complete the contamination management or remediation work in a safe and environmentally acceptable manner.
- Identify the necessary approvals and licences required by regulatory authorities in order to enable the remediation works to proceed.
- Enable an independent accredited site auditor to certify that the site can be made suitable for the proposed use (hospital carpark), if the site is remediated and managed in accordance with this RAP.

1.5 Scope of work

The scope of works to meet the stated objectives comprised the following:

- Collate and review existing data.
- Identify the areas of concern within the site that may require management or remediation.
- Document the relevant guidelines.
- Set the remediation goals for the site.
- Outline suitable management or remediation strategies that may be applicable to contamination on site.
- Develop management or remediation procedures to form a basis from which the earthworks / remediation contractor/s can develop their own detailed work methods.
- Document a validation process to be followed where required.
- Identify appropriate licence and approvals required to undertake the remediation works.
- Outline contingency and emergency response measures.

1.6 Roles and responsibilities

The roles and responsibilities of the various parties involved in the remediation and validation of the site are outlined below.

1.6.1 Principal Contractor Project Manager

Responsible for overall direction of civil and environmental work (including any management or remediation) associated with the earthworks contract.

1.6.2 Principal Contractor Design Team

Responsible for taking the requirements of this RAP into account in preparation of final earthworks design and configuration and relevant design documents and specifications, including consultation with the Environmental Consultant and Site Auditor.

1.6.3 Earthworks / Remediation Contractor (Contractor)

Responsible for:

- Required civil works (i.e. any physical management, remediation or associated works), including all measures required to protect worker and public health and the environment during the works.
- Preparing a detailed work plan for implementing the works.
- Undertaking material inspections and clearances in accordance with this RAP, the approved Construction Quality Assurance (CQA) program, final design and specifications.
- Preparing / obtaining and providing all relevant supporting documentation to the Environmental Consultant in relation to any remediation works carried out.

1.6.4 Environmental Consultant

Responsible for:

- Providing technical guidance to the earthworks / remediation contractor in appropriately implementing the requirements of the RAP.
- Verifying the Contractor's adherence to the RAP, relevant aspects of the CQA program, final design and specifications.
- Monitoring of work areas for environmental purposes, collection and analysis of validation and characterisation samples, and advising the Principal Contractor of appropriate actions on the basis of observations, sampling and analysis.
- Preparing a Remediation and Validation Report at the completion of remediation.

1.6.5 NSW EPA Accredited Site Auditor

Responsible for:

- Reviewing the CQA plan and other relevant documentation to be developed as part of the final design and specifications, for consistency with this RAP.
- Reviewing the work of the Environmental Consultant.
- Providing a Site Audit Statement regarding the suitability of the site at the completion of remediation and validation.

2. Summary of site conditions

2.1 Site location and description

As presented in Figure 1, Appendix A, the site (Part Lot 401 DP 755237) forms part of the 'Metford Triangle' – the area bounded by Metford Road to the north-west, the Northern Railway to the north-east, and residential properties (separated by a power easement) to the south – generally comprising Lot 7314 DP 1162607 (to the south), Lot 266 DP 755237 (to the east), and Lot 401 DP 755237 (to the north). The site has an approximate area of 2 hectares (ha).

GHD notes that the site is located within the expired mining lease (ML) 1523 and the proposed commercial/industrial land use boundary as shown in the *Closure Mine Operations Plan* (MOP) (VGT, 2015) *Figure 5*.

According to previous investigations the site is part of a property which commenced operation as a quarry and brick manufacturing facility in approximately 1960 (prior to which it was vacant). Site activities included the extraction of clay from on-site quarries (including "Pit 2") and production of clay bricks (which ceased in 2006). The quarrying activities produced large stockpiles of excavated materials, some of which were not used prior to the end of production activities and remained on site prior to remediation.

Following the completion of quarrying activities, quarry voids (including those outside of Part Lot 401) were filled with materials including:

- Waste from coal and oil furnace burning processes
- Waste and hydrocarbon-impacted soils associated with underground fuel storage tanks
- Metal oxides used as colorants in the brick manufacturing process
- Building waste products from building demolition and the manufacturing process
- Quarry overburden (unsuitable for brick manufacturing)

It is understood that remediation and validation works have been carried out on site, presumably resulting in changes to the site conditions and contamination status.

2.2 Surrounding land use

The surrounding land uses (and approximate distances) include:

- **North** – former PGH Bricks & Pavers sales and manufacturing (remaining northern portion of Lot 401) (adjacent), followed by the Northern Railway (300 m), East Maitland Cemetery (350 m), Raymond Terrace Road (450 m), and wetlands associated with Two Mile Creek (500 m).
- **East** – former PGH Bricks & Pavers quarry site (adjacent) (northern corner of Lot 7314 followed by Lot 266), followed by the Northern Railway (400 m), East Maitland Cemetery (portions unused and vegetated) (450 m), and Raymond Terrace Road (550 m).
- **South** – former PGH Bricks & Pavers quarry site (adjacent) (Lot 7314), followed by residential properties (300 m) separated by a power line easement (20 m wide).
- **West** – Metford Road (adjacent), followed by Fieldsend Oval (public sporting/football field) and western CSR/PGH site (50 m), and Two Mile Creek and industrial properties (250 m).

2.3 Environmental setting

The following information is sourced from previous investigations.

2.3.1 Topography

Based on the topographic map of NSW (Land and Property Information, maps.six.nsw.gov.au, accessed 4 July 2019), the site is at approximately 10-24 metres Australian Height Datum (mAHD). The site topography has been significantly altered by historical quarrying activities. In general, the central and western portions of the site appear to slope gradually to the south-west, while the far-eastern portion of the site slopes to the east.

2.3.2 Hydrology

The nearest surface water to the site includes depressions/pits in the disturbed northern portions of Lot 266 (adjacent, which ultimately drain into wetlands approximately 400 m north-east of the site, associated with Two Mile Creek) and Two Mile Creek (approximately 250 m west of the site). Runoff on site is expected to follow the variable landforms and drain towards either the depressions/pits (for the eastern portion of the site) or the stormwater drain along Metford Road (for the western portion of the site), which drains into Two Mile Creek.

2.3.3 Geology and soils

Review of the Geological Survey map of NSW Newcastle 1:100,000 sheet indicated that the regional geology comprises the Tomago Coal Measures consisting of shale, mudstone, sandstone, coal seams and clay layers.

Previous investigations describe the subsurface soil profile encountered as generally comprising clay, brick and ash fill material overlying variable clays, silt stones, fine grained sandstones, coal seams and shales.

2.3.4 Hydrogeology

Groundwater at the site is generally present at 10-15 metres below ground level (mbgl) and the inferred hydraulic gradient is to the east.

Perched groundwater was encountered in Pit 2 at approximately 6 mbgl during the initial investigations undertaken by DLA (2014).

An online search of groundwater bore information (accessed 22 September 2019) reported 11 registered groundwater bores within a 500 m radius of the CSR/PGH site. Of the 11 groundwater bores, nine were registered for monitoring purposes (for the CSR/PGH site), and one was registered for unknown purpose. None of the listed bores were registered for drinking water purposes.

There are two existing monitoring bores on the site (MW61 and MW62) and five existing monitoring bores adjacent the site boundary (MW5, MW400S, MW400D, MW404S and MW404D) as shown in Figure 2 (Appendix A).

2.4 Previous investigations

A review of the following documents was undertaken by GHD and is summarised below (reproduced from the Site Investigation report, GHD, 2019):

- EA 2011 – Preliminary Contamination Assessment – February 2011
- LeVert 2011 – Stage 2 Soil Investigation – September 2011
- VGT 2014 – Mine Operation Plan and Mine Closure Plan – June 2014
- VGT 2015 – Closure Mine Operations Plan – March 2015
- DLA 2014 – Phase 2 Detailed Environmental Site Assessment – January 2014
- DLA 2015a – Additional Detailed Site Investigation (Pit 2 Area) – June 2015
- DLA 2015b – Additional Environmental Investigation – December 2015
- Golder 2015 – Screening Health and Environmental Risk Assessment – December 2015

2.4.1 General

Figure 1 from EA (2011) identifies a number of (former) potential contaminating activities or features in this area of the brickworks site, including the following:

- Calcium fluoride disposal area (also indicated on LeVert 2011 Figure 2 as a Calcium sulphate disposal area. Elsewhere in LeVert 2011 it is described as a fine white gravel which is spent calcium sulphate from the flue gas scrubbers).
- Filled areas (possibly within Part Lot 401).
- 'No. 2 Pit' (possibly within Part Lot 401).

A number of these features are also shown in figures from LeVert 2011 (these have not been attached, for brevity). The Calcium sulphate disposal area is noted as 2 m deep.

VGT (2014) Figure 9 "Domain Areas" 26/03/2014 identifies the following domains in Part Lot 401:

- Domain A – Disturbed floor and stockpiles
- Domain C – Natural steep face with good vegetation
- Domain G – Mixed revegetated land and shallow water bodies
- Lime stockpile (identified in EA 2011 as Calcium fluoride disposal area – a waste product produced from scrubbers)

DLA (2014) noted some site remediation had occurred to the south west of the former factory, creating several large stockpiles. The stockpiles consist of hydrocarbon impacted material undergoing bio-remediation, a large sorted brick, concrete and rubble stockpile with minor polycyclic aromatic hydrocarbon (PAH) detections and two large soil stockpiles, one designated 'clean' and the other 'marginal' both with detections of PAH. It is not known where these stockpiles were in relation to Part Lot 401.

The following is a brief summary of previous investigations undertaken within Lot 401 (focussing on Part Lot 401).

2.4.2 Soil

Intrusive soil investigations were undertaken by LeVert (2011) and DLA (2014-2015).

LeVert recommended further investigations into fill depth and contamination in the filled area south west of the factory, including former Pit 2 (potentially applicable to Part Lot 401).

DLA (2014) sampled approximately 40 test pits in the overall area of Lot 401, as indicated on Figures 3, 4 and 8 (attached, along with Figure 2 "Figure Reference Map"). One of these ("Pit 2") (adjacent/immediately to the north of Part Lot 401) was a large pit measuring approximately 30 m x 30 m wide and 9 m deep, with an additional shaft excavated to bedrock at 14.6 m deep. DLA also collected numerous samples from stockpiles in the area.

DLA (2014) identified the following soil samples exceeding adopted assessment criteria or exhibiting evidence of contamination:

- Total recoverable hydrocarbon (TRH) at 3.5 and 4.5 m depth in TP213.
- Benzo(a)pyrene (BaP) toxic equivalence quotient (TEQ) in Pit 2.
- TRH in test pit 225.
- DLA noted the material encountered within the Pit 2 excavation was relatively consistent throughout the dig, varying between clay with mixed gravel and coal chitter. TP225 was located along the western boundary of Pit 2 within the adjoining bund, and foreign materials were encountered approximately 2-3 m below the surrounding surface level, including processed timber, plastic, metal fragments, a large steel beam, material bags and old drums. DLA noted that although these materials were discovered during excavations into the edge of Pit 2 in this area, the large excavation directly into the Pit 2 area did not encounter any bulk foreign materials.
- Test Pits 191 and 213 were excavated within a 'bund' in the eastern portion of Part Lot 401. DLA noted the bund seemed to be comprised of two separate bunds most likely constructed at different times. The material from natural bedrock to approximately 4 m (about half way up the bund) seems to have been predominantly clean clays with low foreign material content. The upper half (approx. 4 to 5 m at TP191/TP213 location) seems to have been a lower quality source material, with mixed refuse including plastic, steel, emptied material storage bags and sacks, an old crushed 5000 L underground storage tank (UST), and large quantities of broken brick scattered throughout some layers. DLA considered it was highly possible that more USTs may be located in this area given the noted hydrocarbon odour through this upper bund material in at least three (3) separate test pits along the length of the bund. GHD notes that this 'bund' has been now excavated to natural rock and reinstated with soil (and seeded) – refer to Section 2.5**.**

Locations TP103-111, possibly TP188 and TP189, TP190, TP198, TP201, TP214, TP215, TP225, and TP243-245 were also excavated, but did not show evidence of contamination and analysed soil samples did not exceed the adopted assessment criteria.

DLA (2015a) investigations involved additional excavations in the vicinity Pit 2. From the DLA (2015a) report and with reference to attached Figure 1 "CSR/PGH Soil Sampling Locations - Pit 2" 29/08/2014, it appears these investigations comprised "Proposed Pit 2-2" (to the south of previous excavation "Pit 2") and "Proposed Pit 2-4" (to the north of previous excavation "Pit 2"). "Existing Pit 2-1" appears to have been the pit designated as "Pit 2" excavated as described in DLA (2014), and proposed Pit 2-3 does not appear to have been excavated based on subsequent discussion in the DLA (2015a) report. Proposed Pit 2-2 and the southern portion of the area designated as Proposed Pit 2-3 were within Part Lot 401.

Some 14 stockpiles were generated from these excavations (some of which are shown on attached DLA 2015a Figure 1 "Metford former brickworks Stockpile Locations" 7/11/2014), and variously contained materials such as asbestos, ash-like material, foreign materials (concrete, steel and timber), with contaminants including hydrocarbons, PAHs and asbestos. The stockpiles were documented by DLA and either used to backfill the Pit 2 excavations, or remained on site (with some stockpiles undergoing land-farming). GHD notes these stockpiles are no longer present on site. – refer to Section 2.5.

DLA's investigations included the following conclusions relevant to Part Lot 401 (refer to DLA Figure 1 "Pit 2" 29/08/2014 and Figure 1 "Stockpile Locations" 7/11/2014, noting discrepancies in pit extents):

> "… *the following contamination issues may potentially pose an unacceptable risk to human health, the environment and the general amenity of the Site*:
>
> – B(a)P concentrations in the western wall of Pit 2-2;
> – Asbestos-impacted soils in the north-east of Pit 2-2;

DLA (2015a) also concluded that "*It is important to note that this investigation involved excavation into three pits within the greater Pit 2 area… It is likely that contamination remains within the unexcavated areas of Pit 2. Additionally, the widespread nature of contamination at the Site, the heterogeneous distribution of contamination and the uncontrolled history of filling at the Site infer that chemical, asbestos and aesthetic impact is likely to remain at the Site, requiring both future delineation and possibly management*".

While DLA reported the presence of ACM fragments in various samples, including an instance where "*the ACM was observed to have broken into small fragments amongst heavy wet clay", they also reported that "No Asbestos Fines / Fibrous Asbestos (AF/FA) was detected in any of the samples submitted for asbestos analysis*". Brief review of the DLA (2015a) report indicates numerous soil samples (approximately 0.5 kg samples) were quantified for asbestos by the laboratory, with "no asbestos detected". However DLA's methodology in quantifying ACM in larger bulk samples is not detailed, and discussion of results (in DLA weekly reports) is limited to statements that sieve analysis was conducted and the material meets Commercial Industrial criteria. This information is insufficient to assess whether more sensitive criteria would be met. Assessment of the significance of any asbestos contamination will also depend on other considerations such as how asbestos contamination is to be managed.

Data gaps identified by Golder (2015) include the following:

- Understanding of the depth and distribution of fill across the Site
- The exact location of the various historical activities and infrastructure, particularly fuel and chemical storage
- Understanding and mapping of the presence of asbestos

The stated significance of these data gaps varies, and depends primarily on the proposed remediation and management approach.

2.4.3 Surface water/sediment

No previous surface water or sediment sampling appears to have been undertaken within Part Lot 401.

2.4.4 Groundwater

Refer to DLA Figure 1 “Groundwater Monitoring Well Locations” 10/12/2015.

DLA (2014) sampled 5 groundwater wells (MW5, MW7, MW4, MW9 and MW10). MW5 is just north of Part Lot 401. Copper, lead, nickel, and/or zinc concentrations exceeded ANZECC trigger values in a number of groundwater samples, which DLA presumed to be a regional groundwater quality issue. The wells were reported as existing, and no logs were provided.

DLA (2015b) sampled 14 wells in Lot 401 (including MW61 and MW61 within Part Lot 401, and MW5 adjacent as noted previously) and analysed groundwater samples for TRH, benzene, touluene, ethylbenzene and xylene (BTEX), PAH, volatile organic compounds (VOCs), 10 metals and fluoride.

No PAH, BTEX or VOCs were reported above the laboratory limit of reporting (LOR). Low concentrations of TRH were detected in MW93 and MW203, downgradient and some distance to the north of Part Lot 401. Concentrations of various heavy metals exceeded the assessment criteria. DLA did not draw any conclusions regarding the groundwater results.

2.4.5 Previous soil vapour testing

DLA (2015b) also sampled soil vapour from 14 sub-soil locations and one sub-slab location (as shown in Figure 1 19/10/2015, incorrectly titled “Groundwater Monitoring Well Locations”), one of which (GW1) was located within Part Lot 401, and two (GW2 and GW6) nearby (to the north of Part Lot 401). Chloroform was detected in GW1 (and GW6), below the adopted assessment criteria (US EPA Regional Screening Levels for indoor commercial air quality).
Cis 1,2 - dichloroethene was detected in GW2, below the adopted assessment criteria (NEPM 1999, amended 2013) for all land use settings.

2.5 Site inspection

A site inspection was undertaken Monday 12 February 2018, by Jesse Simkus, an experienced senior environmental engineer who was familiar with the site and the proposed development. GHD has undertaken more recent inspections throughout 2019, during site visits associated with the development of Lot 7314. Significant changes to the site conditions (since February 2018) are noted below.

As of February 2018, CSR was active on Part Lot 401, predominantly using the area for storage and management of excavated fill material from Lot 401 remediation works. Site features and observations are summarised in the Site Investigation report (GHD, 2018). The site was predominantly unsealed and bare, with the exception of the embankment in the eastern portion of the site, which had been recently seeded. Several waste stockpiles were on site, associated with Lot 401 remediation works.

Significant changes to the site conditions (since February 2018) include:

- The fill mound/berm in the western portion of the site is no longer present.
- The waste stockpiles are no longer present.
- Ground cover has been established across the site, generally sparse with the exception of the embankment in the eastern portion of the site, which is reasonably well-established.

2.6 Conceptual site model

2.6.1 Sources

The following contaminants of concern (CoPC) are based on investigations on the adjacent Lot 7314 (GHD, 2015) and the review of previous investigations relating to Part Lot 401:

- Total recoverable hydrocarbons (TRH)
- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Polycyclic aromatic hydrocarbons (PAH)
- Metals (including arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium and zinc)
- Pesticides (including organochlorines, OCP)
- Polychlorinated biphenyls (PCB)
- Volatile organic compounds (VOC)
- Asbestos

The following potential sources of contamination (and associated CoPC) have been identified:

- Pit 2 – former quarry void fill material including waste building materials (including ACM) and hydrocarbon-contaminated soils.
- Existing natural embankment in the eastern portion of the site, subjected to fill material originally including waste building materials (including ACM) and a disused underground fuel storage tank (UST).
- Remaining surface soils.

As mentioned previously, it is understood that remediation and validation works have been carried out on site (since the investigations summarised in Section 2.4), presumably resulting in changes to the site conditions and contamination status.

2.6.2 Pathways

Soil and geology

The main geological units expected at the site, in order of stratigraphic sequence, include:

- Fill material – heterogeneous fill material of variable origin and thickness is present over much of the site. Potential exists for sand, silt, clays and gravels and anthropogenic inclusions such as ash, plastic, timber, metals, brick, ceramics, concrete, and asbestos cement fragments. Expected to be highly permeable.
- Natural soils – clays. Expected to be low to moderate permeability.
- Natural rock – shale, mudstone, sandstone, coal seams (carbonaceous layers). Expected to have variable permeability.

The key transport mechanisms for soil contaminants include mobilisation through windborne dust, transportation as sediments via surface water runoff, or leaching to groundwater.

Groundwater

Groundwater provides a key transport mechanism for contaminants through horizontal and vertical migration of contaminated surface water/groundwater through the fill material (into the underlying aquifer), and then possible migration of the impact via advection and dispersion towards the creeks and into the wetlands.

There is a low potential for vertical migration of contaminated groundwater beyond the fill as subsurface materials are predominantly clays, which generally have low permeability.

Surface water

Surface water drainage over the majority of the site is judged to be predominantly via runoff. The site is predominantly unsealed and rainfall is expected to infiltrate into the surface soils or follow drainage contours (natural and channels) to existing water courses (to the east) or the stormwater system on Metford Road (to the west).

Runoff on site is expected to follow the variable landforms and drain towards either the depressions/pits (for the eastern portion of the site) or the stormwater drain along Metford Road (for the western portion of the site), which drains into Two Mile Creek.

Surface water has a potential to transport contaminants at the site, via lateral overland flow during rain events, causing re-deposition of contaminants on other areas of the site or off-site.

Exposure (contaminant uptake) pathways

Based on the identified receptors and the release, fate, and transport characteristics of the CoPC, pathways through which receptors may become exposed include inhalation, ingestion and dermal absorption. These are discussed briefly below in the context of the site setting:

- Inhalation Exposure Pathway: There is the potential for creation of dust from unsealed surfaces. Risk of potential inhalation of contaminated dusts and asbestos fibres.
- Ingestion Exposure Pathway: Ingestion of contaminants by current and future site occupants may occur through day-to-day activities and direct contact with contaminated soils or surface water.
- Groundwater: A risk to human health exposure if groundwater in the area is used for domestic or irrigation purposes. A risk to ecological receptors as groundwater is likely to discharge to Two Mile Creek.
- Dermal Exposure Pathway: Exposure may occur via sorption through biological membranes such as skin. This pathway may be a concern whenever contaminated soil, surface water or groundwater comes into direct contact with a biological membrane. This pathway could also be a concern if contaminated surface water (runoff from the site) was to come into direct contact with benthic and aquatic flora and fauna within off-site surface-water receiving environments.

2.6.3 Potential receptors

The investigation identified a number of potential human and environmental receptors of contamination, provided an exposure pathway exists. These receptors are listed below in the context of the current and proposed site use. These are:

- **Human Health Receptors**, including:
  - Future site users/visitors (including construction and maintenance workers, and potential for long-term patients and associated visitors e.g. family).
  - Off site receptors (e.g. residents on neighbouring properties, users of nearby water courses for recreational purposes, users of groundwater as potable resource).
- **Environmental Receptors**, including:
  - On-site flora and fauna.
  - Off-site ecosystems including down-gradient surface water environments (e.g. creeks and wetland).

2.7 Site and material suitability

2.7.1 General site materials

The site has been compared to “Tier 1” investigation or screening levels for land use settings equivalent to commercial/industrial, which is considered a conservative basis to assess the suitability of site materials for a hospital carpark. It is noted that the HSLs and ESLs for hydrocarbons presented in the NEPM are based on petroleum hydrocarbons using a fuel composition typical of fresh petrol and diesel fuels, and may not be directly applicable to the type of hydrocarbons found at the site (considered to be associated with carbonaceous shales and shale oils). Site specific criteria would be complex to calculate and this is not considered warranted if a conservative approach is taken to assessment and management of the materials at the site.

The identified hydrocarbon (TRH and PAH) “contamination” (this term is used for convenience to indicate any materials presenting a potential health or environmental risk, including naturally occurring materials at the site) is considered to predominantly result from the presence of fill or disturbed materials containing carbonaceous material, as well as in-situ carbonaceous material. However, some hydrocarbon contamination may be associated with disposal of former fuel infrastructure and waste from coal and oil furnace burning processes.

On the basis of the investigations undertaken as discussed above, with the exception of fill containing asbestos contamination, other identified contaminant concentrations are considered relatively minor and isolated, and from a contamination perspective, the fill materials are expected to be acceptable for use in the proposed development.

2.7.2 Asbestos

No asbestos fines / fibrous asbestos (AF/FA) was detected in soil samples from the site, however ACM was identified (bonded condition with no significant degradation), which generally presents a low risk to human health provided it is not disturbed. However, no visible asbestos in surface soils should be present, and both the NEPM and WHS regulations require removal of visible asbestos prior to any work activities that may disturb it. Any ACM to be disposed off site would require appropriate classification in accordance with the *Waste Classification Guidelines*: Part 1 – Classifying waste (EPA, 2014) prior to disposal to an appropriately licenced facility. A final inspection of the areas by a suitably qualified consultant should be undertaken following removal of the ACM.

Given the extent of remediation activity (including material transport and re-use) believed to have occurred on site, there may be other areas that have been impacted by ACM e.g. where stockpiles were stored and in the vicinity of haul roads. Based on the future risk of disturbance to other areas of the site during redevelopment, any exposed ACM should be managed using an AMP containing an unexpected finds protocol.

2.7.3 Aesthetics

It is noted that some areas of fill on the site contain ‘aesthetic issues’ including bricks, and to a lesser extent building and domestic wastes. These materials may not be acceptable for use at the surface, but could be buried at depth or disposed of off-site to a licenced landfill facility prior to development. Where these materials are to be buried, the location and depth should be documented.

2.7.4 Potentially combustible materials

Based on findings and observations on the adjacent Lot 7314, it is possible that potentially combustible (carbonaceous) materials may be present on site, and may require some form of management and remediation to minimise and mitigate future combustibility risks.

2.7.5 Unexpected Finds and Soil Management

The findings of the investigations to date are based on lines of evidence including historical site use, site observations and sampling and analysis from discrete locations. While the site history indicates previous site use was predominantly quarrying activities, and remediation works are understood to have been undertaken, it is possible that contaminated fill may be encountered during redevelopment of the site. There is also a possibility that unexpected contamination could be encountered during earthworks for redevelopment of the site.

The management requirements for unexpected finds are discussed further in Section 7.1.

3. Relevant guidelines and legislation

3.1 Guidelines for contamination assessment and management

3.1.1 National Environmental Protection (Assessment of site Contamination) Amendment Measure 2013

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (referred to here as the NEPM) was produced by the federal National Environmental Protection Council (NEPC) in 1999 and was revised and updated in 2013 by way of the National Environmental Protection (Assessment of site Contamination) Amendment Measure 2013. The NEPM provides a national framework for conducting assessments of contaminated sites in Australia.

The purpose of the NEPM is to *"establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, landowners, developers and industry."*

The desired environmental outcome for the NEPM is to *"provide adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination".*

The NEPM addresses assessment of contamination, and does not provide specific guidance for remediation or management of risk.

The NEPM includes two Schedules: Schedule A comprises a flowchart of the recommended general process for the assessment of site contamination and its relationship to the management of site contamination and Schedule B consists of technical guidelines about site assessment criteria, site investigation procedures, laboratory analyses, human health risk assessment, ecological risk assessment, derivation of investigation levels, groundwater risk assessment, community engagement and risk consultation and competencies and acceptance of environmental auditors and related professionals.

In broad terms, the assessment process can be described as:

- Tier 1 Preliminary investigation, laboratory analysis and interpretation, development of a conceptual site model (CSM) and assessment of results with reference to investigations or screening levels. The need for risk-based remediation assessment to derive response levels and/or the need for remediation is evaluated.
- Where required, Tier 1, Tier 2 or 3 Detailed investigation / Site specific risk assessment, laboratory analysis and interpretation is completed, and the requirement for remediation is evaluated.

3.2 State legislation and guidelines

NSW has a comprehensive suite of guidelines relating to assessment and management of contamination, administered by the EPA[1] under the *Contaminated Land Management Act* (CLM Act) 1997 and the *Protection of the Environment Operations Act* (POEO Act) 1997. These include the following:

- NSW EPA (1995). *Contaminated sites: Sampling Design Guidelines*. New South Wales Environment Protection Authority, 1995.

[1] The NSW Government re-established the EPA as an independent statutory authority in February 2012. Before this, the EPA was part of the Office of Environment and Heritage (OEH) within the Department of Premier and Cabinet.

- NSW EPA (2014). *Waste Classification Guidelines, Part 1: Classifying Waste*. November 2014.
- NSW EPA (2015). *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. New South Wales Environment Protection Authority, 2015.
- NSW OEH (2011). *Contaminated sites: Guidelines for Consultants Reporting on Contaminated sites*. New South Wales Office of Environment and Heritage, 2011.
- NSW EPA (2017). *Contaminated Sites: Guidelines for NSW Site Auditor Scheme (3rd ed.)*. New South Wales Office of Environment and Heritage, 2011.
- NSW DEC (2007). *Guidelines for the Assessment and Management of Groundwater Contamination*. NSW Department of Environment and Conservation, 2007.
- NSW EPA (2015). *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. NSW Environment Protection Authority, 2015.
- NSW EPA (2014). *Waste Classification Guidelines Part 1: Classification of Waste*. NSW Environmental Protection Authority, 2014.

Guidelines approved under the CLM Act also include:

- NEPC (2013). *National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 1999.* National Environment Protection Council, as amended in May 2013.
- NHMRC/NRMMC (2011). *Australian Drinking Water Guidelines.* National Health and Medical Research Council and Natural Resource Management Ministerial Council of Australia and New Zealand, 2011 (updated November 2016).
- ANZECC (2000). *National Water Quality Management Strategy, Paper No. 4, Australian and New Zealand Guidelines for Fresh and Marine Water Quality, October 2000*. Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

  The Australian and New Zealand Governments (ANZG) (2018) criteria were endorsed by NSW EPA under s 105 of the CLM Act on 4 September 2018. At the same time the Australian and New Zealand Environmental Conservation Council (ANZECC) (2000) water quality guidelines were revoked. While the ANZG (2018) have been endorsed, preliminary review of these guidelines by GHD and others has identified a number of discrepancies with ANZECC (2000), which have yet to be clarified. As such, ANZECC (2000) criteria have still been adopted for the purposes of this SAQP until the issues with ANZAST (2018) have been resolved (at which time this SAQP may be revised, along with subsequent reports).
- Friebel, E and Nadebaum, P (2011). *Health screening levels for petroleum hydrocarbons in soil and Groundwater. CRC CARE Technical Report no. 10*. CRC for Contamination Assessment and Remediation of the Environment, Adelaide, Australia, 2011.
- CRC CARE (2017) *Technical Report No. 39, Risk-based management and remediation guidance for benzo(a)pyrene*. CRC for Contamination Assessment and Remediation of the Environment, January 2017.

Other guidelines used in the framework for assessment of asbestos contamination include:

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

3.2.1 State Environmental Planning Policy 55

SEPP55 introduces state wide planning controls for the remediation of contaminated land. Under the provisions of SEPP55, "*land must not be developed if it is unsuitable for a proposed use owing to contamination and must be remediated prior to development"*.

Under the requirements of the SEPP55, remediation is to be classified as either:

- Category 1– remediation work for which development consent is required; or
- Category 2 – remediation work not requiring development consent.

GHD has not carried out a detailed planning assessment, however as far as the "remediation work" is concerned, to the best of our knowledge none of the below apply to the site. On this basis the remediation work is considered to be Category 2.

- The works do not comprise a designated development or require development consent under another State environmental planning policy or a regional environmental plan.
- The works are not proposed to be carried out on or have a significant effect upon land declared to be a critical habitat, threatened species, population or ecological community.
- The works are not proposed to be carried out in an area or zone classified as:
  - (i) coastal protection
  - (ii) conservation or heritage conservation
  - (iii) habitat area, habitat protection area, habitat or wildlife corridor
  - (iv) environment protection
  - (v) escarpment, escarpment protection or escarpment preservation
  - (vi) floodway
  - (vii) littoral rainforest
  - (viii) nature reserve
  - (ix) scenic area or scenic protection
  - (x) wetland
- The works are not proposed to be carried out in a manner that does not comply with a policy made under the contaminated land planning guidelines by City of Maitland Council.

GHD considers that any remediation work would be ancillary to the proposed development of the site for a health services facility. On this basis clause 15 (1) is considered applicable, which states in relation to category 2 remediation:

> (1) A remediation work that would of itself be a category 2 remediation work but which is ancillary to designated development that requires development consent may, as an applicant chooses:
>
> (a) be made part of the subject of the development application for the designated development instead of being made the subject of a separate development application, or
>
> (b) be treated as a category 2 remediation work.

As the proposed redevelopment works will require development consent with associated conditions, it is considered unlikely that any separate approvals would be required for the remediation/soil management. It is understood that the Principal Contractor will determine (in consultation with their planners and the approving authority) how they wish to treat the remediation work in relation to clause 15 of SEPP 55.

Notice must be given to the council for Category 2 remediation work at least 30 days before the commencement of the work and within 30 days after the completion of the work.

3.2.2 Protection of the Environment Operations Act

Activities requiring an EPA license under Schedule 1 of the POEO Act include contaminated soil treatment works for on-site or off-site treatment (including in either case incineration or storage of contaminated soil but excluding excavation for treatment at another site) that:

1. Handle more than 1,000 m^3 per year of contaminated soil not originating from the site on which the works are located; or
2. Handle contaminated soil originating exclusively from the site on which the works are located and:
   - Incinerate more than 1,000 m^3 per year of contaminated soil.
   - Treat otherwise than by incineration and store more than 30,000 m^3 of contaminated soil.
   - Disturb more than an aggregate area of 3 hectares (30,000 m^2) of contaminated soil.

It is not anticipated that any of these thresholds will be exceeded by the proposed remediation works, and hence licensing would not be required under the POEO Act.

3.2.3 Work Health and Safety Act and asbestos removal regulations and code of practice

The Principal Contractor has a legal obligation under the Work Health and Safety (National Uniform Legislation) Act 2011, (the WHS Act) and prescribed in the Work Health and Safety (National Uniform Legislation) Regulations 2017, to ensure the work health and safety of its workers, subcontractors and visitors.

As there is a potential for asbestos to be encountered within fill at the site, the primary legislative requirements detailing the Principal Contractor's obligations regarding the presence of asbestos (if it is encountered) on the site are listed as follows:

- Work Health and Safety Act 2011(NSW)
- Work Health and Safety Regulations 2017 (NSW)
- How to Manage and Control Asbestos in the Workplace, 2016 SafeWork NSW
- How to Safely Remove Asbestos, 2016 SafeWork NSW

3.3 Local Council requirements

Maitland City Council does not have a specific policy related to contaminated land. The requirements of SEPP55 would apply in relation to notification of remediation works.

It is considered that Maitland City Council will address any particular concerns relating to site contamination as part of the development approval process.

3.4 Commonwealth legislation

The principal Commonwealth environmental legislation potentially relevant to the site is the Environment Protection and Biodiversity Act 1999 (EPBC Act). The EPBC Act provides that the Commonwealth is to be involved in matters of "National Environmental Significance" (NES). Under the environmental assessment provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of NES are subject to an assessment and approval process. The EPBC Act identifies seven matters of NES:

- World Heritage properties
- National Heritage places
- Ramsar Wetlands of international significance
- Nationally listed threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining)

When there are habitats or species of national significance (as listed under the schedules of the Environment Protection and Biodiversity Conservation Regulation 2000) within the project remediation area likely to be impacted negatively upon by the proposed remediation works, then preparation and lodgement of an EPBC Act referral to the Commonwealth for the assessment would need to be considered and addressed accordingly.

Such requirements will presumably be addressed in planning and approval documentation for redevelopment of the site, and have not been further considered in this RAP.

4. Assessment criteria

4.1 Relevant guidelines

The framework for the contamination assessment was developed with reference to relevant guidelines relating to assessment and management of contamination as detailed in Section 3.1.

In the first instance, the most sensitive assessment criteria will be compared with the concentrations of any contamination identified at the site. If these are exceeded, the specific land use and exposure scenarios relevant to the area and depth at which the subject material is located will be examined, and the concentrations compared with the appropriate criteria for those circumstances. If the relevant criteria are exceeded, the material will be managed or remediated in accordance with this RAP.

4.2 Soil assessment/validation criteria

The NEPM includes a range of ecological investigation and screening levels, health investigation levels and health screening levels for a range of contaminants and for a range of land use and exposure scenarios.

The selection of the assessment criteria has been based on the following considerations, some of which are peculiar to the proposed development of the site as a hospital:

- The site will predominantly be sealed by the proposed carpark, with limited potential for direct contact within contaminated soils.
- There is a potential for vapour intrusion from hydrocarbon contamination for future buildings (although this is considered a low potential given the nature of the historical site use, with contaminants of concern unlikely to include volatile hydrocarbons, and also considering the distance to the nearest proposed building).
- The health investigation levels (HILs) developed for the commercial/industrial land use scenario are not applicable to a site used frequently by more sensitive groups such as children (within childcare centres, hospitals and hotels) and the elderly (within hospitals, aged care facilities and hospices). Notwithstanding the above, the commercial/industrial HILs are considered applicable to the proposed use of Part Lot 401 as a car park.

Where investigation levels are not presented in the NEPM (as amended 2013), other references sources (such as the USEPA regional screening levels) will be used, e.g. for CoPC associated with brick manufacturing – barium, fluoride and manganese.

4.2.1 Health investigation and screening levels

HILs have been developed for a broad range of metals and organic substances and are applicable for assessing human health risk via all relevant pathways of exposure. The HILs are generic to all soil types. Site specific conditions determine the depth to which HILs apply for land uses other than residential (generally to depth of 3 m).

Health screening levels (HSLs) for petroleum compounds (which comprise TRH including BTEX) have been developed for assessing human health risk via the vapour exposure pathway. The HSLs apply to the same land use settings as HILs and include additional dimensions of soil type and depth.

Given the considerations outlined above, the following assessment criteria, which are sourced from Schedule B1 of the NEPM 1999 (as amended 2013), will be adopted:

- HIL C – open space purposes (public open space such as parks, playgrounds, playing fields e.g. ovals, secondary schools and footpaths) for any open space areas
- HIL D – commercial / industrial for car parking areas
- HSL D – commercial / industrial for car parking areas

No single summary statistic will fully characterise a site and appropriate consideration of relevant statistical measurements should be used in the data evaluation process and iterative development of the CSM. The preferred approach is to examine a range of summary statistics including the contaminant range, median, arithmetic/geometric mean, standard deviation and 95% upper confidence limit (UCL).

At the very least, the maximum and the 95% UCL of the arithmetic mean contaminant concentration should be compared to the relevant Tier 1 screening criteria. However, where there is sufficient data available, and it is appropriate for the exposure being evaluated, the arithmetic mean (or geometric mean in cases where the data is log normally distributed) should also be compared to the relevant Tier 1 investigation or screening level. The implications of localised elevated values (hotspots) should also be considered.

The results should also meet the following criteria:

- The standard deviation of the results should be less than 50% of the relevant investigation or screening level.
- No single value should exceed 250% of the relevant investigation or screening level.

Statistical assessment will be based on sample populations from similar soil profiles (e.g. fill material will be not be assessed with samples of underlying natural soils), and if appropriate, for similar or localised areas of the site (i.e. expected to be subject to the same impact).

In statistical assessments, only one result will be used per sample ID, with the greater of the primary or duplicate sample used where applicable. Where the analytical result is less than the laboratory detection limit, the detection limit is to be used for the statistical assessment.

4.2.2 US EPA Regional screening levels (RSLs)

The US EPA residential soil guidelines are risk-based screening levels (RSLs) that have been derived from equations combining exposure assumptions with chemical-specific toxicity values.

The RSLs will be used to assess the soil exposure pathway for contaminants in the absence of a HSL or HIL guideline value.

4.2.3 Ecological investigation levels and ecological screening levels

Ecological investigation levels (EILs) have been developed for selected metals and organic substances and are applicable for assessing risk to terrestrial ecosystems. EILs depend on land use scenarios and generally apply to the top 2 m of soil. EILs have been developed for three generic land use settings including areas of ecological significance, urban residential areas and public open space, and commercial and industrial land uses.

Added contaminant limit (ACL) based EILs have been derived for As, Cu, Cr III, DDT, naphthalene, Ni, Pb and Zn. The application of ACL-based EILs is also dependent on site specific soil characteristics including pH and cation exchange capacity (CEC). These soil characteristics will be investigated to determine the ACL.

Generic EILs have been derived for aged As, fresh DDT and fresh naphthalene.

Ecological Screening Levels (ESLs) have been developed for selected petroleum hydrocarbon compounds and TRH fractions and are applicable for assessing risk to terrestrial ecosystems. ESLs also depend on land use scenarios (identical to EILs) and broadly apply to coarse- and fine-grained soils and various land uses. They are generally applicable to the top 2 m of soil.

Given the proposed development of the site, the following assessment criteria will be adopted:

- Soil Specific ACL-based EILs for urban residential and public open space
- Generic EILs (for arsenic and fresh DDT) for urban residential and public open space
- ESLs (for TRH and BaP) for urban residential areas and public open space

EILs / ESLs will not be applicable for areas covered by permanent paving.

4.2.4 Management limits

The NEPM includes “Management Limits” which are considered after application of the HSLs and ESLs, to address a number of policy considerations which reflect the nature and properties of petroleum hydrocarbons:

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

The management limits have been adopted in the NEPM as interim Tier 1 guidance to avoid or minimise these potential effects. The NEPM states that application of the management limits will require consideration of site-specific factors such as the depth of building basements and services and depth to groundwater, to determine the maximum depth to which the limits should apply, and that the management limits may have less relevance at operating industrial sites (including mine sites) which have no or limited sensitive receptors in the area of potential impact.

As part of the Tier 1 screening, GHD will consider the management limits for TRH fractions F1-F4 in soil for residential / open space.

4.2.5 Health screening levels for asbestos contamination in soil

The NEPM provides guidance relating to the assessment of known and suspected asbestos contamination in soil and addresses both friable and non-friable forms of asbestos. The health screening levels for asbestos in soil have been adopted from the Western Australian Department of Health (WA DoH) *Guidelines for Remediation and Management of Asbestos Contaminated Sites in Western Australia* (WA DoH 2009).

The NEPM guidance emphasises that the assessment and management of asbestos contamination should take into account the condition of the asbestos materials and the potential for damage and resulting release of asbestos fibres. Therefore, for the purposes of assessing the significance of asbestos in soil contamination, three terms are used as summarised below:

- Bonded asbestos containing material” (Bonded ACM) – sound condition although possibly broken or fragments and the asbestos is bound in a matrix.
- Fibrous asbestos (FA) – friable asbestos materials such as severely weathered ACM and asbestos in the form of loose fibrous materials such as insulation.
- Asbestos fines (AF) – including free fibres of asbestos, small fibre bundles and also fragmented ACM that passes through a 7 mm x 7 mm sieve.

From a risk to human health perspective, FA and AF are considered to be equivalent to “friable” asbestos in Safe Work Australia (2011), which is defined therein as ‘material that is in a powder form or that can be crumbled, pulverised or reduced to a powder by hand pressure when dry, and contains asbestos’.

Bonded ACM in sound condition represents a low human health risk. However, both FA and AF materials have the potential to generate, or be associated with, free asbestos fibres and may represent a significant human health risk if disturbed and fibres are made airborne.

As per Section 4.2.1, the following health screening levels have been adopted as the most appropriate to the site:

- Residential A – includes residential with gardens/accessible soils
- Recreational C – includes public open space such as parks, playgrounds, playing fields (e.g. ovals), secondary schools and unpaved footpaths
- Commercial / Industrial D – includes premises such as shops, offices, factories and industrial sites

	Health Screening Level (w/w)		
Form of Asbestos	Residential A	Recreational C	Commercial/Industrial D
Bonded ACM	0.01%	0.02%	0.05%
FA and AFa (friable asbestos)	0.001%		
All forms of asbestos	No visible asbestos for surface soil		

a. The screening level of 0.001% w/w asbestos in soil for FA and AF only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

A tiered approach to risk assessment of asbestos contamination is recommended, including the development of an appropriate Conceptual Site Model (CSM). A weight of evidence approach is recommended with consideration given to factors such as the distribution of different fill types, the heterogeneity of the contamination and the uncertainty associated with the sampling methodology.

The NEPM states that if the Tier 1 screening levels are not exceeded, and an appropriate level of investigation has been carried out, then no contamination management actions are required except for ensuring the surface soil is free of visual asbestos. This may be achieved by multidirectional raking or tilling and hand-picking of exposed fragments of bonded ACM. Final visual inspection of assessment/remediated areas should not detect any visible asbestos.

4.2.6 Aesthetics

Assessment of aesthetic issues will be undertaken as outlined in Schedule B(1) of the NEPM (1999) which states that ‘there are no specific numeric aesthetic guidelines, however site assessment requires balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity’.

General assessment considerations include:

- That chemically discoloured soils or large quantities of various types of inert refuse, particularly if unsightly, may cause ongoing concern to site users.
- The depth of the materials, including chemical residues, in relation to the final surface of the site.
- The need for, and practicality of, any long-term management of foreign material.

The NEPM notes that in some cases, documentation of the nature and distribution of the foreign material may be sufficient to address concerns relating to potential land use restrictions.

4.2.7 Selected criteria

The methodology used when assessing contamination levels in soils during the site validation will be to use the EILs/ESLs and HILs/HSLs as cut off points to classify soils either as:

- Soils not contaminated, which pose no risk to the environment or human health and warrant no further action, i.e. concentrations less than or equal to the EILs/ESLs.
- Soils containing elevated concentrations of contaminants, which may pose a risk to the environment (in particular plant species or soil organisms) but pose no risk to human health under the proposed land use scenarios i.e. concentrations greater than the ecological values and less than the adopted HILs/HSLs. A qualitative risk assessment may be sufficient to evaluate the potential impact for the proposed land use.
- Soils significantly contaminated which pose a risk to both the environment and human health, i.e. concentrations significantly greater than relevant investigation or screening levels. Soils in this category would likely require site-specific health and/or ecological risk assessment (Tier 2 or 3) carried out as appropriate for the proposed land use. This will usually require the collection of additional site data. Alternatively, a conservative management approach may be adopted, depending on the likely cost effectiveness of further assessment when compared with the cost of conservative management.

4.3 Waste classification criteria

Materials that may require offsite disposal as part of site remediation will be classified using the *Waste Classification Guidelines – Part 1: Classification of Waste* (NSW EPA 2014). In accordance with NSW EPA 2014, the following six-step guide to the classification of waste and waste classification principles apply:

- Step 1: establish if the waste should be classified as a special waste.

  'Special waste' is a class of waste that has unique regulatory requirements. The potential environmental impacts of special waste need to be managed to minimise the risk of harm to the environment and human health. Special wastes are:

  – Clinical and related waste
  – Asbestos waste
  – Waste tyres

  Asbestos waste means any waste that contains asbestos. If asbestos is mixed with other waste to form asbestos waste, the waste must continue to be assessed in accordance with the guidelines to enable the disposal of the asbestos waste at an appropriate waste facility. Asbestos waste must be managed to meet the management and disposal requirements of both asbestos and the other class of waste with which it is mixed (if any).
- Step 2: If not a special waste, establish whether the waste should be classified as a liquid waste.
- Step 3: If not special waste or liquid waste, establish whether the waste is of a type that has already been pre classified. A number of commonly generated wastes have been pre-classified.
- Step 4: If the waste is not a special waste, liquid waste or is not suitable for pre classification, establish whether it has certain hazardous characteristics and should therefore be classified as hazardous.
- Step 5: If the waste does not possess hazardous characteristics, chemically asses to determine what class of waste.

- Step 6: The first test used to chemically assess waste is the Specific Contaminant Concentration (SCC) test, which determines the total concentration of each contaminant in the waste sample. The guidelines set different maximum levels for the total concentration of each contaminant in order for waste to be classified as either general solid waste or restricted solid waste.

  The toxicity characteristic leaching potential (TCLP) test estimates the potential for waste to release chemical contaminants into a leaching liquid. The guidelines set different maximum levels of the leachable concentration of each contaminant in order for waste to be classified as general solid waste, restricted solid waste or hazardous waste.

The following principles must be applied at all times when using the step-by-step waste classification process.

- If special waste is mixed with another class of waste, the waste must be managed to meet the requirements of both the special waste and the other class of waste.
- If asbestos waste is mixed with any other class of waste, all the waste must be classified as asbestos waste. For example, asbestos waste mixed with building and demolition waste must be managed as asbestos waste.
- If liquid waste is mixed with a hazardous or solid waste and retains the characteristics of liquid waste, the waste remains liquid waste.
- Two or more classes of waste must not be mixed in order to reduce the concentration of chemical contaminants. Dilution of contaminants is not an acceptable waste management option.
- Where practicable, it is desirable to separate a mixture of wastes before classifying them separately. For example, if waste tyres (a special waste) are mixed with lead acid batteries (a hazardous waste) it would be desirable to separate the wastes so that only the hazardous component needs to be managed as hazardous waste.

4.4 Surface water and groundwater

Analytical results will be assessed with reference to Schedule B1 of the NEPM 1999 (as amended in May 2013) Groundwater Investigation Levels (GILs). These guidelines are based on the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* ANZECC/ARMCANZ 2000 (ANZECC), the *Australian Drinking Water Guidelines* 2011 (ADWG), and the Guidelines for Managing Risk in Recreational Waters 2008 (GMRRW). The GILs for fresh and marine waters are based on the trigger values (TVs) applying to typical slightly to moderately disturbed systems which generally comprise the 95% protection level but also includes the 99% protection level as a default value for some parameters (to allow for chronic effects for particular species, or to allow for potential bioaccumulation). Given the end recipient of groundwater emanating from the site is likely Two Mile Creek, the freshwater (FW) GILs will be considered.

NSW EPA has advised that the low reliability trigger values from Table 8.3.7 of ANZECC (2000) should be considered if no other data is available.

Where more than one criterion is available for a parameter (e.g. multiple valence states or isomers), the lowest trigger value will be adopted.

The GMRRW recommend applying a multiplication factor of 10 to 20 to the ADWG for assessment of the acceptability of recreational water quality. GILs for other receptors should be obtained directly from the 'primary industries' section of ANZECC 2000 where relevant. Note that the recreational and aesthetics sections of ANZECC 2000 have been superseded by the GMRRW.

5. Remediation options review

5.1 Overall objectives and remediation goals

The overall goal of the remediation or management is to cost effectively manage, remediate or remove identified contaminated soils within the site to mitigate potential environmental and health hazards from exposure to impacts during redevelopment of the site and ongoing future use as a health services facility.

In order to achieve this overall objective, management or remediation works may be required at the site to address potential contamination issues identified in the Site Investigation report, and unexpected contamination that may be encountered during the site redevelopment.

Specific remediation goals would be as follows:

- Manage or remediate and validate areas of contamination identified in the Site Investigation report. CoPC include hydrocarbons (TRH, PAH), ACM and aesthetic impacts.
- Manage aesthetic impacts so they do not detract from the proposed development.
- Manage any naturally occurring carbonaceous materials (if encountered in significant quantities) so they do not present a risk to the proposed development.
- Appropriately manage or remediate as required any unexpected finds that may be encountered during the site redevelopment.

Remediation (where required, if management to prevent exposure to potential contamination is not feasible) is to be undertaken to achieve residual concentrations of contaminants less than the adopted criteria as discussed in Section 4.2.

5.2 Technical and policy considerations

The key principles for remediation and management of contaminated sites presented in the NEPM (NEPC 2013) indicate that the preferred hierarchy of options for site clean-up and management should include (in descending order):

- On-site treatment of the contamination so that it is destroyed or the associated risk is reduced to an acceptable level.
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which soil is returned to the site.

If the above are not practicable,

- Consolidation and isolation of the soil on site by containment with a properly designed barrier.
- Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material.

Or

- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.

Other options, which are consistent with the philosophy of contamination management described in the NEPM, could include the following:

- Adopting a less sensitive land use to minimise the need for remedial works, which may include partial remediation.
- Leaving contaminated material in-situ providing there is no immediate danger to the environment or community and the site has appropriate management controls in place.

The NEPM also states the following:

When deciding which option to choose, the sustainability (environmental, economic and social) of each option should be considered, in terms of achieving an appropriate balance between the benefits and effects of undertaking the option.

In cases where no readily available or economically feasible method is available for remediation, it may be possible to adopt appropriate regulatory controls or develop other forms of remediation.

It should be emphasised that the appropriateness of any particular option will vary depending on a range of local factors. Acceptance of any specific option or mix of options in any particular set of circumstances is therefore a matter for the responsible participating jurisdiction.

In relation to asbestos, the NEPM (Schedule B1 section 4.11) notes that remediation options which minimise soil disturbance and therefore public risk are preferred; and management of asbestos in situ is encouraged, which may include covering the contamination with uncontaminated fill or other protective or warning layers. However, Section 4.1 of Schedule B1 notes that this guidance is not applicable to asbestos materials which are wastes such as demolition materials present on the surface of the land. Section 4.3 also notes that if visible asbestos is present and it may be disturbed during work activities, it must be removed.

The Waste Avoidance and Resource Recovery Act 2001 establishes the following hierarchy for the management of resources:

- Avoid unnecessary resource consumption
- Recover resources (including reusing, reprocessing, recycling and recovering energy)
- Disposal

5.3 Evaluation of remediation technologies

A brief overview of commonly used remediation technologies (and whether they may be applicable to the CoPC identified at the site) is presented in Table 5-1. This is a “screening level” evaluation, from which relevant technologies have been further examined in Section 5.4.

Table 5-1 Overview of remediation technologies

Remediation Method	Description	Applicability
Health / Ecological Risk Assessment (HERA)	A site-specific consideration of the toxicology and exposure to contaminants present and may demonstrate that higher concentrations of contaminants (greater than “investigation levels”) can justifiably remain on the site without presenting an unacceptable health risk.	UNLIKELY TO BE SUITABLE: A site specific HERA is not considered practical at this time given the long-term future use of specific areas of the site are not certain. Further, the earthworks and pavements required at the site provide opportunity to remove exposure pathways to identified contamination, without HERA being required.
Management of Exposure	Precluding access to the site (secure fencing and signage) to prevent or minimise access to affected areas and reduce the potential for exposure. This method requires a Site Management Plan to ensure the site remains secure and no migration of contamination has occurred.	NOT APPLICABLE: Given the objectives of the remediation work is to allow the site to be redeveloped, this option is not considered to be applicable, although it may be appropriate as an interim management measure.
Vertical Mixing	The technique of mixing contaminated surface soil with cleaner soil found at depth (generally developed for use on broad-acre agricultural land).	NOT APPROPRIATE: Vertical mixing is not considered appropriate for asbestos or aesthetic contamination, or for the nature of this site.
Bioremediation	Use of microbial organisms to convert contaminants into harmless products often with the use of artificial stimulation. Often referred to as land farming, bioremediation technology is mainly used to destroy organic contaminants.	NOT APPROPRIATE. TRH contaminated soils may respond to bioremediation however it is not appropriate for heavy metals, PAHs and asbestos. Limitations also include timing constraints and availability of site area.
Chemical Remediation Methods	Vitrification/ Acid Leaching/Thermal Oxidation and Catalytic Chemical Oxidation/ Immobilisation	NOT APPLICABLE: Due to the nature of the contaminants, generally low concentrations involved and high costs of establishment.
Soil Washing	A physical process that separates the contaminants and then concentrates them into fractions which have much lesser volumes and can be treated	NOT APPLICABLE: Due to the nature of contamination involved and high costs and complexity of soil washing systems.
Physical Separation	Physical separation (such as mechanical screening) to separate types or sizes of material enabling removal or concentration of contaminants.	MAY BE APPLICABLE: For ACM contamination on site and for anthropogenic wastes (eg. bricks) presenting aesthetic impacts. Not applicable to hydrocarbon contaminated soils. Would not remediate all contamination at the site and would have to be used in conjunction with other methods.

Remediation Method	Description	Applicability
Excavation and Disposal	Excavation and offsite disposal to a NSW EPA approved landfill disposal site with appropriate environmental safeguards. The resulting excavation is generally backfilled (if required) using clean, validated fill materials. Disposal of contaminated material is permitted by the NSW EPA subject to the provisions of the POEO Act 1997. NSW EPA 2014 sets out the methodology for assessing and classifying solid wastes to be disposed to landfill.	POTENTIALLY SUITABLE: This method is suitable for some contamination at the site where low volumes are expected or where policy prefers off-site disposal (such as ACM contamination). Principles including sustainability and waste minimisation may prefer other methods particularly where large volumes are involved.
On-site capping and containment	Capping involves the installation of a physical barrier to separate contaminated soil from infiltration and to provide a barrier to minimise human exposure. Containment involves the installation of a physical barrier around the contaminated area to prevent contaminants migrating away for the area. Thus, when used in combination, capping and containment essentially isolates the contaminated soil from the surrounding area. The inclusion of an effective low permeability capping system and appropriate surface water controls/management can be used to result in minimisation of groundwater generated within the cell. Capping and containment generally require long term management to prevent future exposure, in the form of a Site Management Plan.	POTENTIALLY SUITABLE: Capping is a commonly used remedial strategy due to its effectiveness, simplicity and low overall cost. Further, earthworks and pavement will be required for the proposed car park which may be used for conservative management of contaminated soils identified on site. As noted in Section 5.2, the NEPM advocates in-situ management of asbestos contaminated soils (with some exceptions), and this may be applicable for large volumes of soil with low levels of occurrence (or potential occurrence) of ACM.

5.4 Recommended remediation/soil management options

As a general principle in redevelopment of the site, HI has committed to using best endeavours to manage contamination on site, where appropriate.

Potential contamination scenarios at the site are considered to include:

- Isolated instances of asbestos-containing material (ACM)
- Areas of anthropogenic wastes
- Presence of natural carbonaceous materials
- Potential for “unexpected finds” of contamination to occur during earth works

The CoPC at the site include TRH, PAH, ACM and aesthetic impacts. These contaminants cannot readily be destroyed, and treatment methods that reduce contaminant concentrations so that soils can be re-used on site are not considered suitable options.

Physical removal and disposal of potential ACM contamination associated with illegally dumped materials (if identified) that may be disturbed by the site works is the preferred strategy and consistent with regulatory requirements for asbestos. Any remediated areas will then be cleared by a licenced contractor and validated by an environmental consultant.

Where small quantities of asbestos are present (or potentially present) in large volumes of soil, considerations of sustainability and waste minimisation may result in on-site containment of such material.

Physical separation and removal of unacceptable material may be appropriate to address aesthetic impacts across the general site area, however it may be more effective to simply use such material for bulk fill (subject to geotechnical requirements or constraints) in areas where it is unlikely to be disturbed.

Although offsite disposal is low on the remediation hierarchy, this option (where required) is considered to be the most appropriate and practical to be used for ACM and other unacceptable materials (aesthetic impacts) where these cannot be managed on site.

Capping and containment is considered appropriate as a conservative management option for potential TRH, PAH and ACM impacted soils where contamination will not be subject to exposure under normal foreseeable use of the site (eg. burial at depths greater than 2 m below design structure levels or beneath permanent infrastructure as part of the redevelopment). This would also address the issues of combustibility of natural carbonaceous material. Based on a low likelihood of leachable contaminants, impermeable capping of material is not considered necessary.

Management of “unexpected finds” will apply to all areas of the site during development works.

A Long Term Site Management Plan (LTSMP) will be required to record the placement of any contaminated material on site, and provide procedures to be used in the event that it should be disturbed.

The particular methods to be used for each material / source should be agreed with HI and the Principal Contractor (and their designers) for the development in conjunction with finalisation of design, to account for any particular geotechnical requirements, optimise earthmoving and minimise the potential for future disturbance of contaminated or problematic materials. It is anticipated this will take the form of a “material re-use schedule”, to be prepared as part of final design and consistent with the principles described in this RAP. A CQA plan (as discussed in Sections 5.4 and 6.6) will be required as a basis for verifying and documenting the appropriate implementation of this RAP and final design documentation.

These documents (including relevant aspects of the final design, specifications, material re-use schedule and CQA plan) shall be reviewed by the Environmental Consultant and Site Auditor prior to the commencement of remediation to confirm that they are consistent with the principles of this RAP.

The principles below should be followed in the finalisation of the earthworks design and specifications.

6. Remediation works plan

This section provides a description of the remediation works steps and procedures required to protect health, safety and the environment during any required remediation works. It is expected that these will be supplemented by technical specifications for the earthworks, and that the Contractor will prepare an appropriate detailed work plan based on the requirements of this RAP and the technical specifications.

The “material re-use schedule” and CQA plan mentioned in Section 5.4 may be prepared as part of final design, in consultation between the Contractor and design team. It is recommended that the Environmental Consultant and Site Auditor be consulted during the preparation of these documents (i.e. prior to final review), to facilitate appropriate interpretation of the contamination remediation or management requirements.

The roles and responsibilities of the Principal Contractor Project Manager, Site Auditor, Environmental Consultant and Contractor are outlined in Section 1.6.

6.1 Preliminaries

Prior to commencing remedial works, all relevant licences and approvals must be obtained by the site owner and/or Contractor from the relevant authorities.

Prior to the establishment at the site, the Contractor is required to prepare a Detailed Work Plan incorporating the following documentation:

- Work Health and Safety Plan (WHSP) including emergency response procedures
- Construction Environmental Management Plan (CEMP)
- Asbestos Management Plan (AMP)

It is a requirement for the various plans to be reviewed and accepted by the nominated responsible parties prior to any remediation works commencing. A separate WHSP will be prepared for environmental consulting works.

It is the responsibility of the Contractor to prepare and/or obtain all appropriate documentation prior to the commencement of the works including plans, programmes, licences and certificates and have undertaken any notifications necessary for the commencement of the work. All such documents must be completed and approved by the relevant consent authority (where required). These documents are anticipated to include, but are not limited to, the following:

- Consent from the relevant approving authority to undertaken the remediation works (if not already covered by the project approvals)
- Insurance Certificates
- SafeWork NSW notifications

Following provision and approval of these documents, the Contractor will mobilise all necessary plant, equipment and amenities as required to complete the project in accordance with these requirements.

6.2 Site mobilisation

Management of the site mobilisation process is to be included in the Detailed Work Plan including the following:

- Site access and security - The Contractor will be responsible for ensuring the security of all work areas and all plant and equipment maintained on-site during remediation works. This includes signage, control of site access (authorised personnel and vehicles only) and safety inductions and documentation.
- Plant re-fuelling/maintenance/cleaning - The Contractor will be responsible for designating locations/areas for equipment refuelling, maintenance, and cleaning activities undertaken during the site works and to ensure all vehicles leaving the site are free of any contaminated material. No refuelling or maintenance activities shall be undertaken without specific approval from the Principal Contractor Project Manager.
- Traffic control - The Contractor will be responsible for ensuring adequate traffic control measures are in place to ensure site safety and take into consideration the entry and egress of vehicles from the main site entrance off Metford Road or other approved access points.
- Environmental controls - The Contractor will be responsible for installing and maintaining environmental controls consistent with their CEMP.

6.3 Vegetation clearance

Vegetation clearance will be subject to any requirements of the project approvals and design. In relation to site contamination, particular care shall be taken when clearing any thickly vegetated areas to avoid disturbance and spreading of contaminated materials, particularly ACM. An appropriately trained “spotter” shall supervise all vegetation clearance to ensure these requirements are met. The unexpected finds protocol shall be implemented if any contamination is observed during vegetation clearance.

6.4 Asbestos management

As noted in Section 6.1, the Contractor is required to prepare an AMP as part of their site management documentation. The Contractor’s AMP shall be consistent with the following requirements for remediation or management of asbestos encountered at the site (as required), and meet the requirements of the WHS Regulation (2011) and relevant Codes of Practice.

6.4.1 Surface ACM removal

In relation to asbestos, the NEPM (Schedule B1 section 4.11) notes that asbestos materials which are present on the land surface and are included in wastes such as demolition materials, must be removed prior to disturbance during proposed site work activities.

Hand picking procedure

- Hand picking of any observed fragments (as required) must be completed by a licenced asbestos removal contractor (if it is more than 10m^2) or competent person in consultation with the Environmental Consultant.
- If ACM is identified/collected during hand picking, the location and weights of asbestos should be recorded.

- Hand picking should consist of at least two passes of the picking area made with 90^0 direction change between each and using a grid pattern. If fragments are partially buried, surface raking of the top 100 mm of soil should be undertaken to disturb the subsurface soils and remove any partially buried fragments.
- ACM should not be further damaged or distributed by the process.
- Percent ACM contamination may be calculated using 1 cm as soil depth for hand picking.
- A final visual inspection should not detect surface ACM.
- The affected areas should be validated to confirm the removal of the ACM by visual and mechanical screening.
- Any asbestos materials found and recovered will be handled in accordance with *How to Safely Remove Asbestos – Code of Practice*, SafeWork NSW 2016 (approved under Section 274 of the Work Health and Safety Act 2011), classified in accordance with the NSW EPA Waste Classification Guidelines, Part 1: Classifying Waste (NSW EPA 2014), and disposed of offsite to a facility licenced to receive asbestos waste.

Excavation procedure

Should extensive surface or buried ACM be identified during the DSI or during development works, that cannot be feasibly removed by handpicking, these materials may be addressed by management of the ACM impacts through excavation and burial or capping under hardstand as per the procedure detailed in Section 6.5 below.

6.5 Development earthworks

One of the major components of the proposed redevelopment of the site is the bulk excavation and re-use of sub surface materials that may contain low impact contamination (aesthetic impacts, hydrocarbons, ACM and carbonaceous materials). Bulk earthworks will generally include the following steps as outlined in Table 6-1.

Table 6-1 Bulk earthworks – tasks and responsibilities

Activity	Responsibility
Locate the areas designated for bulk earthworks and assess the area as to the risk of disturbance of identified contamination.	Contractor and Environmental Consultant
Removal of vegetation as appropriate (eg shrubs) for mulching or as otherwise required by specifications. See Section 6.3.	Contractor
Visual assessment of exposed surface for potential ACM and foreign materials.	Contractor and Environmental consultant
Excavation/movement of site soils (surface and subsurface materials and stockpiles) with visual screening for potentially contaminated material (ACM, aesthetic impacts).	Contractor and environmental consultant
Segregation and stockpiling or direct re-use of different waste streams (as required) based on visual assessment (see Section 6.6 for further details).	Contractor
Characterisation of stockpiled material for management on site (burial or capping), or for waste classification/disposal off site in accordance with NSW EPA 2014.	Contractor / Environmental Consultant

Activity	Responsibility
Use of suitable material in designated areas as appropriate for the development ensuring burial at depths greater than 2 m below design structure levels, or capping under proposed hard stand (as per Section 6.6).	Contractor
Transport contaminated material by licensed waste transporter, to an appropriately licensed site for disposal or to an approved recycling facility where appropriate. (Section 6.7)	Contractor
Final design surfaces including pavements, topsoiling and revegetation as required.	Contractor

All excavation and materials movement shall be conducted in accordance with the Contractor's Detailed Work Plan and CEMP. All excavations undertaken within suspected contaminated areas or stockpiles shall be conducted under supervision of the Environmental Consultant to ensure all contamination is addressed and the objectives of this RAP are fulfilled, while minimising the amount of uncontaminated soil that is disturbed.

The Environmental Consultant shall undertake visual inspection and sampling on completion of the excavations to validate the remediation as required. As a general principle, if materials encountered during the site development are consistent with those characterised by previous investigations, validation sampling would not be considered necessary (as conservative management measures will be applied). Validation sampling may be required in the event of unexpected finds or for potentially contaminated materials remaining at the site surface, or if materials are imported to the site. Validation procedures are described in Section 8.3.2, and would be used where necessary to determine the extent of any further remediation as required.

Excavation procedures shall be documented in the Detailed Work Plan as prepared by the Contractor and should include (but not be limited to):

- Definition of the boundaries of the areas to be disturbed (excavated) and expected depths (including liaison with the environmental consultant where required).
- Methods for excavation and stockpiling including selective excavations should different materials be encountered.
- Designated areas and depths for placing (i.e. for immediate re-use) or stockpiling excavated materials.
- Plans for surface run-off protection measures around the immediate area in order to prevent surface waters running into or out of the disturbed areas (also to be included in CEMP).
- Backfill and compaction requirements
- Material tracking control covering all stages of the works including excavation, stockpiling and backfilling to include:
  - Minimisation of mixing unless specifically required or approved
  - A register of material movements (source area, material characteristics / description, stockpile identification, the volume of material, the destination (including on-site locations for intermediate movement), the date of any movements, authorisation details)
- Material transport control.

Upon completion of the excavation works the Contractor shall ensure that plant and equipment is cleaned and decontaminated as per Section 9.6. Waste generated during the decontamination works is to be disposed of in accordance with NSW EPA 2014.

6.6 On site re-use of materials –burial at depth or capping

6.6.1 Principles of re-use

The discussion presented below is based on the assumption that the Principal Contractor will opt to re-use the majority of the materials from Part Lot 401 as part of the regrading for development, with any potentially contaminated materials preferentially placed at depth under permanent structures (roads, car parks). Such containment may also apply to fill materials with aesthetic impacts (bricks, coal chitter) from other areas of the site that are not suitable to remain at the surface or in areas of future sensitive land use.

As noted in Section 6.1, it is anticipated material excavation and re-use would be detailed in a "material re-use schedule" to be developed by the design team and/or Contractor for approval by the Principal Contractor project manager with input from the Environmental Consultant and Site Auditor. Key principles for re-use include the following:

- Preference should be given to burial of problematic materials (eg. contamination or aesthetic impacts) at depths greater than 2 m below design structure levels (including footings or subsurface infrastructure invert levels) to minimise the disturbance of such materials during redevelopment of the site. Consideration should also be given to avoiding areas that will require deep piles or other excavation extending more than 2 m below the design levels.
- Problematic materials encountered during later stages of the development could be contained in shallower fill beneath areas of pavement provided these areas are unlikely to be disturbed.
- In-situ native soils (to be excavated for design levels) and stockpiles of ripped sandstone material should be reserved for the upper layers of the development.

6.6.2 Visual screening / segregation

Appropriate identification and segregation of different material types that occur on site will lower the costs associated with on-site management, and potential off-site disposal during the redevelopment works.

Visual screening can be applied to the large scale treatment (segregation) of a stockpile to detect ACM and aesthetic impacts. With regard to ACM, it is most suitable for minor bonded ACM impact, not for fibre generating materials. The general methodology is described below:

- May be preceded by hand picking of visual ACM impacts if appropriate.
- Excavation works should be supervised by a competent person and any indication of building or demolition wastes, aesthetic impacts (coal chitter, rubbish) or combustible materials noted and selected materials segregated as required.
- Visual inspection and validation sampling (if required) will determine the suitability of the materials for re-use, placement under the required capping area or the requirement for disposal off site.
- Materials should be segregated into specific stockpiles (or directed to agreed fill areas) according to the material re-use schedule and decision process for re-use or disposal.
- Impacted soils should not be mixed with other soils and impacted materials shall not be used for final surface levels in sensitive areas of the development.
- Final visual inspection of the screened materials should not detect ACM or aesthetic impacts.

Should ACM impacts be identified during the screening steps the following procedure should be followed:

- Soils should be pre-wet and the ongoing screening procedure subject to dust/fibre control and monitoring measures as outlined in the AMP.
- If suspect materials are identified, a detailed inspection should be undertaken with a subsample of the materials spread out over a contrasting surface (black plastic) for inspection for ACM.
- The materials should be segregated into stockpiles for burial at depth, capping on site under hardstand or disposal off site.

The selected methodology shall be described in detail by the Contractor in their Detailed Work Plan, and will depend on the frequency of occurrence and the nature of potential ACM finds and other foreign materials in the soil, as well as the physical characteristics of the soil itself. The methodology may need to be varied depending on the effectiveness.

6.6.3 Capping/Containment

At this stage, based on previous investigations for the site and the adjacent site, any materials that are proposed to be contained on site are unlikely to be sufficiently contaminated to warrant a containment wall around the emplacement areas, and no impermeable capping is considered necessary. Appropriate capping (as described below) is considered sufficient to minimise potential exposure and (where relevant) the potential for leachate formation and impact to the site environment. “Containment” as used herein therefore refers to placing contaminated materials in a particular area of the site either at depth or capped by hard stand or similar surfacing. Capping and containment will only be used in appropriate areas and with methods complying with NSW EPA 2017 and ANZECC 1999 *Guidelines for the Assessment of On-site Containment of Contaminated Soil*. This includes the following considerations:

- Geotechnical requirements appropriate for the future land use of the areas used for containment shall be met so as to maximise the long-term stability of the capping system and any proposed structures above it (from an engineering perspective) and, where applicable, minimises the potential for leachate formation.
- Containment will not be undertaken in any areas where structures would subsequently be built on the containment area that may result in a risk of harm to public health or the environment.
- Notification and enforcement mechanisms will be used to ensure that the containment areas are protected from any unintentional or uncontrolled disturbance that could breach the integrity of the physical barrier, such as placing a covenant on the property title and a notation on the Section 10.7 certificate. The containment areas will be subject to a long-term site management plan as discussed in Section 6.12.

The method of capping and containment works will be undertaken as follows:

- Designated containment or capping areas/voids are to be excavated to the required depth (as per detailed design plans and material re-use schedule to be developed as part of final design).
- Placement of segregated materials to be contained/capped within the designated areas, minimising disturbance to surrounding areas as far as reasonably practicable, in accordance with geotechnical requirements and the principles outlined in Section 6.6.1.

- Placement of uncontaminated capping material (minimum 0.5 m thick, or greater in areas where deep-rooted landscaping or underground services are proposed) to physically separate sensitive receptors from the contained materials. Where capping thickness is less than 2 m (based on final design surface levels), a high visibility marker layer shall be placed over the contaminated material. Concrete slabs or surface paving (asphalt or concrete) over a gravel base may provide an equivalent barrier.
- To minimise the potential for surface water infiltration, the final design and location of the containment areas will need to be either located away from surface water sources or, the redevelopment should be engineered to divert any up gradient surface water sources away from the containment area. Further, the finished levels of the capping layer are to be designed to encourage drainage of surface water away from the containment area. Erosion of the cap surface layer will also require control (potentially through revegetation or sealing of the finished surface).

Final design and specification of the containment and/or capping will be provided to the site auditor for review once the requirement for containment is confirmed and the volumes of materials and nominated areas for containment are known. The design and specification shall comply with the minimum requirements of this RAP.

Both placement of the fill materials within the containment area and the construction of the final capping layer must be supervised by a competent person to ensure construction in accordance with any design specifications and geotechnical suitability for the final design.

In areas subject to management of contamination, any future services shall be installed above the contained materials designated by the marker layer or if installation is required at greater depth, services shall be installed in trenches lined with marker layer and in clean backfill material to facilitate any future repairs and maintenance. Excavation and preparation of trenches shall be subject to material handing requirements for contaminated soil.

Verification of capping construction (where utilised) will include inspection and testing of material characteristics and placement as required by the design and specifications, and validation of the final cap thickness in accordance with specifications by way of a survey prior to cap installation and following completion. Following placement of the cap, a detailed inspection of the cap profile, drainage systems and overall site will be undertaken.

A CQA plan should be prepared as part of final design and specifications, to detail the requirements for verification of capping construction and to provide a basis for verifying and documenting the appropriate implementation of this RAP and final design documentation.

6.6.4 Potentially combustible materials

Potentially combustible materials (generally carbonaceous fill, stockpiles or outcroppings) have been identified in areas of Lot 7314 adjoining the site, and similar materials may be encountered during excavations on the site.

DP (2015b) stated that provided that the material is deemed suitable for re-use from a contamination viewpoint, it may be suitable as bulk filling provided the recommendations outlined below are followed.

- Capping – placement and compaction of a non-combustible layer of at least 0.5 m thickness over the identified potentially combustible materials.
- Removal of coal materials – excavation of accessible areas of concentrated combustible materials for disposal and/or reuse as part of blending operations.

- Reshaping works – earthworks in areas of potential combustible materials to reduce slope angles and compact loose materials to minimise the potential for oxygen ingress and subsequent combustion.
- Blending – mixing of highly combustible material with non-combustible material to reduce the overall combustible percentage of the material and minimise the risk of combustion. Blending may be with underlying soil/rock (e.g. ripping of near-surface coal with underlying soil/rock) or mixing with imported materials.
- DP also recommended that a management plan is prepared for future management of combustion risk at the sites.

DP 2015b states that where carbonaceous materials are to be used as controlled fill, the filling should be blended with non-carbonaceous materials and placed in horizontal layers not exceeding 300 mm loose thickness and compacted to a dry density ratio of at least 100% Standard.

6.7 Transport of material

Transportation of material shall be undertaken in accordance with the Detailed Work Plan and CEMP.

- All material movements, including on-site movements, shall be recorded on a material tracking plan documenting material source, type, description, volume, destination, reference to testing results, approval for movement and date(s) of movement. A register setting out this information shall be established as part of the CQA plan.
- Wastes shall only be removed off-site after the material has been classified and written approval has been received for the disposal of the contaminated soil at the nominated treatment or disposal site, or evidence of appropriate recycling (in accordance with regulatory requirements and relevant codes of practice) has been provided.
- All asbestos debris and contaminated PPE should be doubled bagged prior to transportation to an appropriately licensed landfill that can accept asbestos waste. Management of asbestos waste is to be undertaken in accordance with the POEO (Waste) Regulation 2014.
- Waste tracking shall be undertaken in accordance with EPA requirements (specifically the POEO (Waste) Regulation 2014) and include evidence of instructions, load registers/records (source, classification, volume, date and time, vehicle details etc), weigh bridge dockets.
- Any vehicles used to transport contaminated materials from the site shall meet NSW EPA licensing requirements for the waste transported.
- All trucks carrying contaminated materials off-site shall have the load covered, the exterior of the vehicle, including wheels, thoroughly cleaned down by the Contractor after it has received its load and prior to the vehicle leaving the site. Only vehicles which have clean exterior bodywork and which will not pollute the off-site transportation corridors shall be permitted to leave the site.

6.8 Site reinstatement

Following the completion of any excavation works, the Contractor shall reinstate the site. Reinstatement should be undertaken by re-contouring the surface to remove any trip hazards, and/or backfilling with suitable site materials and/or imported fill of suitable composition to address the final redevelopment design specifications. Fill of suitable composition shall meet geotechnical and other material property requirements for the area of use, not present hazards to future development from pH, electrical conductivity (EC) or contamination, and should also be compatible with the existing soil characteristics for site drainage purposes.

Compaction requirements will be dependent on final redevelopment design, dimensions of excavations, and the type of soil used in each location. The compaction method proposed for the area must be approved by the Principal Contractor Project Manager prior to commencing works. *Australian Standard AS 3798-2007 Guidelines on earthworks for commercial and residential developments* should be used as a guideline document for compaction.

Where not covered by structures (eg. car park pavement), the area shall be revegetated or otherwise reinstated to a stable condition as directed by the Principal Contractor Project Manager.

6.9 Imported fill materials

It is expected that final design will aim to balance cut and fill volumes on the site, and that importation of significant volumes of fill material will not be required, except for construction materials for which specific characteristics are required (eg. road base, structural fill, drainage gravels, landscaping materials etc). If required, compatible fill material from other portions of the project site (i.e. Lot 7314 to the south) may be used in accordance with the control measures described in this RAP.

Any fill imported from outside the project site must be Virgin Excavated Natural Material (VENM) or material subject to a Resource Recovery Order that is permitted to be used as a fill material under the conditions of the associated Resource Recovery Exemption, in accordance with the provisions of the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment (Waste) Regulation 2014*.

Any imported construction or landscaping materials must comply with the relevant Australian Standards for that material.

Where there is any question of the suitability of the material from an environmental or health-risk perspective, the Contractor shall advise Principal Contractor of the material characteristics prior to importation to the site, for assessment by the Environmental Consultant.

All material imported to the site shall be appropriately validated in accordance with the procedures described in Section 8.3.

6.10 Review of the RAP

This RAP will require review and updating following any significant changes in characteristics of the site, including those resulting from unexpected finds.

6.11 Interim site management

Management of the site is required between the date of this RAP and commencement of redevelopment activities, to minimise the potential for additional contamination to occur from activities such as illegal dumping, or for changes to site characteristics to occur from on-site remediation activities in other areas of the CSR property that may affect the site.

It is recommended that the Principal Contractor implement a site security program to ensure a secure fence is maintained around the site, that access to the site from within the CSR property is limited to activities approved by the Principal Contractor and that all activities undertaken on the site are documented.

Should illegal dumping or other incidents occur, and assessment should be made as to whether contamination can be adequately managed on site until the commencement of redevelopment, or whether immediate remediation is required to prevent the spread of contamination. The relevant procedures outlined in this RAP should be followed if any remediation is required.

6.12 Long term site management

A Long Term Site Management Plan (LTSMP) will be required to record the placement of any contaminated material on site, and provide procedures to be used in the event that it should be disturbed. The LTSMP will also address any combustion risk management requirements remaining at the site.

The LTSMP would include measures to prevent exposure under normal site use, and specific procedures would need to be developed for any works which would result in potential exposure.

The LTSMP is not likely to require any “active” management measures because contamination will only be left in locations that are not subject to exposure (eg. at depths greater than 2 m below design structure levels or under roads/car parks), but is likely to be a simple “awareness” plan to document the locations, depths and types of contaminated material in case structures that prevent exposure to the contamination are removed in the future, or future development or maintenance works disturb the material.

As per NSW EPA 2017 the LTSMP will succinctly describe the nature and location of contamination remaining on-site and state what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan’s implementation and over what time frame actions specified in the plan will take place.

As implementation of the LTSMP would involve no “active” requirements until such time as site surfaces are disturbed or site structures are removed, enforcement could be linked to the planning process, and the LTSMP would be registered as a covenant on the title and/or a notation on the planning certificate, subject to discussions with HI and the Auditor.

7. Remediation contingency plan

The site has been investigated for contamination as detailed in previous investigations and will be further assessed during development to address remaining data gaps. A degree of uncertainty is inherent in any site contamination investigation and there is a potential for undetected contaminated soils or wastes to be identified in other areas of the site.

Table 7 1 outlines some of the unexpected situations that may arise during the site works. The unexpected finds protocol and emergency response plans described in Sections 7.1 and 7.2 would apply in the event of any such issues arising.

Table 7-1 Contingency procedures

Issue	Response
A greater volume of soil contamination may be encountered than is estimated, or other types of contamination may be encountered.	The presence of previously unidentified types of contaminants may be detected during remedial works by observation of any unusual physical/sensory characteristics of the impacted soil. Indications of potential contamination may include: • Stained or discoloured fill, soils or seepage water. • Odorous fill, soils or seepage waters. • Construction/demolition wastes such as concrete, bricks, timber, tiles, asbestos sheeting, fragments and pipes. • General rubbish such as plastic, glass, packaging. • Materials such as ash or slag or coal chitter. If previously unidentified types of contaminants are detected, then validation may be required and validation criteria may have to be revised to incorporate those contaminants. In the event that significant additional contaminants or volumes of contamination are identified, work would cease in the area of concern. An assessment of the impact of the additional contaminants would be undertaken by the Environmental Consultant. Any potential contaminated material in addition to the type previously identified will be treated in a method considered suitable for the type of contaminant. Additional testing would be undertaken to determine requirements in this respect. EPA requirements for treatment and disposal would be met in accordance with NSW EPA 2014.
Identification of ACM	In the event that further ACM is identified during remediation works, and the nominated means of removing ACM from soil are not considered to be sufficient, then a surface scrape or excavation of the impacted area may be required, and the material would be disposed off-site in accordance with NSW 2014. This shall only be carried out at the direction of the Principal Contractor Project Manager and Environmental Consultant, and in accordance with the AMP and unexpected finds protocol. Buried ACM shall be managed in accordance with relevant codes of practice and regulatory requirements.
Unacceptable Environmental Impacts as a result of remediation activities	The RAP has considered the potential environmental impact of side effects of the works such as noise, odour, dust and surface runoff. However, in the event that unacceptable levels of such side effects are detected at the site boundaries during remedial works, the Contractor shall cease work and the Environmental Consultant will assess the situation and direct corrective action, in accordance with the CEMP prepared for the remediation works and current EPA regulations and requirements, and in consultation with the Principal Contractor Project Manager.

7.1 Unexpected finds protocol

A contingency plan incorporating an “Unexpected Finds Protocol” (UFP) to be followed in the event of unexpected situations shall be prepared by the Contractor and form part of the Detailed Work Plan. The Contractor will be required to follow the contingency plan if unexpected situations are encountered.

A preliminary unexpected finds protocol (UFP) has been developed for the site and is included in Appendix C. The UFP will be integrated with the site specific emergency response plan (ERP) as detailed in Section 7.2 below, however, the ERP would take precedence over the UFP should any unexpected contamination or materials be identified that present an immediate hazard.

7.2 Emergency response plan - environmental protection and pollution control

The Contractor shall prepare a Site Specific Emergency Response Plan if unexpected situations are encountered. The following outlines some of the unexpected situations that may arise:

- Spills or leaks
- Adverse weather conditions
- Dust, noise, odour levels measured at site boundary may exceed acceptable levels
- Surface runoff may leave the site

The Contractor will have available measures, equipment and materials to counter these contingencies, and should ensure all staff are aware of and have had training in appropriate measures.

8. Validation

The process as outlined in the following sections applies to all areas of the site proposed for remediation and/or validation and will be based on aesthetic issues/visual observations combined with collection of soil samples from the walls and base of excavation and trenches with analysis for the contaminants of concern as discussed in Section 2.6.

8.1 Data quality objectives

A process for establishing data quality objectives for an investigation site has been defined by Australian Standard AS4482.1 (1997) Guide to the Sampling and Investigation of Potentially Contaminated Soil - Parts 1 and 2 and DEC 2006. The Data Quality Objective (DQO) will be applied to the investigation, as described below, to ensure that data collection activities are appropriate and achieve the project objectives. The DQO process involves seven steps as follows:

- Step 1 - State the issue
- Step 2 - Identify the decision
- Step 3 - Identify inputs to the decision
- Step 4 - Define the study boundaries
- Step 5 - Develop a decision rule
- Step 6 - Specify limits on decision errors
- Step 7 - Optimise the design for obtaining data

The DQO steps defined above have been addressed as follows.

Step 1 – State the issue

Historically Part Lot 401 has been part of a larger site used for quarrying, storage of stockpiles and illegal dumping. The site is no longer operational and is being considered for redevelopment as a hospital car park.

Contamination has been identified at the site that may adversely impact its suitability for various uses and/or may have adverse impacts upon environmental receptors (eg. soil and groundwater). Sources of contamination at the site have been identified to include:

- Filling at various locations across the site containing demolition wastes and ACM.
- Naturally occurring carbonaceous soils and shale oils (source of TRH and PAH contamination).

In its current state the site is not suitable for the proposed development without management of ACM and potentially contaminated soils.

Step 2 – Identification of the decision(s)

The decisions are those required to ensure the successful management or remediation of contamination at the site and consequently the protection of the environment and human health. Key decisions include:

- Have identified data gaps been addressed?
- Have known areas of contamination been remediated and validated to achieve residual concentrations of contamination less than the adopted criteria?

- Have any unexpected finds encountered during site works been appropriately managed or remediated?
- Is the site condition, from a contaminant perspective, suitable to allow redevelopment of the site for the proposed land use.

Step 3 - Inputs to the decisions

Data to be input to the decision making process includes:

- Information from previous investigations.
- Quantitative data gained via intrusive soil and groundwater sampling and analytical works during the redevelopment.
- Current assessment criteria as discussed in Section 4.
- Consideration of proposed land use as discussed in Section 1.
- Monitoring the Contractor's work, site conditions and the Contractor's implementation of the CQA plan.
- Review of relevant documentation to be provided by the Contractor.
- Observations and analyses to be undertaken during the site remediation and validation works and site development earthworks.

Step 4 - Define the study boundaries

The lateral boundaries of the study area are the boundaries of Part Lot 401 as shown in Figure 1, Appendix A.

The vertical boundaries of the study area are the vertical extent of proposed earthworks and contamination identified in site materials during previous investigations and investigations during the development.

Step 5: Site decision rule

Review of previous site investigations has been used to identify the main contaminants of concern and areas likely to require remediation or management prior to site redevelopment.

Although specific validation sampling and analysis is not proposed (except for imported fill), it may be required should unexpected contamination be identified during site works. Concentrations of contaminants for validation (where required) will be compared with the criteria discussed in Section 4, giving consideration to the redevelopment land uses relevant to the particular areas of the site, to assess the success of the remediation and/or screening processes and/or to assess waste disposal requirements.

Concentrations of contaminants for validation (where required) will be compared with the criteria discussed in Section 4 to assess the success of the remediation and/or screening processes and/or to assess waste disposal requirements.

In order to decide whether the data obtained is precise, accurate, reliable and reproducible for the site at the time of the investigation, field and laboratory quality control and quality assurance (QA/QC) procedures will be utilised throughout and sampling completed. All sampling work will be carried out in accordance with Standard Field Operating Procedures, based on standard industry practices. QA/QC results will be compared to nominal acceptance limits (as outlined in in Section 8.4).

Step 6 - Specify limits on decision errors

The guidelines as listed in Section 3 will be used to assess the contamination status of the soils within the subject site. DQIs as described in Section 8.2 will be used to evaluate the acceptability of the data.

Where quantitative data is used as a basis for decisions, data will be evaluated on a statistical basis as described in the NEPM (NEPC 2013), to a 95% confidence level.

Step 7: Optimising the design for obtaining data

As detailed above, no specific validation sampling and analysis has been proposed for the bulk earthworks, except for imported fill (if required). However, if required, validation sampling will be undertaken as per the Validation Methodology and Quality Assurance (QA) procedures presented in Appendix B.

A CQA program will be developed as part of final design and specifications, which will include appropriate inspection and test plans and documentation requirements including material tracking to verify that site works are undertaken in accordance with this RAP. The Contractor will be responsible for implementing the CQA plan, which will be monitored and reviewed by the Environmental Consultant. Where necessary to verify appropriate implementation of the CQA plan, the Environmental Consultant will undertake independent inspections and/or testing as required.

8.2 Data quality indicators

The following Data Quality Indicators (DQIs) have been selected to ensure that the data is of a quality from which to draw conclusions:

- **Data representativeness** - expresses the degree which sample data accurately and precisely represents a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples in an appropriate pattern across the site, and by using an adequate number of sample locations to characterise the site. Consistent and repeatable sampling techniques and methods are utilised throughout the sampling. These principles will also be applied to visual observations during the site works.
- **Completeness** - defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study. If there is insufficient valid data, then additional data are required to be collected. Completeness will also be applied to visual observations and inspection records undertaken during implementation and review of the CQA plan.
- **Comparability** - is a qualitative parameter expressing the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples and ensuring analysing laboratories use consistent analysis techniques and reporting methods. In relation to qualitative observations, comparability will be maintained by using appropriately experienced and qualified environmental staff to undertake inspections, and comparison of observations with conditions documented in previous investigation reports.

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the data is assessed by calculating the Relative Percent Difference (RPD) between duplicate sample pairs.

$$RPD(\%) = \frac{|C_o - C_d|}{C_o + C_d} \times 200$$

Where Co = Analyte concentration of the original sample
Cd = Analyte concentration of the duplicate sample

GHD adopts a nominal acceptance criteria of ± 30% RPD for field duplicates and splits for inorganics and a nominal acceptance criteria of ± 50% RPD for field duplicates and splits for organics, however it is noted that this will not always be achieved, particularly in heterogeneous soil or fill materials, or at low analyte concentrations. Precision criteria will only apply to analytical data.

- **Accuracy** - measures the bias in a measurement system. Accuracy can be undermined by such factors as field contamination of samples, poor preservation of samples, poor sample preparation techniques and poor selection of analysis techniques by the analysing laboratory. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes, laboratory blanks and analyses against reference standards. The nominal “acceptance limits” on laboratory control samples are defined as follows:

  1. * Laboratory spikes – 70-130 % for metals/inorganics, 60-140 % for organics.
  2. * Laboratory duplicates - <30 % for metals/inorganics, <50 % for organics.
  3. * Laboratory blanks - <practical quantitation limit.

  Accuracy of field works is assessed by examining the level of contamination detected in field and equipment blanks. Blanks should return concentrations of all organic analytes as being less than the practical quantitation limit of the testing laboratory.

  The individual testing laboratories will conduct an assessment of the laboratory QC program, internally; however the results will also be independently reviewed and assessed by the Environmental Consultant. Accuracy criteria will only apply to analytical data.

8.3 Validation methodology

If validation of materials is required at the site, the procedures described below will be used, in conjunction with the DQOs described in Section 8.1 and the criteria discussed in Section 4.

8.3.1 Decision process

Aesthetic issues

The aesthetic criteria (Section 4) and visual observations will be used to guide the extent of excavations in areas of the site requiring remediation as deemed necessary by the Environmental Consultant and subject to further consultation with the Principal Contractor Project Manager and the Site Auditor during the remediation works.

Health risk

The health-based assessment criteria for the identified contaminants on the site are discussed in Section 4. The site will be deemed to be successfully remediated (as required) if:

- The 95% UCLAVG concentration for contamination in soils remaining at the surface after remediation is less than the relevant criteria for area being remediated.

- No single sample concentration is greater than 2.5 times the relevant criteria.
- The standard deviation is less than half of the selected criteria.

These criteria will be applied to each remediation area as a whole.

Environmental risk

The environmental based criteria for the identified contaminants on the site are discussed in Section 4.

Given the disturbed nature of the site, and that the end use for the site may include a health facility including a hospital and the potential for public outdoor recreation areas, the following assessment criteria have been considered:

- Soil Specific ACLs for urban residential and public open space.
- Ecological Screening Levels for TRH, BTEX and benzo(a)pyrene fractions –urban residential areas and public open space (fine soil textures apply).

These criteria will be applied to each remediation area as a whole, where ecological criteria are relevant (i.e. not covered by paving or structures).

Off-site disposal

Any excavated material shall be stockpiled in designated areas of the site for characterisation and waste classification if off-site disposal of the material is required. Criteria for classification of material for disposal will be as per the NSW EPA *Waste Classification Guidelines* (2014).

Following stockpiling, representative samples shall be collected from each "batch" of material destined for disposal. (A batch being defined for the purposes of this RAP as a volume of material of similar physical and chemical characteristics, generally excavated from a particular area of the site). The material will be deemed to be suitable for disposal if the 95% $_{UCLAVG}$ concentration for each contaminant of concern is less than the relevant waste classification criteria.

Imported fill

Imported fill will be as specified in Section 6.9. VENM fill shall be verified by a VENM certificate prepared by an appropriately qualified and experienced consultant, and the source and material as delivered shall be inspected by the Environmental Consultant to verify consistency with the VENM certificate. Where no supporting analytical results are available, a minimum of three samples from any particular fill source shall be analysed for the parameters below.

Non-VENM imported materials will be validated for suitability for use as fill material at an equivalent density to the requirements of *The excavated natural material order 2014*, and at least three samples from any particular fill source. In order to avoid importation of contamination to the site, fill judged suitable for use will have TPH, BTEX, heavy metals, OCP/PCBs and PAHs concentrations below the criteria in *The excavated natural material order 2014* (or Australian Standard relevant to the material) and shall contain no detectable asbestos. Physical characteristics of imported soil shall be consistent with the surrounding material, or specific to intended end use as approved by the Principal Contractor's Project Manager.

8.3.2 Validation methodology

Sample identification

Validation and characterisation soil samples will be identified using a “V” prefix for validation, or a “C” prefix for characterisation. A detailed sample register will be kept, recording the sample number, date sampled, location, depth interval and field observations (including soil description). Duplicate samples will be recorded in the register, as will subsequent validation samples where these are needed to re-validate an area that has not met the assessment criteria and has had further remediation.

Validation following asbestos removal

The validation of areas of the site where ACM materials have been removed will be undertaken visually (by a combination of inspection and raking) by a SafeWork NSW Licenced Asbestos Assessor (LAA) or a “competent person” as detailed in SafeWork NSW guidelines.

In accordance with the NEPM 1999, if a pass across the area results in no ACM being found, then the soil will be considered effectively free of ACM. Confirmatory sampling of asbestos in soils will be undertaken in accordance with the NEPM 1999 (Amendment 2013) Schedule B2 Section 11 and WA DOH 2009 Section 4.3. Sampling rates for where ACM has been removed from a large area/excavation will be based on a rate of twice the minimum grid sampling guidelines from Table A (NSW EPA 1995).

Validation of excavations

Validation sampling of excavations will only be required where excavated surfaces may be subject to exposure following completion of the development, or where validation of unexpected finds is required.

Validation sampling from excavations will generally involve collecting one sample per 25 m^2 from the base of each excavation, with at least one base sample from any single excavation and one sample per 5 m of wall, with at least one sample for each excavation wall. Samples of surface soils (0.0-0.2 m) will be taken from each side of the excavation to validate the horizontal extent of remediation, with samples also taken from mid-depth (or any visually impacted soil strata) if the excavation depth exceeds 0.5 m. Aesthetic issues (re odours, debris) will be taken into account in the validation.

In the areas of aesthetically impacted soils, validation will be undertaken by visual assessment of the resultant excavations.

Soil samples collected for validation purposes will be analysed for the particular contaminants previously identified as exceeding (or potentially exceeding) assessment criteria in the area of the excavation.

Photographs of the excavation will be taken as part of the validation works. The extent and depth of the completed excavation shall be measured by the environmental consultant, with reference to site boundaries or physical features.

Validation for materials prior to re-use on site

If required, validation sampling for ACM will be undertaken by the Environmental Consultant to demonstrate that materials have been appropriately screened of asbestos contamination and anthropogenic inclusions to a standard that is suitable for proposed placement either at the surface or in sensitive areas of the site. Sampling and analysis for other potential contaminants will also be undertaken if required.

Validation sampling for asbestos from screened stockpile materials or other similar materials will involve a final detailed visual inspection of the screened materials that should not detect ACM. Where ACM is encountered, percentage contamination will be calculated using the weight of ACM found for a particular area or volume. The recommended sampling rate for known volumes of screened materials is one sample per 250 m^3 with a minimum of three samples collected from any one portion of the stockpile (equivalent to the stockpile sampling density from the ENM exemption 2012). Analysis will be for both ACM quantification and asbestos in soils (AF/FA) in accordance with the NEPM 1999. Exceedence of HSL A or HSL C criteria will not necessarily preclude placement of the materials, but may entail more stringent management requirements (including during movement/handling) if significant asbestos is encountered.

Validation of Excavated Material/Stockpiles for waste classification

Waste classification samples will be collected from any soil requiring off-site disposal to landfill at a rate of one sample per 25 m^3 of material with a minimum of three samples per batch. For larger volumes of soil (>100 m^3) sampling frequency may be reduced provided statistically representative classification can be achieved. Samples collected for waste classification purpose will be analysed for heavy metals (arsenic, cadmium, chromium, lead, mercury and nickel), TRH, PAH and asbestos.

If required for classification purposes, representative soil samples will also be submitted for Toxicity Characteristic Leaching Procedure (TCLP) and the resultant leachate analysed for the relevant contaminants governing the waste classification.

In accordance with the NSW EPA 2014 Step 2, any liquids within the excavations during the remediation works that require offsite disposal would be classified as liquid waste, and as such “there is no need to undertake any further assessment”. GHD notes that the liquid waste should be disposed of to a facility licensed to accept / treat the liquid under the POEO Act 1997.

Validation of imported materials

If excavations are to be backfilled with imported VENM, as defined by NSW EPA (2014), the material is considered pre-classified. Materials may only be classified as VENM if they have been excavated from an area that is not contaminated with other waste materials or by manufactured chemicals. The material should be classified as VENM by an appropriately qualified environmental professional, taking into consideration the following points:

- The history of the site of origin of the material should be understood and documented to identify whether any potentially contaminating activities have been undertaken at that location.
- An inspection of the source site should be undertaken by an appropriately qualified environmental professional, including a visual inspection of the VENM. Findings of the inspection should be fully documented.
- Validated as suitable for use as VENM with collection of samples at a minimum rate of 1 sample per 100 m^3, with at least three samples from any particular source.
- A visual inspection of the VENM should be undertaken as it is imported onto site to ensure that the material is consistent with documented observations.

Validation of cap

Verification of capping shall be undertaken in accordance with Section 6.6.3.

8.3.3 Analytical test methods and detection limits

In general, laboratory analysis will be conducted in accordance with the standard test methods outlined in Schedule B(3) of the NEPM (1999) for soils.

Where possible, the project laboratories will be NATA accredited for the analysis and will utilise their own internal procedures and their test methods (for which they are NATA, or equivalent, accredited) in accordance with their own quality assurance system that forms part of their accreditation.

8.4 Quality assurance / quality control

8.4.1 Quality assurance

All fieldwork will be conducted in general accordance with Standard Field Operating Procedures, which are aimed at collecting environmental samples using uniform and systematic methods. Key requirements of these procedures are as follows:

- Decontamination procedures - including the use of new disposable gloves for the collection of each sample, decontamination of the sampling equipment between each sampling location and the use of dedicated sampling containers provided by the laboratory.
- Requirements for soil bore logs - subsurface characteristics and field observations will be fully documented.
- Sample identification procedures - collected samples will immediately be transferred to sample containers of appropriate composition and preservation for the required laboratory analysis. All sample containers will be clearly labelled with a sample number, sample location, sample depth and sample date. The sample containers will then be transferred to a chilled cooler for sample preservation prior to and during shipment to the testing laboratory.
- Field equipment calibration requirements – field equipment will be provided from the supplier with calibration certificates/documents. Where required, equipment will be calibrated in the field.
- Chain of custody information requirements - a chain-of-custody form, for each batch of samples, will be completed and forwarded to the testing laboratory.
- Sample duplicate frequency approximately 10% (5% each for intra and inter laboratory duplicates) – for chemical analysis only.

Field quality control procedures to be used during the project will include the collection and analysis of the following (for chemical analysis only):

- **Intra Laboratory (Blind) duplicates/replicates:** Comprise a single sample that is divided into two separate sampling containers. Both samples are sent anonymously to the project laboratory. Blind duplicates/replicates provide an indication of the analytical precision of the laboratory, but are inherently influenced by other factors such as sampling techniques and sample media heterogeneity. It is proposed to collect and analyse blind duplicate samples at a rate of at least 5%.

- **Inter Laboratory duplicates/replicates:** Individual samples are split in two in the field by the sampling crew and are placed in two separate containers. One sample is sent to the project laboratory and one sample is sent to an independent check laboratory. Field split duplicate samples provide an indication of the analytical accuracy of the project laboratory, but may be affected by other factors such as sampling methodology and the inherent heterogeneity of the sample medium. It is proposed to collect and analyse blind duplicate samples at a rate of at least 5%.
- **Trip blanks**: These are samples of organic free water normally prepared by the analytical laboratory which is providing the bottles to be used for sampling. They remain with the sample bottles while in transit to the site, during the sampling and during the return trip to the laboratory. At no time during these procedures are they opened. Upon return to the laboratory, they are analysed for all analytical parameters as if they were a field sample. Trip blanks are a check on sample contamination originating from sample transport, handling, shipping and site conditions.
- **Trip spikes**: The samples of either soil or water prepared by the analytical laboratory which is providing the bottles to be used for sampling. A known quantity of volatiles (usually BTEX) is added to the samples by the lab. They remain with the sample bottles while in transit to the site, during the sampling and during the return trip to the laboratory. Upon return to the laboratory, they are analysed for all analytical parameters as if they were a field sample. Checks for degradation of analyte during collection, storage and handling.
- **Equipment blanks:** These are prepared in the field (at the sampling site) using empty bottles and the distilled water used during the final rinse of sampling equipment. After completion of the decontamination process fresh distilled water is poured over the sampling equipment and collected. The distilled water is exposed to the air for approximately the same time the sample would be exposed. The collected water is then transferred to an appropriate sample bottle and the proper preservative added, if required. Equipment blanks are a check on equipment decontamination procedures.
- **Field blanks:** These are similar to trip blanks except the water is transferred to sample containers on site. Field blanks are a check on sample contamination originating from sample transport, handling, shipping, site conditions or sample containers.

8.4.2 Laboratory program

The National Association of Testing Authorities of Australia (NATA) accredited project laboratory will use their internal procedures and NATA accredited methods in accordance with their quality assurance system. The environmental consultant is to ensure that the laboratory analytical methods and limits of reporting are acceptable for analysis required.

Laboratory quality control procedures used during the project should include (where relevant):

- **Laboratory duplicate samples**: Duplicate sub samples collected by the laboratory from one sample submitted for analytical testing at a rate equivalent to one in twenty samples per analytical batch, or one sample per batch if less than twenty samples are analysed in a batch. A laboratory duplicate provides data on the analytical precision and reproducibility of the test result.
- **Spiked Samples**: An authentic field sample is spiked by adding an aliquot of known concentration of the target analyte(s) prior to sample extraction and analysis. A spike documents the effect of the sample matrix on the extraction and analytical techniques. Spiked samples will be analysed for each batch where samples are analysed for organic chemicals of concern.

- **Certified Reference Standards**: A reference standard of known (certified) concentration is analysed along with a batch of samples. The Certified Reference Standard (CRS) or Laboratory Control Spike provides an indication of the analytical accuracy and the precision of the test method and is used for inorganic analyses.
- **Surrogate Standard/Spikes**: These are organic compounds which are similar to the analyte of interest in terms of chemical composition, extractability, and chromatographic conditions (retention time), but which are not normally found in environmental samples. These surrogate compounds are spiked into blanks, standards and samples submitted for organic analyses by gas-chromatographic techniques prior to sample extraction. Surrogate Standard/Spikes provide a means of checking that no gross errors have occurred during any stage of the test method leading to significant analyte loss.
- **Laboratory Blank**: Usually an organic or aqueous solution that is as free as possible of analytes of interest to which is added all the reagents, in the same volume, as used in the preparation and subsequent analysis of the samples. The reagent blank is carried through the complete sample preparation procedure and contains the same reagent concentrations in the final solution as in the sample solution used for analysis. The reagent blank is used to correct for possible contamination resulting from the preparation or processing of the sample.

The individual testing laboratories will conduct an assessment of the laboratory QC program, internally; however the results will also be independently reviewed and assessed by the Environmental Consultant.

Laboratory duplicate samples should return RPDs within the NEPM acceptance criteria of ±30%. Per cent recovery is used to assess spiked samples and surrogate standards. Per cent recovery; although dependent on the type of analyte tested, concentrations of analytes and sample matrix; should normally range from about 70-130%. Method (laboratory) blanks should return analyte concentrations as ‘not detected’.

8.4.3 Dispatch and transport of samples

All samples will be dispatched and transported with chain of custody documentation in accordance with laboratory procedures and requirements. The Environmental Consultant will conduct a review of these procedures and requirements to ensure that all statutory requirements are complied with.

The Environmental Consultant will seek to ensure that the specified holding times for analytes are not exceeded due to delays between sample dispatch and laboratory receipt.

9. Protection of environment and community

Significant site levelling and earth movement at the site is required to enable development. A major part of the site management will involve the installation and maintenance of environmental protection and pollution control measures. The measures to be implemented are outlined within this section of the RAP. For the purposes of this RAP, these measures are specific to “remediation works”, including movement of potentially contaminated materials, but should also be applied to all development works undertaken at the site, and the Contractors’ safety and environmental management documentation should be developed on that basis.

These measures are designed to achieve the following objectives:

- Protection of the surrounding environment during all phases of remediation works
- Protection of the local community during all phases of the remediation works
- The containment of all contaminated and potentially contaminated materials (soils, run-off etc) to the site

As per Section 6.1, prior to commencing works, the Contractor must possess plans, programmes, licences, certificates and other documents necessary for the commencement of the work, addressing as a minimum the requirements of this RAP. These documents shall be subject to review by the Principal Contractor Project Manager and the Environmental Consultant.

The remedial program should be undertaken with due regard to legislative requirements and any relevant environment planning instruments that apply to the site.

9.1 Interim controls

Prior to the commencement of site remediation works, the following interim controls should be put in place:

- The Contractor is responsible for the construction of permanent fences around the subject area meeting appropriate specifications to prevent unauthorised entry.
- The Contractor is responsible for the construction of silt and sediment controls around the remediation site, meeting appropriate specifications to prevent erosion and runoff.

9.2 Hours of operation

Unless otherwise permitted by the project approvals, all remediation work, including transport, shall be conducted within the following hours:

- Monday to Friday: 7 am – 6 pm
- Saturday: 8 am – 5 pm

The above meets the requirements of Maitland City Council. No work will be undertaken on Sundays or Public Holidays.

9.3 Contact details during remediation

During remediation works, representatives and on-site supervisors from the Contractor will be available to be contacted at all times. The Contractor’s CEMP should detail the incident reporting procedure for reporting environmental incidents during the project.

Additionally, the Site Health & Safety and Environmental Management plans as prepared by the Contractor will detail contact numbers for key project contacts once confirmed, emergency services and utility authorities.

9.4 Heritage and ecology issues

The subject site is highly disturbed. GHD understand that there are no known heritage or ecological constraints to the redevelopment of the site.

9.5 Containing contaminated material

It shall be the responsibility of the Contractor to ensure all potentially contaminated materials are contained on-site, within the confines of the designated work areas. This will be achieved by the control of potential pathways capable of moving contaminated material off-site including surface water runoff, erosion/sediment transport, vehicle/plant movements and dust generation. Specific controls for the site works shall be provided in the Detailed Work Plan and the CEMP prepared by the Contractor, as summarised in the following sections.

9.5.1 Soil and water management

All remediation works will be undertaken in accordance with a CEMP that will provide the specific details of the soil and water management measures. It is expected that a detailed soil and water management plan will be required by consent conditions for the proposed development. The Contractor shall be responsible for implementation and maintenance of soil and water management measures throughout the remediation works. A summary of relevant measures is presented below:

- Surface runoff control – may include diversion drains, silt fences, sumps and pumping systems to prevent runoff entering or leaving excavation areas and to prevent runoff/suspended solids entering or leaving stockpile areas.
- Stockpiles – are not to be placed on footpaths or roads and shall be placed away from drainage lines, gutters or stormwater pits or inlets. Stockpiles likely to generate dust or odours shall be covered and stockpiles of contaminated soil shall be stored in a secure area. Preference will be given to storing segregated contaminated material in skip bins prior to disposal, where volumes are small enough for this to be feasible. This particularly applies to segregated foreign materials or ACM.
- Vehicle access - Movement of excavation equipment and trucks to and from the site will be strictly controlled, restricted to a minimum and will only take place during the designated working hours. Controls must be in place to prevent any material being tracked onto offsite roads including wheel washing and sediment barriers. Soil, earth, mud and other similar materials must be removed from the roadway preferably by dry methods (sweeping, shovelling)
- Excavation pump-out - If ponding occurs and it is not feasible for it to be re-used onsite (dust suppression, irrigated), or if time constraints restrict leaving water to evaporate or infiltrate, then offsite disposal will be required. Pump-out and transportation of ponded water within excavations for appropriate treatment/disposal may be required. Disposal (if required) should be undertaken by a liquid waste transporter. It is noted that discharge to stormwater would require consultation with the Principal Contractor, NSW EPA and local Council, if considered. No surface runoff and/or water from excavations/pits/trenches from the working area of the site is permitted to be discharged to the surrounding environment, except as may be required for dust suppression with the express approval of the Project Manager and Environmental Consultant.

- Subject to approval from HI (and the Principal Contractor) and compliance with relevant consent conditions and regulatory requirements, sediment dams may be constructed and/or existing voids and ponds on the site or adjoining areas of the overall development area may be utilised for detention of stormwater runoff. Details shall be prepared and approved as part of the detailed soil and water management plan, including design flows, sampling and discharge requirements.
- Landscaping - Due care shall be taken to protect any existing vegetation unless removal is required to undertake the remedial works. Any vegetation designated for protection shall be fenced to prevent disturbance during the works.

9.5.2 Noise

It shall be the responsibility of the Contractor to minimise noise generated from the remediation operations in accordance with NSW EPA and local council standards. Noise controls will be specified in the Detailed Work Plan and EMP.

The remediation works shall comply with the NSW Department if Environment and Climate Change (DECC) *Interim Construction Noise Guideline,* July 2009 (ICNG).

9.5.3 Vibration

The use of any plant and/or machinery shall not cause vibrations that can be felt or are capable of being measured at any off-site premises.

9.5.4 Waste management

The Contractor shall establish appropriate waste disposal containers as part of site mobilisation, which shall be maintained on site for the duration of the works. All waste materials (e.g. garbage) must be disposed of using safe waste disposal practises. No waste shall be disposed of on site. The waste disposal containers shall be emptied as necessary to avoid overflowing, and the contents disposed of to a waste disposal facility approved for the relevant waste type.

The Contractor shall prepare a waste management plan identifying materials that can be re-used or recycled, and how these will be managed during the remediation works.

All potential pollutant materials shall be stored well clear of any poorly drained areas, flood-prone areas, and stormwater drainage areas. Such materials should be stored in a designated area. Containment bunds should be constructed with provision for collection and storage of any spilt material.

9.5.5 Air quality

Dust and particulate control

Dust emissions shall be confined within the site boundary. Dust control procedures may be employed to comply with this requirement including erection of perimeter dust screens, covering of stockpiles, dust suppression (water) and covering of truck loads. Dust control measures shall be specified in the Contractors' Detailed Work Plan and CEMP.

Consideration should be given to air quality monitoring during bulk earth works in accordance with the NSW Department of Environment and Conservation (DEC) *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (2005).

Asbestos

Where works are undertaken involving disturbance of asbestos containing materials, airborne fibre monitoring for asbestos should be conducted in accordance with the site AMP, the SafeWork NSW Code of Practice: How to Safely Remove Asbestos (2016) and the WHS legislation (NSW). The monitoring should be conducted in accordance with NOHSC Guidance Note on the Membrane Filter Method for Estimating Method Airborne Asbestos Fibres 2nd Edition [NOHSC:3003 (2005)]. Asbestos air monitoring requirements and action levels will be specified in the AMP and HESP.

Air monitoring requirements vary depending on the type of asbestos being removed, the location/position of the asbestos, if an enclosure is used and whether the asbestos removal work is within a building or outside.

- Friable asbestos – Air monitoring is mandatory for all friable asbestos removal and includes prior to dismantling an enclosure and for the purposes of the clearance inspection. An independent licensed asbestos assessor must be engaged to carry out air monitoring.
- Non-friable asbestos (>10 m²) – Air monitoring is not required but may be considered to be carried out by an independent licensed asbestos assessor or competent person to ensure compliance with the duty to eliminate or minimise exposure to airborne asbestos and to ensure the exposure standard is not exceeded.
- Public Location – Air monitoring should be considered where the asbestos removal work is being undertaken in or next to a public location.
- Exposure air monitoring – Air monitoring should be carried out at other times to determine a worker's exposure to airborne asbestos if, based on reasonable grounds, there is uncertainty as to whether the exposure standard may be exceeded and a risk assessment by a competent person indicates it is necessary. Since most uses of asbestos are prohibited, exposure monitoring should not be required frequently.

Air monitoring may be required when:

- It is not clear whether new or existing control measures are effective.
- There is evidence (for example, dust deposits are outside the enclosure) the control measures have deteriorated as a result of poor maintenance.
- Modifications or changes in safe work methods have occurred that may adversely affect worker exposure.
- There has been an uncontrolled disturbance of asbestos at the site.

Table 9-1 Air monitoring action levels

Action Level	Action
< 0.01 fibres/ml	Continue with control measures
At 0.01 fibres/ml or <= 0.02 fibres/ml	Review control measures, investigate cause and implement controls to minimise exposure and prevent further release.
> 0.02 fibres/ml	Stop removal work Notify relevant regulator (phone followed by written statement) Investigate the cause Implement controls to eliminate or minimise exposure and prevent further release Do not recommence removal work until further air monitoring is conducted and fibre levels are < 0.01 fibres/ml

Odour control

It is noted that based on the nature of the contamination identified on the site odours are unlikely, however no odours should be detectable at any boundary of the property relying purely on a sense of smell. Dust control measures shall be specified in the Detailed Work Plan and CEMP. Controls may include covering stockpiles, use of fine mist sprays, odour mitigating agents and minimising exhaust emissions.

9.6 Traffic movements and management

Management of traffic movements will form part of the Detailed Work Plan as provided by the Contractor.

9.7 Community consultation

Any Community Consultation or consultation with other stakeholders will be conducted by the the Principal Contractor Project Manager or nominated representative.

Any enquires made by members of the public to worker on site during remediation should be directed to the Principal Contractor representative.

10. Health and safety

10.1 Work health and safety

Work Health and Safety (WHS) is a necessity on all remediation and development projects to ensure the health and safety of all personnel working/visiting the site. Therefore work shall be carried out in accordance with a site-specific Work Health and Safety Plan (WHS Plan). The remediation contractor shall prepare a site specific WHS Plan (or combined HSE Plan) for the remediation works, addressing as a minimum the requirements of this RAP, and shall appoint a Site Safety Officer for the duration of the works.

It is the responsibility of the Contractor to take all necessary practicable actions to safeguard the safety and health of all employees and subcontractors while they are on the site. The aim of the WHS Plan shall be to provide and maintain safety standards and practices, which offer the highest practical degree of personal protection, based on current knowledge.

All work undertaken shall be performed in accordance with the provisions of the Work Health and Safety Act 2011, the Work Health and Safety Regulations 2017 and any other relevant regulations or directions issued by regulatory authorities.

10.2 Community health and safety

To ensure the protection of the local community, the remediation contractor shall control the exposure pathways identified in this section.

Control mechanisms will include the following:

- Site security measures to control direct contact with the contamination
- Dust suppression measures to control inhalation exposure
- Cleaning and tarping trucks to control direct contact from migration of contaminated soils

These measures are described in Section 9 - Protection of the Environment and Community, and shall be documented in detail in the remediation contractor's CEMP.

11. Conclusion

GHD was engaged by Multiplex to prepare a RAP for Part Lot 401 DP 755237 (the site), Metford Road, Metford, NSW. Part Lot 401 forms a portion of the overall development area for the New Maitland Hospital (NMH).

Redevelopment of the site is proposed to involve a change of land use to include a hospital car park.

This RAP provides a summary of identified site contamination issues and description of the proposed remediation and soil management programs, procedures and standards which can be followed during the course of the redevelopment, to ensure the successful remediation of the site and consequently the protection of the environment and human health.

As a general principle in redevelopment of the site, HI has committed to using best endeavours to manage contamination on site, where appropriate. The types of contaminants potentially encountered at the site (primarily ACM, TRH, PAH and aesthetic impacts) cannot readily be destroyed, and soil treatment methods that reduce contaminant concentrations are not considered suitable for the site. Therefore, the following remediation methods are considered appropriate for the site for possible contamination scenarios:

- ACM contamination - Physical removal and disposal of potential ACM contamination associated with illegally dumped materials (if identified) that may be disturbed by the site works is the preferred strategy and consistent with regulatory requirements for asbestos. Any remediated areas will then be cleared by a licenced contractor and validated by an environmental consultant.
- Visual screening and segregation of unacceptable materials (foreign inclusions, aesthetic impacts, ACM, hydrocarbon contaminated materials, potentially combustible materials) to address contamination impacts within stockpiles and across the general site area.
- Capping and containment as a conservative soil management option for segregated materials (as above) where contamination will not be subject to exposure under normal foreseeable use of the site (eg. burial at depths greater than 2 m below design structure levels or beneath permanent infrastructure as part of the redevelopment).
- Re-use of uncontaminated materials (VENM, screened overburden and fill) for bulk fill subject to geotechnical requirements or constraints.

The particular methods to be used for each material / source will be based on the results of previous investigations and any further investigations undertaken during the development, and will be agreed with HI and the Principal Contractor (and their designers) for the development in conjunction with finalisation of design, to account for any particular geotechnical requirements, optimise earthmoving and minimise the potential for future disturbance of contaminated or problematic materials. It is anticipated this will take the form of a material re-use schedule, to be prepared as part of final design and consistent with the principles described in this RAP.

A CQA plan will be required as a basis for verifying and documenting the appropriate implementation of this RAP and final design documentation. These documents (including relevant aspects of the final design, specifications, material re-use schedule and CQA plan) shall be reviewed by the Environmental Consultant and Site Auditor prior to the commencement of remediation to confirm that they are consistent with the principles of this RAP.

A LTSMP will be required following completion of the development earthworks, to record the placement of any contaminated or combustible material on site, and provide procedures to be used in the event that it should be disturbed.

GHD considers that the site can be made suitable for the proposed use (hospital car park) by implementation of this RAP during earthworks undertaken for development of the site.

12. Limitations

This Remediation Action Plan / Contamination Management Plan (the RAP) for New Maitland Hospital Part Lot 401, Metford Road, Metford (the site):

- Has been prepared by GHD Pty Ltd ("GHD") for Multiplex on behalf of NSW Health Infrastructure (HI).
- May be used and relied on by HI and the Principal Contractor.
- May be used by and provided to the Site Auditor acting as an agent of HI in this respect.
- May be used by and provided to the NSW EPA and the relevant planning authority for the purpose of meeting statutory obligations in accordance with the relevant sections of the CLM Act 1997 or the Environment Planning and Assessment (EP&A) Act 1979.
- May only be used for the purpose as stated in Section 1.3 of the Report (and must not be used for any other purpose).

GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than HI arising from or in connection with this RAP.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the RAP are excluded unless they are expressly stated to apply in this RAP.

The services undertaken by GHD in connection with preparing this Report:

- Were limited to those specifically detailed in Section 1.5 of this RAP.
- Were undertaken in accordance with current professional practice and by reference to relevant environmental regulatory authority and industry standards, guidelines and assessment criteria in existence as at the date of this RAP and any previous site investigation and assessment reports referred to in the RAP

The opinions, conclusions and any recommendations in this RAP are based on assumptions made by GHD when undertaking the services and preparing the RAP ("Assumptions"), as specified throughout this RAP.

GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.

Subject to the paragraphs in this section of the RAP, the opinions, conclusions and any recommendations in this RAP are based on conditions encountered and information reviewed at the time of preparation of this RAP and are relevant until such times as the site conditions or relevant legislations changes, at which time, GHD expressly disclaims responsibility for any error in, or omission from, this RAP arising from or in connection with those opinions, conclusions and any recommendations.

This RAP is based solely on the investigations and findings contained in the reports referenced in the RAP (Section 13) and on the conditions encountered and information reviewed at the time of each referenced report. This RAP should be read in conjunction with the referenced reports. It is also subject to all the limitations and recommendations in the referenced reports.

GHD has prepared this Report on the basis of information provided by HI and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked ("Unverified Information") beyond the agreed scope of work.

GHD expressly disclaims responsibility in connection with the Unverified Information, including (but not limited to) errors in, or omissions from, the RAP, which were caused or contributed to by errors in, or omissions from, the Unverified Information.

The opinions, conclusions and any recommendations in this RAP are based on information obtained from, and testing undertaken at or in connection with, specific sampling points and may not fully represent the conditions that may be encountered across the site at other than these locations. Site conditions at other parts of the site may be different from the site conditions found at the specific sampling points.

Investigations undertaken in respect of this RAP were constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this RAP.

GHD has considered and/or tested for only those chemicals specifically referred to in this RAP and makes no statement or representation as to the existence (or otherwise) of any other chemicals.

Site conditions (including any the presence of hazardous substances and/or site contamination) may change after the date of this RAP. GHD expressly disclaims responsibility:

- Arising from, or in connection with, any change to the site conditions
- To update this RAP if the site conditions change

Except as otherwise expressly stated in this RAP GHD makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials (“ACM”) on the site. If fill material has been imported on to the site at any time, or if any buildings constructed prior to 1970 have been demolished on the site or material from such buildings disposed of on the site, the site may contain asbestos or ACM.

Subsurface conditions can vary across a particular site and cannot be exhaustively defined by the investigations carried out prior to this RAP. As a result, it is unlikely that the results and estimations expressed or used to compile this RAP will represent conditions at any location other than the specific points of sampling. A site that appears to be unaffected by contamination at the time of the RAP may later, due to natural causes or human intervention, become contaminated.

Except as otherwise expressly stated in this RAP, GHD makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.

These Disclaimers should be read in conjunction with the entire RAP and no excerpts are taken to be representative of the findings of this RAP.

13. References

ANZECC 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* ANZECC and ARMCANZ, October 2000.

DLA 2014a. *Phase 2 Detailed Environmental Site Assessment, CSR/PGH Maitland, Metford Road, Metford NSW 2323*. DLA Environmental, January 2014.

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Appendices

Appendix A – Figures

Figure 1 “Site location”

Figure 2 “Existing groundwater monitoring wells”

BVN Drawing 01A-AX0-102 Issue 2 “Site Plan”

EA Figure 1 "Location and Property Boundaries" 22/2/2011

VGT Figure 9 “Domain Areas” 26/03/2014

DLA Figure 2 “Figure Reference Map” 29/11/2013

DLA Figure 3 "2011-2013 Soil Sample Locations" 11/11/2013

DLA Figure 4 "Factory Area Soil Sampling Locations 2013" 11/11/2013

DLA Figure 8 "Grass Area Sample Locations" 11/11/2013

DLA Figure 1 “Soil Sampling Locations - Pit 2” 29/08/2014

DLA Figure 1 “Stockpile Locations” 7/11/2014

DLA Figure 1 “Groundwater Monitoring Well Locations” 10/12/2015

DLA Figure 1 "Vapour Monitoring Well Locations" incorrectly titled “Groundwater Monitoring Well Locations” 19/10/2015

Paper Size A4

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Site boundary
- Metford Triangle
- Cadastre
- Railway
- Waterbody
- Watercourse (as per topographic mapping for area)

NSW Health Infrastructure
New Maitland Hospital
Part Lot 401
Site Investigation

Job Number 22-19924
Revision 0
Date 24 Sept 2019

Site location

Figure 1

G:\22\18003\GIS\Maps\Deliverables\2219924\ContamInvestigation\2219924_CI001_SiteLocation_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: Geoscience Australia: 250k Topographic Data Series 3, 2006; LPI: DCDB & DTDB - 2012; Nearmap: Aerial Imagery Extracted 20180830. Created by: fmackay

Paper Size A4

0 5 10 20 30 40

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Site boundary
- Cadastre
- Existing groundwater monitoring well

NSW Health Infrastructure
New Maitland Hospital
Part Lot 401
Site Investigation

Existing groundwater monitoring wells

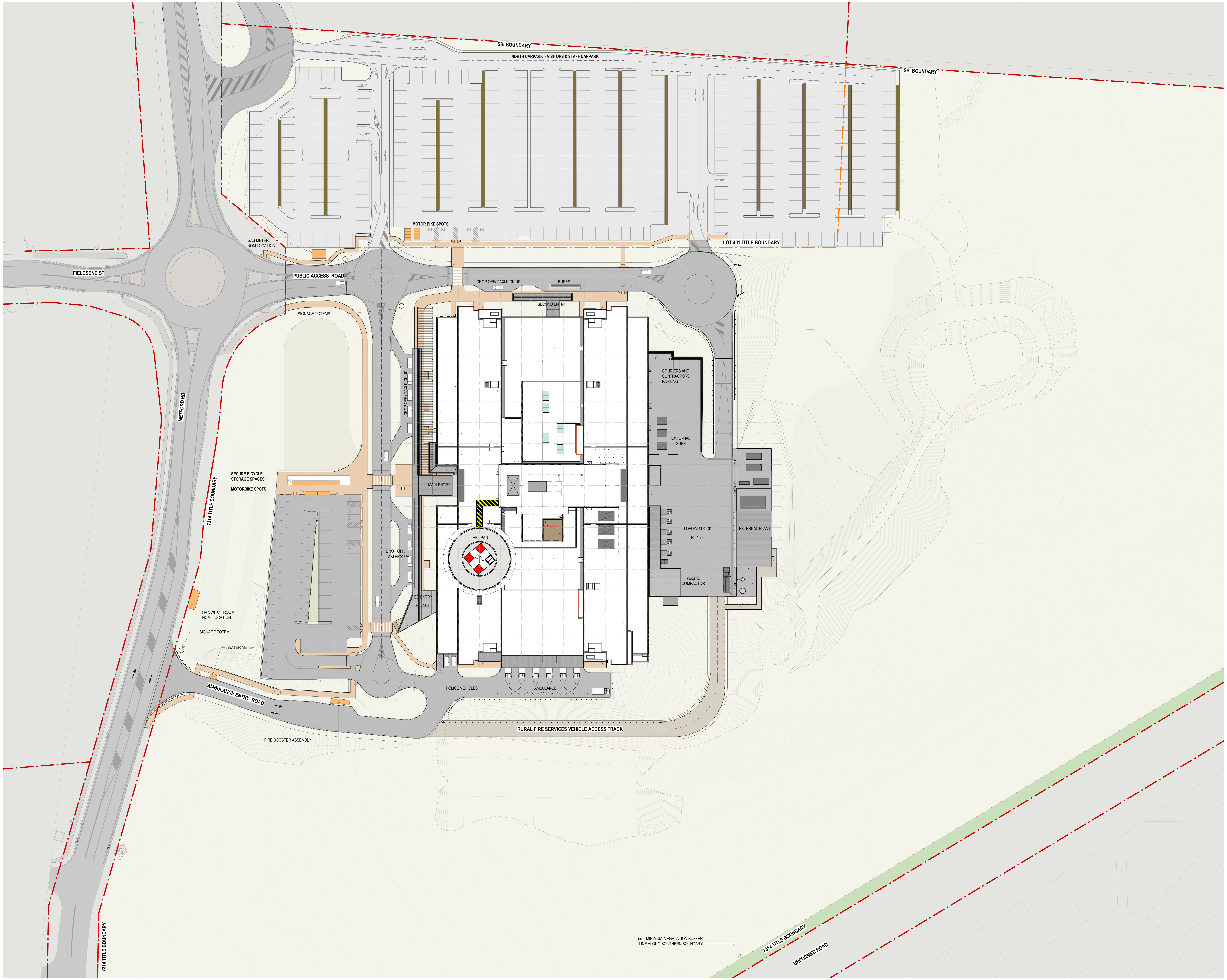
Job Number	22-19924
Revision	0
Date	24 Sep 2019

Figure 2

G:\22\18003\GIS\Maps\Deliverables\2219924\ContamInvestigation\2219924_CI002_Sampling_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com **W** www.ghd.com.au

Data source: LPI: DCDB & DTDB, 2012; Nearmap: Aerial Imagery Extracted 20180830. Created by: fmackay



FUTURE TRAFFICABLE LANDSCAPED SPACE

COURTYARD

FUTURE NON-TRAFFICABLE LANDSCAPED SPACE

ROOM BOUNDING

PUBLIC LIFT

PATIENT LIFT

HOT LIFT

SUMMERY OF CAR PARKS

- NORTH CARPARK:
589 PARKING SPOTS
6 ACCESSIBLE SPOTS
8 MOTORBIKE SPOTS

- WEST CARPARK:
79 PARKING SPOTS
8 ACCESSIBLE SPOTS
4 MOTORBIKE SPOTS

GENERAL NOTES:

-TOPOGRAPHY CONTOURS ARE INDICATIVE, REFER TO CIVIL DOCUMENTS FOR EXTENT OF EARTH WORKS.

-REFER TO CIVIL AND LANDSCAPE DOCUMENTS FOR EXTENT OF EXTERNAL LANDSCAPE WORKS AND ROAD WORKS.

-REFER CIVIL HYDRAULICS AND ELECTRICAL CONSULTANTS FOR SETOUT AND EXTENTS OF TRENCHING AND SERVICES ALLOCATIONS FOR ALL SITE INFRASTRUCTURE WORKS.

BVN

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

NSW ARCHITECTS REGISTRATION BOARD / NOMINATED ARCHITECTS
6501 ABBIE GALVIN
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7053 MATTHEW BLAIR
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4937 JAMES GROSE

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

	ISSUE	DATE	DESCRIPTION
	1	06/09/19	SSI 2 ISSUE
	2	17/09/19	SSI 2 ISSUE

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(02) 9299 1312

PCA / BCA / DDA /
TBC
TBC

FIRE ENGINEERING
PGA

PROJECT
NEW MAITLAND HOSPITAL

550-560 High Street
Maitland NSW 2320

BVN PROJECT NUMBER
S1806011.000

DRAWING KEY

TRUE NORTH | PROJECT NORTH

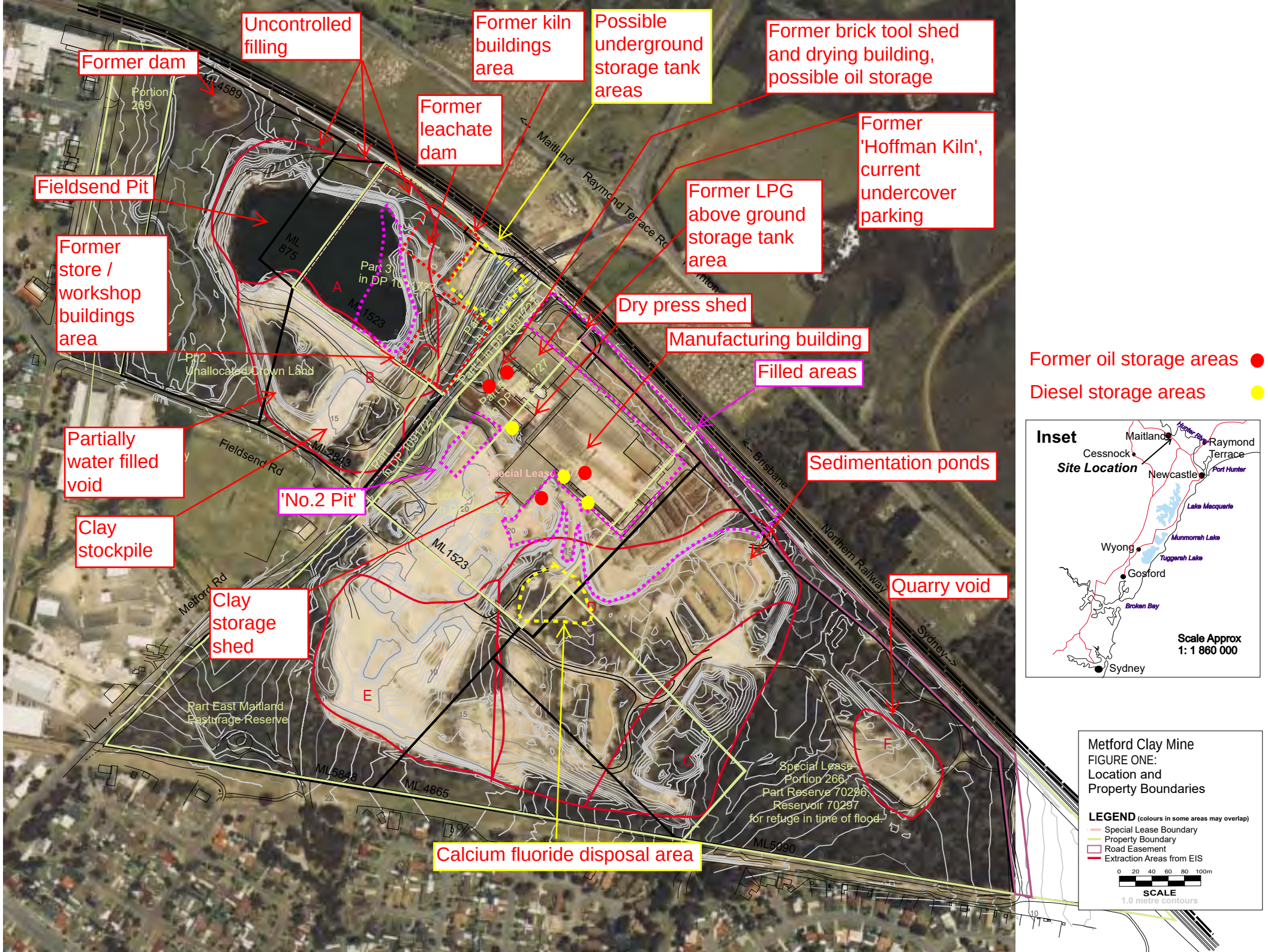
SCALE
As indicated @A0 DO NOT SCALE
0 1000 4000 8000
1:200

DRAWN BY: Author | CHECKED BY: Checker
DESIGNED BY: Designer | APPROVED BY: Approver

STATUS
DESIGN DEVELOPMENT

DRAWING
SITE PLAN

DRAWING NUMBER: 01A-AX0-102
ISSUE: 2


Former dam
Uncontrolled filling
Former kiln buildings area
Possible underground storage tank areas
Former brick tool shed and drying building, possible oil storage
Former leachate dam
Former 'Hoffman Kiln', current undercover parking
Fieldsend Pit
Former LPG above ground storage tank area
Former store / workshop buildings area
Dry press shed
Manufacturing building
Filled areas
Partially water filled void
Sedimentation ponds
'No.2 Pit'
Clay stockpile
Quarry void
Clay storage shed
Calcium fluoride disposal area
Former oil storage areas
Diesel storage areas
Inset
Site Location
Maitland
Cessnock
Raymond Terrace
Newcastle
Wyong
Gosford
Sydney
Lake Macquarie
Munmorrah Lake
Tuggerah Lake
Broken Bay
Scale Approx 1: 1 860 000
Metford Clay Mine
FIGURE ONE:
Location and Property Boundaries
LEGEND (colours in some areas may overlap)
Special Lease Boundary
Property Boundary
Road Easement
Extraction Areas from EIS
SCALE
1.0 metre contours