FOUNDATION EARTH SCIENCES

DETAILED SITE INVESTIGATION (DSI)

Property Address
51 Brickworks Road, Thornton NSW

Prepared for
Lion Quarries Pty Ltd

Date

February 2021

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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*	**TCLP**	*Toxicity Characteristics Leaching Procedure*
DP	*Deposited Plan*	**TPH**	*Total Petroleum Hydrocarbons*
DQOs	*Data Quality Objectives*	**UCL**	*Upper Confidence Limit*
EPA	*Environment Protection Authority*	**UST**	*Underground Storage Tank*
ESA	*Environmental Site Assessment*	**VHC**	*Volatile Halogenated Compounds*
HIL	*Health-Based Soil Investigation Level*	**VOC**	*Volatile Organic Compounds*
LGA	*Local Government Area*	**DPI**	Department of Primary Industries
NEHF	*National Environmental Health Forum*		
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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EXECUTIVE SUMMARY

Foundation Earth Sciences was appointed by Lion Quarries Pty Ltd to undertake a Detailed Site Investigation (DSI) for the property situated at 51 Brickworks Road, Thornton NSW ("the site").

Refer to **Figure 1** - Site Location and **Figure 2** - Site Features and Borehole Locations.

The site is currently occupied by a former quarry and brickworks facility. The site is proposed for rezoning into a B5 Business development zone. The Site Assessment forms part of SEPP 55 Guideline (Remediation of Land) with a proposed redevelopment to determine the end land-use suitability of the property.

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 Laboratory Analysis

The soil data revealed the following:

- The laboratory results for all soil samples were below the adopted detection limits and/or the relevant guideline criteria.
- No asbestos was detected in the soil samples analysed.

It was also noted that any previous fragments of asbestos had been removed from the site.

It is considered that the site would be deemed suitable for the proposed development.

Any soils to be removed should be classified in accordance with NSW EPA Waste Classification Guidelines 2014.

If during any potential site works, significant odours and / or evidence of gross contamination (including asbestos) not previously detected are encountered, or any other significant unexpected occurrence, site works should cease in that area, at least temporarily, and the environmental consultant should be notified immediately to set up a response to this unexpected occurrence.

Thank you for the opportunity of undertaking this work. We would be pleased to provide further information on any aspects of this report.

1.0 INTRODUCTION

Foundation Earth Sciences was appointed by Lion Quarries Pty Ltd to undertake a Detailed Site Investigation (DSI) for the property situated at 51 Brickworks Road, Thornton ("the site").

Refer to **Figure 1** - Site Location and **Figure 2** - Site Features and Borehole Locations.

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2.0 OBJECTIVE

The NSW Environmental Protection Agency (EPA) indicate that a Detailed Site Environmental Investigation should provide comprehensive information on:

- Any issues raised in preliminary investigations;
- The type, extent and level of contamination;
- Contaminant dispersal in the air, surface water, soil and dust;
- The potential effects of contaminants on public health and the environment;
- Where applicable, off-site impacts on soil, sediment and biota; and
- The adequacy and completeness of all information available to be used in making decisions on remediation.

The project objectives of this Detailed Site Investigation (DSI) are to satisfy the stated OEH Detailed Site Investigation requirements in accordance with *NSW EPA Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites, 2020.* Specifically, this investigation will consider the potential for suspected historical activities to have caused contamination at the Site and determine land use suitability for the proposed land use.

The proposed investigation program and the Detailed Site Investigation are designed to assess the presence of any unacceptable on site or off-site risk to human health or the environment. The report will draw conclusions regarding the land use suitability of the Site for the proposed land use or provide recommendations to enable such conclusions and determine the need for a further assessment.

3.0 SCOPE OF WORKS

The scope of works for this Detailed Site Investigation (DSI) included:

- Collecting site information, review of historical information and past site practices, (site surveys, site records on waste management practices, NSW Land Titles Office records of ownership, aerial photographs obtained from the NSW Department of Lands, WorkCover NSW records and site interviews);
- A site inspection to identify areas of environmental concern, on-site waste disposal practices and location of sewers, drains, holding tanks, Underground Storage Tanks, Aboveground Storage Tanks and pits, spills and ground discolouration etc.;
- A targeted soil boring/sampling investigative study – formulating and conducting a sampling plan and borehole investigation; the soil samples are taken and submitted for analysis on particular contaminants;
- Laboratory analysis and results from sample analysis – findings and comparison to regulatory guidelines;
- Quality Assurance/Quality Control (QA/QC) – all QA/QC procedures were undertaken in accordance with the Foundation Earth Sciences Quality Assurance/Quality Control manual;
- Interpretation of results and findings; and
- Recommendations and final conclusions drawn from interpretation of the results.

4.0 SITE IDENTIFICATION AND SITE HISTORY REVIEW

4.1 Site identification

The site is identified as follows:

Table 1: Site Identification Review

Site Identifier	Site Details	
Site Location	51 Brickworks Road, Thornton NSW	
Lot/DP	Lot 14 DP 10419 Lot 15 DP 10419	
Site Coordinates #	NW corner: Latitude: -32.766094, Longitude: 151.623588 NE corner: Latitude: -32.768836, Longitude: 151.629521 SE corner: Latitude: -32.773771, Longitude: 151.628556 SW corner: Latitude: -32.769044, Longitude: 151.622998	
Site Area	Approximate 22 ha – approximately 11 ha that has been impacted by brickmaking and quarry activities.	
Local Government Area (LGA)	Maitland	
Zoning##	RU2: Rural Landscape	
Surrounding Land Uses	*North*	Rural residential followed by residential
	South	Parkland followed by residential
	East	Quarry followed by residential
	West	Rural residential

Notes: # 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 Review of Historical Maps

A review of the maps originally produced by Higinbotham & Robinson from late-nineteenth-century was undertaken. No relevant information was found as part of this assessment.

4.3 Underground Services

Dial Before You Dig' plans were requested and reviewed for the Site. Plans were provided by Endeavour Energy, Jemena Gas North, Sydney Water, NBN Co & Telstra NSW. The plans did not indicate the presence of any major underground services or utility easements at the Site.

4.4 Review of aerial photographs

The following information regarding the aerial photographs has been obtained and the summary of this review are presented in the following table:

Table 2 Review of Aerial Photographs

Year	Site		Surrounding areas
1966	Agricultural/Brickmaking Quarry	The site appeared to be used for brick making and rural area	The surrounding area appears to be used for brick making agriculture purposes.
1975	Brickmaking Quarry	Increases in quarry area to the south and west	No major changes noticed.
1994	No major changes	No major changes	Surrounding land has redeveloped with more residential buildings visible
2005	No major changes	No major changes	Surrounding residential areas continue to increase in density.
Current	No major change	No major changes Bushland area has regenerated in areas where former buildings existed.	No major changes

The aerial photographs have indicated the site appeared to be occupied by a brickmaking quarry property from 1966 to the 1990. After that the site was owned by private residents and remained relatively unchanged from 1994 to the current date.

The surrounding land appeared to be agricultural until 1966. From 1966 the surrounding land included residential buildings type development and has continued progressively to the north and south to the present date.

4.5 Title search

A review of historical documents held by Direct Info (approved LPI NSW Information broker) was undertaken to characterise the previous land use and occupiers of the site.

Table 3 Historical land title data

Lot 14 in DP10419		
Year	**Proprietor**	**Company/Personal Occupation**
2005-Current	Nouradeen Abdul Rahman, Marie Elford	-
1990	Anthony Randall	-
1921	Edwards Oag an Company Ltd	*Brick Company*
1920	James Edwards	-

Lot 15 in DP10419		
Year	**Proprietor**	**Company/Personal Occupation**
2005-Current	Nouradeen Abdul Rahman, Marie Elford	-
1990	Anthony Randall	-
1965	Thornon Fire and Brick Building Company	*Brick Company*
1946	Eva and Alma Rich	-
1921	John Rich	-

In summary, the land titles have indicated the following:

- The land has been owned by private ownership and commercial owners being a brick manufacturing company in the mid part of the 20th Century.
- The land titles have revealed commercial activities as potential concerns in relation to land use.

4.6 Anecdotal Evidence

No anecdotal evidence was available at the time of the investigation.

4.7 NSW EPA Records

The NSW EPA publishes records of contaminated sites under Section 58 of the Contaminated Land Management (CLM) Act 1997. The notices relate to investigation and/or remediation of site contamination considered to pose a significant risk of harm under the definition in the CLM Act.

A search of the database revealed that the subject site is not listed.

It should be noted that the NSW EPA record of Notices for Contaminated Land does not provide a record of all contaminated land in NSW.

4.8 NSW EPA POEO Register

A search of the POEO Register revealed that the site was not listed.

4.9 Planning Certificate

Review of Section 149 Planning Certificates for the site (i.e. Lots 14 and 15) indicated that the site has no matters arising under the Contaminated Land Management Act 1997.

The lots are also within a Clay Conservation Area. The Section 149 Certificate states that in determining an application Council shall have regard to the conservation value of any existing or probable sources of mineral or extractive minerals on or under the land. The Section 149 certificate also states that submissions made to Council by the chief executive of the Department of Mineral Resources shall be taken into consideration when determining a development application on the land.

4.1 Previous Report

This report prepared by Douglas Partners presents the findings of a Preliminary Contamination and Geotechnical Assessment for Lots 14 and 15, DP 10419, Brickworks

Rd, Thornton, New South Wales. The assessment was carried out at the request of Mr Ali Abdul-Rahman of Lion Quarries Pty Ltd.

All soil and chemical analysis results were within the health-based criteria for low density residential land use (i.e. NEHF A), and NSW EPA sensitive land use criteria for TRH and BTEX. The results of laboratory analysis indicated the presence of asbestos within fibro fragments at the surface of Pits 9 and 10 and from the stockpile in the central portion of the site (sample S1).

Asbestos fibre bundles between 1 mm and 3 mm in length were also found in filling at the surface of Pit 10, and also in soil sample S1 taken from the stockpile in the central portion of the site. Trace PAH concentrations were found in a number of samples (within NEHFA criteria), which is likely to be attributed to the presence of ash/coal material and possibly asphalt materials (Pit 1). Heavy chain hydrocarbons (C1o to C36) were also detected in near surface soils at Pit 18, at concentrations within sensitive land use criteria.

Remediation of the asbestos-impacted soils would require the preparation of a remediation action plan (RAP), appropriate excavation and removal/disposal of asbestos materials, followed by validation sampling and analysis in accordance with the NSW DECC guidelines.

4.2 Summary of site history

In summary:

- The aerial photographs have indicated the site appeared to be occupied by a brickmaking quarry property from 1966 to the 1990. After that the site was owned by private residents and remained relatively unchanged from 1994 to the current date.
- The surrounding land appeared to be agricultural until 1966. From 1966 the surrounding land included residential buildings type development and has continued progressively to the north and south to the present dateThe land has been owned by private ownership and commercial owners being a brick manufacturing company in the mid part of the 20th Century.
- The land titles have revealed commercial activities as potential concerns in relation to land use.
- NSW EPA Records reveal that the subject site is not listed.
- Approximately 12 ha has been impacted by previous quarrying and brick making activities.

4.3 Integrity Assessment

The information found in the historical sources has been found to be in general concurrence. It is therefore considered that accuracy of this data is acceptable for this investigation.

5.0 REVIEW OF ENVIRONMENTAL INFORMATION

Table 4: Site Condition and Surrounding Environment Review

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 general public. The nearest watercourse is Four Mile Creek.
Soil Landscape *Review of NSW Soil and Land Information website ESPADE.*	Reference to the 1:100,000 Soil Landscape Series for Newcaslte (Sheet 9232) prepared by the department of land & water Conservations of NSW, indicates that the site is underlane by the Beresfield residual soil landscape (north east portion of the site) and the cockle creek alluvial soil landscape (south western portion of the site). The Beresfield Soil landscape is generally defined as having the following properties: • Low undulating hills and rises on Permian sediments; • Partially cleared tall open forest; • The main soil types are Yellow and Brown Podzolic Soils on crest with Red Podzolic Soils and Red Sololths on the upper slopes. Yellow and brown Soloths occur on side slopes and Yellow Podzolic Soils and Yellow Soloths on the lower slopes; • Water erosion hazard; • Highly acid soils of low fertility.

<table>
<tr><th>Site Information</th><th colspan="6">Descriptions</th></tr>
<tr><td></td><td colspan="6">The Cockle Creek Soil Landscape is generally defined as having the following properties:
Narrow floodplains with alluvial fan deposits and broad delta deposits;
Cleared open-forest;
The main soil types are Yellow Soloths and Yellow Podzolic soils on floodplains, Yellow Earths and Grey Earths on delta and fan deposits;
Water erosion hazard;
Flood hazard with permanently high localised water tables;
Infertile sodic/ dispersible soils of low wet strength.</td></tr>
<tr><td>Geological Profile</td><td colspan="6">The 1:100,000 scale Newcastle Regional Coalfield Geology map indicates the site is underlain by the Late Permian aged Tomago Coal Measures which generally comprise sandstone, siltstone, claystone, coal and tuff. The Thornton Syncline runs in a north-west direction through site.</td></tr>
<tr><td>Presence of Acid Sulphate Soils Review of NSW Department of Land & Water Conservation (DLWC) Acid Sulphate Soil Risk Maps (Edition Two, December 1997, Scale 1:250,000.</td><td colspan="6">Reference to the Beresfield Acid Sulphate Soil Risk Map prepared by the Department of Land & Water Conservation indicates that there is no known occurrence of acid sulphate soil materials within the site.</td></tr>
<tr><td>Localised Hydrogeology</td><td>Number</td><td>Location from Site</td><td>Depth</td><td>SWL</td><td>Use</td><td>Water Bearing Zones</td></tr>
</table>

Site Information	Descriptions					
Review of DPI (Office of Water) Database. Copies of the groundwater bore records are located in:	GW200414	<500m SW	10m	-	Monitoring Bore	-
	GW200415	<500m SW	20.10m	-	Bore	-
	GW078839	2.5km NW	10.0m	9.690m	Monitoring Bore	Shale, siltstone, sandstone
Nearest Surface Water Body	The nearest watercourse is Four Mile Creek located approximately 400m west of the site.					
Nearest Active Service Station (Google Maps Search)	Approximately 2.5km west 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 University, which is located approximately 13.7km from Thornton. The records indicate that the median monthly rainfall in May (date of fieldwork) was 88.3mm and the highest monthly rainfall was 303.2mm.					

6.0 REVIEW OF CONSTRUCTION AND SERVICE INFORMATION

6.1 Proposed Development

The site is currently occupied by a former quarry and brickworks facility. The site is proposed for rezoning into a B5 Business development zone.

7.0 SITE VISIT

7.1 General

The site was visited on the 28th January 2021 by Foundation Earth Sciences Environmental Scientists to inspect the site for any potential sources of contamination.

The following items were considered as part of the site visit:

- Description of the building structures;
- Site surroundings;
- Present and past industrial processes and operations at the site;
- Surface water, groundwater, stormwater and sewer;
- Present and past storage of chemicals and wastes associated with site use and their on-site location;
- Waste management practices and management of hazardous materials;
- Presence of Underground Storage Tanks or Above Ground Storage Tanks;
- Odour; and
- Occupational health and safety.

7.2 Site observations

At the time of the site visit the following observations were made as per the following table:

Table 5: Site Inspection Review

Factors Considered	Description
Buildings & Structures on Site	The site is currently occupied by a former quarry. Several dilapidated structures were present within the site and were identified as part of the previous report. Approximately 12 ha of the site was impacted by quarrying and brickmaking.
Percentage Hard-standing surface	0%
Concrete Condition	Average
Chemical Storage	No Chemical storage area were noticed on the site within accessible areas.
Above and Underground Storage Tanks	USTs and ASTs were not identified within the property.
Trade Waste Pits	No trade waste agreements or pits were identified for the building.
Nearby Electrical Transformers	A substation was not identified on the site.
Asbestos	Fibro cement sheeting was identified within the building structures and on the surface soils surrounding the former building areas.
Soil Staining and Odours	No odours were identified within the property. No significant soil staining was noted during the inspection
Stormwater and Sewer	Stormwater and sewage were connected to the local utilities.

Refer to **Figure 2** - Site Features and Borehole Locations.

8.0 PRELIMINARY CONCEPTUAL SITE MODEL (CSM)

Based on the above information, site history and site walkover, the areas of potential concern and associated contaminants for the site CSM were identified. These are summarised in the following table.

Table 6: Areas and Contaminants of Concern

Known and potential contamination source	Associated Contaminants
Historical Site Uses & Current Site Uses (agricultural and quarry)	Heavy Metals, TRH, BTEX, PAH, OCP, PCB
Imported Fill	Heavy Metals, TRH, BTEX, PAH, OCP, PCB
Car parking Areas	TRH, BTEX, PAH
Building degradation/ Demolition	Heavy Metals and Asbestos

Table 7: Potentially Contaminated Media

Known and potential contamination source	Associated Contaminants
Fill Material	There is the potential for contamination to be present in the upper fill material.
Groundwater	There is the potential for the leaching of contaminants into groundwater onsite and also migration of the contaminants.

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).

Aerial photography has indicated that there were significant unsealed ground surfaces and therefore, there is the potential for migration of contaminants via wind-blown dust.

Rainfall infiltration at the site is expected to occur in unsealed areas. There is therefore the potential that soil contamination could result in impacts to groundwater.

Potential Exposure Pathways

Potential exposure pathways include:

- Dermal;
- Ingestion; and
- Inhalation.

Due to the presence of exposed potentially impacted soil/fill on ground surfaces, dermal and inhalation exposure is considered a potential exposure pathway.

The potential for ingestion of soil is considered as a potential exposure pathway. Although groundwater is not proposed to be used at the site, there is the potential, for ingestion of contaminants via groundwater removed from monitoring wells or future bores.

Receptors

Potential receptors of environmental impact present within the site which will be required to be addressed with respect to the suitability of the site for the proposed use include:

- Excavation/construction/maintenance workers conducting activities at the site, who may potentially be exposed to COPCs through direct contact with impacted soils, Vapour Intrusion and/or groundwater present within excavations and/or inhalation of dusts/fibres associated with impacted soils;
- Future occupants/users of the site may potentially be exposed to COPCs through direct contact with impacted soils and/or ingestion of impacted soils and/or inhalation of dusts/fibres associated with impacted soils and/or exposure to vapour; and/or
- Offsite sensitive receptors of groundwater; and/or
- Flora species to be established on vegetated areas of the site.
- Four Mile Creek

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.

9.0 REVIEW OF DATA QUALITY OBJECTIVES

The DQOs were also prepared using Appendix IV of the Site Auditor Guidelines. These require 7 steps. The steps being

a. State the problem
b. Identify the decisions
c. Identify inputs to decision
d. Define the study boundaries
e. Develop a decision rule
f. Specify limits on decision errors
g. Optimise the design for obtaining data

9.1 State the Problem

The site requires to be confirmed suitable for the proposed development. The site is proposed to be redeveloped and has had some areas of potential concern, those being historical & current land uses (brickworks and quarry), possible areas of imported fill of unknown origin, degradation of the building materials and leakages from vehicles on site.

Technically defensible evidence needs to be provided so that the identified Site does not present an unacceptable risk to human health or the environment and is suitable for the intended land use.

9.2 Identify the Decisions

The decisions to be made on the contamination and the new environmental data required includes considering relevant site contamination criteria for each medium (fill, soil and sediment). A proposed use of the 95% UCL on the mean concentrations for all soil chemicals of potential concern must be less than the site criteria identified for the relevant land use suitability.

The decisions made in completing this assessment are as follows:

- Does the site or is the site likely to present a risk of harm to humans or the environment
- Is the site currently suitable for the proposed land use being commercial / industrial?
- Is there a potential for soil and groundwater contamination?
- Is there a potential for offsite migration issues?
- Do the sampling results meet the site criteria proposed?
- If not, does the site require remediation works

9.3 Identify Inputs to Decision

This step requires the identification of the environmental variables/characteristics that need measuring, identification of which media (fill, soil etc.) need to be collected, identification of the site criteria for each medium of concern and appropriate analytical testing. Inputs include:

- Existing site information
- Site history

- Regional geology, topography and hydrogeology
- Potential contaminants
- Proposed Land Use
- Site assessment criteria
- Results as measured against criteria

9.4 Define the Study Boundaries

Specific spatial and temporal aspects must be provided to identify the boundaries of the investigation and to identify any restrictions that may hinder the assessment process. The site is located at 51 Brickworks Road, Thornton NSW. The site is approximately 22 ha in area.

Refer to **Figure 1** - Site Location and **Figure 2** – Site Features, Borehole Locations & Exceedance Plan.

9.5 Develop a Decision Rule

The information obtained through this assessment will be used to characterise the soils and the groundwater on the site in terms of contamination issues and risks to human health and the environment. The decision rule in characterising the site will be as follows:

- Laboratory test results will be measured against the criteria provided within this report
- The site will be deemed suitable for the proposed use if the following criteria are fulfilled:

- Soil and groundwater concentrations are within background levels
- QA/QC shows data can be relied upon
- Results generally meet regulatory criteria
- Results are from NATA accredited laboratories
- Detection limits are below assessment criteria
- Results can be shown to be of minimal concern

9.6 Specify Limits on Decision Errors

The limits on decision errors for this assessment are as follows:

- The assessment criteria adopted from the guidelines within this report have risk probabilities already incorporated.
- The acceptable limits for inter/intra laboratory duplicate sample comparisons are laid out within our protocols.
- The acceptable limits for laboratory QA/QC parameters are based upon the laboratory reported acceptable limits and those stated within the NEPM 2013 Guidelines.

9.7 Optimise the Design for Obtaining Data

A resource-effective sampling and analysis design was undertaken for data collection that satisfies the DQO's. The sampling and analytical plan is designed to avoid Type 1 and Type 2 errors and includes defining minimum sample numbers required to detect contamination as determined with procedures provided in the NSW EPA 1995 Sampling Design Guidelines and AS 4482.1 - 2005 and appropriate quality control procedures.

Furthermore, only laboratories accredited by NATA for the analysis undertaken were used. The laboratory data was assessed from quality data calculated during this assessment. Field QA/QC protocols adopted and incorporate traceable documentation of procedures used in the sampling and analytical program and in data verification procedures.

10.0 INTRUSIVE SOIL INVESTIGATION

The intrusive soil investigation took place on the 28th January 2021 and was designed to meet the Data Quality Objectives.

10.1 Soil Assessment

Twenty-nine (29) composite soil samples were recovered from one hundred and sixteen (116) borehole locations spread across the site and were labelled S1-S29. These locations were selected to detect any contamination that may have originated from past and present activities, and due to potential excavation and future development in these areas. This was all targeted to area of former quarrying or brickmaking in accordance with the CSM. A further ten (10) samples were collected from areas where contamination was likely to be identified such as filled area and former brick kilns.

Areas outside this are were noted to be remnant bushland in which historical aerial phots indicate minimal impacts. Seven (7) samples were collected in these areas in order to identify any potential unexpected impacts.

A field pH screen also was undertaken in several location across the site to assess the individual pH of the soils assessed.

Table 8: Sampling Information - Soil

Analyte / Analyte Group / Sample	Depth (m)	SAMPLING DATE	HEAVY METALS (8)	TRH	BTEX	PAH	OCP	OP	PCB	PH / CEC / %CLAY	Duplicate / Ttriplicate	TRH C6-C10 & BTEXN	Asbestos
BH1	0.2-0.3	16.9.2019	x	x	x	x	x	x	x	x			
BH1	0.6-0.7	16.9.2019	x	x	x	x	x	x	x	x			
BH2	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH3	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH4	0.2-0.3	16.9.2019	x	x	x	x	x	x	x		x		
BH4	0.7-0.8	16.9.2019	x	x	x	x	x	x	x				
BH5	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH6	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH6	0.4-0.5	16.9.2019	x	x	x	x	x	x	x				
BH7	0.1-0.2	16.9.2019	x	x	x	x	x	x	x				
BH8	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH9	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH10	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH11	0.1-0.2	16.9.2019	x	x	x	x	x	x	x				
BH12	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH13	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH13	0.7-0.8	16.9.2019	x	x	x	x	x	x	x				
BH14	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH15	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH16	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH17	0.2-0.3	16.9.2019	x	x	x	x	x	x	x		x		
BH18	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				
BH18	0.7-0.8	16.9.2019	x	x	x	x	x	x	x				
BH19	0.2-0.3	16.9.2019	x	x	x	x	x	x	x				x
BH19	0.7-0.8	16.9.2019	x	x	x	x	x	x	x				
BH20	0.1-0.2	16.9.2019	x	x	x	x	x	x	x				
D1	-	16.9.2019	x	x	x	x	x	x	x				
D2	-	16.9.2019											
SS1	-	16.9.2019											
SS2	-	16.9.2019											
TS1	-											x	
TB1	-											x	

The locations of the boreholes and samples are shown in **Figure 2**.

Based on information from all boreholes, the surface and sub-surface profile across the site is generalised as follows:

- Fill: Silty Sandy Clay;
- Natural: Silty Sandy CLAY.

10.2 Sampling Density and Rationale

The NSW EPA "Sampling Design Guidelines" (September 1995) requires a minimum sampling density of two hundred and twenty (227) sampling points for a site approximately area of 22ha.

However, based on the CSM it was identified that only 11 ha of the site had been impacted by previous activities and the sampling density (116 samples) was conducted as per the impacted area.

One hundred and sixteen labelled (BH1 to BH116) were drilled by adopting a systematic grid-based sampling pattern across the site and to provide general site coverage with consideration given to accessibility and limitations in relation to underground services & access. Some of the samples were composited due to similar geology and location.

10.3 Sampling Methodology

In summary:

- Soil samples were also collected directly from the push tube / split spoon sampler.
- Soil samples were collected using a hand auger, DCP and U50 to collect undisturbed samples.
- Samples were transferred directly into appropriately labelled clean laboratory supplied containers;
- Samples were transferred into chilled eskies for sample preservation;

- A Chain of Custody was completed and forwarded to the laboratory. Sampling analysis was based on field observations and were in accordance to the schedule outlined in Section 12.
- Soil samples were submitted to their respective laboratories as specified in Section 12.4.

Sampling of asbestos was undertaken as follows:

- Soil samples were submitted to their respective laboratories as specified in Section 12.4.
- A minimum 10L sample from each sample location was recovered;
- Each sample (minimum of 10 L) was 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 sampling location was submitted for laboratory analysis for AF.

Sampling of pH was undertaken as follows:

- Soil samples were collected in a jar and mixed with distilled water at a rationale of 1:5
- The solution was mixed for one minute in order to dissolve the soils;
- Each sample was then measured using a YSI Pro pH probe.
- Results were recorded as part of the fieldworks.

11.0 QUALITY ASSURANCE / QUALITY CONTROL

11.1 General QA/QC

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

Table 9: QA/QCs 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:

11.2 Sample Containers

Soil samples collected during the investigation were placed immediately into laboratory prepared glass jars with Teflon lid inserts. Standard identification labels were adhered to each individual container and labelled according to depth, date, sampling team and media collected.

11.3 Decontamination

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;

Foundation Earth Sciences also adopted a sampling gradient of lowest to highest potential contamination to minimise the impact of cross contamination. This gradient was determined from the historical review and the on-site inspection that was carried out prior to sampling.

Although Foundation Earth Sciences maintains consistent sampling procedures, a rinsate sample is obtained to ensure false positive samples are not generated and that decontamination procedures are effective in preventing cross contamination. The Rinsate water is collected after being in contact generally with the trowel used for sampling. Analytical results that target the contaminants of concern are compared to a blank sample, which is taken directly from the rinsate water container supplied by the laboratory.

A rinsate sample was not collected as the samples were taken either directly from the push tube / split spoon sampler or U50 tube and therefore the chance for cross-contamination was minimal.

11.4 Sample Tracking, Identification and Holding Times

All samples were forwarded to Envirolab and SGS under recognised chain of custodies with clear identification outlining the date, location, sampler and sample ID. All samples were recorded by the laboratory as meeting their respective holding times. The sample tracking system is considered adequate for the purposes of sample collection.

11.5 Sample Transport

All samples were packed into an esky with ice from the time of collection. A trip blank and trip spike are collected where appropriate. These were transported under chain of custody from the site to Envirolab Pty Ltd and SGS, both NATA registered laboratories. During the project, the laboratory reported that all the samples arrived intact and were analysed within holding times for the respective analytes.

Samples were kept below 4°C at all times, soil samples submitted for asbestos analysis are not required to be kept below 4°C.

11.6 Trip Spike

Trip Spike samples were obtained from the laboratory prior to conducting field sampling where volatile substances are suspected. Foundation Earth Sciences QA/QC procedures for the collection of environmental samples involves the collection of trip blanks, trip spikes and duplicate samples both intra and inter laboratory.

11.7 Trip Blank

A trip blank accompanied the sampling for the sampling process and is not separated from the sample collection and transportation process. The purpose of the trip blank is to identify whether cross-contamination is occurring during the sample collection and transport process.

11.8 Field Duplicate Samples

The tables below list the duplicate soil samples collected with their corresponding primary samples.

Table 10: Soil Field Duplicate Samples

Primary Sample	Sample Depth (m BGL)	Intra Duplicate	Inter Duplicate	Date Sampled
BH4	0.2-0.3	D1	SS1	16.9.2019
BH17	0.2-0.3	D2	SS2	16.9.2019

Field duplicate samples for soil were prepared in the field through the following process:

- A larger than normal quantity of soil is recovered from the sample location selected for duplication.
- Two Portions of the sub-sample are immediately transferred, one for an intra-laboratory duplicate and another as a sample.

- Samples are placed into a labelled, laboratory supplied 250ml glass jar and sealed with an airtight, Teflon screw top lid. The fully filled jars are labelled as the sample and duplicate and immediately placed in a chilled esky.

Soil Intra-Laboratory duplicate samples were sent to Envirolab Pty Ltd while Inter-Laboratory duplicate samples were sent to SGS.

A summary of the test results with the Relative Percentage Difference (RPD) is presented in the following tables.

The comparisons between the duplicates and original samples indicate acceptable RPDs when they comply with criteria which are commonly set at:

- less than 30% for inorganics and 50% for organics
- greater than five (5) times the laboratory limit of recording (LOR)
- greater than 50% of the relevant health investigation level (HIL) concentration.

The tables, below, give details of intra laboratory and inter laboratory duplicates.

Table 11: Intra-lab Soil Sample D1 RPDs

ANALYTE	BH4 0.2-0.3 mg/kg	ENVIROLAB D1 mg/kg	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	<4	<4	-
Cadmium	<0.4	<.4	-
Chromium	15	18	18
Copper	7	7	0
Lead	13	13	0
Mercury	<0.1	<0.1	-
Nickel	5	5	0
Zinc	35	30	15
TRH			
C10-C14	<50	<50	-
C15-C28	<100	<100	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toulene	<0.5	<0.5	-
Ethylbenzene	<1	<1	-
Xylenes - Total	<3	<3	-
POLYCYCLIC HYDROCARBONS (PAH)			
Benzo(a)pyrene	<0.05	<0.05	-
Total PAH	<0.05	<0.05	-
ORGANOCHLORINE PESTICIDES			
Heptachlor	<0.1	<0.1	-
Aldrin	<0.1	<0.1	-
Dieldrin	<0.1	<0.1	-
DDD	<0.1	<0.1	-
DDE	<0.1	<0.1	-
DDT	<0.1	<0.1	-
Chlordane (trans & cis)	<0.1	<0.1	-
POLYCHLORINATED BIPHENYLS			
Total PCB	<0.1	<0.1	-

Table 12: Intra-lab Soil Sample D2 RPDs

ANALYTE	BH17 0.2-0.3 mg/kg	ENVIROLAB D2 mg/kg	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	<4	<4	-
Cadmium	<0.4	<0.4	-
Chromium	12	14	15
Copper	36	44	20
Lead	8	8	0
Mercury	<0.1	<0.1	-
Nickel	25	28	11
Zinc	22	25	13
TRH			
C10-C14	<50	<50	-
C15-C28	<100	<100	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toulene	<0.5	<0.5	-
Ethylbenzene	<1	<1	-
Xylenes - Total	<3	<3	-
POLYCYCLIC HYDROCARBONS (PAH)			
Benzo(a)pyrene	<0.05	<0.05	-
Total PAH	0.1	1.1	-
ORGANOCHLORINE PESTICIDES			
Heptachlor	<0.1	<0.1	-
Aldrin	<0.1	<0.1	-
Dieldrin	<0.1	<0.1	-
DDD	<0.1	<0.1	-
DDE	<0.1	<0.1	-
DDT	<0.1	<0.1	-
Chlordane (trans & cis)	<0.1	<0.1	-
POLYCHLORINATED BIPHENYLS			
Total PCB	<0.1	<0.1	-

The comparisons between the intra-laboratory duplicates and corresponding original samples for soil and groundwater indicated acceptable RPD with the exception of the concentration of TRH (C10-C16) for groundwater GWD1 which exceeded the DQOs for

this project, however these exceedances are not considered significant because they are most likely due to the heterogeneity of the sample or low concentrations within the sample.

Table 13: Inter-lab Soil Sample SS1 RPDs

ANALYTE	BH4 0.2-0.3 mg/kg	ALS SS1 mg/kg	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	<4	<5	-
Cadmium	<0.4	<1	-
Chromium	15	16	6
Copper	7	8	13
Lead	13	15	14
Mercury	<0.1	<0.1	-
Nickel	5	6	18
Zinc	35	38	8
TRH			
C10-C14	<50	<50	-
C15-C28	<100	<100	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toulene	<0.5	<0.5	-
Ethylbenzene	<1	<0.5	-
Xylenes - Total	<3	<0.5	-
POLYCYCLIC HYDROCARBONS (PAH)			
Benzo(a)pyrene	<0.05	<0.05	-
Total PAH	<0.05	<0.05	-
ORGANOCHLORINE PESTICIDES			
Heptachlor	<0.1	<0.05	-
Aldrin	<0.1	<0.05	-
Dieldrin	<0.1	<0.05	-
DDD	<0.1	<0.05	-
DDE	<0.1	<0.05	-
DDT	<0.1	<0.05	-
Chlordane (trans & cis)	<0.1	<0.05	-
POLYCHLORINATED BIPHENYLS			
Total PCB	<0.1	<0.1	-

Table 14: Inter-lab Soil Sample SS2 RPDs

ANALYTE	BH17 0.2-0.3 mg/kg	ALS SS2 mg/kg	RELATIVE PERCENTAGE DIFFERENCE %
HEAVY METALS			
Arsenic	<4	<5	-
Cadmium	<0.4	<1	-
Chromium	12	12	**0**
Copper	36	54	40
Lead	8	9	12
Mercury	<0.1	<0.1	-
Nickel	25	37	39
Zinc	22	25	13
TRH			
C10-C14	<50	<50	-
C15-C28	<100	<100	-
C29-C36	<100	<100	-
BTEX			
Benzene	<0.2	<0.2	-
Toulene	<0.5	<0.5	-
Ethylbenzene	<1	<0.5	-
Xylenes - Total	<3	<0.5	-
POLYCYCLIC HYDROCARBONS (PAH)			
Benzo(a)pyrene	<0.05	<0.05	-
Total PAH	0.1	<0.05	-
ORGANOCHLORINE PESTICIDES			
Heptachlor	<0.1	<0.05	-
Aldrin	<0.1	<0.05	-
Dieldrin	<0.1	<0.05	-
DDD	<0.1	<0.05	-
DDE	<0.1	<0.05	-
DDT	<0.1	<0.05	-
Chlordane (trans & cis)	<0.1	<0.05	-
POLYCHLORINATED BIPHENYLS			
Total PCB	<0.1	<0.1	-

The comparisons between the inter-laboratory duplicates and corresponding original samples for soil and groundwater indicated generally acceptable RPD overall which exceeded the DQOs for this project, however these exceedances are not considered significant because they are most likely due to the heterogeneity of the sample or low concentrations within the sample.

Field duplicates provide an indication of the whole investigation process, including the sampling process, sample preparation and analysis. The accuracy of the data is considered to be adequate due to the effect on confidence intervals with low concentrations in the samples and their duplicates.

11.9 Trip Spike and Trip Blank Results

Trip Spike samples were obtained from the laboratory prior to conducting field sampling where volatile substances are suspected. Trip spike and trip blank samples were collected to assess the effect of sample handling on volatile concentrations in the samples collected and the results are listed in the tables below:

Table 15: Trip Spike

ANALYTE	TS2 Trip Spike % Soil (mg/kg) 16.9.2019	ANALYTE	TS1 Trip Spike % water (ug/L)
BTEX		**BTEX**	
Benzene	81%	Benzene	119%
Toluene	76%	Toluene	106%
Ethyl Benzene	78%	Ethyl Benzene	113%
O-Xylenes	79%	O-Xylenes	112%
M & P Xylenes	79%	M & P Xylenes	108%

Results discussed in Section 12.11

Table 16: Trip Blank

ANALYTE	Trip Blank Soil (TB1) mg/kg 16.9.2019	ANALYTE	Trip Blank Water (TB1) ug/L
TRH		**TRH**	
C6-C10	<25	C6-C10	<10
BTEX		**BTEX**	
Naphthalene	<1	Naphthalene	<1
Benzene	<0.2	Benzene	<1
Toluene	<0.5	Toluene	<1
Ethyl Benzene	<1	Ethyl Benzene	<1
Total Xylenes	<3	Total Xylenes	<3

Results discussed in Section 12.11

11.10 Laboratory QA/QC

The integrity of analytical data provides the second step in the QA/QC process for total data compliance. The data validation techniques adopted by Foundation Earth Sciences are based upon techniques published by the US EPA and in line with methods and guidelines adopted by the NSW EPA and outlined in the NEPM, 2013.

Descriptions are provided of the specific mechanisms used in the assessment of accuracy, precision and useability of analytical data within the project.

Refer to **Appendix H**- NATA Laboratory Test Results.

11.11 QA/QC Results

The QA/QC results for soil collected at the site are summarised in the table below:

Table 17: QA/QC Results Summary

Data Quality Indicator	Results	DQI Met
Completeness		
Soil & Groundwater		
Data from critical samples is considered valid	Data is considered valid	Yes
Satisfactory frequency / result for QC samples	The QC results are considered adequate for the purpose of the investigation with the exception of laboratory certificate ES1931188 in the water matrix. Laboratory duplicates and Matrix Spikes for semivolatile compounds and TRH were not completed. This is considered a non-conformance.	Partial
Field documentation completed	Field records are complete	Yes
Boreholes logs & COCs completed and holding times complied with	Logs, COCs and holding times have been completed and complied with	Yes
Comparability		
Soil & Groundwater		
Standard operating procedures used	Yes	Yes
Consistent field conditions, sampling staff and laboratory analysis	Sampling was conducted by one Foundation Earth Sciences scientist operating under the SOPs. The laboratories remained consistent throughout the investigation	Yes

Data Quality Indicator	Results	DQI Met
Same analytical methods used	All analytical methods used between laboratories were based on the USEPA/APHA methods	Yes
Limit of reporting appropriate and consistent	The LORs were the same within each laboratory but differed between the primary and secondary laboratories. The LORs were considered appropriate based on the results.	Yes
Representativeness		
Soil & Groundwater		
Sampling appropriate for media and analytes	All sampling was conducted in accordance with Foundation Earth Sciences SOPs with the exception of five samples for asbestos in laboratory certificate 226339. Excessive volume was received by the laboratory and therefore the material was sub sampled. This is considered a non-conformance.	Partial
Samples adequately preserved	The majority of samples collected were received by laboratories at the correct temperature. Where relevant, samples were stored in acid-preserved containers supplied by laboratories.	Yes
Precision		
Soil & Groundwater		
SOPs appropriate and complied with in relation to field duplicates	The recovery of field duplicates was conducted in accordance with Foundation Earth Sciences SOPs s to allow for the assessment of field precision.	Yes

Data Quality Indicator	Results	DQI Met
RPDs of the field duplicates within control limits	An RPD of >50% was identified in a number of samples analysed for C10-C16 and was likely due to the heterogeneity of the sample and/or the low concentrations in the sample. Given that the majority of RPDs for the remaining analytes were <50%, the data set was considered to be adequately precise.	Partial
RPDs of the laboratory duplicates within control limits	The RPDs of the laboratory duplicates were within the control limits with the exception of laboratory certificate 226339. The RPD acceptance criteria for chromium and nickel were exceeded in sample 226339-1. Therefore, a triplicate result has been issued as laboratory sample number 226339-32. This is considered a non-conformance.	Partial
Accuracy		
Soil & Groundwater		
SOPs appropriate and complied with in relation to field blanks	Yes	Yes
Rinsate Blanks, trip blanks & laboratory blanks free of contaminants	Laboratory blanks & trip blanks were free of contaminants.	Yes
Surrogate spikes within control limits	Yes	Yes
Laboratory control spikes within control limits	Laboratory Control Spike recoveries were within control limits with the exception of laboratory certificate ES1931188 for the water matrix. Recovery was less than the lower control limit for QC-2609622-022 for PAH. This was considered a minor	Partial

Data Quality Indicator	Results	DQI Met
	non-conformance.	
Matrix Spike recoveries within control limits	Matrix spike recoveries were within control limits with the exception of laboratory certificate ES1931188 for the water matrix. Matrix spike recoveries were less than lower control limit for Styrene, Chloroethane and Dichloromethane in sample ES1931158--001 / GWSS1. This was considered a minor non-conformance.	Partial
Trip spike recoveries within control limits	Yes	Yes

11.12 QA/QC Evaluation / Conclusion

In summary, the findings of the QA/QC evaluation indicated the following:

- Data Completeness – The following non-conformance was identified with regards to data completeness:
    - The QC results are considered adequate for the purpose of the investigation with the exception of laboratory certificate ES1931188 in the water matrix. Laboratory duplicates and Matrix Spikes for semivolatile compounds and TRH were not completed. This is considered a non-conformance.
- Data Comparability – The data set is considered comparable.
- Data Representativeness – The following non-conformance was identified with regards to data representativeness:

- All sampling was conducted in accordance with Foundation Earth Sciences SOPs with the exception of five samples for asbestos in laboratory certificate 226339. Excessive volume was received by the laboratory and therefore the material was sub sampled. This is considered a non-conformance.

- Data Precision – The following non-conformance was identified with regards to data precision:
  - RPD of >50% was identified in a number of samples analysed for metals and were likely due to the heterogeneity of the sample and/or the low concentrations in the sample. Given that the majority of RPDs for the remaining analytes were <50%, the data set was considered to be adequately precise.
  - The RPDs of the laboratory duplicates were within the control limits with the exception of laboratory certificate 226339. The RPD acceptance criteria for chromium and nickel were exceeded in sample 226339-1. Therefore, a triplicate result has been issued as laboratory sample number 226339-32. This is considered a non-conformance.
- Data Accuracy – The following non-conformance was identified with regards to data accuracy:
  - Matrix spike recoveries were within control limits with the exception of laboratory certificate ES1931188 for the water matrix. Matrix spike recoveries were less than lower control limit for Styrene, Chloroethane and Dichloromethane in sample ES1931158--001 / GWSS1. This was considered a minor non-conformance.
  - Laboratory Control Spike recoveries were within control limits with the exception of laboratory certificate ES1931188 for the water matrix. Recovery was less than the lower control limit for QC-2609622-022 for PAH. This was considered a minor non-conformance.

It is therefore considered that the data is sufficiently reliable and that the results can be used for the purpose of this project.

12.0 SITE ASSESSMENT CRITERIA

12.1 SOILS

12.1.1 Health Investigation Levels (HILs)

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).

The site is currently occupied by a former quarry and brickworks facility. The site is proposed for rezoning into a B5 Business development zone.

The site will be assessed against the NEPM exposure scenario 'Commercial / Industrial D' Health Investigation Levels of the above-mentioned guidelines and specifically refers to the following:

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

The soil regulatory guidelines are presented in the table below.

Table 18: Health Investigation Levels (HIL) Criteria for Soil Contaminants

Benviron group	Commercial/Industrial D	Reference
Heavy Metals		
Arsenic	3000	NEPC 2013 - Table 1A(1) HILs
Beryllium	500	NEPC 2013 - Table 1A(1) HILs
Boron	300000	NEPC 2013 - Table 1A(1) HILs
Cadmium	900	NEPC 2013 - Table 1A(1) HILs
Chromium (VI)	3000	NEPC 2013 - Table 1A(1) HILs
Cobalt	4000	NEPC 2013 - Table 1A(1) HILs
Copper	240000	NEPC 2013 - Table 1A(1) HILs
Lead	1500	NEPC 2013 - Table 1A(1) HILs
Manganese	60000	NEPC 2013 - Table 1A(1) HILs
Methylmercury	80	NEPC 2013 - Table 1A(1) HILs
Mercury (inorganic)	730	NEPC 2013 - Table 1A(1) HILs
Nickel	6000	NEPC 2013 - Table 1A(1) HILs
Selenium	300000	NEPC 2013 - Table 1A(1) HILs
Zinc	400000	NEPC 2013 - Table 1A(1) HILs
Organotin (Total)	1000	NEPC 2013 - Table 1A(1) HILs
Polycyclic Aromatic Hydrocarbons (PAHs)		
Carcinogenic PAHs (as BaP TEQ)	40	NEPC 2013 - Table 1A(1) HILs
Total PAHs	4000	NEPC 2013 - Table 1A(1) HILs
Organochlorine Pesticides		
DDT + DDE + DDD	3600	NEPC 2013 - Table 1A(1) HILs
Aldrin + Dieldrin	45	NEPC 2013 - Table 1A(1) HILs
Chlordane	530	NEPC 2013 - Table 1A(1) HILs
Endosulfan	2000	NEPC 2013 - Table 1A(1) HILs
Heptachlor	50	NEPC 2013 - Table 1A(1) HILs
HCB	80	NEPC 2013 - Table 1A(1) HILs
Phenols		
Phenol	240000	NEPC 2013 - Table 1A(1) HILs
Pentachlorophenol	660	NEPC 2013 - Table 1A(1) HILs
Cresols	25000	NEPC 2013 - Table 1A(1) HILs
Polychlorinated Biphenyls (PCBs)		
PCBs	7	NEPC 2013 - Table 1A(1) HILs
Other Pesticides		
Atrazine	2500	NEPC 2013 - Table 1A(1) HILs
Chlorpyrifos	2000	NEPC 2013 - Table 1A(1) HILs
Endrin	100	NEPC 2013 - Table 1A(1) HILs
Herbicides		
2,4,5-T	5000	NEPC 2013 - Table 1A(1) HILs
2,4-D	5000	NEPC 2013 - Table 1A(1) HILs
MCPA	5000	NEPC 2013 - Table 1A(1) HILs
MCPB	5000	NEPC 2013 - Table 1A(1) HILs
Mecoprop	5000	NEPC 2013 - Table 1A(1) HILs
Picloram	15000	NEPC 2013 - Table 1A(1) HILs
Other Organics		
PCBs (Dioxin-like)	10	NEPC 2013 - Table 1A(1) HILs

Note - All values are in mg/kg

12.1.2 Health Screening Levels (HSLs)

The HSLs are applicable to generic land uses such as residential, commercial/industrial or recreational/public open space and different soil types between the ground surface and soils >4 metres below ground level. The HILs have been applied to assess human health risks via the inhalation and direct contact pathways of exposure.

It should be noted that HSL D can be used in lieu of HSL B for buildings that comprise car parks or commercial properties on the ground floor.

For assessing TRH and BTEX contamination at sites used for sensitive land use, such as residential, the NEPM refers to the 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 profile consisted of predominantly Clay.

Table 19: Health Screening Levels (HSL) Criteria

	HSL D	HSL D	HSL D	HSL D	Soil Saturation Concentration (Csat)	Reference
	0m to <1m	1m to <2m	2m to <4m	4m+		
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
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	230	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

Note - All values are in mg/kg

12.1.3 (EILs) and (ESLs)

Ecological Investigation Levels (EILs) -

The NEPM 2013 states that "Ecological investigation levels" (EILs) for the protection of terrestrial ecosystems have been derived for common contaminants in soil based on a species sensitivity distribution (SSD) model developed for Australian conditions. EILs have been derived for As, Cu, CrIII, DDT, naphthalene, Ni, Pb and Zn

Insufficient data was available to derive ACLs for arsenic (As), DDT, lead (Pb) and naphthalene. As a result, the derived EILs are generic to all soils and are presented as total soil contaminant concentrations in Tables 1B (4) and 1B (5) within the NEPM 2013.

For the purposes of EIL derivation, a contaminant incorporated in soil for at least two years is considered to be aged for the purpose of EIL derivation. The majority of contaminated sites are likely to be affected by aged contamination. Fresh contamination is usually associated with current industrial activity and chemical spills.

The following process describes the method for calculation of site specific EILs.

A. EILs for Ni, Cr III, Cu, Zn and Pb aged contamination (>2 years)

Steps 1–4 below describe the process for deriving site-specific EILs for the above elements using Tables 1B (1) – 1B (4), which can be found at the end of the NEPM 2013.

1. Measure or analyse the soil properties relevant to the potential contaminant of concern (pH, CEC, organic carbon, clay content). Sufficient samples need to be taken for these determinations to obtain representative values for each soil type in which the contaminant occurs.

2. Establish the sample ACL for the appropriate land use and with consideration of the soil-specific pH, clay content or CEC. The ACL for Cu may be determined by pH or CEC and the lower of the determined values should be selected for EIL calculation. Note that the ACL for Pb is taken directly from Table 1(B) 4.

3. Calculate the contaminant ABC in soil for the particular contaminant and location from a suitable reference site measurement or other appropriate method.

4. Calculate the EIL by summing the ACL and ABC:

$$EIL = ABC + ACL$$

B. EILs for As, DDT and naphthalene

EILs for aged contamination for DDT and naphthalene are not available and the adopted EIL is based on fresh contamination taken directly from Table 1B (5). The EILs for As, DDT and naphthalene are generic i.e. they are not dependent on soil type and are taken directly from Table 1B (5). Only EILs for fresh contamination are available for As, DDT and naphthalene due to the absence of suitable data for aged contaminants.

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 20: Ecological Investigation Levels (EIL) and Ecological Screening Levels (ESL) Criteria

Benviron group	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					
DDT	**Fresh**	3	180	640	NEPM 2013 - Table 1(B) 1-5 EILs
	Aged	3	180	640	NEPM 2013 - Table 1(B) 1-5 EILs
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}) *(Management Limits)*	**Coarse**		700	700	NEPM 2013 - Table 1(B) 6-7 EILs
	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}) *(Management Limits)*	**Coarse**		1000	1000	NEPM 2013 - Table 1(B) 6-7 EILs
	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}) *(Management Limits)*	**Coarse**		2500	3500	NEPM 2013 - Table 1(B) 6-7 EILs
	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}) *(Management Limits)*	**Coarse**		10000	10000	NEPM 2013 - Table 1(B) 6-7 EILs
	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.

12.2 Asbestos

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 21: 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			

12.3 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).

12.4 Groundwater

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 ***Fresh water trigger*** values are applicable for investigating chemical concentrations in groundwater at the site. The nearest watercourse is Four Mile Creek located approximately 150m to the west 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 considered to be moderately disturbed ecosystems and the ANZECC (2000) 95% protection values are therefore considered appropriate groundwater assessment criteria for the site.

13.0 RESULTS

SOIL

The laboratory certificates are presented in **Appendix H** – NATA Accredited Laboratory Certificates.

A summary of the results together with the assessment criteria adopted are provided in **Appendix K** – Summary Tables.

13.1 HEAVY METALS

13.1.1 Heath Investigation Levels

As indicated in Table K1 all the heavy metals were below the respective LOR and/or the Health Investigation Level (HIL) for a commercial / industrial development, that being the HIL 'D'.

13.1.2 Ecological Investigation Levels

The EILs for Copper, Zinc, Lead, Nickel and Chromium III were derived by adding the Ambient Background Concentration (ABC) to the Added Contaminant Limits (ACL), as per the following formula:

EIL = ABC + ACL

The ABC for the site has been determined by recovering a sample from an appropriate reference point, that being:

- BH1 (0.2-0.3m)
- BH1 (0.6-0.7m)

The soil samples collected from BH1 were analysed for pH, CEC & %CLAY to provide the background parameters for the soil on the site.

As shown in Table K1 all of the locations were below the site derived EILs for a commercial / industrial development.

13.2 TRH, BTEX, NAPHTHALENE &/OR BENZO (A) PYRENE

13.2.1 Heath Screening Levels & Management Limits

As indicated in Table K1, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), benzene, toluene, ethyl benzene, xylenes and naphthalene concentrations were below the HSL 'D' for a Silt, Clay & Sand soil profile with a source depth of "0m to <1m" & "1m to <2m".

As shown in Table K1, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), F3 (C_{16}-C_{34}), F4 (C_{34}-C_{40}), concentrations were below the Management Limits for both fine & coarse-grained soil for a commercial / industrial development.

13.2.2 Ecological Screening Levels

As indicated in Table K1, the F1 (C_6-C_{10}), F2 (>C_{10}-C_{16}), F3 (C_{16}-C_{34}), F4 (C_{34}-C_{40}), benzene, toluene, ethyl benzene, xylenes and benzo(a)pyrene concentrations were below the ESL for both fine & coarse-grained soil for a commercial / industrial development.

13.3 PAH, OCP, OPP & PCB

13.3.1 Heath Investigation Levels

As indicated in Table K1, the concentrations of the benzo(a)pyrene (as TEQ), PAH, OCP, OPP & PCB were below the Health Investigation Level (HIL) for a commercial / industrial development, that being the HIL 'D' and/or the limit of reporting (LOR).

13.3.2 EILs & ESLs

As indicated in Table K1, the concentrations of arsenic, naphthalene and DDT were below the EILs & ESLs for commercial and industrial.

13.4 Asbestos

As shown in Table K1, no asbestos was detected in the soil samples tested.

13.5 pH

Results indicate the pH range for soils collected across the site were between the ranged of 4.5 – 5.2.

14.0 DISCUSSION

14.1 SOILS

The soil data revealed the following:

- The laboratory results for all soil samples were below the adopted detection limits and/or the relevant guideline criteria.
- No asbestos was detected in the soil samples analysed. Also any previous asbestos had been removed from the site.

Reference should be made to Figure 2 for a copy of the site plans.

A pH field monitoring scheme undertaken across the site identified that soils were considered to be slightly acidic (4.5-5.2). This is considered to be consistent with a sandstone geology

14.2 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.

15.0 CONCLUSION AND RECOMMENDATION

It is considered that the site would be deemed suitable for the proposed development.

Any soils to be removed should be classified in accordance with NSW EPA Waste Classification Guidelines 2014.

16.0 LIMITATIONS

To the best of our knowledge information contained in this report is accurate at the date of issue, however, 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.

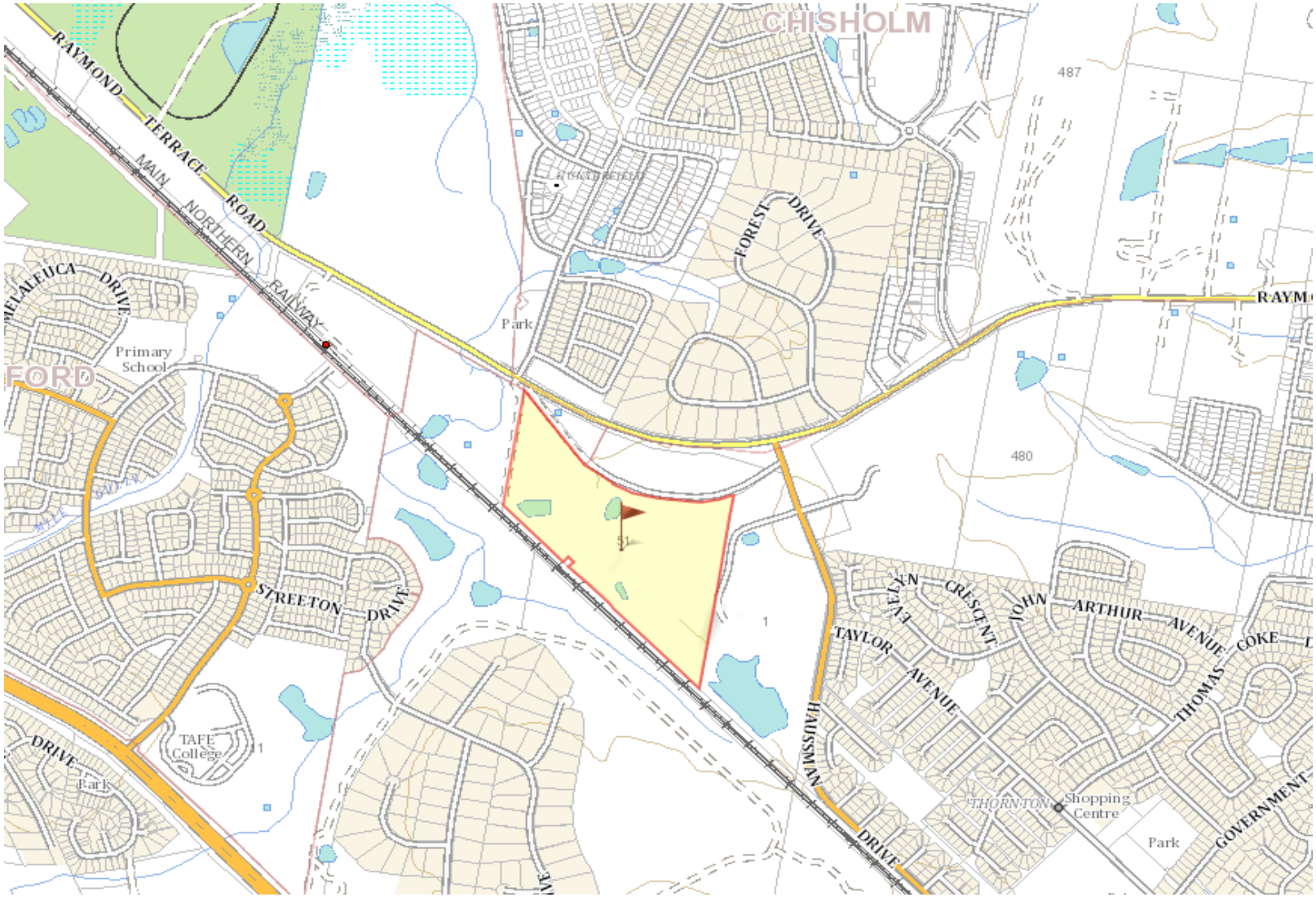
Opinions expressed herein are judgements and are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions.

REFERENCES

- Australian and New Zealand Environment and Conservation Council (ANZECC) (1996) – *Drinking Water Guidelines*.
- Australian and New Zealand Environment and Conservation Council (ANZECC) (2000) – *Guidelines for Fresh and Marine Waters*.
- Department of Urban Affairs and Planning – EPA (1998) "*Managing Land Contamination – Planning Guidelines – SEPP 55 – Remediation of Land*".
- 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 (2009) "*Guidelines on Significant Risk of Harm from contaminated land and the duty to report*".
- NSW OEH "Guidelines for Consultants Reporting on Contaminated Sites" (2011). NSW Environment Protection Authority, Sydney.
- NSW DEC, "Guidelines for the Assessment and Management of Groundwater Contamination" (March 2007).
- NSW DEC "Guidelines for the NSW Site Auditor Scheme" (2006, 2nd edition). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) – "Waste Classification Guidelines, Part 1: Classifying Waste";
- NSW EPA "Guidelines for Consultants Reporting on Contaminated Sites" (2011). NSW Environment Protection Authority, Sydney.
- NSW EPA (2014) "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.

FIGURE 1: SITE LOCATION



Key

Site Location

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DRAWN BB	**Site Location**
FIGURE 1	Lion Quarries Pty Ltd
Job # E2286	51 Brickworks Road, Thornton NSW

FIGURE 2: SITE FEATURES AND BOREHOLE LOCATIONS

Feature No	Details
a	Bitumen Car Park
b	Pond
c	former Brick Kiln Area

N

Key

Site Location

FES Soil 2020

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DRAWN BB	**Site Features , Soil Borehole Locations, Exceedance & Additional Investigation Plan**
Figure 2	Lion Quarries Pty Ltd
Job # E2286	51 Brickworks Road, Thornton NSW