ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

DETAILED SITE INVESTIGATION FOR CLAREMONT MEADOWS SERVICES FACILITY

ROAD AND RAIL EXCAVATIONS PTY LTD

20 SEPTEMBER 2022
122045
VERSION 3

ENVIRONMENTAL EARTH SCIENCES
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20 September 2022

Road and Rail Excavations Pty Ltd
2/17 Mount Erin Road
Campbelltown NSW 2560

Attention: [redacted]

Detailed Site Investigation – Claremont Meadows Services Facility, Sydney Metro – Western Sydney Airport

Please find enclosed a copy of our report entitled as above. Thank you for the opportunity to undertake this work.

Should you have any queries, please do not hesitate to contact us on (02) 9922 1777.

For and on behalf of
Environmental Earth Sciences NSW

Co-Author
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Co-Author/ Project Manager
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Project Director
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Internal Reviewer
[redacted]

122045RP01V03

Version History

Version	Dated	Issued By	Comments
1	22-Jun-22	Environmental Earth Sciences	Initial version for CPBG and Site Auditor review
2	27-Jul-22	Environmental Earth Sciences	Revision to address review comments.
3	20-Sep-22	Environmental Earth Sciences	Revision to address Sydney Metro comments.

EXECUTIVE SUMMARY

Introduction and objectives

Environmental Earth Sciences NSW was engaged by Road and Rail Excavations Pty Ltd (Road and Rail) on behalf of CPB-Ghella Joint Venture (CPB-G) to undertake a detailed site investigation (DSI) at the proposed Claremont Meadows Services Facility (CMSF) to assess potential contamination at the site.

It is understood that the DSI is required to meet Condition E92 (Contaminated sites) of the SMWSA Conditions of Approval, being:

"Before commencement of any construction that would results in the disturbance of moderate to high-risk contaminated sites as identified in the documents identified in Condition A1, Detailed Site Investigations (for contamination) must be conducted to determine the full nature and extent of the contamination. The Detailed Site investigation Report(s) and the subsequent report(s), must be prepared, or reviewed and approved, by consultants certified under either the Environment Institute of Australia and New Zealand's Certified Environmental Practitioner (Site Contamination) scheme (CEnvP(SC)) or the Soil Science Australia Certified Professional Soil Scientist Contaminated Site Assessment and Management (CPSS CSAM) scheme. The Detailed Site Investigations must be undertaken in accordance with guidelines made or approved under Section 105 of Contaminated Land Management Act 1997 (NSW)."

In addition to the Conditions of Approval, specific project Deed requirements that need to meet were:

- Investigate areas of proposed excavation and disturbance
- Investigate land within the construction site or extra land surrounding the areas of proposed excavation or distance with respect to the potential migration of contamination via groundwater, ground gas and odour into areas of excavation or disturbance; and
- Provide *in situ* waste classification for solid waste (i.e. spoil) in accordance with minimum sampling densities outline in VIC EPA (2009).

The technical objectives for the DSI were to:

- Meet the requirements of the SAQP (Tetra Tech Major Projects. TTPM, 2022) and SAQP Addendum (Environmental Earth Sciences, 2022).
- Update the respective preliminary conceptual site model (CSM) for contamination risk, determining whether there are any potentially unacceptable risks to human health and the environment.
- Provide conclusion on suitability of each site for proposed use, or alternatively provide recommendations for further assessment and/or management of any identified risk(s).

- Provide further recommendation for offsite management of material which may be surplus to requirements, including:
    - Waste classification status of fill material in accordance with the Waste Guidelines (NSW EPA, 2014a); and
    - Protection of the Environment Operations Act (POEO Act).

Findings

Soil

In all 31 test pits were advanced across the site to a maximum depth of ~4 mBGL, while three deep soil/ rock cores were advanced in the location of the proposed tunnel shaft. Shallow fill materials (<0.5) were encountered during the intrusive test pitting investigation across the site.

In TP01 in the north east corner of the site, a layer of asphalt ~0.08 m thick was found at a depth of 0.4 mBGL. Asphalt was found within shallow fill materials in other test pits but generally as gravels to cobbles and not a consistent layer across the base of the test pit.

In the south of the site, topsoils/ fill indicated a degree of rework with trace anthropogenic materials (e.g., concrete, tiles, metal and plastic) potentially associated with the historic agricultural activities at the site.

Natural material was generally relatively shallow (<0.5 mBGL) and comprised brown to grey clays with mottles of red and orange with trace ironstone gravels and occasional sandstone cobbles.

Shale bedrock was encountered as shallow as ~1.0 mBGL in TP08, however most test pits did not encounter bedrock at the achieved depths. Weathered sandstone was identified at a depth of ~3.2 mBGL also.

Potential asbestos containing material (PACM) was not observed during the test pitting assessment.

Groundwater seepage was encountered at the following locations:

- TP4 at 3.2 mBGL.
- TP10 at 2.2 mBGL.

The highest photo-ionisation meter (PID) reading was 1.2 parts per million (ppm) which is not indicative of impact by volatile organic compounds (such as petroleum hydrocarbons). PID readings have been provided on detailed borelogs within **Appendix A**.

The reported concentrations of CoPC were either below the adopted site assessment criteria when considering the suitability of the site for use as a construction site (**Section 9**) or the laboratory's limit of reporting (LOR).

Groundwater

The following summary is based on the observations during gauging and sampling:

- The samples were cloudy with a light brown colour.
- No olfactory or visual indicators of contamination were noted during sampling of groundwater.

Concentrations of nutrients (Ammonia as N) were below the adopted site assessment criteria in both samples of groundwater at 0.7 mg/L and 0.2 mg/L for SMGW-B365 and SMGW-BH-A109S respectively. The shallow bore (SMGW-BH-A109A) also reported detections of nitrate and ortho-phosphate which were below the LOR in the deep bore (SMGW-BH-A365).

The majority of dissolved heavy metals were below the LOR with the exception of zinc, iron and manganese with zinc and manganese reporting above the adopted site assessment criteria in both bores as summarised below:

- SMGW-BH-A109S:
    - zinc at 0.051 mg/L
    - manganese at 2.9 mg/L
- SMGW-BH-A365:
    - zinc at 0.028 mg/L
    - manganese at 2.10 mg/L

All organic compounds (TRH and BTEX) and pesticides (OCP and OPP) were reported below the LOR in both groundwater samples submitted.

Hazardous ground gas

The concentration of methane in bore SMWSA-A366 was below the minimum resolution of the handheld gas analyser of 0.1 % v/v, while the flow rate was also below the minimum resolution of 0.1 L/hr. Carbon dioxide was reported above the threshold value of 1.5% v/v at 18% v/v, however it is recognised that the threshold from NSW EPA (2016) guideline is ‘above background values’ but there is currently no comparable background for the site.

Stockpile assessment

The footprint beneath a former stockpile was assessed following removal by mechanically advancing eight test pits to ~1 mBGL. Three soil samples were collected from each test pit with two samples being submitted for laboratory analysis of CoPC. Asbestos as asbestos fines (<7 mm) was reported in one sample from the surface in TP207 and quantified as per ASC NEPM (2013) requirements. All CoPC were reported below either the adopted site assessment criteria or LOR.

Conclusion and recommendations

- The site was owned privately prior to c. 1970 before being transferred to various NSW stage government entities and is currently owned by Sydney Metro.
- The site has been used for rural residential purposes including agriculture at a market gardener scale.
- Following the site being obtained by NSW state government entities the site has been used for purposes associated with various road infrastructure projects.
- The site is underlain by fill and natural materials as follows:
    - Fill material comprised of brown, sandy gravel to ~0.3 mBGL located in the centre of the site and toward the north.
    - Fill material comprised of firm, brown clay with mottles to ~2.4 mBGL and trace anthropogenic materials in mainly in the north west corner of the site.
    - Fill material comprised of firm to medium, brown clay to ~0.4 mBGL and trace anthropogenic material in the south of the site.
    - Natural material is comprised of firm to very firm, brown to grey clay with red, orange and grey mottles between 0.00 - 4.00 mBGL is present across the site.
    - Natural shale bedrock is present at depth with weathered bedrock potentially as shallow as ~1.2 mBGL.
    - All analytical soils results were reported below the relevant site investigation criteria considering a commercial/ industrial land use scenario.
- The groundwater investigation indicates:
    - Groundwater is present beneath the site at ~3.20 mBGL.
    - Groundwater is inferred to flow in a north east direction.
    - Major cations and anions indicate that there is a shallow (fresher) and deeper (relatively saline, potentially connate) groundwater system,
    - The shallow systems likely hosted at the interface of soils and bedrock.
    - The deeper systems is likely hosted within fractures in bedrock.
    - Analytical results were generally below the adopted site assessment criteria or where above, the potential beneficial use of groundwater was not adversely impacted.
- Hazardous ground gas screening indicated:
    - Methane was below the instrument resolution

- Carbon dioxide was above the adopted site assessment criteria
- Oxygen was below adopted site assessment criteria, indicating a depleted oxygen environment.
- No flow or pressure was identified from subsurface hazardous ground gases.
- No suitable background values were available to determine if elevated carbon dioxide was driven by off-site sources.

Based upon the results and findings of this assessment the site is considered to be suitable for use as a construction site, under a commercial/ industrial land-use scenario without further assessment or remediation required. The proposed site works are considered unlikely to disturb moderate to high-risk contaminated land.

Proposed site works are considered to be low risk from a contamination perspective.

Although potentially complete pathways are noted to exist at the site (see Table 17, Section 13) the potential risk to receptors is considered to be low provided the recommendations outlined in Section 16 are implemented.

In view of the results and conclusions of the DSI, the following recommendations are made:

- Following removal of the stockpile near the south west boundary (see **Figure 2**) the underlying soils were validated with all CoPC below the adopted site assessment criteria.
- The potential effect of tunnelling on groundwater should be assessed as changes in groundwater levels may induce/ enhance leachate migration from the former Gipps Street landfill which is located ~70 m to the south of the site.
- An assessment of hazardous ground gases in accordance with NSW EPA guidelines should be completed.
- A remedial action plan (RAP) should be prepared to address potential risks associated with asbestos soil contamination. It should include a construction environmental management plan (CEMP) if one does not already exist to address managing asbestos soil contamination, waste material, and unexpected finds.
- Waste material needs to be disposed in accordance with the POEO Act based on the waste classifications herein

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1 INTRODUCTION

Environmental Earth Sciences NSW was engaged by Road and Rail Excavations Pty Ltd (Road and Rail) on behalf of CPB Contractors-Ghella Joint Venture (CPBG) to undertake a detailed site investigation (DSI) at the proposed Claremont Meadows Services Facility (CMSF) to assess potential contamination at the site.

The proposed CMSF will consist of a construction and materials storage site that is approximately 4.0 ha and is located at 1-17 Claremont Meadows NSW 2747 (the "site"). Site locality can be seen in **Figure 1**, with the site boundary and features shown in **Figure 2**. The site is formally identified as:

- Part of Lot 100 in Deposited Plan (DP) 1275138

It is noted that a section of the site was fenced off, shown in **Figure 2**, and that CPBG, the principal contractor issued instructions to exclude that section from investigation. As such no data has been gathered from this area and it is not considered to form part of the site. The site boundary for this assessment has been defined as the construction site footprint, as outlined on **Figure 2**.

The site is currently owned by Sydney Metro and is proposed to be used to support the construction of new infrastructure associated with the Sydney Metro – Western Sydney Airport (SM-WSA) project. It is understood that the site will be used as an intermediate service facility to support construction activities for the underground tunnel portions of the SMWSA and therefore will include a shaft, as well as temporary construction facilities and amenities.

Previous investigations have been conducted at the site however these have been limited in scope. Based on the site history and the potential for contamination, further investigation was required to inform the design and construction of the services facility. A sampling and analysis quality plan (SAQP) and subsequent addendum were prepared to inform the investigation presented herein:

- Tetra Tech Major Projects (TTMP) (2022a), Claremont Meadows – Sampling Analysis Quality Plan – Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works (ref. SMWSASBT-CPBJV-SWD-SW000-GE-RPT-040501 RevA, dated 30 March 2022) and;

- Environmental Earth Sciences (2022), Sampling Analysis and Quality Plan Addendum - Claremont Meadows Services Facility, Sydney Metro – Western Sydney Airport (ref: 122045_SAQP Addendum_V1; dated 27 May 2022).

The compliance of this assessment with the 'Deed' has been summarised in **Table 1** (below).

Table 1: Compliance summary table

Ref. No.	Deed Item	Relevant Report Section
1.1	**Detailed Site Investigations**	-
1)	The SBT Contractor must perform and submit to the Principal's Representative and the Independent Certifier a Detailed Site Investigation prior to commencing any excavation activities (except in relation to Preliminary Works) to the extent required under the Planning Approvals or by Law.	This report.
2)	Notwithstanding clause 12.19(a), the SBT Contractor may also perform additional Detailed Site Investigations carried out in other areas of the Construction Site or outside the Construction Site if the SBT Contractor deems it necessary to manage the risks associated with contaminated land and to appropriately plan for Remediation. Any additional Detailed Site Investigation performed in accordance with this clause 12.19(b) must also be submitted to the Principal's Representative and the Independent Certifier.	**Section 15 Recommendations**.
3)	**(3) Each Detailed Site Investigation must:**	**-**
3) 1)	investigate areas of proposed excavation or disturbance;	**Section 3 Works Undertaken** **Section 4 Site Identification**
3) 2)	investigate land within the Construction Site or Extra Land surrounding the areas of proposed excavation or disturbance with respect to the potential migration of Contamination via groundwater, ground gas and odour into the areas of excavation or disturbance;	**Section 3 Works Undertaken** **Section 15 Recommendations**.
3) 3)	characterise risks to the construction, operation and maintenance of Sydney Metro - Western Sydney Airport and its infrastructure from Contamination;	**Section 7 Preliminary Conceptual Site Model** **Section 12 Discussion and Revised CSM**
3) 4)	be prepared in accordance with Law, Approvals, applicable Codes and Standards, the lawful requirement of any Authority, Good Industry Practice, all guidelines made or approved by the EPA, the National Remediation Framework, the Human Health and Environment Risk Assessment and any other requirements of this deed;	**Section 17 References**
3) 5)	be reviewed and approved by a Certified Contaminated Land Consultant;	Covering letter
3) 6)	be reviewed and endorsed by an Accredited Site Auditor;	N/A
3) 7)	be accompanied by an Interim Site Audit Advice prepared by the Accredited Site Auditor when submitted to the Principal's Representative and the Independent Certifier in accordance with clause 12.19(a);	N/A

Ref. No.	Deed Item	Relevant Report Section
3) 8)	characterise the risk of Contamination migrating from the Construction Site as a result of the SBT Contractor's Activities; and	**Section 12 Discussion and Revised CSM**
3) 9)	characterise the suitability of Contamination for reuse on the Construction Site in accordance with the terms of this deed, the Law, Approvals, applicable Codes and Standards, the lawful requirements of any Authority, guidelines made or approved by the EPA, the National Remediation Framework and the Human Health and Environment Risk Assessment and any other requirements of this deed.	**Section 10 Investigation Results** **Section 12 Discussion and Revised CSM**
4)	**In addition to the requirements set out in clauses 12.19(c), each Detailed Site Investigation must be prepared in accordance with the relevant guidelines made or approved by the EPA and:**	**Section 17 References**
4) 1)	determine and delineate the lateral and vertical extent of Contamination within each area the subject of Detailed Site Investigation;	**Section 10 Investigation Results** **Section 12 Discussion and Revised CSM**
4) 2)	include in-situ classification of Solid Waste at sampling densities not less than that specified within the NEPM (2013) and the Industrial Waste Resources Guidelines (7), Sampling and Analysis: Soil Sampling (EPA Victoria 2010), except for Virgin Excavated Natural Material (VENM) and Excavated Natural Material (ENM) which are to be classified in accordance with the requirements of the POEO Act;	**Section 13 Waste Classification** **Section 14 Conclusions**
4) 3)	classify the Solid Waste in accordance with the Waste Classification Guidelines and the relevant provisions of the POEO Act including resource recovery exemptions and orders, using a statistical approach where relevant; and	**Section 13 Waste Classification** **Section 14 Conclusions**
4) 4)	be suitably detailed so as to inform the development of the Remediation Action Plan and any Agreed Remediation Scope and to characterise contamination risk to the construction, operation and maintenance of Sydney Metro - Western Sydney Airport (including but not limited to soil, groundwater, ground gas and odour risks arising from Contamination within the area of proposed excavation or disturbance or migrating into the area of proposed excavation or disturbance).	**Section 12 Discussion and Revised CSM** **Section 14 Conclusions** **Section 15 Recommendations**

This report is to be read in conjunction with the assumptions contained within the proposal (ref: PO122070_V3 dated 20 April 2022) and the limitations at the end of this report.

Legend

- Site Boundary
- Overview Extent
- Stockpile (not assessed)

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

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Title: Site Locality Map

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG	Scale: As Shown	Job No: 122045
Drawn By: SG	Date: June 2022	

Figure 1

Legend

- Site Boundary
- Road-base Gravel at surface
- Stockpiles
- Former Gipps Stree tLandfill (approximate)

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

ENVIRONMENTAL EARTH SCIENCES
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Title: Observed Site Layout

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG	Scale: As Shown	Job No: 122045
Drawn By: SG	Date: July 2022	

Figure 2

2 OBJECTIVES

2.1 Administrative

It is understood that the DSI is required to meet Condition E92 (Contaminated sites) of the SMWSA Conditions of Approval (ref. SSI-10051, Sydney Metro - Western Sydney Airport dated 23 July 2021), being:

"Before commencement of any construction that would results in the disturbance of moderate to high-risk contaminated sites as identified in the documents identified in Condition A1, Detailed Site Investigations (for contamination) must be conducted to determine the full nature and extent of the contamination. The Detailed Site investigation Report(s) and the subsequent report(s), must be prepared, or reviewed and approved, by consultants certified under either the Environment Institute of Australia and New Zealand's Certified Environmental Practitioner (Site Contamination) scheme (CenvP(SC)) or the Soil Science Australia Certified Professional Soil Scientist Contaminated Site Assessment and Management (CPSS CSAM) scheme. The Detailed Site Investigations must be undertaken in accordance with guidelines made or approved under Section 105 of Contaminated Land Management Act 1997 (NSW)."

2.2 Technical

The technical objectives for the DSI were to:

- Meet the requirements of the SAQP (TTMP, 2022a) and SAQP Addendum (Environmental Earth Sciences, 2022).
- Meet the requirements of the WSA Station Box and Tunnels Deed (**Table 1**).
- Update the respective preliminary conceptual site model (CSM) for contamination risk, determining whether there are potentially unacceptable risks to human health and the environment.
- Provide conclusion on suitability for the proposed use, or alternatively provide recommendations for further assessment and/or management of identified risk(s).
- Provide further recommendation for offsite management of material which may be surplus to requirements, including:
    - Waste classification status of fill material in accordance with the Waste Guidelines (NSW EPA, 2014a); and
    - Protection of the Environment Operations Act 1997 (POEO Act).

3 WORKS UNDERTAKEN

The scope of works to achieve the objectives is presented in the following subsections.

3.1 Preliminary items

The following preliminary items were undertaken:

- Review of historical reports/ documents including Cardno (2021a and 2021c), Golder-DP (2021), M2A (2021) and TTMP (2022a).
- Review of current projects and plans including TTMP (2022b and 2022c).
- Preparation of a SAQP Addendum (Environmental Earth Sciences, 2022).
- Preparation of a safe work method statement (SWMS) for tasks undertaken by Environmental Earth Sciences.
- Undertake a dial-before-you-dig (DBYD) search to identify potential underground utilities at the site.
- Inspection of the site to further inform on the intrusive investigation locations.
- Conducting scan for underground services, supervising a qualified utility search subcontractor to mark-out safe locations for intrusive assessment.
- Completion of site induction process.

3.2 Intrusive work and sampling

3.2.1 Soil assessment

The following intrusive work was completed to assess soils for potential contamination:

- Supervision of test pitting by qualified excavation subcontractor on 26 to 28 April 2022, advancing 31 test pits to a maximum depth of 4.00 metres (m) below ground level (BGL) for soil assessment (IDs: TP1 – TP31).
- Collection of soil samples at pre-defined intervals down the profile or where changes in stratigraphy were observed or at indications of potential contamination (e.g., visual or olfactory, if any).
- Field logging of test pits including material type, texture, moisture, and inclusions and indications of visual / olfactory contamination (if any).
- Semi-quantitative field screening for potential volatile organic compounds (VOCs) using a calibrated photo-ionisation detector (PID) meter.

- Collection of field duplicate and split duplicate samples for quality assurance / quality control (QA/QC) purposes.
- Drilling of three deeper soil cores to ~21.0 mBGL (IDs: BH1235 – BH1237) to facilitate waste characterisation of the rock within the proposed tunnel shaft.
- A fourth deep core was drilled to 21 mBGL (ID: GW-1028) for the purposes of installing a groundwater monitoring well with no soil samples collected or analysed.

3.2.2 Groundwater assessment

The groundwater assessment included:

- Installing and developing one new groundwater monitoring well to (ID: GW-1028). No groundwater samples were collected from this bore.
- Sampling groundwater from two existing monitoring wells (identified as SMGW-BH-A109S and SMGW-BH-A365).

3.2.3 Hazardous ground gas screening

The hazardous ground gas screening included using a calibrated GFM436 to assess for concentrations of bulk hazardous ground gases (methane, carbon dioxide and oxygen) along with trace carbon monoxide and hydrogen sulfide in an existing gas bore (ID: SMGW-BH-A366).

3.2.4 Stockpile assessment

The following assessment was undertaken for two stockpiles onsite in July 2022:

- Stockpile footprint validation sampling:
    - Advanced eight test pits via mechanical excavation to a maximum of 1 mBGL
    - Field logging of test pits including material type, texture, moisture and inclusions/ indications of visual / olfactory contamination (if any).
    - Collection of soil samples at pre-defined intervals down the profile or where changes in stratigraphy were observed or at indications of potential contamination (e.g., visual or olfactory, if any).
    - Collection of field duplicate samples for quality assurance purposes.
- Small stockpile onsite:
    - Advance six test pits via manual methods to a maximum of 0.3 mBGL into the stockpile.
    - Collection of soil samples from below the stockpile surface.

- Field logging of material encountered within the stockpile including material type, texture, moisture and inclusions/ indications of visual / olfactory contamination.

3.3 Laboratory analysis

Laboratory assessment of samples of soil and groundwater were submitted to laboratories accredited by National Associated of Testing Authorities (NATA) for analysis.

3.3.1 Soils

Up to two soil samples per *in situ* test pit were submitted for laboratory assessment for inorganic and organic analysis along with for identification of potential asbestos in soils.

Soil samples were collected at approximate intervals of 2-3 m from the three deep cores (IDs: BH1235 – BH1237) and analysed for a reduced analytical suite.

Soil laboratory analyses for primary samples included:

- 72 samples submitted for:
    - Eight priority heavy metals / metalloids (As, Cd, C_{TOTAL}, Cu, Hg, Pb, Ni and Zn).
    - Total recoverable hydrocarbons (TRH) (Fractions C_6 – C_{40}) / Total petroleum hydrocarbons (TPH) (Fractions C_6 – C_{36}).
    - Benzene, toluene, ethylbenzene and total xylenes (BTEX).
    - Polycyclic aromatic hydrocarbons (PAH).
- 46 samples also analysed for:
    - Organochlorine pesticides (OCP) / organophosphorus pesticides (OPP).
    - Phenolic compounds.
    - Polychlorinated biphenyls (PCB).
- 90 samples were submitted for analysis of asbestos in soil (presence/ absence).

Five field/ blind duplicate samples and five split/ inter-laboratory duplicate samples submitted for QA/QC purposes for the full analytical suite detailed above with the exception of asbestos in soils which was not assessed for any duplicate samples. Two trip blank and trip spike soil pairs were submitted within the two batches of samples submitted to the primary laboratory.

3.3.2 Groundwater

Two groundwater samples (IDs: BH-A365 – BH109S) were submitted for laboratory analysis of:

- TRH (C_6 – C_{40}) / TPH (C_6 – C_{36}).

- BTEX.
- OCP.
- Dissolved heavy metals / metalloids (Al, As, Cd, Cr_{TOTAL}, Cu, Fe, Hg, Mn, Ni, Pb and Zn).
- Ionic balance (major cations and anions, nutrients, pH and total dissolved solids (TDS)).

One field/ blind duplicate sample was submitted analysis of above analytical suite.

3.3.3 Stockpile assessment

Two representative soil samples were submitted for analysis from each of the eight test pits advanced within the footprint of the former stockpile (one from the surface at <0.1 mBGL, and one from the sub-surface at ~0.5 mBGL).

Six samples were also collected from the smaller onsite stockpile from ~0.3 m below the surface of the stockpile.

- In total 25 primary samples were submitted for the following analyses in soil:
    - Eight priority heavy metals / metalloids (As, Cd, C_{TOTAL}, Cu, Hg, Pb, Ni and Zn).
    - TRH (C_6 – C_{40}) / TPH (C_6 – C_{36}).
    - BTEX.
    - PAH.
    - Asbestos in soils (24 samples tested for presence / absence, and one where asbestos fines (AF) / friable asbestos (FA) was quantified.
- A further eight samples were analysed for:
    - OCP / OPP.
    - PCB.
- Four samples from the former stockpile footprint were analysed for per- and polyfluoroalkyl substances (PFAS).

3.4 Reporting

Preparation of this report to document the following:

- Interpretation of information and data from the various inputs including prior investigations, desktop information.
- Desktop assessment for likelihood of potential / actual acid sulfate soils and/ or saline soils.

- Summary of site investigation works and laboratory assessment completed.
- Laboratory analytical results with comparison to adopted 'Tier 1' criteria thresholds.
- QA/QC evaluation to assess appropriateness of fieldwork methods adopted and suitability of data collected.
- Preparation of borelogs and figures to illustrate observations, site investigation locations and interpretation of results.
- Update of the CSM for contamination and presentation of any partially complete / fully complete risk linkages and/or residual data gaps (if encountered).
- Conclusion on site suitability from a contamination risk perspective.
- Recommendations for management, including:
    - Addressing any identified data gaps through additional assessment.
    - Management of identified areas of environmental concern (AEC).
    - Provisional waste classification for *in situ* soil materials prior to development with estimation of volumes.

4 SITE IDENTIFICATION

4.1 Site identification and details

The site identification details are summarised in **Table 2** and the site locality is shown in **Figure 1**.

Table 2: Site identification details

Aspect	Details
Address	1-17 Gipps Street, Claremont Meadows, NSW 2747
Lot & Plan number	Part Lot 100 on DP1275138
Area	~4.0 Ha
Local Government Area (LGA)	Penrith City Council
Zoning	R3 (Medium Density Residential) and B6 (Enterprise Corridor)
Local Environmental Plan (LEP)	Penrith Local Environmental Plan 2010
Current land use	Cleared vacant land
Proposed land use	Commercial / Industrial – construction site
Site location and layout	**Figure 1** and **Figure 2**

The site boundary and layout as observed during this DSI has been presented on **Figure 2** while the proposed site layout, has been presented on **Figure 3**.

4.2 Surrounding features

Features of surrounding land uses identified near the site area are summarised in **Table 3**.

Table 3: Surrounding site uses

Direction	Description
North	Immediately adjacent is Great Western Highway, while beyond is vacant land while toward the northeast is a dis-used timber and joinery premise and commercial shops, including a 7-Eleven service station (~125 m NE). The ecological receptor of Claremont Creek is located ~200 m north of the site
East	Immediately adjacent is Gipps Street, beyond which is a vacant block of land followed by an Ampol service station (~170 m E). The ecological receptor of South Creek is ~500 m east of the site.
South	Immediately adjacent is Gipps Street, beyond which is the western portion of the former Gipps Street landfill. ~500 m south of the site are residential premises of Claremont Meadows.
West	The site is bordered to the west by Gipps Street beyond which are residential premises. The ecological receptor of Claremont creek is ~150 m west of the site.

4.3 Site inspection

A site inspection was completed on 26 April 2022 where observations indicated that the site was largely vacant. Vegetation near the centre of the site had recently been cleared and a layer of compacted sand and grey igneous gravel had been placed to establish a trafficable surface.

A stockpile of soil material was observed located in the south west of the site that will be removed. It is understood to be the responsibility of others to manage the removal of this material. Groundwater and subsurface monitoring bores installed by other during earlier phases of investigation were observed. The general site layout from site observations has been presented in **Figure 2** (above).

Note: This stockpile was removed from the site in June 2022 by others.

Legend

- Site Boundary
- Excluded Area
- Carpark
- Crane Pad and Spoil Bin
- Laydown Areas
- Offices/ Workshop
- Sediment Basins
- Shaft
- Water Treatment Plant

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

ENVIRONMENTAL EARTH SCIENCES
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Title: Proposed Site Layout

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG	Scale: As Shown	Job No: 122045
Drawn By: SG	Date: June 2022	

Figure 3

5 SITE SETTING

5.1 Geology

The Penrith 1:100,000 Geological Series Sheet 9030 (Clark & Jones, 1991) describes the lithology of the site and its immediate surroundings as Quaternary aged unconsolidated alluvial fine-grained sand, silt and clay Quaternary period underlain by the Triassic aged Bringelly Shale of the Wianamatta Group. Bringelly Shale is comprised of dark shale, rare coal, lithic sandstone, laminate and carbonaceous claystone.

5.2 Soil

5.2.1 Soil landscape

The Penrith 1:100,000 Soil Landscape Series Sheet 9030 (Hazelton *et al.,*1989) indicates that the soils at the site belong to either the fluvial South Creek soil landscape or the residual landscape of the Blacktown soil landscape.

The South Creek soil landscape is characterised by flood plains, valley flats and drainage depressions or channels within the Cumberland Plain. Soils are often very deep layered sediments over bedrock or relict soils that may include structured plastic clays or structured loams where pedogenesis has occurred.

The residual Blacktown soil landscape is characterised by gently undulating rises on Wianamatta Group shales with local relief up to 30 m with ridges of gentle inclined slopes (>5%) forming broad rounded crests. Soils are shallow to moderately deep with mottled texture comprising red and brown podzolic soils (on crests) grading to yellow podzolic soils on lower slopes and drainage lines.

5.2.2 Salinity

A review of NSW Department of Infrastructure, Planning and Natural Resources (2002) *Salinity Potential in Western Sydney* indicates that the site is of moderate to high salinity potential. Areas along the length of Claremont Creek were identified as ‘known saline’, through either field observations of salinity indicators (e.g. scalding, salt efflorescence, vegetation die back etc) or inferred from aerial imagery.

Areas of high salinity potential in Western Sydney are often associated with drainage lines and low/ foot slopes on Quaternary sediments or Wianamatta Shales where high seasonal water tables and soil saturation can result from surface water movement.

5.3 Acid Sulphate Soils

A review of Australia Soil Resource Information System (ASRIS) indicates the site is located within an area of ‘extremely low acid sulfate soil occurrence probability’.

5.4 Topography

The site sits at an elevation of approximately 30 m Australian Height Datum (AHD) and slopes gently in a north-west direction towards Claremont Creek. The topographic variation across the site is approximately 4 m from south east to north west.

5.5 Hydrogeology

Groundwater flow is anticipated to be toward South Creek, which is north east from the site. Water-bearing units potential comprise a shallow, unconfied systems and a deeper bedrock hosted system. The site soils potentially host a low yield, shallow unconfined alluvial aquifer likely to be present at the interface between soil and rock at about 3-7 mBGL. A deeper groundwater system is potentially present within the bedrock, likely hosted by fractures/ joints or more permeably lithologies (e.g., sandstone more likely than claystone/ shale), although bedding planes may support some horizontal groundwater flow.

Groundwater velocity is anticipated to be very slow with low hydraulic conductivity, due to the low permeability and (primary) porosity of the site geology.

The nearest registered groundwater bores are located approximately 100 m east of the site, three bores were installed at the Ampol service station to 6 mBGL for monitoring purposes. No additional detail such as groundwater level was available.

5.6 Hydrology and drainage

There are no natural surface water features at the site. The nearest surface water receptor is Claremont Creek located ~130 m NW of site while South Creek is located ~520 m E of the site.

The site's surface is predominantly unsealed cleared land with low (grassy) vegetation, there is an area of compacted gravel in the central-eastern area of the site (refer **Figure 2**). It is anticipated that precipitation at the site would slowly infiltrate the soil profile with a degree of run-off due to the low porosity and permeability of the natural clay soils.

6 SUMMARY OF RELEVANT INVESTIGATIONS AND REPORTS

6.1 Previous investigations and reports

Investigations associated with the environmental impact statement (EIS) for the project along with geotechnical and contamination investigations that included details relevant to the site were:

- Cardno (2021a) - Contamination Assessment Report, Sydney Metro Western Sydney Airport (Ref. 80021888; 5 May 2021).

- Cardno (2021b) - Contamination Assessment Report – Phase D/E, Sydney Metro Western Sydney Airport (Ref. 80021888 Rev.B; 22 November 2022).
- Golder and Douglas Partners (2021) - *Factual Contamination Report – Preliminary Site Investigation* (Ref. 19122621-003-R-Rev3; 19 February 2021).
- M2A Joint Venture (M2A) (2020) - Sydney Metro – Western Sydney Airport, Technical Paper 8: Contamination.

Due to the broad nature of these investigations and assessments, a summary of the information pertinent to this DSI is presented in the following subsections.

6.1.1 M2A (2020)

Preliminary assessment

The M2A (2020) report was a technical paper prepared to support the project's EIS and was essentially a preliminary site investigation detailing the site's history from desktop resources including aerial imagery and historic land titles.

The M2A (2020) report (*Appendix C*) presented a high-level review of aerial imagery indicating that the predominant site use was for market gardens and pastureland with a small number of residential buildings and associated structures prior to 1955 and demolished between 1980 and 2000. Recent site uses appear to have been for road construction related activities with a construction compound, stockpile areas on the northern half of the site with two small sediment ponds.

Historic land titles supported the review of aerial images indicating that the site was privately owned between 1905 and 1974 when it was purchased by The Housing Commission of NSW before being transferred to The Land Commission of NSW. The site was purchased in 2012 by Roads and Maritime Services (now Transport for NSW).

The environmental setting of the site was broadly summarised including geology, soils, salinity potential, acid sulfate soil risk, groundwater and surface water.

A brief summary of findings was made from prior investigations circa 2011. This included that the site was associated with an earlier infrastructure proposal (Stage 1 Werrington Arterial Road project).

The following information summary was prepared from the M2A (2020) review of the Aurecon (2012) - *Stage 1 PSI for Werrington Arterial Road Project.*

Within Aurecon (2012) a brief summary of a report prepared by JBS Environmental (2011) *Detailed Contamination Assessment Lots 1 & 2 DP 771697 and Lots 777 & DP 263543, Gipps Street, Claremont Meadows NSW* noted two the lots (Lots 777 and 781 in DP263543) along with two additional lots (Lots 1 and 2 in DP771697) were previously subject to detailed investigation. It is noted that the lot forming majority of the current site (Lot 100 in DP1275138) was not formally identified in the JBS Environmental (2011) report.

A review of Lot 1 in DP771697 on aerial imagery (Six Maps) noted that the site had an address of 1 Great Western Highway, Claremont Meadows and was located beneath the north-bound portion of Gipps Street while Lot 2 did not appear to be a current identifier

As JBS Environmental (2011) was only summarised in Aurecon (2012), the M2A (2020) presented summary could not be verified and was ambiguous with regard to the position of assessment locations and results across the four lots detailed. Key findings presented were:

- Limited remediation of identified asbestos impacts were completed via removal of an ACM pipe and 'emu picking' of fragments with no validation samples collected in the south eastern portion of the site.
- The above remediation was apparently abandoned (reasons unknown).
- Bonded ACM was identified in the southeast, east and north portions of the assessment area (no figure available to determine locations of extent of impacts) and inferred to be associated with the demolition of former sheds and residences.
- No CoPC (metals, TPH, BTEX, PAH, OCP, PCB or asbestos fibres) were reported in results for testing of soils, with the exception of chromium which was generally noted to exceed the now outdated phytotoxicity based investigation levels. The site however was observed as appearing healthy and bioavailability was considered to be low due to the dominant clay soil texture.
- Lot 1 was considered suitable for road use, Lot 777 and Lot 781 were suitable for residential use and Lot 2 was suitable if ACM was removed and validated.

A summary of publicly available records including NSW EPA records indicated that the former Gipps Street landfill (which is adjacent the southern boundary, refer **Figure 2** was listed as a site notified to NSW EPA. The site and neighbouring properties were not included on the contaminated land register, sites licensed under the POEO Act (current and former) or as a per- and polyfluoroalkyl substances (PFAS) investigation sites.

Potential existing sources of contamination were identified as the former Gipps Street landfill with both the construction footprint and the tunnel alignment identified as potential receptors to this source. M2A (2020) identified the following three AECs at the site from the desktop review of information:

- AEC5: An area where stockpiling of spoil from road construction and material laydown occurred along with potential for asbestos containing material (ACM) in soil.
- AEC6: Groundwater impacted by the off-site former Gipps Street landfill and potentially up-gradient industrial sites.
- AEC7: Contamination and landfill (hazardous ground gases) from the offsite former Gipps Street Landfill.

These AECs are illustrated on **Figure 4**, adapted from *Figure A3* of M2A (2020) noting that AEC1 - AEC4 were not related to the site.

The inflow of potentially contaminated groundwater (from the former landfill) to the proposed shaft excavation was recognised, however the risk was considered to be minor due to a proposed excavation for a cut-off wall, using secant piles to obstruct horizontal groundwater migration.

A preliminary CSM was presented identifying AEC5 - AEC7 and evaluating the potentially complete pathways for all identified sensitive receptors. These included risks to onsite workers / maintenance workers and the surface water ecosystems of South Creek and Claremont Creek from:

- Leachate contaminated groundwater extracted during shaft excavation impacting South Creek and Claremont Creek.
- Offsite migration from former Gipps Street landfill accumulating in trenches or in ground services and presenting an inhalation/ asphyxiation and explosive risk to intrusive maintenance workers.

M2A (2020) identified the following risks during the site's operational phase:

- Potential disturbance of saline soils or acid sulfate soils
- Spills and leaks of hydrocarbons including fuels and oils associated with operation and maintenance of heavy vehicles during construction.

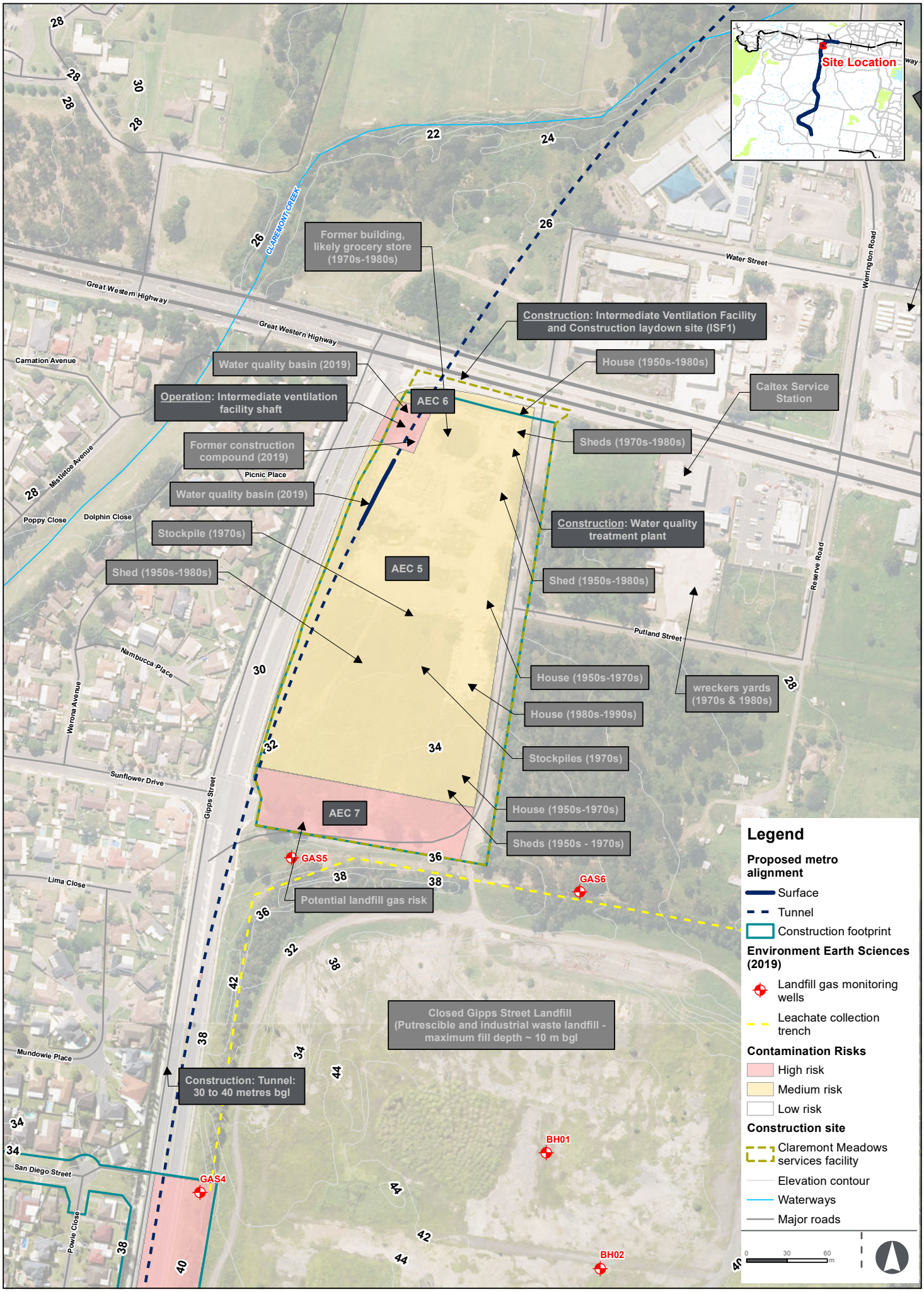
6.1.2 Golder-DP (2021a)

Two shallow soil samples (<1.5 mBGL) were collected and one sample from depth in bore SMGW-BH-A110. Details of the three investigation locations included in Golder-DP (2021a) are summarised in **Table 4**.

Table 4: Golder-DP (2021a) investigation location summary

Bore ID/ details	SMGW-BH-A109	SMGW-BH-A109s	SMGW-BH-A110
Type	Deep soil/ rock bore	Shallow soil bore	Deep soil/ rock bore
Groundwater monitoring bore	Yes	Yes	No
Total depth	42.35 mBGL	5.55 mBGL	46.25 mBGL
Soil/ rock samples	2	None	1
Groundwater samples	5	6	-

Notes:
mBGL Metres below ground level



Sydney Metro – Western Sydney Airport

Claremont Meadows Services Facility contamination sources and risk ranking

*HBM - Potential hazardous building materials
Indicative only, subject to design development

Figure A3

The borelogs indicate the stratigraphy consists of up to 1 m of fill material was present comprising brown and yellow-grey, silty clay with rounded to sub-angular ironstone gravels. The natural soils were similar to identified fill being red-brown silty to gravelly clay with trace sub-rounded to sub-angular ironstone and pale grey and orange mottles. Bedrock was encountered at ~5.2 mBGL initially as fine grained orange-brown extremely weathered sandstone becoming dark grey siltstone and interbedded siltstone and sandstone.

Details regarding the collection of soil samples were not presented including field QA and QC procedures, however it is expected that this was likely presented in a previously prepared SAQP for the investigation work.

Multiple readings of groundwater depth in bores SMGW-BH-A109 and SMGW-BH-A110 was between ~2.6 mBGL and ~4.1 mBGL with deeper groundwater occurring after the initial readings.

Groundwater samples from bores SMGW-BH-109S and SMGW-BH-109 were collected with passive Hydrasleeve sampling devices, following bore development which was completed with either foot-valves or disposable bailers.

During sample collection field parameters including pH, electrolytic conductivity (EC), oxidation-reduction potential (ORP), dissolved oxygen (DO) and temperature were recorded using residual volumes not required for analytical sampling (from the Hydrasleeves).

6.1.3 Laboratory analysis

Soil and groundwater samples specific to the site were submitted for a wide variety of analytical results including:

- Heavy metals and metalloids (dissolved phase for groundwater).
- TRH / TPH.
- BTEX.
- PAH.
- OCP and OPP.
- PCB
- Asbestos (presences/ absence) (excluded from groundwater samples).
- Volatile organic compounds (VOCs).
- Phenols (total).
- Ammonia.
- PFAS.

6.1.4 Summary of laboratory results

Laboratory results indicates that CoPC were below the site assessment criteria (based on a commercial/ industrial land-use scenario) except for zinc at SMGW-BH-A110 which exceeded the EIL, noting that this sample was collected from 29 mBGL and therefore the application of an EIL is considered inappropriate.

Trace detections of perfluoro-octanesulfonate (PFOS) were reported from bore SMGW-BH-A109 at 0-0.1 mBGL, however this was a common result from many of the surface/ near surface samples collected across the wider investigation. No samples were collected or analysed /presented from SMGW-BH-A109S.

6.1.5 Cardno (2021a and 2021b)

Cardno (2021a and 2021b) installed further groundwater monitoring bores at the site as summarised below:

- Deep monitoring bore SMGW-BH-A304 (drilled to 39.17 mBGL, well installed to 26 m with 9 m screen.)
- Shallow monitoring bore SMGW-BH-A365 (Drilled to 10 mBGL, well installed at 10 mBGL with 3 m screen from 6 to 9 mBGL).
- Shallow gas monitoring bore SMGW-BH-A366 (drilled to 4 mBGL, well installed to 4 mBGL with uncertain screen.)

Concentrations of TRH, BTEX and PFAS were detected in samples at depths greater than 6 mBGL. These samples were of underlying rock. Cardno considered this during the data validation evaluation and concluded that the detections were false positives due to drilling additives and greases used in the coring process.

In general, the relevant soil samples from the Cardno (2021a and 2021b) investigations were reported below the site assessment criteria, considering a commercial / industrial land use scenario.

6.2 Current project reports and plans

Recent reports prepared specific for the Station Boxes and Tunnel project are:

- Tetra Tech Major Projects (TTMP) (2022b), *Groundwater Monitoring Program – Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works* (ref. SMWSASBT-CPG-SWD-SW000-GE-RPT-040404 Rev0, dated 9 September 2022).
- Tetra Tech Major Projects (TTMP) (2022c), *Project-wide Groundwater Modelling Report – Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works* (ref. SMWSASBT-CPG-SWD-SW000-GE-RPT-040402 RevB.01, dated 29 July 2022).

Information pertinent to the site have been detailed in the following sub-sections.

6.2.1 Tetra Tech Major Projects (2022b)

TTMP (2022b) is a Groundwater Monitoring program (GWMP) applicable to the Station Boxes and Tunnelling Works (SBT Works) Package of the SM-WSA project describing how CPBG will monitor the groundwater impacts of the SBT Works in NSW.

Baseline monitoring groundwater wells were installed across the project between 2019 and 2021 and designed to target the following three hydrogeological units:

- Quaternary alluvial aquifer;
- Residual soils, including perched water; and
- Bedrock aquifer, predominantly in the Bringelly Shale.

At the Claremont Meadows site, the following baseline groundwater monitoring bores were installed:

- SMGW-BH-A109 (Bedrock)
- SMGW-BH-A109S (Residual)
- SMGW-BH-A121 (Bedrock)
- SMGW-BH-A122 (Bedrock)
- SMWSA-BH-A365 (Bedrock)

Monitoring of these bores identified that groundwater flow in the across the Claremont Meadows Services facility is expected to generally follow topography towards South Creek in a northerly and easterly direction towards South Creek.

During construction of the Claremont Meadows shaft, sustained inflow to the excavation is assessed to be 0.25 L/s from the base of the shaft during construction with an extent of influence of 350 m to the east and 1 m drawdown of the water table up to 250 m from the excavation. The magnitude of groundwater level drawdown towards the north, where higher hydraulic conductivity alluvial sediments exist, is expected to be limited. Initial inflow would be greater in the short term but is expected to stabilise within the construction timeframe.

The general characteristics of the groundwater are:

- Brackish salinity with the average EC generally exceeding 10,000 µS/cm with the residual aquifer on average slightly less saline than in the bedrock aquifer.
- pH is typically slightly acidic to neutral, with field pH ranging from 5.5 to 8.4 and laboratory pH ranging from 4.9 to 12.2. Strongly alkaline groundwater (pH>10) has consistently been reported in one location (SMGW-BH-A122) at tunnel depth to the south of Claremont Meadows and the Gipps St Landfill.
- Groundwater is typically of sodium-chloride water type.

Groundwater quality monitoring will be carried out at a combination of existing and proposed

baseline monitoring bores. Assessment of water groundwater quality for the site is ongoing and will need to be updated as the monitoring program progresses.

6.2.2 Tetra Tech Major Projects (2022c)

TTMP (2022a) considered the numerical groundwater model to meet the requirements for Class 2 or Class 3 in accordance with Barnett *et al.,* (2012) prepared to look at the project's influence on groundwater with regard to the station boxes, intermediate services facilities (including the site) and two sections of twin tunnels.

Four aquifers were identified:

- Fill materials;
- Quaternary alluvial aquifer;
- Residual soil;
- Bedrock aquifer.

Recharge to the aquifers was primarily inferred to occur through precipitation with the alluvial aquifers likely experiencing the most significant recharge while a degree of recharge was anticipated from water courses. Watercourses were considered to act predominantly as groundwater discharge areas.

Groundwater movement in the Bringelly Shale (bedrock aquifer) was anticipated to be lateral, away from mounds and toward water courses while precipitation recharge to the bedrock aquifer was anticipated to be low (~1-2 % of annual rainfall, TTMP, 2022a), due to the low permeability of the residual soil profiles.

The maximum inflow modelled inflow for the Claremont Meadows excavation was ~64,000 L per day which reduced to 111 L/ day (e.g. very minimal) in the permanent model.

7 PRELIMINARY CONCEPTUAL SITE MODEL

The development of a CSM is an essential part of all site assessments that is undertaken through an iterative process that outlines the way a site was contaminated and how identified receptors may be exposed to potentially unacceptable contamination.

The preliminary CSM identifies potential sources of contamination, potential migration pathways along which identified contaminants could migrate and potential receptors which may become exposed.

The preliminary CSM considers plausible pollutant linkages associated with the identified contamination. By evaluating these linkages proposed controls can be outlined and recommendations developed for appropriate remediation or management.

The preliminary CSM was developed in Environmental Earth Sciences NSW (2022) and has been summarised in **Table 5** through the preliminary source-pathway-receptor analysis.

Table 5: Preliminary Source-Pathway-Receptor analysis

Source/ CoPC	Pathway	Receptor	Risk linkage	Notes
Onsite				
Soil soils and fill materials: **Historic site uses indicates potential for application of pesticides and herbicides at the surface. Localised uncontrolled fill may have historically occurred.** **Includes AEC5 from M2A (2020).** **CoPC:** • **M8.** • **OCP/ OPP.** • **TRH / TPH** • **BTEX** • **PAH** • **Asbestos**	Direct contact with contaminated materials. Application of CoPC to site surfaces along with spills and leaks into environmental media and downward migration into the sub-surface.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes. Groundwater: Shallow groundwater system.	POTENTIALLY COMPLETE	The site does not appear to have an intense agricultural use and has largely been vacant for at least ten years aside from parts of the site being used in conjunction with nearby road work related activities. Residual impacts may exist associated with the historic use and requires confirmation.
	Lateral migration with groundwater flow toward receptors.	Ecological: Surface water bodies of South Creek	NO LINKAGE	Groundwater flow is likely slow due to the underling soils being clay dominated and geology being siltstone. Environmental receptors are relatively distal, allowing for biodegradation and natural attenuation of any CoPC present within groundwater.
	Inhalation of vapour from soil and/ or groundwater	Human health: Current and future workers/ visitors along with intrusive maintenance workers	NO LINKAGE	The site history does not suggest a strong likelihood of volatile CoPC that may pose a soil vapour inhalation risk.
	Inhalation of asbestos fibres	Human health: Current and future workers/ visitors along with intrusive maintenance workers	POTENTIALLY COMPLETE	Potential for asbestos/ ACM is recognised which may present a risk through the inhalation pathway to human health receptors.
Historic building footprints: **Use of hazardous building materials and poor demolition practices** **CoPC:** • **M8.** • **OCP/ OPP** • **Asbestos**	Direct contact with contaminated materials.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes.	POTENTIALLY COMPLETE	Wash bay (canopy) was situated on hardstand with any run-of likely controlled by the site's drainage network.
	Vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Groundwater: Shallow groundwater.	POTENTIALLY INCOMPLETE	CoPC associated with hazardous building materials are not anticipated to be highly mobile.
	Inhalation of asbestos fibres	**Human Health:** Site workers/ visitors and intrusive maintenance workers.	POTENTIALLY COMPLETE	Potential for asbestos is recognised which may present a risk through the inhalation pathway to human health receptors.
Potential former service station • **Lead** • **TRH / TPH** • **BTEX** • **PAH (including naphthalene)**	Direct contact with contaminated materials.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes.	POTENTIALLY INCOMPLETE	Potential for soil contamination to existing around possible underground storage tanks and in areas where fuels may have been distributed (e.g., bowsers and fuel lines).
	Vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Groundwater: Shallow groundwater.	POTENTIALLY COMPLETE	Potential for residual impacts to migrate vertically into shallow groundwater.
Contaminated groundwater: **Migration of contaminated groundwater beneath the site.** **Includes AEC6 from M2A (2020).** **CoPC:** • **M8.** • **TRH.** • **BTEX and Naphthalene.** • **VOC.** • **pH**	Downward vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	POTENTIALLY COMPLETE	Groundwater migration is anticipated to be slow due to the underlying soils and geology. Potential interaction between site workers/ visitors with groundwater is considered unlikely. Exception may include where dewatering is required, however this is considered a specific and temporary activity.
	Inhalation and accumulation of groundwater vapours (including hazardous ground gases).	Human health: Current and future workers/ visitors along with intrusive maintenance workers.	POTENTIALLY COMPLETE	In the current layout of the site there is limited potential for accumulation, however the proposed development should consider if there is a potential risk from soil vapours and hazardous ground gases.

Source/ CoPC	Pathway	Receptor	Risk linkage	Notes
• **Nutrients** • **Hazardous ground gases**				
Stockpiled material: **Storage of waste materials, including soils/ fill that may be contaminated.** **CoPC** • **M8.** • **PAHs** • **TRH** • **BTEX** • **Asbestos** • **PFAS**	Direct contact with contaminated materials. Leaching of chemicals/ compounds over time.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	POTENTIALLY COMPLETE	Onsite stockpile was anecdotally reported to contain asbestos and PFAS. Small stockpile identified during site inspection. Soils underlying the stockpile should be validated to be free from unacceptable concentrations of CoPC following removal.
Offsite				
Former Gipps Street Landfill: **Historic waste disposal via landfilling.** **Includes AEC7 from M2A (2020).** **CoPC:** • **M8.** • **TRH/ TPH** • **BTEX** • **Naphthalene** • **PFAS**	Leaching of CoPC from waste into groundwater which may migrate beneath the site.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and groundwater.	POTENTIALLY COMPLETE	Available groundwater results indicate elevated indicators of landfill leachate (e.g. nutrients) in groundwater. These may be derived from application of fertilisers at the site and not as a result of off-site sources.
	Lateral migration of hazardous ground gases	Human Health: Current and future workers/ visitors along with intrusive maintenance workers.	POTENTIALLY COMPLETE	Hazardous ground gases may migrate a great distance from the source area along preferential pathways which can include natural stratigraphic variations.
Nearby service stations: • **TRH** • **BTEX** • **Naphthalene** • **Lead**	Leaks and spills from bulk hydrocarbon storage and dispensing systems impacting groundwater.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	POTENTIALLY COMPLETE	Low potential to be complete with regard to underlying soils and geology and position of service station sites down-inferred hydraulic gradient. Consideration to project dewatering may be required.

Notes:
NO LINKAGE – desktop review and site investigation did not identify a current risk(s) that was considered unacceptable.
POTENTIALLY COMPLETE – desktop review and site investigation identified a partially complete linkage that can be managed to ensure no unacceptable risk.
COMPLETE LINKAGE – desktop review and site investigation identified a complete risk linkage that presents an unacceptable risk and further assessment/ delineation is required.

M8	Heavy metals/ metalloids denote arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc
TRH	Total recoverable hydrocarbons
PAH	Polycyclic aromatic hydrocarbons
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
PCB	Polychlorinated biphenyls

8 METHODOLOGY

8.1 Intrusive investigation

8.1.1 Site contamination assessment

The mechanical test pitting assessment advanced 31 investigation locations in accordance with the SAQP and addendum (TTMP 2022 and Environmental Earth Sciences 2022). The mechanical test pitting was completed with an excavator to maximum depth of ~4.0 mBGL ensuring that fill material (where identified) was vertically delineated. The advanced test pits were backfilled with the excavated material, replacing material in the same order as it was removed. Given the site's rural residential history and the location of historic on-site structures, test pitting to investigate subsurface conditions is considered suitable for identifying if asbestos or ACM was present within the sub-surface. The test pit locations have been presented on **Figure 5**. NSW EPA (1995) recommends a minimum of 50 sampling points for a site area of 4 hectares.

The number of sampling locations is considered appropriate given soil investigation has already been completed at six locations (TTMP, 2022a), the conceptual site model, and with respect to additional investigation locations advanced during the Stockpile assessment (**Section 8.1.5**)

Screening of soils for potential ACM via collection of 10 L bulk samples, screened through a 7 mm sieve was undertaken at 11 test pits (IDs: TP1-TP3, TP6, TP7, TP12, TP15, TP18, TP20, TP24 and TP31). The clay nature of soils impeded the sieving process, such that 10 L was collected initially and then sieved before being visually inspected for potential ACM.

Site soils were logged in the field including descriptions of the encountered strata, extent of strata, colour, texture and observations of potential contamination (e.g. visual and/ or olfactory, if any). Soils were field screened using a calibrated photoionisation detection (PID) device to provide a semi-quantitative assessment of volatile organic compounds (VOC) within soil pore spaces that may indicate potential contamination. The calibration certificate is included in **Appendix A**.

Representative samples of soil material were collected at pre-determined intervals down the soil profile (i.e., 0.1 mBGL, 0.5 mBGL, 1.0 mBGL then one sample for each additional meter below) or where changes in the soil profile were noted. Soil samples were collected using a fresh pair of disposable nitrile gloves between samples from the excavated material. For sampling purposes, a fresh representative soil surface was exposed from within the material excavated, ensuring to exclude material that may have potentially contacted the excavator bucket directly. At each location, excavator buckets were scraped by hand with a shovel to remove loose material that was non-representative.

Three deep soil/ rock bores were advanced via rotary drilling using a poly-crystalline diamond (PCD) drill bit and potable water as the drilling fluid. Samples of drill cuttings were collected using a sieve to extract material at 0.5 m intervals. No drilling additives were used, and fresh potable water was used at each drilling location.

The samples were placed into laboratory supplied glass jars and transported to the laboratory in a chilled container under full chain-of-custody documentation. The laboratory was accredited by NATA for each analytical method used. Sampling of soil was conducted in accordance with the following:

- Standards Australia (1999) Guide to the investigation and sampling of sites with potentially contaminated soil, Part 2: Volatile substances (AS 4482.2), Standards Australia, Homebush, NSW
- Standards Australia (2005), Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds (AS 4482.1), Standards Australia, Sydney, NSW
- Environmental Earth Sciences NSW (2010), Procedures for field, laboratory and reporting quality assurance and quality control manual.
- Environmental Earth Sciences (2011), *Soil, gas and groundwater sampling manual*, 7th Edition (Unpublished).

8.1.2 Groundwater bore installation

The new deep groundwater monitoring bore (ID: GW-1028) was installed using class 18 uPVC screen and casing to depth of 21 mBGL and constructed with a 6 m screen due to the low permeability and porosity of the fine-grained sedimentary stratigraphy. The screen was machine slotted with 1 mm wide slits to allow groundwater to enter the bore with 2-3 mm graded sand used to create a filter to 0.5 m above the top of the screen section.

Above the sand a 0.5 m bentonite clay plug was installed to prevent groundwater from overlying water bearing zones entering the screen along with top-down water ingress through the bore annulus. The bore annulus was then grouted to the surface and finished with a steel monument.

Following installation, the groundwater monitoring bore was developed using a dedicated PVC bailer to remove water introduced through drilling along with fine sediments and foreign materials (e.g., plastic shavings) introduce by drilling and bore construction. The location of the bore GW-1028 has been included on **Figure 6**.

8.1.3 Groundwater sampling

Groundwater bores SMGW-BH-A190S and SMGW-BH-A365 were sampled per the SAQP and addendum (TTMP 2022 and Environmental Earth Sciences 2022). The sampling methodology was as follows:

- Prior to sampling, bores were dipped for standing water level (SWL) using an interphase meter to assess for potential light or dense non-aqueous phase liquids (L/ DNAPL), measuring to the highest point of the bore casing.
- Bores were also dipped to end of bore hole to ensure details match the indicated construction details from available borelogs.

- Waterra foot-valves were used to purge the monitoring bores and facilitate collection of samples to ensure that groundwater representative of aquifer conditions was being sampled.
- The tubing and Waterra foot-valve was dedicated to each bore to reduce potential for cross contamination to occur.
- A calibrated YSI water quality meter was used to measure field parameters as summarised in **Table 6**.

Table 6: Water quality parameters and acceptable limits

Parameter	Metric
pH	± 0.05 pH
Electrical conductivity (EC)	± 3% EC
Oxidation reduction potential (ORP)	± 10 mV ORP
Dissolved oxygen (DO)	± 10ppm DO when >1 ppm
Temperature	n/a

- Field parameters were measured *ex situ* with an in-line flow cells, with stabilisation criteria (**Table 6**) indicating that representative groundwater conditions were suitable for sample collection.
- Purging was undertaken until the above-mentioned groundwater parameters were stabilised, or until the bore was purged dry.
- Where bores purged dry due to the low yields of the aquifer, bores were allowed to recover prior to sampling.
- Representative groundwater samples were collected, using the same tubing and Waterra foot-valve, into clean laboratory supplied containers and submitted under full chain of custody documentation for analysis.
- For containers with preservatives, these were filled with sub-samples from un-preserved containers of the respective material (e.g., glass ambers for H_2SO_4 preserved VOC vials).
- VOC samples were collected, ensuring that appropriate zero headspace containers were used and that there was no headspace remaining within the container prior to sealing.

The location of the groundwater monitoring bores have been presented on **Figure 6**.

Field sampling sheets and calibration certificates have been included in **Appendix A**.

8.1.4 Hazardous ground gas screening

The GFM436 was used to record additional parameters such as borehole flow and atmospheric pressure. Flow was measured prior to assessing composition, connecting to

the quick connect fittings on the bores' gas cap to ensure representative sampling without external atmospheric influence.

The location of the gas monitoring bore has been presented on **Figure 6**.

Field sampling sheets and calibration certificates have been included in **Appendix A**.

8.1.5 Stockpile assessment

Mechanical excavation of eight test pits (IDs: TP201 to TP208) was undertaken into the footprint beneath the former large stockpile using an excavator to a maximum depth of ~1 mBGL. This assessment was undertaken following removal of the stockpile from the site to validate that underlying soils were not impacted as a result of the material stockpile being placed directly upon the site's soils. This stockpile was classified in accordance with NSW EPA (2014) by EDP Consulting (EDP, 2022) noting that the stockpile was noted to contain asbestos and low-level PFAS.

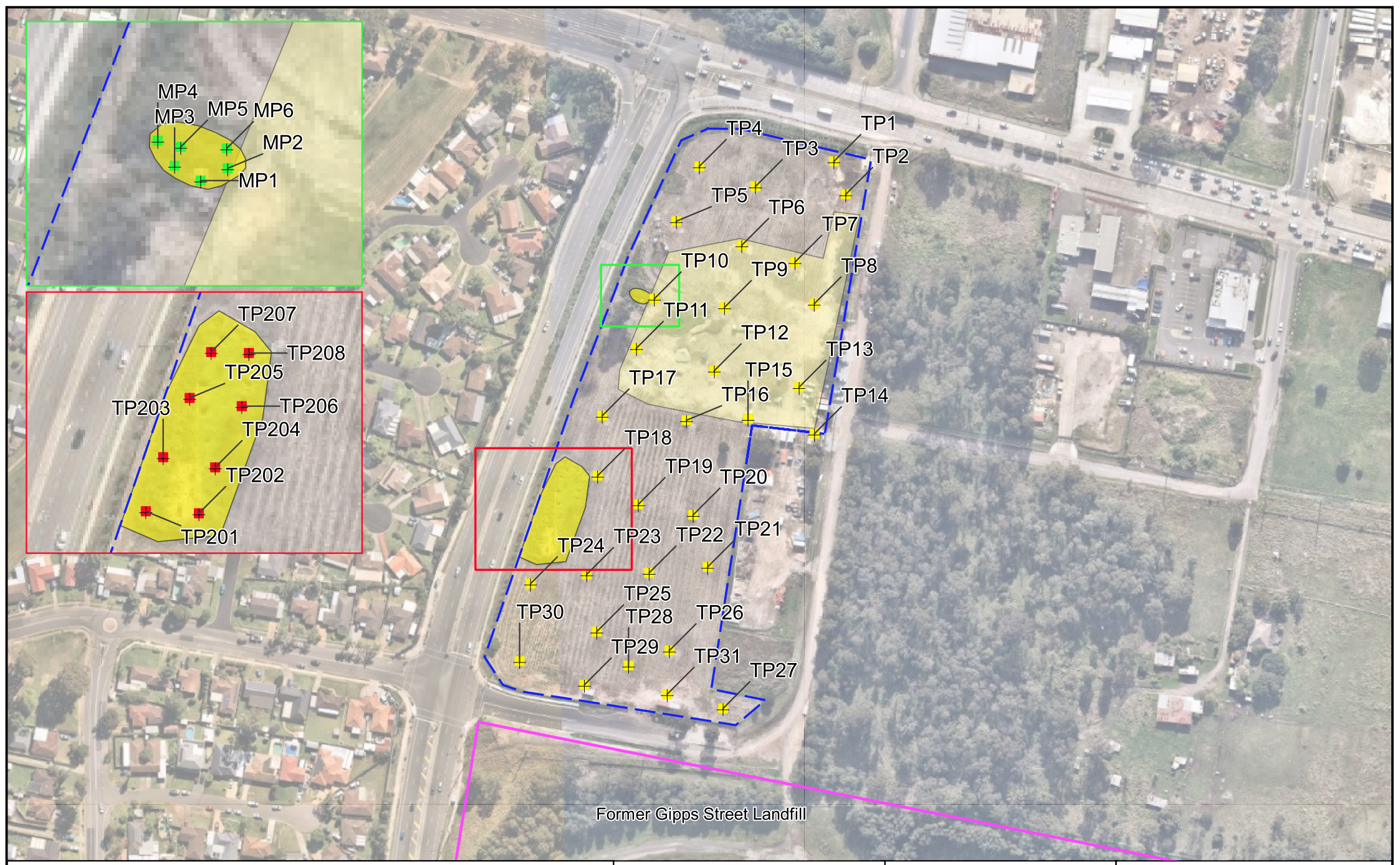
The soils beneath the footprint were logged in the field including descriptions of the encountered strata, extent of strata, colour, texture and observations of potential contamination (e.g., visual and/ or olfactory, if any).

Representative samples of soil material were collected at pre-determined intervals down the soil profile (i.e., ~0.1 mBGL, 0.5 mBGL and 1.0 mBGL). Soil samples were collected using a fresh pair of nitrile gloves between samples from the excavated material, ensuring that fresh, representative material was exposed and sampled.

A smaller stockpile near TP10 was also sampled with six soil samples (IDs: MP1 to MP6) collected from test pits advanced into the stockpile via manual methods.

Samples to be analysed for asbestos in soils were sieved in the field with a 7 mm metal sieve for an estimated 10 L of material, noting that the soils were clay texture dominated and not ideal for sieving.

The sample locations for the footprint of the former stockpile and the small stockpiled have been presented on **Figure 5**.



Legend

Sample Locations

- Site investigation
- Small stockpile
- former Stockpile footprint
- Site Boundary
- Former Gipps Street Landfill (approximate)

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Title: Soil Investigation Locations

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG | Scale: As Shown | Job No: 122045

Drawn By: SG | Date: July 2022

Figure 5

Legend

- Site Boundary
- Excluded Area
- Groundwater Bore
- Soil/ Rock Bore
- Gas Bore
- Unknown Bores
- Former Gipps Street Landfill (approximate)

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Title: Groundwater and Hazardous Ground Gas Investigation Locations

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG	Scale: As Shown	Job No: 122045
Drawn By: SG	Date: June 2022	

Figure 6

8.2 Laboratory analysis

Laboratory analysis was completed by laboratories accredited by NATA. Laboratory analysis was completed by:

- ALS Environmental Pty Ltd (ALS).
- Envirolab Services Pty Ltd.
- Sydney Analytical Laboratories (SAL).
- Australia Safer Environment and Technology (ASET).

8.2.1 Soils

Selected soil samples were submitted for the following:

- Eight priority heavy metals/ metalloids (As, Cd, C_{TOTAL}, Cu, Hg, Pb, Ni and Zn) – 100% of samples
- TRH (C_6 – C_{40}) / TPH (C_6 – C_{36}) – 100% of samples
- BTEX – 100% of samples
- PAH (including naphthalene) – 100% of samples
- OCP / OPP – 50% of samples
- Phenolic compounds – 50% of samples.
- Polychlorinated biphenyls (PCB) – 50% of samples
- Asbestos in soil (presence/ absences) – 100% of samples

Five soil samples were submitted for laboratory assessment of pH, total Fe and cation exchange capacity (CEC) to facilitate calculation of site-specific ecological investigation levels (EILs).

For samples collected from the deep bores, a reduced analytical suite was adopted due to the lack of potential contamination sources to migrate vertically. The samples from the deep bores were analysed for:

- Eight priority heavy metals/ metalloids – 100% of samples
- (C_6 – C_{40}) / TPH (C_6 – C_{36}) – 100% of samples
- BTEX – 100% of samples
- PAH – 100% of samples

Note: Considering the site's history, trace detections, preliminary CSM and the proposed use of the site, PFAS were not assessed for soils.

8.2.2 Groundwater

Both primary and the field duplicate groundwater samples were scheduled for laboratory for analyses of the following tests at laboratories accredited by NATA:

- TRH (C_6 – C_{40}) / TPH (C_6 – C_{36}).
- BTEX
- OCP
- Dissolved heavy metals / metalloids (As, Cd, Cr_{TOTAL}, Cu, Hg, Ni, Pb and Zn).
- Ionic balance (major cations and anions, nutrients, pH and TDS).

The reduced analytical suite for groundwater was selected considering the site's history and the low permeability and porosity of clays at the site likely preventing significant vertical (or lateral) migration of potential dissolved phase contamination.

8.2.3 Stockpiles

Selected soil samples from footprint of the former stockpile and the small stockpile were submitted for the following:

- Eight priority heavy metals/ metalloids (As, Cd, C_{TOTAL}, Cu, Hg, Pb, Ni and Zn) – 100% of samples
- TRH (C_6 – C_{40}) / TPH (C_6 – C_{36}) – 100% of samples
- BTEX – 100% of samples
- PAH (including naphthalene) – 100% of samples
- OCP / OPP – 50% of samples
- Phenolic compounds – 50% of samples.
- Polychlorinated biphenyls (PCB) – 50% of samples
- Asbestos in soil (presence/ absences) – 100% of samples
- Asbestos in materials – four samples of potential asbestos containing materials (ACM)
- Asbestos in soil (quantification as per ASC NEPM, 2013) – one sample
- PFAS (four samples from the stockpile footprint only)

9 SITE ASSESSMENT CRITERIA

9.1 Soils

Site assessment criteria was adopted given the proposed commercial industrial land use. The site assessment criteria were sourced from investigation and screening levels for the industrial/ commercial land use scenario (HIL D) of **Schedule B1** *Guideline on the investigation levels for soil and groundwater* from the ASC NEPM (2013). Typically for contaminant concentration to be considered acceptable for the respective land use criteria, the data set must conform to the following requirements:

- No single sample analytical result is greater than 250% of the site criteria.
- The 95% upper confidence limit (UCL) of the arithmetic mean of analytical results is below the site criteria.
- The arithmetic (or geometric in cases where the data is log-normally distributed) mean is below the site criteria.
- The standard deviation is less than 50% of the site criteria.

9.1.1 Health investigation levels

Applicable Tier 1 human-health criteria for commercial / industrial land use scenario (Setting 'D') from ASC NEPM (2013) are presented in **Table 7**.

Table 7: Health investigation level threshold criteria

Analytes	Health Investigation Level[1] (mg/kg)
	Commercial / industrial Setting D
Metals and Inorganics	
Arsenic [2]	3,000
Cadmium	900
Chromium (VI)	3,600
Copper	240,000
Lead [3]	1,500
Mercury (inorganic)	730
Nickel	6,000
Zinc	400,000
Polycyclic Aromatic Hydrocarbons (PAHs)	
Carcinogenic PAHs (as BaP TEQ) [4]	40
Total PAHs [5]	4,000

Notes:

1. Generic land uses are described in detail in Schedule B7 Section 3 of ASC NEPM (2013). HIL D - Commercial/industrial, includes premises such as shops, offices, factories and industrial sites.

2. Arsenic: HIL assumes 70% oral bioavailability. Site-specific bioavailability may be important and should be considered where appropriate (refer Schedule B7).
3. Lead: HIL is based on blood lead models (IEUBK for HILs A, B and C and adult lead model for HIL D where 50% oral bioavailability has been considered. Site-specific bioavailability may be important and should be considered where appropriate.
4. Carcinogenic PAHs: HIL is based on the 8 carcinogenic PAHs and their TEFs (potency relative to B(a)P) adopted by CCME 2008 (refer Schedule B7). The B(a)P TEQ is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its B(a)P TEF, given below, and summing these products.
5. Total PAHs: HIL is based on the sum of the 16 PAHs most commonly reported for contaminated sites (WHO 1998). The application of the total PAH HIL should consider the presence of carcinogenic PAHs and naphthalene (the most volatile PAH). Carcinogenic PAHs reported in the total PAHs should meet the B(a)P TEQ HIL. Naphthalene reported in the total PAHs should meet the relevant HSL.

PAH species	TEF	PAH species	TEF
Benzo(a)anthracene	0.1	Benzo(g,h,i)perylene	0.01
Benzo(a)pyrene	1	Chrysene	0.01
Benzo(b+j)fluoranthene	0.1	Dibenz(a,h)anthracene	1
Benzo(k)fluoranthene	0.1	Indeno(1,2,3-c,d)pyrene	0.1

9.1.2 Health screening levels

The Health Screening Levels (HSL) for commercial / industrial land use scenario (Setting 'D') for volatile petroleum hydrocarbons in soil are based on vapour intrusion risk associated with material type and depth of contamination (ASC NEPM, 2013). The HSLs are for assessing human health risk associated with inhalation, and depend on specific soil properties and depths, types of land use and characteristics of buildings for each land use scenario. Refer to the summary of Tier 1 HSLs in **Table 8**.

Table 8: Health screening level threshold criteria

Analyte	Soil type	0 m to <1 m	1 m to <2 m	2 m to <4 m	≥4 m
TRH (C_6-C_{10}) (F1) (minus BTEX)	Clay	310	480	NL	NL
TRH (>C_{10}-C_{16}) (F2) (minus naphthalene	Clay	NL	NL	NL	NL
Benzene	Clay	4	6	9	20
Toluene	Clay	NL	NL	NL	NL
Ethylbenzene	Clay	NL	NL	NL	NL
Total xylenes	Clay	NL	NL	NL	NL

Notes:

mg/kg Milligrams per kilogram
NL No applicable risk-based limit applies
F Short for 'Fraction' such that F1 is 'Fraction 1'.

9.1.3 Management limits

The adopted management limits (MLs) and for petroleum hydrocarbons in soil for commercial / industrial land use scenario have been applied to be protective of human health from dermal contact (ASC NEPM, 2013). Refer to **Table 9** for a summary of these ML threshold concentrations.

Table 9: Site-specific management limits

Analyte	Soil texture	Management limits for Commercial / industrial land use
		mg/kg
TRH (C_6-C_{10}) (F1)	Fine	800
TRH (>C_{10}-C_{16}) (F2)	Fine	1,000
TRH (>C_{16}-C_{34}) (F3)	Fine	5,000
TRH (>C_{34}-C_{40}) (F4)	Fine	10,000

Note: fine textured soils adopted based upon the predominantly clay materials encountered at the site.

9.1.4 Asbestos

HSLs for asbestos soil contamination within a commercial / industrial land use scenario are adopted from ASC NEPM (2013). Thresholds are summarised in **Table 10**.

Table 10: HSLs for asbestos in soil

HSL concentration (%w/w)	Commercial / industrial D
Bonded ACM	0.05 % w/w
FA and AF (friable asbestos)	0.001 % w/w
ACM on surface	Any visible asbestos

Notes:
1. FA denotes friable asbestos
2. AF denotes asbestos fines
3. The screening level of 0.001% w/w asbestos in soil for FA and AF (i.e. non-bonded/friable asbestos) only applies where the FA and AF are able to be quantified by gravimetric procedures. This screening level is not applicable to free fibres.

9.1.5 Ecological investigation levels

The ecological investigation levels (EILs) assigned by ASC NEPM (2013) - *Schedule B5a: Guideline on Ecological Risk Assessment* are adopted for this assessment. This guideline presents the methodology for deriving terrestrial EILs using both fresh and aged (i.e., >2 years old) contamination for soil in urban residential / public open space and commercial / industrial scenarios.

The methodology has been developed to protect soil processes, soil biota (flora and fauna) and terrestrial invertebrates and vertebrates. Adopted EILs for this assessment will be protective of commercial / industrial land use scenarios. Applicable EILs derived comprise the sum of ambient background concentrations (ABCs) and added contaminant limits (ACLs). The ACL concentrations are ascertained for representative locations based on site-specific results for either pH alone, or pH and cation exchange capacity (CEC) in accordance with procedures in ASC NEPM (2013) - *Schedule 5c: - EILs for As Cr Cu DDT Pb Naphthalene Ni Zn*.

Site specific EILs were calculated by using the average cation exchange capacity (CEC) and pH for soils encountered at the site. Baseline EILs are presented in **Table 11**.

Table 11: Generic EIL threshold criteria

Chemical	Adopted EILs (mg/kg)
	Commercial / industrial
Arsenic	160 [1]
Chromium (III)	670 [2]
Lead	1,800 [3]
Nickel	210 [2]
Copper	260 [2]
Zinc	630 [2]
DDT	640 [1]
Naphthalene	370 [1]

Notes:
1. Generic EIL adopted
2. Site-specific derived EIL (using average CEC and pH)
3. Generic ACL adopted

9.1.6 Ecological screening levels

Adopted ESL criteria for assessment are summarised in **Table 12** for fine soil textures encountered (ASC NEPM, 2013).

Table 12: Ecological screening level threshold criteria

Analyte	Commercial / industrial land use (mg/kg)
TRH (C_6-C_{10}) (F1) (minus BTEX)	215 *
TRH (>C_{10}-C_{16}) (F2) (minus naphthalene)	170 *
TRH (>C_{16}-C_{34}) (F3)	2,500
TRH (>C_{34}-C_{40}) (F4)	6,600
Benzene	95
Toluene	135
Ethylbenzene	185
Total Xylenes	95
Benzo(a)pyrene	172 **

Notes:
* ESLs are of low reliability except where indicated by * which indicates that the ESL is of moderate reliability
** Threshold adopted from CRC Care (2017) Technical Paper No.39

9.2 Solid waste

In NSW under the POEO Act the following classes of waste are formally defined:

- Special waste.
- Liquid waste.
- Hazardous waste (HAZ).
- Restricted solid waste (RSW).
- General solid waste (GSW) – non-putrescible.
- General solid waste (GSW) – putrescible.

The process for classification of waste materials in NSW is undertaken through a four-part process referred to as the 'Waste Classification Guidelines' with the four specific guideline documents and addendum being:

- NSW EPA (2014a) Waste Classification Guidelines - Part 1: Classifying waste.
- NSW EPA (2014b) Waste Classification Guidelines - Part 2: Immobilising waste.
- NSW EPA (2014c) Waste Classification Guidelines - Part 3: Waste containing radioactive material.
- NSW EPA (2014d) Waste Classification Guidelines - Part 4: Acid sulfate soils.

- NSW EPA (2016b) Addendum to the Waste Classification Guidelines (2014) - Part 1: Classifying Waste.

Part 1 of the *Waste Classification Guidelines* outlines the six-step assessment process for classifying waste summarised below:

- Step 1: Is the waste special waste?
- Step 2: Is the waste liquid waste?
- Step 3: Is the waste pre-classified?
- Step 4: Does the waste possess hazardous characteristics
- Step 5: Determining a waste's classification using chemical assessment
- Step 6: Is the waste putrescible or non-putrescible?

When waste classification cannot be determined from Steps 1 to 4, chemical characterisation (Step 5) is used to derive the waste classification in accordance with the *Waste Classification Guidelines*. The *Waste Classification Guidelines* initially require analytical results for contaminants to be compared to the CT as outlined in **Table 13** for classification where:

- value < CT1 = GSW
- value > CT1, but below CT2 = RSW
- value > CT2 = HAZ

If the presence of asbestos is confirmed, the classification of 'Special Waste – Asbestos' applies in addition to the classification derived from chemical analysis.

Table 13: Contaminant thresholds for waste classification (without TCLP)

Chemical	Maximum values of total concentration for classification without TCLP	
	General Solid Waste (CT1)	Restricted Solid Waste (CT2)
	Total Concentration (mg/kg)	Total Concentration (mg/kg)
Arsenic	100	400
Benzene	10	40
Benzo(a)pyrene	0.8	3.2
Cadmium	20	80
Chromium (VI)	100	400
Chlorpyrifos	4	16
Ethyl-benzene	600	2,400
Endosulfan	60	240
Lead	100	400

Chemical	Maximum values of total concentration for classification without TCLP	
	General Solid Waste (CT1)	Restricted Solid Waste (CT2)
	Total Concentration (mg/kg)	Total Concentration (mg/kg)
Mercury	4	16
Nickel	40	160
PAHs (total)	200	800
Phenol (non-halogenated)	288	1,152
Polychlorinated biphenyls	<50	<50
Scheduled chemicals	<50	<50
Styrene (vinyl benzene)	60	240
TPH fraction (C6 – C9)	650	2,600
TPH fraction (C10 – C36)	10,000	40,000
Toluene	288	1,152
Xylenes (total)	1,000	4,000
Moderately harmful pesticides (total)	250	1,000

Notes:
1. Totals expressed as milligrams per kilogram (mg/kg) on a dry weight basis.
2. Where chemical results exceed the maximum threshold for Restricted Solid Waste (CT2), then the waste is classified as Hazardous waste.
3. Waste classifications can be revised following completion of toxicity characteristic leaching procedure (TCLP).

If the total concentration for a contaminant exceeds the CT1 or CT2 threshold (**Table 13**), the potential leachability of the contaminant (following extraction via the toxicity characteristics leaching procedure – TCLP) can be used in conjunction with the specific contaminant concentrations (SCC) to derive a waste classification with regard to potential leachate risk:

- value < SCC1 / TCLP1 = GSW.
- value > SCC1 / TCLP1 but below SCC2 / TCLP2 = RSW.
- value > SCC2 / TCLP2 = HAZ.

The SCC and TCLP threshold from *Table 2* of NSW EPA (2014a) have been summarised in **Table 14**.

Table 14: Criteria for waste classification with TCLP

Chemical	Maximum values for leachable concentration and total concentration when used together			
	General Solid Waste		Restricted Solid Waste	
	Total (mg/kg)	Leachable (mg/L)	Total (mg/kg)	Leachable (mg/L)
Arsenic	500	5	2,000	20
Benzene	18	0.5	72	2
Benzo(a)pyrene	10	0.04	23	0.16
Cadmium	100	1	400	4
Chromium (VI)	1,900	5	7,600	20
Chlorpyrifos	7.5	0.2	30	0.
Ethylbenzene	1,080	30	4,320	120
Endosulfan	108	3	432	12
Lead	1,500	5	6,000	20
Mercury	50	0.2	200	0.8
Nickel	1,050	2	4,200	8
PAHs (total)	200	N/A	800	N/A
Phenol (non-halogenated)	518	14.4	2,073	57.6
Polychlorinated biphenyls	<50	----	<50	----
Scheduled chemicals	<50	----	<50	----
Styrene (vinyl benzene)	108	3	432	12
TPH fraction (C6 – C9)	650	N/A	2,600	N/A
TPH fraction (C10 – C36)	10,000	N/A	40,000	N/A
Toluene	518	14.4	2,073	57.6
Xylenes (total)	1,800	50	7,200	200
Moderately harmful pesticides (total)	250	----	1,000	----

Notes:
---- Indicates there is no leachable criterion for specified analytes.
Where analytical results exceed either the SCC2 or TCLP2 maximum thresholds, was is classified as 'hazardous waste'.

9.3 Groundwater

The following guidelines endorsed by the NSW EPA are adopted for the assessment of impact to surface water receptors from groundwater quality at the site:

- Australian and New Zealand Environment and Conservation Council (ANZECC) / Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) *Australian and New Zealand Guidelines for fresh and Marine Water Quality* (ANZECC / ARMCANZ, 2000).

- Australian and New Zealand Government (2018) *Guidelines for Fresh and Marine Water Quality* (ANZG, 2018).

- Friebel & Nadebaum (2011) Health Screening Levels for Petroleum Hydrocarbons in Soil and Groundwater, Part 1: Technical Development Document, September 2011, Technical Report No. 10, Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE).

- National Environment Protection Council (NEPC) (2013) National Environmental Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013) (ASC NEPM, 2013).

NSW Department of Environment and Conservation (DEC) (2007) provides the framework for the protection of groundwater and associated beneficial uses throughout NSW. NSW DEC (2007) allows for a consistent approach to the prevention of contamination of groundwater and clean-up of pollution of groundwater throughout NSW and sets environmental quality indicators and objectives for each beneficial use.

There are certain environmental values that are conducive to public benefit, welfare, safety or health that require protection from effects of pollution, waste discharge and deposits. From Schedule B6 Guideline on The Framework for Risk-Based Assessment of Groundwater Contamination of the ASC NEPM (2013), they are:

- Ecosystem protection.

- Aquaculture and human consumers of food.

- Agricultural water (irrigation and stock water).

- Recreation (primary and/or secondary contact) and aesthetics.

- Drinking water / potable use.

- Industrial water.

However, it is important to consider the background groundwater quality and therefore, environmental values may be precluded based on:

- Insufficient yield.

- Background level of water quality indicator/s other than total dissolved solids (TDS) precludes a beneficial use.

- Soil characteristics preclude a beneficial use.

- Groundwater quality restricted use zone has been declared by NSW EPA.

Any assessment of the likelihood of beneficial uses of groundwater being realised should be based on an evaluation of whether an owner/ occupier of the site (or in the vicinity of the site) may reasonably expect to use or be able to use groundwater for the relevant purposes. Based upon the zoning of the site ecosystem protection for Claremont Creek and South Creek located ~100 m west and ~500 m east from the site respectively (freshwater bodies) is the most relevant anticipated concept for groundwater at the site.

ANZECC/ ARMCANZ (2000) (updated to ANZG, 2018 guidelines) and ASC NEPM (2013, Table 1C) outline the relevant threshold criteria for ecosystem protection. As groundwater is expected to discharge into South Creek to the north east, a freshwater environment and slightly impacted by nearby human activities, the 95% protection of species guideline for a freshwater ecosystems is considered the most suitable criteria for the groundwater assessment at the site. The adopted Tier 1 criteria for protection of human health and the environmental are listed in **Table 15**.

Table 15: Tier 1 criteria for groundwater

Analyte	Units	Ecosystem [1]	Industrial [2]	Direct contact / recreation [3]
Inorganics				
pH	pH Unit	6.5 - 8.5	----	----
Ammonia	mg/L	0.91	----	----
Nitrate	mg/L	10.6 [H]	----	----
Arsenic	mg/L	0.024	----	0.1
Cadmium	mg/L	0.0014	----	0.02
Chromium III	mg/L	0.027	----	0.5
Chromium VI	mg/L	0.001	----	----
Copper	mg/L	0.0014	----	20
Lead	mg/L	0.0034	----	0.1
Mercury (inorganic)	mg/L	0.00006 [4]	----	0.01
Nickel	mg/L	0.011	----	0.2
Zinc	mg/L	0.008	----	30
Organics				
Benzene	µg/L	950	30,000	1
Toluene	µg/L	180	NL	800
Ethylbenzene	µg/L	80	NL	300
Total xylenes	µg/L	75 [5]	NL	600
TRH (F1)	µg/L	----	NL	700
TRH (F2)	µg/L	----	NL	180
Naphthalene	µg/L	16	NL	170

Notes:

1. 95% species protection for marine ecosystems (ANZG, 2018)
2. ASC NEPM (2013) Health screening level (commercial / industrial land use in clay (>2 – 4m depth)
3. Recreational water quality guidelines (ANZG, 2018)
4. 99% species protection for marine ecosystems (ANZG, 2018) considering bioaccumulation
5. Criteria value for meta-xylene applied to total xylenes.

µg/L Micrograms per litre

mg/L	Milligrams per litre
LTV	Long-term trigger value
STV	Short-term trigger value
H	Hickey (2013) value used for nitrate

9.4 Hazardous ground gases

Potential risks associated hazardous ground gases are assessed in accordance with NSW EPA (2020) *Contaminated Land Guidelines: Assessment and management of hazardous ground gases*. The framework consists of a tiered approach as follows:

- Level 1 risk assessment – fully qualitative
- Level 2 risk assessment – partially quantitative
- Level 3 risk assessment – quantitative

The three levels require increasing amounts of data such that a level 1 risk assessment can be completed with a limited amount of detail while a level 3 risk assessment is undertaken via modelling and probabilistic estimates of (rare) event occurrence.

For the purposes of this assessment the adoption of thresholds from NSW EPA (2016) - *Environmental Guidelines Solid Waste Landfills, Second edition* are considered acceptable as a 'Tier 1' values for screening. It is noted that these guidelines are used by NSW EPA to assess applications for new or varied landfill licences under the POEO Act and to assess issues arising post-closure of landfills. The relevant thresholds for further investigation and corrective action from NSW EPA (2016) have been presented in **Table 16**.

Table 16: Hazardous ground gas thresholds

Analyte	Units	Value
Methane	% v/v	1.0[1]
Carbon dioxide	% v/v	1.5[1]
Oxygen	% v/v	<18%

Notes:
1. Threshold values are noted to be "above established natural background levels"
2. % v/v is % volume/ volume.

It should be noted that hazardous ground gas assessments should attempt to obtain samples under a variety of climatic conditions so as to capture a 'worst-case' scenario, broadly defined as continued decrease in barometric pressure of ≥ 4 mbar across a minimum three hour duration (CL:AIRE, 2018).

10 INVESTIGATION RESULTS

Investigation results from the intrusive assessment and sampling of environmental media have been presented against the adopted site assessment criteria along with observations from site works in the following subsections. The *in situ* waste classification assessment has been presented separately in **Section 13**.

10.1 Soils

10.1.1 Field observations

A general summary of the observed sub-surface conditions encountered during the intrusive assessment has been summarised in **Table 17**. Sampling locations are shown in **Figure 3** with bore and test pit logs provided in **Appendix B**. Photographs from the test pitting investigation are provided in **Appendix C**.

Table 17: Summary of sub-surface stratigraphy

General stratigraphy	General depth range (mBGL)	Comment
FILL Gravel with brown sandy clay	0.0 - 0.30 m; 0.30 - 0.40 m.	Road base-type material present in the centre of the site. Not present in all locations but sometimes found beneath a clay fill layer.
FILL Brown, sandy clay with trace concrete and brick fragments	0.20 - 2.50 m	Present to depth in TP04 and TP05 in the north west corner of the site and slightly shallower (0.9 mBGL) in TP9. Otherwise generally shallow (<0.5 mBGL).
NATURAL Firm to stiff, brown clay with orange mottles and trace organics (rootlets) or very stiff red/ light grey clay, at times mottled.	0.40 - 1.70 m	Trace ironstone gravels and at times becoming weathered shale at depth. Roots often degraded and black.
NATURAL Highly weathered to weathered bedrock	~1.00 m	Weathered shale and sandstone bedrock, not often encountered with most locations terminated in clay.

- Potential asbestos containing material (PACM) was not observed during the test pitting assessment.
- Groundwater seepage was encountered at TP4 (3.20 mBGL) and TP10 (2.20 mBGL, from ground surface).
- The highest PID reading was 1.2 ppm which is not indicative of hydrocarbon/ volatile impact. PID readings have been provided on detailed borelogs within **Appendix B** and calibration certificates have been provided in **Appendix A**.

10.1.2 Analytical results

Tabulated laboratory results are presented in **Appendix D** as listed below and laboratory certificates of analysis are provided in **Appendix E**. Tabulated results have been presented as follows:

- **Table A** – TRH, BTEX and PAH laboratory results summary.
- **Table B** – OCP, OPP and PCB laboratory results summary.
- **Table C** – Inorganics laboratory results summary (e.g. heavy metals and metalloids) and asbestos
- **Table D** – EIL calculation parameters.

The reported concentrations of CoPC were either below the adopted site assessment criteria when considering the suitability of the site for use as a construction site (refer **Section 9**) or the laboratory's limit of reporting (LOR). A brief summary of the reported results has been presented below.

- Low concentrations of heavy metals below adopted site assessment criteria with some reported below the LOR.
- PAH were mostly below the LOR with low detections in sample ID TP12_0.2 of pyrene and fluoranthene.
- BTEX compounds were reported below the LOR in all samples.
- Low detections of middle to heavy end TRH with maximum reported concentration of TRH >C_{16}-C_{34} of 390 mg/kg and TRH >C_{34}-C_{40} of 670 mg/kg both in sample ID TP11_0.2.
- Reported concentrations of OCP/ OPP and PCB were below the laboratory's LOR.
- Asbestos was not detected in any samples except for friable asbestos (FA) in one sample sample (ID: TP15_0.0-0.1) which was quantified at 0.0004% w/w and below the adopted HSL.

10.2 Groundwater

10.2.1 Field results

The field data collected during groundwater monitoring from the two bores samples has been summarised in **Table 18** while SWL was measured as:

- SMGW-BH-A190S – 2.00 mBGL (25.39 mAHD).
- SMGW-BH-A365 – 3.14 mBGL (29.96 mAHD).

Table 18: Summary of groundwater field data at sampling

Location ID	Sample date	DO (ppm)	EC (µS/cm)	pH	ORP (mV)	Temp (°C)	Odour	Colour
SMGW-BH-A190S	5 May 22	4.81	946	6.36	156	18.1	None	Cloudy, light brown.
SMGW-BH-A365	5 May 22	0.37	31,471	6.18	-40	19.7	None	Cloudy, light brown.

Notes:

DO	Dissolved oxygen	PPM	Parts per million
EC	Electrical conductivity	µS/cm	Microseimens per centimetre
ORP	Oxygen reduction potential		

10.2.2 Analytical results

Groundwater analytical results compared to adopted site assessment criteria are presented in **Table E** (inorganics) and **Table F** (organics) within **Appendix D**. Laboratory certificates of analysis are provided in **Appendix E**.

Concentrations of nutrients (ammonia as N) were below the adopted site assessment criteria in both samples of groundwater at 0.7 mg/L and 0.2 mg/L for SMGW-B365 and SMGW-BH-A109S respectively. The shallow bore (SMGW-BH-A109A) also reported detections of nitrate and ortho-phosphate which were below the LOR in the deep bore (SMGW-BH-A365).

The majority of dissolved heavy metals were below the LOR with the exception of zinc, iron and manganese with zinc and manganese reporting above the adopted site assessment criteria in both bores as summarised below:

- SMGW-BH-A109S
    - Zinc at 0.051 mg/L
    - Manganese at 2.9 mg/L
- SMGW-BH-A365
    - Zinc at 0.028 mg/L
    - Manganese at 2.10 mg/L

All organic compounds (TRH, BTEX, OCP and OPP) were reported below the LOR in both groundwater samples submitted.

10.3 Hazardous ground gas

Hazardous ground gas screening was completed via hand-held instrumentation on one subsurface gas monitoring bore (ID: SMWSA-BH-A366) on 5 May 2022. Weather

observations and climatic data[1] from the day of sampling has are presented in **Table 19** and the results of this screening have been presented in **Table 20**.

Table 19: Weather observations – 5 May 2022

Date	Weather	Min. temp. (°C)	Max. temp. (°C)	Rainfall (mm)	Max. wind gust (km/hr/ direction)	Barometric pressure (mbar)
5 May 2022	Clear and sunny	14.6	23.3	0.8	20 / SW	1013.7 – 1011.6

Table 20: Summary of hazardous ground gas screening

Analyte	Units	Threshold	SMWSA-BH-A336
Flow	L/hr	----	<0.1
Bore Pressure	mbar	----	<0.1
Atmospheric Pressure	mbar	----	1006
Methane	% v/v	>1.0 [5]	<0.1
Carbon Dioxide	% v/v	>1.5 [5]	18
Oxygen	% v/v	<18 [6]	0.1
Balance[8]	% v/v	-	81.9
Carbon Monoxide	ppm	-	<1
Hydrogen Sulphide	ppm	-	<1

Notes:

1. L/ hr is litres per hour
2. mbar is millibar
3. % v/v is % volume per volume
4. ppm is parts per million
5. Thresholds after NSW EPA (2016) *Environmental Guidelines*: *Solid Waste Landfill* and are 'above background values'
6. Threshold is for a depleted oxygen environment.
7. Minimum instrument resolution presented where results were read as '0'.
8. Balance is 100 – sum of measured gases, mostly comprised of nitrogen and less amounts of argon.

[1] Sourced from Bureau of Meteorology (www.bom.gov.au, dated 19 September 2022) Badgerys Creek weather station, approximately 14.5 km south of site.

10.4 Stockpiles

10.4.1 Stockpile footprint validation

Field observations

Environmental Earth Sciences NSW undertook validation sampling of the footprint beneath the former stockpile that was initially excluded from the site investigation on 13 July 2022. It is understood that this stockpile was removed under instruction from Sydney Metro with offsite disposal of the soil material in accordance with the waste classification report prepared by EDP (2022).

The walkover of the footprint area observed exposed bare soil with little to no vegetation and with several fragments of plastic and ceramic tile in addition to one fragment of a vinyl tile at the surface. The subsurface stratigraphy in the eight test pits (IDs: TP101 to TP108) was similar to that from the wider site investigation assessment and is briefly described below:

- Topsoil / fill material: brown, clay with minor gravels and trace anthropogenic materials (e. g., glass, tiles and plastic).
- Natural: red/ light brown, very stiff clay with minor mottles (red/ grey).

A narrow metal pipe was identified in TP1 and continued through to TP2 and TP3 with no olfactory indication of potential fuel hydrocarbons either around or emanating from the pipe.

Groundwater seepage was not identified in the eight test pits (IDs: TP201 to TP208) advanced to ~1 mBGL

Analytical results

Tabulated laboratory results for the former stockpile footprint are presented in **Appendix D** in **Table G** and laboratory certificates of analysis are provided in **Appendix E**.

The reported concentrations of CoPC were either below the adopted site assessment criteria when considering the suitability of the site for use as a construction site (refer **Section 9**) or the laboratory's LOR. A brief summary of the reported results has been presented below:

- Low concentrations of heavy metals below adopted site assessment criteria with some reported below the LOR.
- PAH were below the LOR in all samples.
- BTEX compounds were reported below the LOR in all samples.
- TRH were below the LOR in all samples
- Reported concentrations of OCP/ OPP and PCB were below the laboratory's LOR.
- Asbestos as AF (<7 mm) was detected in one sample (ID: TP207_0.05) at a concentration of 0.0002% w/w (below adopted HSL-D site assessment criteria).

- Low concentrations of PFAS were reported in the four samples submitted for screening with all samples (IDs: TP203_0.05, TP204_0.05, TP206_0.05 and TP207_0.05) reporting below the site acceptance criteria for commercial / industrial land use (HEPA, 2020).

10.4.2 Small stockpile

Field observations

A small stockpile of material was noted near TP10 with estimated dimensions including:

- 10 m long.
- 15 m wide.
- 1 m high.

The small stockpile was noted to be a mixture of mulch (~20%) and igneous gravels (~30%) and soil (~50%). The mulch was most prevalent on the western end and top of the stockpile while gravels and soils were mixed throughout.

Analytical results

Tabulated laboratory results are presented in **Appendix D** within **Table H** and laboratory certificates of analysis are provided in **Appendix E**.

The reported concentrations of CoPC were either below the adopted site assessment criteria when considering the suitability of the site for use as a construction site (refer **Section 9**) or the laboratory's limit of reporting (LOR). A brief summary of the reported results has been presented below.

- Low concentrations of heavy metals below adopted site assessment criteria with some reported below the LOR.
- PAH were mostly below the LOR noting one sample (ID: MP5) had an elevated LOR but within acceptable limits.
- BTEX compounds were reported below the LOR in all samples.
- TRH were below the LOR in all samples
- Reported concentrations of OCP/ OPP and PCB are below the laboratory's LOR.
- Asbestos was not detected in any samples.

11 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance is achieved by confirming field or anticipated results based upon the comparison of field observations with laboratory results. Field observations are compared

with laboratory results when they are not as expected and confirmation, re-sampling and reanalysis are undertaken if results cannot be correlated.

A full appraise of QA and QC has been presented in **Appendix F** while a brief summary of QA and QC evaluation has been presented herein. The overarching QA and QC process aims to ensure that the results of intrusive site investigation and laboratory analysis are complete and representative of the site's contamination condition.

11.1 Field QA and QC summary

11.1.1 Holding times

All samples were submitted to the requisite laboratories within the recommended holding times.

11.1.2 Relative percentage difference appraisal

Collection of field (blind) duplicates and interlaboratory (split) duplicates assess for comparability between field sampling methods and laboratory extraction and analysis (between laboratories). The laboratory reported concentrations in primary samples were compared to those reported in blind and split duplicate samples and relative percent difference (RPDs) calculated.

The minimum frequency of 5% was considered to be met by the collection and analysis of five field (blind) duplicates and five interlaboratory duplicates for 80 primary soil samples and one field (blind) duplicate for two primary groundwater samples.

All RPD calculations were considered within the acceptable range when considering the MDQI thresholds (see *Table 2* of **Appendix F**) for the reported LORs. Where RPDs were outside the acceptable limits, this was discussed in **Appendix F** and were not considered to impact on the quality of the results as all results adhered to chemical laws or were not outside logical explanation.

11.1.3 Sample transport and handling

All samples were submitted to the requisite laboratories in sealed eskies under full chain of custody documentation.

To assess for potential volatile loss or cross contamination during sampling transport laboratory prepared trip blank and trip spike samples were submitted along with the

Two trip blank and trip spike pairs were submitted for the three batches of soil sample submitted which is below the required one per batch, however volatiles (TRH C_6-C_{10} and BTEX) were note identified in concentrations in soil results to suggest these were a high-risk CoPC. No trip blanks or trip spikes were submitted for water samples which was not anticipated to invalidate the assessment as volatiles (TRH C_6-C_{10} and BTEX) were reported below the LOR which aligns with observations in the field (e.g. no odours or sheens).

11.2 Laboratory QA/QC summary

Quality control was achieved by using a NATA accredited laboratory supported by internal duplicates, the checking of high, abnormal or otherwise anomalous results, against background and other chemical results for the sample concerned. Internal laboratory QA and QC frequencies are determined by the laboratory with duplicate analysis undertaken on a basis of one duplicate for every 20 analysed (5%).

The appraisal of the internal laboratory QA and QC indicated the following:

- No method blank outliers reported for all samples.
- No surrogate outliers reported for all samples (with one exception in ES2214734).
- Recoveries for matrix spike samples were reported in acceptable limits for the laboratory, with the exception of one matrix spike sample.
- Recoveries for laboratory control samples were reported in acceptable limits for the laboratory.
- RPDs for laboratory duplicate samples were reported within acceptable ranges for the laboratory (RPD <20 – 70%).
- All laboratory duplicate samples passed acceptable limits for ALS laboratory with the following exceptions:
    - Cr_{TOTAL} in soil for ES2215508 with a RPD of 46.9%
    - Cr_{TOTAL} in soil for ES2214734 with a RPD of 36.1%

The above exceedances of ALS' internal RPD criteria were discussed with ALS who indicated that these results were re-run and RPDs exceeded on all occasions indicating a degree a heterogeneity within the sample material. As all results were reported below relevant site assessment criteria and ALS attempt to re-run the samples with the same (or similar) conclusions, these exceedances are not considered to invalidate the dataset.

12 DISCUSSION AND REVISED CSM

12.1 Soil

The site is underlain by fill material of variable quality, it includes gravel with brown sandy clay, and sandy clay with trace brick and concrete fragments.

The reported concentrations of CoPC were below the laboratory's LOR and the adopted site assessment criteria considering a commercial/ industrial land-use scenario.

The intrusive assessment of the site did not identify widespread or visible asbestos/ ACM impact, however it is noted that the vegetation ground cover on the southern end of the site may have reduced the ability to identify potential asbestos/ACM visually.

The deepest fill material in TP4 and TP5 is considered to have been placed relatively recently, likely due to the infilling of temporary onsite retention/ sediment dams when the site was used for construction purposes c. 2016 (Nearmap imagery).

This indicates that the site's predominant historical use as a rural agricultural residence has not resulted in contamination of soils and is unlikely to pose an unacceptable risk to identified receptors or could be acting as a secondary source of contamination to soil water / groundwater.

Asbestos was detected through laboratory assessment as FA in one surface sample (ID: TP15_0.05) however was reported below the adopted HSL-D assessment criteria. It is understood that the principal contractor (CPBG) has prepared an asbestos management plan (SMWSASBT-CPG -1NL-NL000-SF-PLN-000024) to ensure appropriate management of any further potential unidentified asbestos impacts in soil during the construction stage. It is noted that the underlying sample at TP15 (ID: TP15_0.5) did not report a positive detection of ACM/ AF/ FA, indicating that impact is likely restricted to the surface/ shallow sub-surface.

12.2 Groundwater

Groundwater inflow was observed during the intrusive investigation at a depth of 2.20 mBGL at location TP10 and 3.20 mBGL at location TP4. At both locations the groundwater was present within underlying natural clay material. The lack of groundwater at other test pit locations indicates that groundwater is shallow, perched, and discontinuous. This suggests that groundwater with the potential to be impacted by site activities was not encountered onsite.

The depth to groundwater measured in the two monitoring bores sampled as during the investigation was 2.00 mBGL (SMGW-BH-A190S) and 3.14 mBGL (SMGW-BH-A365). This equates to a groundwater elevation of between 25.4 – 30.0 mAHD between locations SMGW-BH-A190S and SMGW-BH-A365 respectively. With consideration to the nearby surface water features, groundwater flow is inferred to be northly and broadly aligned with regional topography.

Groundwater samples from the two bores reported two broad chemistries likely reflecting the shallow (alluvial) groundwater system and the deeper bedrock system. These systems were dominated by the same cations and anions (Na^+ and Cl^-) but an order of magnitude difference in concentrations. The sub-dominant cations and anions in each system were different with the shallow system (bore SMGW-BH-A109S) having greater proportions of Ca^{2+} and HCO_3^- while the deeper (bore SMGW-BH-A365) had greater Mg^{2+} and SO_4^{2-}. This is potentially a reflection of the deeper groundwater system being comprised of connate water while the shallow is precipitation dominated.

The two groundwater samples collected and analysed did not indicate impact from landfill leachate with potential indicators of leachate impact (e.g., ammonia, nitrate and potassium) generally at anticipated background concentrations for groundwater systems beneath agricultural land. The identified groundwater impacts from ammonia and nitrate were reported below the adopted site assessment criteria for toxicants.

The potential risk posed by groundwater to receptors is low as the majority of analytes were reported below the adopted site assessment criteria, although it is recognised that certain

heavy metals exceeded. These exceedances were in both groundwater samples collected for Fe, Mn and Zn, which is likely a reflection of natural background conditions not a contamination from an on-site (or off-site) source.

Groundwater beneath the site was considered to have limited potential for beneficial reuse due to the high TDS/ salinity and/ or low productivity due such that use for stock watering, irrigation or drinking water was considered untenable.

Assessment of water groundwater quality for the site is ongoing and will need to be updated as the monitoring program progresses as outlined in the GWMP (TTMP, 2022b).

12.3 Ground gas

The concentration of methane at bore SMWSA-A366 was reported below the minimum resolution of the handheld gas analyser of 0.1 % v/v, while the flow rate was also below the minimum resolution of 0.1 L/hr. Carbon dioxide was reported above the threshold value of 1.5% v/v at 18% v/v, however it is recognised that the threshold from NSW EPA (2016) is 'above background values' but there is currently no comparable background for the site.

The sampling conditions for the HGG screening were not considered to represent a 'worst-case' scenario.

12.3.1 Stockpile assessment

The samples of soils collected from the footprint of the stockpile that was removed from site reported all CoPC below the adopted site assessment criteria. It is noted one sample (ID: TP207_0.05) reported a positive identification of AF as cement fibre material with an estimated 0.00002 %w/w (i.e. below the adopted screening level for AF under all sites).

Samples from the smaller stockpile near TP10 were reported below the adopted site assessment criteria and were not reported to contain asbestos.

12.4 Revised Conceptual Site Model

The preliminary CSM as presented in Environmental Earth Sciences (2022) and summarised in **Section 7** has been revised considering the results of the site investigation in **Table 21**.

Table 21: Revised Conceptual Site Model

Source/ CoPC	Pathway	Receptor	Risk linkage	Notes
On-site				
Soil soils and fill materials: **Historic site uses indicates potential for application of pesticides and herbicides at the surface. Storage of pesticides may have occurred. Localised uncontrolled fill may have historically occurred.** **Includes AEC5 from M2A (2020).** **CoPC:** • **Heavy metals/ metalloids** • **OCP/ OPP.** • **TRH / TPH** • **BTEX** • **PAH** • **Asbestos**	Direct contact with contaminated materials. Application of CoPC to site surfaces along with spills and leaks into environmental media and downward migration into the sub-surface.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes. Groundwater: Shallow groundwater system.	NO LINKAGE	Analytical results did not exceed the assessment criteria adopted based on the proposed land use.
	Lateral migration with groundwater flow toward receptors.	Ecological: Surface water bodies of South Creek	NO LINKAGE	Groundwater flow is likely slow due to the underlying soils being clay dominated derived from shale bedrock. Furthermore, environmental receptors are relatively distal, which means natural attenuation would occur even if contamination was present.
	Inhalation of vapour from soil and/ or groundwater	Human health: Current and future workers/ visitors along with intrusive maintenance workers	NO LINKAGE	Volatile CoPC are not present at concentrations above the assessment criteria.
	Inhalation of asbestos fibres	Human health: Current and future workers/ visitors along with intrusive maintenance workers	NO LINKAGE	Friable asbestos was identified in one soil sample collected at TP15 from the top 150 mm of the soil profile. However, the reported concentration was below the asbestos HSL.
Historic building footprints: **Use of hazardous building materials and poor demolition practices** **CoPC:** • **Heavy metals/ metalloids** • **OCP/ OPP** • **Asbestos**	Direct contact with contaminated materials.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes.	NO LINKAGE	Analytical results did not exceed the assessment criteria adopted based on the proposed land use.
	Vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Groundwater: Shallow groundwater.	NO LINKAGE	Analytical results did not exceed the assessment criteria adopted based on the proposed land use.
	Inhalation of asbestos fibres	**Human Health:** Site workers/ visitors and intrusive maintenance workers.	NO LINKAGE	Friable asbestos was identified in one soil sample collected at TP15 from the top 100 mm of the soil profile. However, the reported concentration was below the asbestos HSL.
Potential former service station • **Lead** • **TRH / TPH** • **BTEX** • **PAH (including naphthalene)**	Direct contact with contaminated materials.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes.	POTENTIALLY INCOMPLETE	All CoPC were reported below the LOR or adopted site assessment criteria. It is noted that the number of test pits advanced in the location of the potential former service station was low. Further assessment would increase confidence that no unacceptable risk exists.
	Vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Groundwater: Shallow groundwater.	POTENTIALLY COMPLETE	Groundwater was not found to contain elevated CoPC. It must be noted that location of groundwater bores were not located so as to close-out this potential risk pathway. Prior to assessing groundwater, further assessment of soils (as above) would

Source/ CoPC	Pathway	Receptor	Risk linkage	Notes
				determine if additional sampling of groundwater via targeted bores in this area would be warranted.
Former on-site retention/ sediment basins: **CoPC (see overleaf):** • **Heavy metals/ metalloids** • **OCP/ OPP.** • **TRH / TPH** • **BTEX** • **PAH** • **Asbestos**	Direct contact with contaminated materials.	Soils: Human Health: Site workers/ visitors and intrusive maintenance workers Ecological: Flora, fauna and soil processes.	NO LINKAGE	Site investigations identified deep fill material in two test pits (IDs: TP4 and TP5), which from Nearmap imagery is interpreted to be the location of earlier on-site retention/ sediment basins. These basins were associated with constructions activities either at the site or nearby and were constructed c. 2016 and then backfilled c. 2018. Anthropogenic material was identified within these test pits and laboratory assessment indicated there were no unacceptable risks posed by contaminants in soil to identified receptors.
	Vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Groundwater: Shallow groundwater.	NO LINKAGE	
	Inhalation of asbestos fibres	**Human Health:** Site workers/ visitors and intrusive maintenance workers.	NO LINKAGE	
Contaminated groundwater: **Migration of contaminated groundwater beneath the site.** **Includes AEC6 from M2A (2020).** **CoPC:** • **Heavy metals/ metalloids** • **TRH.** • **BTEX and Naphthalene.** • **VOC.** • **pH** • **Nutrients** • **Hazardous ground gases**	Downward vertical migration of CoPC from soils/ fill materials leaching into shallow groundwater.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	NO LINKAGE	Groundwater migration is anticipated to be slow due to the underlying soils and geology. Potential interaction between site workers/ visitors with groundwater is considered unlikely given depth to groundwater and proposed construction activities. The exception may be where dewatering is required, however this is considered a specific and temporary activity.
	Inhalation and accumulation of groundwater vapours (including hazardous ground gases).	Human health: Current and future workers/ visitors along with intrusive maintenance workers.	POTENTIALLY COMPLETE	Hazardous ground gas within the subsurface is comprised of carbon dioxide with low/ no oxygen with no flow or pressure, however no assessment of background conditions is available therefore results may indicate migration onto the site. Any works below ground as part of proposed construction are likely to be well ventilated.
Stockpiled material: **Storage of waste materials, including soils/ fill that may be contaminated.** **CoPC** • **Heavy metals** • **PAHs** • **TRH** • **BTEX** • **Asbestos**	Direct contact with contaminated materials. Leaching of chemicals/ compounds over time.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	POTENTIALLY COMPLETE	The on-site stockpile was excluded from the assessment under the understanding that this would be managed and removed by others. Anecdotal information indicated potential for asbestos and PFAS to be present within the stockpile. Soils underlying the stockpile should be validated to be free from unacceptable concentrations of CoPC following removal.

Source/ CoPC	Pathway	Receptor	Risk linkage	Notes
• **PFAS**				
Off-site				
Former Gipps Street Landfill: **Historic waste disposal via landfilling.** **Includes AEC7 from M2A (2020).** **CoPC:** • **Heavy metals. metalloids** • **TRH/ TPH** • **BTEX** • **Naphthalene** • **PFAS**	Leaching of CoPC from waste into groundwater which may migrate beneath the site.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and groundwater.	NO LINKAGE	Beneficial use of groundwater considered unlikely due to low porosity and permeability. Given depth to groundwater, direct contact is not likely to occur. Concentrations of heavy metals/ metalloids considered representative of background and not due to site contamination. Other COPC do not exceed the adopted assessment criteria.
	Lateral migration of hazardous ground gases	Human Health: Current and future workers/ visitors along with intrusive maintenance workers.	POTENTIALLY COMPLETE	Hazardous ground gases may migrate a great distance from the source area along preferential pathways which can include natural stratigraphic variations. The highly limited assessment to date is not suitable to close out migration from off-site sources on to the site.
Nearby service stations: • **TRH** • **BTEX** • **Naphthalene** • **Lead**	Leaks and spills from bulk hydrocarbon storage and dispensing systems impacting groundwater.	Human Health: Current and future workers/ visitors along with intrusive maintenance workers. Ecological: Flora, fauna and soil processes, groundwater.	NO LINKAGE	The service stations are down-hydraulic gradient of the site, meaning contamination would migrate away from the site rather than towards it.

Notes:
NO LINKAGE – desktop review and site investigation did not identify a current risk(s) that was considered unacceptable.
POTENTIALLY COMPLETE – desktop review and site investigation identified a partially complete linkage that can be managed to ensure no unacceptable risk.
COMPLETE LINKAGE – desktop review and site investigation identified a complete risk linkage that presents an unacceptable risk and further assessment/ delineation is required.

M8	Heavy metals/ metalloids denote arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc
TRH	Total recoverable hydrocarbons
PAH	Polycyclic aromatic hydrocarbons
OCP	Organochlorine pesticides
OPP	Organophosphorus pesticides
PCB	Polychlorinated biphenyls

13 WASTE CLASSIFICATION

Waste classification of *in situ* material was required by the deed to facilitate the potential off-site disposal of material from the site during the proposed redevelopment. The intrusive test pitting investigation, borehole assessment and (removed) stockpile footprint sampling was used to address this deed requirement as detailed in the following sections. The six-step process to classify waste in NSW is presented in **Table 22**.

Table 22: Waste classification process steps

Step	Comment
Step 1: **Is the waste special waste?**	Yes, due to the presence of friable asbestos and asbestos fines in two samples the waste meets the requirement to be classified as special waste (asbestos waste). Additional assessment is required to determine the final waste classification of the material.
Step 2: **Is the waste liquid waste?**	No.
Step 3: **Is the waste pre-classified?**	The waste does not meet the requirement for any of the pre-classified HAZ wastes. The waste does not meet the requirements for any of the pre-classified GSW (putrescible) wastes. Natural soils and rock may meet the requirement to be pre-classified as GSW (non-putrescible) under a virgin excavated natural material (VENM) pre-classification. Refer to Section 13.1. Additional assessment is required to determine this.
Step 4: **Does the waste possess hazardous characteristics?**	The waste is considered highly unlikely to posses hazardous characteristics.
Step 5: **Determining a waste's classification using chemical assessment.**	Chemical characterisation undertaken using results of test pitting and bore hole investigations. Refer to Section 13.2.
Step 6: **Is the waste putrescible or non-putrescible?**	The waste is considered to be non-putrescible, being comprised predominantly of waste soils.

13.1 Virgin excavated natural material

Virgin excavated natural material is a material defined under the POEO Act and is also pre-classified under NSW EPA (2014a) as 'General Solid Waste – non-putrescible'. To meet the definition of VENM under the POEO Act the following points need to be addressed:

- Is the material contaminated by manufactured chemicals or process residues?

- Are sulfidic ores or soils present?
- Are naturally occurring asbestos soils present?
- Is there any other waste present?
- Is chemical assessment necessary?

The site's history does not suggest significant chemical contamination, which was supported through the chemical assessment of natural materials encountered during test pitting. Where deeper excavations into natural material are undertaken, this material is considered likely to meet the definition of virgin excavated natural material under the POEO Act. Due to the presence of overlying other wastes/ fill caution should be applied when attempting to beneficially re-use material under a VENM classification.

The intrusive investigation identified fill material, containing anthropogenic materials (e.g., concrete, asphalt, tiles, wire and plastic etc) therefore there is additional waste present.

From the chemical assessment undertaken, impacts to underlying natural soils were not identified as demonstrated by most results being below the LOR or within anticipated background concentrations (e.g., heavy metals/ metalloids). The results of chemical assessment have been included as **Table I** from the test pitting samples and **Table J** from the deep soil/ rock bores.

Site soils and underlying rock are not known to contain naturally occurring asbestos and there are no known occurrences of acid sulfate soils in the project area. Chemical appraisal of bedrock from the three deep soil bores does not indicate zones of mineralisation or presence of sulfidic ores with metal concentrations considered within background ranges for sedimentary bedrock of the Wianamatta Group.

Natural soils and underlying bedrock could meet the POEO Act definition of VENM provided that appropriate management of the overlying fill (i.e., waste) is undertaken. Specific recommendations are provided in **Section 17**.

Note: Due to the depth of fill in the north west corner of the site (~2.4 mBGL), additional consideration of potential contamination prior to removing material for potential beneficial re-use as VENM is recommended.

13.2 Chemical assessment

13.2.1 Waste volumes

The material to be excavated at the site is associated with three main areas:

- General site earthworks including site preparation and detention/ sediment basin construction.
- Crane pad and soil bin.
- Tunnel shaft excavation.

General site earth works are understood to include the top-soil strip and site preparations, including internal haul road construction, laydown yard preparations, and excavation and construction of two on-site detention/ sediment basins.

These excavation works are generally shallow in nature with the topsoil strip likely to remove the top 0.2 m of material which would likely be stockpiled and retained on-site to be re-instated at the completion of site works.

The excavation of the two onsite sediment basins is likely between 3-4 mBGL with areas of ~170 - 260 m^2 for an estimated volume of ~510 - 1,040 m^3.

The crane pad and soil bin from combination of LIDAR survey and proposed design are understood to have a total cut volume of 2,600 m^3 and a fill volume of 1,800 m^3 resulting in a net cut volume of 800 m^3.

The tunnel shaft excavation area is ~700 m with bedrock located at ~5 mBGL such that the volume of material to be removed from the shaft overlaying bedrock is ~3,500 m^3

Considering the estimated nature of the waste volumes and the relatively shallow depth of fill materials across most of the site, it is anticipated that waste material from site establishment works is likely < 5,000 m^3.

13.2.2 Sample frequency

The Waste Classification Guidelines (NSW EPA, 2014a) require the frequency of testing to provide representative samples for all contaminants in the waste, however does not provide a specific sampling rate.

In accordance with Victoria (Vic) EPA (2009) *Industrial Waste Resource Guidelines 702 for Soil Sampling* (IWRG 702), minimum sampling frequency for volumes of material is one sample per 25 m^3 of material up to 250 m^3 total. Above 250 m^3 it is considered that statistical appraisal (95% Upper Confidence Limit of the arithmetic mean, $UCL_{AVERAGE}$) can be used to classify at a rate of one sample per 250 m^3. Classification using the 95% $UCL_{AVERAGE}$ is consistent with NSW EPA (2014a).

Therefore, to chemically characterise up to 5,000 m^3 of material 20 samples of representative material is considered appropriate.

Note: Statistical appraisal via calculation of the 95% $UCL_{AVERAGE}$ is only required where reported analytical results exceed the relevant waste characterisation threshold values as outlined in **Table 12** and **Table 13**.

13.2.3 Chemical assessment

The waste classification summary tables have been presented in **Table G** of **Appendix D** for the test pitting assessment.

The reported concentrations of analytes were below the maximum threshold concentrations for general solid waste except for nickel (threshold of 40 mg/kg) as follows:

- TP13_0.4 at 74 mg/kg.

- TP22_0.32 at 73 mg/kg.
- TP23_0.32 at 92 mg/kg.

The 95% UCL for nickel was calculated using ProUCL based on the 37 samples of fill material collected <0.5 mBGL. The 95% $UCL_{AVERAGE}$ for nickel is 31.16 mg/kg, which is below the GSW threshold for nickel. The dataset generated for the statistical appraisal and the ProUCL 5.1 output for nickel has been presented in **Appendix G**.

13.2.4 Asbestos

Chrysotile asbestos was reported in one sample collected from TP15 within the top 0.15 m of the sub-surface along with sample TP207_0.05 located within the footprint of a former stockpile anecdotally reported to contain asbestos (EDP, 2022). Asbestos/ ACM was not observed or identified at other investigation locations or samples submitted for laboratory assessment. Material around TP15 and TP207 is therefore pre-classified as 'special waste – asbestos waste' in addition to the chemical characterisation of 'General Solid Waste – non-putrescible'.

13.3 Waste classification

The waste classifications are summarised in **Table 22** and illustrated in **Figure 7**.

Table 23: Waste classification process steps

Material	Location	Depth	Classification
Fill material	All[1]	<0.5 m[2]	General solid waste (non-putrescible)
Fill material	TP15[3]	0.2 m	General solid waste (non-putrescible) / Special Waste (Asbestos)[4]
Natural	All	>0.5 m[1]	General solid waste (non-putrescible) / VENM

Notes:

1. Note material around TP15 and TP207 is excluded due the detection of friable asbestos – see **Figure 7**.
2. Deep fill was encountered in TP4 and TP5 to ~2.4 mBGL while at TP9 was ~0.9 mBGL.
3. An area around TP15 and TP207 has been classified as 'special waste (Asbestos)' by considering the position of site investigation locations that were not reported to contain asbestos.
4. The extent of special waste (asbestos) should be validated prior issuing a clearance certificate to demonstrate appropriate management and removal of special waste (asbestos) – see **Section 16 Recommendations**.

Legend

Test Pit Locations

- Test Pits
- Small Stockpile
- Stockpile Footprint

Waste Classifications

- General Solid Waste
- Special Waste - Asbestos Waste
- Site Boundary

0 25 50 75 m

N

Details approximate only.
Datum: GDA 2020

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Title: Shallow Soil Waste Classification

Client: Road and Rail Excavations

Location: 1-17 and 19 Claremont Meadows, NSW 2747

Project Manager: SG | Scale: As Shown | Job No: 122045

Drawn By: SG | Date: July 2022

Figure 7

14 CONCLUSIONS

- The site was owned privately prior to c. 1970 before being transferred to various NSW stage government entities and is currently owned by Sydney Metro.
- The site has been used for rural residential purposes including agriculture at a market gardener scale.
- Following the site being obtained by NSW state government entities the site has been used for purposes associated with various road infrastructure construction projects.
- The site is underlain by fill and natural materials as follows:
    - Fill material comprised of brown, sandy gravel to ~0.3 mBGL located in the centre of the site and toward the north.
    - Fill material comprised of firm, brown clay with mottles to ~2.4 mBGL and trace anthropogenic materials across the site but shallower toward the south of the site.
    - Natural material comprises firm to very firm, brown to grey clay with red, orange and grey mottles between 0.0 to ~4.0 mBGL is present across the site.
    - Natural shale bedrock is present at depth with weathered bedrock potentially as shallow as ~1.2 mBGL.
    - Analytical soils results were reported by the relevant site investigation criteria considering a commercial/ industrial land use scenario.
- The groundwater investigation indicates:
    - Groundwater is present beneath the site at ~3.20 mBGL.
    - Groundwater is inferred to flow in a northerly direction considering location of surface water features and regional topography.
    - Major cations and anions indicate that there is a shallow (fresher) and deeper (relatively saline, potentially connate) groundwater system.
    - The shallow systems likely hosted at the interface of soils and bedrock.
    - The deeper systems are likely hosted within fractures/ joints/ bedding planes in bedrock.
    - Analytical results were generally below the adopted site assessment criteria or where above, the potential beneficial use of groundwater was not adversely impacted.

- Hazardous ground gas screening indicated:
    - Methane was below the minimum instrument resolution
    - Carbon dioxide was above the adopted site assessment criteria
    - Oxygen was below adopted site assessment criteria, indicating a depleted oxygen environment.
    - No flow or pressure was identified from subsurface hazardous ground gases.
    - No suitable background values were available to determine if elevated carbon dioxide was driven by off-site sources.
- Stockpile assessment:
    - The footprint of the former stockpile was noted to contain asbestos (EDP, 2022), however testing in this assessment reported non-friable AF in one sample (ID: TP207_0.05), below the adopted HSL-D screening level.
    - All other CoPC were reported below the LOR and/ or adopted site assessment criteria.
- Waste classification
    - *In situ* waste classification of solid waste was completed in accordance with the requirements of NSW EPA (2014) and VIC EPA (2009).
    - Natural materials (i.e. VENM) was classified in accordance with the requirements of the POEO Act.

Based upon the results and findings of this assessment the site is considered to be suitable for use as a construction site, under a commercial/ industrial land use scenario with further assessment or remediation required outlined in Section 15. The proposed site works are considered unlikely to disturb moderate to high-risk contaminated land.

15 RECOMMENDATIONS

In view of the results and conclusions of the DSI, the following recommendations are made:

- Areas that have been excluded for the site boundary as defined for this assessment should be investigated if they become part of the construction site at a later stage of the project.
- A remediation action plan (RAP) should be prepared and implemented with sufficient details to address managing asbestos soil contamination, waste material, and unexpected finds. To this end Environmental Earth Sciences NSW is aware of the

following Preparatory CEMP - SMWSASBT-CPG-1NL-EV-PLN-00002 and an asbestos management plan - SMWSASBT-CPG-1NL-NL000-SF-PLN-000024.

- All management plans should be implemented prior to bulk earth works commencing to mitigate against potential risks.
- Caution should be taken during top-soil stripping and clearing and grubbing as from the site's history, unidentified impacts (such as ACM) may be present or localised in the shallow sub-surface.
- Any asbestos removal works should be undertaken by a suitably licensed asbestos removalist (LAR) and following removal a clearance certificate should be issued to demonstrate all impacts have been suitably managed/ removed.
- Confirmatory sampling of soils via a targeted test pitting assessment in the vicinity of the potential former service station (near north boundary) to close out potential for unidentified impacts from potential bulk fuel storage and distribution. Any additional assessment should be appropriately documented in accordance with NSW EPA (2022a).
- The potential effect of tunnelling on groundwater should be assessed as changes in groundwater levels may induce/ enhance leachate, or potentially hazardous ground gas migration from the former Gipps Street landfill which is located ~70 m to the south of the site.
- Existing groundwater and landfill gas monitoring should continue to assess potential groundwater risks and hazardous ground gas migration culminating in an assessment of hazardous ground gases in accordance with Contaminated Land Guidelines *Assessment and management of hazardous ground gases (*NSW EPA 2020).
- Waste material needs to be disposed in accordance with the POEO Act based on the waste classifications herein, ensuring waste is disposed of to suitably licenced facilities.

16 LIMITATIONS

This report has been prepared by Environmental Earth Sciences NSW ACN 109 404 006 in response to and subject to the following limitations:

1. The specific instructions received from Road and Rail Excavations Pty Ltd;
2. The specific scope of works set out in PO122070_V3 dated 20 April issued by Environmental Earth Sciences NSW for and on behalf of Road and Rail Excavations Pty Ltd;
3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences NSW (which consent may or may not be given at the discretion of Environmental Earth Sciences NSW);

4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;

5. The report only relates to the site referred to in the scope of works being located at 1-17 and 19 Gipps Street, Claremont Meadows, NSW, formally identified as Lot 100 in DP1275138 and Lot 777 in DP263543 (the "site");

6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;

7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;

8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill, excavated natural material (ENM) or virgin excavated natural material (VENM) if deposited off site;

9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and

10. Our General Limitations set out at the back of the body of this report.

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18 GLOSSARY OF TERMS

The following descriptions are of terms used in the text of this report.

Acid Sulfate Soil (ASS). A soil containing iron sulfides deposited during either the Pleistocene or Holocene geological epochs (Quaternary aged) as sea levels rose and fell.

Alluvial. Describes material deposited by, or in transit in, flowing water.

Anaerobic. Reducing or without oxygen.

Aquifer. A rock or sediment in a formation, group of formations, or part of a formation which is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs.

Aquifer, confined. An aquifer that is overlain by a confining bed with significantly lower hydraulic conductivity than the aquifer.

Aquifer, perched. A region in the unsaturated zone where the soil is locally saturated because it overlies soil or rock of low permeability.

Background. The natural level of a property.

Baseline. An initial value of a measure.

Biodegradation. A biochemical process of microbial oxidation of complex organic compounds, to simpler chemical products. Micro-organisms derive the energy and cell carbon for growth from oxidation of organic compounds.

Bore. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a well, monitoring well or piezometer, although piezometers are typically of small diameter and only used for measuring the groundwater elevation or potentiometric surface.

Borehole. An uncased well drill hole.

Cation Exchange Capacity (CEC). The maximum positive charge required to balance the negative charge on colloids (clays and other charged particles). The units are milli-equivalents per 100 grams of material or centimoles of charge per kilogram of exchanger.

Clay. A soil material composed of particles finer than 0.002 mm. When used as a soil texture group such soils contain at least 35% clay.

Colluvial. Unconsolidated soil and rock material moved down-slope by gravity.

Confined Aquifer. An aquifer that is confined between two low-permeability aquitards. The groundwater in these aquifers is usually under hydraulic pressure, i.e. its hydraulic head is above the top of the aquifer.

Confining layer. A layer with low vertical hydraulic conductivity that is stratigraphically adjacent to one or more aquifers. A confining layer is an aquitard. It may lie above or below the aquifer.

Contaminant. Generally, any chemical species introduced into the soil or water. More particularly relates to those species that render soil or water unfit for beneficial use.

Contamination. Is considered to have occurred when the concentration of a specific element or compound is established as being greater than the normally expected (or actually quantified) background concentration.

Diffusion. A process by which species in solution move, driven by concentration gradients (from high to low).

Dilution. The mixing of a small volume of contaminated leachate with a large volume of uncontaminated water. The concentration of contaminants is reduced by the volume of the lower concentrated water. However the physical process of dilution often causes chemical disequilibria resulting in the destruction of ligand bonds, the alteration of solubility products and the alteration of water pH. This usually causes precipitation by different chemical means of various species.

Discrete sample. Samples collected from different locations and depths that will not be composited but analysed individually.

Dispersion. A process by which species in solution mix with a second solution, thus reducing in concentration. In particular, relates to the reduction in concentration resulting from the movement of flowing groundwater.

Dissolved Oxygen (DO). Oxygen in the gaseous phase dissolved in water. Measured either as a concentration in mg/L or as a percentage of the theoretical saturation point, which is inversely related to temperature. At 19, 20 and 21 degrees Celsius, the oxygen concentrations in mg/L corresponding to 100% saturation are 9.4, 9.2 and 9.0 respectively.

Electrical Conductivity (EC). The EC of water is a measure of its ability to conduct an electric current. This property is related to the ionic content of the sample, which is in turn a function of the total dissolved (ionisable) solids (TDS) concentration. An estimate of TDS in fresh water can be obtained by multiplying EC by 0.65.

Flow path. The direction in which groundwater is moving.

Fluvial. A material deposited by, or in transit, in streams or watercourses.

Fracture. A break in the geological formation, e.g. a shear or a fault.

Gradational. The lower boundary between soil layers (horizons) has a gradual transition to the next layer. The solum (soil horizon) becomes gradually more clayey with depth.

Gradient. The rate of inclination of a slope. The degree of deviation from the horizontal; also refers to pressure.

Groundwater. The water held in the pores in the ground below the water table.

Groundwater Elevation. The elevation of the groundwater surface measured relative to a specified datum such as the Australian Height Datum (mAHD) or an arbitrary survey datum onsite, or “reduced level” (mRL).

Head space. The air space at the top of a soil or water sample.

Heavy Metals. All metallic elements whose atomic mass exceeds that of calcium (20) and includes lead (Pb), copper (Cu), Zinc (Zn), cadmium (Cd), and tin (Sn).

Heterogeneous. A condition of having different characteristics in proximate locations. Non-uniform. (Opposite of homogeneous).

Horizon. An individual soil layer, based on texture and colour, which differs from those above and below.

Hydraulic Conductivity (K). A coefficient describing the rate at which water can move through a permeable medium. It has units of length per time. The units for hydraulic conductivity are typically m3/day/m2 or m/day.

Hydraulic Gradient (i). The rate of change in total head per unit of distance of flow in a given direction – the direction is that which yields a maximum rate of decrease in head. Hydraulic Gradient is unit less.

Hydraulic Head (h). The sum of the elevation head and the pressure head at a point in an aquifer. This is typically reported as an elevation above a fixed datum, such as sea level.

Hydrocarbon. A molecule consisting of carbon and hydrogen atoms only, such as found in petroleum.

Hydrocarbon, volatile. A hydrocarbon with a low boiling point (high vapour pressure). Normally taken to mean those with ten (or less) carbon atoms per molecule.

Infiltration. The passage of water, under the influence of gravity, from the land surface into the subsurface.

Ionic Exchange. Adsorption occurs when a particle with a charge imbalance, neutralises this charge by the attraction (and subsequent adherence of) ions of opposite charge from solution. There are two types of such a charge: pH dependent; and pH independent or crystalline charge. Metal hydroxides and oxy-hydroxides represent examples of the former type, whilst clay minerals are representative of the latter and are normally associated with cation exchange.

Ions. An ion is a charged element or compound as a result of an excess or deficit of electrons. Positively charged ions are called cations, whilst negatively charged ions are called anions. Cations are written with superscript +, whilst anions use - as the superscript. The major aqueous ions are those that dominate total dissolved solids (TDS). These ions include: Cl-, SO42-, HCO3-, Na+, Ca2+, Mg2+, K+, NH4+, NO3-, NO2-, F-, PO43- and the heavy metals.

Lithic. Containing large amounts of fragments derived from previously formed rocks.

Mottled. Masses, blobs or blotches of sub-dominant, varying colours in the soil matrix.

Nodulation. Are hard, usually small, accumulation of precipitated iron and/or manganese in the soil profile, usually a result of past alternating periods of oxidation/reduction.

Nodule. A small, concretionary (hard) deposit, usually of iron and/or manganese.

Organics. Chemical compounds comprising atoms of carbon, hydrogen and others (commonly oxygen, nitrogen, phosphorous, sulfur). Opposite is inorganic, referring to chemical species not containing carbon.

Oxidation. Was originally referred only to the addition of oxygen to elements. However oxidation now encompasses the broader concept of the loss of electrons by electron transfer to other ions.

Perched Groundwater. Unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone. Perched groundwater typically occurs in discontinuous, often ephemeral, lenses, with unsaturated conditions both above and below.

Permeability (k). Property of porous medium relating to its ability to transmit or conduct liquid (usually water) under the influence of a driving force. Where water is the fluid, this is effectively the hydraulic conductivity. A function of the connectivity of pore spaces.

Piezometric or Potentiometric Surface. A surface that represents the level to which water will rise in cased bores. The water table is the potentiometric surface in an unconfined aquifer.

pH. A logarithmic index for the concentration of hydrogen ions in an aqueous solution, which is used as a measure of acidity.

Polycyclic aromatic Hydrocarbons (PAHs). Complex organic molecules which originate typically in the combustion of organic compounds.

Potential Acid Sulfate Soil (PASS). A soil that has the potential to become acidic if it is exposed to the atmosphere.

Porosity (n). The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment. Typically given as a percentage.

Porosity, effective (ne). The volume of the void spaces through which water or other fluids can travel in a rock or sediment divided by the total volume of the rock or sediment.

Precipitation (chemical). There are two types of precipitation, pH dependent precipitation and solubility controlled precipitation. As the pH is raised beyond a threshold level the precipitation of metal cations such as oxy-hydroxides and hydroxides occur. As the pH is raised further precipitation continues until there are very few metal cations remaining in solution. This reaction is entirely reversible. Solubility controlled precipitation occurs between two ions when, at a given temperature and pressure, the concentration of one of the ions exceeds a certain level.

Profile. The solum. This includes the soil A and B horizons and is basically the depth of soil to weathered rock.

Purge (wells). The pumping out of well water to remove drilling debris or impurities; also conducted to bring fresh groundwater into the casing for sample collection. The later ensures that a more representative sample of an aquifer is taken.

QA/QC. Quality Assurance / Quality Control.

Recharge Area. Location of the replenishment of an aquifer by a natural process such as addition of water at the ground surface, or by an artificial system such as addition through a well

Recovery. The rate at which a water level in a well rises after pumping ceases.

Redox. REDuction-OXidation state of a chemical or solution.

Redox potential (Eh). The oxidation/reduction potential of the soil or water measured as milli-volt.

Reducing Conditions. Can be simply expressed as the absence of oxygen, though chemically the meaning is more complex. For more details refer to OXIDATION.

Remediation. The restoration of land or groundwater contaminated by pollutants, to a state suitable for other, beneficial uses.

Representative Sample. Assumed not to be significantly different than the population of samples available. In many investigations samples are often collected to represent the worst case situation.

Saturated Zone. A zone in which the rock or soil pores are filled (saturated) with water.

Shale. Fine-grained sedimentary rock formed by the compaction of silt, clay, or sand that accumulates in deltas and on lake and ocean bottoms. It is the most abundant of all sedimentary rocks.

Standing Water Level (SWL). The depth to the groundwater surface in a well or bore measured below a specific reference point – usually recorded as metres below the top of the well casing or below the ground surface.

Stratigraphy. A vertical sequence of geological units.

Subsoil. Subsurface material comprising the B and C horizons of soils with distinct profiles. They often have brighter colours and higher clay content than topsoils.

Texture. The size of particles in the soil. Texture is divided into six groups, depending on the amount of coarse sand, fine sand, silt and clay in the soil.

Topsoil. Part of the soil profile, typically the A1 horizon, containing material which is usually darker, more fertile and better structured than the underlying layers.

Total Dissolved Salts (TDS). The total dissolved salts comprise dissociated compounds and undissociated compounds, but not suspended material, colloids or dissolved gases.

Toxicity. The inherent potential or capacity of a material to cause adverse effects in a living organism.

Unsaturated Zone. The zone between the land surface and the water table, in which the rock or soil pores contain both air and water (water in the unsaturated zone is present at less than atmospheric pressure). It includes the root zone, intermediate zone and capillary fringe. Saturated bodies such as perched groundwater may exist in the unsaturated zone. Also referred to as the Vadose Zone.

Volatile. Having a low boiling or subliming pressure (a high vapour pressure).

Water table. Interface between the saturated zone and unsaturated zones. The surface in an aquifer at which pore water pressure is equal to atmospheric pressure.

Well. A hydraulic structure that facilitates the monitoring of groundwater level, collection of groundwater samples, or the extraction (or injection) of groundwater. Also known as a Bore.

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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences NSW. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should

not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences NSW disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences NSW disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences NSW's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

ENVIRONMENTAL EARTH SCIENCES
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30 September 2022

CPB Contractors-Ghella JV
c/- Road and Rail Excavations Pty Ltd
2/17 Mount Erin Road
Campbelltown NSW 2560

Attention: [redacted]

Data gap assessment for additional targeted investigation near the north boundary at the Claremont Meadows Services Facility –
1-17 Gipps St, Claremont Meadows NSW 2747

Please find enclosed a copy of our report titled as above. Thank you for the opportunity to undertake this work.

1 Introduction and background

Environmental Earth Sciences was engaged by Road and Rail Excavations Pty Ltd (R&R) to undertake a data gap assessment near the north boundary at the Claremont Meadows Services Facility – 1-17 Gipps St, Claremont Meadows NSW (the 'site') to address potential unidentified impacts due to an alleged bulk fuel storage and distribution that is alleged to have occurred in the 1970s. The site locality is shown in **Figure 1**.

A sampling and analysis quality plan (SAQP) was prepared by Tetra Tech Coffey (TTC, 2022) that identified a potential former service station along the northern boundary of the site from a review of historical aerial imagery. The SAQP was reviewed and approved by NSW EPA-accredited Site auditor, Mr Tom Onus of Ramboll. Environmental Earth Sciences prepared an SAQP Addendum (Environmental Earth Sciences, 2022a) and noted that when combined with historic land titles provided in M2A (2020), this part of the site was more likely to have been used as a greengrocer owned by a market as there were no visible fuel bowsers or a clear refuelling area present in available aerials.

Environmental Earth Sciences completed a detailed site investigation (DSI) that included with intrusive test pitting and sampling of soils across the site including one test pit (ID: TP3) within the area potentially identified as being a former service station (Environmental Earth Sciences, 2022b). The results of the DSI in relation to location TP3 did not indicate the presence of hydrocarbon impact. However, upon review of the DSI, the Site auditor considered there to be uncertainty regarding potential impacted associated with the alleged former service station (considered to be an area of concern [AOC]) and requested a data gap assessment be completed to address this matter.

This letter report was prepared to document the data gap assessment into the AOC near the northern site boundary, having been identified as the footprint of an alleged former service station and should be read in conjunction with Environmental Earth Sciences (2022b) and the limitations detailed in **Section 10** and Environmental Earth Sciences NSW's general limitations.

2 Objective

The objective was to complete a data gap investigation to address potential risks associated with possible historic use of part of the site as a service station which may have resulted in hydrocarbon impact from bulk storage and distribution of hydrocarbon fuels.

3 Scope of work

The scope of work for the data gap assessment included:

- Supervision of borehole drilling, advancing six boreholes for soil assessment targeting the AOC (IDs: BH1 – BH6).
- Logging and field-screening of soils.
- Collection of representative soil samples.
- Laboratory analysis for chemicals of potential concern.
- Evaluation of field and laboratory data and preparation of this letter report.
- Preparation of this letter report.

4 Investigation criteria

The investigation criteria (Tier 1 thresholds) were adopted from *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM) published by the National Environment Protection Council (NEPC, 2013) for the industrial / commercial land use (Setting 'D') in accordance with the DSI (Environmental Earth Sciences, 2022b) and included the following:

- Health screening levels (HSLs) setting 'D' (HSL-D) for volatile petroleum hydrocarbons in soil of clay texture (ASC NEPM, 2013).
- Health screening levels (HSLs) setting 'D' (HSL-D) for asbestos soil contamination (ASC NEPM, 2013).

- Health investigation levels (HILs) setting 'D' (HIL-D) for contaminants in soil (ASC NEPM, 2013), in particular total PAH and benzo(a)pyrene TEQ.
- Management limits (MLs) for petroleum hydrocarbon fractions in soil in commercial / industrial land use.
- Site specific ecological investigation levels (EILs) for heavy metals and fresh naphthalene in soil.
- Ecological screening levels (ESLs) for petroleum hydrocarbon fractions in soil in industrial/ commercial land use (ASC NEPM, 2013), and benzo(a)pyrene (CRC Care, 2017).

5 Methodology

5.1 Intrusive investigation

The intrusive investigation was completed on 9 September 2022 with six boreholes (IDs: BH1 – BH6) advanced using a 350 mm diameter auger mounted on an excavator. The location of boreholes is presented in **Figure 2** and were advanced as follows:

- two boreholes to a depth of 1.00 metre (m) below the base of the sediment basin that had already been excavated adjacent the northern site boundary (IDs: BH1 and BH2); and
- four boreholes to a depth of 3.00 m below ground level (BGL) to the south of the sediment basin (IDs: BH3 – BH6).

Soils were logged in the field including colour, texture and indications of potential contamination (e.g. visual and/ or olfactory, if any).

5.1.1 Sample collection

Representative samples of soil material were collected at pre-determined intervals down the soil profile (i.e., 0.1 mBGL, 0.5 mBGL, 1.0 mBGL then one sample for each additional meter below) or where changes in the soil profile were noted.

One intra- and one inter-laboratory duplicate sample were collected for quality assurance and quality control (QA/QC) purposes.

Soil samples were collected wearing a fresh pair of disposable nitrile gloves, changed between samples. For sampling purposes, the auger was advanced to the target depth, screwed into the soil and then pulled up to the surface to extract the soil from the target depth. Samples were collected from the auger, ensuring to exposure a fresh representative soil surface and exclude material not from the target depth.

The samples were placed into laboratory supplied glass jars and transported to the laboratory in a chilled container under full chain-of-custody documentation. The laboratory was accredited by National Association of Testing Authorities (NATA) for each analytical method used. Sampling of soil was conducted in accordance with the following:

- Standards Australia (1999) *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 2: Volatile substances* (AS 4482.2), Standards Australia, Homebush, NSW
- Standards Australia (2005), *Guide to the investigation and sampling of sites with potentially contaminated soil, Part 1: Non-volatile and semi-volatile compounds* (AS 4482.1), Standards Australia, Sydney, NSW
- Environmental Earth Sciences NSW (2010), *Procedures for field, laboratory and reporting quality assurance and quality control manual*.
- Environmental Earth Sciences (2011), *Soil, gas and groundwater sampling manual*, 7th Edition (Unpublished).

5.1.2 Field testing

Soils were field screened using a calibrated photoionisation detection (PID) device to provide a semi-quantitative assessment of volatile organic compounds (VOC) within soil pore spaces that may indicate potential contamination. The calibration certificate is included in **Appendix A**.

10 litre samples collected from the fill layer from BH3 – BH6) were spread out the soil across a white plastic sheet for assessment of asbestos fragments before collecting a 500 gram sample for laboratory analysis of potential asbestos fines (FA) and fibrous asbestos (FA).

5.2 Laboratory analysis

Sixteen primary samples and one field duplicate (intra-laboratory) sample were submitted to ALS Environmental Pty Ltd (ALS), and one split duplicate (inter-laboratory) sample was submitted to Envirolab Services Pty Ltd (Envirolab) for analysis.

Four samples of fill materials were submitted to Australia Safer Environment and Technology (ASET) for asbestos analysis.

The primary and duplicate soil samples were assessed for the following CoPC:

- Eight priority heavy metals/ metalloids (As, Cd, C_{TOTAL}, Cu, Hg, Pb, Ni and Zn).
- Total Recoverable Hydrocarbons (TRH) (C_6 – C_{40}) (ASC NEPM, 2013 Fractions).
- Benzene, toluene, ethylbenzene and total xylenes (BTEX).
- Polycyclic aromatic hydrocarbons (PAH, including naphthalene).
- Asbestos in soil (presence/ absences).

- Asbestos weight/weight quantification (if required).

6 Results

6.1 Field observations

At the time of the investigation, grassy vegetation had been removed and earthworks were progressing at the site/ AOC with the excavation of a trench (~3-3.5 m deep) to create an emergency spillway to the existing swale drain along Great Western Highway to the north. The area to the east of the AOC had its surface engineered with hard-packed sandy and gravelly clay to accommodate the installation of a water treatment plant.

The field conditions can be described as:

- The sediment basin was excavated ~3.0 m into natural soils which were observed to be a firm, dry brown clay with orange-grey mottles at the base of the excavation. It is understood that evidence of hydrocarbon impact was not noted during excavation of this material (pers. comm. Shane Coleman, September 2022).
- Boreholes advanced into the base of the sediment basin (locations BH1 and BH2) identified a firm, dry light brown clay with white-orange mottles and inclusions of red ironstone cobbles ~1 m below the base.
- Boreholes BH3 to BH6 adjacent the south of the sediment basin encountered the following:
    - Fill/ reworked natural brown clay with trace inclusions of concrete gravels and black gravels to ~1 mBGL
    - Undisturbed, natural material was observed from ~1.0 mBGL consisting of firm brown-red clay with light grey mottling
    - Becoming a stiff, light grey clay at ~2.2 mBGL with trace red mottling/ red ironstone cobbles to 3 mBGL.
- Groundwater was not encountered in any of the borehole excavations.
- Evidence of gross contamination (including potential asbestos containing materials (ACM) or staining was not evidenced at the site surface or during the intrusive soil assessment. No evidence of potential sources of contamination such as areas fuel/ chemical storage were observed.
- The highest PID reading was 0.8 ppm.

Detailed borehole logs, including PID readings are presented in **Appendix B** with photo plates of the site investigation presented in **Appendix C**. The calibration certificate for the PID is provided in **Appendix A**.

6.2 Analytical results

The laboratory reported concentrations for CoPC were below the adopted site assessment criteria or the laboratory's limit of reporting (LOR) except for asbestos.

Asbestos fines were detected in one surface sample (ID: BH6_0.2) which was quantified at 0.00005% w/w and is below the adopted HSL which is applicable to all land uses.

Tabulated laboratory results are presented in **Table 1** and **Table 2** (at the end of this report) and full laboratory certificates of analysis and chain of custody documentation are provided in **Appendix D**.

7 Quality assurance and quality control

Field QA/ QC was evaluated through the collection of field and split duplicate samples with comparison of the relative percentage difference (RPD) between the reported results.

Internal laboratory QA/QC included the evaluation of method blanks (MB), matrix spikes (MS) recovery, laboratory control samples (LCS) and surrogate spike recovery. The split duplicate sample also serves to assess for reproducibility of results between analytical laboratories. To minimise potential QA/ QC related issues due to low quality analytical assessments all laboratories engaged were suitably accredited by NATA.

The overall assessment of the data is as follows:

- All samples were analysed within recommended holding times;
- Inter and intra laboratory duplicates RPD results were within acceptable limits.
- The internal laboratory QA/QC indicated:
    - No method blank outliers reported for all samples.
    - No surrogate outliers reported for all samples.
    - Recoveries for matrix spike samples were reported in acceptable limits for the laboratory.
    - Recoveries for laboratory control samples were reported in acceptable limits for the laboratory.
    - RPDs for internal laboratory duplicate samples were reported within acceptable ranges for the laboratory (RPD <20 – 70%).
- With regard to the above the dataset as a whole is considered reproducibly and reliable and is therefore suitable for use.

The evaluation of QA/ QC is provided in **Appendix E**.

8 Discussion and CSM

The following discussion and conceptual site model (CSM) pertain to the AOC along the northern site boundary, having been identified as the footprint of an alleged former service station. It is noted that from the aerial images presented in M2A (2020) the potential service station was present for a relatively short period of time between ~1965 to 1978. After this time, the site boundaries have been altered via widening the Great Western Highway, such that part of the area in question is partially located outside the current site boundary.

No potential hydrocarbon odours were identified during the intrusive investigation and PID readings (<1 ppm) were indicative of ambient background conditions.

The reported concentrations of hydrocarbon-related CoPC were below the laboratory's LOR or the adopted site assessment criteria for commercial/ industrial land-use.

9 Conclusion and recommendations

Based upon the results of the intrusive assessment, the following key findings were made:

- Earthworks were in progress at the site as a sediment basin (approx. 20 m long, 10 m wide and ~3-3.5 m deep) was being excavated near the northern site boundary and within the AOC.
- Natural, firm dry, brown-grey clay was exposed at the base of the sediment basin with orange-grey mottling (ID: BH1 and BH2).
- Fill material consisting of brown clay with trace anthropogenic inclusions present at locations BH3 to BH6 from surface to ~1 mBGL.
- Natural material from ~1 mBGL at locations BH3 to BH6 consisted of brown/ red mottled clay becoming stiff, red/ yellow, pale grey mottled clay from ~2 mBGL with very dry, crumbly pale grey clay with red mottles/ red ironstone cobbles observed from 2.5 to 3 mBGL.
- Observations of subsurface soils at the locations assessed did not note any visual / olfactory indications of contamination or asbestos.
- Results of soil laboratory analyses for CoPC were either below the laboratory's LOR and/or within acceptable thresholds for ongoing commercial / industrial land use (Setting D) (ASC NEPM, 2013).
- Asbestos was detected one surface sample (ID: BH6_0.2) which was quantified at 0.00005% w/w and below the adopted HSL.

Based upon results and findings from this assessment, Environmental Earth Sciences concludes there is no unacceptable risk to human health or the environment for ongoing commercial / industrial land use (Setting D) due to the alleged former service station. As such additional assessment and/ or remediation is considered not necessary.

10 Limitations

This report has been prepared by Environmental Earth Sciences NSW ACN 109 404 006 in response to and subject to the following limitations:

1. The specific instructions received from CPB-Ghella Joint Venture c/- Road and Rail Excavations Pty Ltd;

2. The specific scope of works set out in email communications dated 9 September 2022 issued by Environmental Earth Sciences NSW for and on behalf of Road and Rail Excavations Pty Ltd, is included in Section 3 of this report;

3. May not be relied upon by any third party not named in this report for any purpose except with the prior written consent of Environmental Earth Sciences NSW (which consent may or may not be given at the discretion of Environmental Earth Sciences NSW);

4. This report comprises the formal report, documentation sections, tables, figures and appendices as referred to in the index to this report and must not be released to any third party or copied in part without all the material included in this report for any reason;

5. The report only relates to the site referred to in the scope of works being located at 1-17 Gipps Street, Claremont Meadows NSW 2747 (“the site”);

6. The report relates to the site as at the date of the report as conditions may change thereafter due to natural processes and/or site activities;

7. No warranty or guarantee is made in regard to any other use than as specified in the scope of works and only applies to the depth tested and reported in this report;

8. Fill, soil, groundwater and rock to the depth tested on the site may be fit for the use specified in this report. Unless it is expressly stated in this report, the fill, soil and/or rock may not be suitable for classification as clean fill, excavated natural material (ENM) or virgin excavated natural material (VENM) if deposited off site;

9. This report is not a geotechnical or planning report suitable for planning or zoning purposes; and

10. Our General Limitations set out at the back of the body of this report.

Should you have any queries, please do not hesitate to contact us on (02) 9922 1777.

For and on behalf of
Environmental Earth Sciences NSW

Author

[redacted]

Internal Reviewer

[redacted]

Project Manager

[redacted]

122045RP02V01

11 References

Assessment of Site Contamination National Environment Protection Measure (ASC NEPM) 2013, Schedule B (1): Guidelines on the Investigation Levels for Soil and Groundwater.

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

Environmental Earth Sciences NSW (2022a) *Detailed Site Investigation for Claremont Meadows Services Facility* (ref. 122045RP01V3, dated 20 September 2022).

Environmental Earth Sciences NSW (2022b) *Sampling Analysis and Quality Plan Addendum – Claremont Meadows Services Facility, Sydney Metro- Western Sydney Airport (ref. 122045_SAQP Addendum V1, dated 27 May 2022).*

M2A Joint Venture (M2A) (2020) Sydney Metro – Western Sydney Airport, Technical Paper 8: Contamination.

NSW EPA (2015) *Sample Design Guidelines* (note recently superseded by NSW EPA, 2022a and 2022b).

NSW EPA (2017), *Guidelines for the NSW Site Auditor Scheme* (3rd edition) (the "Site Auditor Guidelines").

NSW EPA (2020), Contaminated Land Guidelines: Consultants Reporting on Contaminated Land.

NSW EPA (2022a) *Contaminated Land Guidelines – Sampling design part 1 – application*.

NSW EPA (2022b) *Contaminated Land Guidelines – Sampling design part 2 – interpretation.*

Tetra Tech Major Projects (TTMP) (2022), *Claremont Meadows – Sampling Analysis Quality Plan – Sydney Metro Western Sydney Airport Station Boxes and Tunnelling Works* (ref. SMWSASBT-CPBJV-SWD-SW000-GE-RPT-040501 RevA, dated 30 March 2022).

ENVIRONMENTAL EARTH SCIENCES
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ENVIRONMENTAL EARTH SCIENCES GENERAL LIMITATIONS

Scope of services
The work presented in this report is Environmental Earth Sciences response to the specific scope of works requested by, planned with and approved by the client. It cannot be relied on by any other third party for any purpose except with our prior written consent. Client may distribute this report to other parties and in doing so warrants that the report is suitable for the purpose it was intended for. However, any party wishing to rely on this report should contact us to determine the suitability of this report for their specific purpose.

Data should not be separated from the report
A report is provided inclusive of all documentation sections, limitations, tables, figures and appendices and should not be provided or copied in part without all supporting documentation for any reason, because misinterpretation may occur.

Subsurface conditions change
Understanding an environmental study will reduce exposure to the risk of the presence of contaminated soil and or groundwater. However, contaminants may be present in areas that were not investigated, or may migrate to other areas. Analysis cannot cover every type of contaminant that could possibly be present. When combined with field observations, field measurements and professional judgement, this approach increases the probability of identifying contaminated soil and or groundwater. Under no circumstances can it be considered that these findings represent the actual condition of the site at all points.

Environmental studies identify actual sub-surface conditions only at those points where samples are taken, when they are taken. Actual conditions between sampling locations differ from those inferred because no professional, no matter how qualified, and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden below the ground surface. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated. However, steps can be taken to help minimize the impact. For this reason, site owners should retain our services.

Problems with interpretation by others
Advice and interpretation is provided on the basis that subsequent work will be undertaken by Environmental Earth Sciences NSW. This will identify variances, maintain consistency in how data is interpreted, conduct additional tests that may be necessary and recommend solutions to problems encountered on site. Other parties may misinterpret our work and we cannot be responsible for how the information in this report is used. If further data is collected or comes to light we reserve the right to alter their conclusions.

Obtain regulatory approval
The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.

Limit of liability
This study has been carried out to a particular scope of works at a specified site and should not be used for any other purpose. This report is provided on the condition that Environmental Earth Sciences NSW disclaims all liability to any person or entity other than the client in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by any such person in reliance, whether in whole or in part, on the contents of this report. Furthermore, Environmental Earth Sciences NSW disclaims all liability in respect of anything done or omitted to be done and of the consequence of anything done or omitted to be done by the client, or any such person in reliance, whether in whole or any part of the contents of this report of all matters not stated in the brief outlined in Environmental Earth Sciences NSW's proposal number and according to Environmental Earth Sciences general terms and conditions and special terms and conditions for contaminated sites.

To the maximum extent permitted by law, we exclude all liability of whatever nature, whether in contract, tort or otherwise, for the acts, omissions or default, whether negligent or otherwise for any loss or damage whatsoever that may arise in any way in connection with the supply of services. Under circumstances where liability cannot be excluded, such liability is limited to the value of the purchased service.

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FIGURES

Legend

- Area of concern (AOC) - Approximate footprint of potential historical service station
- Site boundary

0 5 10 15 m

ENVIRONMENTAL EARTH SCIENCES
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Title: Site locality

Client: Road and Rail Excavations

Location: Claremont Meadows Services Facility - 1-17 Gipps St, Claremont Meadows NSW

Project Manager: Sam Goldsmith	Scale: As Shown	Job No: 122045
Drawn By: Karin Azzam	Date: September 2021	

Figure 1

Legend

- Borehole locations - Data gap investigation
- Test pit locations (EES, Mar 2022)
- Approximate footprint of potential historical service station
- Trench
- Location of proposed water treatment plant
- Site boundary

0 5 10 15 m

ENVIRONMENTAL EARTH SCIENCES
CONTAMINATION RESOLVED

Title: Sampling locations

Client: Road and Rail Excavations

Location: Claremont Meadows Services Facility - 1-17 Gipps St, Claremont Meadows NSW

Project Manager: Sam Goldsmith | Scale: As Shown | Job No: 122045

Drawn By: Karin Azzam | Date: September 2021

Figure 2