Prepared for
John Holland CPB Ghella Joint Venture
Prepared by
Ramboll Australia Pty Ltd
Date
23 September 2021
Project Number
318000323-005
Audit Number
RS-139

SITE AUDIT REPORT
BARANGAROO STATION BOX, HICKSON ROAD, BARANGAROO

RAMBOLL Bright ideas. Sustainable change.

RAMBOLL

ENVIRONMENT
& HEALTH

23 September 2021

John Holland CPB Ghella Joint Venture
Attn.: Stuart Anstee
Level 9, 50 Bridge Street
Sydney NSW 2000

By email: stuart.anstee@sydneymetro2.com.au

Dear Stuart

SITE AUDIT REPORT - BARANGAROO STATION BOX, HICKSON ROAD, BARANGAROO

I have pleasure in submitting the Site Audit Report for the subject site. The Site Audit Statement, produced in accordance with the NSW *Contaminated Land Management Act 1997*, is included as Appendix B of the Site Audit Report. The Audit was commissioned by John Holland CPB Ghella Joint Venture to assess the suitability of the site for its intended use as a Sydney Metro underground train station (commercial/industrial land use).

The Audit was initiated to comply with requirements of *Condition E67 of Infrastructure Approval, application SSI 15_7400,* approved by the Minister for Planning on 9 January 2017, and is therefore a statutory audit.

The Audit was commenced by Tom Onus (TO-024) however was transferred to Rowena Salmon to allow completion of the audit in the absence of Tom Onus.

Thank you for giving me the opportunity to conduct this Audit. Please call me on 9954 8100 if you have any questions.

Yours sincerely,
Ramboll Australia Pty Ltd

Rowena Salmon
EPA Accredited Site Auditor 1002

cc: NSW EPA – Statement only
City of Sydney Council

Ramboll Australia
Level 3, 100 Pacific Highway
PO Box 560
North Sydney NSW 2060

T +61 2 9954 8100
www.ramboll.com

Ref 318000323-005

Ramboll Australia Pty Ltd
ACN 095 437 442
ABN 49 095 437 442

CONTENTS

LIST OF TABLES

APPENDICES

Appendix C
Interim Audit Advice

Appendix D
ADE Report List

LIST OF ABBREVIATIONS

Measures

%	per cent
µS/cm	Microsiemens per Centimetre
h	Hour
ha	Hectare
kL	Kilolitere
km	Kilometres
L	Litre
m	Metre
m^3	Metre Cubed
m^3/s	Metre Cubed per Hour
m^3/s	Metre Cubed per Second
mAHD	Metres Australian Height Datum
mbgl	Metres below ground level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Litre
mg/m^3	Milligrams per Cubic Metre
mm	Millimetre
$mL/m^2/hr$	Millilitres per Square Metre per Hour
mV	Millivolts
ppm	Parts Per Million
t	Tonnes
w/w	Weight per weight

General

ACM	Asbestos Containing Material
ADE	ADE Consulting Group Pty Ltd
ADWG	Australian Drinking Water Guidelines
AER	Air exchange rate
AHD	Australian Height Datum
ANZG	Australian & New Zealand Guidelines
ASS	Acid Sulphate Soil
ASSMP	Acid Sulphate Soil Management Plan
AST	Aboveground Storage Tank
ANZECC	Australian and New Zealand Environment and Conservation Council
BaP	Benzo(a)pyrene
BTEXN	Benzene, Toluene, Ethylbenzene, Xylenes & Naphthalene
CBD	Central Barangaroo Development
CLM Act	NSW Contaminated Land Management Act 1997
COC	Chain of Custody
Council	City of Sydney Council
CS	Characteristic Situation
CSM	Conceptual Site Model
DGV	Default Guideline Value
Douglas	Douglas Partners Pty Ltd
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
DSI	Detailed Site Investigation
EMP	Environmental Management Plan
ENM	Excavated Natural Material
EPA	Environment Protection Authority (NSW)
EPL	Environment Protection Licence
ERM	Environmental Resource Management Australia Pty Ltd
GIL	Groundwater Investigation Level
GSV	Gas Screening Value
GSW	General Solid Waste
HI	Hazard Index
HIL	Health Investigation Level
HQ	Hazard Quotient

HSL	Health Screening Level
HW	Hazardous Waste
IAA	Interim Audit Advice
JBS&G	JBS&G Australia Pty Ltd (formerly JBS Environmental Pty Ltd)
JHCPBG JV	John Holland CPB Ghella Joint Venture
LCS	Laboratory Control Sample
LEP	Local Environment Plan
Metals	As: Arsenic, Cd: Cadmium, Cr: Chromium, Cu: Copper, Ni: Nickel, Pb: Lead, Zn: Zinc, Hg: Mercury
METRON	METRON Consortium (Arcadis and Mott MacDonald, with principal sub-consultants Robert Bird Group, Foster + Partners, Architectus and WT Partnership)
ML	Management Limits
MS	Matrix Spike
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NL	Non-Limiting
n	Number of Samples
OCPs	Organochlorine Pesticides
OEH	Office of Environment and Heritage
OPPs	Organophosphorus Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
pH	A measure of acidity, hydrogen ion activity
PID	Photoionisation Detector
PQL	Practical Quantitation Limit
PSI	Preliminary Site Investigation
PSM	Pells Sullivan Meynink
QA/QC	Quality Assurance/Quality Control
Ramboll	Ramboll Australia Pty Ltd – previously Ramboll Environ Australia Pty Ltd and ENVIRON Australia Pty Ltd
RAP	Remediation Action Plan
RL	Reduced/Relative Level
RPD	Relative Percent Difference
RRE	Resource Recovery Exemption
RRO	Resource Recovery Order
RSL	Regional Screening Level
RSW	Restricted Solid Waste
SAR	Site Audit Report
SAS	Site Audit Statement
SCWCI	Supplementary Contamination and Waste Classification Investigation
SPR	Source-pathway-receptor
SSI	State Significant Infrastructure
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalence Quotient
TPHs	Total Petroleum Hydrocarbons
TRHs	Total Recoverable Hydrocarbons
TSE	Tunnel and Station Excavation
TV	Trigger Value
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VENM	Virgin Excavated Natural Material
VIAR	Vapour Intrusion Assessment Report
VLDPE	Very Low Density Polyethylene
VOCs	Volatile Organic Compounds
WTP	Water Treatment Plant
-	On tables is "not calculated", "no criteria" or "not applicable"

1. INTRODUCTION

1.1 Audit Details

A site contamination audit has been conducted in relation to the Barangaroo Station site of the Sydney Metro City and South West, which is located at Hickson Road, Barangaroo.

The Audit was conducted to provide an independent review by an EPA Accredited Auditor of whether the land is suitable for any specified use or range of uses, i.e. a "Site Audit" as defined in Section 4 (1) (b) (iii) of the NSW *Contaminated Land Management Act 1997* (the CLM Act).

A State Significant Infrastructure (SSI) development application (SSI 15_7400) was approved by the NSW Minister for Planning on 9 January 2017 for the construction and operation of a metro rail line, approximately 16.5 km long (of which approximately 15.5 km is located in underground rail tunnels) between Chatswood and Sydenham, including the construction of a tunnel under Sydney Harbour, links with the existing rail network, seven metro stations, and associated ancillary infrastructure. Condition E67 of the SSI development approval relates to contamination and requires a site audit as follows:

> *"If a Site Contamination Report prepared under Condition E66 finds such land contains contamination, a site audit is required to determine the suitability of a site for a specified use. If a site audit is required, a Site Audit Statement and Site Audit Report must be prepared by a NSW EPA Accredited Site Auditor. Contaminated land must not be used for the purpose approved under the terms of this approval until a Site Audit Statement is obtained that declares the land is suitable for that purpose and any conditions on the Site Audit Statement have been complied with."*

The Audit was initiated to comply with condition E67 of the SSI development approval and is therefore a statutory audit. The site audit is also a requirement of Clause 10.14B of the *Sydney Metro City & Southwest Tunnel and Station Excavation Works Design and Construction Deed* (Contract No: 00013/11200).

Details of the Audit are:

Requested by:	Caitlin Richards on behalf of John Holland CPB Ghella Joint Venture (JHCPBG JV)
Request/Commencement Date:	5 October 2017 (commenced by Tom Onus)
Auditor:	Transferred to Rowena Salmon in September 2021
Accreditation No.:	1002

1.2 Project Background

As part of the Sydney Metro City and South West (Sydney Metro) Tunnel and Station Excavation (TSE) Works Package, a Remediation Action Plan (RAP) was developed to detail the work required to remediate impacted fill material during construction of the station box. The RAP was reviewed by the previous Auditor (see Section 1.3 for details) prior to remediation commencing.

The site comprises the 'excavation footprint' shown in blue on Attachment 1 (Appendix A) which includes the main station box in the east and 'sharks fin' in the west. The surrounding 'Worksite Area' shown in red is not part of the audit site area. Remediation was undertaken by excavation and off-site disposal of all fill material and natural soil/bedrock to depths of approximately 16.9 metres below ground level (mbgl) within the sharks fin and 27.67 mbgl within the remainder of the site. The station box has been designed to be fully tanked in the permanent case, with a 2.3 m thick watertight slab at the base. The walls are approximately 1.1 m thick and wrapped in two layers of 2 mm very low density polyethylene (VLDPE) membrane.

An underground pedestrian connection is proposed to connect the final station development to the adjacent proposed Central Barangaroo Development (CBD). The development of the Station Box is, however, more advanced than the CBD, and as such temporary structures have been constructed which will be replaced at the time of connection of the pedestrian access between the two developments. The CBD levels below the groundwater table will also be tanked, and temporary dewatering is being conducted as part of its construction. In addition, the temporary dewatering adjacent to the Station Box has the potential to damage the structure due to uneven pressures on different sides of the Station Box. Depressurisation will therefore be used as an interim measure to balance water pressures until the adjacent dewatering has been completed.

The requirements for the development of Barangaroo Station are regulated by the *Sydney Metro City & Southwest, Barangaroo Station Development, Construct Only Delivery Deed* (Contract No: 501 dated 12 March 2021) (the Deed).

1.3 Interim Audit Advice

Interim Audit Advice (IAA) was prepared by the previous Auditor in May 2018 which provided a review of the suitability and appropriateness of a RAP, as well as a review of the previous investigations undertaken at the site. The reports reviewed for the IAA are listed in Section 1.4 below.

The IAA concluded that the proposed process for remediation of fill material was practical and that the site could be made suitable for the proposed land use if remediated in accordance with the RAP. The IAA noted that "*Further investigation of groundwater during remediation and redevelopment is required to assess potential migration of contamination from the off-site gasworks located to the south. The scope of the investigation should be provided to the Auditor for review. Should the results of the investigation indicate a need for additional remediation to address groundwater and soil vapour contamination, an addendum to the RAP should be prepared and provided to the Auditor for review. At the completion of remediation of the site, a Section A Site Audit Statement and supporting Site Audit Report certifying suitability for the proposed use should be prepared.*".

The IAA is attached in Appendix C and is referenced throughout this Site Audit Report (SAR) where required, however, full details of the IAA are not repeated. The current Auditor has reviewed the IAA and associated reports and is in agreement with the IAA findings.

1.4 Scope of the Audit

The scope of work undertaken for the IAA included:

- Review of the following reports:
  - 'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, March 2018', report reference: Revision 0, dated 8 March 2018, prepared by Douglas Partners Pty Ltd (Douglas) (*the PSI*).
  - 'Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018', report reference: Revision 1, dated 7 May 2018, prepared by Douglas (*the DSI*).
  - 'Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018', report reference: Revision 0, dated 7 May 2018, prepared by Douglas (*the RAP*).
- A site visit by the previous Auditor on 17 April 2018.

- Discussions with Sydney Metro, JHCPBG JV and with Douglas who undertook the investigations and prepared the RAP.

Draft versions of the PSI, DSI and RAP reports were issued for audit review. Review comments (issued by the Auditor by email) were incorporated into the final Douglas reports (listed above). The PSI makes reference to previous reports by Environmental Resource Management Australia Pty Ltd (ERM), JBS Environmental Pty Ltd (JBS, now JBS&G), Douglas and Golder Associates. Two Long Term Environmental Management Plans (EMPs) have been prepared by JBS&G for Headland Park and Barangaroo Central Promenade located along Hickson Road. ENVIRON (now Ramboll) issued Site Audit Statements (SAS) reviewing the investigation, remediation, validation and EMPs for portions of the site within the Barangaroo remediation works in 2015 (GN439C-2 and GN439C-3). The reports were not provided to the Auditor for review, however a summary of relevant information from these reports was included in the Douglas reports.

The RAP summarised a hydrogeological interpretive report prepared by Pells Sullivan Meynink Pty Ltd (PSM) (dated 19 March 2018) which was prepared to model the groundwater inflows into the Sydney Metro excavations. This report was not reviewed by the Auditor.

The Auditor has relied on the report summaries presented by Douglas for consideration in the site audit where relevant.

In addition to the scope completed for the IAA, the scope of work undertaken in competing the SAR included:

- Review of the following reports:
  - 'Acid Sulfate Soil Management Plan, Barangaroo Station Site, Hickson Road, Barangaroo NSW', dated 4 June 2018, Prepared by ADE Consulting Group Pty Ltd (ADE) (*the ASSMP*).
  - 'Report on Supplementary Contamination and Waste Classification Investigation, Sydney Metro City & South West, Tunnel & Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, NSW', Ref 85608.08.R.030.DftA dated 15 June 2018, prepared by Douglas (*the SCWCI*).
  - 'Addendum to Remediation Action Plan, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo', Ref: 85608.08.R.036.Rev2, dated 27 February 2019, prepared by Douglas (*the RAP Addendum*).
  - 'Barangaroo Station Vapour Intrusion Assessment Report Stage 2 & 3 Detail Design Underground Stations Design and Technical Services' Document No: SMCSWSBR-MET-SBR-EM-REP-000001, Revision P04.1, dated 15 September 2021 (and previous versions), prepared by METRON Consortium (METRON) (*the VIAR*).
  - 'Report on Validation of Remediation, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Barangaroo Station, Hickson Road, Barangaroo', dated 21 September 2021 (Rev 0) (and previous versions), prepared by Douglas (*the Validation Report*).
- Review of supporting documentation appended to the Validation Report including waste classification reports prepared by ADE and Douglas for material disposed from the site. A list is provided in Appendix D.
- A site visit by the previous Auditor on 31 March 2021 and a virtual site inspection by the current Auditor on 16 August 2021.
- Discussions with Sydney Metro, JHCPBG JV and with Douglas who undertook the remediation and validation works.
- Expert risk support provided to the Auditor by Dr Anand Chandra of Ramboll.

2. SITE DETAILS

2.1 Location

The site is identified as the '*Excavation Area'* (the site) for the station, shown in blue on Attachment 1 (Appendix A). The '*Worksite Area*' shown in red on Attachment 1 surrounding the '*Excavation Area'* has been excluded from the Douglas investigations and is not part of the site audit area. The site details are as follows:

Street address:	Hickson Road, Barangaroo, NSW 2000
Identifier:	Part of Lot 1 DP863317, part of Lot 52 DP1213772 and part of Hickson Road
Local Government:	City of Sydney
Owner:	State Government - Portions are owned by Transport for New South Wales and Barangaroo Delivery Authority (BDA) (now Infrastructure NSW)
Site Area:	Approximately 0.7 hectares (ha)
Zoning:	B4 – Mixed Use and RE1 – Public Recreation

The boundaries of the site comprise the walls of the excavation. The Worksite Area is bound by the temporary Hickson Road and High Street to the east, Hickson Road to the north and south, and the CBD construction site and Nawi Cove/Sydney Harbour to the west.

A survey plan of the site has been provided in the SAS (Appendix B) and identifies the site audit boundary.

2.2 Zoning

The current zoning of the site is B4 – Mixed Use and RE1 – Public Recreation under State Environmental Planning Policy (State Significant Precincts) 2005.

2.3 Adjacent Uses

The site is located within an area of mixed landuse including commercial and high density residential. The surrounding site use includes:

North: The worksite area, then Hickson Road.

East: High Street, then residential buildings beyond.

South: The worksite area, then Hickson Road and commercial buildings.

West: The worksite area and CBD construction site, then Nawi Cove and Sydney Harbour further to the west.

The site is relatively flat at 2.5 m Australian Height Datum (AHD). Douglas identified the closest sensitive ecological receptor for groundwater as Nawi Cove and Sydney Harbour located approximately 20 m to the northwest through 200 m to the west. Considering the close proximity to the harbour, the groundwater is expected to be impacted by tidal movement.

The western portion of the site is located within the CBD site. Investigation of the CBD site by ERM identified fill material impacted by polycyclic aromatic hydrocarbons (PAHs), metals and asbestos. Portions of the CBD site (as well as off-site areas) have been remediated by capping impacted fill material beneath hardstand and landscaped areas. Long Term EMPs have been prepared for Headland Park and Barangaroo Central Promenade located along Hickson Road.

The PSI identified a former gasworks (previously owned by AGL) located approximately 50 m to 180 m south of the site. The gasworks previously had a Declaration of Remediation and

Management Order under the CLM Act and, following remediation, is currently listed as *Contamination formerly regulated under the CLM Act*.

2.4 Site Condition

2.4.1 Pre-Remediation

Douglas inspected the site for the PSI on 22 September 2017 and noted the following:

- The majority of the site was occupied by a road, car park and footpath paved with asphalt and concrete. Some trees and vegetation were noted in the road reserves.
- The west section of the site (adjacent to Hickson Road) was an open grassed area with trees (part of Nawi Square lawn which extended further north). A fenced compound was located to the south of the lawn.
- A small section of the fenced compound formed part of the site and was occupied with containers and site sheds. Construction activity was noted in the south section of the fenced area. The area was not accessible during the site visit.
- Sandstone and concrete retaining walls were located along the site boundaries indicating historical filling to achieve the current site levels. High Street, Windmill Street and Dalgety Road were approximately 10 m above Hickson Road above a sandstone cut.
- The land use beyond the site was mainly commercial/high-density residential.

During the previous Auditor's site visit on 17 April 2018, the site was an active construction site, with the following features noted:

- The majority of the site surface had been cleared of slabs and pavements. Exposed soil was visible over the surface.
- Imported material (DGB and excavated natural material (ENM)) had been placed on the surface in some sections for the construction of temporary piling platforms.
- Piling had commenced along the north and northeast site boundaries. Piling spoil was stockpiled in the central and south sections pending final waste classification for off-site disposal.
- Temporary/demountable sheds were located off-site in the Worksite Area. The area surrounding the sheds had been filled with recycled aggregate (crushed concrete, terracotta and brick).

2.4.2 Post-Remediation

Douglas noted in the Validation Report that a post remediation walkover was undertaken on 16 February 2021. Douglas observed that the base and the walls of the excavation (where not concealed by plastic lining) were covered in concrete or shotcrete.

Construction related activities were ongoing and similar conditions to Douglas were noted by the previous Auditor during a site visit on 31 March 2021. During the virtual site visit on 16 August 2021 the Auditor observed the VLDPE membrane to have been completed above the groundwater table with final stages of waterproofing in progress. The underground station had been constructed within the excavation with the observed roof of the structure comprising the lower ground floor slab.

2.5 Proposed Development

The proposed development comprises a new below ground station building and upgrades to pedestrian access. The depth of excavation ranges from approximately 16.9 mbgl (Sharks Fin) to 27.67 mbgl for the station box.

The VIAR indicates the following development construction details:

- A perimeter wall has been constructed around the northern, western and southern station boundaries, consisting of secant piles keyed into medium to high strength sandstone and the area between piles will be sealed by a minimum thickness of 600 mm of jet-grout. The excavation face will then be finished off with a shotcrete face.
- The deeper sections of the perimeter wall which encountered sandstone joints, bedding planes and the nearby Luna Park Fault zone were rock grouted to reduce the permeability of the rock mass.
- The station box has been designed to be fully tanked in the permanent case, with a 2.3 m thick watertight slab at the base. The walls are approximately 1.1 m thick and wrapped in two layers of 2 mm VLDPE membrane.
- The internal train tunnel structure or 'running tunnels' will be separated from the 'outer' station box concrete wall by a cavity.
- The station 'platform area' is to be closed off from the running tunnels by way of barriers and platform screen doors, which will only open for train arrival/departure.
- The platform area is designed to be sealed for both residual groundwater ingress and residual vapour intrusion from the main running tunnels and under platform areas.
- The platform area has a direct filtered air supply system, that is separate to the tunnel ventilation system that will service the running tunnels.
- The Deed (Section 2.3.4(b)) states that the '*Cooling systems must be capable of delivering a minimum outside air ventilation rate of 20 m^3/s to the platform space, which encompasses two platform edges and must be evenly distributed to each AHU on a percentage supply air basis*.' Email advice from Sydney Metro (provided in Appendix M of the Validation Report) states that this should be interpreted to mean a ventilation rate of 20 m^3/s per platform edge (ie. 40 m^3/s for the platform space*).*
- The Deed (Section 2.2.10(f)) requires ventilation in accordance with Australian Standard (AS1668) and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

The Validation Report documents the following interim works for the interface between the CBD and depressurisation system:

<u>CBD Interface</u>

- A temporary shoring wall has been constructed at the interface area of the proposed access connection to the CBD. The future connection to the station structure will be completed by the CBD developer. This area is located on level B3 (concourse level) and does not extend to other levels in this area, which have been finished and waterproofed to the standard of the remainder of the Station Box.
- The temporary shoring wall will not be subject to the same waterproofing as the remainder of the station box, and groundwater inflow through this wall is expected to be in the order of 2 mL/m^2/hr.
- Water which seeps through the shoring wall will be collected in an open drain and from there conveyed out of the station development through the depressurisation drainage system described below. A temporary structural hoarding will be constructed between the open drain and the remainder of the station box to prevent physical access to this area for station employees/users.

- Section 2.10 of the Deed Schedule C1, Appendix B3.1 provides requirements for the interface area, and an extract of this Section was provided in Appendix M of the Validation Report. These requirements include the following (Section 2.10(b)):
  - "*The Contractor must ensure that the underground horizontal connection can be made without:*
    i. *structural modification other than breaking through the provisioned opening;*
    ii. *relocating building services*
    iii. *interruption to the Normal Operations of the Station, OSD or retail at the Unpaid Area;*
    iv. *impacting the Station water tightness during and post execution of the breakthrough; and*
    v. *compromising the Fire and Life Safety of the Station*."
- A Particular Specification document with respect to requirements for the interface area was provided in Appendix M of the Validation Report and includes the following requirement (Section 1.2.2(b)(ii)): "*provision for a future southern station entrance connecting to the Central Barangaroo Development, including construction of an interim protection hoarding at concourse level*.".
- An email from Sydney Metro to JHCPBG JV (provided in Appendix M of the Validation Report) states that the Southern Entrance Interim Arrangement design consists of two layers, namely:
  - Structural hoarding designed for construction impact loading during the demolition of the piling wall for the CBD breakthrough. This is stated to be offset 200 mm from the shoring wall to allow for a crash zone and to comprise 20 mm steel plate fixed to Parallel Flange Channel members in discrete segments; and
  - Architectural hoarding designed for robustness, wind and cladding loads. This will remain whilst the Structural Hoarding is taken down and the structural infill between the adjacent development is completed.
- A semi-permanent structural hoarding is understood to be proposed in the area of the CBD interface to meet these requirements and will prevent physical access to the only area where groundwater seepage into the Station Box is expected.

<u>Dewatering and Depressurisation Systems</u>

- A temporary substrate dewatering system was operated for the final stage of the Station Box construction, and at the time of reporting had been decommissioned. The substrate dewatering system included shallow (approximately 1.5 m deep) depressurisation wells in the base of the station box designed to relieve hydrostatic pressure underneath the base slab. These wells have been sealed/grouted up to prevent future groundwater ingress. Water from this system was conveyed to the project water treatment plant (WTP) for subsequent treatment and disposal in accordance with the environmental protection licence (EPL).
- A Semi-permanent Depressurisation System has been commissioned and will operate until the decommissioning of the adjacent temporary dewatering to balance the hydrostatic pressure. The semi-permanent depressurisation system is designed to draw down groundwater for an initial period of at least three years following completion of the station box. It is to be decommissioned once the adjacent CBD has completed construction and has ceased dewatering.

- Operation of the Semi-permanent Depressurisation System will be handed over to the follow on contractor at the completion of JHCPG JV work. It is anticipated that the follow on contractor will obtain all necessary approvals to continue operation of the system in accordance with the *Protection of the Environment Operations Act 1997*.
- The total inflow into the depressurisation system is calculated to be a maximum of 129,600 L per day.
- The semi-permanent depressurisation system will be located outside of the station box waterproofing and will extract groundwater from a depth of approximately - 15 mAHD outside of the east, south and southern portion of the west station box walls. The water will be pumped through a depressurisation ring main inset into the rock outside of the waterproof membrane and 1.1 m thick concrete cassette.
- The semi-permanent depressurisation system conveys water through a drainage system to a closed tank at the B3 level (approximately – 15 mAHD). Collected water from the tank is then pumped to the WTP for subsequent treatment and any hydrocarbons removed via carbon filtration.

JHCPBG JV has constructed the station structure and shell including the waterproofing and temporary interface structures. The station building fitout, including commissioning of the ventilation system, and aboveground roadworks will be undertaken by Watpac, the follow on contractor.

For the purposes of this audit, the 'commercial/industrial' land use scenario will be assumed.

3. SITE HISTORY

The IAA noted that the PSI provided a summary of the site history for the site based on a review of historical title deeds, aerial photographs, NSW EPA records and Section 149 (now termed Section 10.7) certificates. The site history from the IAA is summarised as follows.

The site was developed and used mainly for shipping and stevedoring purposes between 1905 and 1998. During this time, the site was owned by the Sydney Harbour Trust Commission. Hickson Road had been established in 1930. The western section of the site was initially occupied by two warehouses. Further west comprised finger wharves that were converted to longshore berthing after 1951 by filling behind seawalls with material from unknown sources.

One of the warehouses onsite was demolished by 1970 and the second by 1982. Large sections of the site were developed as hardstand between 1970 and 1982. Sydney Harbour Foreshore Authority owned the site from 1998 to 2009. It appears that the structures associated with the shipping activities had been removed by 2010.

The site was owned by BDA between 2009 and 2016. A passenger terminal for cruise ships had been established to the west of the site, which was removed in 2013.

The PSI noted that previous reports indicate that fuels and dangerous goods were stored for shipping operations, although these storages were not located at, or in the vicinity of, the site. A vehicle wash bay appears to have been positioned adjacent to the site area, as shown on Attachment 1, Appendix A.

Douglas noted that previous assessments by ERM (2007, 2008) and JBS&G (2012) identified lead, asbestos and PAH impacted soil in the greater Barangaroo development site, which includes the west of the site. Off-site groundwater (to the south) appears to have been impacted by heavy metals, PAHs, BTEX and TPH associated with the former gasworks. An overarching RAP was prepared by ERM (2010) for remediation of Barangaroo, which included part of the subject site. The RAP was reviewed and approved by Graeme Nyland of ENVIRON (now Ramboll) as part of the site audit process (GN439A). Remediation of Barangaroo Point Reserve and Barangaroo Central Promenade was undertaken by JBS&G and reviewed by Graeme Nyland of ENVIRON in SAS GN439C-2 and GN439C-3, respectively. The SASs concluded that these areas were suitable for public open space use subject to compliance with Long Term EMPs prepared by JBS&G.

The former gasworks is located approximately 50 m to 180 m south of the site. Remediation of the gasworks was completed in 2020 and the NSW EPA Declaration was lifted.

Based on the site location and history, potential contamination could have impacted the site from on-site and/or off-site sources.

3.1 Auditor's Opinion

In the Auditor's opinion, the site history indicates past activities at the site and immediate surroundings having a high potential for significant contamination. Sources of contamination are associated with commercial/industrial land use (including shipping and stevedoring), demolition of former buildings, significant filling and former gasworks. A SafeWork NSW records search for dangerous goods was not undertaken by Douglas and is considered a data gap. The Auditor considers that the site history is broadly understood and adequate for identification of contaminants of concern (Section 4) and remediation of the site (Section 11).

4. CONTAMINANTS OF CONCERN

As outlined in the IAA, the Douglas PSI and DSI provided a list of contaminants of concern and potentially contaminating activities. These were also listed by Douglas in the RAP and SCWCI and have been tabulated in Table 4.1.

Table 4.1: Contaminants of Concern

Area	Activity	Potential Contaminants
Entire Site	Fill and surface soil imported from unknown sources. Demolition of former buildings containing hazardous materials. Spills and leakage of chemicals associated with historical commercial/industrial land use.	Metals, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes & naphthalene (BTEXN), volatile organic compounds (VOCs), PAHs, organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCBs), phenols (including cresols), lead (from paint), asbestos and ammonia.
Off-Site Sources	Migration of potential contaminants from off-site sources including historical filling, former shipping activities, gasworks and wash bay.	Metals, petroleum hydrocarbons (BTEXN, TPH), VOCs, cyanide, phenols (including cresols) and ammonia.

4.1 Auditor's Opinion

The Auditor considers the analyte list used by Douglas adequately reflects the site history and condition.

There has been no assessment by the consultants for the presence of per- and poly-fluoroalkyl substances but in the Auditor's opinion there are no indications in the site history that they would be potential contaminants of concern.

5. STRATIGRAPHY AND HYDROGEOLOGY

5.1 Stratigraphy

Douglas reviewed geological maps and reported that the site is underlain by Hawkesbury sandstone which comprises medium to coarse grained quartz sandstone, very minor shale and laminite lenses. The site is located on the boundary of disturbed terrain to the west and Gymea soil landscape to the east.

The sub-surface profile of the site encountered during the Douglas DSI and SCWCI, prior to remediation, is summarised by the Auditor in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0.0 – 0.85 (maximum)	Asphalt Concrete pavements/slab. Grey sandy gravel roadbase was detected in boreholes located along Hickson Road reserve.
1.0 – 14.0	Fill material comprising sand, gravel and clay with inclusions of brick, concrete, wood, asphalt, ash, charcoal, slag and ceramics.
6 – 15	Natural sand, sandy clay and clayey sand.
2 to 20	Sandstone.

mbgl – metres below ground level

The subsurface profile detected relatively deep fill (particularly in the west of the site) underlain by natural soil and sandstone.

Douglas indicated that the western and southern portions of the site are located within an area of disturbed terrain where soil investigations are required to assess for acid sulfate soils (ASS). The DSI and SCWCI included sampling and analysis of selected fill, natural and bedrock samples for ASS. The results identified ASS to be present in filling and natural soils between the water table and sandstone bedrock and that management of ASS is required.

Following remediation of the site (discussed in Section 11), fill material and natural soil/rock were removed from the entire site area to a depth of approximately 29.65 mbgl.

5.2 Hydrogeology

The PSI undertook a search of the groundwater information database maintained by the NSW Government and identified 33 registered groundwater bores within a 0.5 km radius of the site. The majority of the bores were registered by BDA for monitoring purposes. The depth of standing water in the bores was not summarised by Douglas.

The PSI concluded that based on the topography and information from previous investigations, groundwater at the site is tidally influenced and is anticipated to flow to the west and northwest. Douglas identified the closest sensitive ecological receptor for groundwater to be Nawi Cove and Sydney Harbour located approximately 20 m to the northwest. Excess surface water run-off is anticipated to flow into the local stormwater network which would discharge into Sydney Harbour or via overland flow directly into Sydney Harbour.

As part of the DSI, eight monitoring wells (four shallow (BRBH02, BRMW07, BRMW11 and BRMW16) and four deep (BRBH04, BRMW10, BRMW15 and BRMW17)) were installed at the site (Attachment 2, Appendix A). Groundwater observations and sampling was undertaken as part of the DSI on 18 to 20 December 2017. Depth to groundwater in the monitoring wells was recorded between 1.45 mbgl to 2.75 mbgl.

The DSI included field records of groundwater parameters recorded during sampling. They indicated that the pH was 5.87 to 7.33, dissolved oxygen (DO) was 0.35 to 3.32 mg/L, redox was -30 to 100 mV, and electrical conductivity (EC) was 970 to 43,700 µS/cm.

The RAP includes a summary of the PSM (2018) Hydrogeological Interpretive Report, which modelled the groundwater seepage rates expected during and post construction. Details of the modelling and the results are included in the Hydrogeological Interpretive Report. Douglas summarised the findings as follows:

- Draw down was not simulated in the fill materials based on the assumption that a strong hydraulic connection is present between the harbour and fill material. PSM note that due to the lack of site specific hydraulic testing, this cannot be confirmed;
- The design intention is to limit the inflow of contaminated groundwater and/or sea water from entering the excavation by adopting a soil retention system;
- Maximum modelled seepage rate during construction was 103 kL/day;
- Modelled steady state seepage rate post construction and prior to tanking was 57 kL/day;
- The water table shows the influence of tidal fluctuations at a depth of approximately 2 mbgl;
- The modelled zone of capture for the first 5 years would extend to approximately 160 m from the site. The full extent may not be realised as the station and cavern would be tanked sooner than the maximum travel time; and
- PSM identified the following two primary sources of groundwater contamination which may influence the quality of water draining into the excavation: former gasworks located to the south of the site; and reclaimed lands to the immediate west of the site. Previous investigations of the former gasworks had identified the presence of dissolved phase contamination and dense non-aqueous phase liquids (DNAPL) with higher concentrations in the deeper aquifer within the sandstone bedrock. The main contaminants of concern include TRH, BTEX, ammonia, total organic carbon (TOC), PAHs, phenol, cyanide and selected metals.

The Auditor has not reviewed the PSM (2018) Hydrogeological Interpretive Report, however considers that the primary long term source of seepage/ inflows is likely to be fill, alluvial soil and seepage from the harbour. This is based on the stratigraphy and hydrogeology encountered during the DSI.

5.3 Auditor's Opinion

The Auditor considers that the site stratigraphy and hydrogeology detailed by Douglas adequately reflect the site conditions and are sufficiently well known for the purpose of the audit.

6. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

An evaluation of the overall quality of the data obtained in previous investigations (DSI) at the site was presented in the IAA (Appendix C). In considering the data as a whole, the previous Auditor concluded in the IAA that:

- The laboratories provided adequate information to conclude that the data are of adequate precision and accuracy to inform the remedial framework and assess risks.
- Further data gap investigations are proposed to address sample density and to target areas of environmental concern to increase the completeness and representativeness of the soil data.
- The completeness and representativeness of groundwater and ground gas data is considered adequate to inform the remedial framework and assess risks.
- There is a reasonable degree of confidence that the data are comparable for each sampling and analytical event.

Subsequent to the PSI and DSI and preparation of the IAA, additional investigations were undertaken for the SCWCI, as outlined in Table 6.1.

Table 6.1: Summary of Additional Investigations

Stage of Works	Field Data	Analytical Data
SCWCI (Douglas, 2018) *Fieldwork date: February 2018* Attachment 2 (Appendix A)	Seven boreholes (BRBH22 to BRBH28) targeting inaccessible areas from the DSI to provide site coverage. Field screening of all samples for ASS using field and peroxide pH.	Soil: Metals, TRH/BTEX, PAHs, phenols, OCPs, OPPs, PCBs, VOCs, cyanide, asbestos (presence/absence) and chromium reducible sulfur (select samples)

The Auditor's assessment of data quality follows in Tables 6.2 and 6.3.

Table 6.2: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Data Quality Objectives (DQO) Douglas defined specific DQOs in accordance with the seven-step process outlined in Schedule B2 of NEPM (2013). The following decisions for the SCWCI were identified in the DQOs: • What is the conceptual site model (i.e. sources, receptors, migration pathways, exposure)? • Do the existing fill materials and/or natural soils pose a potential risk to identified receptors? • Is the data sufficient to make a decision regarding the abovementioned risks, the compatibility of the site for the proposed development, or are additional investigations required? • Does contamination at the site, if encountered, trigger the Duty to Report requirements under the CLM Act? • Are there any off-site migration issues or migration on-site from off-site sources that need to be considered? • Do the fill materials comply with a current Resource Recovery Order? • What is the waste classification of soils for off-site disposal?	The identified DQOs were considered appropriate for the investigations conducted.

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Sampling pattern and locations *Soil:* Investigation locations were targeted to areas previously not accessible during the DSI to gain coverage of the majority of the site. The various fill and natural materials within the proposed excavation depth at the site were also targeted for sampling.	In the Auditor's opinion, the investigation locations provide increased site coverage and adequately target the main areas of concern.
Sampling density *Soil:* The additional sampling density of seven locations from the SCWCI supplementing the 16 obtained from the DSI (reviewed in the IAA) over approximately 0.7 ha exceeds the minimum recommended by EPA (1995) *Sampling Design Guidelines*. The coverage provides a 95% confidence of detecting a residual hot spot of approximately 23.9 m diameter. Samples analysed for asbestos were not collected according to the density outlined in NEPM (2013) (Schedule B1).	In the Auditor's opinion, the sampling density was appropriate to supplement the density from the DSI. Considering that the fill from the entire site would be excavated and disposed off-site as part of the development, the sampling adopted by Douglas is acceptable to give a general indication of the presence/absence of asbestos in soil.
Sample depths Samples were collected and analysed from a range of depths, targeting fill, natural soils and bedrock. The depths of sample intervals varied, with samples collected from 0.4 m to 6.35 mbgl.	In the Auditor's opinion, the sampling strategy was appropriate and adequate to characterise the primary material types present on site.
Sample collection method Samples from the top 2 m were collected from solid stem auger returns, whilst most samples below this depth were collected from standard penetration test (SPT) split spoon sampler. 50 g samples were collected for laboratory analysis for asbestos. Samples analysed for asbestos were not collected according to the asbestos quantification methodology outlined in NEPM (2013) (Schedule B1).	Soil sample collection from the auger flights is not ideal as it can result in loss of volatiles and sample cross contamination, although cross contamination was minimised by removing external material. Results for samples collected from solid flight augers may underestimate concentrations of volatile contaminants. Considering that a large portion of samples were from SPT sampler, the overall sample collection method was found to be acceptable. Assessment of asbestos concentrations using 50 g samples is not in accordance with NEPM (2013), however it is noted that all fill material was removed from site during remediation and is therefore acceptable for the purposes of the investigation.
Decontamination procedures Sampling equipment was cleaned with detergent, tap water and then de-ionised water prior to sampling and between sampling events to prevent cross contamination. New gloves were reportedly used for each new sample. Decontamination of augers between locations was not explicitly reported.	Acceptable considering the results reported (Section 8)
Sample handling and containers Samples were placed into prepared and preserved sampling containers provided by the laboratory and chilled during storage and subsequent transport to the labs. Samples for asbestos analysis were placed in plastic zip-lock bags.	Acceptable
Chain of Custody (COC) Completed COC forms were provided in the report.	Acceptable
Detailed description of field screening protocols Field screening for volatiles was undertaken using a PID. Soil sub-samples were placed in ziplock plastic bags and the headspace measured for VOCs after allowing time for equilibration.	Acceptable

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Calibration of field equipment The reports indicated that calibration had been undertaken prior to use. Calibration certificates from the equipment supplier were not provided.	Acceptable
Sampling logs Soil logs are provided within the report, indicating sample depth, PID readings and lithology. The logs reported inclusions in fill (brick, concrete and asphalt) which could pose a contamination risk.	Acceptable

Table 6.3: QA/QC – Field and Lab Quality Assurance and Quality Control

Field and Lab QA/QC	Auditor's Opinion
Field quality control samples Field quality control samples including trip blanks, trip spikes, rinsate blanks, field intra-laboratory and inter-laboratory duplicates were undertaken.	Acceptable
Field quality control results The results of field quality control samples were generally within appropriate limits. The following exceptions were noted: Relative percent difference calculations (RPDs) for the intra-laboratory duplicate samples were outside the acceptance criteria for metals in two samples and TRH and PAHs in one sample. RPDs for the inter-laboratory duplicate samples were outside the acceptance criteria for metals in three samples and PAHs in two samples. Douglas assessed field duplicate results along with the primary sample results against the site acceptance criteria.	Overall, the field quality control results were found to be acceptable. RPD exceedances were generally infrequent and minor, are representative of the heterogeneity of fill samples and do not impact the overall dataset. Douglas assessed the results for primary samples and field duplicates against the site acceptance criteria which is considered appropriate. The Auditor has adopted the highest concentration of duplicates in the assessment of results.
NATA registered laboratory and NATA endorsed methods Laboratories used included: Envirolab (primary)and Eurofins | mgt (secondary). Laboratory certificates were NATA stamped.	Acceptable
Analytical methods Analytical methods were included in the laboratory test certificates. Both laboratories provided brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods (excluding asbestos) for extraction and analysis in accordance with the NEPM (2013). Asbestos identification was conducted by Envirolab using polarised light microscopy with dispersion staining by method AS4964-2004 *Method for the Qualitative Identification of Asbestos Bulk Samples*.	The analytical methods are considered acceptable for the purposes of the site audit, noting that the AS4964-2004 is currently the only available method in Australia for analysing asbestos. DOH (2009) and enHealth (2005) state that *"until an alternative analytical technique is developed and validated the AS4964-2004 is recommended for use"*.
Holding times Review of the COCs and laboratory certificates indicate that the holding times had been met. Douglas also reported that holding times have been met.	Acceptable
Practical Quantitation Limits (PQLs) PQLs (except asbestos) were less than the threshold criteria for the contaminants of concern.	The soil PQLs are acceptable.
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks and duplicates were undertaken by the laboratory.	Acceptable

Field and Lab QA/QC	Auditor's Opinion
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: The laboratory RPD acceptance criteria were exceeded for individual metals and PAHs. Triplicate result was issued by the laboratory under a different sample number. Percentage recovery was not possible for individual metals and TRH due to high concentrations, the inhomogeneous nature of the compound in the sample and/or interference from analytes. Asbestos analysis had to be sub-sampled from the samples provided by the laboratory as samples were not provided in zip-lock bags.	In the context of the dataset reported, the elevated RPD is not considered significant and the laboratory quality control results are acceptable.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) Predetermined data quality indicators (DQIs) were set for laboratory analyses including blanks, replicates, duplicates, laboratory control samples, matrix spikes and surrogate spikes. These were discussed with regard to the five category areas. There was no overall discussion of the QC data.	An assessment of the data quality with respect to the five category areas has been undertaken by the Auditor and is summarised below.

6.1 Auditor's Opinion

In considering the SCWCI data the Auditor concludes that:

- The data are likely to be largely representative of the overall site conditions. Results for volatile organics in soil samples collected by solid stem auger may underestimate actual concentrations. Sampling and analysis for asbestos was not undertaken in accordance with the current guidance (NEPM, 2013) and results may not be representative of fill conditions however this is acceptable in the context of the remediation performed.
- The data is considered to be adequately complete.
- There is a high degree of confidence that data is comparable for each sampling and analytical event.
- The primary laboratory provided sufficient information to conclude that data is of sufficient precision.
- There is a high degree of confidence that the data are accurate.

In considering the overall validation data, including the DSI, SCWCI and additional data collected during validation (discussed in Section 11), and in the context of the remediation performed (discussed in Section 11), the Auditor concludes that the validation data is adequately representative, complete, comparable, precise and accurate for the purposes of the Audit.

7. ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed the results against Tier 1 criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013). Other guidance has been adopted where NEPM (2013) is not applicable or criteria are not provided. Based on the proposed development (Section 2.5), criteria for the 'commercial/industrial' land use scenario were adopted.

7.1 Soil Assessment Criteria

7.1.1 Human Health Assessment Criteria

The Auditor has adopted human health assessment criteria from the following sources:

- NEPM (2013) Health Investigation Levels (HILs) for 'Commercial/Industrial' (HIL D) land use.
- NEPM (2013) Health Screening Levels (HSLs) for 'Commercial/Industrial' (HSL D) land use. The HSLs assumed a sand soil type. Depth to source adopted was <1 m as an initial screen.
- NEPM (2013) Management Limits (MLs) for petroleum hydrocarbons for 'Commercial/ Industrial' land use and assuming coarse soil texture.
- The presence/absence of asbestos.
- Friebel & Nadebaum (2011) HSLs for direct contact for all land use categories, and vapour inhalation/direct contact pathways for intrusive maintenance workers.
- USEPA Regional Screening Levels (RSLs) 'Composite Worker Soil' criteria. Online database of assessment criteria that are current as of May 2021. Soil assessment criteria derived for carcinogenic compounds were multiplied by a factor of 10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000 to be consistent with Australia's recommended target cancer risk level. For most chemicals, where a criterion was derived using both non-cancer and cancer toxicity data, the lower criteria was adopted.

7.1.2 Ecological Assessment Criteria

The Auditor has not adopted ecological soil assessment criteria as soil from the site will be excavated to a maximum depth of 27.67 mbgl and disposed off-site during development. Ecological soil criteria are applicable to depths of 2 mbgl and are therefore not applicable for the remaining natural soil.

7.1.3 Soil Aesthetic Considerations

The Auditor has considered the need for soil remediation based on 'aesthetic' contamination as outlined in *Section 3.6 Aesthetic Considerations* of NEPM (2013) Schedule B1, which acknowledges that there are no chemical-specific numerical aesthetic guidelines. Instead, site assessment requires a balanced consideration of the quantity, type and distribution of foreign material or odours in relation to the specific land use and its sensitivity.

7.1.4 Imported Fill

Imported fill has been assessed in relation to attributes expected of virgin excavated natural material (VENM). The NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste* defines VENM as *"…natural material (such as clay, gravel, sand, soil or rock fines):*

- *'that has been excavated or quarried from areas that are not contaminated with manufactured chemicals, or with process residues, as a result of industrial, commercial, mining or agricultural activities*
- *'that does not contain sulphidic ores or soils, or any other waste, and includes excavated natural material that meets such criteria for virgin excavated natural material as may be approved from time to time by a notice in the NSW Government Gazette."*

On this basis, the Auditor considers that for soil to be classified as VENM, the following criteria generally apply:

- Organic compounds (including petroleum hydrocarbons, PAHs, OCPs, PCBs and phenols) should be less than the PQLs.
- Inorganic compounds should be consistent with background concentrations.
- The material should not contain or comprise actual or potential acid sulphate soil.

Imported material, such as excavated natural material (ENM) or mulch, was assessed against the requirements of the applicable resource recovery order (RRO) and resource recovery exemption (RRE) issued by the EPA under clause 93 of the *Protection of the Environment Operations (Waste) Regulation 2014*.

7.2 Groundwater Assessment Criteria

7.2.1 Human Health Assessment Criteria

NEPM (2013) HSLs are not appropriate for assessing risks from groundwater to human health at the site due to the potential for direct contact. The Auditor has adopted human health assessment criteria from the following sources to assess risk from direct contact, inhalation and incidental ingestion:

- NHMRC (2011) *National Water Quality Management Strategy, Australian Drinking-Water Guidelines* (ADWG), Version 3.5 Updated August 2018.
- USEPA RSLs Residential Tap Water Criteria. Online database of assessment criteria that are current as of May 2021. Tap water assessment criteria derived for carcinogenic compounds were multiplied by a factor of 10 to adjust the target cancer risk level from 1:1,000,000 to 1:100,000 to be consistent with Australia's recommended target cancer risk level. For some chemicals, where a criteria has been derived using both non-cancer and cancer toxicity data, the lower criteria was adopted.
- WHO (2017) *Guidelines for Drinking-water Quality, Fourth Edition*, incorporating the 1st addendum.
- WHO (2008) *Petroleum Products in Drinking-water. Background document of WHO Guidelines for Drinking-water Quality* (adopted in absence of health-based criteria in WHO (2017) because the taste and odour of petroleum products will in most cases be detectable at concentrations below those of health concern).

7.2.2 Ecological Assessment Criteria

The Auditor has adopted ecological groundwater assessment criteria from the following sources:

- 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 (www.waterquality.gov.au/anz-guidelines). Default guideline values (DGVs) for marine water and 95% level of protection were adopted.

7.3 Auditor's Opinion

Groundwater monitoring wells were screened across different soil profiles (fill and sandstone). Deep and shallow groundwater monitoring wells were installed to assess groundwater conditions at different depths. The extraction and use of groundwater as a resource is unlikely as the site is very close to the harbour and is impacted by sea water intrusion. Given the absence of bores for beneficial groundwater use and presence of a reticulated water supply for the area, extraction and use of groundwater as a resource is unlikely. Therefore, assessment of direct contact and consumption of groundwater is not considered to be required.

The environmental quality criteria referenced by the Auditor are consistent with those adopted by Douglas and in the IAA except for the following:

- The DSI does not mention assessment of 'aesthetic' contamination as outlined in NEPM (2013). However, the report discusses potential aesthetic issues detected during sampling.
- The DSI and IAA adopted Groundwater Investigation Levels (GILs) listed in NEPM (2013) for protection of aquatic ecosystems referenced in ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. The 95% marine water level of protection was adopted. The ANZG (2018) DGVs for marine water and 95% level of protection adopted by the Auditor are largely based on trigger values (TVs) from ANZECC (2000).

Given the results obtained, the Auditor considers that these discrepancies do not affect the overall conclusions reached by Douglas and the Auditor.

8. EVALUATION OF SOIL RESULTS

The soil analytical results obtained from the DSI undertaken prior to the preparation of the RAP were reviewed by the Auditor and presented in the IAA (Appendix C). Sampling locations are shown on Attachment 2 (Appendix A). In assessing the results reviewed in the IAA, the Auditor made the following observations:

- The majority of the analytical results for the fill samples were at concentrations below the screening criteria. One fill sample contained an elevated lead concentration of 2,800 mg/kg, above the screening criteria. Douglas reported that the source of lead is likely from the general filling at the site and that no specific source was identified (Section 4). Statistical analysis (95% Upper Confidence Limit (UCL)) undertaken on the fill dataset returned a 95% UCL mean concentration for lead of 255 mg/kg and standard deviation of 387 mg/kg. Douglas concluded that the overall fill dataset was within the screening criteria.
- Fill samples detected elevated mid to heavy fraction TRH concentrations (F3 and F4) with a maximum F3 value of 1,200 mg/kg. All of the results were below the Management Limit criteria. The TRH detections were widespread in the fill. Douglas undertook silica gel clean-up analysis on the sample with the highest concentration of TRH. The TRH results after clean-up were significantly lower when compared to the primary results.
- Asbestos was not detected in the fill/ natural soil samples analysed by Douglas.
- Marginally elevated concentrations of metals and PAHs were detected at concentrations below the screening criteria in some natural soil samples. The source of these contaminants can be attributed to the following:
  - Detections of PAHs in the natural soil in BRMW11, BRMW15 and BRMW17 could be attributed to cross contamination from the overlying fill soil as the samples were obtained from the auger directly beneath the fill.
  - The majority of the metal results are consistent with background concentrations except for lead in BRBH09 (0.9-1 mbgl) which was above typical background levels (10-40 mg/kg) with a concentration of 79 mg/kg. The source of lead could be attributed to cross contamination from the overlying fill soil as the sample was obtained directly beneath the fill.

8.1 Additional Data Collected in SCWCI

Douglas undertook the SCWCI in order to supplement the DSI and address identified data gaps in the RAP. The SCWCI comprised the drilling of seven boreholes (BRBH22 to BRBH28) as shown in Attachment 2 (Appendix A). The following sub sections outline the soil field and analytical results obtained for the SCWCI.

8.1.1 Field Results

Anthropogenic inclusions were noted within fill in boreholes BRBH22, BRBH23, BRBH26 and BRBH28. The anthropogenic inclusions generally comprised fragments of brick, concrete and/ or asphalt. Nails were also noted in fill from 0.9 m to 0.94 m depth in BRBH25. A trace of shell fragments was also observed in fill from depths of 4.6 m in BRBH24 and from 3.6 m in BRBH25.

A slight sulphur odour was noted in fill from 3.3 mbgl in BRBH22, and could be associated with ASS.

Field PID screening recorded values of less than 10 ppm in all field screening samples.

There were no other recorded visual or olfactory evidence (i.e. staining or odours) indicative of the presence of contamination within the soils/fill investigated.

8.1.2 Analytical Results

Soil samples were analysed for a variety of contaminants detailed in Tables 8.1 (fill) and 8.2 (natural). The results have been assessed against the environmental quality criteria outlined in Section 7 and are summarised below.

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria
Asbestos in soil	33	0	<PQL	0 above 0.1 g/kg
BTEX	35	0	<PQL	0 above HSL D 0-1 m, sand
F1 (TRH C_6–C_{10} minus BTEX)	35	0	<PQL	0 above HSL D 0-1 m, sand 260 mg/kg
F2 (TRH >C_{10}–C_{16} minus naphthalene)	35	1	380	0 above HSL D 0-1 m, sand NL
TRH C_6–C_{10}	35	0	<PQL	0 above ML (commercial/industrial) 700 mg/kg
TRH >C_{10}–C_{16}	35	1	380	0 above ML (commercial/industrial) 1000 mg/kg
TRH >C_{16}-C_{34}	35	3	2,900	0 above ML (commercial/industrial) 3500 mg/kg
TRH >C_{34}-C_{40}	35	1	260	0 above ML (commercial/industrial) 10,000 mg/kg
Naphthalene	35	6	6.2	0 above HSL D 0-1 m, sand NL
Benzo(a)pyrene TEQ	35	14	**130**	**1 above HIL D 40 mg/kg**
Total PAHs	35	27	3,200	0 above HIL D 4000 mg/kg
Total Phenols	31	0	<PQL	0 above HIL D 240,000 mg/kg
Arsenic	35	11	20	0 above HIL D 3000 mg/kg
Cadmium	35	2	0.8	0 above HIL D 900 mg/kg
Chromium	35	35	25	0 above HIL D 3600 mg/kg
Copper	35	35	5,200	0 above HIL D 240,000 mg/kg
Lead	35	35	**2,500**	**1 above HIL D 1500 mg/kg**
Mercury	35	27	4.4	0 above HIL D 730 mg/kg
Nickel	35	33	22	0 above HIL D 6000 mg/kg
Zinc	35	35	3,200	0 above HIL D 400,000 mg/kg
PCB	31	0	<PQL	0 above HIL D 7 mg/kg
OCP	31	0	<PQL	0 above HIL D
OPP	31	0	<PQL	0 above HIL D
VOCs	31	0	<PQL	-
Cyanide	31	0	<PQL	0 above HIL D 1500 mg/kg

n number of samples
- No criteria available/used
NL Non-limiting
<PQL Less than the practical quantitation limit
TEQ Toxic Equivalence Quotient

Table 8.2: Evaluation of Natural Soil Analytical Results – Summary Table

Analyte	n	Detections	Maximum (mg/kg)	n > Human Health Screening Criteria
BTEX	8	0	<PQL	0 above HSL D 0-1 m, sand
F1 (TRH C_6–C_{10} minus BTEX)	8	0	<PQL	0 above HSL D 0-1 m, sand 260 mg/kg
F2 (TRH >C_{10}–C_{16} minus naphthalene)	8	0	<PQL	0 above HSL D 0-1 m, sand NL
TRH C_6–C_{10}	8	0	<PQL	0 above ML (commercial/industrial) 700 mg/kg
TRH >C_{10}–C_{16}	8	0	<PQL	0 above ML (commercial/industrial) 1000 mg/kg
TRH >C_{16}-C_{34}	8	0	<PQL	0 above ML (commercial/industrial) 3500 mg/kg
TRH >C_{34}-C_{40}	8	0	<PQL	0 above ML (commercial/industrial) 10,000 mg/kg
Naphthalene	8	0	<PQL	0 above HSL D 0-1 m, sand NL
Benzo(a)pyrene TEQ	8	0	<PQL	0 above HIL D 40 mg/kg
Total PAHs	8	2	2.9	0 above HIL D 4000 mg/kg
Total Phenols	6	0	<PQL	0 above HIL D 240,000 mg/kg
Arsenic	8	2	5	0 above HIL D 3000 mg/kg
Cadmium	8	0	<PQL	0 above HIL D 900 mg/kg
Chromium	8	8	66	0 above HIL D 3600 mg/kg
Copper	8	8	350	0 above HIL D 240,000 mg/kg
Lead	8	8	130	0 above HIL D 1500 mg/kg
Mercury	8	1	0.4	0 above HIL D 730 mg/kg
Nickel	8	6	6	0 above HIL D 6000 mg/kg
Zinc	8	8	130	0 above HIL D 400,000 mg/kg
PCB	6	0	<PQL	0 above HIL D 7 mg/kg
OCP	6	0	<PQL	0 above HIL D
OPP	6	0	<PQL	0 above HIL D
VOCs	6	0	<PQL	-
Cyanide	6	0	<PQL	0 above HIL D 1500 mg/kg

n number of samples
- No criteria available/used
NL Non-limiting
<PQL Less than the practical quantitation limit
TEQ Toxic Equivalence Quotient

In reviewing the analytical results, the Auditor notes the following:

- The majority of the analytical results of the fill samples were at concentrations below the screening criteria. One fill sample contained an elevated lead concentration of 2,500 mg/kg, above the adopted human health criterion of 1,500 mg/kg. Statistical analysis undertaken on the fill dataset (including the DSI data) returned a 95% UCL mean concentration for lead of

387.1 mg/kg and standard deviation of 413.7 mg/kg. Douglas concluded that the overall fill dataset was within the adopted human health criteria.

- One fill sample contained an elevated Benzo(a)pyrene TEQ concentration of 130 mg/kg which is more than 250% above the adopted human health criteria. Douglas concluded that this location was a hotspot relative to the adopted human health criteria.
- Concentrations of PAHs were identified in the natural sandstone samples above the laboratory PQL obtained from BRBH23, BRBH26 and BRBH28. Arsenic concentrations at BRBH23 were also marginally above the PQL while concentrations of copper, lead, mercury and zinc were considerably above expected concentrations for natural sandstone bedrock. These detections could be attributed to cross contamination from the overlying fill soil as the samples were obtained from spiral augers directly beneath the fill.

8.1.3 Acid Sulfate Soil

Field screening for ASS was undertaken on samples collected during the DSI and SCWCI, with Chromium Reducible Sulphur Suite analysis subsequently carried out on 22 representative soil samples as the potential for ASS was identified in the screening test results. This investigation confirmed the presence of ASS in fill and natural soils below the groundwater table, extending from depths of 2.9 mbgl.

Douglas considered that ASS are required to be assessed and managed in accordance with an ASS Management Plan (ASSMP). Douglas prepared an ASSMP which recommended that all fill and natural soils below observed groundwater (1.45 mbgl) should be treated as though it potentially contains ASS until such time as analytical results confirm otherwise.

ADE revised the ASSMP, however provided the same conclusions as the Douglas ASSMP.

8.2 Auditor's Opinion

In the Auditor's opinion, the soil analytical results reviewed in the IAA indicate that contamination was present at the site. Further investigation was recommended to further characterise soil impacts and remediation of fill material. The results indicate the fill to be locally impacted by lead, PAHs and TRH. Contamination from asbestos containing material (ACM) is possible and considered likely although no asbestos detections were made in soil samples analysed. Low level contamination of fill and underlying natural soil was identified, however, this was at concentrations less than the assessment criteria.

Additional investigation and remediation of fill material was undertaken and is discussed further in Section 11.

9. EVALUATION OF GROUNDWATER RESULTS

Groundwater samples were collected by Douglas during the DSI from eight monitoring wells (four shallow (BRBH02, BRMW07, BRMW11 and BRMW16) and four deep (BRBH04, BRMW10, BRMW15 and BRMW17). Groundwater well locations are shown on Attachment 2 (Appendix A).

The groundwater analytical results were reviewed by the Auditor in preparation of the IAA (Appendix C). In assessing the results reviewed in the IAA, the Auditor made the following observations:

- Elevated copper, manganese, nickel and zinc concentrations were detected in the groundwater samples. The DSI concluded that the heavy metals can be attributed to diffuse urban-sourced background levels and are not from a site-specific source.
- Low concentrations of light to mid fraction TRH, BTEX and selected VOCs were detected in groundwater sample BRMW17 (deep well screened within the sandstone). The DSI concluded that on-site sources of TRH/ BTEX and VOCs were not identified and the potential source could be from the former wash bay (Attachment 1, Appendix A) located off-site or other off-site sources.
- Low concentrations of OCPs, with one concentration of Dieldrin above the ecological screening criteria, were detected in the groundwater samples. Douglas stated that OCPs were detected in the soil samples tested from the site and could be a potential source of contamination. OCP concentrations were less than the human health screening criteria.
- Low concentrations of PAHs were detected in BRMW15 and BRMW17 (deep wells screened within the sandstone) located close to the former wash bay. The majority of the detections were within the deeper sandstone aquifer. The DSI stated that the PAH detections could also be from the former gasworks located off-site.
- The DSI concluded that the potential on-site sources (mainly fill) will be removed during site works and that groundwater treatment requirements should be considered for groundwater disposal.
- The benzo(a)pyrene PQL is above the ecological and the human health screening criteria. Benzo(a)pyrene was not detected in any of the samples and no other individual PAH contaminant was detected above the PQL in any of the groundwater samples that were analysed. Therefore, benzo(a)pyrene is not considered to be a contaminant of concern in groundwater at the site.

The Auditor concluded in the IAA that *"Reported concentrations are not considered to pose a significant risk to on-site human health receptors. The former gasworks located to the south of the site is a potential source of groundwater contamination. The DSI did not establish if the low level PAH groundwater contamination is from the gasworks, or from an alternative source such as the wash bay. Further monitoring is considered to be required to assess for potential migration of contamination from the gasworks towards the site as a result of excavation dewatering activities during remediation and redevelopment."*

The IAA and RAP noted that further investigation of groundwater may be required during remediation to assess any migration of contaminants onto the site. An alternative approach to further groundwater assessment was proposed and included in the RAP Addendum. The RAP Addendum was reviewed as discussed in Section 11 of this SAR.

9.1 Auditor's Opinion

In the Auditor's opinion, the groundwater analytical results are consistent with the field observations and indicate minor groundwater impact from historical on-site and off-site land use. The Auditor notes that the station requires a tanked excavation which will limit ingress of

contaminants onto the site. A vapour intrusion assessment has been prepared for the site to demonstrate that contamination associated with off-site sources (if migrating onto the site) does not pose an unacceptable risks to site receptors.

10. EVALUATION OF CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representation of the source, pathway and receptor linkages at a site. Douglas developed a CSM and used it iteratively throughout the site assessment to inform decisions around investigation and remediation requirements. The CSM was initially developed following the preliminary investigations and included in the RAP and was reviewed by the Auditor in the IAA. The Auditor concluded in the IAA that the CSM presented was an adequate representative of the site. Table 10.1 provides the Auditor's review of the pre-remediation CSM presented in the Validation Report.

Table 10.1: Review of the Pre-Remediation Conceptual Site Model

Element of CSM	Consultant	Auditor Opinion
Contaminant source and mechanism	Imported fill/former site activities. Though no contaminants of potential concern were detected above the adopted criteria in soil, the potential for soil acting as a source/secondary source to groundwater cannot be excluded. Contaminated groundwater from off-site areas impacted by historical filling, historical spills or leaks of fuels or chemicals (such as during previous shipping operations) or from previous nearby wash bay. Contaminated groundwater from off-site areas including the former gasworks to the south of the property and the former nearby wash bay. Potential for as-yet unidentified contamination in soils from previously imported (extensive) fill, site activities and demolition of former structures.	The identified contaminant sources and the mechanism for soil and groundwater contamination is considered appropriate. Management and off-site disposal of contaminated soils within the excavation areas is proposed. Implementation of an unexpected finds protocol (UFP) to address any contamination identified during excavation of the site is appropriate.
Affected media	Soil, groundwater and vapour.	The affected media have been adequately identified.
Receptor identification	Future site and maintenance workers, construction workers, adjacent land users, surface water receptors (beyond site boundary) and groundwater.	The receptors have been adequately identified.
Exposure pathways	Inhalation of dust and vapours, ingestion and/or dermal contact, surface water runoff, contaminant leaching and migration into groundwater, lateral migration of groundwater, direct contact of contaminated ground with in-ground structures and groundwater extraction for dewatering and disposal.	The CSM identified all potential exposure pathways.
Presence of preferential pathways for contaminant movement	The location and distribution of contamination may have been influenced by trenches excavated for buried services, as these trenches may have acted as preferential migratory pathways in the past.	Preferential pathways are not considered relevant given all fill removed during remediation. The underground pedestrian connection proposed to connect the final station development to the adjacent proposed CBD could act as a preferential pathway for vapour and groundwater migration to the site.

Element of CSM	Consultant	Auditor Opinion
Potentially complete source-pathway-receptor (SPR) linkages requiring remediation or management	The pre-remediation CSM did not clearly specify potentially complete SPR linkages. The RAP provides an SPR approach to assess the potential risks of harm being caused to human or environmental receptors from contamination sources on, or in the vicinity of the site, via exposure pathways (potential complete pathways).	The exposure pathways have been adequately identified.
Evaluation of data gaps	The RAP identified data gaps to be addressed during additional investigations and remediation of the site. The data gaps are discussed further in the IAA in Appendix C.	Identified data gaps from the RAP have been addressed and no further potentially significant data gaps have been identified.

10.1 Auditor's Opinion

The Auditor is of the opinion that the CSM was a reasonable representation of the contamination at the site prior to remediation and was an adequate basis for assessing remedial requirements. The post-remediation CSM is presented in Section 13.2.

11. EVALUATION OF REMEDIATION

11.1 Remediation Required and RAP

Douglas determined remedial requirements based on review of investigation results against screening criteria and consideration of aesthetic issues. The RAP considered the horizontal extent of the remediation to be the excavation footprint, and the vertical extent to be the depth of contaminated or potentially contaminated soils, or the base of the excavation (whichever occurs first). Douglas anticipated that all contaminated or potentially contaminated soils within the excavation footprint will be removed as part of the bulk excavation works required for the development. Excavation and off-site reuse or disposal of the soil was therefore considered in the RAP by Douglas to be the only practicable remediation strategy.

An evaluation of the RAP was undertaken by the Auditor as part of the IAA (Appendix C), which included a comparison with the requirements of OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites* (current at the time of the IAA). The RAP was found to address the required information, and the Auditor concluded that the proposed remediation works were adequate to address contaminated fill material during redevelopment of the site through: excavation and off-site disposal of contaminated fill material and natural soil; implementation of the UFP; and successful validation.

The requirement for further groundwater monitoring during remediation and redevelopment to assess potential migration of contamination from the gasworks located to the south of the site was identified and it was recommended that the scope of the proposed investigation should be provided to the Auditor for review. Further it was recommended that the results of the investigations and any additional remediation proposed should be documented and provided to the Auditor for review.

11.2 RAP Addendum

A RAP Addendum was prepared by Douglas to address site conditions and inherent limitations to the proposed further groundwater assessments outlined in the RAP. An assessment approach was proposed in the RAP Addendum which included:

- JHCPBG JV undertake monthly visual inspections of seepage into the station box excavation during construction. Unexpected signs of concern (including odours, observed oil and discolouration) will trigger the UFP in the RAP, and sampling from the dewatering sumps (used for the adopted "sump and pump" dewatering method).
- In response to the above JHCPBG JV undertake "Grab" sampling and analysis of water from dewatering sumps at the base of the southern end of station box excavation to identify changes in quality of groundwater inflow during dewatering (whilst dewatering from the sump is ongoing during construction).
- Review of the analytical results from the management of water from dewatering.
- Monitoring of groundwater from new wells installed immediately south of the site at the completion of Station Box construction works when accessible.

The Validation Report indicates that access was not available for construction of new wells to the south of the site. As such an alternative approach to that described in the RAP Addendum was adopted, with a risk assessment conducted based on the presumption that the 'worst case' available results from the modelled groundwater capture zone in PSM (2018) reached the site (documented in the VIAR). Douglas noted that some grab samples were collected from within the station box by JHCPBG JV, and the results are discussed in Section 11.6.

The Auditor reviewed the RAP Addendum and revised approach during the course of the Audit, which was updated in response to the Auditor's comments. The revised approach presented in

the RAP Addendum and the proposed risk assessment in place of additional groundwater monitoring required in the RAP was considered by the Auditor to be appropriate.

11.3 Additional Data Collected

Subsequent to the IAA and SCWCI, the Validation Report indicates that additional intrusive investigations were undertaken by ADE to delineate identified contamination hotspots and higher waste streams and to undertake *in situ* waste classifications. Numerous supporting validation documents prepared by ADE were provided with the Validation Report (listed in Appendix D of this SAR).

Section 10 of the Validation Report includes a summary of the delineation and validation results obtained by ADE during the additional assessments. Based on the proposed development involving the excavation of fill and natural soils, the Validation Report has considered validation of the site soils via delineation of waste streams higher than general solid waste (GSW). This is relevant to the audit to confirm that waste materials have been appropriately classified, however is not relevant to the overall site validation since all fill materials have been removed from the site.

Section 11.5 discusses the delineation/validation of the identified higher waste stream areas, including delineation/validation of VENM where contaminant detections were made in natural soil and rock.

11.4 Remedial Works Undertaken

General excavation and spoil management was carried out by JHCPBG JV with Bakers Group and State Roads Construction carrying out haulage of materials. The Validation Report indicated that construction phase environmental consulting services for the project were undertaken by Douglas up until June 2018, and by ADE from May 2018 until the completion of remediation.

The following sequence of remediation/bulk earthworks was undertaken:

- Piling works between February 2018 and February 2019.
- Excavation works between July 2018 and September 2019.

Materials were imported to the site and the overall Barangaroo Station construction site to be temporarily used during construction. Imported materials were subsequently classified for off-site disposal purposes by ADE and, following completion of use on site, were disposed off-site to licensed facilities. The Validation Report indicates that some of the temporary imported materials were not disposed off-site and were re-used in other parts of the construction site (Worksite Area) beyond the site boundary. The defined waste classification extents were progressively excavated and disposed off-site in accordance with their assigned classification. Spoil from piling and excavation works identified to be ASS were subject to lime treatment adjacent to the validation site.

11.5 Validation Activities

11.5.1 Higher Waste Classification Delineation Sampling in Fill

Based on the additional assessment results obtained by ADE and the previous results from the DSI and SCWCI, the following higher waste classification areas were identified in fill:

- Fill at BRMW16 was provisionally classified as restricted solid waste (RSW) in the DSI as benzo(a)pyrene (BaP) and total PAH concentrations in the replicate sample (BD1-20171128) from a depth of 0.9 to 1.0 m exceeded the criteria for GSW.
- Fill at BRMW17 was provisionally classified as RSW in the DSI as the concentration of BaP in the sample collected from a depth of 0.9 to 1 m exceeded the criteria for GSW.

- Fill at BRBH25 was provisionally classified as RSW in the SCWCI as concentrations exceeded the GSW criteria for BaP and lead in the sample from depth 1.4 to 1.5 m, and concentrations exceeded the GSW criteria for total PAH and BaP in a sample collected from a depth of 2.0 to 2.45 m.
- Fill at BRBH26 at depths between 0.4 m to 1.9 m was provisionally classified as hazardous waste (HW) in SCWCI as concentrations of PAH and BaP exceeded the RSW criteria in the samples from depth 0.4 to 0.5 m.
- Fill at ADE test pit 14575-WAC3-TP2 classified as HW as a concentration of lead exceeded the RSW criteria in a sample from a depth of 1.0 m.
- Fill at ADE test pit 14961-WAC1-TP4 classified as HW as a concentration of BaP exceeded the RSW criteria in samples obtained from depths of 1.5 m and 2.5 m.

The Validation Report indicates that ADE conducted delineation/validation sampling of *in situ* soil materials surrounding the identified higher waste classification areas in fill (RSW or HW) to delineate the presence of contaminants including PAH, BaP and lead. The ADE reports were appended to the Validation Report and documented the collection of soil samples for analysis of relevant contaminants for total concentrations and for Toxicity Characteristic Leaching Procedure (TCLP). Based on the results reported, the vertical and lateral extent of each higher waste steam classification was delineated by ADE at each location.

Douglas provided summary discussions on the delineation/validation assessment undertaken by ADE however provided no specific comments on whether extents had been adequately defined or whether areas were validated. As a concluding comment Douglas considers *"…the reviewed reports covering validation and delineation sampling … provide an appropriate record of these works for the purposes of describing the waste delineation methods, results, and site validation".*

Auditor's Opinion

The Auditor is satisfied that the works undertaken were adequate to delineate the various waste streams and allow appropriate classification of materials to be disposed off-site.

11.5.2 Delineation Sampling for VENM Classification

Based on the additional assessment results obtained by ADE and the previous results from the DSI and SCWCI, contaminant detections made in natural soil and rock material that were not consistent with the proposed VENM classification were identified as follows:

- Natural soil and rock samples collected during the DSI from BRMW15 (depth 4.5-4.6 m) and BRMW17 (depths 5.5-5.6 m and 6-6.45 m) recorded elevated concentrations of PAHs. Elevated concentrations of PAH were also recorded for the rock sample from SCWCI location BRBH26 (depth 5-5.9 m).
- Natural rock sample collected during the DSI from BRMW11 (depth 3.9-4.0 m) recorded elevated concentrations of PAHs.
- Natural rock sample collected during the SCWCI from BRBH28 (depth 3.9-4.0 m) recorded elevated concentrations of PAHs and metals (copper, lead, mercury and zinc).
- Natural rock sample collected during the SCWCI from BRBH23 (depth 1.4-1.5 m) recorded concentrations of PAHs and arsenic and BRBH23 (depth 1.9-2.0 m) recorded concentration of PAHs.
- Natural rock sample collected during the DSI from BRMW09 (depth 0.9-1.0 m) recorded concentrations of cadmium and lead.

The Validation Report reviews ADE reports that address the above via:

- Excavation, stockpiling and disposal as GSW for *in situ* materials surrounding these locations and validation sampling of the *in situ* natural sandstone materials following removal of the identified impacted material.
- Excavation of test pits surrounding and beneath the locations and analysis of samples to delineate the vertical and lateral extent of the non-VENM materials.

Douglas considered the presence of metals concentrations to be "*within published background ranges for Australian soils (NEPC, 1999)*" at one location where ADE did not conduct a specific VENM assessment (BRBH23). In addition, lines of evidence suggested relevant materials had been excluded from the VENM classified material (BRMW09). This was supported by the Auditor's review of data which indicated cadmium and lead results provided in the ADE report were below the PQL and lead concentrations were consistent with expectations for sandstone bedrock.

Douglas considered that *"…the reviewed reports appropriately validate the rock remaining within the site and do not identify any issues of concern within the site potentially presenting an unacceptable risk to future site users or the environment".*

Auditor's Opinion

The Auditor is satisfied that the works undertaken were adequate to confirm the remaining materials were appropriately classified as VENM.

11.5.3 Validation of VENM

Following the initial VENM delineation sampling, the Validation Report indicates that VENM reports were completed by ADE as the excavation of the site progressed vertically and laterally. Four ADE reports were listed and appended to the Validation Report. The Validation Report provided a brief summary of each report with the summary indicating that approximately 45 natural samples were obtained at various stages of the excavation works between July 2018 and July 2019 with samples analysed for a variety of contaminants. One sample obtained in July 2019 reported a low detection (marginally above the laboratory PQL) for TRH C16-C34. The sample was further subject to silica gel clean-up TPH analysis, with the recorded result below the laboratory PQL. All other recorded concentrations for potential organic contaminants were less than the PQLs and Douglas considered that results for metals were within the quoted published background levels.

The Validation Report indicates that the aerial imagery in the most recent ADE VENM assessment report shows a haul road ramp of soil and rock materials was present in the sharks fin area of the site to provide access of mobile plant and trucks. The Validation Report indicates that the placed materials were initially excavated, stockpiled, treated with lime for ASS and assessed by ADE for off-site disposal. The ADE report for the stockpile assessment was appended to the Validation Report and indicated that ten samples were collected from approximately 1,800 m^3 of material and analysed for TRH, BTEX, metals, PAH, PCB, OCP, cyanide, ammonia, volatile halogenated compounds, field pH test (pHF), field pH peroxide test (pHFOX) and asbestos. The assessment also included a review of applicable results for samples collected from DSI boreholes located in the source area. Based on the results, ADE classified the stockpile as GSW.

With respect to assessing the site suitability of the material, Douglas noted that concentrations of contaminants for the stockpile presented in the ADE report were within the adopted site criteria.

The Validation Report does not provide a discussion on when this material was removed from the site or provide documentation that the material was not disposed off-site with underlying VENM. Table 2 of the Validation Report and the JHCPBG JV prepared spoil disposal register appended to the Validation Report indicate that approximately 3,499.98 tonnes of GSW (treated ASS) was disposed from the site using the referenced ADE waste classification report between 9 October 2019 and 17 October 2019. A photograph of the exposed bedrock beneath the soil ramp following removal was provided too Douglas by JHCPBG JV and was appended to the Validation Report.

Douglas considered that *"…the reviewed reports appropriately validate the rock remaining within the site and do not identify any issues of concern within the site potentially presenting an unacceptable risk to future site users or the environment".*

Auditor's Opinion

The Auditor is satisfied that the works undertaken were adequate to confirm the materials to be appropriately classified as VENM.

11.5.4 Imported Material

The Validation Report indicated that approximately 9,562.55 tonnes (t) of material was imported to the overall Barangaroo Station construction site (including the site) for temporary purposes including for the construction of piling pads, crane pads and drilling rig pads. The Validation Report indicated that JHCPBG JV maintained an imported materials register which was provided in Appendix G of the Validation Report. Douglas provided a summary of the imported materials register which has been summarised by the Auditor in Table 11.1.

Table 11.1: Imported Fill

Source	Volume Imported (t)	Material Type	Supporting Documentation
Select Quarry Materials (Albion Park)	2,020.4	DGB20	The Validation Report indicates that DGB20 was supplied by Select Quarry Materials Pty Ltd between January 2018 and September 2018 using materials originally supplied from Holcim (Australia) Pty Ltd. A letter from Holcim (Australia) Pty Ltd to Select Quarry Materials Pty Ltd dated 16 January 2015 stating that all materials supplied to Select Quarry Materials from Albion Park Quarry are processed from a natural hard rock quarry located at Woollybutt Drive, Albion Park was provided in Appendix G of the Validation Report.
WestConnex Stage 1B (Tunnel Spoil)	3,635.63	Sandstone (tunnel spoil)	WestConnex Stage 1B tunnel spoil was imported under NSW EPA *The WestConnex Stage 1B tunnel spoil exemption 2016 (Resource Recover Exemption under Part 9, Clauses 91 and 92 of the Protection of the Environment Operations (Waste) Regulation 2014)* in February 2018. A soil characterisation assessment report prepared by ADE was referenced in the Validation Report and Douglas provided a summary of the report findings. The material was described as white/grey coarse-grained sandstone with shale cobbles and samples were tested for a combination of common contaminants (metals, TRH, BTEX, PAH, OPP, OCP, PCB, phenols, electrical conductivity, pH, sulfates, chlorides and asbestos). Douglas noted that detectable concentrations of TRH F3 were reported slightly above the laboratory PQL in some of the analysed samples. ADE considered that the likely source of trace hydrocarbons is heavy oils (lubricants) from machinery used in the extraction and loading of the tunnel spoil. Concentrations of metals were considered by ADE to be within published background ranges for natural materials. Concentrations of BTEX, PAH, PCB, OCP and OPP and total phenols were below the PQLs. Asbestos was not observed or detected in the samples. ADE stated "*that the subject material generally meets the criteria for the Resource Recovery Order*". The Validation Report indicated that the order does not provide assessment criteria for contaminants, and it appears that ADE have adopted NEPM (2013) criteria for residential land use (HIL/HSL A) to demonstrate that the material is not considered to be contaminated. The Validation Report indicates that Douglas also reviewed the concentrations of all tested contaminants provided in the ADE report and compared them with the adopted site assessment criteria for the validation site, with all of the results assessed by Douglas to be within the adopted SAC. Douglas considered that

Source	Volume Imported (t)	Material Type	Supporting Documentation
			the most likely source of the recorded TRH is naturally occurring organic substances which are commonly encountered in shale in Sydney. Such substances are not considered to represent contamination. The source of the phenols and how representative it is of the assessed material is unknown, however, given its low concentration (well below the adopted criteria) it is not considered to present a risk to future site users.
Boral Quarries	3,541.16	Quarried 10 mm drainage aggregate	The Validation Report indicates that 10 mm Drainage VENM was imported from Boral Emu Plains Quarry between April 2018 and March 2020. A letter from Boral Quarries to Bachy Soletanche Australia dated 22 October 2018 stating that 10 mm Drainage from Emu Plains Quarry is classified as VENM.
Select Quarry Materials (Albion Park)	365.36	75 mm crushed sandstone	The Validation Report indicates that 75 mm Crushed Sandstone was supplied by Select Quarry Materials Pty Ltd in September 2018 using materials originally supplied from Holcim (Australia) Pty Ltd.

Following completion of use on site, all of the imported materials were subsequently classified and disposed of off-site to licensed facilities. The off-site disposal of these imported materials is discussed in Section 14.4. The Validation Report indicates that some of the imported materials were re-used elsewhere at the construction site (Worksite Area) beyond the site boundary.

Auditor's Opinion

The Auditor is satisfied that the validation of imported materials was adequate to demonstrate the material as suitable for use at the site and fit for purpose prior to removal.

11.5.5 Material Disposed Off-Site

Waste materials generated on-site were sampled and classified in accordance with the EPA (2014) *Waste Classification Guidelines*. Sampling from stockpiles of excavated soils and in-situ material was undertaken to characterise and classify the waste materials prior to off-site disposal. The Validation Report reports that 420,809.53 tonnes (t) of waste material was disposed off-site including the following waste types:

- General Solid Waste (non-putrescible) (GSW)
- GSW (non-putrescible) (treated ASS)
- Restricted Solid Waste (RSW)
- Hazardous Waste (HW)
- HW (untreated ASS)
- Virgin Excavated Natural Material (VENM)
- Excavated Natural Material (ENM).

Quantities of other wastes associated with demolition and construction activities were also documented in the Validation Report, however, are not reviewed in the SAR.

Waste materials were disposed from the site between May 2018 and October 2019. Douglas included supporting documentation from the contractors including waste disposal dockets, tipping information and registers for receival sites.

Auditor's Opinion

The Auditor has reviewed the documentation provided and is of the opinion that the supplied documentation is consistent with the remedial works described. Further assessment of the waste classifications and disposal quantities is provided in Section 14.4.

11.6 Risks from Off-site Groundwater

As discussed in Section 11.2, the additional groundwater assessment requirements outlined in the RAP Addendum could not be undertaken and an alternative approach was adopted to assess the potential risks from off-site groundwater contamination, documented in the VIAR. The VIAR is discussed in Section 13.1 of this SAR.

Section 2.5 provides a list of construction related items which were included in the station box design and which further reduce the potential risks from off-site groundwater to the site. The design aspects formed the basis of assumptions and modelling within the VIAR and were discussed within the Validation Report with manufacturers specifications for different components appended.

The VIAR assumes that ingestion or dermal contact with potentially contaminated groundwater within the station will not be significant, and this exposure pathway was not modelled. JHCPBG JV has advised that the expected seepage rate of groundwater through the main Station Box structure is expected to be zero due to the completed waterproofing works. The only area where seepage of groundwater into the Station Box is expected to occur is the CBD interface area, where groundwater inflow through this wall is expected to be in the order of 2 $mL/m^2/hr$ until completion of the pedestrian connection.

Douglas reviewed the interim design requirement of the CBD interface area and the Deed Schedule C1, Appendix B3.1 requirements in the Validation Report and considers that the potential for dermal contact or ingestion of groundwater seepage into the Barangaroo Station by future site users or station workers is negligible, and that the presumption of the VIAR that this is not a significant pathway is appropriate.

11.6.1 Assessment of Site Seepage Water Quality

The Validation Report indicates that during bulk excavation works JHCPBG JV occasionally collected 'grab' water samples from various areas of interest where groundwater was observed seeping into the station box as well as from the temporary depressurisation system (after its installation). JHCPBG JV obtained nine samples between July 2019 and December 2020 with the results tabulated in Appendix K of the Validation Report.

The Validation Report indicates that it was understood that samples from the depressurisation system (collected after September 2019) were from a sediment tank which collected water from the shallow depressurisation wells in the base slab.

The Validation Report provided a summary of the JHCPBG JV grab sampling results and noted the following:

- The recorded TRH C6-C10, BTEXN, ammonia and phenol concentrations were less than the concentrations adopted in the VIAR models, and in some cases less than the laboratory PQL.
- The TRH C>10-C40 concentrations were less than the TRH C10-C16 concentrations adopted in the VIAR models.
- The volatile compounds 2-Propanone (Acetone), 2-Butanone (MEK), 2-Methylphenol (o-Cresol) and 3&4-Methylphenol (m&p-Cresol) were recorded above the PQL with a maximum concentration of 0.004 mg/L, 0.031 mg/L, 0.013 mg/L and 0.008 mg/L respectively. These compounds were not assessed in the VIAR, but the recorded concentrations were noted by Douglas to be significantly less than the USEPA RSL for tapwater, and therefore Douglas considered these detections to not be a cause of concern.

Douglas considered that the volatile contaminants recorded in water sampled at the site during the construction phase period are adequately assessed by the VIAR.

11.6.2 Waterproofing

The station box has been designed to be fully tanked in the permanent case, with a 2.3 m thick watertight slab at the base. The walls are approximately 1.0 m thick and wrapped in two layers of 2 mm VLDPE membrane.

The Validation Report indicates that the materials used in the waterproofing are required to have a 100-year design life. Supporting documentation provided in the Validation Report indicate that the groundwater results presented in the DSI and RAP will not affect the VLDPE membrane of the 100-year design warranty.

The Validation Report includes a summary of the waterproofing quality assurance process to be adopted by JHCPBG JV which include:

- The waterproofing works are divided into 'worklots'.
- Each worklot contains a signed off Inspection and Test Plan (ITP), along with other QA checklists. This records all the testing that has been conducted on site to meet the project specification. This documentation has been reviewed and approved for use by the project's Independent Certifier.
- The documentation for each worklot is collated for review by the JHCPBG JV quality team for completeness and compliance. The documentation is then provided to the Independent Certifier for review prior to submission to Sydney Metro.
- A Worklot Completion Notice is then prepared including a record of the review of Independent Certifier and associated comments.
- The worklots are then submitted to TfNSW.

Douglas provided cover pages supplied by JHCPBG JV for three Worklot Completion Notices for waterproofing (Appendix L of Validation Report) and have been advised by JHCPBG JV that all waterproofing for the project has been completed in accordance with project specifications.

11.6.3 Auditor's Opinion

The Auditor agrees that the potential for dermal contact or ingestion of groundwater seepage into the Barangaroo Station by future site users or station workers is negligible. The verification of construction of the waterproofing via the Independent Certifier is appropriate as this aspect is outside the Auditor's area of expertise. The seepage sampling results are adequately assessed by the concentrations assumed in the VIAR.

11.7 Overall Auditor's Opinion

In the Auditors' opinion, the excavation works were appropriate to remediate onsite contamination and were conducted in general accordance with the RAP and RAP Addendum. Delineation sampling of higher waste classification materials and confirmation of VENM classifications was adequate. Materials imported for temporary works were suitable and fit for purpose prior to removal.

Construction of waterproofing has been verified by the Independent Certifier which supports the negligible potential for dermal contact or ingestion of groundwater seepage into the Barangaroo Station by future site users or station workers. Installation of new groundwater wells for validation purposes as proposed in the RAP and RAP Addendum was not possible. The risks posed from potentially contaminated off-site groundwater via vapour intrusion are discussed in Section 13.1.

12. CONTAMINATION MIGRATION POTENTIAL

Based on the remediation/excavation works outlined in the Validation Report, it is considered that all on-site sources of contamination have been removed during remediation/excavation works.

Contaminants detected within soil prior to remediation have not adversely affected the groundwater quality, except possibly locally. As the highest concentrations of potentially leachable contaminants in soil were removed during the remediation works, ongoing impacts to groundwater are unlikely.

Off-site sources with the potential to impact future site users have been identified, namely contaminated groundwater associated with the former Miller's Point gasworks to the south and reclaimed lands to the west of the site. The risk from potential onsite migration is discussed in Section 13.

13. ASSESSMENT OF RISK

13.1 Vapour Intrusion Modelling

Assessment of risks posed by vapour intrusion was undertaken by METRON as documented in the VIAR. The Auditor reviewed the VIAR during the course of the Audit, which was updated in response to the majority of the Auditor's comments, however, not all relevant scenarios were modelled. Douglas therefore conducted further sensitivity analysis modelling to supplement the VIAR. The risk assessment process undertaken is summarised below.

13.1.1 Issues Identification.

METRON considered the objective of the VIAR was to assess potential risks to human health from volatilization of volatile contaminants from theoretical groundwater seepage into the station structure and subsequent inhalation exposure by commuters, commercial workers, and non-intrusive maintenance workers. As a conservative, 'worst-case' assessment, maximum concentrations of volatile contaminants of concern in groundwater within a 160 m buffer of the station were considered as potential source concentrations for volatilisation into station air. This distance was adopted as it was the maximum distance over which draw down from station dewatering during construction was predicted to occur by PSM (2018). This is considered conservative as the draw down distance will decrease once dewatering of the excavation is no longer required due to tanking of the station. The maximum concentrations of contaminants in groundwater adopted in the VIAR were reported by AECOM (2013) in a well located 140 m south of the site, in the area of the former gasworks, and are summarised in Table 13.1 below.

Table 13.1: Maximum Concentration of Contaminants in Groundwater Adopted in the VIAR

Contaminant	Maximum Concentration mg/L
TRH F1	1.51
TRH F2	1.51
Benzene	40.2
Toluene	7.9
Ethylbenzene	<0.5
Xylene	2.84
Naphthalene	7.8
Ammonia	23.3
Phenol	1.88
Cyanide	0.75

Auditor's Opinion

The Auditor considers that the adoption of the maximum concentrations of volatile contaminants within a 160 m radius of the site is a conservative assumption and is likely to present a worst-case scenario as no dilution or biodegradation of contaminants is considered. The Auditor further notes that cyanide was excluded from the risk calculations without appropriate justification. However, it is considered that this exclusion will not change the final risk conclusions.

13.1.2 Toxicological Information

METRON adopted quantitative toxicity values for the identified contaminants in accordance with guidance available from enHealth (2012) and the NEPM (2013) Schedule B7.The rationale for adoption of the toxicity values was reviewed by the Auditor and the values are summarised in Table 13.2. As discussed in Section 11.6, vapour intrusion was identified as the only applicable exposure pathway, hence only inhalation toxicity reference values were considered.

13.2: Inhalation Toxicity Reference Values Adopted in the VIAR

Contaminant	Non-threshold $(mg/m^3)^{-1}$	Reference	Threshold (mg/m^3)	Reference
TRH F1	NA	-	1 (aliphatic) 0.2 (aromatic)	TPHCWG
TRH F2	NA	-	1 (aliphatic) 0.2 (aromatic)	TPHCWG
Benzene	0.004	USEPA (2012)	0.03	USEPA (2012)
Toluene	NA	-	5	USEPA (2012)
Ethylbenzene	NA	-	1	ATSDR (2010)
Xylene	NA	-	0.1	ATSDR (2007)
Naphthalene	NA	-	0.003	ATSDR (2005)
Ammonia	NA	-	0.5	USEPA (2016)
Phenol	NA	-	0.035	NEPM (2013)

Background exposure concentrations were considered by METRON in the assessment as follows:

- TRH C6-C10 – 10% of adopted inhalation threshold toxicity value
- TRH C10-C16 – 10% of adopted inhalation threshold toxicity value
- Benzene – 20% of adopted inhalation threshold toxicity value
- Phenols – 30% of adopted inhalation threshold toxicity value

Background concentrations were not considered for toluene, ethylbenzene, xylenes, naphthalene and ammonia.

Auditor's Opinion

The adopted toxicity reference values for inhalation pathways and the background exposure contributions are considered reasonable.

13.1.3 Exposure Assessment

The exposure assessment involves the determination of the receptor populations who may be exposed to the chemicals of concern identified for the assessment during normal activities and the pathway by which they are exposed. METRON identified the following potential receptors:

- Commuters
- Metro Station personnel
- Station and retail workers
- Non-intrusive maintenance personnel

METRON note that the station is tanked and that accumulation and dermal contact and ingestion of impacted seepage water was unlikely to occur. The assessment, therefore, focused on the vapour intrusion pathway and potential for detectable nuisance odours. Indoor air concentrations are estimated assuming 100% of volatile contaminants in assumed seepage water is volatilised. Originally, METRON included two potential exposure scenarios, one assumed the air mixing zone would encompass the entire station box (scenario A), and another assuming a more limited air mixing zone associated with a 'platform compartment' (scenario B). Following confirmation that the station design would include platform doors that would limit the mixing zone to the platform

area, scenario A was not considered further. Assumptions adopted in the exposure assessment included:

- Groundwater is in direct contact with a portion of the station structure and seepage occurs at a rate of 2 mL/m^2/hr.
- The area of seepage covers 736 m^2 (based on a platform height of 9.2 m and length of 80 m)
- The platforms are separated from the train tunnels by doors and, therefore, the air mixing space is not the entire station box. The volume of mixing area considered in the VIAR was of 10,557 m^3 (based on a platform height of 9.2 m, width of 6.75 m and length of 170 m)
- Impacted groundwater associated with the former gasworks to the south may migrate to and seep into the station structure. Therefore, maximum reported groundwater concentrations within the 160 m draw down buffer were assumed to reach and impact upon the south western station walls continuously for up to 30 years.
- While smaller spaces used for services and utilities are present at the southern end of the lower platform, these spaces were not considered to have a complete pathway for water ingress into the indoor air spaces due to the external facing wall of the southernmost level being fully tanked, and a separated lower platform area to capture drainage
- The stormwater and seepage water collection and conveyance system is a 'gas-tight' system and groundwater seepage or stormwater that enters the pit and pipe conveyance system will not contribute significant odours or vapour to the station indoor air cavity
- 100% of the volatile chemicals in the groundwater volatilise and mix in station air
- An air exchange rate (AER) of 12 exchanges per hour was assumed initially by METRON for both scenario A and B, but an AER of 1.2 per hour was adopted following an update (see below for further details).
- A station worker may be exposed for 8 h/day, 240 days/year for 35 years
- Averaging time for non-threshold contaminants is 70 years and 35 years for threshold contaminants

METRON state in the VIAR that the adopted AER was based on engineering designs and was based on "*supply by air handling units with duty standby fans at either end of the station used for air conditioning and air circulation into the station. 40 m^3/s is provided directly to the platform level, plus an additional 20 m^3/s is provided at the high-level concourse. The calculated AER for the platform level was conservatively calculated based on the 40 m^3/s and the calculated volume of the platform area*". Following Auditor comments, METRON advised that AER estimates presented were based on old station design with outdated platform dimensions. METRON provided an updated VIAR report where platform dimensions and resulting volume and AER estimates were updated. For scenario A, an updated AER of 1.2 per hour was provided in Table 5.1 of updated VIAR report. However, the remaining parts of the report were not updated including risk calculations as it was stated that following redesign scenario A was no longer relevant.

Douglas notes in the Validation Report that this does not appear to be consistent with the wording of the Deed, however, is consistent with the interpretation of the Deed as stated by Sydney Metro. The Deed specifies a ventilation rate of 20 m^3/s and as an additional assessment of risk, Douglas undertook additional sensitivity modelling to further assess the conclusions of the VIAR. In addition, Douglas considered in the Validation Report that the following exposure scenarios had not been specifically considered in the VIAR:

- Exposure within smaller plant and service rooms
- Exposure within the concourse.

Douglas note in the Validation Report that "*it is considered that whilst the assumptions of the VIAR are highly conservative, they do not provide a scenario consistent with the minimum ventilation requirement in the Deed or the actual structure. As such, DP has conducted three additional sensitivity analysis models to assess how variations to the modelled spaces would modify the risk*."

The scenarios modelled by Douglas were:

- The scenario B from the VIAR with an amended ventilation rate of 20,000 m^3/h and AER of 1/h and 4/h
- Scenario C Concourse which assumed increase seepage through a 20 m long interface (within an area measuring 60 m x 20 m x 11 m) between the station and the CBD concourse
- Scenario D assumed a 'reasonable worst case' service room allowing for reduced room size (10 m x 3.3 m x 4 m) and ventilation rate (0.2 m^3/h) and assuming a worker accesses the room for 0.5 hours a day.

Auditor's Opinion

METRON originally assumed the air mixing zone would encompass the entire station box, however, following confirmation that platform doors would limit the mixing zone to the platform area, this scenario was not considered further. METRON revised the VIAR based on Auditor comments but did not recalculate risk levels based on revised assumptions in relation to mixing zone volume and AERs. However, the additional exposure scenario modelling completed by Douglas is considered sufficient to assess risks associated with the revised assumptions.

The Auditor notes that the area connecting the station to the CBD has not yet been waterproofed and seepage may occur through this area and hence there is a potentially complete vapour intrusion exposure pathway. The exposure parameters adopted for the assessment of the vapour intrusion risk from seepage water into the station are considered to be adequately conservative to address this pathway.

13.1.4 Risk Characterisation

The VIAR compared calculated incremental lifetime cancer risk estimates for non-threshold contaminants to an adopted acceptable carcinogenic risk level of 1 in 100,000 (1×10^{-5}). This value is recommended by the NEPM (2013) and enHealth (2012) as an acceptable incremental lifetime risk of developing cancer due to single or multiple carcinogens. A Hazard Quotient (HQ) was calculated for threshold contaminants and a Hazard Index (HI) estimated. METRON note that *"If the HI is less than one, then cumulative exposure to the [contaminants of potential concern] is considered unlikely to result in an adverse effect. If the sum is significantly greater than one, a more detailed and critical evaluation of the hazards may be required, or appropriate risk management measures at the site may need to be implemented."*

Both METRON and Douglas calculated risk levels that were within the acceptable risk thresholds for all modelled scenarios. METRON concluded in the VIAR that:

"Health risks due to vapour intrusion / volatilisation from groundwater seepage into the station structure, with subsequent inhalation exposure by permanent station workers including non-intrusive maintenance workers, were calculated to be low and acceptable.

Exposure by other, less exposed receptors such as commuters, were also therefore considered to be low and acceptable.

Odour and aesthetic impacts within the station due to vapour intrusion / volatilisation from groundwater seepage were considered unlikely, as conservative worst case indoor air concentrations were well below adopted odour threshold values."

Douglas concluded in the Validation Report that:

"*Whilst the risk assessment includes some assumptions which are not reflective of the current structural design or apparent Deed ventilation requirements, overall it is based on highly conservative assumptions. The additional sensitivity analysis conducted by [Douglas]… indicates that these assumptions do not change the conclusions of the VIAR. As such, based on the VIAR and the discussion above [Douglas] considers that contamination in off-site groundwater does not pose an unacceptable risk to future site users or station workers*."

Auditor's Opinion

The Auditor considers that the acceptable levels of risk defined in the VIAR and the Validation Report are reasonable with uncertainties and sensitivities discussed. The Auditor has reviewed the calculation approach used by METRON and Douglas and considers them acceptable. Based on the considered exposure pathway, exposure assumptions and risk calculations, the Auditor agrees that the risks posed by vapour intrusion to future station workers and users are low and acceptable.

13.1.5 References

ATSDR, 2005. Toxicological Review of Naphthalene. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. August 2005.

ATSDR, 2007. Toxicological Profile for Xylenes. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. August 2007.

ATSDR, 2010. Toxicological Profile for Ethylbenzene. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Public Health Service. November 2010.

enHealth (2012) Environmental health risk assessment; guidelines for assessing human health risks from environmental hazards, Environmental Health Subcommittee (enHealth) of the Australian Health Protection Principal Committee, Canberra, Australia.

NEPC, 2013. National Environment Protection (Assessment of Site Contamination) Amendment Measure 1999 (No. 1). National Environment Protection Council. Amended 2013.

TPHCWG (1997) Development of fraction specific reference doses (RfDs) and reference concentrations (RfCs) for total petroleum hydrocarbons (TPH), TPH Criteria Working Group, Toxicity Technical Action Group, Vol. 4 Amherst Scientific, Amherst, Massachusetts.

USEPA, 2012. Toxicological Summary of Benzene, U.S. Environmental Protection Agency, National Center for Environmental Assessment. January 2012. Doc link: https://www.epa.gov/sites/production/files/2016-09/documents/benzene.pdf

USEPA, 2012. Toxicological Summary of Toluene, U.S. Environmental Protection Agency, National Center for Environmental Assessment. July 2012. Doc link: https://www.epa.gov/sites/production/files/2016-09/documents/toluene.pdf

USEPA, 2016. IRIS (Integrated Risk Information System): Toxicological Review of Ammonia Noncancer Inhalation, U.S. Environmental Protection Agency, National Center for Environmental Assessment. September 2016.

13.2 Post-Remediation CSM

Douglas provided the following post-remediation CSM in the Validation Report:

Source	Transport Pathway	Receptor	Comments
S3 - Contaminated groundwater from off-site areas	P6 - Extraction via dewatering and disposal	R1 - Surface waters	Pathway complete until decommissioning of the depressurisation system. Risk is expected to be managed by treatment and disposal of water in accordance with POEO Act.
		R4 - Construction workers	Pathway complete until decommissioning of the depressurisation system. This can be managed by the adoption of appropriate WHS methods during treatment and management of dewatering works.
	P2 - Inhalation of vapours	R3 - Future site users and maintenance workers	Pathway complete: Based on the results of the VIAR the pathway is complete, however, the risk is modelled to be low and acceptable.
	P7 - Direct contact of contamination with ground structures	R6 - In ground building structures	Pathway complete: however, based on information from the material suppliers the contamination will not prevent performance of the waterproofing materials in accordance with the project specifications.

13.3 Overall Auditor's Opinion

Based on assessment of results against relevant guidelines and consideration of the overall investigations and remediation performed, the Auditor considers that contaminant concentrations remaining onsite do not pose a risk to site users or the environment under the proposed land use scenario.

Off-site sources with the potential to impact future site users have been identified, namely contaminated groundwater associated with the former Miller's Point gasworks to the south and reclaimed lands to the west of the site. The VIAR concluded that identified potential volatile and odorous groundwater contaminants of concern (TRH, BTEXN, ammonia, phenols and cyanide) within a 160 m radius of the site. The Auditor notes that the potential risk from the off-site sources will be limited by the secant pile wall, the tanking/waterproofing of the station, and the station ventilation system (once constructed). Construction of the development in accordance with the Deed and appropriate management of the CBD interface is required such that the assumptions of the risk assessment remain valid.

14. COMPLIANCE WITH REGULATORY GUIDELINES AND DIRECTIONS

14.1 General

The Auditor has used guidelines currently made and approved by the EPA under section 105 of the CLM Act.

The investigations were generally conducted in accordance with SEPP 55 Planning Guidelines and reported in accordance with the OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites* (which was applicable at the time the reports were prepared). The Validation Report was generally prepared in accordance with the NSW EPA (2020) *Consultants Reporting on Contaminated Land, Contaminated Land Guidelines*.

14.2 Development Approval

A statutory site audit is required to address the requirements of Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the NSW Minister for Planning on 9 January 2017. Condition E67 relates to contamination and requires a site audit as follows:

> *"If a Site Contamination Report prepared under Condition E66 finds such land contains contamination, a site audit is required to determine the suitability of a site for a specified use. If a site audit is required, a Site Audit Statement and Site Audit Report must be prepared by a NSW EPA Accredited Site Auditor. Contaminated land must not be used for the purpose approved under the terms of this approval until a Site Audit Statement is obtained that declares the land is suitable for that purpose and any conditions on the Site Audit Statement have been complied with."*

This SAR and accompanying SAS were prepared to comply with this condition.

14.3 Duty to Report

Consideration has been given to the requirements of the EPA (2015) *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997*. Based on the findings of this SAR, the Auditor considers that the site is not required to be notified under the Duty to Report requirements.

14.4 Waste Management

In accordance with Section 4.3.7 of the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme (3rd Edition),* the Auditor has checked the following aspects relating to waste disposal and recycling.

14.4.1 Waste Classification

Approximately 70 waste classification letters prepared by ADE and Douglas were listed in the Validation Report as relevant to the site, with only a select few appended to the Validation Report. The remaining waste classification letters were provided separately and approximately 50% were reviewed in detail during the course of the audit. The Validation Report included a spoil disposal register prepared by the JHCPBG JV and presented a summary table of waste classification reports prepared for the site and corresponding disposal information. It was reported that wastes were classified in accordance with the NSW EPA (2014) *Waste Classification Guidelines, Part 1: Classifying Waste*. The adopted waste classification strategy included sampling from stockpiles of excavated soils and in-situ material.

Based on the summary of waste classification reports presented in the Validation Report and the spoil disposal register prepared by the JHCPBG JV, the waste classification reports were prepared for the following soils at the site:

- GSW (non - putrescible) for selected fill and impacted natural bedrock.

- GSW (non - putrescible) (treated ASS) for select fill material and piling spoil.
- RSW for fill materials in the vicinity of BRMW16, BRMW17 and BRBH25.
- HW for fill material identified at sample 14575-WAC3-TP2 and BRBH26.
- HW (untreated ASS) for fill material in vicinity of ADE test pit 14961-WAC1-TP4.
- VENM for natural soils and bedrock.
- ENM for stockpiled sandstone bedrock sourced from adjacent to Hickson Road and eastern boundary.

14.4.2 Waste Volumes, Disposal Receipts and Disposal Facilities

The Validation Report provides disposal dockets for the off-site disposal of different wastes between May 2018 and October 2019. Dockets include materials disposed during demolition and excavation stages of the project. The Validation Report also includes a waste receiving site register and a waste tracking register prepared by the JHCPBG JV.

Douglas report in Table 3 of the Validation Report that a total of 420,809.53 t (including ENM and VENM) was removed off-site. The JHCPBG JV records provided in Appendix H of the Validation Report indicate that a total of 422,660.752 t was removed off-site. The Auditor has assessed the volumes presented and calculates a similar amount to that provided by JHCPBG JV. Douglas noted in the Validation Report that whilst the JHCPBG JV registers were generally used as the basis for the summaries in Table 3 of the Validation Report, these have been updated as considered appropriate by Douglas based on the corresponding waste classification reports. Specifically, some of the listed GSW appears to have been sourced from outside of the site and was therefore not included in the summaries, and some materials listed as GSW appear to have been GSW (treated ASS) and have therefore been reassigned to this classification. This discrepancy is not considered to be significant.

The Validation Report indicates that JHCPBG JV adopted a density of 2.2 t/ m^3 when converting volumes to mass for tracking of spoil, and Douglas adopted this value in average check calculations for *in situ* materials. Douglas however considered this to be on the higher end of the expected mass for soils, and likely to be an underestimate for sandstone bedrock, and therefore assessed specific volume/mass conversions with different densities in the Validation Report when considered appropriate.

Based on the development area and excavation depths, Douglas calculated an expected total volume of spoil from the bulk excavation of approximately 180,000 m^3, which at a density of 2.2 t/m^3 gives 390,000 t. Douglas noted that this volume was based on a simplified site model, and did not account for various 'steps ins' in the bulk excavation or additional spoil from other sources (i.e., additional piling returns; lime used to treat the ASS; spoil imported for temporary use; or spoil excavated from adjacent, off-site, areas including under the same classification and disposal records as some on-site-sourced spoil). The JHCPBG JV spoil tracking register provides disposal information for approximately 432,000 t (including pavement materials), which was considered by Douglas to correlate well with Douglas's calculated total 'expected' mass (less than 10% variance), especially given the broad average density estimate adopted and the known discrepancies mentioned above.

Table 14.1 summarises the waste disposal information for non-VENM and ENM soils disposed off-site to several waste management facilities that are licensed to receive the specified waste under their EPL.

Table 14.1: Summary of Waste Disposal

Waste Classification	Tonnage (t)	Disposal Facility	EPL No.
GSW (non-putrescible)	337.3 17,021.92 19,899.22 2,659.41 1,092.59 Total: 41,010.44	MET Recycling Pty Ltd, Silverwater Sydney Recycling Park, Kemps Creek Breen Resources Pty Ltd, Kurnell Cleanaway (Enviroguard), Erskine Park Hi Quality Waste Management Pty Ltd, St Marys	20948 12901 4608 4865 5857
GSW (non-putrescible) (treated ASS/PASS)	1,933.24 7,995.92 46,836.63 372.38 410.16 Total: 57,548.33	Sydney Recycling Park, Kemps Creek Breen Resources Pty Ltd, Kurnell Cleanaway (Enviroguard), Erskine Park Dial-A-Dump (EC), Eastern Creek Veolia Environmental Services (Australia) Pty Ltd, Horsley Park	12901 4608 4865 13426 20339
RSW	368.4	SUEZ Recycling & Recovery P/L, Kemps Creek	4068
HW	177.22 104.96 Total: 282.18	Cleanaway Pty Ltd, Kooragang Island Environmental Treatment Solutions Pty Ltd, Blayney	6124 13230

The Validation Report indicates that as part of the validation process Douglas carried out a review of the JHCPBG JV spoil classification and disposal documentation and EPLs for the receiving sites as published on the NSW EPA website. Upon review of EPLs and the disposal documentation provided, Douglas concluded that "*it appears that the waste soils (classified as GSW, RSW and HW) has been disposed to appropriately licenced facilities*.".

14.4.3 Auditor's Opinion

The Auditor considers that the waste management assessed as part of the remedial works was undertaken in general accordance with the relevant guidelines and regulations. As discussed in Section 11.5, validation sampling was generally not undertaken following removal of defined extents of different (higher) classified wastes however delineation sampling was undertaken to determine extents and VENM assessments were performed on the underlying natural material which validated removal of pre-existing fill material. In the Auditor's opinion, the lack of validation sampling has been compensated by the delineation and VENM assessments.

14.5 VENM and Other Imported Materials

As detailed in Section 11.5.4, VENM and other materials were imported to the site for temporary use to allow for construction activities. Douglas indicated in the Validation Report that following completion of use on site, all of the imported materials were subsequently classified and disposed of off-site to licensed facilities. The off-site disposal of these imported materials is discussed in Section 14.4. The Validation Report indicates that some of the imported materials were re-used elsewhere at the construction site (Worksite Area) beyond the site boundary.

14.5.1 Auditor's Opinion

In the Auditor's opinion, the importation, disposal or local reuse of materials was undertaken in general accordance with the relevant guidelines and regulations.

14.6 Conflict of Interest

The Auditor has considered the potential for a conflict of interest in accordance with the requirements of section 3.2.3 of the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme*.

The Auditor considers that there are no conflicts of interest, given that:

1. The Auditor is not related to a person by whom any part of the land is owned or occupied.
2. The Auditor does not have a pecuniary interest in any part of the land or any activity carried out on any part of the land.
3. The Auditor has not reviewed any aspect of work carried out by, or a report written by, the site auditor or a person to whom the site auditor is related.

15. CONCLUSIONS AND RECOMMENDATIONS

Based on the results documented in the Validation Report, Douglas concluded that "*All on-site sources of contamination have been removed and appropriately validated to not pose a risk to future site users; and Off-site sources have been assessed by the VIAR to not present a risk to human health under the proposed development. [Douglas] considers that this conclusion is appropriate, based on the discussions provided herein. Accordingly, it is considered that the site has been made suitable for the proposed station development from a contamination risk perspective. It is noted that changes to the proposed development, including the water ingress potential at the connection to the CBD or the ventilation system could change the risk from contamination at the site. As such, if any such changes are proposed, the impact on risk from contamination should be reviewed, and the development works modified if required to manage any potentially unacceptable risks.*".

Based on the information presented in the Validation Report and other reports referenced, as well as observations made on site, and following the Decision-making process for assessing urban redevelopment sites in NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, the Auditor concludes that the site is suitable for the proposed underground train station, constructed in accordance with the *Sydney Metro City & Southwest, Barangaroo Station Development, Construct Only Delivery Deed* (Contract No: 501 dated 12 March 2021).

Groundwater has not been assessed for any beneficial re-use. Any future use of groundwater would require appropriate assessment and regulatory approvals from the NSW Office of Water.

16. OTHER RELEVANT INFORMATION

This Audit was conducted on the behalf of JHCPBG JV for the purpose of assessing whether the land is suitable for the proposed commercial/industrial uses, i.e. a "Site Audit" as defined in Section 4 (definition of a 'site audit' (b)(iii)) of the CLM Act.

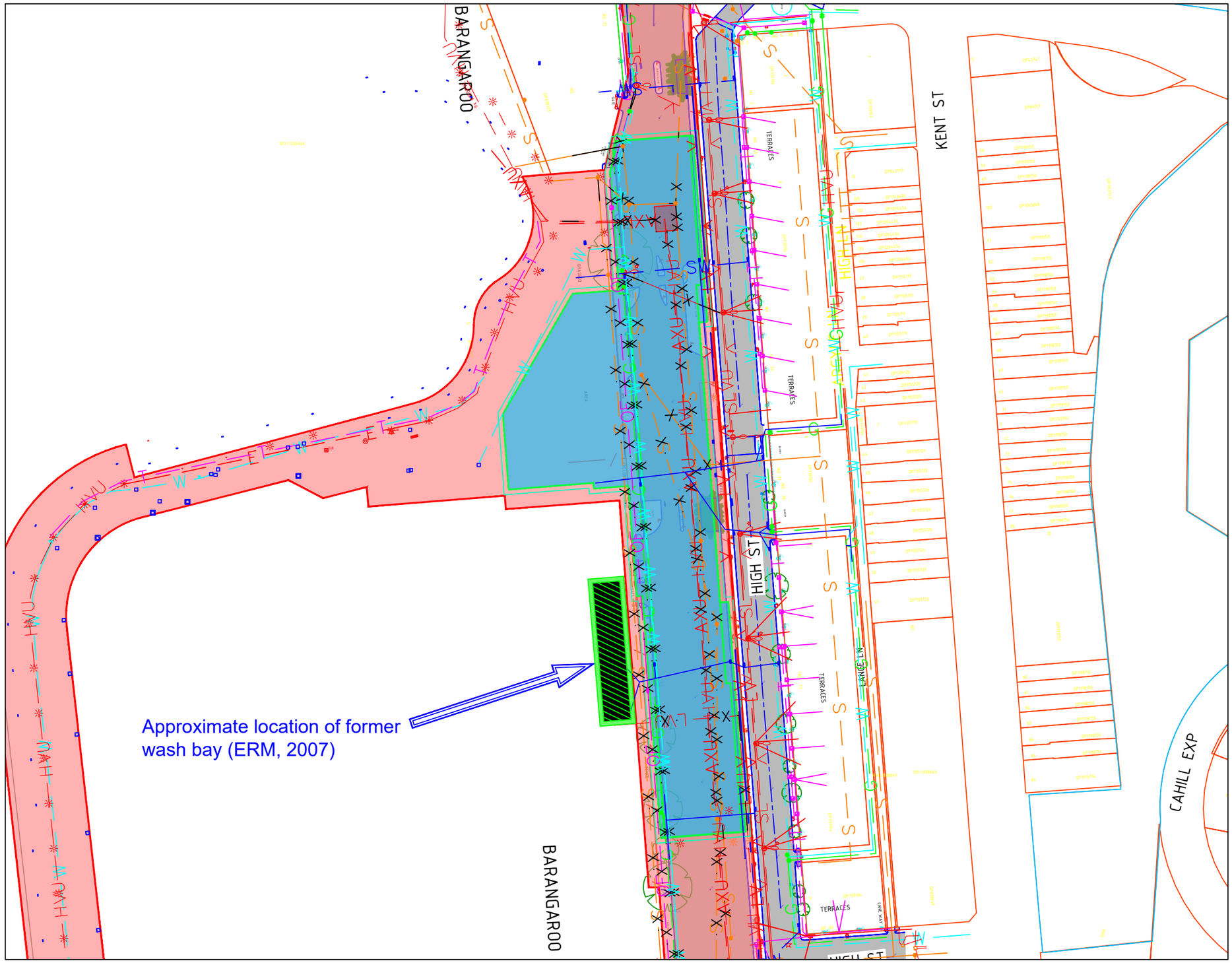
This summary report may not be suitable for other uses. The reports listed in Section 1 included limitations. The Audit must also be subject to those limitations. The Auditor has prepared this document in good faith, but is unable to provide certification outside of areas over which the Auditor had some control or is reasonably able to check.

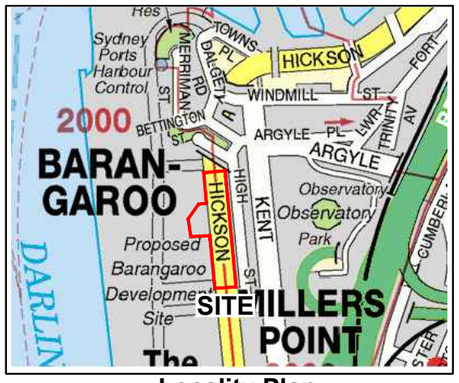
The Auditor has relied on the documents referenced in Section 1 of the Site Audit Report in preparing the Auditors' opinion. If the Auditor is unable to rely on any of those documents, the conclusions of the audit could change.

It is not possible in a Site Audit Report to present all data which could be of interest to all readers of this report. Readers are referred to the referenced reports for further data. Users of this document should satisfy themselves concerning its application to, and where necessary seek expert advice in respect to, their situation.

APPENDIX A
ATTACHMENTS

Attachment 1: Site Location and Audit Boundary
Attachment 2: Historical Sample Locations and Areas of Concern





Locality Plan

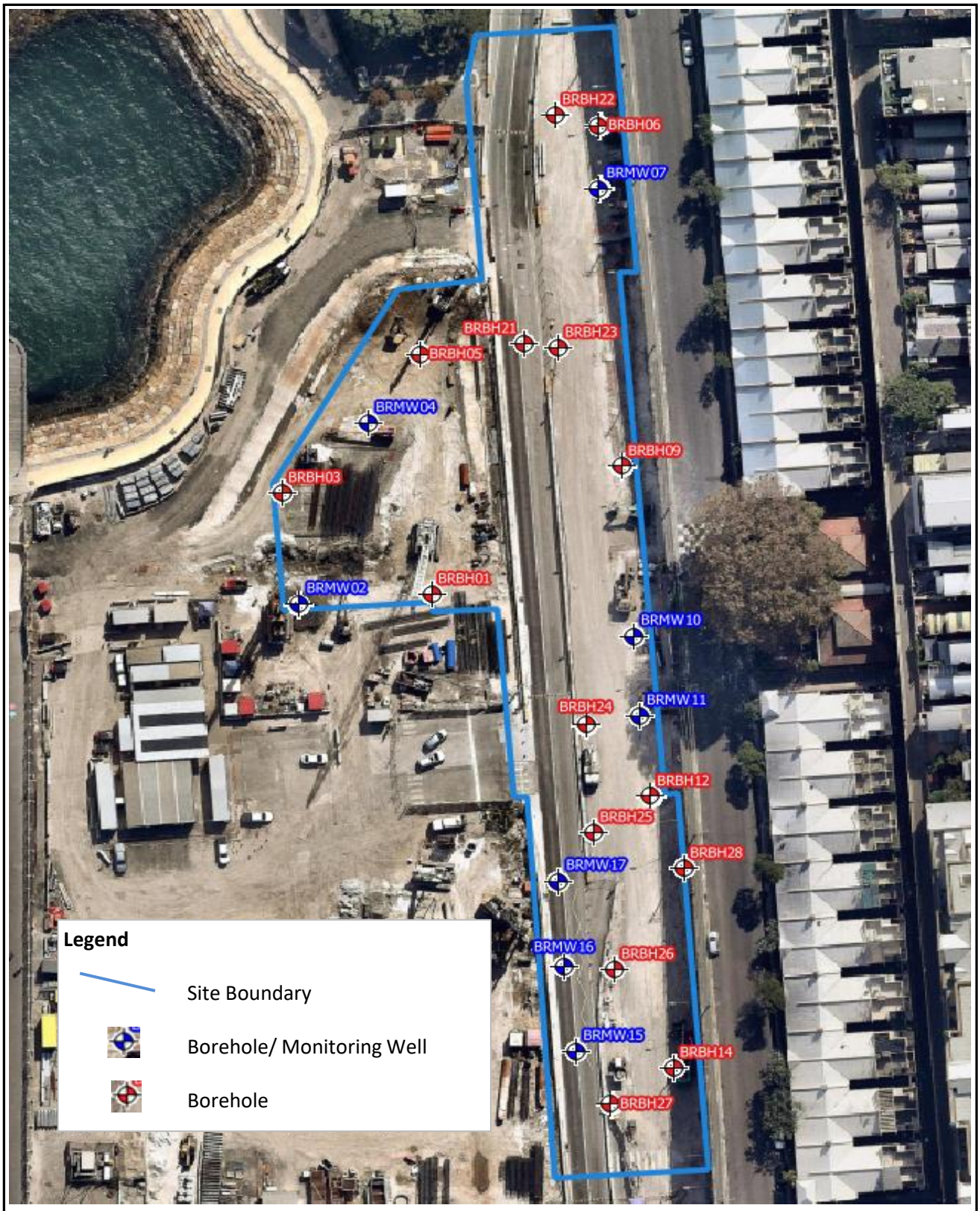
NOTE:
1: Base drawing from client (Dwg SMCSWTSE-JCG-TPW-CN-SKE-071xxx)

0 5 10 20 30 40 50 75 100 125m
1:1250 @ A3

LEGEND

- WORKSITE AREA
- EXCAVATION AREA (THE SITE)
- 1.2-1.5m PILING ZONE

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: **Site Location**	PROJECT No: 85608.20
	OFFICE: Sydney / DRAWN BY: PSCH/MG	**Sydney Metro City & South West, Tunnel and Station Works**	DRAWING No: 1
	SCALE: 1:1250 @ A3 / DATE: 08.06.2021	**Barangaroo Station, Hickson Road, BARANGAROO**	REVISION: 0



Douglas Partners Geotechnics / Environment / Groundwater	**DSI and SCWCI Sample Locations Sydney Metro City & South West, Tunnel & Station Works Package Hickson Road, Barangaroo**	PROJECT: 85608.20
		DWG No: 2
		REV: 0
	CLIENT: John Holland CPB Ghella JV	DATE: 25.06.21

APPENDIX B
SITE AUDIT STATEMENT

NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. RS-139

This site audit is a:

☒ statutory audit

☐ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name	Rowena Salmon
Company	Ramboll Australia Pty Ltd
Address	Level 3
	100 Pacific Highway, North Sydney
	Postcode 2060
Phone	02 9954 8100
Email	rsalmon@ramboll.com

Site details

Address: Sydney Metro Barangaroo Station, Hickson Road, Barangaroo, NSW

Postcode: 2000

Property description

The site covers an approximate irregular rectangle shape (see figure at end of Part I of this statement). The Lot/Deposited Plan (DP) numbers for the site are as follows:

Part of Lot 1 DP863317, part of Lot 52 DP1213772 and part of Hickson Road

Local government area: City of Sydney

Area of site (include units, e.g. hectares): Approximately 0.7 hectares

Current zoning: B4 – Mixed Use and RE1 – Public Recreation

Regulation and notification

To the best of my knowledge:

☐ **the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)

- ☐ Declaration no.
- ☐ Order no.
- ☐ Proposal no.
- ☐ Notice no.

☒ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

☐ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☒ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

Site audit commissioned by

Name: Caitlin Richards

Company: John Holland CPB Contractors Ghella Joint Venture (JHCPBG JV)

Address: 2&4/177 Pacific Highway, North Sydney NSW

Postcode: 2000

Phone: 0407 176 672

Email: Caitlin.Richards@cpbcon.com.au

Contact details for contact person (if different from above)

Name: Stuart Anstee

Phone: 0418 903 837

Email: stuart.anstee@sydneymetro2.com.au

Nature of statutory requirements (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)

☐ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

☒ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the Minister for Planning on 9 January 2017

☐ Requirements under other legislation (please specify, including date of issue)

Purpose of site audit

☒ **A1** To determine land use suitability

Intended uses of the land: Below ground train station

OR

☐ **A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land:

OR

(Tick all that apply)

☐ **B1** To determine the nature and extent of contamination

☐ **B2** To determine the appropriateness of:

- ☐ an investigation plan
- ☐ a remediation plan
- ☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

- ☐ **voluntary management proposal** or
- ☐ **management order** under the *Contaminated Land Management Act 1997*

☐ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land:

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Douglas Partners Pty Ltd (Douglas)

ADE Consulting Group Pty Ltd (ADE)

METRON Consortium (METRON)

Titles of reports reviewed:

'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, March 2018', report reference: Revision 0, dated 8 March 2018, prepared by Douglas.

‘Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018’, report reference: Revision 1, dated 7 May 2018, prepared by Douglas.

‘Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018’, report reference: Revision 0, dated 7 May 2018, prepared by Douglas.

‘Acid Sulfate Soil Management Plan, Barangaroo Station Site, Hickson Road, Barangaroo NSW’, dated 4 June 2018, Prepared by ADE.

‘Report on Supplementary Contamination and Waste Classification Investigation, Sydney Metro City & South West, Tunnel & Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, NSW’, Ref 85608.08.R.030.DftA dated 15 June 2018, prepared by Douglas.

‘Addendum to Remediation Action Plan, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo’, Ref: 85608.08.R.036.Rev2, dated 27 February 2019, prepared by Douglas.

‘Barangaroo Station Vapour Intrusion Assessment Report Stage 2 & 3 Detail Design Underground Stations Design and Technical Services’ (Document No: SMCSWSBR-MET-SBR-EM-REP-000001, Revision P04.1, dated 15 September 2021), prepared by METRON.

‘Report on Validation of Remediation, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Barangaroo Station, Hickson Road, Barangaroo’, dated 21 September 2021 (Rev 0), prepared by Douglas (the Validation Report).

Review of supporting documentation appended to the Validation Report including waste classification reports prepared by ADE and Douglas for material disposed from the site.

Other information reviewed, including previous site audit reports and statements relating to the site:

‘Site Audit Report, Overarching Remedial Action Plan, Barangaroo’, and SAS GN 439A, dated 2 June 2010 by Graeme Nyland of ENVIRON Australia Pty Ltd

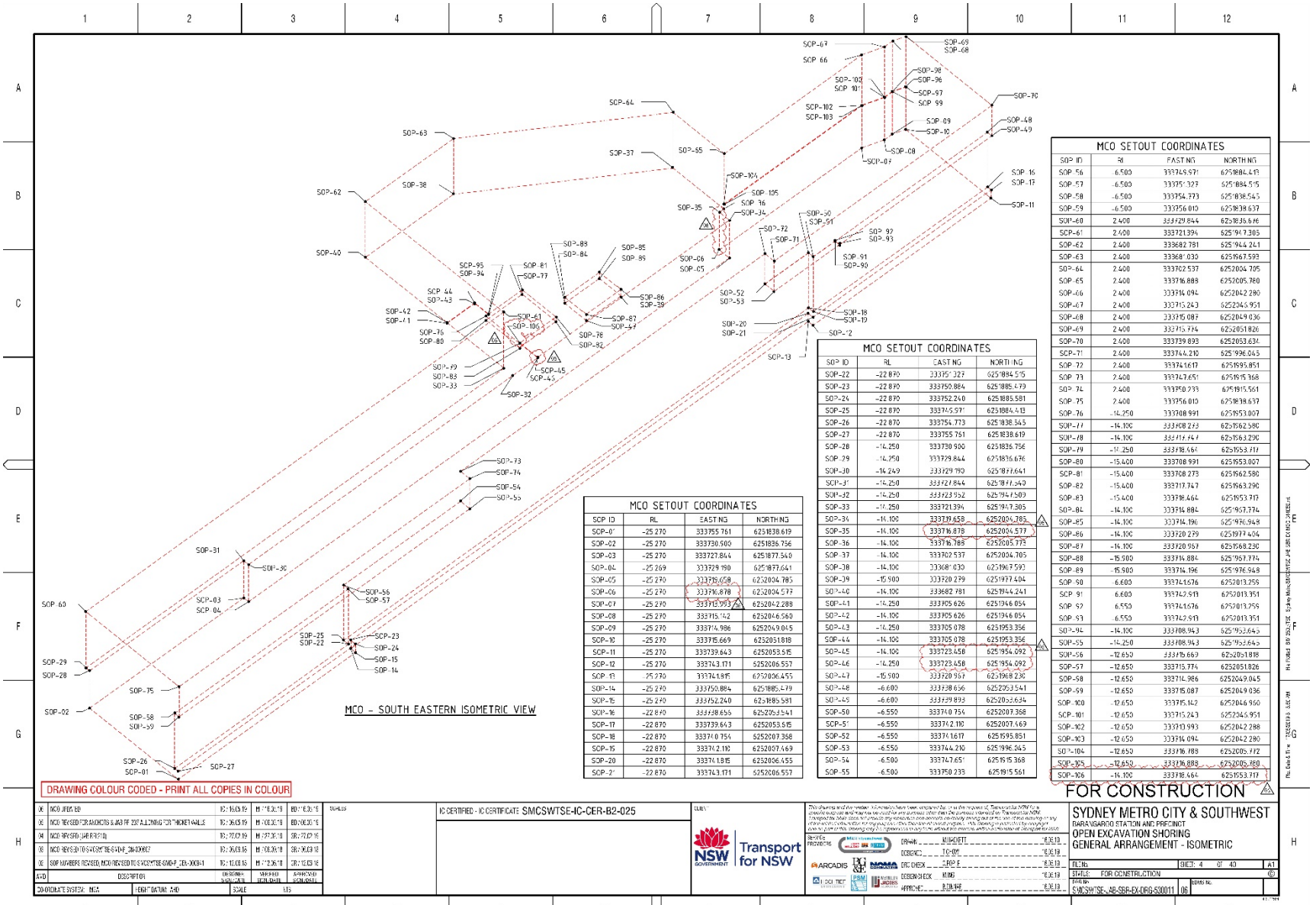
‘Site Audit Report, Remediation and Validation, Barangaroo Point Reserve’ and SAS GN 439C-2, dated 4 September 2015 by Graeme Nyland of ENVIRON Australia Pty Ltd

‘Site Audit Report, Validation of Barangaroo Central Promenade’ and SAS GN 439C-3, dated 4 September 2015 by Graeme Nyland of ENVIRON Australia Pty Ltd

‘Interim Audit Advice Letter No.6 – Remediation Action Plan, Barangaroo Station, Hickson Road, Barangaroo, NSW’, dated 31 May 2018 ‘ by Tom Onus (Ramboll)

Site audit report details

Title	Site Audit Report – Barangaroo Station Box, Hickson Road, Barangaroo		
Report no.	RS-139 (Ramboll Ref: 318000323-005)	Date	23 September 2021



MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-01	-25.270	333755.761	6251838.619
SCP-02	-25.270	333730.500	6251836.756
SCP-03	-25.270	333727.844	6251877.540
SCP-04	-25.269	333729.190	6251877.641
SCP-05	-25.270	333716.658	6252004.785
SCP-06	-25.270	333716.878	6252004.577
SCP-07	-25.270	333715.993	6252002.288
SCP-08	-25.270	333715.142	6252046.560
SCP-09	-25.270	333714.986	6252049.045
SCP-10	-25.270	333715.669	6252051.818
SCP-11	-25.270	333739.643	6252053.515
SCP-12	-25.270	333743.171	6252206.557
SCP-13	-25.270	333744.815	6252206.455
SCP-14	-25.270	333750.884	6251885.479
SCP-15	-25.270	333752.240	6251885.581
SCP-16	-22.870	333738.656	6252054.541
SCP-17	-22.870	333739.643	6252053.515
SCP-18	-22.870	333740.754	6252207.368
SCP-19	-22.870	333742.110	6252207.469
SCP-20	-22.870	333743.815	6252206.455
SCP-21	-22.870	333743.171	6252206.557

MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-22	-22.870	333751.327	6251884.515
SCP-23	-22.870	333750.884	6251885.479
SCP-24	-22.870	333752.240	6251885.581
SCP-25	-22.870	333745.971	6251884.413
SCP-26	-22.870	333754.773	6251838.545
SCP-27	-22.870	333755.761	6251838.619
SCP-28	-14.250	333730.900	6251836.756
SCP-29	-14.250	333729.844	6251836.676
SCP-30	-14.249	333729.190	6251877.641
SCP-31	-14.250	333727.844	6251877.540
SCP-32	-14.250	333723.952	6251947.500
SCP-33	-14.250	333721.394	6251947.305
SCP-34	-14.100	333719.658	6252004.785
SCP-35	-14.100	333716.878	6252004.577
SCP-36	-14.100	333716.788	6252005.773
SCP-37	-14.100	333702.537	6252004.705
SCP-38	-14.100	333681.030	6251967.593
SCP-39	-15.900	333720.279	6251977.404
SCP-40	-14.100	333682.781	6251944.241
SCP-41	-14.250	333705.626	6251946.054
SCP-42	-14.100	333705.626	6251946.054
SCP-43	-14.250	333705.078	6251953.356
SCP-44	-14.100	333705.078	6251953.356
SCP-45	-14.100	333723.458	6251954.092
SCP-46	-14.250	333723.458	6251954.092
SCP-47	-15.900	333720.957	6251968.230
SCP-48	-6.600	333738.656	6252053.541
SCP-49	-6.600	333739.893	6252053.634
SCP-50	-6.550	333740.754	6252207.368
SCP-51	-6.550	333742.110	6252207.469
SCP-52	-6.550	333743.617	6251995.851
SCP-53	-6.550	333744.210	6251996.045
SCP-54	-6.500	333747.651	6251915.368
SCP-55	-6.500	333750.233	6251915.561

MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-56	-6.500	333749.971	6251884.413
SCP-57	-6.500	333751.327	6251884.515
SCP-58	-6.500	333754.773	6251838.545
SCP-59	-6.500	333756.010	6251838.637
SCP-60	2.400	333729.844	6251836.676
SCP-61	2.400	333721.394	6251947.305
SCP-62	2.400	333682.781	6251944.241
SCP-63	2.400	333681.030	6251967.593
SCP-64	2.400	333702.537	6252004.705
SCP-65	2.400	333716.888	6252005.780
SCP-66	2.400	333714.094	6252042.280
SCP-67	2.400	333715.243	6252046.951
SCP-68	2.400	333715.087	6252049.036
SCP-69	2.400	333715.774	6252051.826
SCP-70	2.400	333739.893	6252053.634
SCP-71	2.400	333744.210	6251996.045
SCP-72	2.400	333743.617	6251995.851
SCP-73	2.400	333747.651	6251915.368
SCP-74	2.400	333750.233	6251915.561
SCP-75	2.400	333756.010	6251838.637
SCP-76	-14.250	333708.991	6251953.007
SCP-77	-14.100	333708.273	6251962.580
SCP-78	-14.100	333717.747	6251963.290
SCP-79	-14.250	333718.464	6251953.717
SCP-80	-15.400	333708.991	6251953.007
SCP-81	-15.400	333708.273	6251962.580
SCP-82	-15.400	333717.747	6251963.290
SCP-83	-15.400	333718.464	6251953.717
SCP-84	-14.100	333714.884	6251957.774
SCP-85	-14.100	333714.196	6251976.948
SCP-86	-14.100	333720.279	6251977.404
SCP-87	-14.100	333720.957	6251968.230
SCP-88	-15.900	333714.884	6251957.774
SCP-89	-15.900	333714.196	6251976.948
SCP-90	6.600	333741.676	6252013.259
SCP-91	6.600	333742.913	6252013.351
SCP-92	6.550	333741.676	6252013.259
SCP-93	6.550	333742.913	6252013.351
SCP-94	-14.100	333708.943	6251953.643
SCP-95	-14.250	333708.943	6251953.643
SCP-96	-12.650	333715.669	6252051.818
SCP-97	-12.650	333715.774	6252051.826
SCP-98	-12.650	333714.986	6252049.045
SCP-99	-12.650	333715.087	6252049.036
SCP-100	-12.650	333715.142	6252046.960
SCP-101	-12.650	333715.243	6252046.951
SCP-102	-12.650	333713.993	6252042.288
SCP-103	-12.650	333714.094	6252042.280
SCP-104	-12.650	333716.788	6252005.772
SCP-105	-12.650	333716.888	6252005.780
SCP-106	-14.100	333718.464	6251953.717

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
    - (B1) the nature and extent of contamination, and/or
    - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
    - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
    - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
    - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ ~~Residential, including substantial vegetable garden and poultry~~

☐ ~~Residential, including substantial vegetable garden, excluding poultry~~

☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~

☐ ~~Day care centre, preschool, primary school~~

☐ ~~Residential with minimal opportunity for soil access, including units~~

☐ ~~Secondary school~~

☐ ~~Park, recreational open space, playing field~~

☐ ~~Commercial/industrial~~

☒ Other (please specify):

Underground train station, constructed in accordance with the *Sydney Metro City & Southwest, Barangaroo Station Development, Construct Only Delivery Deed* (Contract No: 501 dated 12 March 2021).

OR

☐ ~~I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.~~

Overall comments:

The site history identified sources of contamination associated with commercial/industrial landuse (including shipping and stevedoring), demolition of former buildings, significant filling and former gasworks located off-site to the south.

Historical investigations undertaken at the site identified elevated concentrations of lead and polycyclic aromatic hydrocarbons (PAHs) in fill soils. Fill was also impacted by other metals and total recoverable hydrocarbons (TRH) at concentrations less than the adopted assessment criteria. Natural soils in some areas were also identified to be impacted by PAHs and metals. Acid sulfate soils (ASS) were identified to be present in fill and natural soils between the water table and underlying sandstone bedrock. An ASS management plan (ASSMP) was prepared for the management of the identified ASS. Investigation of groundwater conditions identified elevated concentrations of metals, however these were attributed to urban background levels. Low concentrations of light to mid fraction TRH, BTEX, PAHs, organochlorine pesticides (OCPs) and selected volatile organic compounds (VOCs) were detected in groundwater samples. On-site sources were not identified and the potential source was identified as the former wash bay located off-site or other off-site sources such as the former gasworks.

The development (underground train station) required excavation to depths of between approximately 16.9 m and 27.67 m. Excavated soils and rock were classified and disposed

off-site. The excavation works successfully removed the onsite sources of contamination (fill) however potential risks remain from contaminated groundwater in off-site areas to the south and west of the site. The excavation works for the proposed station required the installation of a secant pile wall around the perimeter and the construction of a tanked basement. The station construction is also understood to contain a ventilation system. These construction items, constructed in accordance with the Deed, will limit the potential risk of impacted groundwater and soil vapour migrating onto the site.

The site suitability is based on construction in accordance with the Deed. It is noted that changes to the proposed development, including changes that result in increased water ingress potential (particularly at the connection to the Central Barangaroo District pedestrian tunnel) or long-term changes to the ventilation system could change the risk from contamination at the site. As such, if any such changes are proposed, the impact on risk from contamination should be reviewed, and the development works modified if required to manage any potentially unacceptable risks.

Groundwater has not been assessed for any beneficial re-use. Any future use of groundwater would require appropriate assessment and regulatory approvals from the NSW Office of Water.

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

EMP details

Title

Author

Date No. of pages

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

☐ requires operation and/or maintenance of **active** control systems[3]

☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

Purpose of the EMP:

Description of the nature of the residual contamination:

Summary of the actions required by the EMP:

How the EMP can reasonably be made to be legally enforceable:

How there will be appropriate public notification:

Overall comments:

Section B

Purpose of the plan[4] which is the subject of this audit:

_____

_____

_____

I certify that, in my opinion:

(B1)

☐ The nature and extent of the contamination **has** been appropriately determined

☐ The nature and extent of the contamination **has not** been appropriately determined

AND/OR (B2)

☐ The investigation, remediation or management plan **is** appropriate for the purpose stated above

☐ The investigation, remediation or management plan **is not** appropriate for the purpose stated above

AND/OR (B3)

☐ The site testing plan:

- ☐ **is** appropriate to determine
- ☐ **is not** appropriate to determine

if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

AND/OR (B4)

☐ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):

- ☐ **have** been complied with
- ☐ **have not** been complied with.

*voluntary management proposal no. _____

**management order no. _____

AND/OR (B5)

☐ The site **can be made suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

IF the site is remediated/managed* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title

Plan author

Plan date No. of pages

SUBJECT to compliance with the following condition(s):

Overall comments:

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. 1002

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed: 

Date: 23 September 2021

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

- the **local council** for the land which is the subject of the audit.

APPENDIX C
INTERIM AUDIT ADVICE

31 May 2018

John Holland CPB Ghella Joint Venture
Attn: Robert Muir
Senior Environment Coordinator
Sydney Metro City & Southwest
Level 3, 140 Sussex Street, Sydney NSW 2000

By email: Robert.Muir@sydneymetro2.com.au

Dear Robert

Ramboll Australia Pty Ltd
Level 3, 100 Pacific Highway
PO Box 560
North Sydney NSW 2060

T +61 2 9954 8100

www.ramboll.com

Ref 318000323-005

RE: INTERIM AUDIT ADVICE LETTER NO. 6 - REMEDIATION ACTION PLAN, BARANGAROO STATION, HICKSON ROAD, BARANGAROO, NSW

1. INTRODUCTION

As a NSW Environment Protection Authority (EPA) accredited Contaminated Sites Auditor, I am conducting an Audit in relation to the subject site. This initial review has been undertaken to provide an independent review of the suitability and appropriateness of a Remediation Action Plan (RAP).

A statutory site audit is required for the proposed Barangaroo Station development, part of the Sydney Metro rail project between Chatswood and Sydenham, to address the requirements of Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the Minister for Planning on 9 January 2017. The site audit is also a requirement of Clause 10.14B of the Sydney Metro City & Southwest Tunnel and Station Excavation Works Design and Construction Deed (Contract No: 00013/11200).

This Interim Audit Advice (IAA) letter is based on a review of the documents listed below and observations made on a site visit on 17 April 2018, as well as discussions with John Holland CPB Ghella Joint Venture (JHCPBG JV) and Douglas Partners Pty Ltd (DP) who undertook the investigations.

The reports reviewed were:

- *'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, March 2018'*, report reference: Revision 0, dated 8 March 2018, prepared by DP (the PSI).
- *'Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo*

Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018', report reference: Revision 1, dated 7 May 2018, prepared by DP (the DSI).

- *'Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018'*, report reference: Revision 0, dated 7 May 2018, prepared by DP (the RAP).

Draft versions of the PSI, DSI and RAP reports were issued for audit review. Review comments (issued by the Auditor by email) were incorporated into the final DP reports (listed above). The PSI makes reference to previous reports by Environmental Resource Management Australia Pty Ltd (ERM), JBS Environmental Pty Ltd (JBS, now JBS&G), DP and Golder Associates. Two Long Term Environmental Management Plans (EMPs) have been prepared by JBS&G for Headland Park and Barangaroo Central Promenade located along Hickson Road. ENVIRON (now Ramboll) issued Site Audit Statements reviewing the investigation, remediation, validation and EMPs for portions of the site within the Barangaroo remediation works in 2015 (GN439C-2 and GN439C-3). The reports were not provided to the Auditor for review, however a summary of relevant information from these reports was included in the DP reports.

The RAP summarised a hydrogeological interpretive report prepared by Pells Sullivan Meynink Pty Ltd (PSM) (dated 19 March 2018) which was prepared to model the groundwater inflows into the Sydney Metro excavations. This report was not reviewed by the Auditor.

2. SITE DETAILS

2.1 Location

The site is identified as the '*excavation footprint'* (the site) for the station structure shown on Attachment 1. A small section of Hickson Road (approximately 100 m^2) and the '*Worksite Area*' shown on Attachment 1 have been excluded from the DP investigations and are not part of the site audit area.

The site details are as follows:

Street address:	Hickson Road, Barangaroo, NSW 2000
Identifier:	Part of Lot 101 DP1204946 and part of Hickson Road
Local Government:	City of Sydney
Owner:	Portions are owned by Transport for New South Wales, Barangaroo Delivery Authority (BDA) and Roads and Maritime Service (RMS)
Site Area:	Approximately 0.7 ha
Zoning:	B4 – Mixed Use and RE1 – Public Recreation

2.2 Site Condition

DP inspected the site for the PSI on 22 September 2017 and noted the following:

- The majority of the site was occupied by a road, car park and footpath paved with asphalt and concrete. Some trees and vegetation was noted in the road reserves.
- The west section of the site (adjacent to Hickson Road) was an open grassed area with trees (part of Nawi Square lawn which extended further north). A fenced compound was located to the south of the lawn.

- A small section of the fenced compound forms part of the site and was occupied with containers and site sheds. Construction activity was noted in the south section of the fenced area. The area was not accessible during the site visit.
- Sandstone and concrete retaining walls were located along the site boundaries indicating historical filling to achieve the current site levels. High Street, Windmill Street and Dalgety Road were approximately 10 m above Hickson Road above a sandstone cut.
- The landuse beyond the site was mainly commercial/high-density residential.

During the Auditor's site visit on 17 April 2018, the site was an active construction site, with the following features noted:

- The majority of the site surface had been cleared of slabs and pavements. Exposed soil was visible over the surface.
- Imported material (DGB and ENM) had been placed on the surface in some sections for the construction of temporary piling platforms.
- Piling had commenced along the north and northeast site boundaries. Piling spoil was stockpiled in the central and south sections pending final waste classification for off-site disposal.
- Temporary/demountable sheds were located off-site in the Worksite Area. The area surrounding the sheds had been filled with recycled aggregate (crushed concrete, terracotta and brick).

2.3 Adjacent Uses

The site is located within an area of mixed landuse including commercial and high density residential. The surrounding site use includes:

North: Wulugul Walk and Nawi Square lawn, then Barangaroo Reserve beyond.

East: High Street, then residential buildings beyond.

South: Construction compound and part of Lot 101 DP1204946, then commercial buildings located further to the south.

West: Vacant site part of Lot 101 DP1204946, then Nawi Cove and Sydney Harbour further to the west.

The site is relatively flat at 2.5 m Australian Height Datum (AHD). DP identified the closest sensitive ecological receptor for groundwater as Nawi Cove and Sydney Harbour located approximately 20 m to the north and 150 m to the west. Considering the close proximity to the harbour, the groundwater is expected to be impacted by tidal movement.

The western portion of the site is located within the Barangaroo development site. Investigation of the site by ERM identified fill material impacted by polycyclic aromatic hydrocarbons (PAHs), metals and asbestos. Portions of the site (as well as off-site areas) have been remediated by capping impacted fill material beneath hardstand and landscaped areas. Long Term EMPs have been prepared for Headland Park and Barangaroo Central Promenade located along Hickson Road.

The PSI identified a former gasworks (owned by AGL) located approximately 50 m to 180 m south of the site. The gasworks is listed as a contaminated site under the Contaminated Land Management Act 1997 (CLM Act) and has a Declaration of Remediation and Management Order.

2.4 Proposed Development

The proposed development comprises a new below ground station building and upgrades to pedestrian access. The depth of excavation will range from approximately 16.9 metres below ground level (mbgl) (Sharks Fin) to 29.65 mbgl for the station box (Attachment 2) with localised deeper excavation for water collection sumps at each end of the station. The base of the structure will comprise an

approximately 125 mm thick concrete slab. The walls will comprise bored cast in place piles with shotcrete and rock grouting (200 mm) to a depth of approximately 17 mbgl.

For the purposes of this audit, the 'commercial/industrial' land use scenario will be assumed.

3. SITE HISTORY

The PSI site history assessment included a review of historical title deeds, aerial photographs, NSW EPA records and Section 149 (2&5) certificates (now known as Section 10.7 certificates). The site history is summarised in Table 3.1.

Table 3.1: Site History

Date	Activity
1905 – 2009	The site was developed and used mainly for shipping and stevedoring purposes between 1905 and 1998. During this time, the site was owned by the Sydney Harbour Trust Commission. Hickson Road had been established in 1930. The western section of the site was initially occupied by two warehouses. Further west comprised finger wharves that were converted to longshore berthing after 1951 by filling behind seawalls with material from unknown sources. One of the warehouses onsite was demolished by 1970 and the second by 1982. Large sections of the site were developed as hardstand between 1970 and 1982. Sydney Harbour Foreshore Authority owned the site from 1998 to 2009. It appears that the structures associated with the shipping activities had been removed by 2010.
2009 - 2016	The site was owned by Barangaroo Delivery Authority. A passenger terminal for cruise ships had been established to the west of the site, which was removed in 2013.
2016 to date	The site is currently owned and occupied by Transport for NSW.

DP noted that previous assessments by ERM (2007, 2008) and JBS&G (2012) identified lead, asbestos and PAH impacted soil in the greater Barangaroo development site, which includes the west of the site. Off-site groundwater (to the south) appears to have been impacted by heavy metals, PAHs, BTEX and TPH associated with the former gasworks. An overarching RAP was prepared by ERM (2010) for remediation of Barangaroo, which included part of the subject site. The RAP was reviewed and approved by Graeme Nyland of ENVIRON (now Ramboll) as part of the site audit process (GN499A). Remediation of Barangaroo Point Reserve and Barangaroo Central Promenade was undertaken by JBS&G and reviewed by Graeme Nyland of ENVIRON in SAS GN439C-2 and GN439C-3, respectively. The SAS concluded that these areas were suitable for public open space use subject to compliance with Long Term EMPs prepared by JBS&G.

The former gasworks is located approximately 50 m to 180 m south of the site. During the site visit by the Auditor, it appeared that remediation of the gasworks was underway.

Based on the site location and history, potential contamination could have impacted the site from on-site and/or off-site sources.

3.1 Auditor's Opinion

In the Auditor's opinion, the site history indicates past activities at the site and immediate surroundings having a high potential for significant contamination. Sources of contamination appear to be associated with commercial/industrial landuse (including shipping and stevedoring), demolition of former buildings, significant filling and former gasworks. A SafeWork NSW records search for dangerous goods was not undertaken by DP and is considered a data gap.

The Auditor considers that the site history is broadly understood and adequate for identification of contaminants of concern (Section 4) and remediation planning (Section 10).

4. CONTAMINANTS OF CONCERN

The PSI and DSI provided a list of the contaminants of concern and potentially contaminating activities. These have been tabulated in Table 4.1.

Table 4.1: Contaminants of Concern

Area	Activity	Potential Contaminants
Entire Site	Fill and surface soil imported from unknown sources. Demolition of former buildings containing hazardous materials. Spills and leakage of chemicals associated with historical commercial/industrial landuse.	Metals, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes & naphthalene (BTEXN), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCBs), phenols (including cresols), lead (from paint), asbestos and ammonia.
Off-Site Sources	Migration of potential contaminants from off-site sources including historical filling, former shipping activities, gasworks and washbay.	Metals, petroleum hydrocarbons (BTEXN, TPH), VOCs, cyanide, phenols (including cresols) and ammonia.

4.1 Auditor's Opinion

The Auditor considers that the analyte list used by DP adequately reflects the site history and condition. Considering the limited sampling and analysis for asbestos, the RAP should include asbestos as a contaminant of concern.

5. STRATIGRAPHY AND HYDROGEOLOGY

Following a review of the DP reports, a summary of the site stratigraphy and hydrogeology conditions at the site are compiled below.

5.1 Topography, Geology and Stratigraphy

The PSI states that the site is relatively flat at approximately 2.5 mAHD. The site is located on the boundary of disturbed terrain to the west and Gymea soil landscape to the east. The site is underlain by

Hawkesbury Sandstone. DP stated that, considering the depth of excavation and filling associated with the disturbed terrain, there is a risk of encountering acid sulfate soils (ASS) at the site.

The sub-surface profile detailed by DP in the DSI is summarised in Table 5.1.

Table 5.1: Stratigraphy

Depth (mbgl)	Subsurface Profile
0.0 – 0.85 (maximum)	Asphalt Concrete pavements/slab. Grey sandy gravel roadbase was detected in boreholes located along Hickson Road reserve.
1.0 – 14.0	Fill material comprising sand, gravel and clay with inclusions of brick, concrete, wood, asphalt, ash, charcoal, slag and ceramics.
6 – 15	Natural sand, sandy clay and clayey sand.
2 to 20	Sandstone.

mbgl – metres below ground level

The subsurface profile detected relatively deep fill (particularly in the west of the site) underlain by natural soil and sandstone.

5.2 Hydrogeology

The PSI undertook a search of the groundwater information database maintained by the NSW Government and identified 33 registered groundwater bores within a 0.5 km radius of the site. The majority of the bores were registered for monitoring purposes registered by Barangaroo Delivery Authority. The depth of standing water in the bores was not summarised by DP.

The PSI concluded that based on the topography and information from previous investigations, groundwater at the site is tidally influenced and is anticipated to flow to the west and northwest. DP identified the closest sensitive ecological receptor for groundwater to be Nawi Cove and Sydney Harbour located approximately 20 m to the northwest. Excess surface water run-off is anticipated to flow into the local stormwater network which would discharge into Sydney Harbour or via overland flow directly into Sydney Harbour.

As part of the DSI, eight groundwater monitoring wells (four shallow and four deep) were installed at the site (Attachment 2). Groundwater observations and sampling was undertaken as part of the DSI on 18 to 20 December 2017. Depth to groundwater in the monitoring wells was recorded between 1.45 mbgl to 2.75 mbgl. DP report that the groundwater flow would be influenced by the tidal movement with a general flow to the west and northwest.

The DSI included field records of groundwater parameters recorded during sampling. They indicated that the pH was 5.87 to 7.33, dissolved oxygen (DO) was 0.35 to 3.32 mg/L, redox was -30 to 100 mV, and electrical conductivity (EC) was 970 to 43,700 µS/cm.

The RAP includes a summary of the PSM (2018) Hydrogeological Interpretive Report, which modelled the groundwater seepage rates expected during and post construction. Details of the modelling and the results are included in the Hydrogeological Interpretive Report. DP summarised the findings as follows:

- Draw down was not simulated in the fill materials based on the assumption that a strong hydraulic connection is present between the harbour and fill material. PSM note that due to the lack of site specific hydraulic testing, this cannot be confirmed;
- The design intention is to limit the inflow of contaminated groundwater and/or sea water from entering the excavation by adopting a soil retention system;
- Maximum modelled seepage rate during construction was 103 kL/day;

- Modelled steady state seepage rate post construction and prior to tanking was 57 kL/day;
- Water table show the influence of tidal fluctuations at a depth of approximately 2 mbgl;
- The modelled zone of capture for the first 5 years would extend to approximately 160 m from the site. The full extent may not be realised as the station and cavern would be tanked sooner than the maximum travel time; and
- PSM identified the following two primary sources of groundwater contamination which may influence the quality of water draining into the excavation: former gasworks located to the south of the site; and reclaimed lands to the immediate west of the site. Previous investigations of the former gasworks has identified the presence of dissolved phase contamination and dense non-aqueous phase liquids (DNAPL) with higher concentrations in the deeper aquifer within the sandstone bedrock. The main contaminants of concern include TRH, BTEX, ammonia, total organic carbon (TOC), PAHs, phenol, cyanide and selected metals.

The Auditor has not reviewed the PSM (2018) Hydrogeological Interpretive Report, however considers that the primary long term source of seepage/ inflows is likely to be fill, alluvial soil and seepage from the harbour. This is based on the stratigraphy and hydrogeology encountered during the DSI.

5.3 Auditor's Opinion

The Auditor considers that the site stratigraphy and hydrogeology conditions detailed by DP adequately reflect the site conditions and are sufficient for remediation planning.

6. EVALUATION OF QUALITY ASSURANCE AND QUALITY CONTROL

The Auditor has assessed the overall quality of the data by review of the information presented in the referenced reports, supplemented by field observations. The Auditor's assessment follows in Tables 6.1 and 6.2.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment

Sampling and Analysis Plan and Sampling Methodology	Auditor's Opinion
Data Quality Objectives (DQO) The PSI and DSI defined specific DQOs in accordance with the seven step process outlined in Schedule B2 of NEPM (2013).	These were considered appropriate for the investigations conducted.
Sampling pattern and locations *Soil:* The DSI adopted a general grid pattern or systematic sampling plan. Investigation locations were spaced to gain coverage of the majority of the site. The various fill materials at the site were also targeted for sampling. *Groundwater:* Eight monitoring wells were distributed across the site (Attachment 2) along the site boundaries. The wells included four shallow wells (BRMW02, BRMW07, BRMW11 and BRMW16) and four deep wells (BRMW04, BRMW10, BRMW15 and BRMW17).	In the Auditor's opinion these investigation locations provide adequate site coverage and target the main known areas of concern.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Sampling density *Soil:* The DSI included a sampling density of 16 locations (Attachment 2) over approximately 0.7 ha, which does not meet the minimum density of 17 recommended by EPA (1995) *Sampling Design Guidelines*. The DSI notes that the density was reduced due to access limitations at the time of investigation. The coverage provides a 95% confidence of detecting a residual hot spot of approximately 25 m diameter. Samples analysed for asbestos were not collected as outlined in NEPM (2013). *Groundwater:* Eight groundwater samples were obtained from the monitoring wells at the site.	In the Auditor's opinion, the sampling density was appropriate to inform the remediation planning process. Considering that the fill from the entire site would be excavated and disposed off-site as part of the development, the sampling adopted by DP is acceptable to give a general indication of the presence/absence of asbestos in soil. The density of groundwater monitoring wells is adequate to assess the extent and magnitude of groundwater contamination associated with migration from off-site sources (mainly the former gasworks).
Sample depths *Soil:* Samples were collected and analysed from a range of depths targeting the fill and natural sand/clay. The depth intervals ranged from 0.2 m to 12.6 mbgl. *Groundwater*: Groundwater samples were obtained from shallow and deep wells based on the standing water level (SWL) depths observed during sampling. The depth ranged from approximately 3.0 mbgl to 18.5 mbgl.	In the Auditor's opinion, this sampling strategy was appropriate and adequate to characterise the primary material types present on site.
Well construction *Shallow Wells:* The wells were installed from the surface to depths of approximately 4 mbgl to 6.3 mbgl, and were constructed of 50 mm diameter acid washed, class 18, PVC casing and machine slotted well screen intervals. The top of the screened interval was 1 mbgl to 2 mbgl, which extended above the groundwater table. The wells were completed to assess shallow perched groundwater conditions in fill/sandstone. *Deep Wells:* The wells were installed from the surface to depths of approximately 14.65 mbgl to 20.15 mbgl, and were constructed of 50 mm diameter acid washed, class 18, PVC casing and machine slotted well screen intervals. The top of the screened interval was up to approximately 12.2 mbgl to 16.5 mbgl, and therefore the screens of the wells were below the groundwater table. The wells were completed to assess deeper groundwater conditions in the sandstone.	The Auditor notes that the wells are adequate to provide an indication of the shallow and deep groundwater conditions in the subsurface profile. The proposed excavation will extend to a maximum depth of 29.65 mbgl and is therefore likely to intercept deeper groundwater.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
Sample collection method *Soil*: Sample collection was by solid stem auger drilling. Drilling samples were collected from the auger flights, with external material removed prior to collecting the sample or via a SPT split spoon. *Groundwater*: Wells were installed by solid flight augers, developed with a pump and samples were collected by low flow peristaltic pump with dedicated sample tubing.	Soil sample collection from the auger flights is not ideal as it can result in loss of volatiles and sample cross contamination, although cross contamination was minimised by removing external material. Results for samples collected from solid flight augers may underestimate concentrations of volatile contaminants. Considering that a large portion of samples were from SPT spoon, the overall sample collection method was found to be acceptable. The groundwater sample collection methodology is considered acceptable.
Decontamination procedures *Soil:* Sampling equipment was cleaned with detergent (3% Decon 90 solution), tap water and then de-ionised water prior to sampling and between sampling events to prevent cross contamination. New gloves were reportedly used for each new sample. *Groundwater*: Dedicated sampling equipment was used for each well. New gloves were reportedly used for each new sample.	Acceptable.
Sample handling and containers Soil samples were placed into prepared and preserved sampling jars/bottles provided by the laboratory and chilled during storage and subsequent transport to the laboratories. DP report that sub-samples were placed in plastic snap lock bags, however the laboratory reports indicate that asbestos analysis was undertaken on sub-samples from soil jars. Groundwater samples to be analysed for heavy metals were field filtered.	Sampling methodology for asbestos analysis was not detailed in the DSI. The overall methodology was considered adequate for remediation planning purposes.
Chain of Custody (COC) Completed chain of custody forms were provided in the report.	Acceptable.
Detailed description of field screening protocols Field screening for volatiles was undertaken using a calibrated hand held PID unit.	Overall, the field screening protocols were acceptable to assess site contamination in the context of the proposed development.

Table 6.1: QA/QC – Sampling and Analysis Methodology Assessment	
Sampling and Analysis Plan and Sampling Methodology	**Auditor's Opinion**
The PID screening procedure was provided and involved placing the samples in ziplock plastic bags and measuring VOCs in the headspace after allowing time for equilibration. PID readings are provided on selected borehole logs. The majority of the PID results were below 10 ppm. One sample BRBH01 (3.0 – 3.45) detected a PID value of 67 ppm. The sample was analysed for VOCs. The DSI reported groundwater quality parameters measured during well sampling in field logs for each well.	
Calibration of field equipment DP report that the PID was calibrated prior to use in the field. Calibration information for the field equipment (PID and groundwater meters) was included in the DSI.	Acceptable.
Sampling logs Soil logs were provided within the DSI, indicating sample depth, PID readings and lithology. The logs reported inclusions in fill (ash, charcoal and slag) which could pose a contamination risk. Groundwater field sampling records were included in the DSI with well development and sampling details.	Acceptable.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Field quality control samples Field quality control samples including trip blanks (1 per field batch), trip spikes (1 per field batch), rinsate blanks (1 per day), field intra-laboratory and inter-laboratory duplicates (5% of primary samples for soil) were undertaken by DP during the DSI. Inter-laboratory groundwater duplicates were not collected for the DSI, however Envirolab Services Pty Ltd are NATA accredited to ISO17025 (Accreditation No 2901) and provided a summary of external proficiency testing undertaken by NATA, together with results of internal laboratory proficiency testing. The results were found to be acceptable.	Acceptable for remediation planning purpose.
Field quality control results The results of field quality control samples were generally within appropriate limits. The trip blank results were below the laboratory PQL. The trip spike recovery was acceptable. A review of the field rinsate results noted detections of light fraction TRH C_6-C_{10} of 18 µg/L to 95 µg/L in the rinsate	Overall, the field quality control results were found to be acceptable. RPD exceedances were generally infrequent and minor, are representative of the heterogeneity of fill samples and do not impact the overall dataset. DP assessed the

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
samples, which DP report was from demineralised water used for the decontamination process. RPDs for the intra-laboratory duplicate samples outside the acceptance criteria are: 14 individual metals in soil ranged from 32% to 106%; 2 TRH in soil ranged from 56% to 147%; 5 PAHs in soil ranged from 83% to 198%. Groundwater RPDs results were below the acceptance criteria. RPDs for the inter-laboratory soil duplicate samples for 4 metals ranged from 49% to 119% and 3 PAHs from 38% to 120%. The DSI has assessed field duplicate results along with the primary sample results against the site acceptance criteria.	results for primary samples and field duplicates against the site acceptance criteria which is considered appropriate. The Auditor has adopted the highest concentration from field duplicate and triplicate results. The detections of TRH in the rinsate samples were minor and close to the laboratory detection limits. Evidence that the TRH was from the demineralised water was not provided as no field blanks were analysed.
NATA registered laboratory and NATA endorsed methods Laboratories used included: Envirolab Services Pty Ltd (primary) and Eurofins Scientific (secondary). Laboratory certificates were NATA stamped.	Acceptable.
Analytical methods Analytical methods were included in the laboratory test certificates. Both Envirolab and Eurofins provided brief method summaries of in-house NATA accredited methods used based on USEPA and/or APHA methods (excluding asbestos) for extraction and analysis in accordance with the NEPM (2013). Asbestos analysis was based on AS4964-2004.	The analytical methods are considered acceptable for the purposes of the site audit, noting that the AS4964-2004 is currently the only available method in Australia for analysing asbestos. DOH (2009) and enHealth (2005) state that *"until an alternative analytical technique is developed and validated the AS4964-2004 is recommended for use"*.
Holding times Review of the COCs and laboratory certificates indicate that the holding times had been met for the majority of the analysis. The DSI reported that the holding times were achieved. Envirolab Reports 182616 and 180411-A stated that the holding times for OCP/OPP/PCBs analysis in groundwater and TCLP PAHs analysis were outside the acceptance criteria.	Acceptable.

Table 6.2: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Auditor's Opinion**
Practical Quantitation Limits (PQLs) *Soil:* PQLs for individual PCBs were slightly raised in selected soil samples (Envirolab Report/s: 179805, samples 1,1d,2,3; Report: 181094, samples 11,11d) due to interference from analytes other than those being tested. The raised PQLs were below the quality criteria. *Groundwater:* PQLs were within acceptable ranges.	Overall the PQLs are acceptable.
Laboratory quality control samples Laboratory quality control samples including laboratory control samples, matrix spikes, surrogate spikes, blanks, internal standards and duplicates were undertaken by the laboratory.	Acceptable.
Laboratory quality control results The results of laboratory quality control samples were generally within appropriate limits, with the following exceptions: • Percentage matrix spike recovery was not possible for individual metals due to high concentrations, the inhomogeneous nature of the compound in the sample and/or interference from analytes. Low recovery was noted for some metals due to matrix interferences. This was considered acceptable as acceptable recovery was reported for the laboratory control samples (LCS). • Asbestos analysis had to be sub-sampled from the samples provided by the laboratory as samples were not provided in zip-lock bags. • The laboratory RPD acceptance criteria were exceeded for individual metals, TRH and PAHs. Triplicate result was issued by the laboratory to confirm the metals and PAHs results exceeding the RPD criteria.	In the context of the dataset reported, the laboratory quality control results are acceptable for remediation planning purposes.
Data Quality Indicators (DQI) and Data Evaluation (completeness, comparability, representativeness, precision, accuracy) The DSI assessed the field and laboratory results against predetermined data quality indicators (DQIs) and internal standards. These were discussed with regard to the five category areas. There was limited discussion regarding actions required if data do not meet the expected objectives.	An assessment of the data quality with respect to the five category areas has been undertaken by the Auditor and is summarised below.

In considering the data as a whole the Auditor concludes that:

- The laboratories provided adequate information to conclude that the data are of sufficient precision.
- There is a high degree of confidence that the data are accurate.

- The data are likely to be largely representative of the overall site conditions, including fill, natural soil and groundwater. Results for volatile organics in soil samples collected by solid stem auger may underestimate actual concentrations. Sampling and analysis for asbestos was not undertaken in accordance with the current guidance (NEPM, 2013) and results may not be representative of fill conditions.
- The investigation data are considered to be largely complete.
- There is a high degree of confidence that the data are comparable for each sampling and analytical event.

7. ENVIRONMENTAL QUALITY CRITERIA

The Auditor has assessed **soil** data provided with reference to criteria from National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure 1999*, as Amended 2013 (NEPM, 2013). Based on the proposed development (excavation and construction of a station), the Tier 1 (screening) criteria for a 'commercial/industrial' setting were referred to.

- Human Health Assessment:
  - Health Based Investigation Levels (HIL D).
  - Soil Health Screening Levels (HSL D) for Vapour Intrusion. The most conservative criteria were adopted i.e. assumed depth to source <1 m and sand.
  - Asbestos presence/absence.
  - USEPA Regional Screening Level (RSL) (November 2017) Composite Worker Soil Criteria for use where HILs are not applicable or where local guidelines are not available for individual VOC contaminants.
- Terrestrial Ecological Assessment (TEA): The soil data has not been assessed against the TEA as soil from the site will be excavated to a maximum depth of 29.65 mbgl and disposed off-site during development of the site. The TEA is applicable to depths of 2 mbgl and is therefore not applicable for the remaining natural soil.
- Management Limits (ML commercial/industrial) assuming coarse soil.
- Aesthetics:
  - The Auditor has considered the need for remediation based on 'aesthetic' contamination as outlined in the NEPM (2013).

The Auditor has assessed the **groundwater** data provided with reference to Tier 1 (screening) criteria for a 'commercial/industrial' setting. NEPM (2013) HSLs are not applicable as the excavation will be below the SWL.

- Human Health Assessment:
  - NHMRC and NRMMC (2011) *Australian Drinking Water Guidelines* (ADWG), with a factor of 10 for incidental direct contact (for non-volatiles).
  - USEPA RSL (on-line) Residential Tap Water Criteria.
  - WHO (2008) Petroleum Products in Drinking-water guidelines.

- Ecological Assessment:
  - Groundwater Investigation Levels (GILs) listed in NEPM (2013) for protection of aquatic ecosystems referenced in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Trigger values (TVs) provided are concentrations that, if exceeded, indicate a potential environmental problem at the point of use and 'trigger' further investigation. The 95% marine water level of protection was adopted.

Groundwater monitoring wells were screened across different soil profiles (fill and sandstone). Deep and shallow groundwater monitoring wells were installed to assess groundwater conditions at different depths. The extraction and use of groundwater as a resource is unlikely as the site is very close to the harbour and is impacted by sea water intrusion. The site is in an area which has reticulated water supply from Sydney Water. Therefore assessment of direct contact and consumption of groundwater by nearby residents is not considered to be required.

7.1 Auditor's Opinion

The environmental quality criteria referenced by the Auditor are consistent with those adopted by DP, with the exception of the following:

- The DSI does not mention assessment of 'aesthetic' contamination as outlined in the NEPM (2013). However, the report results discuss potential aesthetic issues detected during sampling.

8. EVALUATION OF SOIL ANALYTICAL RESULTS

Soil samples were analysed for a variety of contaminants detailed in Tables 8.1 (fill) and 8.2 (natural). The results have been assessed against the environmental quality criteria and summarised below. Soil sampling locations are presented in Attachment 2.

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table (mg/kg)

Analyte	n	Detections	Maximum	n > Human Health Screening Criteria (NEPM, 2013)
Asbestos in soil (presence/absence)	31	0	<PQL	-
Arsenic	59	23	18	0 above HIL D 3,000
Cadmium	59	3	3	0 above HIL D 900
Total Chromium	59	59	24	0 above HIL D 3,600
Copper	59	57	6,400	0 above HIL D 240,000
Lead	59	59	**2,800**	**1 above HIL D 1,500**
Mercury (inorganic)	59	30	25	0 above HIL D 730
Nickel	59	58	84	0 above HIL D 6,000
Zinc	59	58	720	0 above HIL D 400,000
TRH (C_6-C_{10} minus BTEX)	59	0	<PQL	0 above HSL D (sand 0-1 m) 260 0 above ML 700

Table 8.1: Evaluation of Fill Soil Analytical Results – Summary Table (mg/kg)				
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**
TRH (>C_{10}-C_{16} minus naphthalene)	59	0	<PQL	0 above HSL D (sand 0-1 m) NL 0 above ML 1,000
TRH (>C_{16}-C_{34})	60	19	1,200	0 above ML 3,500
TRH (>C_{34}-C_{40})	60	5	510	0 above ML 10,000
Benzene	59	0	<PQL	0 above HSL D (sand 0-1 m) 3
Toluene	59	0	<PQL	0 above HSL D (sand 0-1 m) NL
Ethylbenzene	59	0	<PQL	0 above HSL D (sand 0-1 m) NL
Xylene	59	0	<PQL	0 above HSL D (sand 0-1 m) 230
Total VOCs	41	0	<PQL	-
Total PAHs	59	48	177	0 above HIL D 4,000
Carcinogenic PAHs (BaP TEQ)	59	48	26	0 above HIL D 40
Benzo(a)pyrene	59	48	19	-
Naphthalene	59	15	1	0 above HSL D (sand 0-1 m) NL
Total Phenols	44	0	<PQL	0 above HIL D 240,000
Total Cyanide	51	0	<PQL	0 above HIL D 1,500
PCBs	48	0	<PQL	0 above HIL D 7
OPPs	46	0	<PQL	0 above HIL D
OCPs	48	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non- limiting

Table 8.2: Evaluation of Natural Soil Analytical Results – Summary Table (mg/kg)				
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**
Asbestos in soil (presence/absence)	10	0	<PQL	-
Arsenic	19	6	9	0 above HIL D 3,000
Cadmium	19	0	<PQL	0 above HIL D 900
Total Chromium	19	19	61	0 above HIL D 3,600
Copper	19	12	59	0 above HIL D 240,000

Table 8.2: Evaluation of Natural Soil Analytical Results – Summary Table (mg/kg)				
Analyte	**n**	**Detections**	**Maximum**	**n > Human Health Screening Criteria (NEPM, 2013)**
Lead	19	19	79	0 above HIL D 1,500
Mercury (inorganic)	19	0	<PQL	0 above HIL D 730
Nickel	19	14	12	0 above HIL D 6,000
Zinc	19	14	90	0 above HIL D 400,000
TRH (C_6-C_{40})	19	0	<PQL	0 above HIL D and ML
BTEXN	19	0	<PQL	0 above HSL D (sand 0-1 m)
Total VOCs	13	0	<PQL	-
Total PAHs	19	4	26	0 above HIL D 4,000
Carcinogenic PAHs (BaP TEQ)	19	4	3.4	0 above HIL D 40
Benzo(a)pyrene	19	4	2.5	-
Total Phenols	18	0	<PQL	0 above HIL D 240,000
Total Cyanide	18	0	<PQL	0 above HIL D 1,500
PCBs	18	0	<PQL	0 above HIL D 7
OPPs	18	0	<PQL	0 above HIL D
OCPs	18	0	<PQL	0 above HIL D

n number of samples
- No criteria available/used
NL Non- limiting

In assessing the results, the Auditor makes the following observations:

- The majority of the analytical results of the fill samples were at concentrations below the screening criteria. One fill sample detected an elevated lead concentration of 2,800 mg/kg above the screening criteria. DP reported that the source of lead is likely from the general filling at the site and that no specific source was identified (Section 4). Statistical analysis (95% Upper Confidence Limit) undertaken on the fill dataset returned a 95% UCL mean concentration for lead of 255 mg/kg and standard deviation of 387 mg/kg. DP concluded that the overall fill dataset was within the screening criteria.
- Fill samples detected elevated mid to heavy fraction TRH concentrations (F3 and F4) with a maximum F3 value of 1,200 mg/kg. All of the results were below the management limit criteria. The TRH detections were widespread in the fill. DP undertook silica gel clean-up on the highest detection. The TRH results after clean-up were significantly lower when compared to the primary results.
- Asbestos was not detected in the fill/ natural soil samples analysed by DP.
- Marginally elevated concentrations of metals and PAHs below the screening criteria were detected in some natural soil samples. The source of these contaminants can be attributed to the following:

- Detections of PAHs in the natural soil in BRMW11, BRMW15 and BRMW17 could be attributed to cross contamination from the overlying fill soil as the samples were obtained from the auger directly beneath the fill.
- The majority of the metal results are consistent with background concentrations except for lead in BRBH09 (0.9-1 mbgl) which was above typical background levels (10-40 mg/kg) with a concentration of 79 mg/kg. The source of lead could be attributed to cross contamination from the overlying fill soil as the samples was obtained directly beneath the fill.

8.1 Auditor's Opinion

In the Auditor's opinion, the soil analytical results are consistent with the site history and field observations. The results indicate the fill to be locally impacted by lead, PAHs and TRH. Contamination from ACM is possible and considered likely although no detections were made in soil samples analysed. Low level contamination of fill and underlying natural soil was identified, however this was at concentrations less than the assessment criteria.

Removal of fill material is required for development of the site. Off-site disposal of impacted fill and natural soil will require careful management during remediation. The remedial strategy outlined in the RAP is reviewed and summarised in Section 10.

9. EVALUATION OF GROUNDWATER ANALYTICAL RESULTS

Groundwater samples were collected from eight monitoring wells (four shallow and four deep) by DP as part of the DSI. The analytical results are summarised below in Table 9.1. Sampling locations are presented in Attachment 2.

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)

Analyte	n	Detections	Maximum	n >ANZECC Marine (2000)	n > ADWG/RSL
Arsenic	8	2	2	0 above criterion of 24[a]	0 above criterion of 100
Cadmium	8	7	0.2	0 above criterion of 0.7	0 above criterion of 20
Total Chromium	8	0	<PQL	0 above criterion of 4.4	0 above criterion of 500
Copper	8	4	**12**	**3 above criterion of 1.3**	0 above criterion of 20,000
Lead	8	1	1	0 above criterion of 4.4	0 above criterion of 100
Manganese	8	7	**1,400**	**7 above criterion of 80[c]**	0 above criterion of 5,000
Mercury	8	0	<PQL	0 above criterion of 0.1	0 above criterion of 10
Nickel	8	8	**16**	**3 above criterion of 7**	0 above criterion of 200

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)					
Analyte	**n**	**Detections**	**Maximum**	**n >ANZECC Marine (2000)**	**n > ADWG/RSL**
Zinc	8	8	**910**	**5 above criterion of 15**	-
TRH (C_6-C_{10} minus BTEX)	8	1	51	-	0 above criteria of 15,000[b]
TRH (>C_{10}-C_{16} minus naphthalene)	8	1	57	-	-
TRH (>C_{16}-C_{34})	8	0	<PQL	-	-
TRH (>C_{34}-C_{40})	8	0	<PQL	-	-
Benzene	8	0	<PQL	0 above criterion of 500	0 above criterion of 1
Ethylbenzene	8	1	2	0 above criterion of 5[c]	0 above criterion of 300
Toluene	8	0	<PQL	0 above criterion of 180[c]	0 above criterion of 800
Xylene (m & p)	8	1	14	0 above criterion of 350[a]	0 above criterion of 600
Xylene (o)	8	1	7	0 above criterion of 200[a]	0 above criterion of 600
Chloroform (Trichloromethane)	8	3	7	0 above criterion of 370[c]	0 above criterion of 250
1,2,4-trimethylbenzene	8	1	9	-	0 above criterion of 56
1,3,5-trimethylbenzene	8	1	6	-	0 above criterion of 60
Isopropylbenzene	8	1	1	0 above criterion of 30[c]	-
Benzo(a)pyrene	8	2	0.1	-	0 above the criterion of 0.1
Naphthalene	8	2	0.02	0 above criterion of 50	0 above criterion of 61
Total PAHs	8	3	2.6	-	-
Aldrin	8	1	0.002	0 above criterion of 0.003[c]	0 above criterion of 30 for Aldrin and Dieldrin
Dieldrin	8	2	**0.13**	**1 above criterion of 0.01[c]**	
Aldrin+Dieldrin	8	1	0.132	-	0 above criterion of 3

Table 9.1: Evaluation of Groundwater Analytical Results – Summary Table (µg/L)					
Analyte	**n**	**Detections**	**Maximum**	**n >ANZECC Marine (2000)**	**n > ADWG/RSL**
Heptachlor epoxide	8	1	0.001	-	0 above criterion of 3
Total OPPs	8	0	<PQL	-	-
Total PCBs	8	0	<PQL	-	-
Total Phenols	8	0	<PQL	0 above criterion of 400	-

n number of samples
- No criteria available/used
a In the absence of marine water guidelines, the fresh water guideline value has been adopted.
b WHO (2008) assessment criteria for TPH aliphatic fraction adjusted by x10 in accordance with NHMRC (2008) recommendations for incidental ingestion of groundwater.
c In the absence of high reliability guidelines, the moderate or low reliability guideline concentration has been adopted.

In assessing the results, the Auditor makes the following observations:

- Elevated copper, manganese, nickel and zinc concentrations were detected in the groundwater samples. The DP DSI concluded that the heavy metals can be attributed to diffuse urban-sourced background levels and are not from a site specific source.
- Low concentrations of light to mid fraction TRH, BTEX and selected VOCs were detected in groundwater sample BRMW17 (deep well screened within the sandstone). The DSI concluded that on-site sources of TRH/ BTEX and VOCs were not identified and the potential source could be from the former wash bay (Attachment 2) located off-site or other off-site sources.
- Low concentrations of OCPs, with one concentration of Dieldrin above the ecological screening criteria, were detected in the groundwater samples. DP stated that OCPs were detected in the soil samples tested from the site and could be a potential source of contamination. OCP concentrations were less than the human health screening criteria.
- Low concentrations of PAHs were detected in BRMW15 and BRMW17 (deep wells screened within the sandstone) located close to the former wash bay. The majority of the detections were within the deeper sandstone aquifer. The DSI stated that the PAH detections could also be from the former gasworks located off-site.
- The DSI concluded that the potential on-site sources (mainly fill) will be removed during site works and that groundwater treatment requirements should be considered for groundwater disposal.

9.1 Auditor's Opinion

In the Auditor's opinion, the groundwater analytical results identified minor groundwater impact from historical on-site and off-site landuse. Reported concentrations are not considered to pose a significant risk to on-site human health receptors.

The former gasworks located to the south of the site is a potential source of groundwater contamination. The DSI did not establish if the low level PAH groundwater contamination is from the gasworks, or from an alternative source such as the wash bay. Further monitoring is considered to be required to assess for potential migration of contamination from the gasworks towards the site as a result of excavation dewatering activities during remediation and redevelopment.

10. EVALUATION OF PROPOSED REMEDIATION

10.1 Conceptual Site Model

A conceptual site model (CSM) is a representation of the contaminant source, pathway and receptor linkages at a site. DP has developed a CSM based on the PSI and DSI. Table 10.1 provides the Auditor's review of the CSM used by DP to inform remediation of the site.

Table 10.1: Review of the Conceptual Site Model

Element of CSM	Consultant	Auditor Opinion
Contaminant source and mechanism	Soil contamination from imported fill material containing lead and PAHs. Detections of OCPs and PAHs in groundwater. The source of OCPs could be the on-site fill. The PAHs is most likely from off-site sources including the former wash bay and gasworks. Unexpected contamination finds during excavation.	Contaminant concentrations in fill material and groundwater are not considered to present a risk to on-site human health receptors. Asbestos was not detected in fill material at the site, however has been detected at the wider Barangaroo development. The DSI included limited sampling and analysis for asbestos. Procedures for managing asbestos identified during remediation and redevelopment of the site are provided in the RAP.
Affected media	Fill material and groundwater.	The affected media have been adequately identified.
Receptor identification	Future site users, construction workers, maintenance works, adjacent land users, surface water and groundwater.	The receptors have been adequately identified.
Exposure pathways	Inhalation of dust and vapours, leaching of contaminants and vertical migration into groundwater, lateral migration of groundwater, ingestion and dermal contact, direct contact with groundwater, extraction for dewatering and disposal.	The exposure pathways have been adequately identified.
Presence of preferential pathways for contaminant movement	Trenches for buried services may act as potential migratory pathways.	The locations of preferential pathways have not been identified.
Evaluation of data gaps	The RAP states that the proposed dewatering of the excavation may draw	Acceptable

Table 10.1: Review of the Conceptual Site Model		
Element of CSM	**Consultant**	**Auditor Opinion**
	contaminated water onto the site. The RAP recommends additional groundwater testing during remediation to assess any migration of contaminants onto the site.	

In the Auditor's opinion, the CSM provides an adequate representative of the site.

10.2 Remediation Required

The Auditor has assessed the RAP by comparison with the checklist included in OEH (2011) *Guidelines for Consultants Reporting on Contaminated Sites*. The RAP was found to address the required information, as detailed in Table 10.2, below.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Remedial Goal The RAP stated four remediation goals as outlined below: *'render the site suitable for the proposed land use; maintain records of the remediation and earthworks undertaken including validation as required; mitigate adverse impacts on surrounding land and waterways during the remediation by the management of dust, water and noise emissions; and maximise the protection of workers involved with remediation and earthworks'.*	In the Auditor's opinion, the goals are appropriate considering the proposed redevelopment of the site.
Discussion of the extent of remediation required DP identified the entire excavation footprint (Attachment 2) as the horizontal remediation extent and the vertical extent to be the depth of contaminated soil or the base of the excavation. Due to the nature of the development, bulk excavation will require removal of site soil to the desired levels (29.65 mbgl). The base and walls of the excavation will be validated. Excavation and dewatering of the site has the potential to draw contamination to the site from the gasworks located to the south. Assessment of remediation requirements is proposed by review of available data from the greater Barangaroo development; review of analytical results from the dewatering process, and sampling of new and existing wells for analysis for contaminants of concern (as a minimum OCP, PAH, TRH, BTEX, ammonia, phenol and metals). The number, location and design of wells and scope of monitoring is to be agree with the Auditor.	Targeted remediation is not required however removal of fill material and natural soil is required for the proposed development. The proposed extent of soil remediation is considered adequate. Further excavation would be undertaken in the event of validation failure. The proposed groundwater monitoring strategy should be proposed to the Auditor for review.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Remedial Options The RAP stated that due to the bulk excavation requirement for the proposed development, excavation and off-site disposal was the only viable option to address contaminated fill material.	Acceptable.
Selected Preferred Option Excavation and off-site disposal of contaminated soil.	Acceptable for soil.
Rationale Development of the site will involve bulk excavation from the surface to a depth of up to 29.65 mbgl. Impacted soil will be excavated and disposed off-site during redevelopment.	Acceptable.
Waste Characterisation and Disposal The DSI has identified the following waste streams based on *in situ* testing of fill material (Attachment 3): restricted solid waste (RSW); general solid waste (GSW); Acid Sulfate Soil (ASS); and VENM as per the NSW EPA (2014) *Waste Classification Guidelines*. DP are to provide documented waste classifications based on an inspection of the material and available analytical data. Further *ex situ* waste characterisation will be undertaken if considered necessary. Waste material is to be removed by a licensed contractor. Each load will be documented, including weighbridge slips, trip tickets and consignment disposal confirmation. Waste will be disposed of at a facility legally able to accept the material.	Acceptable. Additional testing for asbestos should be undertaken to confirm the final disposal classification.
Containment No requirement at this stage.	Acceptable.
Proposed Validation Testing *Excavations (base <500 m^2):* Base – one sample per 25-50 m^2. With a minimum of 3 samples. Walls – one sample per 10 m length exposed with additional samples collected at depths based on observations. *Excavations (base ≥500 m^2):* Base – grid based sampling to meet the density recommended in the NSW EPA *Sampling Design Guidelines* (minimum of 10 samples). Walls – one sample per 20 m length exposed with additional samples collected at depths based on observations. *Stockpiles:* In accordance with NEPM (2013). The RAP states that samples collected will be analysed for the contaminants of concern. However, it does not list the contaminants. Imported material is expected for temporary works such as construction of piling platforms. The RAP includes a material	The Auditor considers the validation sampling densities acceptable. Samples should be analysed for the contaminants of concern, which are considered to include asbestos, metals, TRH, PAHs, VOCs and OCPs. The density of testing for imported material would need to be commensurate with the documentation provided, source, observations and the consistency of the results. VENM certificates based on the template available on the NSW EPA website should be provided.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
importation protocol and criteria for implementation. The protocol requires review and approval of documentation by the environmental consultant, inspection of the material at the source site, inspection during importation and additional testing (details not provided in the RAP).	
Interim Site Management Plan (before remediation) The RAP recommends additional groundwater testing (mainly in the south-west section) during remediation works. The RAP also recommends engaging an asbestos assessor prior to the commencement of excavation.	Acceptable. No other interim management is considered necessary given the site is sealed with concrete and asphalt, fenced and occupied by JHCPBG JV.
Unexpected Finds The RAP includes a contingency plan for unexpected finds, UST removal, stopping work and assessment of the find by an occupation hygienist, asbestos consultant or environmental consultant. The RAP includes contingencies in the event contaminated groundwater and/ or hazardous ground gas are detected during site works. Validation of unexpected finds should be undertaken in accordance with the procedures in the RAP.	The unexpected finds procedure (UFP) is considered acceptable.
Site Management Plan (operation phase) including stormwater, soil, noise, dust, odour and OH&S The RAP includes a site management plan for implementation during remediation and validation that covers specific requirements for asbestos (including notification, air monitoring), specific requirements for chemical contaminants, fencing and signage, security and restriction of access, PPE, decontamination, disposal of water, clearance inspection and certificates.	The site management plan is considered acceptable for remedial planning.
Contingency Plan if Selected Remedial Strategy Fails The RAP states that in the event of validation failure, the remediation contractor will undertake further 'chase out' excavation and disposal, followed by validation sampling.	The remedial strategy to address fill material has a low risk of failure, as validation failure would lead to further excavation.
Contingency Plans to Respond to Site Incidents The RAP includes a soil contingency plan for the handling and disposal of material.	Acceptable.
Remediation Schedule and Hours of Operation Not provided in the RAP.	The hours of operation are to be governed by consent conditions.
Licence and Approvals The RAP notes that the development is approved as critical State significant infrastructure under the *Environmental Planning and*	Acceptable.

Table 10.2: Evaluation of Remedial Action Plan	
Remedial Action Plan	**Auditor Comments**
Assessment Act 1997 (EP&A Act). SEPP55 does not apply to the development. Waste disposal is to be tracked, and the receiving facility is to be licensed to accept the material. Council approval will be required for disposal of groundwater in to the stormwater system if required during works. The RAP notes that an Environmental Protection License will be in place for the disposal of water. In the event of identification of asbestos in fill material, asbestos removal contractors are to be appropriately licensed. Air monitoring for asbestos would be conducted during remediation.	
Contacts/Community Relations Contacts were provided for the consultant and Auditor. The details of the project manager and remediation contractor are to be included following appointment. The emergency procedures and contact details are to be displayed at the site entrance. Direct community consultation is not proposed.	Acceptable.
Long-term environmental management plan No requirement at this stage.	Acceptable.
Validation Reporting The RAP included a validation plan which addresses the validation DQOs, QA/QC and DQIs in accordance with NEPM (2013). The validation requirements include: site inspections, sampling, documentation and reporting.	Acceptable.

It is considered that the remediation approach recommended by DP is largely appropriate. Staged remediation of the different waste streams would be feasible and considered appropriate for this site.

10.3 Auditor's Opinion

In the Auditors' opinion, the proposed remediation works are adequate to address contaminated fill material during redevelopment of the site through: excavation and off-site disposal of contaminated fill material and natural soil; implementation of the UFP; and successful validation.

Further groundwater monitoring is required during remediation and redevelopment to assess potential migration of contamination from the gasworks located to the south of the site. The scope of the proposed investigation should be provided to the Auditor for review. The results of the investigations and any additional remediation proposed should be documented and provided to the Auditor for review.

11. CONCLUSIONS AND RECOMMENDATIONS

The RAP concluded "*… that the site can be rendered suitable for the proposed development subject to implementation of this RAP*".

Based on the information presented in the referenced reports and observations made on site, the Auditor concludes that the proposed process of remediation is practical and that the site can be made suitable for the proposed land use if remediated in accordance with the following RAP:

'Remediation Action Plan, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018', report reference: Revision 0, dated 7 May 2018, prepared by DP (the RAP).

Further investigation of groundwater during remediation and redevelopment is required to assess potential migration of contamination from the off-site gasworks located to the south. The scope of the investigation should be provided to the Auditor for review. Should the results of the investigation indicate a need for additional remediation to address groundwater and soil vapour contamination, an addendum to the RAP should be prepared and provided to the Auditor for review.

At the completion of remediation of the site, a Section A Site Audit Statement and supporting Site Audit Report certifying suitability for the proposed use should be prepared.

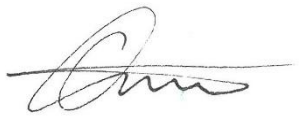
Remediation and reporting can be conducted in stages provided suitable provisions are made to avoid cross-contamination.

* * *

Consistent with the NSW EPA requirement for staged 'signoff' of sites that are the subject of progressive assessment, remediation and validation, I advise that:

- This advice letter does not constitute a Site Audit Report or Site Audit Statement.
- At the completion of the remediation and validation I will provide a Site Audit Statement and supporting documentation.
- This interim advice will be documented in the Site Audit Report.

Yours faithfully
Ramboll Australia Pty Ltd

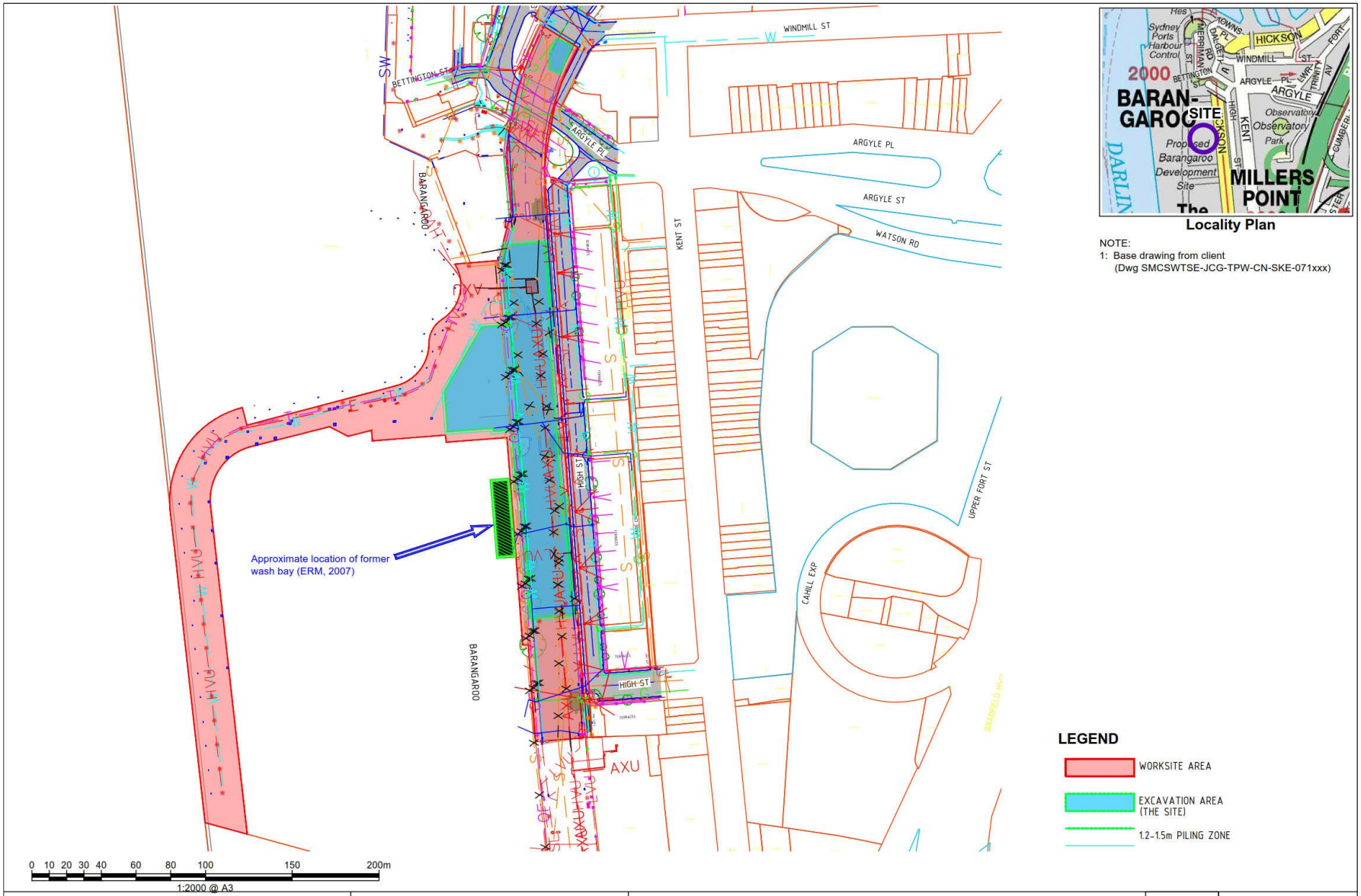


Tom Onus
EPA Accredited Site Auditor 1505

Attachments: 1 Site Locality

2 The DSI Sampling Location Plan

3 Waste Classification and Soil Disposal Plan

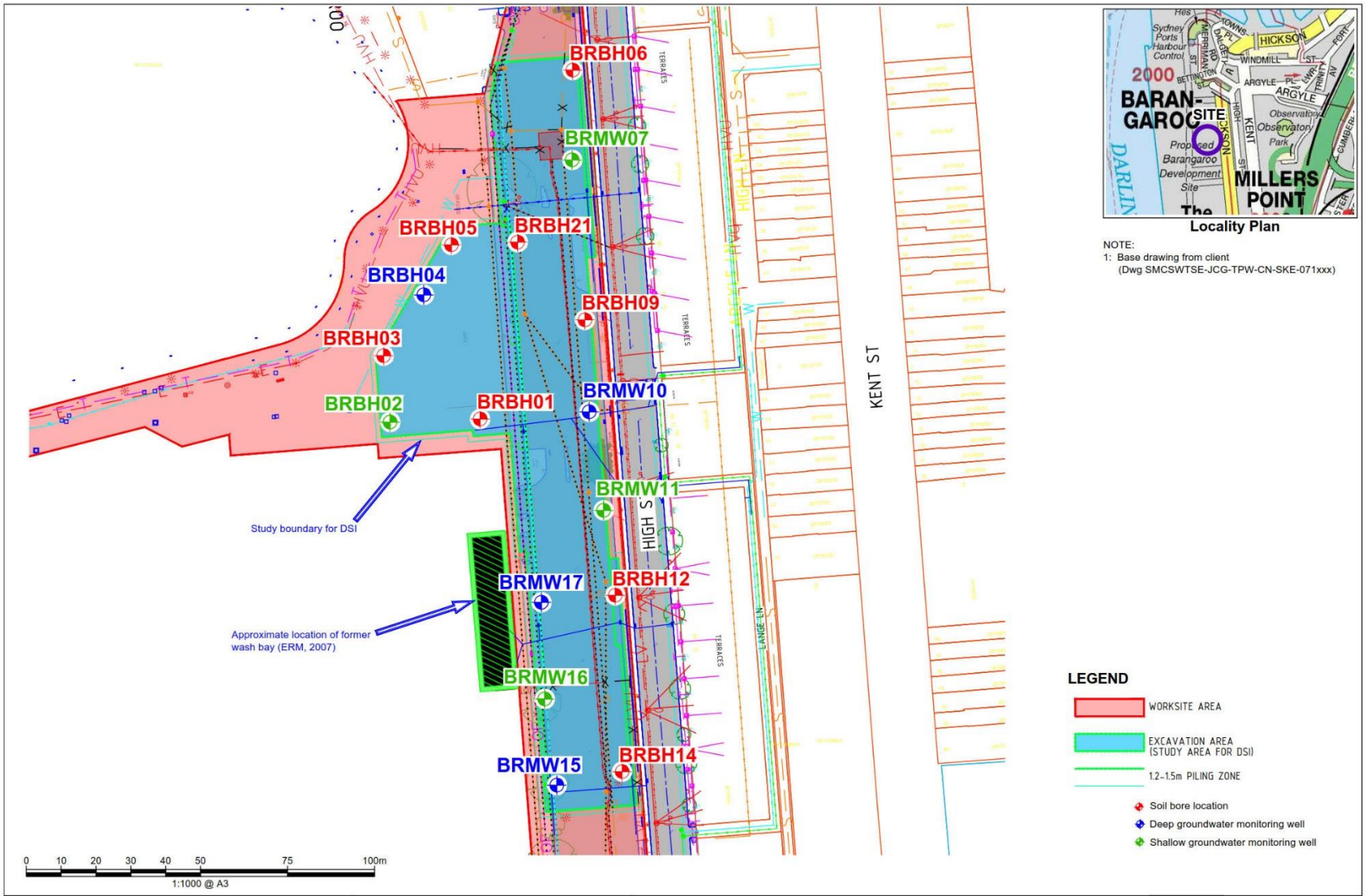


Locality Plan

NOTE:
1: Base drawing from client (Dwg SMCSWTSE-JCG-TPW-CN-SKE-071xxx)

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: Site Locations and Features Sydney Metro City & South West, Tunnel and Station Works Proposed Barangaroo Station, Hickson Road, BARANGAROO	PROJECT No: 85608.08
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 1
	SCALE: 1:2000 @ A3 / DATE: 3.10.2017		REVISION: 0

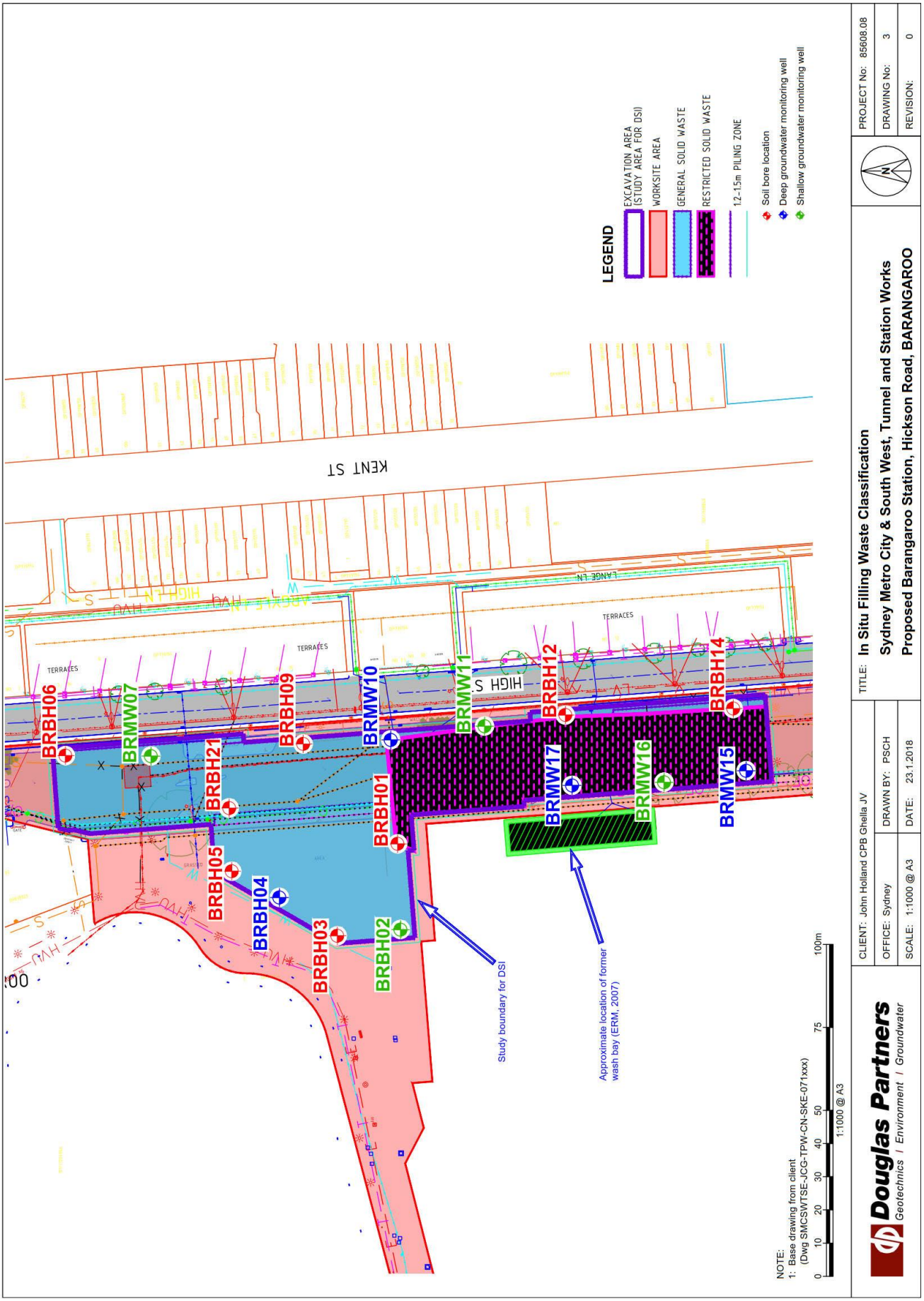
Attachment 1: Site Locality Plan



NOTE:
1: Base drawing from client (Dwg SMCSWTSE-JCG-TPW-CN-SKE-071xxx)

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: John Holland CPB Ghella JV	TITLE: Sampling Locations Sydney Metro City & South West, Tunnel and Station Works Proposed Barangaroo Station, Hickson Road, BARANGAROO	PROJECT No: 85608.08
	OFFICE: Sydney / DRAWN BY: PSCH		DRAWING No: 2
	SCALE: 1:1000 @ A3 / DATE: 12.1.2018		REVISION: 0

Attachment 2: The DSI Sampling Location Plan


LEGEND
EXCAVATION AREA (STUDY AREA FOR DSI)
WORKSITE AREA
GENERAL SOLID WASTE
RESTRICTED SOLID WASTE
1.2-1.5m PILING ZONE
Soil bore location
Deep groundwater monitoring well
Shallow groundwater monitoring well
KENT ST
HIGH ST
LANGE LN
TERRACES
BRBH01
BRBH02
BRBH03
BRBH04
BRBH05
BRBH06
BRBH09
BRBH12
BRBH14
BRBH21
BRMW07
BRMW10
BRMW11
BRMW15
BRMW16
BRMW17
Study boundary for DSI
Approximate location of former wash bay (ERM, 2007)
NOTE:
1: Base drawing from client (Dwg SMCSWTSE-JCG-TPW-CN-SKE-071xxx)
0 10 20 30 40 50 75 100m
1:1000 @ A3
Douglas Partners
Geotechnics / Environment / Groundwater
CLIENT: John Holland CPB Ghella JV
OFFICE: Sydney
DRAWN BY: PSCH
SCALE: 1:1000 @ A3
DATE: 23.1.2018
TITLE: In Situ Filling Waste Classification
Sydney Metro City & South West, Tunnel and Station Works
Proposed Barangaroo Station, Hickson Road, BARANGAROO
PROJECT No: 85608.08
DRAWING No: 3
REVISION: 0

APPENDIX D
ADE REPORT LIST

15. References

15.1 Guidelines

- Acid Sulfate Soils Management Advisory Committee (ASSMAC) *Acid Sulfate Soils Manual 1998*. Wollongbar, NSW, Australia [ASSMAC (1998)];
- *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. Available at www.waterquality.gov.au/anz-guidelines (ANZG 2018);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure 1999* (NEPC, 1999);
- National Environment Protection Council (NEPC), *National Environment Protection (Assessment of Site Contamination) Measure 1999* (as amended 2013) (NEPC, 2013);
- National Health and Medical Research Council (HNMRC) and National Resource Management Ministerial Council (NRMMC) *National Water Quality Management Strategy Australian Drinking Water Guidelines 6 2011*, (NHMRC, 2011) (ADWG);
- National Health and Medical Research Council (NHMRC) *Guidelines for Managing Risks in Recreational Water* (2008) (NHMRC, 2008) (GMRRW);
- NSW Environment Protection Authority (EPA) *Contaminated Land Management: Guidelines for the NSW Site Auditor Scheme 3rd edition*, 2017 (EPA, 2017);
- NSW Environment Protection Authority (EPA) *Waste Classification Guidelines*, 2014 (EPA, 2014);
- NSW Environment Protection Authority (EPA) *Contaminated Sites: Sampling Design Guidelines, 1995* (EPA, 1995);
- NSW Environment Protection Authority (EPA) *Consultants Reporting on Contaminated Land, Contaminated Land Guidelines*, April 2020, Updated 5 May 2020 (EPA, 2020);
- NSW Roads and Traffic Authority (RTA) *Technical Guideline: Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze* (RTA, 2005);
- WA Department of Environment Regulation (DER*) Treatment and management of soil and water in acid sulfate soil landscapes* (DER2015001427, June 2015) (DER, 2015); and
- QASSIT/ Qld NRM&E/SCU/ NatCASS/QASSMAC/ASSMAC Acid Sulfate Soils Laboratory Methods Guidelines Version 2.1-June 2004 Published by Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia, [Qld NRM&E (2004)].

15.2 ADE Reports for Waste Classification & Treatment of Acid Sulfate Soils

For preparation of this validation report, DP were provided with the following reports for waste classification and treatment of acid sulfate soils:

- ADE, *Waste Analysis & Classification Report, 29 Hickson Road, Barangaroo NSW*, Ref: SYM-01-13461 / WAC2 / v1 final, dated 30 January 2019 (13461/WAC2/v1);

- ADE, *Waste Analysis & Classification Report, Stockpile 1 - 29 Hickson Road, Barangaroo NSW*, Ref: SYM-01-13461 / WAC4 / v1 final, dated 30 January 2019 (13461/WAC4/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 2 - 29 Hickson Road, Barangaroo NSW*, Ref: SYM-01-13461 / WAC5 / v1 final, dated 30 January 2019 (13461/WAC5/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Barangaroo NSW*, Ref: SYM-01-14039 / WAC1 / v1 final, dated 2 May 2018 (14039/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14039 / WAC2 / v1 final, dated 15 May 2018 (14039/WAC2/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC1 / v1 final, dated 29 June 2018 (14358/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC2 / v1 final, dated 5 July 2018 (14358/WAC2/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - Stockpile 22 (SP22) at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14358.WAC3.v1f, dated 28 June 2018 (14358/WAC3/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC4 / v1 final, dated 5 July 2018 (14358/WAC4/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC5 / v1 final, dated 4 July 2018 (14358/WAC5/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - Stockpile 24 ('SP24') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14358.WAC7.v1f, dated 4 July 2018 (14358/WAC7/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - Stockpile 26 ('SP26') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14358.WAC8.v1f, dated 17 July 2018 (14358/WAC8/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC9 / v1f, dated 23 July 2018 (14358/WAC9/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14358 / WAC11 / v1f, dated 10 August 2018 (14358/WAC11/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 27 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14358 / WAC12 v1f, dated 25 July 2018 (14358/WAC12/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14575 / WAC3 / v1f, dated 2 October 2018 (14575/WAC3/v1);
- ADE, *Waste Analysis & Classification Report, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14575 / WAC3 / v2f, dated 16 July 2021 (14575/WAC3/v2). [Revision of 14575/WAC3/v1];
- ADE, *Waste Analysis & Classification Report, Stockpile 29 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14575 / WAC4 v1f, dated 26 September 2018 (14575/WAC4/v1);

- ADE, *IS12 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-14961 / WAC1 / v1f, dated 22 November 2018 (14961/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 30 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-14961 / WAC2 / v1f, dated 5 October 2018 (14961/WAC2/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 31 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15095 / WAC1 / v1f, dated 29 October 2018 (15095/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, IS13 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15095 / WAC3 / v1f, dated 9 November 2018 (15095/WAC3/v1);
- ADE, *Waste Analysis & Classification Report, IS14 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15095 / WAC3B / v1f, dated 15 November 2018 (15095/WAC3B/v1);
- ADE, *Waste Analysis & Classification Report, IS15 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15095 / WAC5 / v1f, dated 9 November 2018 (15095/WAC5/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 33 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15095 / WAC6 v1f, dated 9 November 2018 (15095/WAC6 /v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS13 Stockpile 1 ('IS13 SP1') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15095.WAC7.v1f, dated 12 November 2018 (15095/WAC7/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS13 Stockpile 2 ('IS13 SP2') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15095.WAC9.v1f, dated 20 November 2018 (15095/WAC9/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS14 Stockpile 1 ('IS14 SP1') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15332.WAC2.v1f, dated 28 November 2018 (15332/WAC2/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS14 Stockpile 2 ('IS14 SP2') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15332.WAC4.v1f, dated 10 December 2018 (15332/WAC4/v1);
- ADE, *Waste Analysis & Classification Report, IS18 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15332 / WAC5 / v1f, dated 9 January 2019 (15332/WAC5/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS12 Stockpile C ('IS12C') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15332.WAC7.v1f, dated 21 December 2018 (15332/WAC7/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS18 Stockpile 1 ('IS18.SP1') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15332.WAC8.v1f, dated 10 January 2019 (15332/WAC8/v1);
- ADE, *Waste Analysis & Classification Report, IS21 - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15549 / WAC1 / v1f, dated 8 February 2019 (15549/WAC1/v1);

- ADE, *Waste Analysis & Classification Report, IS21 – Station Box Excavation, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / WAC1 / v2f, dated (15549/WAC1/v2). [Revision of 15549/WAC1/v1];
- ADE, *Waste Analysis & Classification Report, BRBH25 Stockpile - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15549 / WAC3 / v1f, dated 11 February 2019 (15549/WAC3/v1);
- ADE, *Waste Analysis & Classification Report, BRMW17 Stockpile - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / WAC4 / v1f, dated 12 February 2019 (15549/WAC4/v1);
- ADE, *Waste Analysis & Classification Report, BRBH26 Stockpile - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / WAC5 / v1f, dated 12 February 2019 (15549/WAC5/v1);
- ADE, *Waste Analysis & Classification Report, BRMW16 Stockpile - Barangaroo Station Site, Hickson Road, Barangaroo NSW*, Ref: SYM-01-15549 / WAC6 / v1f, dated 12 February 2019 (15549/WAC6/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 34 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / WAC7 / v1f, dated 15 February 2019 (15549/WAC7/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS14 Stockpile 3 ('IS14 SP3') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549.WAC8.v1f, dated 11 February 2019 (15549/WAC8/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 37 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15780 / WAC1 / v1f, dated 7 March 2019 (15780/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, IS22 – Station Box Excavation, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15964 / WAC1 / v1f, dated 30 April 2019 (15964/WAC1/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 38 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15964 / WAC2 / v1f, dated 17 April 2019 (15964/WAC2/v1);
- ADE, *Waste Analysis & Classification Report, Stockpile 39 – Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-16118 / WAC2 / v1f, dated 23 March 2019 (16118/WAC2/v1);
- ADE, *Waste Analysis & Classification Report, IS24 – Station Box and Shark Fin Excavation, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-16118 / WAC3 / v1f, dated 24 May 2019 (16118/WAC3/v1);
- ADE, *Re: Excavated Acid Sulfate Soils and Validation Stockpile Field Screening - IS18 Stockpile 40 ('IS18 SP40') at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-16277.WAC5.v1f, dated 24 July 2019 (16277/WAC5/v1);
- ADE, *Waste Analysis & Classification Report, IS27 – Station Box and Shark Fin Excavation, Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-16277 / WAC6 / v1f, dated 1 August 2019 (16277/WAC6/v1); and

- ADE, *Waste Analysis & Classification Report, Stockpile 41 - Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-16779 / WAC1 / v1f, dated 3 October 2019 (16779/WAC1/v1).

15.3 ADE Reports for Delineation Soil Sampling

For preparation of this validation report, DP were provided with the following reports which relate to delineation sampling and analysis:

- ADE, *RE: Validation Soil Sampling of BRBH25(1.4-1.5) and BRBH25(2.0 - 2.45) at the Barangaroo Station Site, 26 Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / LTR3 / v1f, dated 4 February 2019 (15332/LTR3/v1);
- ADE, *RE: Validation Soil Sampling of BRMW16(0.9-1.0) at the Barangaroo Station Site, 26 Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / LTR1 / v1f, dated 6 February 2019 (15549 /LTR1/v1);
- ADE, *RE: Validation Soil Sampling of BRMW17(0.9-1.0) at the Barangaroo Station Site, 26 Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / LTR2 / v1f, dated 6 February 2019 (15549/LTR2 /v1);
- ADE, *RE: Validation Soil Sampling of BRBH26 (0.4-0.5) at the Barangaroo Station Site, 26 Hickson Road, Barangaroo NSW,* Ref: SYM-01-15549 / LTR4 / v1f, dated 12 February 2019 (15549/LTR4 /v1);
- ADE, *RE: Validation Soil Sampling of BRMW11 (3.9-4.0) at the Barangaroo Station Site, 26 Hickson Road, Barangaroo NSW*, Ref: SYM-01-15549 / LTR5 / v1f, dated 5 February 2019 (15549/LTR5/v1);
- ADE, *RE: Validation Sampling of BRBH28 (2.4-2.5) at the Barangaroo Station Site, Hickson Road, Barangaroo NSW,* Ref: SYM-01-15964 / LTR2 / v1f, dated 24 April 2019 (15964/LTR2/v1); and
- ADE, *RE: ADE Responses to Enquiries Regarding the Natural Sandstone Materials at the Barangaroo Station Site,* Ref: SYM-01-15964 / LTR1 / v1f, dated 3 May 2019 (15964/LTR1/v1).

15.4 DP Reports for Waste Classification & Treatment of Acid Sulfate Soils

The following DP reports were prepared for waste classification and the treatment of acid sulfate soils of materials sourced from the site:

- DP, *Waste Classification - Excavations for Piling Platform and Capping Beam, Sydney Metro City & South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo (Sharks Fin)*, Ref: 85608.08.R.005.Rev1, dated 25 January 2018 (R.005);
- DP, *Stockpile ENM Assessment - Sharks Fin, Sydney Metro City & South West - Tunnel and Station Excavation Works Package, Block 7, Hickson Road, Barangaroo,* Ref: 85608.08.R.007.Rev0, dated 1 February 2018 (R.007);
- DP, *Waste Classification - Stockpile BRPLSP1, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin)*, Ref: 85608.08.R.014.Rev0, dated 12 March 2018 (R.014);

- DP, *Waste Classification - Stockpile BRPLSP2, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin),* Ref: 85608.08.R.015.Rev0, dated 15 March 2018 (R.015);
- DP, *Waste Classification - Stockpile BRLT1, Sydney Metro City and South West, Tunnel and Station Excavation Works Package Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin),* Ref: 85608.08.R.017.Rev0, dated 28 March 2018 (R.017);
- DP, *Waste Classification - Stockpile BRLT2, Sydney Metro City and South West, Tunnel and Station Excavation Works Package Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin),* Ref: 85608.08.R.018.Rev0, dated 11 April 2018 (R.018);
- DP, *Waste Classification - Stockpile BRPL3, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.019.Rev0, dated 13 April 2018 (R.019);
- DP, *Waste Classification - Stockpile BRPL4, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin),* Ref: 85608.08.R.020.Rev0, dated 20 April 2018 (R.020);
- DP, *Stockpile Waste Classification Assessment: Stockpiles BRSP06 and BRSP07 Sydney Metro City & South West - Tunnel and Station Excavation Works Package Hickson Road, Barangaroo,* Ref: 85608.08.R.021.Rev0, dated 24 April 2018 (R.021);
- DP, *Waste Classification - Stockpile BRSP8, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.022.Rev0, dated 30 April 2018 (R.022);
- DP, *Waste Classification - Stockpile BRSP10, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo (Sharks Fin),* Ref: 85608.08.R.024.Rev0, dated 9 May 2018 (R.024);
- DP, *Waste Classification - Stockpile BRSP12, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo*, Ref: 85608.08.R.025.Rev0, dated 16 May 2018 (R.025);
- DP, *Waste Classification - Spoil from Piles 64 to 76 and 118 to 146, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo*, Ref: 85608.08.R.027.Rev0, dated 18 May 2018 (R.027);
- DP, *Waste Classification - Stockpile BRSP15, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.028.Rev0, dated 22 May 2018 (R.028);
- DP, *Waste Classification - Stockpile BRSP14, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.029.Rev0, dated 24 May 2018 (R.029);
- DP, *Waste Classification - Stockpile BRSP16, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.031.Rev0, dated 6 June 2018 (R.031);
- DP, *Waste Classification - Stockpile BRSP19, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.032.Rev0, dated 7 June 2018 (R.032);

- DP, *Waste Classification - Stockpile BRSP18, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.033.Rev0, dated 19 June 2018 (R.033); and
- DP, *Waste Classification - Stockpile BRSP17, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Barangaroo Station Site, Hickson Road, Barangaroo,* Ref: 85608.08.R.034.Rev0, dated 19 June 2018 (R.034).

15.5 Other DP Reports

DP reports, other than those listed in Section 15.4 include:

- DP, *Report on Preliminary Site Investigation, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo*, Ref 85608.08.R.001 Rev0 dated 8 March 2018 (PSI);
- DP, *Acid Sulphate Soil Management Plan, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo,* Ref 85608.08.R.008 Rev1 dated 24 April 2018 (ASSMP);
- DP *Report on Detailed Site Investigation, Sydney Metro City and South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo*, Ref 85608.08.R.001 Rev1 dated 7 May 2018 (DSI); and
- DP, *Remediation Action Plan, Sydney Metro City & South West - Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo,* 85608.08.R.006.Rev0 dated 7 May 2018 (RAP).

15.6 Reports by Other Consultants

Reports by consultants, other than ADE and DP listed above, include:

- Environmental Resources Management Australia Pty Ltd (ERM), *East Darling Harbour Geotechnical and Environmental Investigation*, *Summary of Findings,* September 2006 (Reference: 004432RP03 Final) (ERM, 2006);
- ERM, *Environmental Site Assessment, East Darling Harbour, Sydney, NSW, June 2007* (Reference: 0044432RP02 Rev 01 Final) (ERM, 2007);
- ERM, *Additional Investigation Works at Barangaroo, Hickson Road, Millers Point, NSW,* July 2008 (Reference: 0080637R03Rev01) (ERM, 2008);
- ERM, *Overarching Remedial Action Plan for The Barangaroo Project Site, Sydney,* June 2010 (Reference 0114385RP01 Final) (ERM, 2010);
- ENVIRON Australia Pty Ltd (Environ), *Site Audit Report, Overarching Remedial Plan, Barangaroo,* June 2010 (Project Number A121191) (Environ, 2010);
- JBS Environmental Pty Ltd (JBS), *Human Health and Ecological Risk Assessment for Proposed Imported Soils*, *Barangaroo Central, Hickson Road, Sydney, NSW*, July 2012 (Reference: JBS42021-50171 Revision C) (JBS, 2012a);

Ramboll Australia Pty Ltd
Level 3, 100 Pacific Highway
PO Box 560
North Sydney NSW 2060

T +61 2 9954 8100

www.ramboll.com

NSW Site Auditor Scheme

Site Audit Statement

A site audit statement summarises the findings of a site audit. For full details of the site auditor's findings, evaluations and conclusions, refer to the associated site audit report.

This form was approved under the *Contaminated Land Management Act 1997* on 12 October 2017.

For information about completing this form, go to Part IV.

Part I: Site audit identification

Site audit statement no. RS-139

This site audit is a:

☒ statutory audit

☐ non-statutory audit

within the meaning of the *Contaminated Land Management Act 1997*.

Site auditor details

(As accredited under the *Contaminated Land Management Act 1997*)

Name	Rowena Salmon
Company	Ramboll Australia Pty Ltd
Address	Level 3
	100 Pacific Highway, North Sydney
	Postcode 2060
Phone	02 9954 8100
Email	rsalmon@ramboll.com

Site details

Address: Sydney Metro Barangaroo Station, Hickson Road, Barangaroo, NSW

Postcode: 2000

Property description

The site covers an approximate irregular rectangle shape (see figure at end of Part I of this statement). The Lot/Deposited Plan (DP) numbers for the site are as follows:

Part of Lot 1 DP863317, part of Lot 52 DP1213772 and part of Hickson Road

Local government area: City of Sydney

Area of site (include units, e.g. hectares): Approximately 0.7 hectares

Current zoning: B4 – Mixed Use and RE1 – Public Recreation

Regulation and notification

To the best of my knowledge:

☐ **the site is** the subject of a declaration, order, agreement, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985,* as follows: (provide the no. if applicable)

- ☐ Declaration no.
- ☐ Order no.
- ☐ Proposal no.
- ☐ Notice no.

☒ **the site is not** the subject of a declaration, order, proposal or notice under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.

To the best of my knowledge:

☐ the site **has** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*

☒ the site **has not** been notified to the EPA under section 60 of the *Contaminated Land Management Act 1997*.

Site audit commissioned by

Name: Caitlin Richards

Company: John Holland CPB Contractors Ghella Joint Venture (JHCPBG JV)

Address: 2&4/177 Pacific Highway, North Sydney NSW

Postcode: 2000

Phone: 0407 176 672

Email: Caitlin.Richards@cpbcon.com.au

Contact details for contact person (if different from above)

Name: Stuart Anstee

Phone: 0418 903 837

Email: stuart.anstee@sydneymetro2.com.au

Nature of statutory requirements (not applicable for non-statutory audits)

☐ Requirements under the *Contaminated Land Management Act* 1997 (e.g. management order; please specify, including date of issue)

☐ Requirements imposed by an environmental planning instrument (please specify, including date of issue)

☒ Development consent requirements under the *Environmental Planning and Assessment Act 1979* (please specify consent authority and date of issue)

Condition E67 of Infrastructure Approval, application SSI 15_7400, approved by the Minister for Planning on 9 January 2017

☐ Requirements under other legislation (please specify, including date of issue)

Purpose of site audit

☒ **A1** To determine land use suitability

Intended uses of the land: Below ground train station

OR

☐ **A2** To determine land use suitability subject to compliance with either an active or passive environmental management plan

Intended uses of the land:

OR

(Tick all that apply)

☐ **B1** To determine the nature and extent of contamination

☐ **B2** To determine the appropriateness of:

- ☐ an investigation plan
- ☐ a remediation plan
- ☐ a management plan

☐ **B3** To determine the appropriateness of a **site testing plan** to determine if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

☐ **B4** To determine the compliance with an approved:

- ☐ **voluntary management proposal** or
- ☐ **management order** under the *Contaminated Land Management Act 1997*

☐ **B5** To determine if the land can be made suitable for a particular use (or uses) if the site is remediated or managed in accordance with a specified plan.

Intended uses of the land:

Information sources for site audit

Consultancies which conducted the site investigations and/or remediation:

Douglas Partners Pty Ltd (Douglas)

ADE Consulting Group Pty Ltd (ADE)

METRON Consortium (METRON)

Titles of reports reviewed:

'Report on Preliminary Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, March 2018', report reference: Revision 0, dated 8 March 2018, prepared by Douglas.

‘Report on Detailed Site Investigation, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018’, report reference: Revision 1, dated 7 May 2018, prepared by Douglas.

‘Remediation Action Plan, Sydney Metro City and South West, Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, prepared for John Holland CPB Ghella JV, Project 85608.08, May 2018’, report reference: Revision 0, dated 7 May 2018, prepared by Douglas.

‘Acid Sulfate Soil Management Plan, Barangaroo Station Site, Hickson Road, Barangaroo NSW’, dated 4 June 2018, Prepared by ADE.

‘Report on Supplementary Contamination and Waste Classification Investigation, Sydney Metro City & South West, Tunnel & Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo, NSW’, Ref 85608.08.R.030.DftA dated 15 June 2018, prepared by Douglas.

‘Addendum to Remediation Action Plan, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Proposed Barangaroo Station, Hickson Road, Barangaroo’, Ref: 85608.08.R.036.Rev2, dated 27 February 2019, prepared by Douglas.

‘Barangaroo Station Vapour Intrusion Assessment Report Stage 2 & 3 Detail Design Underground Stations Design and Technical Services’ (Document No: SMCSWSBR-MET-SBR-EM-REP-000001, Revision P04.1, dated 15 September 2021), prepared by METRON.

‘Report on Validation of Remediation, Sydney Metro City & South West – Tunnel and Station Excavation Works Package, Barangaroo Station, Hickson Road, Barangaroo’, dated 21 September 2021 (Rev 0), prepared by Douglas (the Validation Report).

Review of supporting documentation appended to the Validation Report including waste classification reports prepared by ADE and Douglas for material disposed from the site.

Other information reviewed, including previous site audit reports and statements relating to the site:

‘Site Audit Report, Overarching Remedial Action Plan, Barangaroo’, and SAS GN 439A, dated 2 June 2010 by Graeme Nyland of ENVIRON Australia Pty Ltd

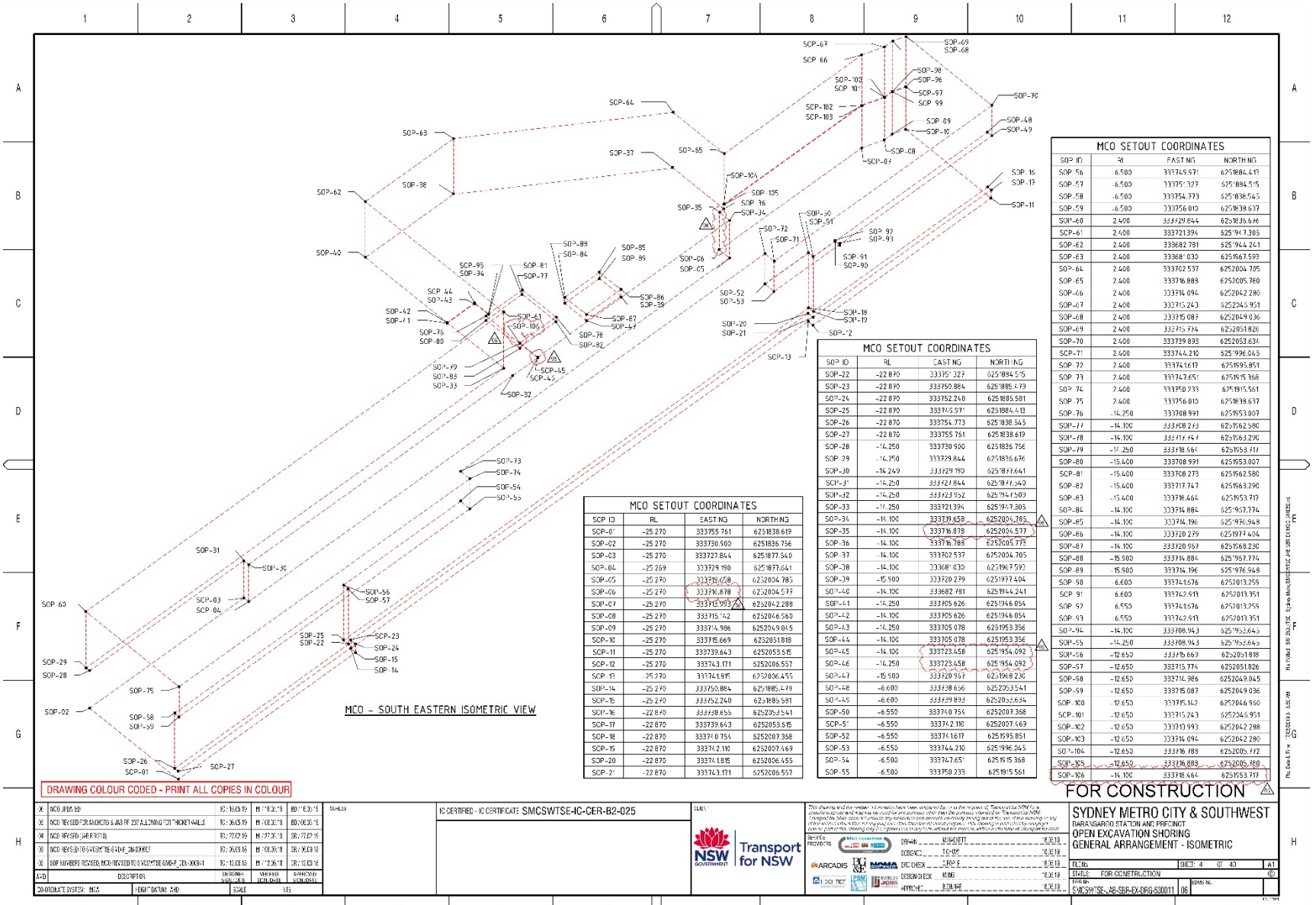
‘Site Audit Report, Remediation and Validation, Barangaroo Point Reserve’ and SAS GN 439C-2, dated 4 September 2015 by Graeme Nyland of ENVIRON Australia Pty Ltd

‘Site Audit Report, Validation of Barangaroo Central Promenade’ and SAS GN 439C-3, dated 4 September 2015 by Graeme Nyland of ENVIRON Australia Pty Ltd

‘Interim Audit Advice Letter No.6 – Remediation Action Plan, Barangaroo Station, Hickson Road, Barangaroo, NSW’, dated 31 May 2018 ‘ by Tom Onus (Ramboll)

Site audit report details

Title	Site Audit Report – Barangaroo Station Box, Hickson Road, Barangaroo		
Report no.	RS-139 (Ramboll Ref: 318000323-005)	Date	23 September 2021



MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-01	-25.270	333755.761	6251838.619
SCP-02	-25.270	333730.500	6251836.756
SCP-03	-25.270	333727.844	6251877.540
SCP-04	-25.269	333729.190	6251877.641
SCP-05	-25.270	333716.658	6252004.785
SCP-06	-25.270	333716.878	6252004.577
SCP-07	-25.270	333715.993	6252002.288
SCP-08	-25.270	333715.142	6252046.560
SCP-09	-25.270	333714.986	6252049.045
SCP-10	-25.270	333715.669	6252051.818
SCP-11	-25.270	333739.643	6252053.515
SCP-12	-25.270	333743.171	6252206.557
SCP-13	-25.270	333744.815	6252206.455
SCP-14	-25.270	333750.884	6251885.479
SCP-15	-25.270	333752.240	6251885.581
SCP-16	-22.870	333738.656	6252054.541
SCP-17	-22.870	333739.643	6252053.515
SCP-18	-22.870	333740.754	6252207.368
SCP-19	-22.870	333742.110	6252207.469
SCP-20	-22.870	333743.815	6252206.455
SCP-21	-22.870	333743.171	6252206.557

MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-22	-22.870	333751.327	6251884.515
SCP-23	-22.870	333750.884	6251885.479
SCP-24	-22.870	333752.240	6251885.581
SCP-25	-22.870	333745.971	6251884.413
SCP-26	-22.870	333754.773	6251838.545
SCP-27	-22.870	333755.761	6251838.619
SCP-28	-14.250	333730.900	6251836.756
SCP-29	-14.250	333729.844	6251836.676
SCP-30	-14.249	333729.190	6251877.641
SCP-31	-14.250	333727.844	6251877.540
SCP-32	-14.250	333723.952	6251947.500
SCP-33	-14.250	333721.394	6251947.305
SCP-34	-14.100	333719.658	6252004.785
SCP-35	-14.100	333716.878	6252004.577
SCP-36	-14.100	333716.788	6252005.773
SCP-37	-14.100	333702.537	6252004.705
SCP-38	-14.100	333681.030	6251967.593
SCP-39	-15.900	333720.279	6251977.404
SCP-40	-14.100	333682.781	6251944.241
SCP-41	-14.250	333705.626	6251946.054
SCP-42	-14.100	333705.626	6251946.054
SCP-43	-14.250	333705.078	6251953.356
SCP-44	-14.100	333705.078	6251953.356
SCP-45	-14.100	333723.458	6251954.092
SCP-46	-14.250	333723.458	6251954.092
SCP-47	-15.900	333720.957	6251968.230
SCP-48	-6.600	333738.656	6252053.541
SCP-49	-6.600	333739.893	6252053.634
SCP-50	-6.550	333740.754	6252207.368
SCP-51	-6.550	333742.110	6252207.469
SCP-52	-6.550	333743.617	6251995.851
SCP-53	-6.550	333744.210	6251996.045
SCP-54	-6.500	333747.651	6251915.368
SCP-55	-6.500	333750.233	6251915.561

MCO SETOUT COORDINATES

SCP ID	RL	EASTING	NORTHING
SCP-56	-6.500	333749.971	6251884.413
SCP-57	-6.500	333751.327	6251884.515
SCP-58	-6.500	333754.773	6251838.545
SCP-59	-6.500	333756.010	6251838.637
SCP-60	2.400	333729.844	6251836.676
SCP-61	2.400	333721.394	6251947.305
SCP-62	2.400	333682.781	6251944.241
SCP-63	2.400	333681.030	6251967.593
SCP-64	2.400	333702.537	6252004.705
SCP-65	2.400	333716.888	6252005.780
SCP-66	2.400	333714.094	6252042.280
SCP-67	2.400	333715.243	6252046.951
SCP-68	2.400	333715.087	6252049.036
SCP-69	2.400	333715.774	6252051.826
SCP-70	2.400	333739.893	6252053.634
SCP-71	2.400	333744.210	6251996.045
SCP-72	2.400	333743.617	6251995.851
SCP-73	2.400	333747.651	6251915.368
SCP-74	2.400	333750.233	6251915.561
SCP-75	2.400	333756.010	6251838.637
SCP-76	-14.250	333708.991	6251953.007
SCP-77	-14.100	333708.273	6251962.580
SCP-78	-14.100	333717.747	6251963.290
SCP-79	-14.250	333718.464	6251953.717
SCP-80	-15.400	333708.991	6251953.007
SCP-81	-15.400	333708.273	6251962.580
SCP-82	-15.400	333717.747	6251963.290
SCP-83	-15.400	333718.464	6251953.717
SCP-84	-14.100	333714.884	6251957.774
SCP-85	-14.100	333714.196	6251976.948
SCP-86	-14.100	333720.279	6251977.404
SCP-87	-14.100	333720.957	6251968.230
SCP-88	-15.900	333714.884	6251957.774
SCP-89	-15.900	333714.196	6251976.948
SCP-90	6.600	333741.676	6252013.259
SCP-91	6.600	333742.913	6252013.351
SCP-92	6.550	333741.676	6252013.259
SCP-93	6.550	333742.913	6252013.351
SCP-94	-14.100	333708.943	6251953.643
SCP-95	-14.250	333708.943	6251953.643
SCP-96	-12.650	333715.669	6252051.818
SCP-97	-12.650	333715.774	6252051.826
SCP-98	-12.650	333714.986	6252049.045
SCP-99	-12.650	333715.087	6252049.036
SCP-100	-12.650	333715.142	6252046.960
SCP-101	-12.650	333715.243	6252046.951
SCP-102	-12.650	333713.993	6252042.288
SCP-103	-12.650	333714.094	6252042.280
SCP-104	-12.650	333716.788	6252005.772
SCP-105	-12.650	333716.888	6252005.780
SCP-106	-14.100	333718.464	6251953.717

Part II: Auditor's findings

Please complete either Section A1, Section A2 or Section B, not more than one section. (Strike out the irrelevant sections.)

- Use **Section A1** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **without the implementation** of an environmental management plan.
- Use **Section A2** where site investigation and/or remediation has been completed and a conclusion can be drawn on the suitability of land uses **with the implementation** of an active or passive environmental management plan.
- Use **Section B** where the audit is to determine:
    - (B1) the nature and extent of contamination, and/or
    - (B2) the appropriateness of an investigation, remediation or management plan[1], and/or
    - (B3) the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or
    - (B4) whether the terms of the approved voluntary management proposal or management order have been complied with, and/or
    - (B5) whether the site can be made suitable for a specified land use (or uses) if the site is remediated or managed in accordance with the implementation of a specified plan.

[1] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

Section A1

I certify that, in my opinion:

The **site is suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ ~~Residential, including substantial vegetable garden and poultry~~

☐ ~~Residential, including substantial vegetable garden, excluding poultry~~

☐ ~~Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry~~

☐ ~~Day care centre, preschool, primary school~~

☐ ~~Residential with minimal opportunity for soil access, including units~~

☐ ~~Secondary school~~

☐ ~~Park, recreational open space, playing field~~

☐ ~~Commercial/industrial~~

☒ Other (please specify):

Underground train station, constructed in accordance with the *Sydney Metro City & Southwest, Barangaroo Station Development, Construct Only Delivery Deed* (Contract No: 501 dated 12 March 2021).

OR

☐ ~~I certify that, in my opinion, the **site is not suitable** for any use due to the risk of harm from contamination.~~

Overall comments:

The site history identified sources of contamination associated with commercial/industrial landuse (including shipping and stevedoring), demolition of former buildings, significant filling and former gasworks located off-site to the south.

Historical investigations undertaken at the site identified elevated concentrations of lead and polycyclic aromatic hydrocarbons (PAHs) in fill soils. Fill was also impacted by other metals and total recoverable hydrocarbons (TRH) at concentrations less than the adopted assessment criteria. Natural soils in some areas were also identified to be impacted by PAHs and metals. Acid sulfate soils (ASS) were identified to be present in fill and natural soils between the water table and underlying sandstone bedrock. An ASS management plan (ASSMP) was prepared for the management of the identified ASS. Investigation of groundwater conditions identified elevated concentrations of metals, however these were attributed to urban background levels. Low concentrations of light to mid fraction TRH, BTEX, PAHs, organochlorine pesticides (OCPs) and selected volatile organic compounds (VOCs) were detected in groundwater samples. On-site sources were not identified and the potential source was identified as the former wash bay located off-site or other off-site sources such as the former gasworks.

The development (underground train station) required excavation to depths of between approximately 16.9 m and 27.67 m. Excavated soils and rock were classified and disposed

off-site. The excavation works successfully removed the onsite sources of contamination (fill) however potential risks remain from contaminated groundwater in off-site areas to the south and west of the site. The excavation works for the proposed station required the installation of a secant pile wall around the perimeter and the construction of a tanked basement. The station construction is also understood to contain a ventilation system. These construction items, constructed in accordance with the Deed, will limit the potential risk of impacted groundwater and soil vapour migrating onto the site.

The site suitability is based on construction in accordance with the Deed. It is noted that changes to the proposed development, including changes that result in increased water ingress potential (particularly at the connection to the Central Barangaroo District pedestrian tunnel) or long-term changes to the ventilation system could change the risk from contamination at the site. As such, if any such changes are proposed, the impact on risk from contamination should be reviewed, and the development works modified if required to manage any potentially unacceptable risks.

Groundwater has not been assessed for any beneficial re-use. Any future use of groundwater would require appropriate assessment and regulatory approvals from the NSW Office of Water.

Section A2

I certify that, in my opinion:

Subject to compliance with the **attached** environmental management plan[2] (EMP), the site is suitable for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

☐ Residential, including substantial vegetable garden and poultry

☐ Residential, including substantial vegetable garden, excluding poultry

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

EMP details

Title

Author

Date No. of pages

EMP summary

This EMP (attached) is required to be implemented to address residual contamination on the site.

The EMP: (Tick appropriate box and strike out the other option.)

☐ requires operation and/or maintenance of **active** control systems[3]

☐ requires maintenance of **passive** control systems only[3].

[2] Refer to Part IV for an explanation of an environmental management plan.
[3] Refer to Part IV for definitions of active and passive control systems.

Purpose of the EMP:

Description of the nature of the residual contamination:

Summary of the actions required by the EMP:

How the EMP can reasonably be made to be legally enforceable:

How there will be appropriate public notification:

Overall comments:

Section B

Purpose of the plan[4] which is the subject of this audit:

_____

_____

_____

I certify that, in my opinion:

(B1)

☐ The nature and extent of the contamination **has** been appropriately determined

☐ The nature and extent of the contamination **has not** been appropriately determined

AND/OR (B2)

☐ The investigation, remediation or management plan **is** appropriate for the purpose stated above

☐ The investigation, remediation or management plan **is not** appropriate for the purpose stated above

AND/OR (B3)

☐ The site testing plan:

- ☐ **is** appropriate to determine
- ☐ **is not** appropriate to determine

if groundwater is safe and suitable for its intended use as required by the *Temporary Water Restrictions Order for the Botany Sands Groundwater Resource 2017*

AND/OR (B4)

☐ The terms of the approved voluntary management proposal* or management order** (strike out as appropriate):

- ☐ **have** been complied with
- ☐ **have not** been complied with.

*voluntary management proposal no. _____

**management order no. _____

AND/OR (B5)

☐ The site **can be made suitable** for the following uses:

(Tick all appropriate uses and strike out those not applicable.)

- ☐ Residential, including substantial vegetable garden and poultry
- ☐ Residential, including substantial vegetable garden, excluding poultry

[4] For simplicity, this statement uses the term 'plan' to refer to both plans and reports.

☐ Residential with accessible soil, including garden (minimal home-grown produce contributing less than 10% fruit and vegetable intake), excluding poultry

☐ Day care centre, preschool, primary school

☐ Residential with minimal opportunity for soil access, including units

☐ Secondary school

☐ Park, recreational open space, playing field

☐ Commercial/industrial

☐ Other (please specify):

IF the site is remediated/managed* in accordance with the following plan (**attached**):

*Strike out as appropriate

Plan title

Plan author

Plan date No. of pages

SUBJECT to compliance with the following condition(s):

Overall comments:

Part III: Auditor's declaration

I am accredited as a site auditor by the NSW Environment Protection Authority (EPA) under the *Contaminated Land Management Act 1997.*

Accreditation no. 1002

I certify that:

- I have completed the site audit free of any conflicts of interest as defined in the *Contaminated Land Management Act 1997,* and
- with due regard to relevant laws and guidelines, I have examined and am familiar with the reports and information referred to in Part I of this site audit, and
- on the basis of inquiries I have made of those individuals immediately responsible for making those reports and obtaining the information referred to in this statement, those reports and that information are, to the best of my knowledge, true, accurate and complete, and
- this statement is, to the best of my knowledge, true, accurate and complete.

I am aware that there are penalties under the *Contaminated Land Management Act 1997* for wilfully making false or misleading statements.

Signed: 

Date: 23 September 2021

Part IV: Explanatory notes

To be complete, a site audit statement form must be issued with all four parts.

How to complete this form

Part I

Part I identifies the auditor, the site, the purpose of the audit and the information used by the auditor in making the site audit findings.

Part II

Part II contains the auditor's opinion of the suitability of the site for specified uses or of the appropriateness of an investigation, or remediation plan or management plan which may enable a particular use. It sets out succinct and definitive information to assist decision-making about the use or uses of the site or a plan or proposal to manage or remediate the site.

The auditor is to complete either Section A1 or Section A2 or Section B of Part II, **not** more than one section.

Section A1

In Section A1 the auditor may conclude that the land is *suitable* for a specified use or uses OR *not suitable* for any beneficial use due to the risk of harm from contamination.

By certifying that the site is *suitable*, an auditor declares that, at the time of completion of the site audit, no further investigation or remediation or management of the site was needed to render the site fit for the specified use(s). **Conditions must not be** imposed on a Section A1 site audit statement. Auditors may include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section A2

In Section A2 the auditor may conclude that the land is *suitable* for a specified use(s) subject to a condition for implementation of an environmental management plan (EMP).

Environmental management plan

Within the context of contaminated sites management, an EMP (sometimes also called a 'site management plan') means a plan which addresses the integration of environmental mitigation and monitoring measures for soil, groundwater and/or hazardous ground gases throughout an existing or proposed land use. An EMP succinctly describes the nature and location of contamination remaining on site and states what the objectives of the plan are, how contaminants will be managed, who will be responsible for the plan's implementation and over what time frame actions specified in the plan will take place.

By certifying that the site is suitable subject to implementation of an EMP, an auditor declares that, at the time of completion of the site audit, there was sufficient information satisfying guidelines made or approved under the *Contaminated Land Management Act 1997*

(CLM Act) to determine that implementation of the EMP was feasible and would enable the specified use(s) of the site and no further investigation or remediation of the site was needed to render the site fit for the specified use(s).

Implementation of an EMP is required to ensure the site remains suitable for the specified use(s). The plan should be legally enforceable: for example, a requirement of a notice under the CLM Act or a development consent condition issued by a planning authority. There should also be appropriate public notification of the plan, e.g. on a certificate issued under s.149 of *the Environmental Planning and Assessment Act 1979*.

Active or passive control systems

Auditors must specify whether the EMP requires operation and/or maintenance of active control systems or requires maintenance of passive control systems only. Active management systems usually incorporate mechanical components and/or require monitoring and, because of this, regular maintenance and inspection are necessary. Most active management systems are applied at sites where if the systems are not implemented an unacceptable risk may occur. Passive management systems usually require minimal management and maintenance and do not usually incorporate mechanical components.

Auditor's comments

Auditors may also include **comments** which are key observations in light of the audit which are not directly related to the suitability of the site for the use(s). These observations may cover aspects relating to the broader environmental context to aid decision-making in relation to the site.

Section B

In Section B the auditor draws conclusions on the nature and extent of contamination, and/or suitability of plans relating to the investigation, remediation or management of the land, and/or the appropriateness of a site testing plan in accordance with the *Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2017*, and/or whether the terms of an approved voluntary management proposal or management order made under the CLM Act have been complied with, and/or whether the site can be made suitable for a specified land use or uses if the site is remediated or managed in accordance with the implementation of a specified plan.

By certifying that a site *can be made suitable* for a use or uses if remediated or managed in accordance with a specified plan, the auditor declares that, at the time the audit was completed, there was sufficient information satisfying guidelines made or approved under the CLM Act to determine that implementation of the plan was feasible and would enable the specified use(s) of the site in the future.

For a site that *can be made suitable*, any **conditions** specified by the auditor in Section B should be limited to minor modifications or additions to the specified plan. However, if the auditor considers that further audits of the site (e.g. to validate remediation) are required, the auditor must note this as a condition in the site audit statement. The condition must not specify an individual auditor, only that further audits are required.

Auditors may also include **comments** which are observations in light of the audit which provide a more complete understanding of the environmental context to aid decision-making in relation to the site.

Part III

In **Part III** the auditor certifies their standing as an accredited auditor under the CLM Act and makes other relevant declarations.

Where to send completed forms

In addition to furnishing a copy of the audit statement to the person(s) who commissioned the site audit, statutory site audit statements must be sent to

- the **NSW Environment Protection Authority**: nswauditors@epa.nsw.gov.au or as specified by the EPA

  AND

- the **local council** for the land which is the subject of the audit.