FOUNDATION EARTH SCIENCES

REMEDIATION ACTION PLAN

Property Address

105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW

Prepared for

East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd

April 2023

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ABBREVIATIONS

AIP	*Australian Institute of Petroleum Ltd*	**QA/QC**	*Quality Assurance, Quality Control*
ANZECC	*Australian and New Zealand Environment and Conservation Council*	**RAC**	*Remediation Acceptance Criteria*
AST	*Aboveground Storage Tank*	**RAP**	*Remediation Action Plan*
BGL	*Below Ground Level*	**RPD**	*Relative Percentage Difference*
BTEX	*Benzene, Toluene, Ethyl benzene and Xylene*	**SAC**	*Site Assessment Criteria*
COC	*Chain of Custody*	**SVC**	*Site Validation Criteria*
DA	*Development Approval*	**SWL**	*Standing Water Level*
DP	*Deposited Plan*	**TCLP**	*Toxicity Characteristics Leaching Procedure*
DQOs	*Data Quality Objectives*	**TPH**	*Total Petroleum Hydrocarbons*
EPA	*Environment Protection Authority*	**UCL**	*Upper Confidence Limit*
ESA	*Environmental Site Assessment*	**UST**	*Underground Storage Tank*
HIL	*Health-Based Soil Investigation Level*	**VHC**	*Volatile Halogenated Compounds*
LGA	*Local Government Area*	**VOC**	*Volatile Organic Compounds*
NEHF	*National Environmental Health Forum*	**DPI**	Department of Primary Industries
NEPC	*National Environmental Protection Council*		
NHMRC	*National Health and Medical Research Council*		
OCP	*Organochlorine Pesticides*		
OPP	*Organophosphate Pesticides*		
PAH	*Polycyclic Aromatic Hydrocarbon*		
PCB	*Polychlorinated Biphenyl*		
PID	*Photo Ionisation Detector*		
PQL	*Practical Quantitation Limit*		

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1.0 EXECUTIVE SUMMARY

Foundation Earth Sciences (FES) was appointed by East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd , to prepare a Remediation Action Plan (RAP) for the property located at 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW ("the site").

The RAP is required for the site as asbestos was identified in two borehole locations (BH115 & BH118) during the Douglas Partners Addendum PSI 2017. The fill material across the proposed basement area will also need to be removed off site. The adopted remedial strategy is the removal of contaminated material to a licensed landfill. The remediation of the site is to take place in the following stages:

- Stage One -Site Preparation;
- Stage Two – Site Walkover;
- Stage Three –Post Demolition;
- Stage Four – Classification and removal of fill across proposed basement area and Asbestos impacted areas (BH115 & BH118);
- Stage Five – Validation basement floor & landscape areas;
- Stage Six – Asbestos Clearance; and
- Stage Seven – Validation Report Preparation.

Therefore, it is considered that the site will be ***suitable*** for the proposed development, subject to the implementation of the remediation and validation works in accordance with this RAP.

2.0 INTRODUCTION

Foundation Earth Sciences (FES) was appointed by East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd, to prepare a Remediation Action Plan (RAP) for the property located at 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW ("the site").

This RAP has been prepared in order to be part of the Development Application (DA) for this site. Work and reporting were conducted in general accordance with the FES proposal, FES environmental protocols and with reference to relevant environmental regulatory criteria including the guidelines issued or endorsed by the NSW EPA.

3.0 OBJECTIVES, SCOPE & DEVIATIONS

3.1 Objectives

The primary objective of this RAP is to inform and guide site remediation and validation through the following:

- Summary of the current contamination status of the site;
- Providing a description of the remediation strategy(s) that will effectively manage the environmental concerns identified, in a manner that protects both human health and the environment;
- Provide a preliminary sampling and analytical quality plan to be used for site validation;
- Comply with DA Conditions for Development;

3.2 Scope

The scope is outlined below:

- Establish remediation goals and criteria
- Evaluation of remedial technologies and selection of appropriate remedial strategy(s)
- Facilitate guidance on approvals, licences, contractor WHS Plan & any other site management plans required for the remedial works.
- Provide an outline of the additional investigations (if required) to be carried out in order to address the recommendations identified in the previous investigation;
- Develop sampling, analysis and quality plan for additional works, remedial works and proposed validation.
- The area of impact within borehole locations BH115 & BH118 are within the upper fill soil profile to depth of 0.4m BGL.

3.3 Deviation from this RAP

It is recommended that an experienced and qualified Environmental Engineer / Scientist be appointed to the project to enable:

- Coordination and implementation of the staged approach to the proposed remediation / validation works;
- Any proposed deviations from the works specified in this RAP are documented and approved as required under NSW EPA "*Consultants Reporting on Contaminated Land* "dated 2020.
- The format of this report closely follows that recommended in the NSW EPA "*Consultants Reporting on Contaminated Land* "dated 2020.

Completion of remedial works without adequate supervision from a qualified Environmental Engineer / Scientist could leave to project delays and extra costs due to additional requirements imposed by a third party, to confirm the environmental status of site. Any waste material removed from site without sufficient characterisation and/ or waste classification may lead to regulatory actions.

4.0 SITE IDENTIFICATION, SITE HISTORY, ENVIRONMENTAL SETTINGS AND BACKGROUND INFORMATION

4.1 Site identification and zoning

Table 1: Site Identification

Site Identifier	Site Details
Site Location	105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW
Lot/DP	Lot 31-32 in DP864001 (121 Hunter Street) Lot 1 in DP77846 (105 Hunter Street) Lot B in DP388647 (109 Hunter Street) Lot A in DP388647 (111 Hunter Street) Lot 100 in DP1098095 Lot 1 in DP 723967 Lot 2 in DP331535 Lot 96 in DP 1098068 Lot 98 in DP 1098034 (3 Morgan Street) Lot 1 in DP819134 (66-74 King Street) Lot 1 in DP 331535 (22 Newcomen Street)
Site Coordinates #	NE corner: Latitude: -32.927308, Longitude: 151.781836 NW corner: Latitude: -32.927006, Longitude: 151.780597 SE Corner: Latitude: -32.928145, Longitude: 151.781646 SW corner: Latitude: -32.92804, Longitude: 151.781238
Parish	Newcastle
County	Northumberland
Site Area	Approximately 6,698m^2

Local Government Area (LGA)	Newcastle	
Zoning##	B4 – Mixed Use	
Surrounding Land Uses	*North*	Mixed Use (Mainly Commercial)
	South	Mixed Use (Mainly Commercial)
	East	Mixed Use (Mainly Commercial)
	West	Mixed Use (Mainly Commercial)

Six Maps

refer to NSW Planning Portal

https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address

//www.planningportal.nsw.gov.au/find-a-property

4.2 Proposed development

The site is currently occupied by mixed use buildings including commercial shops, office, basement car parking, church, and residential properties. The following information further summarises the proposed development:

- The proposed Stage 3 will have
  - Three level basements across of whole site
  - Eight levels above ground including retail and residential in the western portion.
  - Market Square in the middle
  - Three levels above ground at the northeast portion
  - Twelve levels above ground at the southeast portion
- The proposed Stage 4 will have.
  - Three level basements across of whole site
  - Eight levels above ground including retail and residential.

- Due to slopping of the site, south portion of the site will be under ground up to approximate level 02.

- As per ground floor plan, the area contains services/plant, landscaped entry, retail, communal open space & market centre.

Refer to **Appendix B** - Proposed Development Plans.

4.3 Site Conditions and Surrounding Environmental

Table 2: Site Conditions

Site Information	Descriptions
Sensitive Receivers	The nearest sensitive human receptors are the current and future users of the site, construction workers during the site redevelopment and the public. The nearest waterbody is Hunter River (approximate 155m to the north) discharge into Ocean/sea.
Soil Landscape *Review of NSW Soil and Land Information website ESPADE.*	The Soil Landscape Map viewed on NSW ESPADE indicates that the site is located in the Killingworth soil landscape area. It indicates undulating to rolling hills and low hills on the Newcastle Coal Measures of the Awaba Hills region. Elevation 50–160 m, local relief 30–100 m, slopes are 3–20%. Predominantly uncleared tall open-forest.
Topography *Review of NSW Soil and Land Information website ESPADE.*	The topography viewed on NSW ESPADE indicated the following for the Killingworth Landscape area: Rolling low hills to hills. Slope gradients 3–20%, local relief is 30–100 m, elevation 50–160 m. Crests are generally broad (250 m), sideslopes are long (>500 m) and grade into narrow (<3 m) drainage lines. Drainage plains are long (>500 m) and gently inclined. Short, steep (>20%) lower slopes often lead to gullies. Rock outcrop occurs occasionally in the upper catchment.
Geological Profile	The Geological Map of Newcastle (Geological Series Sheet 9231-9129, Scale 1:100,000, Edition 1, 1995), published by the Department of Mineral Resources indicates the residual soils within the site to be underlain by late Permian Age of Lambton subgroup, comprising sandstone, siltstone, claystone, coal & tuff.
Presence of Acid Sulphate Soils	A review of the map "Newcastle" indicated that the site is located in the area

Site Information	Descriptions					
Review of NSW Department of Land & Water Conservation (DLWC) Acid Sulphate Soil Risk Maps (Edition Two, December 1997, Scale 1:250,000.	of "No Known Occurrence" of acid sulphate soils. The Newcastle City Council risk maps indicate Class 5.					
Localised Hydrogeology Review of DPI (Office of Water) Database.	**Number**	**Location from Site**	**Depth**	**SWL**	**Use**	**Water Bearing Zones**
	GW200282	410m E	4.0m	2.0	Irrigation	Sand
	GW200284	430m NE	4.0m	1.2	Irrigation	Fill
	GW201490	712m W	4.5m	2.0	Monitoring bore	-
	GW203132	563m NW	5.1m	2.1	Monitoring bore	-
	GW200283	749m NE	4.1m	2.1	Irrigation	-
Nearest Surface Water Body	The nearest waterbody is Hunter River (approximate 155m to the north) discharge into Ocean/sea.					
Nearest Active Service Station & Dry Cleaner	Service station is 2.35km west of the site and dry cleaners is 400m east of the site.					
Local Meteorology (Bureau of Meteorology BOM website)	The monthly rainfall of the local surrounding area is represented by the data collected from the BOM rainfall gauge located in Newcastle Nobbys Signal Stations, which is approximately 850m from site. The records indicate that the annual mean rainfall recorded was 1118.6mm (date of fieldwork).					

4.4 Previous environmental investigations

FES identified two (2) previous investigations for the surrounding precinct and the relevant information has been summarised. The reports are listed below:

- Douglas Partners Pty Ltd (2008), Preliminary Geotechnical Assessment for Proposed 'Hunter Central' Development at King Street, Newcastle, Prepare for Construction Control Pty Ltd, Project 39826, dated July 2008.
- Douglas Partners Pty Ltd (2017), Addendum to Preliminary Site Investigation (Contamination) Newcastle East End - Staged Development Application, prepared for Iris Land Pty Ltd, project 39826.09, dated 29 May 2017.

FES has completed Three (3) previous investigations for the property and are summarised below:

- FES Pty Ltd (2022), 'Preliminary Site Investigation' 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW, E2970, dated January 2023.
- FES Pty Ltd (2022), 'Detailed Site Investigation' 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW, E2970-2, dated April 2023.
- FES Pty Ltd (2022), 'Acid Sulphate Soil Assessment' 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW, E2970-3, dated April 2023.

4.4.1 DP Preliminary GA (2008)

This report presents the results of a preliminary geotechnical assessment for the proposed GPT 'Hunter Central' development in Newcastle. The assessment was carried out at the request of Construction Control Pty Ltd on behalf of The GPT Group.

The proposed development encompasses an area bounded by King Street, Newcomen Street, Hunter Street and Perkins Street, with overall dimensions of about 260 m by 90 m. The proposed development is still at pre concept stage, however is expected to include development across most of the site including basement floor level at about –3m AHD and roof levels up to about 42 m AHD. A vertical cut is proposed along the southern King Street boundary, resulting in depths of cut in the range 5 m to 25 m.

The site is bounded to the north by Hunter Street (Mall), to the south by King Street, to the east by Newcomen Street and to the west by Perkins Street. Wolfe, Thorn, Laing and Morgan Streets connect Hunter and King Streets.

The site generally contains low to medium (two to five storey) level commercial and residential buildings and two reinforced concrete carparks up to eight storeys are located at the site. A three-storey industrial Telstra building also adjoins the site at the corner of Wolfe and King Streets.

The overall site falls steeply to the north. King Street, at the southern boundary of the site, ranges from about 5 m AHD near Perkins Street to about 24 m AHD at the Newcomen Street intersection at the south eastern corner of the site. King Street appears to be cut into a bench with retaining walls supporting cuts both upslope and downslope.

4.4.2 DP Addendum to PSI (2017)

This report has been prepared to support a staged Development Application that seeks consent to an initial concept proposal for building envelopes and heights, indicative land use mix and floor space allocation. The staged Development Application does not seek consent for any works. This will be the subject of future Development Applications for subsequent stages.

It is understood that the proposed concept design for the redevelopment includes a mix of retail, commercial and residential use. It is further understood that the proposed concept design includes basement car parking for two blocks along the southern side of Hunter Street, between Wolfe and Morgan Streets with floor levels of about RL 0 to 1 AHD requiring cuts in the order of 3 to 4 m along Hunter Street and 5 to 7 m along Laing Street.

The Preliminary Site Investigation for contamination has identified a number of potentially contaminating land uses (current/former) within the site, including: former auto garage and petrol station; plumbers' workshop; dyers; timber yard; blacksmiths; ship smiths, and other activities such as use of underground fuel storage tanks and wells/cisterns/cess pits which have the potential to result in soil/groundwater contamination.

It is noted, that given the site has had over 200 years of human activity, the historical searches conducted for this preliminary assessment cannot be considered exhaustive, and other contaminating activities not identified may have occurred on-site.

It is noted that the investigation was preliminary only, and included limited subsurface investigation, and historical data. Further investigation is recommended to better assess site conditions and implications to the proposed development.

4.4.3 FES PSI (2023)

Foundation Earth Sciences was appointed by East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd & East End Stage 4 Pty Ltd to undertake a Preliminary Site Investigation (PSI) for the property situated at 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW.

The site is currently occupied by mixed use buildings including commercial shops, offices, basement car parking, church, and residential properties. The approved masterplan encompasses:

- Staged Concept Development Application for a major redevelopment of Hunter Street Mall, a mixed-use development comprising retail, commercial, public spaces, residential apartments, associated car parking & site works – Application to Modify Stage 1 of Concept Plan pursuant to Section 4.55(2): building envelopes and height, distribution of land uses, floor space and FSR.

The preliminary soil data from the Douglas Partners PSI revealed the following:

- The soil laboratory results were below the adopted detection limits and/or within the relevant guideline criteria apart from asbestos detected in two locations (115 & 118).

The following data gaps were identified:

- The horizontal and vertical extent of asbestos detected in Douglas Partners PSI has not been fully investigated;
- The previous Douglas Partners PSI is preliminary in nature, therefore the soil and groundwater quality at the site have not been adequately investigated to meet the minimum characterisation requirements for contaminated land assessments.

Based on the results of this investigation it is considered that the risks to human health and the environment associated with soil contamination at the site are moderate in the context of the proposed use of the site. The site can be made suitable for the proposed development, subject to the following recommendations:

- Preparation of a Detailed Site Investigation (Phase 2 Environmental Site assessment) by a suitably qualified Environmental Consultant.
- A hazardous materials assessment is recommended to be completed prior to the demolition of the site.
- Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

4.4.4 FES DSI (2023)

Foundation Earth Sciences (FES) was appointed by East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd & East End Stage 4 Pty Ltd to undertake a Detailed Site Investigation for the property situated at 105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW ("the site").

- The site is currently occupied by mixed use buildings including commercial shops, offices, basement car parking, church, and residential properties. The approved masterplan encompasses:
    - Staged Concept Development Application for a major redevelopment of Hunter Street Mall, a mixed-use development comprising retail, commercial, public spaces, residential apartments, associated car parking & site works – Application to Modify Stage 1 of Concept Plan pursuant to Section 4.55(2): building envelopes and height, distribution of land uses, floor space and FSR.

Soils sampled across the Site were assessed against the Site Acceptance Criteria (SAC) provided by the National Environment Protection (Assessment of Site Contamination) Measure (NEPM 2013) Table 1A – Commercial/Industrial D.

Soil

The soil data revealed the following:

- Borehole 115 &118 had asbestos detection exceeding the adopted site criteria. Further remediation works are required at this location.

Groundwater

Based on the sampling to date the following lines of evidence support the low-risk groundwater conclusions in relation to site suitability:

- The elevated heavy metals are related to offsite regional contaminant concentrations and/or background levels & therefore of limited concern in relation to the GILs;

- Surface soil materials did not indicate a significant presence of the elevated groundwater analytes and therefore unlikely to be a source of the metal exceedances.
- The site is not located in a catchment with contains the water quality objectives of drinking water (i.e. beneficial use) and therefore drinking water guidelines were not applied.

The following data gaps remain:

- Assessment of the soil beneath the south western portion of the Stage 3 area, groundwater conditions beneath the Stage 3 area & delineation of the asbestos impacted areas in Stage 4 need further investigation. Assessment during this DSI was limited due accessibility and/or underground services. Further soil and groundwater investigation is required post demolition of the site structures.

Based on the historical review, environmental information, proposed development and laboratory results of the investigation, the site can be made ***suitable*** for the proposed development, subject to the following:

- It is considered that the site would be deemed suitable for the proposed development subject to the implementation of a Remediation Action Plan (RAP) to manage the abovementioned data gaps environmental concerns.
- Any soil requiring removal from the site, as part of future site works, should be classified in accordance with the "Waste Classification Guidelines, Part 1: Classifying Waste" NSW EPA (2014).

4.4.5 FES - ASSA (2023)

Foundation Earth Sciences (FES) was appointed by East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd to prepare an Acid Sulphate Soil Assessment (ASSA) for the property located at 105, 109, 111, 121 Hunter Street, 3 Morgan Street, 66-74 King Street & 22 Newcomen Street, Newcastle NSW. The site is in the The City Of Newcastle Council municipality.

The assessment of acid sulphate material can be quite complex and can have a lot of interferences associated with the test methods and soil matrix. The following points outline the evidence to support the site is ***NOT*** impacted to the maximum depth of sampling:

- Analysis using the phF & phfox field test protocol showed the Ph of the soil to be absence for AASS / PASS;
- The results of the SPOCAS test determined that the percentage of oxidisable Sulphur (SPOS) & acid trail (TPA/TSA) did not exceed the action criteria in any of the samples from borehole locations investigated. The results are indicative that the soil material unlikely has acid sulphate potential within the soil matrix.
- The chromium reducible analysis indicated the oxidisable sulphur compounds were not detected above to the SPOS action criteria within the samples.

Therefore, it has been determined through laboratory testing that the *site is not impacted by AASS (Actual Acid Sulphate Soil) or PASS (Potential Acid Sulphate Soil)* in the vicinity of the borehole locations (BH1 to BH4) investigated at the site to a maximum depth of 8.5m BGL.

4.5 Site History

The site history as listed in the FES DSI is outlined below:

In summary:

- The land title information for the site indicated business ownership from late 2000s until the present date and generally owned by developers in last ten years. The land titles for the subject site have been summarized in previous report/ table above and indicated the following potential land uses:
    - Former pit / well
    - Possible printery
    - Mine shaft
    - Engine rooms
    - Plumbers workshop

- The aerial photographs for the site indicated generally mixed use of commercial and residential from at least 1944. No major changes until most recent available aerial photo but with some extensions/ additions can be noticed in different stages. The surrounding lands appeared to be mixed use including residential/commercial & possible warehouses from 1944 except for only two small properties in corners of the south of block 3/ west of block 4. That land has been developed into a large building before 1966 and generally remained unchanged to present time.
- The site is not listed on the NSW EPA Contaminated Land Record, NSW EPA List of Notified Sites, POEO Register or the NSW EPA PFAS Investigation Program.

- Foundation Earth Sciences has submitted the application for SafeWork NSW search for this site and no results have been found on premises.
- NSW EPA requires that PFAS is considered when investigating land contamination. The preliminary screen is based on guidelines from the PFAS National Environmental Management Plan (NEMP 2020). As per the FES DSI, PFAS sampling / analysis of soil was below the adopted site criteria.

5.0 CONCEPTUAL SITE MODEL - CURRENT

5.1 Conceptual Site Model Components

5.1.1 Potential Contaminated Media

Table 3: Potential Contaminated Media

Known and potential contamination source	Associated Contaminants
Fill Material	There is known contamination to be present in the upper soil material to depth of 0.4m BGL in boreholes BH115 & BH118. Contaminants of concern include asbestos.
Groundwater	There is the potential for the leaching of contaminants into groundwater onsite and migration of the contaminants.
Soil Vapour	Given the site history, sampling to date and surrounding land uses soil vapour is considered an unlikely potentially contaminated media.

5.1.2 Area of Concern

Table 4: Area of Concern

Known and potential contamination source	Associated Contaminants
Historical Site Uses & Current Site	Heavy Metals, TRH, BTEX, PAH, OCP, PCB
Surrounding land Uses	TRH, BTEX, PAH, VOC, PFAS,
Imported Fill	Heavy Metals, TRH, BTEX, PAH, OCP, PCB
Car parking Areas	TRH, BTEX, PAH
Cemetery	Heavy metals and VOC
Building degradation/ Demolition	Heavy Metals and Asbestos

5.1.3 Chemicals of Concern

Soils

The following chemicals of concern were identified in previous sampling events and are outlined as follows:

- Asbestos was detected within borehole locations BH115 & BH118 in the upper fill soil profile to depth of 0.4m BGL.

5.1.4 Sources

The most likely source of the contaminants of concern is the quality of the soil materials impacted from historical land use across the site.

5.1.5 Pathways (Transport of COC)

Potential exposure pathways include:

- Dermal;
- Ingestion; and
- Inhalation.

The potential for ingestion of soil is considered a potential exposure pathway during site development works as construction workers would be exposed to soil. However once development the exposure pathway would be negligible based on the proposed development which includes removal of bulk soils for basement.

Based on the soil and groundwater sampling to date there is potential for vapour to be present in the underlying profile within the site.

5.1.6 Receptors

Human:

The site groundwater is not currently used for or planned to be used for drinking water as town water is provided by Hunter Water.

Ecological

The ecological receptors would be surface water and benthic organisms in Hunter River.

5.1.7 Potential for Migration

Contaminants generally migrate from site via a combination of windblown dusts, rainwater infiltration, groundwater migration and surface water runoff. The potential for contaminants to migrate is a combination of:

- The nature of the contaminants (solid/liquid and mobility characteristics);
- The extent of the contaminants (isolated or widespread);
- The location of the contaminants (surface soils or at depth); and
- The site topography, geology, hydrology, and hydrogeology.

The potential contaminants identified as part of the site history review & site inspection are present in solid (e.g. impacted fill, asbestos), liquid (e.g. dissolved in water) & gas form (soil vapour).

The redevelopment works at site will create minimal unsealed ground surfaces and therefore, there is a low risk for migration of contaminants via wind-blown dust. Likewise, rainfall infiltration at the site is not expected due to the proposed sealed surfaces across much of the site based on the proposed development. The removal of the contaminated soil, will reduce the risk for any ongoing / future migration of soil contaminants.

5.1.8 Preferential Pathways

For the purpose of this assessment, preferential pathways have been identified as natural and/or man-made pathways that result in the preferential migration of COPCs as either liquids or gases.

Man-made preferential pathways are present throughout the site, generally associated with fill materials and services present beneath existing ground surface. Fill materials and service lines are anticipated to have a higher permeability than the underlying natural soil and/or bedrock.

DBYD plans were requested and reviewed for the Site. Plans were provided by Ausgrid, Hunter Water Corporation, Jemena Gas North, NBN Co NswAct, Optus and/or Uecomm Nsw, Telstra NSW Central, TPG Telecom (NSW) & Vocus Communications. The plans did not indicate the presence of any major underground services or utility easements at the site except for plans provided by Ausgrid, Hunter Water, Jemena Gas, Telstra & Vocus.

The plans provided by Ausgrid indicate several cables running into the site from the surrounding streets along all boundaries. The Hunter Water plans further indicated the presence of major cables running through the site, especially from the eastern boundary

(Newcomen St) to the western (Morgan St). An abandon sewer main (running into 16 Newcomen St) was also noted on the plans. The Jemena Gas plans indicated mains lines running along surrounding streets, with some mains entering the site at 66-74 King St as well as 16-18 Newcomen St. The plans provided by Telstra demonstrate the presence of mains lines running into the site from the surrounding streets. The Vocus plans indicate a mains line running into 121 Hunter Street. It is noted that these underground services are considered a potential preferential pathway.

5.1.9 Frequency of Exposure

As the potential for ingestion of soil is considered a potential exposure pathway during site development works as construction workers would be exposed to soil. The frequency of exposure will be occurring from removal of the existing hard standing surfaces until construction of the new surfaces across the proposed development area.

5.1.10 Offsite Contamination

As the known source of contamination is limited to soil, impacted soil contamination could migrate off site during site development works with surface water run-off.

No offsite contamination risks have been identified to date with regards to potential contamination sources migrating onto the site.

5.1.11 Data Gap Identification

The following data gaps remain:

- Waste classification during excavation works to facilitate offsite disposal (TCLP required for heavy metals, PFAS and PAH).

- Assessment of the soil beneath the south western portion of the Stage 3 area, groundwater conditions beneath the Stage 3 area & delineation of the asbestos impacted areas in Stage 4 need further investigation. Assessment during this DSI was limited due accessibility and/or underground services. Further soil and groundwater investigation is required post demolition of the site structures and has been included as part of the remediation and validation works in section 8.2.

6.0 REMEDIATION CRITERIA

6.1 Soil

6.1.1 Health Investigation Levels (HIL)

To assess the contamination status of soils at a site, the NSW EPA refers to the document entitled National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) (Amendment 2013).

During any future soil investigations, the site will be assessed against the NEPM exposure scenario 'Commercial and Industrial D' Health Investigation Levels of the above-mentioned guidelines and specifically refers to the following:

HIL 'D' Commercial / industrial, includes premises such as shops, offices, factories and industrial sites

The soil regulatory guidelines are presented in the table below.

Table 5: Health Investigation Levels (HIL) Criteria for Soil Contaminants

FOUNDATION EARTH SCIENCES	Commerical/Industrial D	Reference
Heavy Metals		
Arsenic	3000	NEPM 2013 - Table 1(A)1 HILs
Beryllium	500	NEPM 2013 - Table 1(A)1 HILs
Boron	300000	NEPM 2013 - Table 1(A)1 HILs
Cadmium	900	NEPM 2013 - Table 1(A)1 HILs
Chromium (VI)	3600	NEPM 2013 - Table 1(A)1 HILs
Cobalt	4000	NEPM 2013 - Table 1(A)1 HILs
Copper	240000	NEPM 2013 - Table 1(A)1 HILs
Lead	1500	NEPM 2013 - Table 1(A)1 HILs
Manganese	60000	NEPM 2013 - Table 1(A)1 HILs
Mercury (Inorganic)	730	NEPM 2013 - Table 1(A)1 HILs
Methyl Mercury	180	NEPM 2013 - Table 1(A)1 HILs
Nickel	6000	NEPM 2013 - Table 1(A)1 HILs
Selenium	10000	NEPM 2013 - Table 1(A)1 HILs
Zinc	400000	NEPM 2013 - Table 1(A)1 HILs
Cyanide (Free)	1500	NEPM 2013 - Table 1(A)1 HILs
Polycyclic Aromatic Hydrocarbons (PAHs)		
Carcinogenic PAHs (as Bap TEQ)	40	NEPM 2013 - Table 1(A)1 HILs
Total PAHs	4000	NEPM 2013 - Table 1(A)1 HILs
Organochlorine Pesticides		
DDT + DDE + DDD	3600	NEPM 2013 - Table 1(A)1 HILs
Aldrin + Dieldrin	45	NEPM 2013 - Table 1(A)1 HILs
Chlordane	530	NEPM 2013 - Table 1(A)1 HILs
Endosulfan	2000	NEPM 2013 - Table 1(A)1 HILs
Heptachlor	50	NEPM 2013 - Table 1(A)1 HILs
HCB	80	NEPM 2013 - Table 1(A)1 HILs
Phenols		
Phenols	240000	NEPM 2013 - Table 1(A)1 HILs
Pentachlorophenol	660	NEPM 2013 - Table 1(A)1 HILs
Cresols	25000	NEPM 2013 - Table 1(A)1 HILs
Polychlorinated Biphenyls (PCBs)		
PCBs	7	NEPM 2013 - Table 1(A)1 HILs
Other Pesticides		
Atrazine	2500	NEPM 2013 - Table 1(A)1 HILs
Chlorpyrifos	2000	NEPM 2013 - Table 1(A)1 HILs
Bifenthrin	4500	NEPM 2013 - Table 1(A)1 HILs
Herbicides		
2,4,5-T	5000	NEPM 2013 - Table 1(A)1 HILs
2,4-D	9000	NEPM 2013 - Table 1(A)1 HILs
MCPA	5000	NEPM 2013 - Table 1(A)1 HILs
MCPB	5000	NEPM 2013 - Table 1(A)1 HILs
Mecoprop	5000	NEPM 2013 - Table 1(A)1 HILs
Picloram	35000	NEPM 2013 - Table 1(A)1 HILs
Other Organics		
PDBE (Br1-Br9)	10	NEPM 2013 - Table 1(A)1 HILs

6.1.2 Health Screening Levels (HSLs) – HSL D

For selection of the health screening criteria an assessment of the in-situ soil profile should be undertaken. The soil criteria indicate that the upper soil profile is more consistent with **SAND**.

Table 6: Health Screening Levels (HSL) Criteria

FOUNDATION EARTH SCIENCES	HSL D	HSL D	HSL D	HSL D	Soil Saturation Concentration (Csat)	Reference
	0m to <1m	1m to <2m	2m to <4m	4m+		
SAND						
Toluene	NL	NL	NL	NL	560	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	NL	NL	NL	NL	64	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	NL	NL	NL	NL	300	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	NL	NL	NL	NL	9	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	3	3	3	3	360	NEPM 2013 - Table 1(A) 3 HSLs
F1	260	370	630	NL	950	NEPM 2013 - Table 1(A) 3 HSLs
F2	NL	NL	NL	NL	560	NEPM 2013 - Table 1(A) 3 HSLs
SILT						
Toluene	NL	NL	NL	NL	640	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	NL	NL	NL	NL	69	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	NL	NL	NL	NL	330	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	NL	NL	NL	NL	10	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	4	4	6	10	440	NEPM 2013 - Table 1(A) 3 HSLs
F1	250	360	590	NL	910	NEPM 2013 - Table 1(A) 3 HSLs
F2	NL	NL	NL	NL	570	NEPM 2013 - Table 1(A) 3 HSLs
CLAY						
Toluene	NL	NL	NL	NL	630	NEPM 2013 - Table 1(A) 3 HSLs
Ethylbenzene	NL	NL	NL	NL	68	NEPM 2013 - Table 1(A) 3 HSLs
Xylenes	NL	NL	NL	NL	330	NEPM 2013 - Table 1(A) 3 HSLs
Naphthalene	NL	NL	NL	NL	10	NEPM 2013 - Table 1(A) 3 HSLs
Benzene	4	6	9	20	430	NEPM 2013 - Table 1(A) 3 HSLs
F1	310	480	NL	NL	850	NEPM 2013 - Table 1(A) 3 HSLs
F2	NL	NL	NL	NL	560	NEPM 2013 - Table 1(A) 3 HSLs

Note - All values are in mg/kg

Ecological Investigation Levels (EILs) -

Any validation samples collected from *landscape areas with direct access to soil* in the future will be assessed against the site derived EILs. A copy of the site derived EILs is provided below.

Table 7: Site Derived EIL Criteria

	EIL Analytes (mg/kg)							
	ARSENIC	CHROMIUM (VI)[a]	COPPER	LEAD	NICKEL	ZINC	NAPHTHALENE	DDT
Site Derived Ecological Investigation Levels (EILs)								
FES Fill BH2 (0.2-0.3m)	160	660	320	1,900	600	1,600	370	640
FES Nat BH2 (2.2-2.3m)	160	670	280	1,800	290	630	370	640

Notes: a **Chromium VI has been used in lieu of Chromium III**

Ecological Screening Levels (ESLs) -

Ecological screening levels (ESLs) are presented based on a review of Canadian guidance for petroleum hydrocarbons in soil and application of the Australian methodology (Schedule B5b) to derive Tier 1 ESLs for BTEX, benzo(a)pyrene and F1 and F2 (Warne 2010a, 2010b)

The Canadian Council of the Ministers of the Environment (CCME) has adopted risk-based TPH standards for human health and ecological aspects for various land uses in the *Canada-wide standard for petroleum hydrocarbons (PHC) in soil* (CCME 2008) (CWS PHC). The standards established soil values including ecologically based criteria for sites affected by TPH contamination for coarse- and fine-grained soil types.

Table 8: (EIL) and (ESL) Criteria

FOUNDATION EARTH SCIENCES	Contaminant Age/Soil Texture	National parks and areas of high conservation value	Urban residential and open public spaces	Commercial and industrial	Reference
Ecological Investigation Levels (EILs)					
Heavy Metals					
Arsenic	**Fresh**	20	50	80	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	40	100	160	NEPM 2013 - Table 1(B) 1-5 EILs
Chromium (III)	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Copper	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Lead	**Fresh**	110	270	440	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	470	1100	1800	NEPM 2013 - Table 1(B) 1-5 EILs
Nickel	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Zinc	**Fresh**	Site Specific Calculation Required			NEPM 2013 - Table 1(B) 1-5 EILs
	Aged				NEPM 2013 - Table 1(B) 1-5 EILs
Polycyclic Aromatic Hydrocarbons (PAHs)					
Naphthalene	**Fresh**	10	170	370	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	10	170	370	NEPM 2013 - Table 1(B) 1-5 EILs
Organochlorine Pesticides					
Ecological Screening Levels (ESLs) and Management Limits					
F1 (C_6-C_{10})	**Coarse**				NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	125*	180*	215*	NEPM 2013 - Table 1(B) 6-7 EILs
F1 (C_6-C_{10})	**Coarse**		700	700	NEPM 2013 - Table 1(B) 6-7 EILs
(Management Limits)	**Fine**	-	800	800	NEPM 2013 - Table 1(B) 6-7 EILs
F2 (>C_{10}-C_{16})	**Coarse**				NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	25*	120*	170*	NEPM 2013 - Table 1(B) 6-7 EILs
F2 (>C_{10}-C_{16})	**Coarse**		1000	1000	NEPM 2013 - Table 1(B) 6-7 EILs
(Management Limits)	**Fine**	-	1000	1000	NEPM 2013 - Table 1(B) 6-7 EILs
F3 (>C_{16}-C_{34})	**Coarse**	-	300	1700	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	1300	2500	NEPM 2013 - Table 1(B) 6-7 EILs
F3 (>C_{16}-C_{34})	**Coarse**		2500	3500	NEPM 2013 - Table 1(B) 6-7 EILs
(Management Limits)	**Fine**	-	3500	5000	NEPM 2013 - Table 1(B) 6-7 EILs
F4 (>C_{34}-C_{40})	**Coarse**	-	2800	3300	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	-	5600	6600	NEPM 2013 - Table 1(B) 6-7 EILs
F4 (>C_{34}-C_{40})	**Coarse**		10000	10000	NEPM 2013 - Table 1(B) 6-7 EILs
(Management Limits)	**Fine**	-	10000	10000	NEPM 2013 - Table 1(B) 6-7 EILs
Benzene	**Coarse**	10	50	75	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	10	65	95	NEPM 2013 - Table 1(B) 6-7 EILs
Toluene	**Coarse**	10	85	135	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	65	105	135	NEPM 2013 - Table 1(B) 6-7 EILs
Ethylbenzene	**Coarse**	1.5	70	165	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	40	125	185	NEPM 2013 - Table 1(B) 6-7 EILs
Xylenes	**Coarse**	10	105	180	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	1.6	45	95	NEPM 2013 - Table 1(B) 6-7 EILs
Benzo(a)pyrene	**Coarse**	0.7	0.7	0.7	NEPM 2013 - Table 1(B) 6-7 EILs
	Fine	0.7	0.7	0.7	NEPM 2013 - Table 1(B) 6-7 EILs

Notes

1 Urban residential/public open space is broadly equivalent to the HIL-A, HIL-B and HIL-C land use scenarios in Table 1A(1) Footnote 1 and as described in Schedule B7.

2 Aged values are applicable to arsenic contamination present in soil for at least two years. For fresh contamination refer to Schedule B5c.

3 Insufficient data was available to calculate aged values for DDT and naphthalene, consequently the values for fresh contamination should be used.

4 Insufficient data was available to calculate ACLs for As, DDT and naphthalene. The EIL should be taken directly from Table 1B(5).

5 ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability.

6 '-' indicates that insufficient data was available to derive a value.

7 To obtain F1, subtract the sum of BTEX concentrations from C6-C10 fraction and subtract naphthalene from >C10-C16 to obtain F2.

8 Management limits are applied after consideration of relevant ESLs and HSLs

9 Separate management limits for BTEX and naphthalene are not available hence these should not be subtracted from the relevant fractions to obtain F1 and F2.

The adopted site criteria for ESLs include 'Commercial and Industrial' with soil predominantly considered to be 'fine' grained.

6.1.3 Asbestos – Commercial / Industrial D, FA & AF + All forms

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1. The following health screening levels for asbestos can be seen below:

-

Table 9: Health Screening Levels for Asbestos

	Health Screening Levels (w/w)			
Form of Asbestos	**Residential A**	Residential B	Recreational C	**Commercial/Industrial D**
Bonded ACM	0.01%	0.04%	0.02%	**0.05%**
FA and AF (Friable Asbestos)	**0.001%**			
All forms of asbestos	**No visible asbestos for surface soil**			

-

6.1.4 Export of waste

Any additional soil material requiring offsite disposal will analysed against the NSW EPA refers to the NSW EPA (2014) "*Waste Classification Guidelines, Part 1: Classifying Waste".*

6.1.5 Aesthetic Considerations

Schedule B1 in NEPC (2013) requires the consideration of aesthetic issues arising from soils and groundwater within the site. The following assessment criteria were adopted when considering aesthetics:

- no persistently malodourous soils or extracted groundwater;
- no persistent hydrocarbon sheen on surface water;
- no staining or discolouration in soils, taking into consideration the natural state of the soil; and
- no large or frequently occurring anthropogenic materials present (to the extent practicable).

6.2 Groundwater (Contingency)

The NSW DECC has endorsed the use of the Groundwater Investigation Levels (GILs) given in the 1999 NEPM '*Schedule B(1) Guideline on the Investigation Levels for Soil and Groundwater*' (Amendment 2013) and the water quality trigger levels given in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000). These Guidelines provide criteria for:

- Aquatic ecosystems – both marine and fresh waters

The NEPM advises that 'when assessing groundwater contamination, the GILs are to be applied at the point of extraction and as response levels at the point of use, or where there is a likelihood of an adverse environmental effect at the point of discharge'.

For assessing groundwater quality, it is first necessary to assess the potential uses of groundwater downgradient of the site being assessed.

Potential uses of groundwater downgradient of the site include:

- Discharge to water bodies sustaining aquatic ecosystems particularly Fresh Water.
- Extraction of groundwater by local users.

The threshold concentrations presented in the ANZECC (2000) Fresh and Marine Waters Quality Guidelines are considered applicable for the protection of aquatic ecosystems of the receiving waters. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging to receiving waters. It is important to note that these are not threshold values at which an environmental problem is likely to occur if exceeded, rather, if the trigger values are exceeded, then further action is required which may include either further site-specific investigations to assess whether or not there is an actual problem or management / remedial action should be undertaken.

It is considered that ***Marine trigger*** values are applicable for investigating chemical concentrations in groundwater at the site. The nearest watercourse is Hunter River located approximately 100m to the north of the site. It is understood that the NSW EPA policy is that the trigger values for the protection of 95% of aquatic ecosystems should be used as groundwater assessment criteria when considering moderately or highly disturbed receiving environments. The receiving waters for groundwater at the site are moderately disturbed ecosystems and the ANZECC (2000) 95% protection values are therefore considered appropriate groundwater assessment criteria for the site.

Table 10: Groundwater Investigation Levels (GILs)

FOUNDATION EARTH SCIENCES	GIL-Marine Low Reliability 95% (µg/L)	Reference
Heavy Metals		
Arsenic	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Cadmium	0.7	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Chromium, Cr (III)	27.4	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Chromium, Cr (VI)	4.4	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Copper	1.3	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Lead	4.4	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Mercury (Total)	0.1	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Nickel	7	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Zinc	15	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Polycyclic Aromatic Hydrocarbons (PAHs)		
Naphthalene	50	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Benzo[a]pyrene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Monocyclic Aromatic Hydrocarbons		
Benzene	500	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Toluene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Etylbenzene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Xylenes	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Phenols		
Phenols	400	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Chlorinated Alkanes		
Dichloromethane	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Tetrachloromethane (carbon tetrachloride)	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Trichloromethane (chloroform)	770	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000) & ANZG 2018
Trihalomethanes (total)	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,2-Dichloroethane	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,1,2-Trichloroethane	1900	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Chlorinated Alkenes		
Chloroethene (vinyl chloride)	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,1-Dichloroethene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,2-Dichoroethene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Trichloroethene	330	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Tetrachloroethene (PCE)	70	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
Chlorinated Benzenes		
Chlorobenzene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,2- Dichlorobenzene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,3- Dichlorobenzene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,4- Dichlorobenzene	60	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,2,3- Trichlorobenzene	-	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)
1,2,4- Trichlorobenzene	20	NEPM 2013 - Table 1C GILs & ANZECC & ARMCANZ (2000)

Table 11: Groundwater HSLs

FOUNDATION EARTH SCIENCES	HSLD 2m to <4m	HSLD 4m to <8m	HSLD 8m+	SolubilityLimit	Reference
SAND					
Toluene	NL	NL	NL	61	NEPM 2013 - Table 1(A) 4 HSLs
Ethylbenzene	NL	NL	NL	3.9	NEPM 2013 - Table 1(A) 4 HSLs
Xylenes	NL	NL	NL	21	NEPM 2013 - Table 1(A) 4 HSLs
Naphthalene	NL	NL	NL	0.17	NEPM 2013 - Table 1(A) 4 HSLs
Benzene	5	5	5	59	NEPM 2013 - Table 1(A) 4 HSLs
F1	6	6	7	9	NEPM 2013 - Table 1(A) 4 HSLs
F2	NL	NL	NL	3	NEPM 2013 - Table 1(A) 4 HSLs
SILT					
Toluene	NL	NL	NL	61	NEPM 2013 - Table 1(A) 4 HSLs
Ethylbenzene	NL	NL	NL	3.9	NEPM 2013 - Table 1(A) 4 HSLs
Xylenes	NL	NL	NL	21	NEPM 2013 - Table 1(A) 4 HSLs
Naphthalene	NL	NL	NL	0.17	NEPM 2013 - Table 1(A) 4 HSLs
Benzene	30	30	30	59	NEPM 2013 - Table 1(A) 4 HSLs
F1	NL	NL	NL	9	NEPM 2013 - Table 1(A) 4 HSLs
F2	NL	NL	NL	3	NEPM 2013 - Table 1(A) 4 HSLs
CLAY					
Toluene	NL	NL	NL	61	NEPM 2013 - Table 1(A) 4 HSLs
Ethylbenzene	NL	NL	NL	3.9	NEPM 2013 - Table 1(A) 4 HSLs
Xylenes	NL	NL	NL	21	NEPM 2013 - Table 1(A) 4 HSLs
Naphthalene	NL	NL	NL	0.17	NEPM 2013 - Table 1(A) 4 HSLs
Benzene	30	30	35	59	NEPM 2013 - Table 1(A) 4 HSLs
F1	NL	NL	NL	9	NEPM 2013 - Table 1(A) 4 HSLs
F2	NL	NL	NL	3	NEPM 2013 - Table 1(A) 4 HSLs

Units in mg/L

7.0 REMEDIATION STRATEGY

7.1 General

- All works undertaken during the remediation program must be monitored by a suitably qualified person experienced in the assessment and remediation of contaminated sites. The RAP must be adhered to by all personnel and sub-contractors involved in the remediation program.

7.2 NSW EPA preferred hierarchy of options for site remediation

The NSW EPA has a preferred hierarchy of options for site remediation and/or management which is outlined below:

- If practicable, on-site treatment of the contamination so that it is destroyed and the associated risk is reduced to an acceptable level; and
- Off-site treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level.

If the above is not practicable:

- Consolidation and isolation of the soil on-site by containment with a properly designed barrier; and
- Removal of contaminated material to an approved facility followed, if necessary, by replacement with appropriate materials; or
- Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse effect, implementation of an appropriate management strategy.

7.3 Remediation option review

7.3.1 Available remediation / management technologies

There is a range of different remediation technologies that are available for remediation of contaminated sites. Some of these technologies are proven while others have not been successfully implemented, particularly in Australia and / or there is limited local expertise for implementation.

A review of the available soil remediation methods and technologies indicated that the following strategies may be applicable to the remediation of fill material contaminated at concentrations exceeding health-based threshold concentrations:

- Excavation and off-site disposal of contaminated soil to landfill.
- Treatment (on-site or off-site).
- Managing the risks posed by contaminants by preventing any direct exposure pathway between the known and potential contaminated soil and users of the proposed development (through capping).
- Further assessment of phytotoxic and health risks.

7.3.2 Excavation and off-site disposal

This method involves the excavation of contaminated materials and disposal of the materials off-site to a landfill licensed by the NSW EPA.

Excavated soils must be classified before disposal to an appropriate landfill. Depending on the levels of contamination, soil may require pre-treatment (to reduce contaminant levels or immobilise contaminants) prior to off-site disposal to the licensed landfill.

7.3.3 Treatment

There is a range of soil treatment technologies available depending on the type of contaminant including in-situ and ex-situ remediation methods. Most commonly, for contamination, the technologies adopted are ex-situ, requiring excavation of the contaminated material. In-situ remediation technologies generally require a longer timeframe for completion than ex-situ technologies. Most of the treatment technologies that require excavation of the contaminated material could be undertaken on or off-site, subject to obtaining licences.

Some possible treatment methods for heavy metals include soil washing and stabilisation of soil.

7.3.4 Managing risks by preventing any direct exposure pathway between contaminated soil and site users (through capping)

On-site capping is used to isolate areas in the subsurface from the surrounding uncontaminated environment. A physical barrier such as a layer of clean soil, synthetic material liners, asphalt and concrete layers may be installed to cap the contaminated material. A cap is typically used where it is required to remove exposure to the contaminated soils and where the contaminated soils are not mobile or there is no contact with groundwater and / or groundwater is not contaminated.

A site management plan is required with any cap and contain strategy. The site management plan identifies the party responsible for adhering to the plan, and includes commitments for ongoing monitoring and maintenance of the cap as well as control of future excavations, which must be minimised or if required, the appropriate occupational health and safety procedures are adopted and permits acquired before work is carried out.

7.4 Rationale for selection of remedial strategy

Usual considerations in selecting and implementing a remediation strategy for a site include:

- **Proven technology**: the remediation method should have a proven track record of success/failure;
- **Reliability**: this is a measure of the degree of certainty that the remediation method will succeed in meeting the site remediation goals in the short and long term;
- **Regulatory approvals**: the remediation method needs to be endorsed by the relevant regulatory authorities. The difficulty in obtaining regulatory approvals will be largely dependent upon the nature of the remediation method proposed;
- **Cost**: provides an indication as to the likely costs involved in implementing each type of remediation method;
- **Implementation time:** provides an indication as to the likely time frame involved in implementing each type of remediation strategy;
- **Land use restrictions:** if contaminated material is left on-site, the regulatory authority may place restrictions on the land use and/or require notification of the contamination on the property title;

- **Ongoing liabilities (maintenance and monitoring requirements):** a remediation strategy that does not involve the complete removal of all contaminants from the site will necessitate some form of ongoing maintenance and/or monitoring to ensure the longer-term integrity of the remediation strategy adopted;
- **Future liability:** any remediation strategy that does not involve the complete removal of all contaminants from the site will result in future liability for the contamination;
- **Local contractor experience:** the success and cost effectiveness of any remediation method will be at least partially dependent upon the experience local contractors have in undertaking the type of remediation works proposed;
- **On-site space requirements:** some remediation techniques (e.g. land farming) require relatively large amounts of space to spread soil and will only be feasible if sufficient land is available;
- **Disruptions to site structures and activities:** remediation of the site is likely to create some disturbance, both to the existing site operations and structures, as well as to underground services which may pass through the remediation area (e.g. any work involving excavation of the contaminated soil mass will involve the removal of any structures located atop the excavation zone);
- **Human health risks during remediation:** the remediation workers, site users and the general public may be exposed to hazards posed by contamination during the remediation (e.g. significant levels of vapours may be released when disturbing soil contaminated with volatile organic compounds); and
- **Availability of appropriate disposal sites (for remediation techniques involving excavation and off-site disposal)**: landfill disposal of contaminated

soil will only be feasible if a landfill licensed to accept the contaminated soils excavated from the site is available at a reasonable distance from the site.

The table below presents an evaluation of the various options for general remediation projects in Australia based on the above. The table also includes a number of limitations and risks associated with each method.

Table 12: Remediation options

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Cost	Low- Medium	Medium	High	Low
Technical feasibility	Possible for a range of contaminants including those encountered at the site during the investigations	Not possible for heavy metal contaminated material	Not possible for heavy metal contaminated material	Possible for a wide range of contaminants including those encountered at the site
Human Health Risks	Relatively low – excavation and direct offsite disposal will minimise personal contact	Variable – relatively low risk associated with in-situ bioremediation but greater with ex-situ, as soil needs to be excavated	Significant – excavation and handling of contaminated materials will create a volatile contaminant release hazard	Relatively low – only minimal soil disturbance involved

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Reliability	Excellent – system ensures the removal of all contaminated materials	Variable – in-situ bioremediation presents only a low potential to adequately remediate all organic species. Ex-situ is more reliable, due to the more complete mixing of organisms, nutrients and oxygen with the contamination	Moderate – thermal processes have been successfully implemented on most organic contaminant species	Moderate – some potential may exist for contaminant breakthrough if containment wall not properly keyed into bedrock. Care also needs to be taken to prevent preferential gas venting.
Regulatory Approval	Satisfactory – Compliance with Regulatory Authorities. Licensed landfills available for day cover	Satisfactory – on-site treatment is generally the EPA's preferred strategy for site remediation	May be difficult. May require an EIS	Generally satisfactory – whilst on-site containment is not the EPA's preferred option, it is often accepted as a feasible option

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Disruption to Site Structures and Activities	Significant – all existing site structures need to be demolished or relocated to allow excavation of contaminated soils	Variable – disturbance relatively minor for in-situ bioremediation, but ex-situ would require existing structures to be demolished or relocated	Significant – all existing site structures need to be demolished or relocated to allow excavation of contaminated soils	Moderate – some disruption likely to proposed underground services
Ongoing Liabilities	Minimal – all heavily contaminated materials removed	Variable – need for ongoing monitoring will be largely dependent upon the success of bioremediation in destroying contaminants	Variable – need for ongoing monitoring will be largely dependent upon the success of thermal desorption in destroying contaminants	Moderate to high – capping system need to be maintained, and ongoing monitoring necessary to ensure the integrity of the cap and cut-off wall
Contractor Experience	Good – relatively simple strategy involving only basic technologies	Very Limited – technology is still developing, and only a limited amount of trials undertaken in Australia	Very Limited – technology is still developing, and only a limited amount of trials undertaken in Australia	Moderate – contractors available with experience in the implementation of cap and contain systems

Technical Characteristics	Option 1 Excavation – Off-Site Disposal	Option 2 Bioremediation	Option 3 Thermal Treatment	Option 4 Cap and Contain
Availability of Disposal Sites	Good – landfills available to accept solid waste	Not Applicable	Not Applicable	Not Applicable (assuming all materials excavated to form the cut-off wall are retained on-site)
Implementation Time Frame	Short	Long	Short to Moderate	Short to Moderate

7.5 Preferred remediation strategy

For this site, on- and off-site treatment of contaminants, which are the most preferred remedial strategies of the NSW EPA, were ruled out for the following reasons:

- Materials have to be removed from site so if land farming took place, materials would ultimately be removed; and
- The costs of reuse and treatment for more sensitive sites would be substantially higher than off-site disposal to landfill.

The next most preferred strategy of on-site containment was ruled out for the following reasons:

- The site requires a reduction of soils as excavation is required within the site.

The next most preferred remedial option strategy is removal of contaminated material to a licensed landfill and is the selected strategy for the following reasons:

- The costs of off-site disposal to landfill are considerably less than treatment costs.

- The method fits in with the proposed development.

Relative benefits of the "excavate and dispose" strategy are as follows:

- The costs associated with the 'excavate and dispose' remediation method is low to medium;
- The 'excavate and dispose' remediation method is a proven technology for the type of contaminants identified at the site, likely to be approved by the regulatory bodies;
- The 'excavate and dispose' remediation method is dependent upon the cost and availability of suitable landfill disposal sites. These are readily available and cost-effective;
- After completion of the remediation works by the 'excavate and dispose' remediation method, the site would continue to be suitable for the proposed use, and there would be no ongoing liabilities, and very limited (if any) ongoing maintenance / monitoring required;
- As part of the site development, a net reduction of soils is required thus fitting into this remediation strategy; and
- The timeframe for implementation of the 'excavate and dispose' remediation method is relatively short compared to other possible remediation methods.

7.6 Excavation Risk – Offsite Disposal

Prior to commencement of any excavation works, the remediation contractor should refer to the ***engineering report to limit any undermining risks to the adjacent properties.*** An assessment by a suitable qualified contractor / engineering is required to identify a suitable excavation method prior to start of excavation works to ensure integrity of adjacent structures remain.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate approvals obtained from the EPA, if required. ***Details of all soils removed from the site (including VENM) shall be documented by the Contractor with copies of weighbridge slips, landfill receipts, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and/or the NSW EPA Accredited Site Auditor.***

8.0 REMEDIATION WORKS

8.1 Remediation Goal & Objectives

The remediation goal is to render the site suitable for the proposed development upon completion of the remediation and validation works. This would be achieved by remediating the asbestos impacted locations at BH115 & BH118.

Refer to **Appendix C** – Summary Tables.

8.2 Remediation program

Assuming appropriate permits have been granted, the remediation of the site is to take place in the following stages:

Stage One -Site Preparation

- Notice should be given to council at least 30 days prior to the commencement of remediation works. The site developer needs to prepare and implement a Construction Environmental Management Plan (CEMP) and site Work Health and Safety Plan prior to any site works.
- A hazardous material assessment is recommended to be completed prior to demolition of the site structures.

Stage Two -Site Walkover

- Post demolition of structures and removal of hardstand pavements, an appraisal of the prevailing site conditions is to be performed by a suitable qualified environmental scientist / engineer.

- The purpose of the site walkover is to observe any signs / evidence of potential contamination including fibro cement fragments, ACM, heavy staining, odours, presence of waste.
- Unexpected finds protocol will be implemented if signs / evidence of contamination is encountered.

Stage Three -Test Pit Investigation (Post Demolition).

Soil

- Undertake validation test pit investigation works post demolition of structures and removal of hardstand pavements. *Works to occur prior to offsite removal of soil.*
- Soil samples will be analysed in a NATA-accredited laboratory under Chain of Custody. Laboratory analysis for HM, TRH, BTEXN, PAH, OCP/OPP, PCB, PFAS & Asbestos %w/w and TCLP Analysis. Selected VOC.
- Twelve (12) validation locations are proposed to be test pitted to allowed sufficient soil validation collection.
    - One fill and one natural sample from each test pit. If the fill is greater than 1m deep, fill samples to be analysed and collected in each soil horizon.
- Locations to be test pitted to allowed sufficient soil collection for asbestos %w/w analysis of the collected samples.
- Validation boreholes / test pits for acid sulphate soils within the Stage 3 development area. Soil samples will be analysed in a NATA-accredited laboratory under Chain of Custody. Field testing and laboratory analysis for SPOCAS and Chromium Reducible.

Sampling of asbestos %w/w will be undertaken as follows:

- A minimum 10L sample from each sample location will be recovered;
- Each asbestos sample (minimum of 10 L) will be screened through a 7mm sieve and the material retained on the sieve examined for any bonded ACM and / or suspect material and forwarded to the laboratory for analysis if any suspected ACM is encountered;
- If visible FA material is present or suspected, the soil should be wetted to minimise the release of fibres;
- Identified bonded ACM and FA should be weighed for each sample; and
- One wetted 500ml sample from each asbestos sampling location will be submitted for laboratory analysis for AF.

Groundwater

- Post demolition of site structures the installation and sampling of two validation groundwater monitoring wells is recommended in the vicinity of the East End Stage 3 area (Hunter and Laing Street). Analysis for Heavy metals, TRH, BTEX, PAH, PFAS & VOC.
- Allowance for collection and laboratory analysis of groundwater QA/QC samples, including field duplicates, field/rinsate blanks and trip spikes as relevant.
- Provision of qualified and experienced scientists/engineers to supervise and conduct the fieldwork component.

Stage Four -Classification and removal of fill material across proposed basement area and asbestos Impacted areas (BH115 & BH118).

Based on previous investigations the fill material is impacted with asbestos. Therefore, it is proposed to removal all fill material offsite within the proposed basement area and dispose appropriately.

A preliminary soil classification on the sampling completed during the DSI has been completed by FES. This preliminary soil classification refers to 3 in-situ borehole locations from previous Douglas Partners designated as 114,115,118 & 21 in-situ locations from FES DSI designated as BH1 to BH6 & BH8 to BH22.

Refer to Section 11.2

The lateral and vertical extent of the above locations may be extended pending results of the validation sampling. The material is to be classified in accordance with the NSW EPA Waste Classification Guidelines and can be disposed of at EPA licenced landfill facility that can accept the waste.

The fill layer has already been sampled as part of the previous works and these samples will be included within the sampling density for characterisation. Further samples will be recovered either in-situ or from stockpiles. Any excavated fill will be temporarily stockpiled on a heavy-duty plastic sheet or a sealed surface such as concrete, and covered with an impermeable plastic sheet to prevent rain infiltration.

Waste classified for offsite disposal should be loaded onto EPA licensed waste vehicles for transport to designated landfill. Waste classification ex-situ at rate of 1 per 25m3 up to 250m3 for waste classification purposes. Minimum of 3 samples per stockpile. Stockpiles greater than 250m3, sampling frequency reduced to 1 per 50m3 (minimum of 10 samples).

- Collection of QA/QC
- Analysis includes HM, TRH, BTEXN, PAH, OCP, PCBs and Asbestos

Asbestos Impacted Locations

The asbestos impacted locations (BH115 & BH118 are in the proposed basement area). The following remediation works are proposed:

BH115

- BH115– contains asbestos impacted soil materials to a depth of 0.4m BGL. It is intended to initially excavate the Hotspot 2m long x 2m wide x 1m vertically deep. The material is to be classified in accordance with the NSW EPA Waste Classification Guidelines and can be disposed of at EPA licenced landfill facility that can accept the waste. The approximate volume to be disposed of is $4m^3$.
- The test pit will be validated to ensure the successful removal of contaminated fill soils. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.
- Asbestos Air monitoring should be set up in order to monitor the removal works being undertaken. Asbestos monitoring canisters should be set up each day and removed and sent to a NATA Accredited Laboratory for analysis.

BH118

- BH118– contains asbestos impacted soil materials to a depth of 0.05m BGL. It is intended to initially excavate the Hotspot 2m long x 2m wide x 1m vertically deep. The material is to be classified in accordance with the NSW EPA Waste Classification Guidelines and can be disposed of at EPA licenced landfill facility that can accept the waste. The approximate volume to be disposed of is $4m^3$.

- The test pit will be validated to ensure the successful removal of contaminated fill soils. Chasing up of contaminants may be required during this stage of works if levels are found over site criteria.
- Asbestos Air monitoring should be set up in order to monitor the removal works being undertaken. Asbestos monitoring canisters should be set up each day and removed and sent to a NATA Accredited Laboratory for analysis.

Stage Five – Validation of basement floor and landscape areas

After removal of all fill soil material from the proposed basement floor and landscape area in accordance with the NSW EPA Waste Classification guidelines, the floors of the exposed basement and landscape area will be sampled by taking forty-four (44) floor samples plus QA/QC samples to validate the area.

Stage Six – Asbestos Clearance

Following the completion of the remediation and validation, an accredited Asbestos Assessor / Occupational Hygienist should undertake & provide an Asbestos Clearance Certificate.

Stage Seven – Validation Report Preparation

- Remediation will occur by managing soil for offsite disposal to landfill for contaminated soils.
- A validation report will be prepared to present the remediation works undertaken and confirm that the objectives of the remediation works have been attained.

The extent of the remediation works would be extended whether any USTs, associated infrastructure &/or any further contaminated material via unexpected finds are identified during remediation works.

8.3 Extent of remediation works required

As described above the preferred remediation strategy for the site is excavation and off-site disposal of the fill materials. If contaminated material is found during the remediation works, these materials will be chased up and removed. Additional investigations may be required including delineation sampling in order to appropriately quantify the extent and potential additional costs of works to the client. The unexpected finds protocol should be implemented as discussed in Section 16.2.

All additional works and/or delineation sampling should be documented by the use of field notes, site photographs, site plans and reporting. Notice should be given to all key stakeholders, client, project managers & site auditor.

8.4 Regulatory requirements such as licenses and approvals

Approval from a licensed disposal facility will be required prior to removal of any contaminated material from the site.

8.5 Disposal of excavated contaminated material

The contaminated fill or soil excavated from the site will be disposed of at a licensed landfill facility. If disposal of contaminated liquids is required, this will be undertaken by

a licensed contractor. The weighbridge and truck dockets will be retained by the contractor and made available to the principal's environmental representative.

8.6 Contingencies during Remedial Works

8.6.1 Contaminated Soils

Follow the unexpected finds protocol as detailed in Section 16.2 & Appendix A. Works to be suspended until the environmental project manager can further assess impacted soils / materials.

8.6.2 Contaminated Groundwater

During remediation works if any other form of contamination is noticed during excavation works, such as buried drums, waste pits, unexpected USTs etc, a review of groundwater conditions will be required.

Groundwater Investigation (contingencies)

The minimal groundwater contingency will include the installation and sampling of three (3) new monitoring wells is required to determine the water quality at the site. The proposed groundwater monitoring wells are to be surveyed by a registered surveyor.

Any dewatering may require approval under the Water Management Act 2000. Remedial measure may include; source removal, natural attenuation, bioremediation, PSH recovery using active pumping, groundwater permeability barrier, in-situ oxidation / stabilisation.

If a groundwater contaminant plume is identified and migrating offsite or increasing in contaminant concentrations the following is required:

- Review contaminant increase and analytes;
- Review remediation alternatives;
- Undertake downgradient monitoring;
- Complete fate / transport modelling if required; and
- Assess the need for further action.

9.0 VALIDATION PLAN (DATA QUALITY OBJECTIVES)

Data quality objectives have been developed for the validation assessment.

9.1 State the problem

The site is proposed to be redeveloped; however, previous investigations identified the following concerns:

- Soil remediation is currently limited to the asbestos impacted fill soils and proposed basement area.

9.2 Identify the issue

Based on the decision-making process for assessing urban redevelopment sites, the following decisions must be made:

- Are there any unacceptable risks to likely future onsite receptors from soil?
- Are there any impacts of chemical mixtures?
- Are there any aesthetic issues?
- Is there any evidence of, or potential for, migration of contaminants from the site?
- Is a site management strategy required?
- Is the site suitable for the proposed residential land use?

The following decision is also required to assess the remediation works as a whole:

- Have the excess materials, if any, removed from site been disposed to a landfill lawfully licenced to receive such material?

9.3 Identify the inputs to the decision

The inputs to the decisions are:

- Physical observations, including visual and olfactory results during site activities;
- The results of previous investigations (Sections 4.5);
- Soil analytical data from any imported fill;
- Soil analytical data for waste classification purposes for materials requiring off-site disposal; and
- Waste disposal documentation for excess materials disposed off-site

9.4 Define the study boundaries

The study boundary is defined as follows:

- The lateral extent of the study boundary is defined by the site boundaries as shown in Figure 1 - Site Location & Figure 2 - Site Features, Borehole Locations, Hotspots & Exceedances Plan; and
- The vertical extent of the fill soil removal is approximately 1.0m BGL across the asbestos impacted area, up to clean underlying material;

9.5 Decision Rules

The following outlines the decision rules for the project:

Table 13: Summary of Decision Rules

Decisions	Decision Rule
Are there any unacceptable risks to likely future onsite receptors from soil or groundwater?	If there is the decision is Yes then control measures are required to manage the risk. Otherwise the decision is No
Are there any chemical mixtures?	Are there more than one group of contaminants presents which increase the risk of harm? If there is the decision is Yes Otherwise the decision is No
Any aesthetic issues?	If there are any soil discolouration and/or unacceptable odours the decision is Yes Otherwise the decision is No
Is there any evidence of, or potential for, migration of contaminants from the site?	Evidence and/or potential will be outlined and the decision is Yes Otherwise the decision is No
Site Management Strategy required?	Was the answer to any of the above decisions Yes? If yes, a site management strategy is required. If no, a site management strategy is not required. The requirement for site management can typically be precluded by remediation of the areas of environmental impact that causes a site decision to be yes.
Is the site suitable for the proposed residential land use	Soil, soil vapour and groundwater data will be compared to the remediation criteria outlined in Section 4. Statistics may be undertaken where appropriate. If the material is suitable the decision is Yes

	Otherwise the decision is No
Have the excess materials, if any, removed from site been disposed to a landfill lawfully licenced to receive such material?	Fill/soil analytical data will be compared against adopted criteria. Statistical analysis of the data in accordance with relevant guidance documents will be undertaken, where appropriate, to facilitate the decisions (as detailed above). Documentation from the operation receiving the material including the dates, tonnage and classification of the accepted material will be required to facilitate the decision. If the statistical criteria stated above are satisfied, the decision is Yes, and if receipts are provided recording the disposal of material to an off-site licensed facility, the decision is Yes. If the material fails the criteria, and no disposal receipts are provided, the answer is No.

9.6 Specify Limits of Decision Error

This step is to state the decision maker's tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.

Data collected and generated during this project must be considered appropriate to allow decisions to be made with confidence. Specific limits for this project have been applied in accordance with the appropriate guidance documents from the NSW EPA, NEPM 2013, appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard operating FES procedures for field sampling and handling.

9.7 Optimising the Design for Obtaining Data

This step enables decision makers to identify a resource-effective field investigation sampling design that generates data that are expected to satisfy the site manager's decision performance criteria, as specified in the preceding steps of the DQO Process. The output of this step is the sampling design that will guide development of the field sampling and analysis plan. This step provides a general description of the activities necessary to generate and select data collection designs that satisfy decision performance criteria.

Validation data is required to be collected to verify:

- The effectiveness of the remediation works;
- Any contaminated soils retained on-site have been appropriately contained and managed;
- Any material imported to backfill excavations are suitable for the proposed site use; and
- Document the condition of the site as being suitable for the proposed future use.

The proposed validation soil sampling program is outlined in Section 11.

10.0 VALIDATION SAQP & METHODOLOGY

Remediation of the impacted area will be considered validated following the achievement of the two validation objectives;

- Validation of the remedial excavations will continue to the extent of the impacts and resulting samples are within the adopted criteria.
- In the event of backfilling, validation of the imported fill materials used is required to confirm the suitability for the intended land use.

10.1 Soil Validation Methodology

Soil sampling and handling is outlined in the table below:

Table 14: Sampling and Handling

Action	Outline
Sample collection	Soil validation sampling will be collected directly from exposed surface of excavation, or from the material scraped from the excavator bucket. Data shall be recorded in accordance with COC requirements
Sampling, handling, transport and tracking	1.Validation soil samples to be transferred directly into appropriately labelled clean laboratory supplied containers. 2.Validation soil samples to be transferred into chilled eskies for sample preservation. 3.A PID should be used during the collection of each validation soil sample if analysis includes volatiles.

	4.All equipment used in the sampling program was decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following procedures: -Cleaning equipment in potable water to remove gross contamination; -Cleaning in a solution of Decon 90; -Rinsing in clean demineralised water then wiping with clean lint free cloths; 5.A Chain of Custody to be completed and forwarded to the laboratory to ensure sample tracking.
Sampling Frequency	Validation sampling Refer to table 11 Stockpile sampling: Small Volumes (<200m3)- 1 sample every 25m3 Large Volumes (>200m3) as per Table 3 of the Victoria Sampling Guidelines June 2009 (IWRG702)
Laboratory Quality Assurance and Quality Control	The contracted laboratory to conduct in-house QA/QC procedures involving by not limiting to: Blanks, spike recoveries, laboratory duplicates & analysis.
Assessment of DQOs	Provide analysis of the QA/QC samples and procedures & provide assessment of the overall data quality.

10.2 Soil Validation Reporting

All fieldwork, chemical analysis, discussions, conclusions and recommendations will be provided in the final validation report for the site. The validation report will be prepared in accordance with the *NSW EPA, Consultants Reporting on Contaminated Land, 2020* and *NSW DEC (2017) Guidelines for the NSW Site Auditor Scheme* and will confirm the site is suitable for the proposed development. Waste tracking documentation and disposal details will be provided in the validation report.

11.0 VALIDATION WORKS

11.1 Objectives

The objective of the validation program is to ensure that at completion of the remediation works, the site is suitable for continued use and the proposed redevelopment.

Table 15: Soil Validation Sampling Program

Item	Sampling Frequency	Analytes
Validation of Asbestos Impacted Areas (BH115 & BH118)	Excavation Floor -1 sample every 25m2 Excavation Wall -1 sample every 5m (from each distinct horizon / material type)	HM, TRH, BTEX, PAH, OC, OPP, PCB & Asbestos %w/w
Validation basement floor and landscape areas	44 floor samples 1 inter-laboratory duplicate 1 intra-laboratory duplicate Spikes / blanks	HM, TRH, BTEX, PAH, OC, OPP, PCB, & Asbestos
Backfill Material (if required)	Certified VENM or 1 sample per 25m3	HM, TPH, BTEX, PAH, OCP, PCB, Phenol, Cyanide & Asbestos. Additional COPC may need to be included in the testing suite depending on the source site.

	Certified ENM as per NSW EPA Resource Recovery Order 2014	HM, TPH, BTEX, PAH, EC, PH & Foreign Materials & Asbestos
Unexpected Finds	Excavation Floor 1 sample every 25m2 Excavation Wall 1 sample every 5m (from each distinct horizon / material type)	Dependent on the location, type and characteristic of the unexpected find.

11.2 Waste classification of the fill

Based on previous soil investigation the fill material across the site is impacted with asbestos. Therefore, it is proposed to removal all fill material offsite within the proposed basement area and dispose appropriately.

The material is to be classified in accordance with the NSW EPA Waste Classification Guidelines and can be disposed of at EPA licenced landfill facility that can accept the waste.

A preliminary soil classification on the sampling completed during the DSI has been completed by FES. This preliminary soil classification refers to 3 in-situ borehole locations from previous Douglas Partners designated as 114,115,118 & 21 in-situ locations from FES DSI designated as BH1 to BH6 & BH8 to BH22.

Based on the previous site uses the samples were analysed for a selection of Heavy Metals, Total Petroleum Hydrocarbons (TRH), Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Polycyclic Aromatic Hydrocarbons (PAH), Organochlorine Pesticides (OC), OPP, Polychlorinated Biphenyls (PCB) & Asbestos. With reference to the site figures, laboratory analysis, table C4 and with reference to NSW EPA guidelines, the insitu fill soil materials found within the site have been classified as follows;

- *Soil fill material located within the vicinity of DP borehole locations 114 and BH2(0.2-0.3m), BH3, BH4, BH10, BH11, BH14, BH16, BH17, BH18, BH19, BH20, BH21 & BH22 are classified as* ***General Solid Waste (non-putrescible).***
- *Soil fill material located within the vicinity of DP borehole locations 118 (0.7m) and FES borehole locations BH1(0.3-0.4m) (2.3-2.4m), BH2(1.2-1.3m), BH5, BH6, BH8 (0.2-0.3m), BH1 (1.3-1.4m), BH8 (0.8-0.9m), BH9 & BH13 & BH15 are classified as* ***General Solid Waste (non-putrescible).***
- *Soil fill material located within the vicinity of FES borehole locations BH12 are classified as* ***Restricted Solid Waste (non-putrescible).***
- *Soil fill material located within the vicinity of DP borehole locations 115 (0.4m) & 118 (0-0.05m) are classified as* ***Special Waste (Asbestos) & General Solid Waste.***

Refer to **Appendix C** – Summary Tables.

During excavation works a suitable qualified environmental consultant / hygienist should be present to confirm no unexpected finds arise during the removal works. If unexpected find arise, then refer to section 16.2 for procedures.

Any excavated fill will be temporarily stockpiled (prior to disposal) on a heavy-duty plastic sheet or a sealed surface such as concrete, and covered with an impermeable plastic sheet to prevent rain infiltration.

- Asbestos transporters and facilities receiving asbestos waste in NSW weighing more than 100 kilograms or consisting of more than 10m2 of asbestos sheeting in one load must track and report this waste to NSW EPA using WasteLocate.
- Tracking of asbestos waste is to be done via the NSW EPA's online system known as WasteLocate.
- Refer to Section 13.12 for more details.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate approvals obtained from the EPA, if required. ***Details of all soils removed from the site (including VENM) shall be documented by the Contractor with copies of weighbridge slips, landfill receipts, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and/or the NSW EPA Accredited Site Auditor.***

11.3 Validation of Asbestos Impacted Areas

Following removal of soils from the asbestos impacted areas, photographic records of the floor and wall of the excavation will be taken for reference in the Validation Report. Sample will be taken from the floor and walls of each of the areas as per Table 15.

Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

11.4 Validation of basement floor and landscape area

Following removal of the fill from the proposed basement and landscape area, photographic records of the basement excavation will be taken for future reference. General site validation samples are proposed to be collected from the basement floor landscape area. Sampling is to follow a systematic pattern and be analysed for the contaminants of concern identified at these locations, including heavy metals, TRH, BTEX, PAH, OC, OPP, PCB & Asbestos. The soil samples will be collected from between 0-150 mm depth from freshly excavated surfaces.

Samples will be recovered from forty-four (44) locations. Where contaminant concentrations in validation samples exceed the site remediation criteria, further excavation must be carried out, until new validation samples return concentrations below the site validation criteria.

11.5 Validation Results

If validation criteria exceedances are encountered, statistical analysis will be applied to the dataset. The 95% UCL of the mean concentrations of the COPC will be calculated, the standard deviation is required to be less than 50% of the adopted criteria and no single concentration exceeded the criteria by more than 250%.

11.6 Remediation Groundwater Monitoring (contingency only if required)

Installation and sampling of three new monitoring wells to determine water quality at the site.

11.6.1 Groundwater Methodology

Proposed monitoring wells will be constructed by adopting the following methodology:

- 50mm diameter, Class 18PVC threaded and flush joined casing and 0.45 machine-slotted screens were used;
- Coarse, washed sand and gravel to be placed in the annulus surrounding the piping to a height of the screen;
- Bentonite pellets to be placed in the annulus to form an impermeable plug near the top of the well to prevent surface runoff from entering directly into the well;
- Bentonite pellets to be placed in the annulus to form an impermeable plug near the top of the encountered rock (if appropriate);
- A PVC cap placed on the casing;
- 100mm diameter stainless steel flushed covers to be used for all well finishes and concreted onto the ground surface.

11.6.2 Groundwater Sample Collection Methodology

Prior to groundwater sampling, the resting water level will be recorded within the well while checking for the presence of phase separated hydrocarbon.

Sampling will be completed using a low flow pump – a low flow/minimum drawdown sampling technique used to minimise any disturbance to the aquifer.

Field measured parameters will be collected using a certified and calibrated water quality meter. Samples will be collected when field measured parameters (pH, electrical

conductivity, redox potential, dissolved oxygen and temperature) have stabilised. The samples will be placed into appropriate laboratory supplied bottles and preserved on ice. The low flow pump and other sampling equipment will be decontaminated before and after use to avoid possible cross contamination. All samples collected will be preserved on ice and couriered directly to the laboratory under COC documentation.

11.6.3 Groundwater Laboratory Analysis

Laboratory analysis will include the following HM, TRH, BTEXN, PAH & VOC.

11.7 Validation of areas where fill has been temporarily stockpiled

The excavated contaminated fill will be temporarily stockpiled on a plastic sheet and covered with an impermeable plastic sheet to prevent rain infiltration. In order to confirm that cross-contamination of the soil underneath has not occurred during stockpiling; testing of the soil's underneath stockpiles will be required after disposal of the stockpile off-site (where necessary).

11.8 Validation of imported fill

If importation of fill is required it must be ***certified VENM or ENM*** material. Certified VENM must be tested in accordance with the requirements of the NSW EPA waste classification guidelines (including testing for asbestos). Certified ENM material is also acceptable and will be tested in accordance with the NSW EPA Resource Recovery Order 2014 for ENM. VENM and/or ENM will also be visually assessed for fibro sheeting and samples analysed for asbestos if detected.

11.9 Duration of remediation and validation works

Based on the proposed scope of the remediation and validation works, it is expected that the works should be completed within approximately eight to sixteen weeks following receipt of the regulatory approvals. This timeframe does not include reporting which should be completed approximately three to five weeks after completion of the remediation and validation works.

11.10 Validation Reporting

The following information will be included in the final validation report to order to render the site suitable for the proposed and development and/or satisfy any NSW EPA Site Audit condition:

- Summarise the contamination assessments carried out and the remediation recommendations provided in previous reports.
- Describe the remediation works carried out on-site and subsequent validation.
- Classify soils within the site for suitable disposal.
- Representative soil sampling and testing to validate site areas.
- Assessment of laboratory analytical results, based on currently accepted and applicable guidelines.
- Assessment of field and laboratory quality assurance (QA) and quality control (QC).
- Assessment of the resultant suitability of the site for the proposed development.
- The preparation of a validation report.
- Provide a statement on the resultant contamination status of the site and suitability for the proposed development.

12.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The quality assurance/quality control (QA/QC) program aims at ensuring that the data collected is sufficiently accurate, precise and reproducible to be used for the purpose of the validation report. QA/QC should be in accordance with the NEMP 2013 and with the Australian Standard AS4482.1-2005.

12.1 General QA/QC

The frequency required for each field quality assurance / quality control (QA/QC) sample is presented in the table below.

Table 16: QA/QC Frequencies

	Intra Lab	Inter Lab	Rinsate	Spikes	Blanks
Sampling Frequency	1 in 20	1 in 20	1/day	1/day	1/day

During the contamination assessment the integrity of data collected is considered vital. With the assessment of the site, a number of measures were taken to ensure the quality of the data. These are as follows:

12.2 Sample Containers

Soil samples to be collected remediation work are to be placed immediately into laboratory prepared glass jars with Teflon lid inserts. Standard identification labels are

to be used for each individual container and labelled according to depth, date, sampling team and media collected.

12.3 Decontamination

All equipment used in the proposed sampling program are to be decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following procedures:

- Cleaning equipment in potable water to remove gross contamination;
- Cleaning in a solution of Decon 90;
- Rinsing in clean demineralised water then wiping with clean lint free cloths;

FES adopts a sampling gradient of lowest to highest potential contamination to minimise the impact of cross contamination. This gradient is determined from the historical review and the on-site inspection that was carried out prior to sampling.

12.4 Sample Tracking, Identification and Holding Times

All samples are to be forwarded to NATA Accredited laboratories under recognised chain of custodies with clear identification outlining the date, location, sampler and sample ID. All samples are required to comply with the laboratories respective holding times. The sample tracking system is considered adequate for the purposes of sample collection.

12.5 Sample Transport

All samples are to be packed into an esky with ice from the time of collection. A trip blank and trip spike are collected where appropriate. Samples were kept below 4°C at all times, soil samples submitted for asbestos analysis are not required to be kept below 4°C.

12.6 Data Quality Indicators

The pre-determined data quality indicators for the validation program are discussed below in relation to precision, accuracy, representativeness, comparability and completeness and are summarised in the table below:

Table 17: Data Quality Indicator for the proposed Validation Program

Data Quality Indicator	Frequency	DQI Indicator
Completeness		
Data from critical samples is considered valid	All samples	All samples
Satisfactory frequency / result for QC samples	All samples	95%
Field documentation completed	All samples	All samples
Boreholes logs & COCs completed and holding times complied with.	All samples	All samples
Comparability		
Standard operating procedures	All samples	All samples

Data Quality Indicator	Frequency	DQI Indicator
used		
Consistent field conditions, sampling staff and laboratory analysis	All samples	All samples
Same analytical methods used	All samples	All samples
Limit of reporting appropriate and consistent	All samples	All samples
Representativeness		
Sampling appropriate for media and analytes	All samples	All samples
Samples adequately preserved	All samples	All samples
Precision		
SOPs appropriate and complied with in relation to field duplicates	All samples	All samples
RPDs of the field duplicates within control limits	1/20 samples	<50% RPD
RPDs of the laboratory duplicates within control limits	All samples	All samples
Accuracy		
SOPs appropriate and complied with in relation to field blanks	All samples	All samples
Rinsate Blanks, trip blanks & laboratory blanks free of	Laboratory blanks (LB) = 1 per batch	LB = <LOR RB= <LOR

Data Quality Indicator	Frequency	DQI Indicator
contaminants	Rinsate Blanks (RB) = 1 / day Trip Blank (TB)= 1/day	TB= <LOR
Surrogate spikes within control limits	All organic analytes	70-130%
Laboratory control spikes within control limits	Yes	Yes
Matrix Spike recoveries within control limits	1 /20 samples	70-130%
Trip spike recoveries within control limits	1/day	>70%

13.0 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

A site-specific Construction Environmental Management Plan (CEMP) should be prepared for the construction phase for the proposed development. The CEMP should set out the requirements for environmental management during the works including:

- Management structure and responsibilities;
- Approval and licensing requirements;
- Environmental induction and training;
- Emergency contacts;
- Environmental incident response;
- Implementation of the plan;
- Community consultation process consistent with council requirements; and
- Monitoring required during the works and the process for review of the CEMP, if required.

14.0 SITE MANAGEMENT PLAN

Adherence to the SMP will be monitored by an on-site Environmental Scientist who will be present during all critical remediation / validations works. The Site Management Plan (SMP) for the remediation will address:

- Site access;
- Working hours;
- Stormwater and soil management;
- Traffic management;
- Noise, dust and odour control; and
- Work health and safety.

Each of the issues to be addressed in the site management plan is briefly discussed in the following sections.

14.1 General

The remediation and validation works must be undertaken in accordance with applicable statutory requirements. The site manager/foreman of the remediation contractor should have a thorough understanding of the contents of the RAP, corresponding Site Management Plan (SMP), Work Health & Safety Plan (WHS) and should ensure that each employee or sub-contractor is familiarised with the requirements of these plans.

The remediation and validation works will be undertaken under the monitoring of the principal's environmental representative, who will be represented on-site by a field environmental scientist.

14.2 Site access

The contractor will ensure that adequate barriers have been placed around the site to prevent access of unauthorised personnel to areas where contaminated material is exposed. The contractor will also place adequate warning signs around the site.

14.3 Working hours

The working hours for the remediation / validation works will be between 7.00am to 5.00pm Mondays to Fridays and 7.00am to 1.00pm on Saturdays. No work will be carried out on Sundays and public holidays.

14.4 Demolition (including Asbestos Management)

Demolition works are to be completed in accordance with SafeWork NSW Standards and Codes of Practice. Any asbestos identified within the building materials should be managed in accordance with the SafeWork NSW Codes of Practice and Australian Standards.

14.5 Surface water and soil management

The contractor will put in place adequate stormwater runoff, run-on and sediment control measures for the remedial works. These requirements are outlined in Schedule B (9) of the (*site contamination*) NEPM (2013).

These include stockpiling excavated soil in a manner that will prevent contamination from being transported off-site by stormwater, and include the following measures:

- Divert stormwater runoff outside the site so that it does not flow through the site;
- Control drainage on the site by intercepting and redirecting runoff in a controlled manner;
- Stormwater collected at the site in trenches and sumps should be appropriately managed; and
- Silt stop fences should be erected at locations where stormwater may flow outside the site.

The presence of sediment in surface water or runoff must be minimised by the use of sediment controls such as diversion drains, hay bales and silt fencing.

Soils that require stockpiling must be managed in such a manner that these materials remain well contained and easily identifiable and that the effects of wind and rain have minimal impact on their integrity. Subsequently, if adverse weather conditions are anticipated, or if the stockpile is to remain on-site for an extended period, stockpiles must be protected and covered. Stockpile records must be maintained to track the re-use of soils at the site (if any).

Any plant or equipment that comes into contact with soils must be inspected prior to leaving the site, and cleaned as necessary.

14.6 Groundwater management

If groundwater is encountered during excavation works, the groundwater is to be directed to and collected in trenches and sumps. No discharge of groundwater will occur without approval of appropriate regulatory bodies.

14.7 Traffic management

The management of the material leaving the site will be under the monitoring of the principal's environmental representative, who will record the details of these materials.

Vehicular movement is to be conducted in accordance with Council requirements. The contractor will install a vehicle wheel washing or shaking facility and will manage all vehicles as indicated by the principal's environmental representative (FES) to minimise tracking of any materials onto public roads. The wheels of the vehicles will be washed and brushed prior to leaving the site. Loads leaving the site should be maintained moist and must be covered to prevent materials from the site being spilled or left on public or private roadway or adjacent areas. Particular care should be taken if UST or any unexpected material have been encountered and are to be removed from the site.

14.8 Noise Control

The contractor should keep noise levels to a minimum and levels should not exceed limits indicated in AS 2436 1981. Noise levels must also comply with Council and NSW EPA requirements. It is expected that the equipment to be used in the remediation works will not generate noise levels above these requirements.

14.9 Dust control

Works must comply with the requirements listed in Schedule B (9) of the NEPM (2013), Council and the NSW EPA. The generation of dust should be kept to a minimum. Stockpiled contaminated material should be bunded and covered. Water sprays may be used to minimise dust. Water used for this purpose should not be allowed to flow off-site through the stormwater system, sewer, or any other way.

14.10 Odour control

The level of odours generated during remedial activities must be monitored and local Council and NSW EPA requirements must be complied with. Due to the nature of contamination, odours may be encountered. It is noted however that it is expected only small volumes of fill will be excavated at one time and this should minimise the generation of significant odours.

Should odorous compounds be encountered, the remediation contractor should take measures to mitigate them and to prevent their migration outside the site boundaries. This may involve placing the odorous materials as soon as possible in a bunded area,

covered with plastic membrane, and spraying with an odour suppressant approved by the environmental consultant.

14.11 Work Health and Safety Plan

As personnel on-site may be exposed to potentially toxic or hazardous compounds, the Contractor will prepare a site-specific Work Health and Safety Plan (WHS) prior to commencement of remediation and validation work in accordance with relevant legislation. The WHS will identify hazards, assess the risks posed by the hazards and recommend measures to control the hazards. This should include detailed descriptions of vehicle decontamination, protective clothing, equipment and appropriate safety controls that will be adopted during remediation and validation works carried out at the site.

If odours are detected at areas around the site PID measurements will be collected by the on-site Environmental Scientist. If PID readings >30 ppm is recorded breathing masks should be worn by workers in the vicinity of the odour and >300 ppm odour suppressants as well as controlled excavations should be applied.

Personnel working on the site are required to read, understand and apply the requirements of the WHS. All staff working on the site must be inducted by an authorised induction trainer and must sign the relevant induction form.

14.12 Waste / Soil Management Plan (Importation, stockpiles, tracking & disposal)

14.12.1 Imported Soil

Importation of any soil, rock or aggregate is required to meet the following requirements:

- They must be legally able to be imported onto the site in accordance with the Protection of the Environment Operations (Waste) Regulation 2014 and any required consent approvals;
- The soils must meet the remediation criteria for the site (refer to Section 4);
- The soils must be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM) or other materials legally able to be imported onto the site based on a Resource Recovery Exemptions. Where available VENM should be imported in preference to ENM. Soils must be assessed in accordance with the EPA requirements;
- Prior to importation appropriate documentation needs to be provided to, and approved by, the Environmental Consultant and the materials must be inspected at the source site to confirm that there are no signs of contamination;
- The material must be inspected during importation by the Contractor, and any materials not meeting the description given in the provided documentation or displaying signs of contamination will be rejected.

14.12.2 Stockpiles

Stockpiles should be managed to minimise the risk of dust generation, erosion and leaching. The measures required to achieve this should include:

- Restrict the height of stockpiles to reduce dust generation;
- Construct erosion, sediment and runoff control measures;
- Cover stockpiles of contaminated soils to be left on site for more than 24 hours, or if windy conditions are expected;
- Manage the potential for leaching

14.12.3 Waste Tracking

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the POEO Act. All licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate approvals obtained from the EPA, if required. Details of all soils removed from the site (**including VENM**) shall be documented by the Contractor with copies of weighbridge slips, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the contractor.

A site log shall be maintained by the Contractor to track disposed loads against on-site origin. Transport of spoil shall be via a clearly delineated, pre-defined haul route. The proposed waste transport route will be notified to the local Council and truck dispatch shall be logged and recorded by the Contractor for each load leaving the site. A record of the truck dispatch will be provided to the contractor.

14.12.4 Special Waste (Asbestos Waste)

All transport of waste and disposal of materials must be conducted in accordance with the requirements of the POEO Act. All licences and approvals required for disposal of the material will be obtained prior to removal of the materials from the site.

Asbestos transporters and facilities receiving asbestos waste in NSW weighing more than 100 kilograms or consisting of more than 10m2 of asbestos sheeting in one load must track and report this waste to NSW EPA using WasteLocate.

Tracking of asbestos waste is to be done via the NSW EPA's online system known as WasteLocate.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate approvals obtained from the EPA, if required. Details of all soils removed from the site shall be documented by the Contractor with copies of weighbridge slips, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the contractor.

A site log shall be maintained by the Contractor to track disposed loads against on-site origin. Transport of spoil shall be via a clearly delineated, pre-defined haul route. The proposed waste transport route will be notified to the local Council and truck dispatch shall be logged and recorded by the Contractor for each load leaving the site. A record of the truck dispatch will be provided to the contractor.

14.12.5 Waste Disposal

All off-site disposal of wastes, where appropriate, will be undertaken in accordance with the POEO Act.

Any soil and rock to be removed from the site will be classified in accordance with either:

- The NSW EPA Waste Classification Guidelines 2014; or
- A General or Specific Exemption under the Protection of the Environment Operations (Waste) Regulation 2014.

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

All materials excavated and removed from the site shall be disposed in accordance with the POEO Act to a facility/site legally able to accept the material. Copies of all necessary approvals from the receiving site shall be given to the contactor prior to any contaminated material being removed from the site.

A record of the disposal of materials will be maintained. Copies of all consignment notes for the transport, receipt, landfill receipts and disposal of all materials (**including VENM**) will be maintained as part of the site log and made available to the Environmental Consultant for inspection and reporting purposes upon request.

Removal of waste materials from the site shall only be carried out by a licensed contractor holding appropriate licence, consent and/ or approvals to dispose of the waste materials according to the assigned waste classification, and with the appropriate

approvals obtained from the EPA, if required. ***Details of all soils removed from the site (including VENM) shall be documented by the Contractor with copies of weighbridge slips, landfill receipts, tip tickets and consignment disposal confirmation (where appropriate) provided to the Environmental Consultant and the NSW EPA Accredited Site Auditor.***

14.13 Community Engagement

Community engagement should be consistent with council requirements in relation to the development application conditions.

15.0 OPERATIONAL CONTROLS

15.1 Fire and explosion hazard

Explosive atmospheres may be present where any petroleum products or other potentially flammable or explosive substance is encountered / used, including machinery. Therefore, the contractor will put into place measures to prevent fires and explosions, which include:

- pumping and degassing of tanks prior to removal:
- preventing access to the site by unauthorised persons;
- forbidding smoking or using naked flame at the site;
- cutting of concrete to be carried out under a blanket of water in proximity to any underground storage tanks;
- approved fire extinguishers to be maintained in proximity to excavations;
- ensuring that no free product or fuel used for refuelling equipment enters a confined space or drainage/sewer system; and
- using only certified flameproof equipment in proximity to locations where free petroleum fuel is present or is expected to be present.

15.2 Public complaints registry

Given the nature of the remediation and validation works, it is considered that community consultation should be consistent with council requirements in relation to the development application conditions.

15.3 Duties of the on-site environmental scientist

The duties of the on-site environmental scientist include:

- ensure adherence to the Remediation Action Plan, the Work Health and Safety Plan and other plans applicable to the site;
- monitor the excavation of contaminated material undertaken at the site;
- ensure environmental compliance of contractors;
- monitoring with a PID the areas adjacent to open excavated pits at least three times throughout the day, and at additional times if strong or unusual odours or if unusual substances are encountered during the excavations part of the remediation works;
- inspection of the integrity of the sediment controls placed around the site;
- inspection at approximately two hourly intervals of the roadway in the vicinity of the site used by the vehicles leaving the site to ensure that no significant amounts of materials have been tracked off-site by vehicles;
- immediately report actual or potential non-compliances to the principal's environmental representative who will report those to appropriate regulatory bodies;
- note weather conditions, approximate temperature, direction and velocity of the wind, and rainfall at the commencement of work, at about midday and at the end of the day;
- collect samples for validation or other purposes as required by the principal's environmental representative;
- maintain a site diary which will record the following information:
    - date
    - weather conditions
    - presence of odours at the site and at the site boundaries

- PID measurements
- details of materials excavated during the remediation works, and details of actions taken if unexpected materials are encountered
- details of accidents, near misses or incidents, which may have resulted in injury, and the actions taken to prevent their recurrence
- details of environmental issues, which may result in environmental incidents and measures taken to correct them
- details of visitors to the site or other matters relating to environmental or health issues

15.4 Unexpected occurrences

If during remediation works, significant odours and/or evidence of gross contamination not previously detected are encountered, or any other significant unexpected occurrence, site works should cease in that area, at least temporarily, and immediate action taken to abate the odours or prevent / manage cross-contamination occurring. If required, the administering authority will be notified in writing within two working days of significant unexpected occurrence and informed of the remediation actions implemented.

15.5 Non-compliances

If the on-site environmental scientist suspects that some works carried out at the site do not comply with the requirements of the RAP, the WHS or other plans applicable to the site, this should be reported immediately to the principal's environmental representative. If the principal's environmental representative cannot be contacted or if immediate action is required, the on-site environmental scientist has authority to stop

the work or request appropriate action to be taken. This is particularly the case under the following circumstances:

- injury to person due to exposure to materials excavated from the site;
- spillage of materials at the site or on areas adjacent to the site; and
- other events that the environmental scientist believes could give rise to unacceptable risk to human health or to adverse impact to the site or to areas adjacent to the site.

16.0 CONTINGENCY MANAGEMENT

The conditions that may be encountered when excavating is uncertain. As unknown and variable subsurface conditions impose a degree of uncertainty for the project a set of anticipated conditions has been assumed in developing the excavation plan. However, because field conditions vary, flexibility has been built into the excavation plan to adapt to differing conditions.

Table 18: Contingency Management

Anticipated Problem	Corrective Action by Contractor
Asbestos cement sheeting, lagging, pipping etc.	Stop excavations if there is the potential for people to inhale airborne asbestos fibres. Contact FES immediately to assess whether the material is asbestos. Cover the area with plastic and suppress dust by wetting down if needed. Place a warning sign at the entrance to the site where asbestos removal or site remediation is taking place. Adhere to WHS regulations and follow the unexpected finds protocol outlined in 16.2 & Appendix A.
Discovery of USTs	Stop excavations, contact FES immediately. Follow the unexpected finds protocol and UST finds protocol outlined in section 16.2 & 16.3 & Appendix A.
Chemical spill / exposure	Stop work, refer to Occupational Health, Safety and Rehabilitation Plan and immediately contact FES.
Excessive rain	Maintain access roads, cover high-traffic areas with gravel; or cover working areas/stockpiles with plastic during off-shifts; or shut down operations until runoff is more manageable. Inspect & maintain sediment control pond & filter fences.
Unmanageable mud in excavation zone	Improve drainage collection system; add geotextile/gravel in problem areas; or strip off mud/slurry materials; or excavate from the top of the fill.

Excessive drainage	Minimise active/contaminated work area; or improve diversion clean run-on; or maintain sufficient on-site wastewater storage capacity; or mobilise additional storage and/or treatment systems as needed.
Excessive dust	Use water sprays or biodegradable dust sprays, or cease dust-generating activity until better dust control can be achieved, or apply interim capping systems.
Sediment pond water for discharge – analytical results exceed site response levels	Perform in-situ treatment, e.g. flocculants dosing, until response levels are met. Alternatively arrange off-site disposal by a licensed Contractor.
Excessively wet materials	Stockpile and dewater on-site; or add absorbents.
Equipment failures	Maintain spare equipment or parts; or maintain alternate rental options; or shut down affected operations until repairs are made.
Release of fuel/oil from machinery	Remove source, use absorbent booms to remove oil and make any repairs as required.
Silt fence fails	Stop work and repair fence to specifications.
Excessive noise	Identify source and review noise attenuation equipment and as necessary provide silencers on noisy equipment.

Excessive odours / vapours	If excessive organic odours / vapours are generated, stop works and monitor for volatiles at the site boundaries using PID and upgrade PPE if necessary. Implement control measures including respirators for on-site workers, wetting down excavated material, use of odour and volatile suppressing agents to eliminate or reduce odours as required and/or cover odorous material if practicable. FES notes that no nuisance odours shall be detected at any site boundary as part of the remedial works. If odours/vapours are detected then it is recommended, as part of the CEMP & community consultation procedure, that the project manager, client and remediation contractor: 1. Notify the owners / occupiers of the adjoining premises in writing regarding the potential odour issues. Include contact details for any concerns in relation to the odour emissions during remediation. 2. Temporarily pause site works to allow excessive odour to subside whilst implementing the control measures. 3. Record logs for volatile emissions and odours.
Excavation extends below water table into natural materials which are assessed and confirmed to comprise potential acid sulphate soils (PASS).	Implement Acid Sulphate Soils management plan. This will include on-site treatment of the soils in the excavation area. Treatment would likely involve lime addition at a rate to be calculated using methods specified in the ASS Manual (1998).
Unearthing drummed material	Isolate and contact Superintendent. Arrange temporary storage in a secure part of the remediation site (to be nominated).
Identification of cultural or building heritage items	Stop work and notify project manager. Follow the unexpected finds protocol as detailed in section 16.2 & Appendix A.

Complaint Management	Notify client, project managers, and environmental consultant following complaint. Report complaint as per internal procedures, implement control measures to address complaint and notify complainant of the results of the remedial actions.

In addition to the above listed contingencies, the following steps may need to be undertaken should non-spadeable sludge's or buried drums be discovered during the remediation works:

- upgrade of personal protective equipment (PPE), for workers within the active work zone, in accordance with the site Occupational Health, Safety and Rehabilitation Plan;
- segregation and bunding of discovered material;
- use of odour suppressants (where appropriate);
- cover the discovered material with plastic sheeting;
- appropriate sampling and analysis to assess potential contaminants; and
- appropriate off-site disposal of the materials following receipt of analytical results and any associated regulatory approvals required.

16.1 Contact Persons

Table 19: Contact Persons

Responsible Party	Details
Principal Environmental Representative	Foundation Earth Sciences PO Box 4405, East Gosford NSW 2250 Benjamin Buckley
Project Manager and Client	East End Stage 3 Pty Ltd and East End Stage 4 Pty Ltd C/O Warwick Bowyer Iris Capital

16.2 Unexpected Finds Protocol

The sampling strategy for each "unexpected find" shall be designed by a suitably qualified environmental consultant. The strategy will, however, be aimed at determining the nature of the substance – that is, is it hazardous and, if so, at concentrations which pose an unacceptable risk to human health or the environment.

The sampling frequency of the identified substance / materials shall meet the following minimum requirements:

- Excavation Floor
  - 1 sample every 25m^2
  - Samples should be analysed for the chemicals of concern.
- Excavation Wall
  - 1 sample every 5m (from each distinct horizon / material type)
  - Samples should be analysed for the chemicals of concern.

All additional works should be documented by the use of field notes, site photographs, site plans and reporting.

Refer to **Appendix A** for a copy of the Unexpected Finds Protocol.

16.3 USTs

Any unexpected USTs found within the site should be removed in accordance with SafeWork NSW & UPSS Regulation 2014 requirements, and AS4897-2008: The design, installation and operation of underground petroleum storage systems. In the event of conflict between the guidance documents, the latter shall prevail. Due to the volatile nature of petroleum storage tanks, it is recommended that the USTs be excavated and disposed of by an experienced contractor and with an environmental representative present.

Following the removal of any USTs and associated visibly stained or odorous soils, in samples should be collected from the walls and floor of the tank-pits/hotspots and submitted to a NATA accredited laboratory for analysis. The targeted analytes should be, but not be limited to, heavy metals, TPH, BTEX & PAH.

The minimum sampling protocols to be used for unexpected UST areas include:

- 3 samples per backfill UST sands per UST pit;
- 1 sample per tank line;
- 1 sample per vent pipe area;
- 1 sample per spill box (currently not present but may be found);
- 2 base samples and 8 walls (2 samples per wall face) of each tank pit

16.4 Groundwater Contingency

If groundwater contamination is observed during the remediation process, it is recommended to assess the potential impact on the proposed development.

17.0 REGULATORY APPROVALS AND LICENSES

17.1 State Environmental Planning Policies

NSW Department of Planning and Environment– (2022) "*State Environmental Planning Policy (Resilience and Hazards) 2021*" – Remediation of Land sets the regulatory framework for contaminated land and remediation works in NSW. This legislation defines the regulations for Category 1 and Category 2 remediation works. The remedial works to be undertaken at the site constitute Category 2 works. Appropriate permissions for remediation should be obtained prior to commencement.

17.2 State Protection of the Environmental Operations (UPSS) Regulation 2014

UPSS Regulation requires if a storage system is decommissioned, a report for the storage system must be served on the relevant authority within 60 days of decommissioning or remediation is completed. The report must be prepared by a duly qualified person in accordance with EPA guidelines, and must describe the processes used to decommission the storage system and assess contamination at the storage site.

17.3 Duty to Report

Under Section 60 of the Contaminated Land Management Act 1997, the owner of the land is required to notify contamination in circumstances as indicated in the NSW EPA (2015) *Guidelines on Duty to Report Contamination under the Contaminated Land Management Act 1997*.

Sites that are significantly impacted by soil, groundwater and ground gases are likely to require notification to the NSW EPA under section 60 of the CLM Act. A decision process for use by site owners or responsible persons considering reporting contamination under section 60 is provided in Appendix 1 (Figure 1) of the aforementioned guidelines.

No notification to NSW EPA is recommended based on the sampling and investigation to date.

17.4 Development Consent and Control Plans

All works should be in accordance with the The City Of Newcastle Council Development Control Plans and any development consent issued by The City Of Newcastle Council for the development.

17.5 Asbestos Removal Regulations / Work Health Safety Regulations

17.5.1 General

The removal and disposal of asbestos will be managed in accordance with the Work Health and Safety Act (2011) and Work Health and Safety Regulation (2011), "How to Safely Remove Asbestos: Code of Practice (SafeWork 2012), the, SafeWork NSW Guidelines and the NSW EPA Waste Classification Guidelines.

Health screening for asbestos in soil, which are based on scenario-specific likely exposure levels, are adopted from the WA DoH guidelines and are referred in Table 7 in Schedule B1.

The WHS Regulations require a person conducting a business or undertaking who commissions the removal of asbestos at the workplace must also ensure asbestos removal work is carried out only by a licensed asbestos removalist who is appropriately licensed to carry out the work, unless specified in the WHS Regulations that a licence is not required.

If asbestos is non-friable, is more than 10m² and has been determined that it should be removed, it must be removed by a licensed asbestos removalist as soon as reasonably practicable. Where it is not reasonably practicable to remove it, control measures must be put in place to eliminate any exposure, so far as is reasonably practicable, or to minimise exposure so far as is reasonably practicable, but always ensuring the exposure standard is not exceeded.

Class A License can remove any amount or quantity of asbestos or ACM, including:

- any amount of friable asbestos or ACM
- any amount of ACD
- any amount of non-friable asbestos or ACM

Class B Licence can remove:

- any amount of non-friable asbestos or ACM
    - Note: A Class B licence is required for removal of more than 10 m^2 of non-friable asbestos or ACM but the licence holder can also remove up to 10 m^2 of non-friable asbestos or ACM)

- ACD associated with the removal of non-friable asbestos or ACM

- Note: A Class B licence is required for removal of ACD associated with the removal of more than 10 m² of non-friable asbestos or ACM but the licence holder can also remove ACD associated with removal of up to 10m² of non-friable asbestos or ACM

17.5.2 Notification of Asbestos Removal Works

SafeWork must be notified five days before licensed asbestos removal work is commenced.

Asbestos removalists licensed in NSW can lodge the notification electronically using WorkCover's Asbestos and demolition online notification system or complete the form.

Interstate asbestos removalists who hold an asbestos removal licence issued under another Work Health and Safety Regulation must lodge the notification by completing the notification form.

17.5.3 Notification of Respirable Asbestos Fibre Levels at more than 0.02 fibres / ml

SafeWork must be notified within 5 days when the respirable asbestos fibre levels exceed 0.02 fibres/ml in the removal area.

NSW licensed asbestos removalists and interstate asbestos removalists who hold an asbestos removal licence issued under a work health and safety regulation must lodge the notification by completing the notification form.

17.5.4 Notification of the Emergency Demolition of a Structure or plant involving Asbestos

Notification of the demolition or refurbishment of a structure or plant is required for the following:

- that was constructed or installed before 31 December 2003;
- is located in either a workplace or a residential premise where an emergency has occurred;
- the structure or plant must be demolished; and
- asbestos is fixed or installed in the structure or plant before the emergency has occurred.

Demolition or refurbishment does not include minor or routine maintenance work or other minor work.

An emergency is defined if:

- a structure or plant is structurally unsound
- collapse of the structure or plant is imminent.

The person with management or control of the workplace or, if in residential premises, the licensed asbestos removalist must notify SafeWork by completing the notification form.

Interstate asbestos removalists who hold an asbestos removal licence issued under another work health and safety regulation must also notify SafeWork if the work is located in NSW.

Completed notification forms can be lodged by:

- contact (02) 8260 5885
- email to adu@safework.nsw.gov.au
- delivery to 92-100 Donnison Street, Gosford 2250 or any Safework office

Asbestos notifications are free and the asbestos and demolition hotline number is (02) 8260 5885.

17.6 Protection of the Environment Operations (Waste) Regulations 2005

The regulations make requirements relating to non-licensed waste activities and waste transporting.

Section 42 of the Regulation stipulates special transportation, re-use or recycling requirements relating to asbestos waste and must be complied with regardless whether the activity is licensed.

The requirements for the transportation of asbestos waste include:

- bonded asbestos material must be securely packaged at all times,

- friable asbestos material must be kept in a sealed container,
- asbestos-contaminated soils must be wetted down,
- all asbestos waste must be transported in a covered, leak-proof vehicle.

The requirements relating to the off-site disposal of asbestos waste are as follows:

- asbestos waste in any form must be disposed of only at a landfill site that may lawfully receive the waste,
- when asbestos waste is delivered to a landfill site, the occupier of the landfill site must be informed by the person delivering the waste that the waste contains asbestos,
- when unloading and disposing of asbestos waste at a landfill site, the waste must be unloaded and disposed of in such a manner as to prevent the generation of dust or the stirring up of dust,
- asbestos waste disposed of at a landfill site must be covered with virgin excavated natural material or other material as approved in the facility's environment protection licence.

Section 48 of the Regulation requires that wastes are stored in an environmentally safe manner. It also stipulates that vehicles used to transport waste must be covered when loaded.

17.7 Other licences required

Transporters of contaminated waste are required to be licensed to transport contaminated waste to licensed landfills. Landfills are required to be licensed for the category of waste they are scheduled to receive.

Waste classification documentation and waste dockets from the receiving landfill should be kept on file for site validation purposes.

If water is discharged as part of any dewatering activities, the relevant discharge consents must be obtained.

The appointed site contractor should prepare appropriate Construction Environmental Management Plans CEMP, work health safety plans & other plans required by the Council DA and DCPs. Where asbestos removal is required, the contractor must be appropriately licensed to carry out the designated works.

18.0 CONCLUSION

The site is currently occupied by mixed use buildings including commercial shops, office, basement car parking, church, and residential properties. The proposed redevelopment consists of a mixed-use development comprising retail, commercial, public spaces, residential apartments, associated car parking & site works.

Therefore, it is considered that the site will be made suitable for the proposed development, subject to the implementation of the remediation and validation works in accordance with this RAP.

The following assumptions have been utilised in concluding the site will be considered suitable:

- Removal of fill material from the proposed basement and asbestos Impacted areas and dispose of appropriately.
- Validation samples are proposed to be collected from basement floor, landscape areas and asbestos Impacted Areas.
- Contaminant concentrations in validation samples are shown to be below the adopted site validation criteria.
- Data collected and generated during the project is considered appropriate to allow decisions to be made with confidence. Specific limits for the project have been applied in accordance with the appropriate guidance documents from the NSW EPA, NEPM 2013, appropriate indicators of data quality (DQIs used to assess quality assurance / quality control) and standard operating FES procedures for field sampling and handling.

19.0 REFERENCES

- ANZG (2018) "Australian and New Zealand Guidelines for Fresh and Marine Water Quality", Australian and New Zealand Governments and Australian State and Territory Governments, Canberra ACT.
- NSW Department of Planning and Environment– (2022) "*State Environmental Planning Policy (Resilience and Hazards) 2021*".
- HEPA 2020, 'PFAS National Environmental Management Plan', Version 2, 2020.
- National Environmental Protection Council (NEPC) (1999) – *National Environmental Protection (Assessment of Site Contamination) Measure. Amendment 2013*
- National Health and Medical Research Council (NHMRC) & National Resource Management Ministerial Council (NRMMC) "National Water Quality Management Strategy, Australian Drinking Water Guidelines" (2011)
- NSW EPA (2014) "*Technical Note: Investigation of Service Station Sites*".
- NSW EPA (2020), "Consultants Reporting on Contaminated Land". NSW Environment Protection Authority, Parramatta
- NSW DEC "Guidelines for the NSW Site Auditor Scheme" (2017, 3rd edition). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) – "Waste Classification Guidelines, Part 1: Classifying Waste";
- NSW EPA (2015) "Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997";
- NSW EPA "Sampling Design Guidelines" (1995). NSW Environment Protection Authority, Sydney.
- US EPA "Regional Screening Level (RSL) Summary Tables" (2016). United States Environment Protection Authority.

20.0 LIMITATIONS

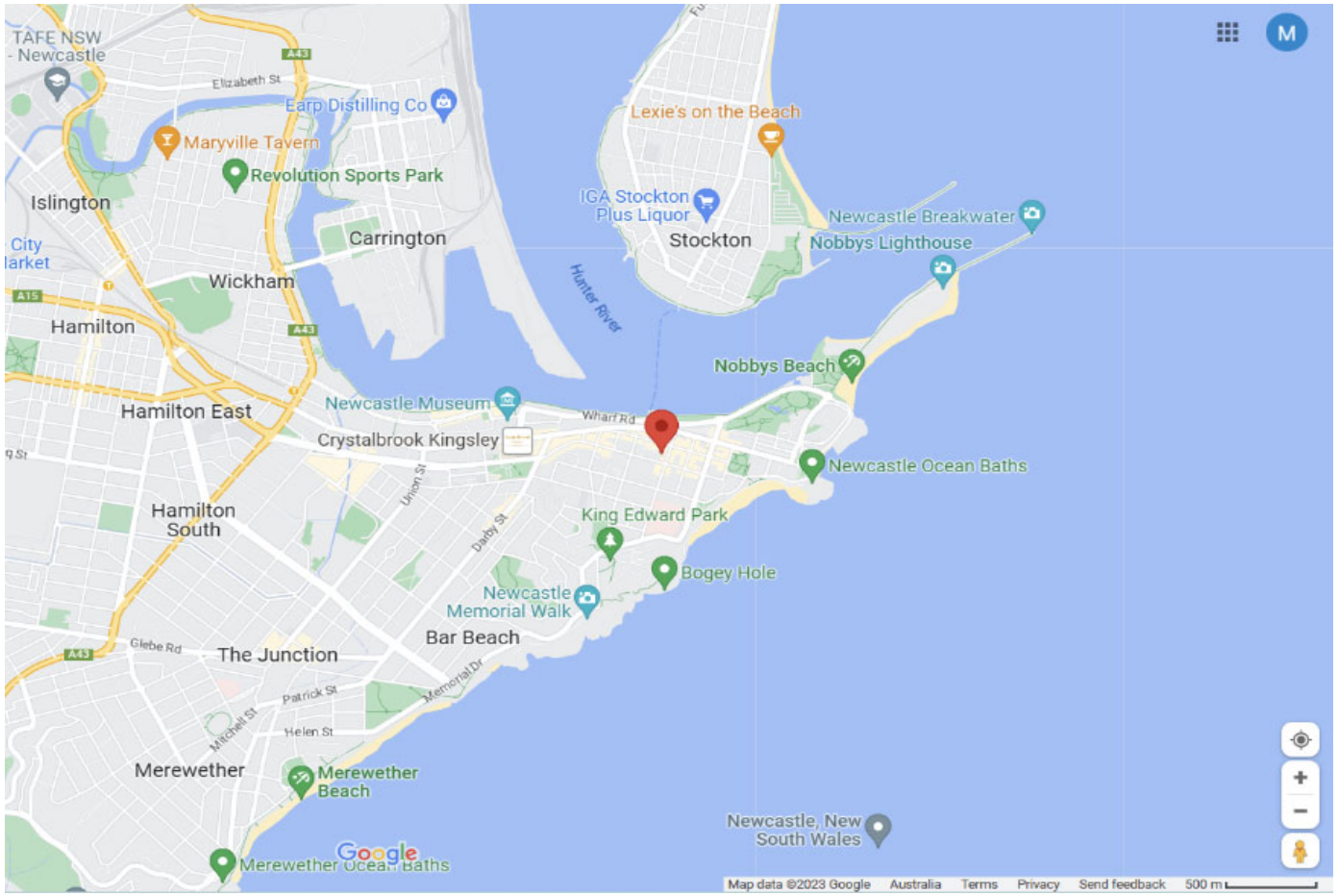
Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, although subsurface conditions, including groundwater levels and contaminant concentrations, can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

There is always some disparity in subsurface conditions across a site that cannot be fully defined by investigation. Hence it is unlikely that measurements and values obtained from sampling and testing during environmental works carried out at a site will characterise the extremes of conditions that exist within the site.

There is no investigation that is thorough enough to preclude the presence of material that presently or in the future, may be considered hazardous at the site. Since regulatory criteria are constantly changing, concentrations of contaminants presently considered low may, in the future, fall under different regulatory standards that require remediation.

Opinions are judgements, which are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions.

FIGURE 1: SITE LOCATION



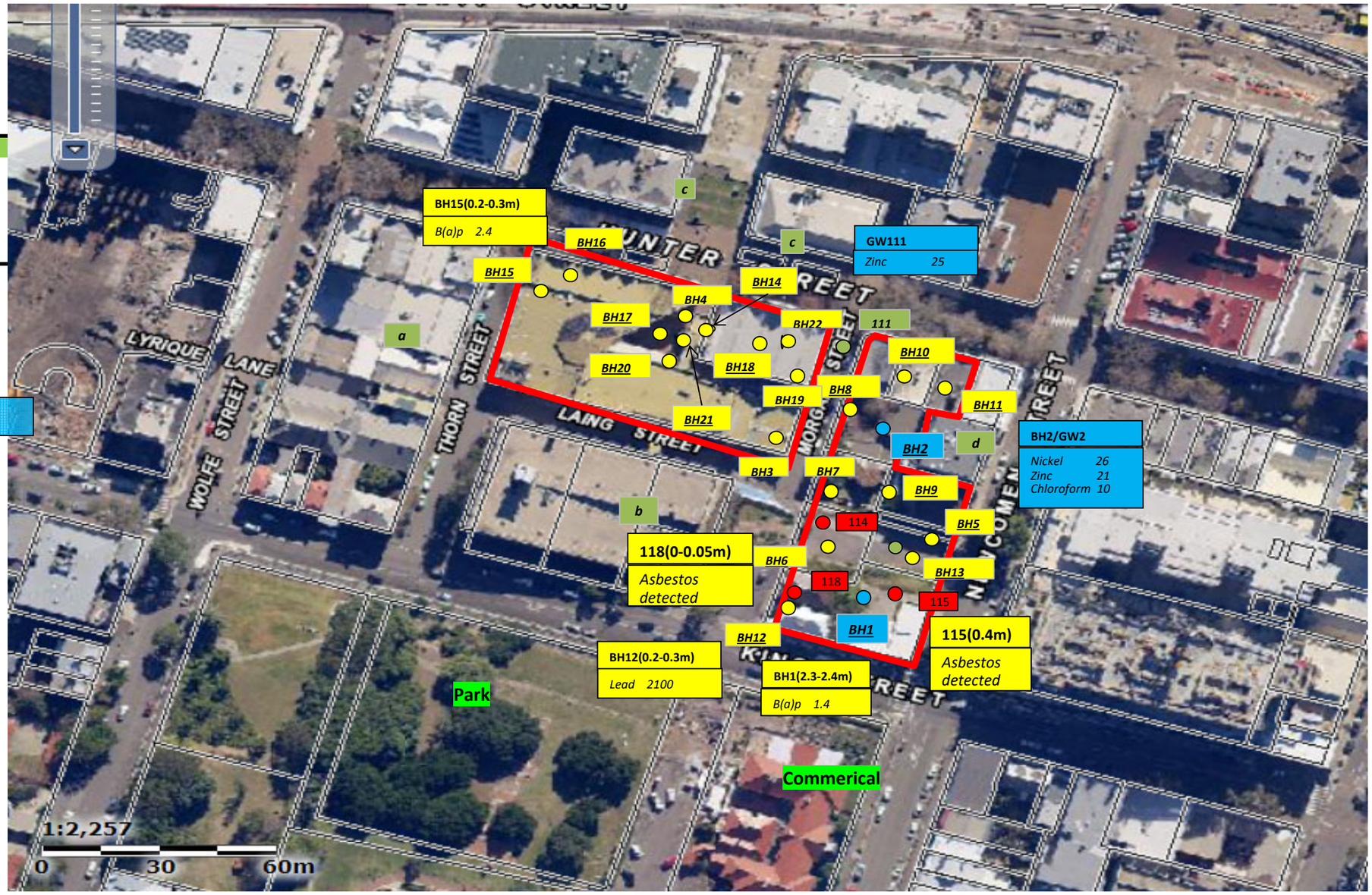
Key Site Location	FOUNDATION EARTH SCIENCES	**DRAWN** MT	**SITE LOCATION**
		FIGURE 1	East End Stage 3 Pty Ltd
		Job # E2970-4	105, 109, 111, 121 Hunter St, 3 Moragn St, 66-74 King St & 22 Newcomen St, Newcastle NSW

FIGURE 2: SITE FEATURES, BOREHOLE LOCATION & EXCEEDANCE PLAN

Feature No	Details
a	Construction Site
b	Vcant Land
c	Comerical/Office
d	Apartment

Soil Exceedance (mg/Kg)

Groundwater Exceedance (ug/L)



Key

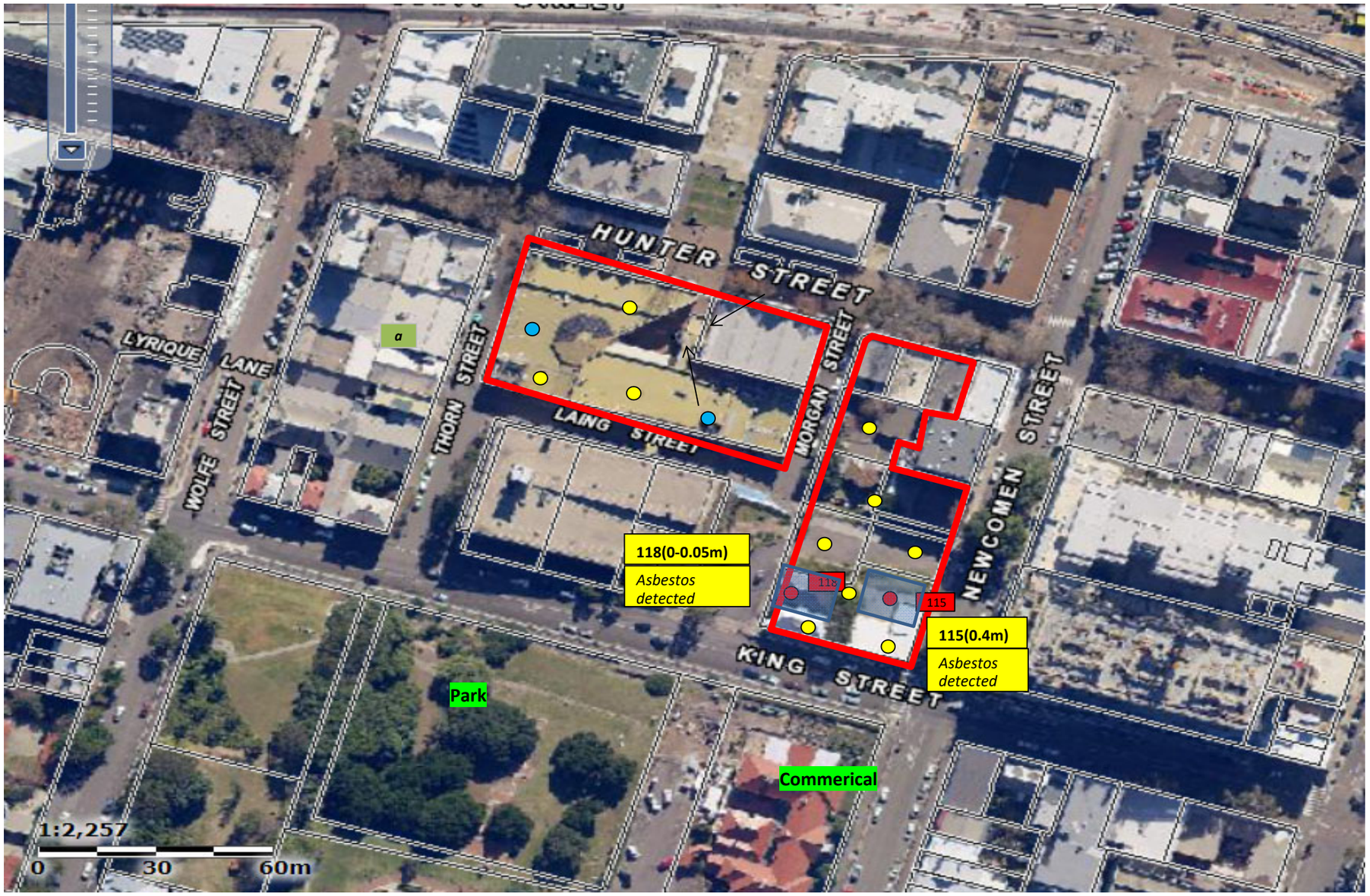
Site Location
Existing GWs
Previous DP Borehole Location
Soil&GW Location
Soil Locations

FOUNDATION EARTH SCIENCES

DRAWN RL/RW	**Site Features, Borehole Locations & Exceedance Plan**
Figure 2	East end Stage 3 Pty Ltd
Job # E2970-2	105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW

FIGURE 3: ASBESTOS IMPACTED AREAS AND PROPOSED TEST PIT INVESTIGATION

Soil Exceedance (mg/Kg)



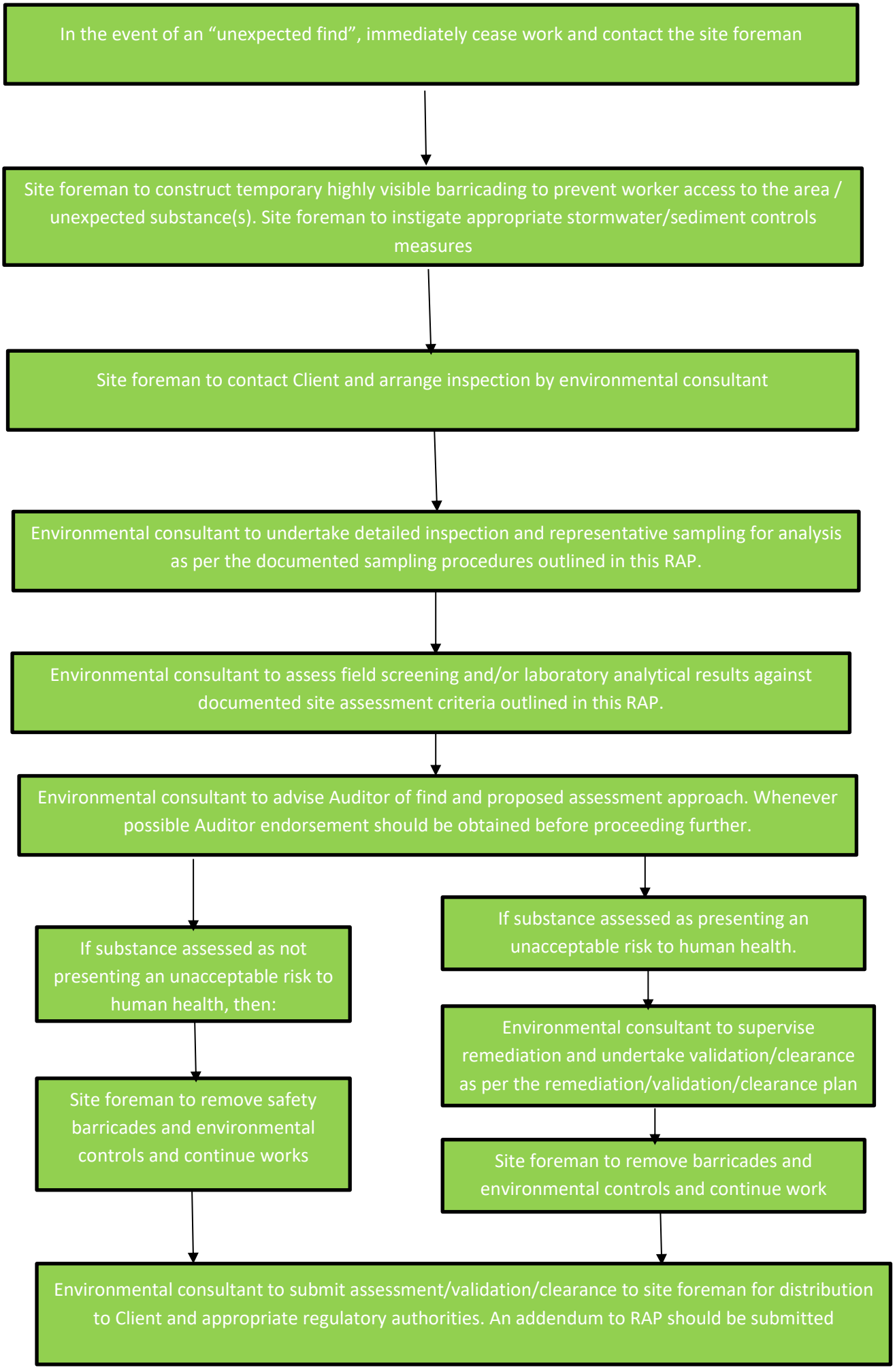
N

Asbestos Areas

Key Site Location Test Pit Location -Soil Previous DP Borehole Location Test Pit Location -Soil + Water	FOUNDATION EARTH SCIENCES	**DRAWN** MS	**Asbestos Impacted Areas and Proposed Test Pit Investigation**
		Figure 3	East end Stage 3 Pty Ltd
		Job # E2970-2	105, 109, 111, 121 Hunter St, 3 Morgan St, 66-74 King St & 22 Newcomen St, Newcastle NSW

APPENDIX A: UNEXPECTED FINDS PROTOCOL

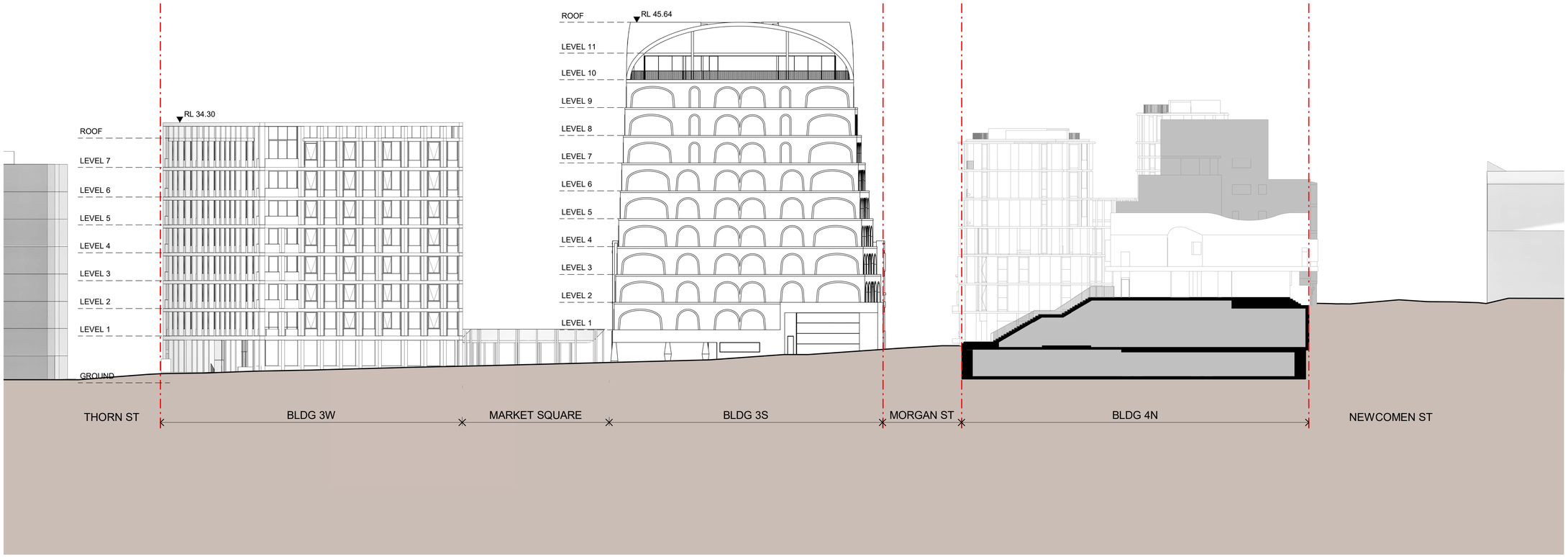
FOUNDATION EARTH SCIENCES



APPENDIX B: PROPOSED DEVELOPMENT PLANS

FOR INFORMATION

Rev	Date	Revision	By	Chk.
1	2022/09/09	FOR INFORMATION	JG	WG
2	2022/09/28	FOR INFORMATION	JG	RY
3	2022/12/05	FOR INFORMATION	JG	RY
4	2023/02/28	FOR INFORMATION	JG	RY



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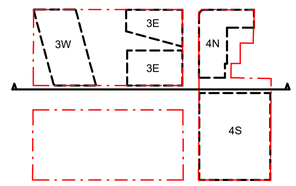

Client

Project
EAST END STAGE 3 & 4

Hunter, Morgan, Newcomen, King Streets NEWCASTLE NSW 2300

Country: AWABAKAL

Drawing Name
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Job No.	Drawing No.	
6668	DA-PR-0361	

FOR INFORMATION

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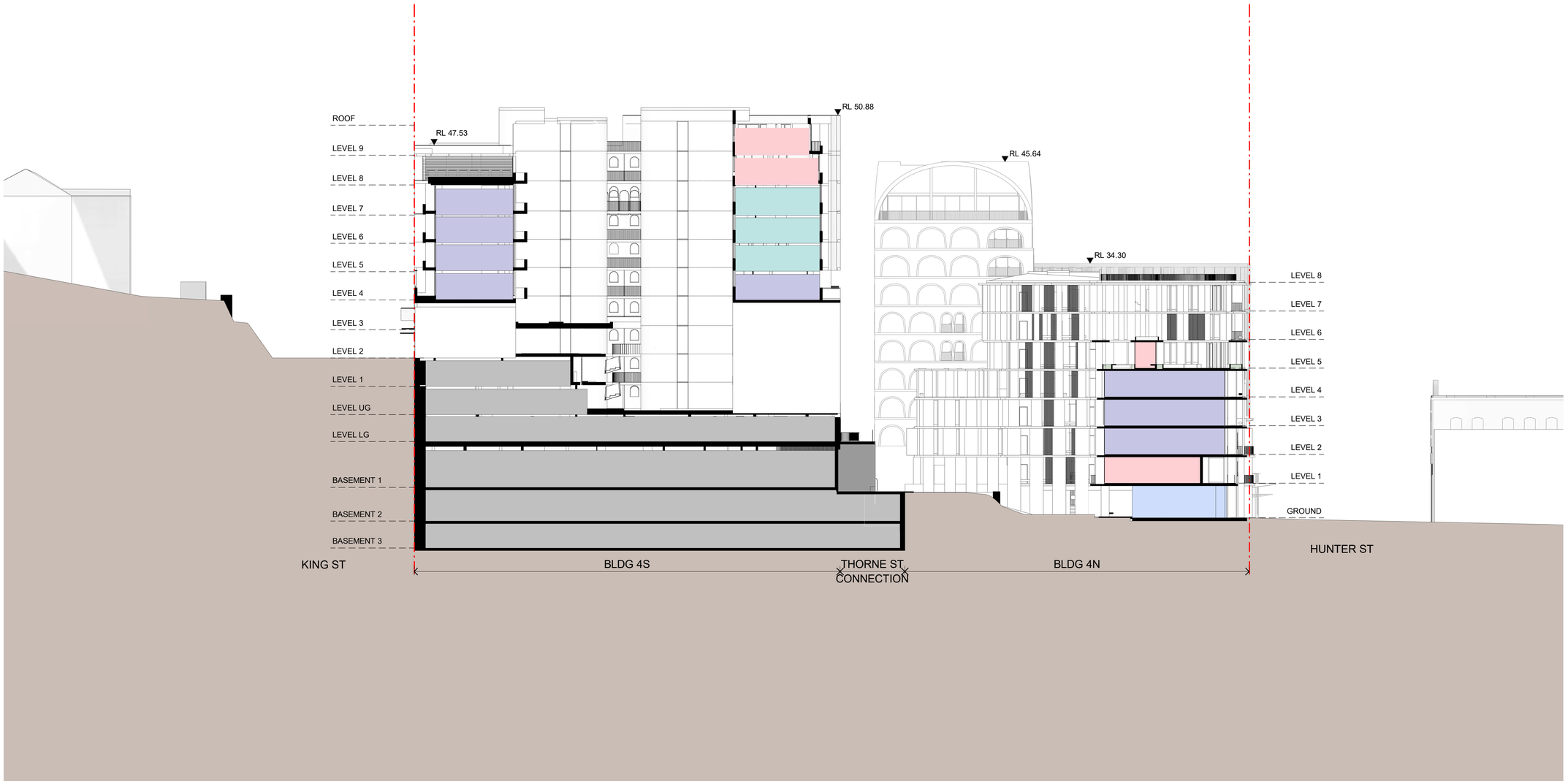
2	2022/09/28	FOR INFORMATION	JG	RY
3	2022/12/05	FOR INFORMATION	JG	RY
4	2023/02/28	FOR INFORMATION	JG	RY



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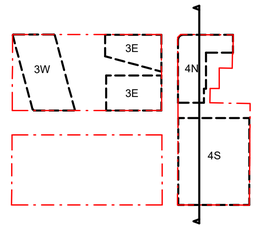

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Country: AWABAKAL

Drawing Name

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FOR INFORMATION

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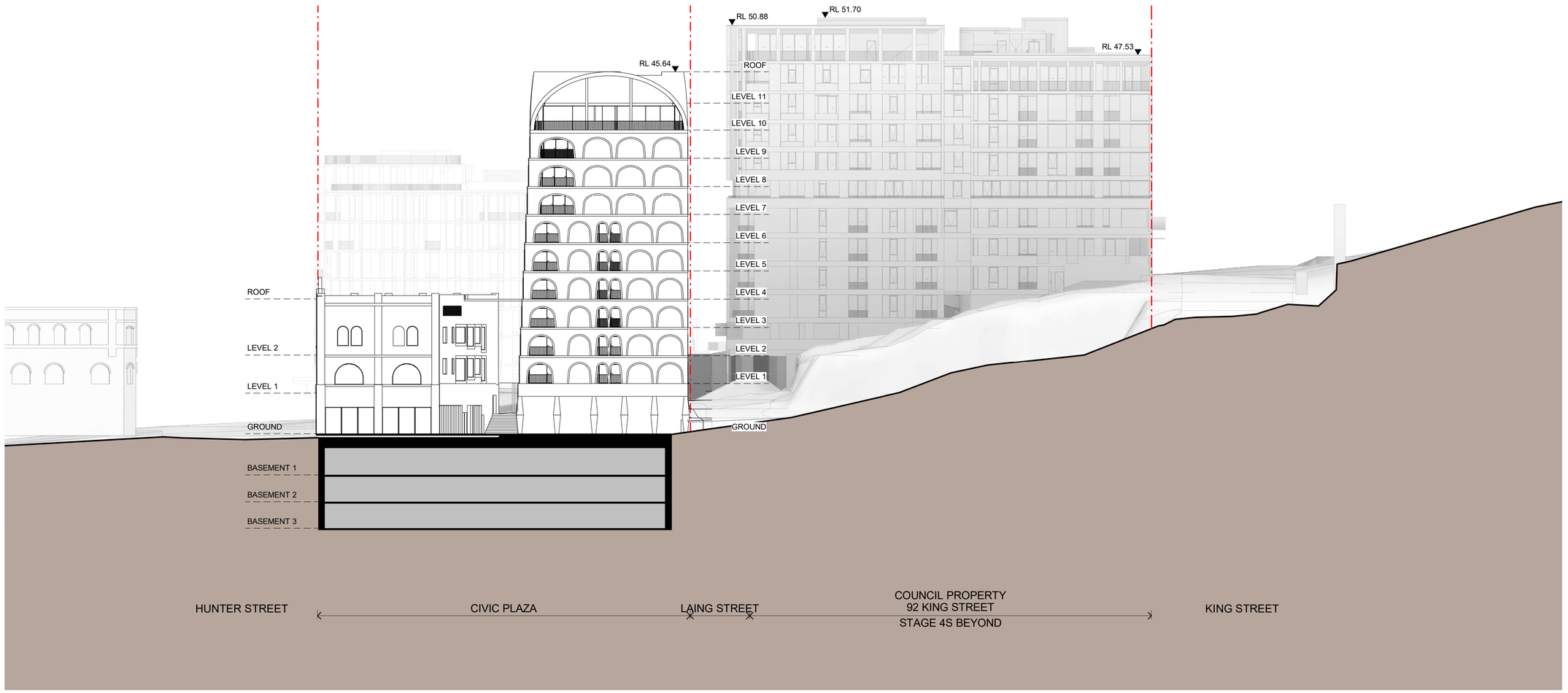
2	2022/12/05	FOR INFORMATION	JG	RY
3	2023/02/28	FOR INFORMATION	JG	RY



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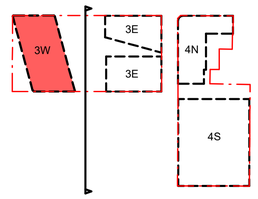

Client

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EAST END STAGE 3 & 4

Hunter, Morgan, Newcomen, King Streets NEWCASTLE NSW 2300

Country: AWABAKAL

Drawing Name

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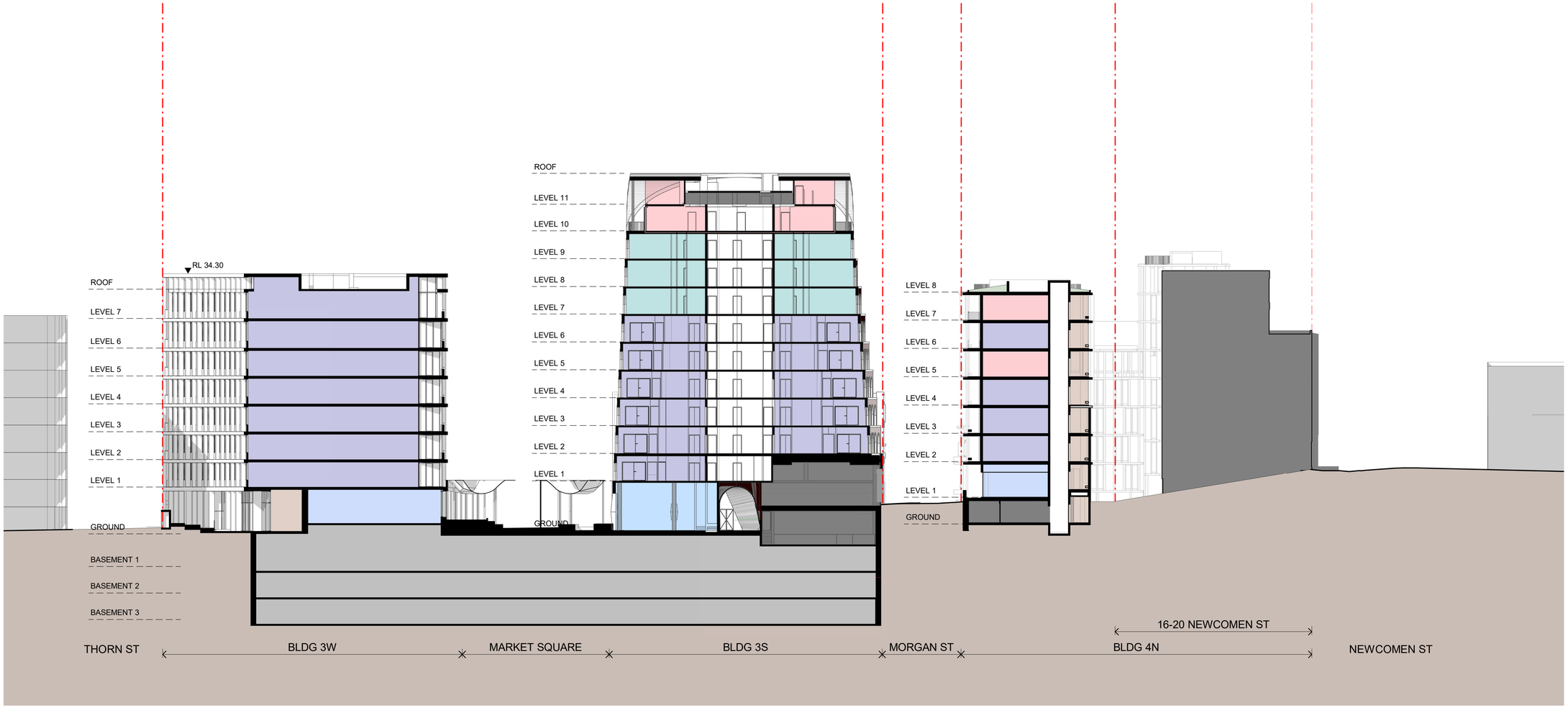

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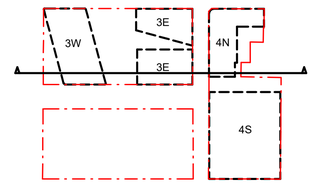

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EAST END STAGE 3 & 4

Hunter, Morgan, Newcomen, King Streets NEWCASTLE NSW 2300

Country: AWABAKAL

Drawing Name

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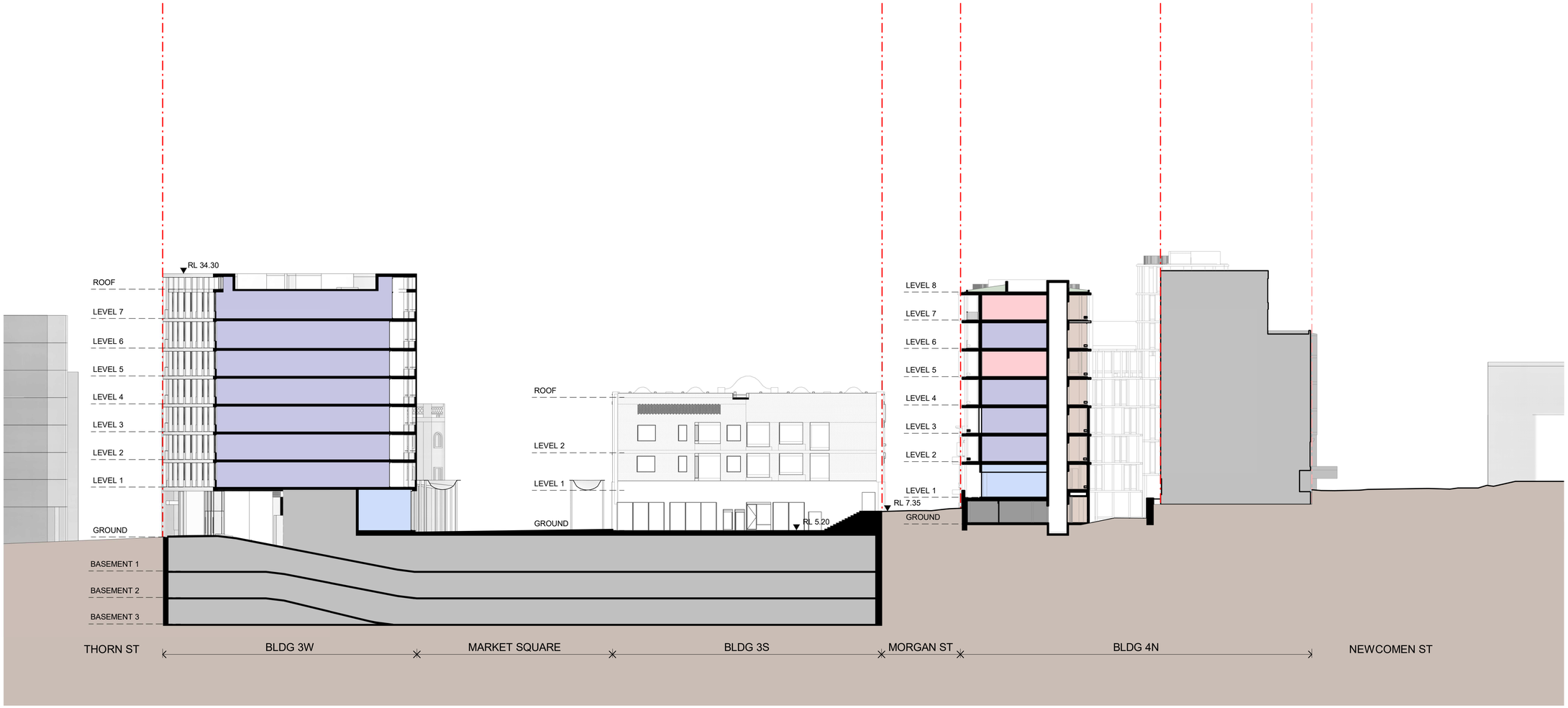
2	2023/02/28	FOR INFORMATION	JG	RY



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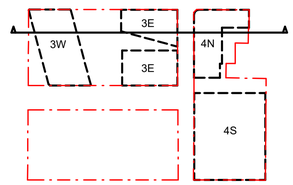

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EAST END STAGE 3 & 4

Hunter, Morgan, Newcomen, King Streets NEWCASTLE NSW 2300

Country: AWABAKAL

Drawing Name
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Job No.	Drawing No.	
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FOR INFORMATION

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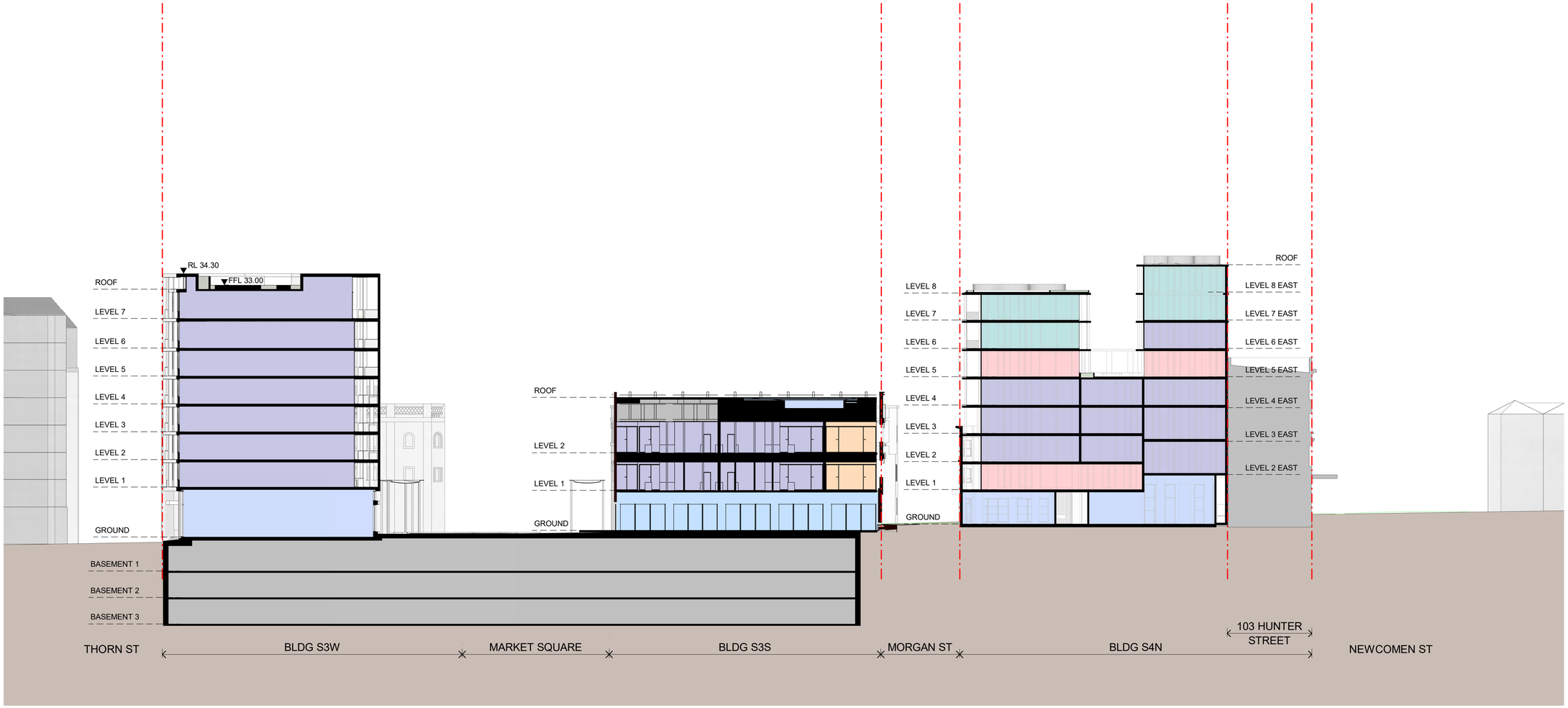

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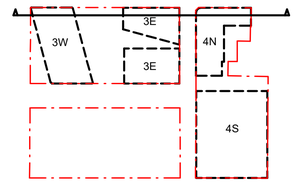

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Country: AWABAKAL

Drawing Name

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Drawn.	Chk.	Revision
JG	RY	2

Job No.	Drawing No.
6668	DA-PR-0366

APPENDIX C: SUMMARY TABLES

Table K1

Sample Information				Heavy Metals (mg/kg)								TRH (mg/kg)						BTEX (mg/kg)					PAH (mg/kg)				OCP (mg/kg)												OPP (mg/kg)					PFAS(ug/kg)			
Label	Depth (m BGL)	Date	Soil Type	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC	F1 (C_6-C_{10}) [2]	F2 (>C_{10}-C_{16}) [3]	F1 (C_6-C_{10})	F2 (>C_{10}-C_{16})	F3 (C_{16}-C_{34})	F4 (C_{34}-C_{40})	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES	NAPHTHALENE	BENZO(A)PYRENE	CARINOGENIC PAHs (as Bap TEQ)	TOTAL PAH	NAPHTHALENE	DDT + DDD + DDE	ALDRIN + DIELDRIN	CHLORDANE	ENDOSULFAN	ENDRIN	HEPTACHLOR	HCB	METHOXYCHLOR	DDT	CHLORPYRIFOS	TOTAL OPP	VOC	Total Phenolics	TOTAL PCB	Sum of PFOS and PFHxS	PFOA	PFOS	Asbestos ID
DG Previous Locations																																													
114	0.5	11.01.2008	Fill:Silty Sandy Gravel	9	<0.3	9.3	9.5	6	0.07	12	35	-	-	-	-	-	-	<0.5	<0.5	<0.5	<1.5	<0.5	<0.05	<0.096	<1.55	<0.1	<0.3	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	-	<0.4	<36	<0.5	<0.9	-	-	-	ND
115	0.4	11.01.2008	Fill:Sand	<3	<0.3	4.6	8.1	180	0.28	4.3	8.3	-	-	-	-	-	-	<0.5	<0.5	<0.5	<1.5	<0.5	0.09	<0.1665	<1.79	<0.1	<0.3	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	-	<0.4	<36	<0.5	<0.9	-	-	-	Detected
115	1	11.01.2008	N:SAND	<3	<0.3	9.2	0.7	6	<0.05	1.6	2.1	-	-	-	-	-	-	<0.5	<0.5	<0.5	<1.5	<0.5	<0.05	<0.096	<1.55	<0.1	<0.3	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	-	<0.4	<36	<0.5	<0.9	-	-	-	-
118	0-0.05	15.01.2008	Fill: Gravel	<3	0.5	7.7	37	200	<0.05	4.2	270	-	-	-	-	-	-	<0.5	<0.5	<0.5	<1.5	<0.5	0.23	<0.353	<2.73	<0.1	<0.3	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	-	<0.4	<36	0.6	<0.9	-	-	-	Detected
118	0.7	15.01.2008	Fill: Sandy Gravel	<3	0.5	9.8	32	280	<0.05	5.2	370	-	-	-	-	-	-	<0.5	<0.5	<0.5	<1.5	0.5	0.18	<0.292	<2.28	<0.1	<0.3	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	-	<0.4	<36	<0.5	<0.9	-	-	-	ND
FES DSI 2023																																												
BH1	0.3-0.4	21.03.2023	Fill:Silty Clayey Sand	7	<0.4	19	93	300	0.5	18	310	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.1	<0.5	1.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	-	ND
BH1	1.3-1.4	21.03.2023	Fill:Silty Clayey Sand	16	0.7	18	96	630	1.2	23	530	<25	<50	<25	<50	170	<100	<0.2	<0.5	<1	<1	<1	0.63	1.1	9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH1	2.3-2.4	21.03.2023	Fill:Silty Sand	7	0.6	21	150	390	9	15	300	<25	<50	<25	<50	210	<100	<0.2	<0.5	<1	<1	<1	1.4	2.2	22	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH1	3.0-3.1	21.03.2023	N: Clayey SAND	5	<0.4	21	20	38	0.5	6	47	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.06	<0.5	0.64	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH2	0.2-0.3	21.03.2023	Fill: Sand	<4	<0.4	3	10	100	0.3	3	65	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.06	<0.5	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH2	1.2-1.3	21.03.2023	Fill:Silty Sand	<4	2	5	10	180	0.5	4	3900	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.2	<0.5	2.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH2	2.2-2.3	21.03.2023	N:Silty SAND	<4	<0.4	5	<1	14	<0.1	1	14	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH3	0.2-0.3	22.03.2023	Fill: Sand	<4	<0.4	23	17	5	<0.1	17	22	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH4	0.05-0.1	22.03.2023	Fill:Silty Sand	<4	<0.4	7	44	6	<0.1	10	27	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	ND
BH4	0.3-0.4	22.03.2023	Fill:Silty Sand	<4	<0.4	1	4	2	<0.1	<1	5	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	-	-
BH5	0.1-0.2	21.03.2023	Fill:Sandy Silt	<4	<0.4	1	9	110	<0.1	2	100	<25	<50	<25	<50	160	<100	<0.2	<0.5	<1	<1	<1	0.88	1.4	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH5	0.5-0.6	21.03.2023	N:Silty SAND	<4	<0.4	4	5	29	<0.1	2	29	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.07	<0.5	0.52	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH6	0.2-0.3	21.03.2023	Fill:Silty Sand	<4	<0.4	7	35	110	0.3	3	120	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.2	<0.5	3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	0.2	<0.1	0.2	-
BH6	1.2-1.3	21.03.2023	Fill:Silty Sand	<4	<0.4	9	36	190	0.6	5	100	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.4	0.6	4.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH6	1.7-1.8	21.03.2023	N: Clayey SAND	<4	<0.4	20	<1	7	<0.1	3	15	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH7	0.2-0.3	21.03.2023	N: Silty Sandy CLAY	7	<0.4	10	6	3	<0.1	2	9	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH7	0.8-0.9	21.03.2023	N: Silty Sandy CLAY	6	<0.4	9	6	3	<0.1	2	9	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH8	0.2-0.3	22.03.2023	Fill:Silty Sand	<4	<0.4	6	14	130	6.9	1	25	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.3	<0.5	3.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH8	0.8-0.9	22.03.2023	Fill:Silty Sand	<4	<0.4	3	1	12	28	2	2	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH8	1.3-1.4	22.03.2023	N:Silty SAND	<4	<0.4	5	1	150	1	3	1	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH9	0.0-0.2	22.03.2023	Fill:Clayey Silt	<4	0.5	9	84	710	0.1	4	400	<25	<50	<25	<50	190	<100	<0.2	<0.5	<1	<1	<1	0.56	0.9	7.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	ND
BH10	0.2-0.3	21.03.2023	Fill:Clayey Sand	<4	<0.4	3	<1	5	<0.1	2	5	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	-	-
BH10	0.4-0.5	21.03.2023	N: Sandy CLAY	<4	<0.4	8	<1	4	<0.1	4	6	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH11	0.2-0.3	21.03.2023	Fill:Silty Sand	<4	<0.4	6	<1	22	0.1	4	13	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH11	0.5-0.6	21.03.2023	N: Clayey SAND	<4	<0.4	6	1	31	0.3	4	16	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH11	0.8-0.9	21.03.2023	N: Clayey SAND	<4	<0.4	5	<1	48	0.2	3	10	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.07	<0.5	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH12	0.2-0.3	21.03.2023	Fill:Sandy Silt	<4	<0.4	13	27	2100	0.2	7	230	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.62	1	7.9	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH13	0.2-0.3	21.03.2023	Fill:Silty Sand	<4	<0.4	4	22	200	0.5	3	150	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.5	0.7	3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	-	-
BH13	1.2-1.3	21.03.2023	N:Silty SAND	<4	<0.4	3	4	22	<0.1	1	48	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.07	<0.5	0.07	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH14	0.1-0.2	22.03.2023	Fill:Silty Sand	<4	<0.4	8	20	13	<0.1	10	53	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	67	3.1	48	-
BH14	0.7-0.8	22.03.2023	Fill:Silty Sand	<4	<0.4	1	<1	1	<0.1	<1	78	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH15	0.2-0.3	22.03.2023	Fill:Silty Sand	<4	<0.4	12	11	67	0.4	7	59	<25	<50	<25	<50	120	<100	<0.2	<0.5	<1	<1	<1	2.4	3	25	0.2	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	<0.1	-	-	-	-
BH16	0.5-0.6	22.03.2023	Fill:Clayey Sand	<4	<0.4	11	18	73	0.1	8	71	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.2	<0.5	2.1	<0.1	<0.1	4.9	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH17	0.1	22.03.2023	Fill:Silty Sand	<4	<0.4	8	11	5	<0.1	12	21	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	ND
BH18	0.1-0.2	22.03.2023	Fill:Silty Sand	<4	<0.4	1	7	<1	<0.1	<1	2	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH19	0.1-0.2	22.03.2023	Fill:Gravel	<4	<0.4	3	3	4	<0.1	2	16	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH20	0.1	22.03.2023	Fill:Silty Sand	<4	<0.4	9	35	5	<0.1	14	23	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH21	0.2-0.3	22.03.2023	Fill:Sandy Silt	<4	<0.4	10	41	16	<0.1	7	68	<25	<50	<25	<50	360	120	<0.2	<0.5	<1	<1	<1	0.08	<0.5	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH22	0.1-0.2	22.03.2023	Fill:Silty Sand	<4	<0.4	1	3	<1	<0.1	<1	1	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
BH22	0.7-0.8	22.03.2023	N:Silty SAND	<4	<0.4	3	4	25	0.3	2	17	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	0.2	<0.5	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
D1	-	21.03.2023	Fill:Sandy Silt	7	<0.4	11	30	270	0.3	6	210	<25	<50	<25	<50	140	<100	<0.2	<0.5	<1	<1	<1	1.5	2	11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
D2	-	22.03.2023	Fill:Silty Sand	<4	<0.4	2	7	12	0.2	<1	8	<25	<50	<25	<50	<100	<100	<0.2	<0.5	<1	<1	<1	<0.05	<0.5	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<0.1	-	-	-	-
SS1	-	21.03.2023	Fill:Sandy Silt	8	0.5	16	33	630	0.31	11	320	<25	25	<25	25	210	<120	<0.1	<0.1	<0.1	<0.3	<0.1	1	1	11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<1	-	-	-	-
SS2	-	22.03.2023	Fill:Silty Sand	1	<0.3	1.1	2.5	2	<0.05	0.7	2.7	<25	<25	<25	<25	<90	<120	<0.1	<0.1	<0.1	<0.3	<0.1	<0.1	<0.3	<0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	-	-	-	<1	-	-	-	-
Statistical Analysis																																												
No of Observations- All Fills except QAQC								28															28																					
Minimum								1															0.05																					
Maximum								2100															2.4																					
Standard Deviation								416.6															0.518																					
Mean								192.4															0.328																					
95% Adjusted Gamma or Chebyshev - UCL								370.4															0.755																					
Limit of Resolution (LOR)				4	0.4	1	1	1	0.1	1	1	25	50	25	50	100	100	0.2	0.5	1	1	1	0.05	0.5	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	36	0.5	0.1					0.1
NEPM (2013) HIL D				**3000**	**900**	**3,600**	**240,000**	**1,500**	**730**	**6,000**	**400,000**													**40**	**4000**		**600**	**10**	**90**	**400**	**20**	**10**	**15**	**500**	**30**	**2000**			**240000**	**7**	**20,000**	**50,000**		
NEPM (2013) EIL & ESLs [1]				160																					370								640										
Fill BH2 (0.2-0.3m)						660	320	1900	600	1600																																		
Natural BH2 (2.2-2.3m)						670	280	1800	290	630																																		
NEPM (2013) ESLs - (Fine Grain Soil - Clay / Silt) [1]												215	170			2,500	6,600	95	135	185	95		1.4																					
NEPM (2013) ESLs - (Coarse Grain Soil - Sand / Gravel) [1]												215	170			1,700	3,300	75	135	165	180		1.4																					
NEPM (2013) HSL D (CLAY)																																												
0m to <1m												310	NL					4	NL	NL	NL	NL																						
1m to <2m												480	NL					6	NL	NL	NL	NL																						
Soil Saturation Concentration (Csat)												850	560					430	630	68	330	10																						
NEPM (2013) HSL D (SAND)																																												
0m to <1m												260	NL					3	NL	NL	230	NL																						
1m to <2m												370	NL					3	NL	NL	NL	NL																						
2m to <4m																																												
Soil Saturation Concentration (Csat)												950	560					360	560	64	300	9																						
NEPM (2013) HSL D (SILT)																																												
0m to <1m												NL	NL					4	NL	NL	NL	NL																						
Soil Saturation Concentration (Csat)												640	570					440	640	69	330	10																						
NEPM (2013) Management Limit (Fine Grain Soil)														800	1,000	5,000	10,000																										
NEPM (2013) Management Limit (Coarse Grain Soil)														700	1,000	3,500	10,000																										
PFAS NEMP 2020																																												
Ecological Direct Exposure																																										**10,000ug/kg**	**1,000ug/kg**	
Ecological indirect exposure																																											**10ug/kg**	
NEPM (2013) HSL - Asbestos																																												Detected

Notes

1 Commerical and industrial is broadly equivalent to the HIL-D land use scenarios in Table 1A(1) Footnote 1 and as described in Schedule B7.

2 To obtain F1 subtract the sum of BTEX concentrations from the C6-C10 fraction.

3 To obtain F2 subtract naphthalene from the >C_{10}-C_{16} fraction.

NL Calculated HSL is Non Limiting per NEPM (2013)

ND Not detected

Table K4

	Heavy Metals (mg/kg)								TRH (mg/kg)					BTEX (mg/kg)				PAH (mg/kg)		OCP (mg/kg)		OPP		PCB (mg/kg)	
	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC	C6-C9	C10-C14	C15-C28	C29-C36	C10-C36 [a]	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES	BENZO(a)PYRENE	TOTAL PAH	Other OCPs	TOTAL ENDOSULFAN [11]	CHLORPYRIFOS	OTHER OPP	TOTAL PCB	ASBESTOS ID (Presence / Absence)
NSW EPA Waste Criteria (No Leachates)																									
CT1	100	20	100	-	100	4	40	-	NA	-	-	-	NA	10	288	600	1000	0.8	200	<50	60	4	250	<50	Detected
CT2	400	80	400	-	400	16	160	-	NA	-	-	-	NA	40	1152	2400	4000	3.2	800	<50	240	16	1000	<50	
NSW EPA Waste Criteria (With Leachates)																									
SCC1	500	100	1900	-	1500	50	1050	-	650	-	-	-	10000	18	518	1080	1800	10	200	Total = <50**	108	7.5	250	<50**	
SCC2	2000	400	7600	-	6000	200	4200	-	2600	-	-	-	40000	72	2073	4320	7200	23	800	Total = <50**	432	30	1000	<50**	
Limit of Resolution (LOR)	4	0.4	5	5	5	0.10	5	5	25	50	100	100	NA	0.2	0.5	1	3	0.05	0.05	0.1	0.1			0.1	
Sample ID	**Date Sampled**	**Depth**																							
DP Previous Locations																									
114	11.01.2008	0.5	9	<0.3	9.3	9.5	6	0.07	12	35	<20	<20	<50	<50	<LOR	<0.5	<0.5	<0.5	<1.5	<0.05	<1.55	<LOR	<0.2	-	<0.4	<0.9	ND
115	11.01.2008	0.4	<3	<0.3	4.6	8.1	180	0.28	4.3	8.3	<20	<20	<50	<50	<LOR	<0.5	<0.5	<0.5	<1.5	0.09	<1.79	<LOR	<0.2	-	<0.4	<0.9	Detected
118	15.01.2008	0-0.05	<3	0.5	7.7	37	200	<0.05	4.2	270	<20	<20	<50	<50	<LOR	<0.5	<0.5	<0.5	<1.5	0.23	<2.73	<LOR	<0.2	-	<0.4	<0.9	Detected
118	15.01.2008	0.7	<3	0.5	9.8	32	280	<0.05	5.2	370	<20	<20	<50	<50	<LOR	<0.5	<0.5	<0.5	<1.5	0.18	<2.28	<LOR	<0.2	-	<0.4	<0.9	ND
FES DSI 2023																									
BH1	21.03.2023	0.3-0.4	7	<0.4	19	93	300	0.5	18	310	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.1	1.8	<LOR	<0.1	<0.1	<0.1	<0.1	ND
BH1	21.03.2023	1.3-1.4	16	0.7	18	96	630	1.2	23	530	<25	<50	130	<100	130	<0.2	<0.5	<1	<1	0.63	9	<LOR	<0.1	-	-	<0.1	-
BH1	21.03.2023	2.3-2.4	7	0.6	21	150	390	9	15	300	<25	<50	150	<100	150	<0.2	<0.5	<1	<1	1.4	22	<LOR	<0.1	-	-	<0.1	-
BH2	21.03.2023	0.2-0.3	<4	<0.4	3	10	100	0.3	3	65	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.06	0.5	<LOR	<0.1	-	-	<0.1	-
BH2	21.03.2023	1.2-1.3	<4	2	5	10	180	0.5	4	3900	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.2	2.9	<LOR	<0.1	-	-	<0.1	-
BH3	22.03.2023	0.2-0.3	<4	<0.4	23	17	5	<0.1	17	22	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH4	22.03.2023	0.05-0.1	<4	<0.4	7	44	6	<0.1	10	27	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	ND
BH4	22.03.2023	0.3-0.4	<4	<0.4	1	4	2	<0.1	<1	5	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	<0.1	<0.1	<0.1	-
BH5	21.03.2023	0.1-0.2	<4	<0.4	1	9	110	<0.1	2	100	<25	56	<100	100	160	<0.2	<0.5	<1	<1	0.88	10	<LOR	<0.1	-	-	<0.1	-
BH6	21.03.2023	0.2-0.3	<4	<0.4	7	35	110	0.3	3	120	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.2	3	<LOR	<0.1	-	-	<0.1	-
BH6	21.03.2023	1.2-1.3	<4	<0.4	9	36	190	0.6	5	100	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.4	4.8	<LOR	<0.1	-	-	<0.1	-
BH8	22.03.2023	0.2-0.3	<4	<0.4	6	14	130	6.9	1	25	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.3	3.3	<LOR	<0.1	-	-	<0.1	-
BH8	22.03.2023	0.8-0.9	<4	<0.4	3	1	12	28	2	2	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH9	22.03.2023	0.0-0.2	<4	0.5	9	84	710	0.1	4	400	<25	<50	110	100	220	<0.2	<0.5	<1	<1	0.56	7.7	<LOR	<0.1	-	-	<0.1	ND
BH10	21.03.2023	0.2-0.3	<4	<0.4	3	<1	5	<0.1	2	5	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	<0.1	<0.1	<0.1	-
BH11	21.03.2023	0.2-0.3	<4	<0.4	6	<1	22	0.1	4	13	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH12	21.03.2023	0.2-0.3	<4	<0.4	13	27	2100	0.2	7	230	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.62	7.9	0.1	<0.1	-	-	<0.1	-
BH13	21.03.2023	0.2-0.3	<4	<0.4	4	22	200	0.5	3	150	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.5	3	<LOR	<0.1	<0.1	<0.1	<0.1	-
BH14	22.03.2023	0.1-0.2	<4	<0.4	8	20	13	<0.1	10	53	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH14	22.03.2023	0.7-0.8	<4	<0.4	1	<1	1	<0.1	<1	78	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH15	22.03.2023	0.2-0.3	<4	<0.4	12	11	67	0.4	7	59	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	2.4	25	0.4	<0.1	<0.1	<0.1	<0.1	-
BH16	22.03.2023	0.5-0.6	<4	<0.4	11	18	73	0.1	8	71	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	0.2	2.1	5.1	<0.1	-	-	<0.1	-
BH17	22.03.2023	0.1	<4	<0.4	8	11	5	<0.1	12	21	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	ND
BH18	22.03.2023	0.1-0.2	<4	<0.4	1	7	<1	<0.1	<1	2	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH19	22.03.2023	0.1-0.2	<4	<0.4	3	3	4	<0.1	2	16	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH20	22.03.2023	0.1	<4	<0.4	9	35	5	<0.1	14	23	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
BH21	22.03.2023	0.2-0.3	<4	<0.4	10	41	16	<0.1	7	68	<25	<50	190	220	410	<0.2	<0.5	<1	<1	0.08	0.3	<LOR	<0.1	-	-	<0.1	-
BH22	22.03.2023	0.1-0.2	<4	<0.4	1	3	<1	<0.1	<1	1	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
D1	21.03.2023	0.2-0.3	7	<0.4	11	30	270	0.3	6	210	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	1.5	11	<LOR	<0.1	-	-	<0.1	-
D2	22.03.2023	0.1-0.2	<4	<0.4	2	7	12	0.2	<1	8	<25	<50	<100	<100	<50	<0.2	<0.5	<1	<1	<0.05	<0.05	<LOR	<0.1	-	-	<0.1	-
SS1	21.03.2023	0.2-0.3	8	0.5	16	33	630	0.31	11	320	<20	22	130	120	270	<0.1	<0.1	<0.1	<0.3	1	11	<LOR	<0.1	-	-	<1	-
SS2	22.03.2023	0.1-0.2	1	<0.3	1.1	2.5	2	<0.05	0.7	2.7	<20	<20	<45	<45	<110	<0.1	<0.1	<0.1	<0.3	<0.1	<0.8	<LOR	<0.1	-	-	<1	-

Notes

1 CT1, CT2 : Total concentrations used for defining General Solid Waste and Restricted Solid Waste respectively (without TCLP)
2 SCC1, SCC2 : Total Concentration used for defining General Solid Waste and Restricted Solid Waste respectively (in conjunction with TCLP)
3 Concentrations in GREEN exceed the CT1 criteria
4 Concentrations in RED exceed the CT2 criteria
5 Concentrations in BLUE exceed the SCC1 criteria
6 Concentrations in ORANGE exceed the SCC2 criteria
7 Concentrations in YELLOW indicate the presence of Asbestos
8 NA = Not Applicable
9 " - " Not Tested
10 *** Indicates Retest Result
11 Total Endosulfan = Endosulfan I, Endosulfan II and Endosulfan Sulphate

Locations	Total Concentration (mg/kg)					Leachable Concentration (mg/L)		
	SCC	CT1	CT2	SCC1	SCC2	TCLP	TCLP1	TCLP2
BH1 (0.3-0.4m)								
Lead	300	100	400	1500	6000	0.75	5	20
BH1 (1.3-1.4m)								
Lead	630	100	400	1500	6000	1.4	5	20
BH1 (2.3-2.4m)								
Lead	390	100	400	1500	6000	1.3	5	20
Mercury	9	4	16	50	200	<0.0005	0.2	0.8
Benzo(a)Pyrene	1.4	0.8	3.2	10	23	<0.001	0.04	0.16
BH2 (1.2-1.3m)								
Lead	180	100	400	1500	6000	1.4	5	20
BH5 (0.1-0.2m)								
Lead	110	100	400	1500	6000	0.37	5	20
Benzo(a)Pyrene	0.88	0.8	3.2	10	23	<0.001	0.04	0.16
BH6 (0.2-0.3m)								
Lead	110	100	400	1500	6000	0.2	5	20
PFOS + PFHxS	0.0002	-	-	1.8	7.2	<0.00001	0.05	0.2
PFOA	<0.0001	-	-	18	72	<0.00001	0.5	2
BH6 (1.2-1.3m)								
Lead	190	100	400	1500	6000	0.2	5	20
BH8 (0.2-0.3m)								
Lead	130	100	400	1500	6000	1.2	5	20
Mercury	6.9	4	16	50	200	<0.0005	0.2	0.8
BH8 (0.8-0.9m)								
Mercury	28	4	16	50	200	0.0013	0.2	0.8
BH9 (0-0.2m)								
Lead	710	100	400	1500	6000	2.4	5	20
BH12 (0-0.2m)								
Lead	**2100**	100	400	1500	6000	4.9	5	20
BH13 (0-0.2m)								
Lead	200	100	400	1500	6000	0.94	5	20
BH14 (0.1-0.2m)								
PFOS + PFHxS	0.067	-	-	1.8	7.2	0.00054	0.05	0.2
PFOA	0.0031	-	-	18	72	0.00005	0.5	2
BH15 (0.2-0.3m)								
Benzo(a)Pyrene	2.4	0.8	3.2	10	23	<0.001	0.04	0.16
D1								
Lead	270	100	400	1500	6000	0.46	5	20
Benzo(a)Pyrene	1.5	0.8	3.2	10	23	<0.001	0.04	0.16
SS1								
Lead	630	100	400	1500	6000	0.16	5	20
Benzo(a)Pyrene	1	0.8	3.2	10	23	0.0003	0.04	0.16

NOTES: (1) SCC : Total Concentration

(2) CT1, CT2 : Total concentrations used for defining General Solid Waste and Restricted Solid Waste respectively (without TCLP)

(3) SCC1, SCC2 : Total Concentration used for defining General Solid Waste and Restricted Solid Waste respectively (in conjunction with TCLP)

(4) TCLP : Leachable concentration laboratory result

(5) TCLP1, TCLP2 : Leachable concentration used in defining General Solid Waste and Restricted Solid Waste respectively (in conjunction with SCC)

(NT) Not Tested

(NA) Not Applicable