M1 Tomago – Sampling and Analysis Quality Plan

John Holland Gamuda Joint Venture
Sampling and Analysis Quality Plan
M1 Raymond Terrace Extension – Black Hill to Tomago project
SCL230006.02
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CONTENTS

LIST OF FIGURES

Figure Section

LIST OF TABLES

Body Report

LIST OF APPENDICES

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1 INTRODUCTION

The M1 Raymond Terrace Extension (M12RT) is a 15 kilometre extension of the existing M1 Pacific Motorway at Black Hill to the existing Pacific Highway at Raymond Terrace within the City of Newcastle and Port Stephens Council local government areas. The M12RT will be delivered as follows:

- Stage 1 - Construction - Southern Package (BH2T), delivered by the John Holland Gamuda Australia Joint Venture (JHGA JV)
- Stage 2 - Construction - Northern Package (Heatherbrae Bypass), delivered by Seymour Whyte.

The JHGA JV has been appointed by Transport for New South Wales (Transport) for the Design and Construct contract for BH2T (the project), which involves the design and construction of 10 kilometres of new dual carriageway motorway with two lanes in each direction, with interchanges at Black Hill, Tarro, and Tomago.

Epic Environmental Pty Ltd (Epic) has been engaged by JHGA to provide and lead the delivery of contaminated land management services for the BH2T project. Contaminated land management requirements for the BH2T project are specified within the Minister's conditions of approval (MCoAs), specifically E111 through E132.

Condition E121, requires a detailed site investigation (DSI) to be undertaken before the commencement of work that would result in any disturbance to land identified as a moderate to high-risk areas of potential contamination risk (AOPCR).

The project Environmental Impact Statement (EIS) identified 29 AOPCR that will potentially be disturbed during construction of the M12RT. 22 of the AOPCR are within the Black Hill to Tomago portion of the project. Epic conducted a review of the AOPCR rating in TfNSW (2022) Table 4-1, reported in the following (Epic, 2023). Ben Wackett of Cavvanba Consulting, as the NSW Environment Protection Authority (EPA) accredited Site Auditor for the project, reviewed Epic's risk rating per Condition E118(b) and provided interim audit advice confirming the risk rating was completed appropriately.

Through Epic's review of AOPCR in the Project submissions report (Transport, 2022), three moderate to high risk AOPCRs within the project footprint were identified:

- AOPCR 3 (waste burial – asbestos)
- AOPCR 10 (asbestos waste Hazmat 2020)
- AOPCR 19 (former night soil disposal)

AOPCR 5, the RZM mineral sands site, was also identified as a high risk AOPCR, however this area has been excluded from Epic's scope.

This sampling and analysis quality plan (SAQP) will provide a basis for the planning of all fieldwork, fieldwork procedures, methodologies, sampling and analysis plan, occupational health and safety (OH&S) and protection of the surrounding environment for DSI works at moderate to high risk AOPCR sites (AOPCR 3, 10 and 19).

1.1 Objectives

The objective of the DSI is to investigate contamination that may require management during construction works and with respect to the final land use. The DSI will be undertaken to ensure the moderate to high-risk areas of potential contamination do not pose an unacceptable risk to human health or the environment prior to disturbance works in accordance with the MCoA (condition E121).

The objective of this SAQP is to provide a plan for the DSI works at the three moderate to high risk sites in accordance with MCoA E119. Additionally, the SAQP will provide a detailed plan of all fieldwork, including fieldwork procedures and methodology, quality assurance and quality control measures, and OH&S procedures to be implemented for the DSI.

1.2 Scope of Work

The following scope of work was completed in the development of this SAQP:

- Review of available site history and environmental setting information (including previous environmental investigations)
- Development of a preliminary conceptual site model (CSM)
- Preparation of this SAQP

1.3 Technical Framework

This SAQP has been prepared with consideration of the following guidelines:

- ANZG (2018). 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality', Australian and New Zealand Governments and Australian State and Territory Governments, Canberra ACT, Australia.
- Department of Environment and Conservation NSW (DEC NSW) (2007), 'Guidelines for the Assessment and Management of Groundwater Contamination, March 2007'
- EPA Victoria (2009). 'Industrial Waste Resource Guidelines, Soil Sampling' (IWRG 701, 702)
- National Chemicals Working Group of the Heads of EPAs Australia and New Zealand (HEPA) (2020). 'PFAS National Environmental Management Plan Version 2.0'
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (ASC NEPM), The National Environment Protection Council (NEPC), as amended May 2013 (NEPC, 2013)
- NSW EPA (2014c). 'Waste Classification Guidelines' – Parts 1 to 4 and Addendum to Part 1
- NSW EPA (2017). 'Guidelines for the NSW Site Auditor Scheme, (3rd edition)'
- NSW EPA (2020a). 'Consultants Reporting on Contaminated Land – Contaminated Land Guidelines'
- NSW EPA (2020b). 'Assessment and management of hazardous ground gases – Contaminated Land Guidelines'
- NSW EPA. (2022). *Sampling design guidelines* . NSW Environment Protection Authority .
- NSW Department of Environment, Climate Change and Water (NSW DECCW) (2010). 'Vapour Intrusion: Technical Practice Note'
- Standards Australia | Standards New Zealand (1998). AS/NZS 5667.11 1998, 'Water quality – Sampling – Guidance on sampling of groundwaters'
- State Environmental Planning Policy (Resilience and Hazards) (NSW Government, 2022)
- Western Australia Department of Health (2009) Guidelines for the Assessment, Remediation and Management of Asbestos Contaminated Sites in Western Australia

2 PREVIOUS INVESTIGATION & PROJECT CONTEXT

A series of preliminary contamination investigations were undertaken to support the Environmental Impact Statement (EIS) for the site. The investigations were not undertaken to confirm and manage site contamination in accordance with NEPM (2013). Investigations were undertaken to provide a preliminary indication of potential contamination and satisfy requirements of the Secretary's Environmental Assessment Requirements (SEARs) and responses to the EIS. The following contamination investigations required under the EIS framework have been reviewed by Epic:

- Jacobs (2021). M1 Pacific Motorway extension to Raymond Terrace - Soils and Contamination Working Paper. Dated July 2021.
- Transport for NSW (2022). M1 Pacific Motorway extension to Raymond Terrace - Submissions Report - Appendix J. Dated June 2022.
- Douglas Partners (2022). M1 Pacific Motorway Extension to Raymond Terrace - Supplementary Report - Soils and Contamination. Dated June 2022.

A brief description of the context of each report, and key findings and recommendations is discussed in the sections below. Specific details from each report on the moderate to high risk AOPCR that are the subject of this SAQP and future DSIs is discussed further in Section 4.

2.1 Jacobs (2021)

The primary objective of the report was to support the environmental impact statement (EIS) for the project. To assess potential soils and contamination impacts that may impact construction and operation of the project, and where required, identify mitigation measures.

General findings in the report included:

- Five sites were classified as high risk AOPCRs and four medium risk AOPCRs. Remaining sites were classified as low contamination risk.
- Construction works including earthworks, construction of new roads, construction of bridges, relocation of utilities and dewatering activities, and dredging have the potential to expose key soil contaminations such as Acid Sulfate Soils, and existing contamination. These construction activities have the potential to mobilise contamination and contaminated groundwater during ground disturbing activities and impact nearby waterways such as Purgatory Creek, The Hunter River, Windeyers Creek, and drainage lines.
- Specific soils and contamination management measures was recommended to be detailed in the Construction Soil and Water Management Plan which include Salinity Management Plan, Acid Sulfate Soils Management Plan, and Progressive erosion and sediment control plans.

2.2 Transport for NSW (2022)

The primary objective of the report was to summarise the submissions of supplementary reports made to assess the potential impacts of the refinements made to the project. Additionally, the supplementary reports summarised in this report assess whether the land is likely to be contaminated and identify if remediation of the land is required in regard to ecological and human health risk posed by contamination of the past, existing, and future land uses. The reports also describe how assessment and/or remediation would be undertaken in accordance with current guidelines.

General findings in the report included:

- Extensive soil and surface water investigations and assessment completed throughout the project area during a multi-year program demonstrated that existing soil and surface water condition typically presents an acceptable risk to ecology and human health.
- Detailed site assessment results including targeted or AOPCR results found that in 2016, dumped wasted that included potential asbestos containing material were observed at three locations, Blackhill, Tarro, and Tomago.
    - Blackhill – AOPCR19, 31 discrete locations in bushland at Blackhill, these locations are now remediated, and post remediation sampling results showed no asbestos material present and

permanent exclusion fencing placed to prevent further illegal access to the bushland area at Blackhill. As AOPCR 19 is in Blackhill, there is a possibility that the site is contaminated with asbestos. However, through aerial photograph, it was unclear if fencing surrounded AOPCR 19.
  - Tarro- AOPCR 3, specifically at 1 Woodlands Close, where a publicly available notice states that the land is believed to be affected by asbestos. This site has not been entered due to access constraints and as such the contamination has not been confirmed or remediated.
  - Tomago – AOPCR10, specifically at a redundant agricultural structure. The structure is located within a registered Aboriginal heritage site and thus area was fenced to prevent access in accordance with relevant statutory requirements.
- Two sites were registered on the NSW Government PFAS investigation program register were located within the project area. These locations were then sampled in 2021. Both sites, AOPCR 18 and AOPCR 9 were generally found below laboratory reporting limits and compliant with the relevant criteria except for AOPCR 18 exceeding the 99% species protection criteria for aquatic ecosystems for perfluorooctane sulfonate (PFOS). These locations are not in close vicinity and are unlikely to affect the three sites focused in this SAQP.
- Groundwater investigation and assessment throughout the project area demonstrated that exceedances of relevant criteria across the project area is not considered to be attributable to specific human activities.
- Extensive detailed investigation of the proposed project outline found that the RZM site poses an unacceptable risk to ecological and human health. As such, remediation would be limited to the RZM site. Other minor locations of contamination are mostly associated with asbestos.

2.3 Douglas Partners (2022)

The primary objective of the report was to collate and provide an updated summary of the current data available to DP for the M12RT project, including comparison of the testing results against current relevant guidelines and incorporating.

General findings in the report included:

- Investigations between 2005-2021 included a total of 182 soil and groundwater tests were summarised for the project outline.
- Fill materials were encountered from 0.1 to 7 m, on average 1.1 m in depth.
- Top of rock varied from 0.15 m to 67 m, on average 12 m in depth.
- No visual or olfactory signs of gross contamination observed during DP 2021.
- Groundwater encountered from above ground surface to depths of 14.9 m, on average 1.4 m in depth.
- No visual or olfactory signs of gross contamination (e.g. floating product, hydrocarbon odour) were observed at the time of groundwater monitoring and sampling during DP 2021.

3 DATA QUALITY OBJECTIVES

A process for establishing data quality objectives for an investigation site has been defined in the ASC NEPM guideline on site characterisation (NEPC, 2013). The data quality objective (DQO) process will be applied to the DSI to ensure that data collection activities are appropriate and will achieve the project objectives as defined in **Section 1.1**. The DQO process includes seven steps as defined in the following sections.

3.1 Step 1: State the Problem

To assess the nature and extent of soil contamination and determine whether the contamination status of the site will pose a risk to receptors during construction and the operational phase of the project.

3.2 Step 2: Identify the Decision

The decisions to be made are based on the requirements specified within the Minister's conditions of approval (MCoAs), specifically E111 through E132, The decisions to be made based on the results of the site investigation are as follows:

- Have previous and surrounding site activities resulted in contamination of soil or groundwater at the site?
- What are the material classification categories for the soil units to be excavated if soils are required to be removed from site?
- Will the site pose an unacceptable risk to onsite receptors, during construction?
- If contamination is identified at the site, with regard to site suitability for the proposed development:
  - is further assessment required?
  - is the contamination able to be managed under a long term environmental management plan (LTEMP)?
  - will remediation of contamination be required at the site?
- Does contamination pose a risk to offsite human health and ecological receptors?
- What is the risk of contamination migrating from the construction site as a result of the construction activities?

3.3 Step 3: Identify Inputs to the Decision

The inputs required to make the above decisions are as follows:

- Site history and available information from government and environmental databases
- Field observations indicating areas of environmental concern (AECs) and the presence of aesthetic issues, including but not limited to odours, discolouration and the presence of foreign materials and wastes.
- Ground conditions recorded from intrusive investigations (boreholes/test pits) on the site.
- Laboratory data from collected samples and analysis for contaminants of potential concern (CoPC).
- Appropriate assessment criteria against which the analytical results of soil samples will be assessed
- The lateral and vertical distribution of materials containing concentrations greater than the laboratory Limit of Reporting (LOR) and/or adopted assessment criteria

3.4 Step 4: Define the Study Boundary

The boundaries for the environmental assessment have been identified as follows

- Spatial boundaries:
  - :Spatial boundaries will be limited to the boundary of the three AOPCR sites (AOPCR 3, AOPCR 10 and AOPCR 19), defined on Figure F2,Figure F4, Figure F6 respectively.
- The depth boundary will be defined as the depth of investigation required to assess ground conditions at the site, comprising a maximum depth of 3 m bgl.
- Temporal boundaries – the temporal boundary is limited to the data collected during this investigation and previous relevant investigations
- Constraints within the study boundaries – the following issues present limitations upon the sampling strategy for the site:

- Subsurface structures or obstructions including existing underground services
- Inaccessible areas due to current usage of the site
- Redundant agricultural structure at AOPCR 10, it was previously mentioned in (Transport for NSW, 2022) that the structure is located within a registered Aboriginal heritage site, and as such fenced to prevent access. TfNSW has described that when the project gains relevant statutory approvals, TfNSW would enter the area and remediate it prior to construction works in the area in accordance with a Site Auditor endorsed Contamination Management Plan, regulatory requirements and industry guidance.

3.5 Step 5: Develop a Decision Rule

Results of soil investigations will be compared against investigation and screening levels outlined in Schedule B1 of NEPM (NEPC, 2013) in consideration of proposed land uses, and potential risks to human health and the environment.

The decision rules for the DSI are presented in **Table 1**.

Table 1. Decision rules

Aspect – Does the site pose an unacceptable risk to onsite receptors (land use suitability)
Detail – Concentrations of contaminants are identified exceeding the adopted site criteria, and will foreseeably remain above the adopted criteria
Mitigation • Further investigation to assess the volume and nature of impacted soils • Statistical analysis and comparison against screening levels • Onsite management and/or remediation (development of a Remedial Action Plan (RAP))
Aspect – Is the data produced reliable and representative of site conditions
Detail – Robust quality assurance/quality control (QA/QC) assessment of field and laboratory data to determine 95% of the dataset will satisfy data quality indicators
Aspect – Delineation of impacts
Detail – Concentrations of contaminants exceeding the adopted criteria at the site cannot be adequately delineated
Mitigation: • Additional investigation • Development and implementation of management measures, as required

Note: Where appropriate, contaminants will be compared to the upper confidence limit (UCL) 95% of the dataset mean, and appropriate statistical methods as outlined in the NEPM

3.6 Step 6: Specify Limits on Decision Errors

The potential decision errors for the DSI include:

- Assessment that the site is uncontaminated, when it is OR is contaminated when it is not
- Assessment that soil or groundwater beneath the site requires management, when no management is required OR does not require management, when management is required

The acceptable limits on decision errors to be applied for the DSI and the manner of addressing possible decision errors have been developed based on the Data Quality Indicators (DQIs) of precision, accuracy, representativeness, comparability and completeness and are presented in **Section 7.3** of this SAQP. The potential for significant decision errors are to be minimised by:

- Where appropriate, 95% Upper Confidence Limit (UCL) will be used for the assessment of sample results
- Completing a robust Quality Assurance/Quality Control (QA/QC) assessment of the field and laboratory data and application of the probability that 95% of data will satisfy the DQIs
- Assessing whether appropriate sampling and analytical density for the purposes of the intrusive assessment has been applied
- Ensuring that the criteria set for the assessment are appropriate for the proposed use of the site
- Use of calibrated field equipment

3.7 Step 7: Optimise the Design for Obtaining Data

Given the objectives of the DSI, the design of the program is based on a sampling pattern to characterise the site and identify/delineate potential risks. The scope of work, SAQP and field and laboratory methodologies to be applied during the DSI are documented in **Section 4** and **5** of this SAQP.

4 SAMPLING & ANALYTICAL RATIONALE

The following sections summarise the site conditions/setting and recommended sampling for each of the AOPCR subject to this SAQP.

4.1 AOPCR 3

4.1.1 Site Identification

AOPCR 3 is located in Woodlands Close Tarro, NSW 2322 and is found adjacent to the New England Highway near Tarro. The site is bound by the town of Tarro to the north, New England Highway to the east, vacant grasslands to the west and south. The site details are summarised in Table 1 and the site location is shown in **Figure F2** .

Table 1. AOPCR 3 Site Identification

Category	Details
Site Description	AOPCR3 – Waste burial (Asbestos)
Site Address (approximate)	Woodlands Close, Tarro NSW 2322
Lot Description	Lot 39 DP 1286426
Site co-ordinates (centre of site)	Latitude: -32.813041372 Longitude: 151.673246
Current owner	TfNSW
Current occupier	TfNSW
Traditional owners	Awabakal People
Site area (approximate)	1 Ha
Local government authority	Newcastle
Current zoning	C2 - Environmental Conservation; C2, Environmental Management
Trigger for assessment	Construction of M12RT
State or local government statutory controls	N/A
Legal permission to access site	Yes

4.1.2 Site Environmental Setting

Site environmental setting information for AOPCR 3 is summarised in **Table 2**.

Table 2. AOPCR 3 Environmental Setting

Environmental component	Summary
Climate	The site is located within a temperate climate shifting from mild and cool in winter to warm and hot in the summer, with no extreme seasonal differences as the weather is moderated by proximity to the ocean.
Surface geology	The NSW Seamless Surface Geology map (version 2.2, accessed via MinView) indicates that the site is underlain by Quaternary aged alluvial backswamp deposits, which consists of organic rich sediments.
Soil Landscape	Mapping gathered from the Soil Landscapes of Central and Eastern NSW classifies the site as an extensive alluvial plain on recent sediments in the Hunter Plain region in the centre of the sheet. Soils at the site form predominantly clay, silt, and sand from overbank deposition of the lower Hunter and Williams Rivers, which overlies estuarine mud deposits at depth. Soils are described as deep (>150 cm), imperfectly to poorly drained prairie soils.
Salinty	The site is described as having moderate salinity hazard (eSpade v2.2)
Acid Sulfate Soils (ASS)	A review of the Atlas of Australian Acid Sulfate Soils indicates the site has a high potential for acid sulfate soils <1 m below ground surface (H1). A review of the Council ASS risk map indicates that the site is classified as Class 2 ASS risk.
Topography	The site is generally flat with elevation less than 10 mAHD reported.
Hydrogeology	A search of registered groundwater bores through Water NSW found no boreholes on the site. 1 borehole was located within a 1 km radius of the site. The borehole is located 900 m south of the site and was registered for monitoring purposes. The well was installed to 3.1 m bgl.

Hydrology	There are no surface water bodies present on site. The nearest surface water body is the Purgatory creek located around 490m to the east, which then flows to the Hunter River located 935 m to the east from site. Available flood mapping indicates that the site is not located on flood prone land.
Contaminated land records	The following was noted from a review of available contaminated land records: • A search of the NSW Contaminated Sites Notified to the NSW EPA found no records for the site. • A search of the NSW Contaminated Site Land record of notices found a current notice issued 1991 for Green Acres Farm, 1 Woodland Close, Tarro NSW. The notice was in regards to asbestos contaminated areas and using clean, non-contaminating material to fill the site and cover the asbestos contaminated areas with not less than one metre of clean, non-contaminating fill. • A search of Environment Protection Licenses (EPL) issued under the Protection of the Environment Operations Act 1997 (POEO) identified no licenses for the Site. • A search of the PFAS investigation program from the EPA NSW found no PFAS investigation for the Site.
Sensitive environments	The closest human receptors to the site is the rural residential premises approximately 450 m north of the site. The closest environmental receptors to the site are clusters of high probability groundwater dependent ecosystems, including the Hunter Wetlands National Park, extending from south to southeast of the Site. Smaller clusters are observed to the north, east, and west of the Site, all being within a 300 m range.

4.1.3 Site History

Site history consisting of the historical titles, aerials, and previous reports for AOPCR 3 are summarised in **Table 3**. Historical titles and aerial photographs are included in **Appendix A.** It is noted that historical titles indicate ownership by commercial/industrial parties, however, land use appears to have remained rural during these periods.

Table 3. AOPCR 3 Site History

Site History Component	Summary
Historical titles	1922 – 1971: [redacted] (farming) 1971 – 1985: Peter R Harris & Co Pty Limited, Dovedale Pty Limited, New England Mineral Industries Pty Limited (industrial) 1985: Dovedale Pty Limited 1985 – 2009: Max Lynch Motor Vehicle Repairs Pty Limited (vehicle repairs) 2009-2023: [redacted] 2023- Present: Transport for NSW
Historical aerials	1953: The site appears to be vacant farmland. Surrounding areas to the northwest of the site appears to be developed with numerous residential premises observed to the town of Tarro. 1965: The site remains as per the previous photograph. The New England Highway has been developed and divided the land in between the town of Tarro and the site. 1974: The site remains vacant and consist of only farmlands. Further developments observed to the northwest, now the town of Tarro with residential/commercial premises becoming widespread. 1983: The site remains vacant and consist of only open grass fields. Electrical towers observed to the south of the site. Surrounding area remains relatively unchanged. 1992: The site is mainly vacant with a water tank observed in the centre of the site. The lot directly to the north of the site is occupied observed by the development of a residential premise. 2000: The water tank previously observed to the centre of the site has been removed. Surrounding areas appear generally unchanged.
Previous reports	(Transport for NSW, 2022): Previous contamination investigation conducted by Jacobs, 2021 identified a regulated site located at 1 Woodlands Close Tarro. A publicly available Notice states that the land is believed to be affected by asbestos however due to access constraints Transport NSW has not entered the land to confirm or remediate the Site. (Douglas Partners, 2022): Location is a known waste burial asbestos site per NSW EPA notice. The planned development of the viaduct on the site is located over compressible soils of more than 10 m thickness with topography being generally flat. Groundwater in the zone was described as relatively

Site History Component	Summary
	shallow and it was presumed that prolonged rainfall in the area may cause it to be inundated. Surface waters surrounding the site includes Purgatory Creek and The Hunter River which is the likely receptor for surface water runoff

4.1.4 Preliminary Conceptual Site Model

A conceptual site model (CSM) of the site can be formed by considering the physical characteristics of the site, potential contamination sources (and associated potential contaminants), potential receptors and the pathways to the receptors. The CSM, as required by the NEPC (2013), is an iterative process requiring updates throughout an investigation as more information becomes available. Using the information obtained during the desktop review, Epic has developed a preliminary CSM for the site to identify potential risks posed to human and ecological receptors on and offsite, as summarise in **Table 4**

Table 4. AOPCR 3 Conceptual Site Model

Source	Contaminants of Potential Concern	Likely Media Potentially Affected	Pathway	Receptor
Known asbestos contamination onsite based on EPA record of notices. Uncontrolled fill Possible pesticide use	Asbestos, Metals, PFAS, PAH, TRH, BTEXN, OCPs, PCBs	Soil	• Direct Contact with contaminated soils • Ingestion or inhalation of dust associated with impacted soils or vapours (volatile contaminants, asbestos) • Overland flow or wind-swept transport of impacted soils • Leaching to groundwater (non-asbestos contaminants)	• Human – Construction workers, maintenance workers • Ecological receptors (terrestrial flora / fauna, aquatic receptors in surface body receiving waters)

4.1.5 Sampling Rationale

The scope of intrusive investigation is based on the recommendations of NSW EPA (2022), with the rationale outlined below in **Table 5.**

Table 5. AOPCR 3 Sampling Rationale

Site	Scope of Sampling	Rationale
AOPCR3 waste burial (asbestos)	Completion of 21 testpits using a 5 tonne excavator to a maximum of 3 mbgl, 0.5 m into natural soils or practical refusal. Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials.	The construction footprint in AOPCR 3 is approximately 1 hectare. An area of higher contamination risk based on aerial imagery indicating recent filling was identified across 1,400 m^2 of the site. With reference to (NSW EPA, 2022) Sampling Design Guidelines, a stratified sampling design will be undertaken. 12 samples will be completed in the recently filled area, and eight samples will be completed across the remainder of the site. The use of test pits will allow for inspection of material and better opportunity for identification of asbestos containing material. Minimal excavation is proposed however surface contamination will likely be disturbed, so analysis of one sample per location is appropriate. Groundwater sampling is not recommended given the primary contaminant of concern (asbestos) is not a risk to groundwater.

4.1.6 Analytical Schedule

The proposed DSI analytical plan has been outlined in **Table 6.** Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials. One sample per location will be analysed for AF/FA.

Field intra-laboratory and inter-laboratory samples will each be included at a 5% rate (each) of the primary sample analytes. One trip blank and one trip spike are proposed to be analysed per sampling event. Rinsate samples will be collected at a rate of one per day (when non-disposable field equipment is utilised) and analysed for heavy metals.

Table 6. Analytical Schedule – AOPCR 3

Analysis	Number of soil primary samples
Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)	21
Polycyclic aromatic hydrocarbons (PAH)	21
Total recoverable hydrocarbons (TRH)	21
Benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)	21
Asbestos (500 ml)	21
Asbestos (I.D.)	As required
Organochlorine pesticides (OCPs)	21
Polychlorinated biphenyls (PCBs)	10
Cation exchange capacity (CEC)	4
Total organic carbon (TOC)	4
Per-poly fluoro alkyl substances (PFAS)	4
Iron	4

Note: Subject to change based on field observations and analytical results. Asbestos I.D. samples will be analysed as encountered during test pitting.

4.2 AOPCR 10

4.2.1 Site Identification

AOPCR 10 is located at 1907 Pacific Highway Tomago, NSW 2322 and is located adjacent to the Hunter River. The site is bound by the Hunter River to the north, RZM site to the west, vacant grassland to the east, and the Pacific Highway to the south. The site details are summarised in **Table 1** and the site location is shown in **Figure F4.**

Table 7. AOPCR 10 Site Identification

Category	Details
Site Description	AOPCR10
Site Address (approximate)	1907 Pacific Highway Tomago, NSW 2322
Lot Description	Lot 51 DP739336
Site co-ordinates (centre of site)	Latitude: -32.812061625° S, Longitude: 151.699336523° E
Current owner	Transport for NSW
Current occupier	Transport for NSW
Traditional owners	Worimi People
Site area (approximate)	2.5 Ha
Local government authority	Port Stephens
Current zoning	Ru2, Rural Landscape, and SP2 Classified Road
Trigger for assessment	Construction of M12RT
State or local government statutory controls	N/A
Legal permission to access site	Yes

4.2.2 Site Environmental Setting

Site environmental setting information for AOPCR 10 is summarised in **Table 8.**

Table 8. AOPCR 10 Environmental Context

Environmental component	Summary
Climate	The site is located within a temperate climate shifting from mild and cool in winter to warm and hot in the summer, with no extreme seasonal differences as the weather is moderated by proximity to the ocean.
Surface geology	The NSW Seamless Surface Geology map indicates that most of the site is likely to be underlain by Quaternary to Holocence aged fluvially deposited fine to medium grained lithic to quartz rich sand, silt, clay. The site also consists of organic rich mud, peat, silt, clay.
Soil Landscape	Geological mapping gathered from the Soil Landscapes of Central and Eastern NSW indicates that the site is likely to be underlain by two main soil landscape. Most of the site form predominantly from quaternary Holocene alluvial sediment. The landscape is described as extensive alluvial plain. Soil is described as deep (>150 cm), imperfectly to poorly drained prairie soils. Secondly, the site is formed from the Permian Tomago Coal measures, and Permian Mulbring Siltstone. The landscape is described as undulating low hills and rises. Soils are described as moderately deep (>120 cm) yellow and brown podzolic soils and brown soloths on crests, red podzolic and soloths on upper slopes, brown and yellow soloths on sideslopes, and yellow and gleyed pdzolic and yellow soloths on lower slopes.
Salinity	The site is described as having moderate salinity hazard (eSpade V2.2).
Acid Sulfate Soils (ASS)	The site is divided to three sections in regards to ASS probability: • The eastern section of the Site is described to have a low potential of ASS >3m below ground surface. • West section describe to have a high potential of ASS 1-3 m below ground surface. • North section described to have a high potential of ASS <1 m below ground surface. Risk of ASS is divided in a similar way.: • Eastern section: Class 4, likely to be found beyond 2 metres below the natural ground surface • Western section: Class 3, likely to be found beyond 1 metre below the natural ground surface • Northern section: Class 2, likely to be found below the natural ground surface.
Topography	The site is generally flat (0-10m), with the area to the south of the site being more elevated.
Hydrogeology	2 registered boreholes were found within a 1 km of the Site. One of the wells is located 350 m west from the site and the other found approximately 900m east of the site. No information is available for either boreholes.
Hydrology	The site is adjacent to the Hunter River and non-perennial creeks running through the site.
Contaminated land records	• A search of the NSW Contaminated Sites Notified to the NSW EPA found no records for the site. However directly west of the site is a notified site named RZM Site located at 1877 Pacific Highway, Tomago. Under the CLM Act, regulation is not required for the RZM Site. • A search of the NSW Contaminated Site Land record of notices found no records for the site. • A search of Environment Protection Licenses (EPL) issued under the Protection of the Environment Operations Act 1997 (POEO) identified no licenses for the Site. • A search of the PFAS investigation program from the EPA NSW found no PFAS investigation for the Site.
Sensitive environments	The closest human health receptors are rural residential land uses 1.9 km northeast of the site. The closest environment receptors are the non-perennial creeks that are found within the site. The creeks are connected to the Hunter River which flows to the Hunter Wetland National Park.

4.2.3 Site History

Site history consisting of the historical titles, aerials, and previous reports for AOPCR 10 are summarised in **Table 9**. Historical titles and aerial photographs are included in **Appendix B**. Site history information indicates rural land uses since the 1930s.

Table 9. AOPCR 10 Site History

Site History Component	Summary
Historical titles	1937-1939: [redacted] (Grazier) 1939-1939: Perpetual Trustee Company (Limited) 1939-1945: [redacted] Merchant) 1945-1995: [redacted] (Dairy and Butcher) 1995-2007: [redacted] 2007- Present: Roads & Traffic Authority of New South Wales
Historical aerials	1953: The site contains three structures believed to either be agricultural or residential premises. 1965: The site remains unchanged. Development of a agricultural or residential premise observed south of the site. Directly west of the site appears to be the development of a mining site. 1974: The site remains unchanged. Several structures observed to the surrounding areas south of the site. Development of what appears to be a mining site observed to the west of the site. 1984: The site remains as per the previous photograph and the surrounding areas appear to be relatively unchanged apart from further developments of industrial premises to the south of AOPCR 10 and to the mining site west of the site. 1992: The site remains as per the previous photograph and the surrounding areas appear to be relatively unchanged. 2000: The site remains as per the previous photograph and the surrounding areas appear to be relatively unchanged.
Previous reports	(Transport for NSW, 2022): Previous contamination investigation identified potential asbestos containing material in soil associated with a redundant agricultural structure within the project area at Tomago. Three or six samples taken on site confirmed the presence of asbestos. The redundant agricultural structure is located within a registered Aboriginal heritage site and as such access to remediate the asbestos material is constrained by the potential risk of impact to Aboriginal cultural heritage artefacts. The asbestos impacted area was fenced to prevent livestock or pedestrian access. (Douglas Partners, 2022): Known asbestos contamination on site identified during previous site investigation. Asbestos understood to be distributed within the topsoil but was not able to be remediated due to being in a cultural heritage site. Site described in Geotechnical Zone 4 where they state that the soils on site consist of a combination of aeolian sand soils and alluvial compressible soil with a flat to undulating topography. Groundwater is described as generally at a shallow depth but likely to be deeper along more elevated sections of the alignment. Surface water within the zone comprise of a shallow creek between the Hunter River and the Pacific Highway and a minor creek to the south of The Botanic Gardens which flows west into the shallow creek prior to discharge into the Hunter River.

4.2.4 Preliminary Conceptual Site Model

Using the information obtained during the desktop review, Epic has developed a preliminary CSM for the site to identify potential risks posed to human and ecological receptors on and offsite, as summarised in **Table 10.**

Table 10. AOPCR 10 Conceptual Site Model

Source	Contaminants of Potential Concern	Likely Media Potentially Affected	Pathway	Receptor
Known asbestos contaminated fill (reported during previous investigations) Uncontrolled fill Possible pesticide use Offsite sources – Former RZM mineral sands facility located directly west of the site.	Asbestos, Metals, PFAS, PAH, TRH, BTEXN, OCPs, PCBs	Soil	• Direct Contact with contaminated soils • Ingestion or inhalation of dust associated with impacted soils or vapours (volatile contaminants, asbestos) • Overland flow or wind-swept transport of impacted soils • Leaching to groundwater (non-asbestos contaminants)	• Human – Construction workers, maintenance workers • Ecological receptors (terrestrial flora / fauna, aquatic receptors in surface body receiving waters)

Note – offsite contamination at RZM has been delineated and investigated under separate Site Auditor. If potential impacts from adjacent site are noted during site works, sampling for radiological materials may be required.

4.2.5 Sampling Rationale

The scope of intrusive investigation is based on the recommendations of NSW EPA (2022), with the rationale outlined below in **Table 11.**

Table 11. AOPCR 10 Sampling Rationale

Site	Scope of Sampling	Rationale
AOPCR10 (asbestos waste Hazmat 2020)	Completion of 42 testpits using a 5 tonne excavator to a maximum of 3 mbgl, 0.5 m into natural soils or practical refusal. Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials.	The construction footprint in AOPCR 10 is approximately 2.3 hectares. Higher contamination risk based on aerial imagery was identified in four discrete portions of the site equalling approximately 700 m^2, 920 m^2, 1,800 m^2 and 500 m^2. With reference to (NSW EPA, 2022) Sampling Design Guidelines, a stratified sampling design will be undertaken. 37 sample locations will be completed in the four portions with inclusion of delineation sampling, and five samples will be completed across the remainder of the site. Minimal excavation is proposed however excavation and recompaction of shallow soils may be undertaken, so analysis of one sample per location is considered appropriate. It is noted that the scope of sampling for AOPCR10 may significantly reduce subject to the results and information contained within Hazmat 2020 (when provided by Transport). Groundwater sampling is not recommended given the primary contaminant of concern (asbestos) is not a risk to groundwater.

4.2.6 Analytical Schedule

The proposed DSI analytical plan has been outlined in **Table 12**. Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials. One sample per location will be analysed for AF/FA.

Field intra-laboratory and inter-laboratory samples will each be included at a 5% rate (each) of the primary sample analytes. One trip blank and one trip spike are proposed to be analysed per sampling event. Rinsate samples will be collected at a rate of one per day (when non-disposable field equipment is utilised) and analysed for heavy metals.

Table 12. Analytical Schedule - AOPCR 10

Analysis	Number of soil primary samples
Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)	35
Polycyclic aromatic hydrocarbons (PAH)	35
Total recoverable hydrocarbons (TRH)	35
Benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)	35
Asbestos (500 ml)	35
Asbestos (I.D.)	As required
Organochlorine pesticides (OCPs)	35
Polychlorinated biphenyls (PCBs)	35
Cation exchange capacity (CEC)	4
Total organic carbon (TOC)	4
Per-and-polyfluoroalkyl substances (PFAS)	4
Iron	4

Note: Subject to change based on field observations and analytical results. Asbestos I.D. samples will be analysed as encountered during testpitting

4.3 AOPCR 19

4.3.1 Site Identification

AOPCR 19 is located in John Renshaw Drive, Black Hill NSW 2322 and is found adjacent to the roundabout connecting John Renshaw Drive, Weakleys Drive, and Pacific Motorway. The site is bound by John Renshaw Drive to the north, Pacific Motorway to the west, and vacant bushlands to the east and south. The site details are summarised in **Table 13** and the site location is shown in **Figure F6.** AOPCR 19 works are subject to access and works approvals to be organised by JHGA.

Table 13. AOPCR 19 Site description

Category	Details
Site Description	AOPCR19 – Former Night Soil Disposal
Site Address (approximate)	John Renshaw Drive, Black Hill NSW 2322
Lot Description	Lot 10 DP1186448
Site co-ordinates (centre of site)	Latitude: -32.813844227° S, Longitude: 151.637263455° E
Current owner	The Council of the City of Newcastle
Current occupier	The Council of the City of Newcastle
Traditional owners	Awabakal People
Site area (approximate)	1.5 Ha
Local government authority	Newcastle
Current zoning	C4
Trigger for assessment	Construction of m1
State or local government statutory controls	N/A
Legal permission to access site	Yes

4.3.2 Site Environmental Setting

Site environmental setting information for AOPCR 19 are summarised in **Table 14**

Table 14. AOPCR 19 Environmental context

Environmental component	Summary
Climate	The site is located within a temperate climate shifting from mild and cool in winter to warm and hot in the summer, with no extreme seasonal differences as the weather is moderated by proximity to the ocean.
Surface geology	The NSW Seamless Surface Geology map (version 2.2) indicates that the site is likely to be underlain by Lopingian aged Tomago Coal Measures, which consist of very fine- to medium-grained grey lithic sandstone, (sporadically interbedded with) laminated to carbonaceous shale and mudstone, siltstone, coal with sporadic interbeds of carbonaceous shale, claystone, sideritic bands, rare pebble paraconglomerate
Soil Landscape	Geological mapping gathered from the Soil Landscapes of Central and Eastern NSW indicates that the site is formed from the Permian Tomago Coal measures, and Permian Mulbring Siltstone. The landscape is described as undulating low hills and rises. Soils are described as moderately deep (>120 cm) yellow and brown podzolic soils and brown soloths on crests, red podzolic and soloths on upper slopes, brown and yellow soloths on sideslopes, and yellow and gleyed pdzolic and yellow soloths on lower slopes.
Salinity	The site is described as having very high salinity hazard (eSpade V2.2)
Acid Sulfate Soils (ASS)	A review of the Atlas of Australian Acid Sulfate Soils indicates that the site is not considered to having a potential for ASS. A review of the council ASS risk map indicates that the site is classified as Class 5 risk.
Topography	The site is generally flat (10-20mAHD) with east of the site being more elevated than the west of the site.
Hydrogeology	48 registered boreholes were found within a 1 km radius of the Site. All 48 boreholes are approximately 480 m northeast of the Site. The boreholes are in proximity of a BP Truckstop and are mainly registered as monitoring bores, installed around 13 m bgl.

Hydrology	There are no surface water bodies present on site. The nearest surface water body is a creek located 134 m north of the site. The creek flows in a northerly direction and travels for 2.87 km before discharging into the southern section of Woodberry Swamp.
Contaminated land records	A search of the NSW Contaminated Sites Notified to the NSW EPA found no records for the site. A search of the NSW Contaminated Site Land record of notices found no records for the site. A search of Environment Protection Licenses (EPL) issued under the Protection of the Environment Operations Act 1997 (POEO) identified no licenses for the Site. A search of the PFAS investigation program from the EPA NSW found no PFAS investigation for the Site.
Sensitive environments	The closest human health receptors, low density residential is 1 km northeast of the site near the town of Beresfield where a public school is located. The site is not considered as a groundwater dependent ecosystem (GDE). However, surrounding the east, west, and south of the site are areas with low to high probability of GDE Threatened ecological communities mapping[1] identified areas of Lower Hunter Spotted Gum – Ironbark Forest in the Sydney Basin Bioregion within AOPCR 19.

4.3.3 Site History

Site history consisting of the historical titles, aerials, and previous reports for AOPCR 19 are summarised in **Table 15**. Historical titles and aerial photographs are included in **Appendix C.** The site has been identified as a nightsoil disposal area (human waste), inferred to be during ownership by Council.

Table 15. AOPCR 19 Site History

Site History Component	Summary
Historical titles	1933-1958: R.W Miller & Company Limited 1958-1976: The Council of The Shire of Lower Hunter 1976-Present: The Council of The City of Newcastle
Historical aerials	1953: The site is fully covered with trees and its surrounding areas are vacant with no developments observed in its vicinity except for the road now called John Renshaw Drive. Surrounding areas are densely vegetated with tree cover observed throughout the vicinity of the Site. 1965: The site has been cleared of trees and several sections surrounding the intersection has also been cleared of trees. 1975: The site remains as per the previous photograph. Areas north to the site has been cleared with trees remaining sparsely mostly on the borders. 1992: The site remains as per the previous photograph. To the north, the current BP Truckstop and Daimler Trucks dealer appear to be farming/ mining site with three structures observed. A circular pond/ water containment unit is observed to the current Dive Newcastle area. 2000: The site remains as per the previous photography. Area to the north that is currently a BP Truckstop starts to take form as a Truck stop. Area to the north that is currently a truck dealership remains relatively unchanged except of the removal of two of the structures and expansion of the remaining structure. Circular pond/ water containment unit remains.
Previous reports	(Douglas Partners, 2022): AOPCR 19 was described in the Geotechnical Zone 1 where it is described to be underlain by residual soils over rock with an undulating topography with moderate to dense vegetation cover. Surface water typically flows away from this zone to lower lying areas and groundwater to be found at depths within bedrock. The site was discussed as a former night soil disposal area (human waste).

4.3.4 Preliminary Conceptual Site Model

Using the information obtained during the desktop review, Epic has developed a preliminary CSM for the site to identify potential risks posed to human and ecological receptors on and offsite, as summarise in **Table 16.**

Table 16. AOPCR 19 Conceptual Site Model

Source	Contaminants of Potential Concern	Likely Media Potentially Affected	Pathway	Receptor

[1] Mapping layer provided from the Environmental Impact Statement (EIS) completed by Jacobs

Nightsoil disposal area Possible uncontrolled fill	Asbestos, Metals, PFAS, PAH, TRH, BTEXN, OCPs, PCBs	Soil	• Direct Contact with contaminated soils • Ingestion or inhalation of dust associated with impacted soils or vapours (volatile contaminants, asbestos) • Overland flow or wind-swept transport of impacted soils • Leaching to groundwater (non-asbestos contaminants)	• Human – Construction workers, maintenance workers • Ecological receptors (terrestrial flora / fauna, aquatic receptors in surface body receiving waters)

4.3.5 Sampling Rationale

The scope of intrusive investigation is based on the recommendations of NSW EPA (2022), with the rationale outlined below in **Table 17.** The Threatened Ecological Communities mapping layer identifies four locations within the TEC areas presented in **Figure F7**. The TEC area will be treated as an exclusion zone, subject to change based on relevant approvals and access organised by JHGA.

Table 17. AOPCR 19 Sampling Rationale

Site	Scope of Sampling	Rationale
AOPCR19 (former night soil disposal)	Completion of 25 testpits using a 5 tonne excavator to a maximum of 1 mbgl, 0.5 m into natural soils or practical refusal. Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials. If stockpiles are encountered a sampling density as per the NSW EPA guidance will be undertaken (1 per 250m^3, minimum of 10 samples)	The construction footprint in AOPCR 19 is approximately 1.5 hectares. (NSW EPA, 2022) Sampling Design Guidelines recommend 25 systematic location to investigate a site up to 1.5 hectares. Given there is **possible** asbestos contamination, single density sampling is recommended, per NSW EPA (2022) Position Statement. Groundwater sampling is not recommended given lack of exposure pathways for groundwater in the construction scope and limited potential for contaminant migration to the water table (PAHs).

4.3.6 Analytical Schedule

The proposed DSI analytical plan has been outlined in **Table 18.** Collection of asbestos for presence/absence and chemical samples at surface and 1 m intervals, with additional samples collected from each fill stratigraphy or any suspect materials including. One sample per location will be analysed for AF/FA.

Field intra-laboratory and inter-laboratory samples will each be included at a 5% rate (each) of the primary sample analytes. One trip blank and one trip spike are proposed to be analysed per sampling event. Rinsate samples will be collected at a rate of one per day (when non-disposable field equipment is utilised) and analysed for heavy metals.

Table 18. Analytical schedule – AOPCR 19

Analysis	Number of soil primary samples
Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn)	25
Polycyclic aromatic hydrocarbons (PAH)	25
Total recoverable hydrocarbons (TRH)	25
Benzene, toluene, ethylbenzene, xylene, naphthalene (BTEXN)	25
Asbestos (500 ml)	25

Asbestos (I.D.)	As required
Organochlorine pesticides (OCPs)	25
Polychlorinated biphenyls (PCBs)	25
Toxicity characteristic leachate potential (TCLP)	5
Per-poly fluoro alkyl substances (PFAS)	4
Cation exchange capacity (CEC)	2
Total organic carbon (TOC)	2
Iron	2

Note: Subject to change based on field observations and analytical results. Asbestos I.D. samples will be analysed as encountered during test pitting

5 FIELDWORK PROCEDURES

5.1.1 Health and Safety Management

Epic will prepare a risk based Safe Work Method Statement (SWMS) and Health, Safety and Environment Plan (HSEP) in accordance with the Epic Integrated Management System (IMS).

5.1.2 Service Locating and Clearing

Epic note the service locating will be managed by JHGA; however, the following will be undertaken prior to Epic's intrusive works occurring.

- Review of the Dial-Before-You-Dig reports and liaising with JHGA project engineers to confirm proposed investigation locations are suitable
- Clearance of each location for subsurface utilities by an accredited service locator, including Ground Penetrating Radar (GPR) if/where required by JHGA
- Services known within the area will be marked with biodegradable spray paint by JHGA
- Development of a ground disturbance permit by JHGA

5.1.3 Sample Naming Convention

All samples will be labelled to facilitate the interpretation and compilation of analytical results. The sample names will follow the general rules outlined in **Table 19** with each sample horizon (as applicable) named with a depth range. Epic notes the sample naming will be consistent across the program.

Table 19.Sample naming convention

Sample Type	Primary Source	Sample Example[1]
Soil (Test Pit)	TP	AOPCRx_TP01_0.1-0.2
Rinsate	RB	AOPCRx _RB01
Quality control	QC	AOPCRx _QC01
Trip blank	TB	AOPCRx _TB01
Trip spike	TS	AOPCRx _TS01

[1]: AOPCRx: refers to which AOPCR the sample was taken from. i.e. samples from AOPCR3 will be labelled as AOPCR3_TP01_0.1-0.2

5.2 Intrusive Site Assessment

The intrusive soil assessment will comprise the establishment of test pits to gain a visual understanding of material encountered at depth and allow inspection of potential asbestos and nightsoils. A test pit log will be produced for each investigative location in accordance with Australian Standard AS1726 -1993 Geotechnical Site Investigations, ASTM D2487 - 17 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), and the Unified Classification System (USBR Earth Manual). Site photographs will be taken during the intrusive assessment.

5.2.1 Test Pits

Test pits will be established using a suitably sized excavator fitted with a bucket. The following outlines the general soil sampling methodology for test pits:

- The excavator bucket will be approached following placement of the bucket on the ground, positive communication has been established with the operator, and the excavator has been set to idle
- Excavated materials will be inspected thoroughly for the presence of foreign material and ACM, including inspection of a 10 L bucket sub sample from each layer of fill
- Soil samples will be collected directly from the centre of the excavator bucket to avoid any cross contamination with the sides of the bucket
- The soil sample will be handled using disposable nitrile gloves
- A clean pair of disposable gloves will be worn to collect each sample

- The soil samples will be immediately transferred into laboratory supplied 250 mL glass jars with Teflon-lined lids, and HDPE plastic jars (where required) for chemical analysis and into zip lock sealed bags for asbestos analysis
- The lids of the jars and the zip lock of the bag will be closed as soon as practicable after collection

6 ASSESSMENT CRITERIA

Epic considers that the proposed site use is most closely approximated by commercial/industrial land use. For risk screening purposes, concentrations in soils will be compared against Health Investigation Levels (HILs) and Health Screening Levels (HSLs) for commercial/industrial land use (HIL-D and HSL-D) from Schedule B1: 'Guideline on Investigation Levels' of the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (ASC NEPM). Where NEPM (2013) criteria are not available for CoPC, concentrations will be compared to the laboratory limit of reporting (LOR) or relevant overseas guidance.

In accordance with the ASC NEPM, protection of the environment is also considered in this site assessment. Soil concentrations will be compared against Ecological Investigation Levels (EILs) and Ecological Screening Levels (ESLs) for commercial / industrial land uses.

The guidance criteria used to establish the soil assessment criteria is summarised in **Table 20**.

Table 20. Adopted Soil Assessment Criteria (SAC)

Contaminant of Potential Concern	Potential Receptor	Guideline Source
Metals, PAH, OCP, OPP, PCBs	Human Health	ASC NEPM, Health based Investigation Level (HIL) – Commercial/Industrial
	Ecological	ASC NEPM Environmental Investigation Level (EIL) – Commercial/Industrial exposure setting
TRH, BTEXN	Human Health	ASC NEPM, Health Screening Level (HSL) – Commercial/Industrial
	Ecological	ASC NEPM (2013) Environmental Screening Level (ESL) – Commercial/Industrial exposure setting
	Management Limits	ASC NEPM – Management limits for commercial/Industrial land uses
	Human Health	Friebel and Nadebaum (2014) Direct contact HSLs
VOC	Human Health	Laboratory Limit of Reporting US EPA (2019) Regional Screening Levels (RSLs): Summary Table – Industrial Soil
PFAS	Human Health/	PFAS National Environment Management Plan (NEMP) 2.0 (2020) Health Investigation Level (HIL) – Commercial/Industrial
	Ecological	PFAS NEMP 2.0 (2020) – Ecological Direct Exposure Limit
Asbestos	Human Health	Presence/absence

For human health and ecological risk assessment, a Tier 1 level assessment as defined by the ASC NEPM will be undertaken. This involves the comparison of analytical results with the adopted investigation and screening levels. Where exceedances are identified, further assessment may be required to better understand and characterise the actual risks to the identified receptors.

ASC NEPM guidance provide Tier 1 investigation levels for human health risk assessment via the direct exposure pathway for the contaminants being considered. ASC NEPM also provides screening levels for the vapour inhalation pathway for volatile hydrocarbons (light end TRH and BTEXN) as a function of depth. Where petroleum hydrocarbon impact is present, additional trigger levels are provided for management actions (i.e., Management Limits). The management trigger levels are concentrations at which hydrocarbon impacted soil should not:

- Form observable light non- aqueous phase liquids (LNAPLs).
- Be a fire or explosive hazard; or
- Have deleterious effects on buried infrastructure (e.g., penetration or damage of underground services and conduits)

NEPM (2013) also refers to direct contact HSLs developed by Friebel & Nadebaum (2011) for exposure through dermal contact, incidental oral ingestion and dust inhalation and combined into a single HSL for direct contact with soil. These levels are significantly higher than other soil screening levels.

Ecological risk assessment with respect to metals is complicated by the occurrence of natural background metals in the environment. Site specific EILs will be derived for soils for chromium, copper, nickel and zinc in accordance with the method described in Section 2.5.10 of Schedule B1: 'Guideline on Investigation Levels' of

the ASC NEPM. The EIL derivation methodology considers the physiochemical properties of soil and background contaminant levels (i.e., the Added Contaminant Limit (ACL) above Ambient Background Levels (ABC)).

For PFAS compounds, the (NEMP, 2020) has established human health and ecological guideline criteria based on the ASC NEPM methodology. Human health guideline values for PFAS in soils are derived for each of the land use categories described in the ASC NEPM. Interim ecological criteria have been developed for direct and indirect exposure scenarios, with the direct and indirect guideline values applicable across all land use categories.

Where published Australian criteria or suitable international criteria are not available for target compounds, the level of reporting will be used as the Tier 1 screening tool.

Where individual sample values exceed the adopted criteria, the site may still be considered suitable for the respective land use if the following conditions are met:

- The 95% UCL is less than the criteria from a suitable population of data targeting a sampled soil type
- The standard deviation of the data subset does not exceed 50% of the adopted land use criteria value
- The individual values are less than 250% of the adopted land use criteria

7 QUALITY ASSURANCE PLAN

The field and laboratory quality assurance and quality control plan to be adopted for the assessment has been designed to achieve pre-determined data quality objectives that will be assessed with respect to Data Quality Indicators (DQIs). The assessment will demonstrate the precision, accuracy, representativeness, completeness and comparability of the dataset and that the dataset is of acceptable quality to meet the objectives of the assessment.

The specific quality assurance and quality control plan for the field and laboratory components of the investigation have been developed and are detailed below.

7.1 Field QA/QC

The field quality assurance procedures to be adopted, the field quality control samples to be collected during the assessment, and the corresponding acceptable control limits are presented in **Table 21.**

Table 21. Field QA/QC

Data Type	Comments and Acceptable Control Limits
Field personnel	Use appropriately trained field personnel and employ procedures detailed in this assessment.
Field data collection	Site conditions and sample locations to be accurately surveyed and properly described. Information is to be recorded on daily field logs and sampling sheets. Field notes are to be appropriately completed, signed, and included in the final report. Test locations are to be recorded on a handheld GPS unit, accurate to 3 m.
Sample handling (storage and transport)	Soil samples will be collected in jars/zip lock bags supplied by the primary analytical laboratory. The sampling containers will be labelled and stored on ice in a chilled, insulated container prior to and immediately after sampling, and during transport to the nominated laboratory. Sample numbers, dates, name of sampler, sample type, preservation and analytical requirements will be recorded on a chain of custody (COC) document, which will be included with the samples during transport to the nominated laboratory. All samples are required to be documented as received by the laboratory chilled and intact.
Field intra-laboratory duplicates/inter-laboratory duplicates	Intra-laboratory duplicates will be collected and analysed at a rate of 1 in every 20 primary samples. Inter-laboratory duplicates will be collected and analysed at a rate of 1 in every 20 primary samples. As per the (NEMP, 2020), PFAS QA/QC samples should be collected at a higher frequency than the recommended 1 sample in 20 by AS4482.1 - 2005. As such, Epic will collect 1 sample in every 10 primary samples. Labelling of duplicate samples on sample bottles and COCs will be done so as to conceal their relationship to the primary sample from the laboratory. According to NSW EPA (2022), typical RPDs are expected to range between 30% and 50%; however, this may be higher for concentrations which are close to the laboratory LOR. Considering this, Epic will adopt the following acceptable RPD limits for the DSI, based on standard industry practice: No limit for concentrations within one to ten times the analyte LOR 50% for concentrations within ten to 30 times the analyte LOR 30% for concentrations greater than 30 times the analyte LOR
Trip blanks	Trip blank samples will be included to provide an indication of cross-contamination between samples during transport from site to the analytical laboratory. Concentrations of analytes to be less than the laboratory detection limits.
Trip spikes	Trip spike samples will be included to provide an indication of the breakdown or loss of analytes during the sampling and transport process (i.e., due to holding time and/or temperature effects). Concentrations of analytes to be within the acceptable recovery ranges.
Rinsate	Rinsate samples will be collected and analysed where re-usable equipment is used. Concentrations of analytes to be less than the laboratory detection limits.

7.2 Laboratory QA/QC

The laboratory quality assurance procedures to be adopted and the internal laboratory quality control samples to be analysed, and the corresponding acceptable control limits are presented in **Table 22.**

Table 22. Laboratory QA/QC

Data Type	Comments and Acceptable Control Limits
Sample analysis	All sample analysis to be conducted using the methods detailed by the primary laboratory Envirolab and the secondary laboratory ALS, who will implement quality control plans in accordance with NEPM (2013)
Holding times	Maximum acceptable sample holding times as follows: • TRH, BTEXN, PAH, VOC, SVOC, OCP, OPP, PCB analysis: 7 to 14 days • Metal analysis (excluding mercury): 6 months • Mercury analysis: 28 days • PFAS: 6 months • Asbestos: Indefinite
Laboratory detection limits	All laboratory detection limits to be less than the assessment criteria.
Laboratory blanks	Laboratory blanks to be analysed at a rate of 1 in 10, with a minimum of one analysed per batch. Concentration of analytes to be less than the laboratory detection limits
Laboratory duplicates	Laboratory duplicates to be analysed at a rate of 1 in 10, with a minimum of one analysed per batch. RPDs to be less than 50% and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.
Laboratory control samples (LCS)	LCSs to be analysed at a rate of 1 in 20. Control limits: 70 to 130 % Acceptable Recovery and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.
Matrix spikes	Matrix spikes and matrix spike duplicates will be prepared by dividing a field sample into two aliquots, then spiking each with identical concentrations of the analytes at a rate of 1 in 20. Matrix spike control limits: 70 to 130 % acceptable recovery and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required. Matrix spike duplicates: RPDs <50% and if not, liaison with the laboratory will be undertaken and samples will be reanalysed, if required.

7.3 Data Quality Indicators

A summary of the data quality indicators (DQIs) and the corresponding measures to be applied for the investigation are presented in **Table 23**.

Table 23. Data Quality Indicators

DQI	Controls	Actions	Acceptance criteria
Precision	Sampling methodologies appropriate and complied with. Collection of intra-laboratory and inter-laboratory duplicate samples.	Analysis of: Field intra-laboratory samples (1 in 20) Field inter-laboratory samples (1 in 20) Laboratory duplicate samples	RPD of <50% RPD of <50% RPD of <50%
Accuracy	Sampling methodologies appropriate and complied with. Collection of rinsate blanks.	Analysis of: Rinsate Blanks Method blanks Matrix spikes Matrix spike duplicates Laboratory control samples Laboratory prepared spikes Reagent blanks Reference materials	Non-detect for CoPC Non-detect 70 – 130 % RPD of <50% 70 – 130% 70 – 130% Non-detect for CoPC Varies

DQI	Controls	Actions	Acceptance criteria
Precision	Sampling methodologies appropriate and complied with	Sample laboratory detection limits	< nominated criteria
Representativeness	Appropriate media sampled according to SAQP All media identified in SAQP sampled	All samples analysed according to SAQP Appropriate sampling techniques and decontamination methods	All samples analysed according to SAQP Acceptable concentrations
Comparability	Same sampling methodologies used on each day of sampling Experienced sampler Climatic conditions Same types of samples collected	Same analytical methods used (including decontamination) Sample laboratory detection limits (justify/quantify if different) Same laboratories and methods (NATA accredited) Same units	As per NEPC (2013) < nominated criteria
Completeness	All critical locations and media sampled All samples collected and analysed Sampling methodologies appropriate and complied with Experienced sampler Documentation correct Data completeness	All critical samples analysed and all analytes analysed according to SAQP Appropriate methods Appropriate laboratory detection limits Sample documentation complete Sample holding times complied with All critical samples analysed and all analytes analysed according to SAQP. Field and Laboratory methodology conducted in accordance with SAQP	As set out in this SAQP

In the event that a DQI is not met by laboratory analysis, the field observations relating to the nature of the samples will be reviewed. If no obvious source for the non-conformance is identified, such as an error in sampling, preservation of samples or heterogeneity of samples, communication with the laboratory will be undertaken in an effort to identify the issue that has given rise to the non-conformance. Additional analysis will be undertaken on the original samples, on duplicate samples or on other samples, if required.

If no explanation for the non-conformance is identified, the concentrations for the affected samples will be noted as estimates.

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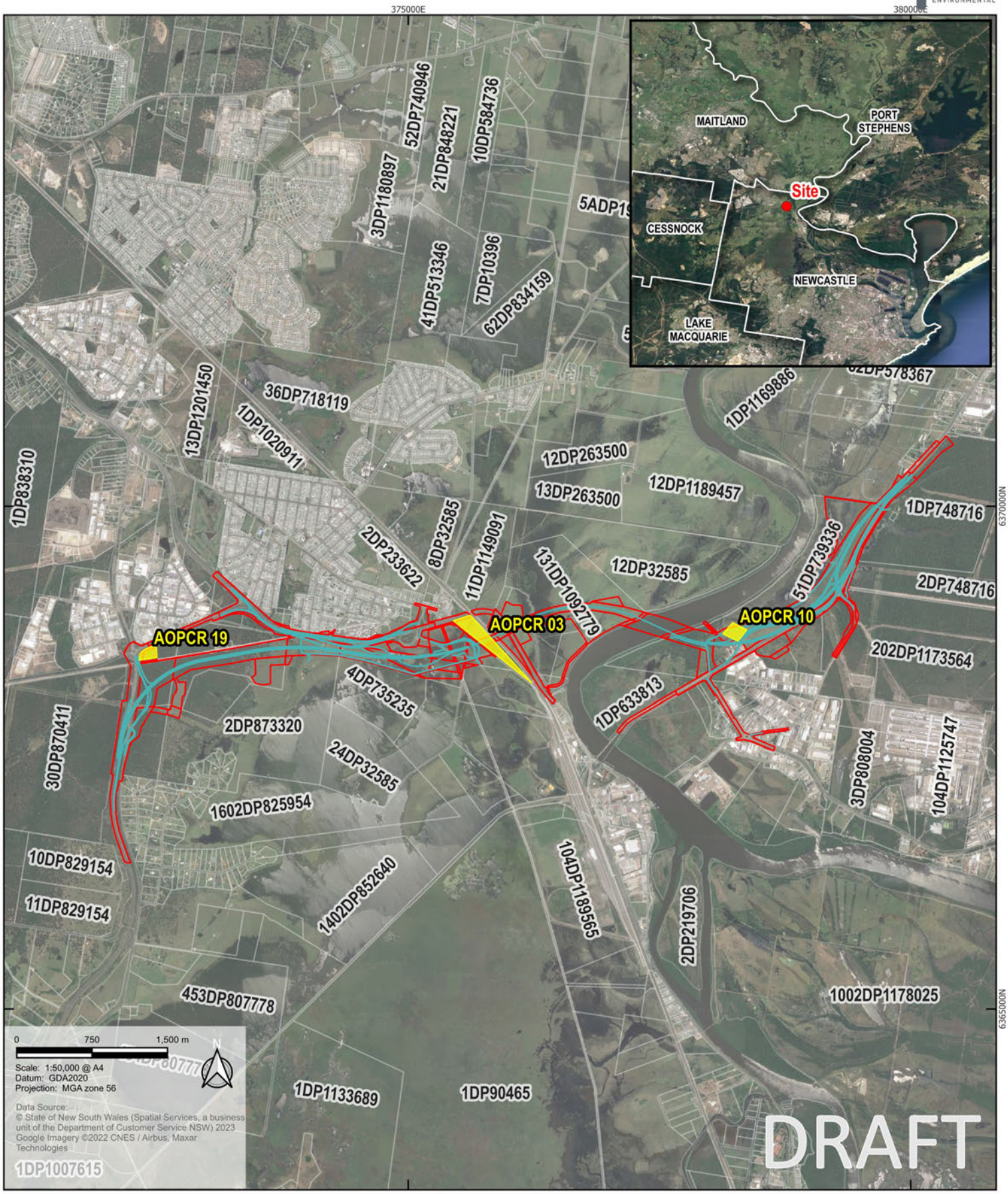
FIGURES



Filepath: ~SCL\SCL230006.01 JHG M1 Black Hill to Tomago CLM\Workspaces\2. SAQP\Figure F1 Site location.qgz

Legend

- Construction footprint
- Lot boundary
- AOPCR site
- Design alignment

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F1
Site location

Filepath: ~SCL\SCL230006.01 JHG M1 Black Hill to Tomago CLM\Workspaces\2. SAQP\Figure F2 AOPCR 3 site outline.qgz

Legend

- Site boundary
- Lot boundary
- Railways
- Watercourses

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F2
AOPCR 3 site outline

Filepath: ~SCL\SCL230006.01 JHG M1 Black Hill to Tomago CLM\Workspaces\2. SAQP\Figure F3 AOPCR 3 sample locations.qgz

Legend

- Site boundary
- Lot boundary
- Area of interest
- Railways
- Watercourses

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F3
AOPCR 3 sample locations

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Legend

- Site boundary
- Lot boundary
- Railways
- Watercourses

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F4
AOPCR 10 site outline

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Legend

- Site boundary
- Lot boundary
- Area of interest
- Watercourses
- Test pit

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F5
AOPCR 10 sample locations

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Legend

- Site boundary
- Lot boundary
- Railways
- Watercourses

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F6
AOPCR 19 site outline

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Legend

- Site boundary
- Area of interest
- Lot boundary

Threatened Ecological Communities – Exclusion Zone

- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
- Watercourses
- Test pit

John Holland Gamuda Australia
M1 Black Hill to Tomago
Sampling and Analysis Quality Plan

Figure F7
AOPCR 19 sample locations

APPENDIX A HISTORICAL TITLES AND HISTORICAL AERIAL PHOTOGRAPH – AOPCR 3

Sensitive information removed

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