nation partners

SOLUTIONS
FOR COMPLEX
PROJECTS

Remediation Action Plan – Chatswood Site

Sydney Metro

Certified B Corporation

nation partners

SOLUTIONS
FOR COMPLEX
PROJECTS

We help solve complex problems for projects

We believe that well-planned and targeted advice can help shape a project that is not only better developed, but is delivered more effectively, with greater acceptance and positive outcomes.

Nation Partners isn't your regular consulting firm. A certified B Corporation, we attract and develop the brightest thinkers and take an active part in shaping the world.

With expertise in projects in the government, transport, water, property and urban development sectors, we provide a suite of services aptly tailored to each client and project at hand.

Document title
Remediation Action Plan – Chatswood Site

Version
2.0

Date
April 2021

Prepared by
Pascal Nicolas and Liam Gooley

Approved by
Luke Clements

File name
NP19158_Chatswood RAP v2.0

Nation Partners Pty Ltd
ABN 96 166 861 892

Level 3, The Alley, 75-77 Flinders Lane
Melbourne Vic 3000

Suite 306, 50 Holt St
Surry Hills NSW 2010

☏ 1300 876 976
✉ info@nationpartners.com.au
🖵 **nationpartners.com.au**

Table of Contents

Tables (in text)

Figures (attached)

Revision History

Revision No.	Date	Reviewed By	Approved By	Comment
1.0	18/03/2021	L Gooley	L Clements	Draft for Sydney Metro and Site Auditor review
1.2	19/04/2021	L Gooley	L Clements	Revised draft addressing comments
2.0	27/04/2021	L Gooley	L Clements	Final

Executive Summary

Background	Nation Partners Pty Ltd (Nation Partners) has been engaged by Sydney Metro to prepare a remediation action plan (RAP) for the property known as the Chatswood Metro site, located at the north-east corner of the Pacific Highway and Mowbray Road, Chatswood, New South Wales (NSW) (the site). The location and boundary of the site are shown on the below **Figure 1**. Nation Partners understands Sydney Metro intends to divest the site following completion of the Sydney Metro – City and Southwest (SMCS) project. Nation Partners completed a Data Gap Investigation (Nation Partners, 2021) which has been utilised to prepare this RAP. This RAP has been prepared to inform and guide the remediation and validation required for the potential redevelopment of the Chatswood Metro site.

Objectives	Following an evaluation of remediation cost estimate (RCE) (Nation Partners, 2020) options, it is understood that an unrestricted development was the preferred option. This involves the preparation of the site to allow for the most conservative land use in accordance with the National Environment Protection Council (NEPC), *National Environmental Protection (Assessment of Site Contamination) Measure, 1999 (2013 amendment)* (NEPM, 2013), low-density residential with accessible soils. This would also therefore render the site suitable for any of the other, less conservative, land uses, such a high-density residential or public open space.
Drivers	A number of potentially complete source-pathway-receptor (SPR) linkages were identified in the refined CSM (Nation Partners, 2021) with respect to the preferred redevelopment scheme. These linkages warrant remediation for the site to be suitable for a potential future low-density residential land use.
Strategy	Following a remediation options assessment, an off-site disposal strategy was considered to be an economical, reliable, and risk adverse management measure to address the identified concentrations requiring remediation. It will achieve the objective of an unrestricted land use for divestment, from a contaminated soil perspective. Further, the site will likely require bulk excavation and earthworks for redevelopment, and the removal of surficial fill will likely represent cost and time savings for the prospective developer.
Additional Work	Following the Data Gap Investigation (Nation Partners, 2021), there are several data gaps with respect to remediation which are required to be addressed prior to the remediation works commencing. In particular: » There is the potential for shallow groundwater impacted by PFAS to be present. Investigation of the likelihood for shallow groundwater is required, in addition to an assessment on the potential exposure risk to site workers (if present). » Waste classification conducted as part of the Data Gap Investigation is considered to be preliminary only, and does not provide a sufficient sampling density to achieve assurance. Additional in-situ waste classification sampling is required to refine the waste classifications. It is noted that ex-situ classification will also be required prior to off-site disposal. » Asbestos containing material (ACM) has previously been reported to be present in the fill soils at the site, however the entire site has not been investigated in a sufficient manner to determine the potential wide-spread presence of ACM or friable asbestos/asbestos fines (FA/AF). An asbestos in soils investigation of the entire site is required to inform this data gap, and refine the remediation approach. » The footprint of the former energy depot building footprint has not been investigated to date. It is required to be investigated to inform the remediation approach. » Prior to demolition of site buildings, a hazardous building materials assessment is required to be completed by a suitably qualified person. Following completion of the above, a RAP Addendum should be prepared to document deviations from, and improvements to, the approach presented in this RAP.

Remediation Tasks	The proposed remediation methodology generally comprises: » Site preparation works, including establishment of the site, protection of off-site roads, and removal of buildings and hardstand with suitable controls for hazardous building materials (if identified). » Additional sampling to address the residual data gaps, define the remediation extent, and refine waste classifications. » Underground storage tank removal, and excavation of asbestos and chemically impacted soil. » Final waste classification of ex-situ waste stockpiles, prior to off-site disposal. » Materials tracking of all waste disposed of off-site, and materials imported to site. » Validation sampling of excavated surfaces, and preparation of a validation report demonstrating site suitability. » Earthworks and installation of erosion and sediment control measures to manage the site whilst vacant.
Remediation Extent	The indicative extent of remediation, prior to refinement following the additional sampling, is defined as: » Remediation Area A – former asbestos burial pits, and chemical impacts associated with a former service station. » Remediation Area B – a former asbestos slab. » Remediation Area C – a former underground storage tank associated with a former energy depot. » Remediation Area D – two former USTs, also associated with the former energy depot. » Remediation Areas E and F – exceedances in shallow soils. The above indicative extents are shown on the below **Figure C-1**.


Area A
3650m2
Area B
257m2
Area C
227m2
Area D
232m2
Area E
142m2
Area F
178m2
Pacific Highway
Mowbray Road
Appendix C-1: Indicative Extent of Remediation
Sydney Metro - Remediation Action Plan
Chatswood Site
Legend
Site Boundary
Asbestos Pit Location
Underground Storage Tanks
Possible Asbestos Slab
Indicative Extent of Remediation
nation partners

Post Remediation Considerations	Following completion of the works, it is not currently proposed to import material to replace the balance removed during remediation. It is also recognised that development plans may not be finalised or approved prior to completion of the remediation works. As such, interim site management is required. In particular, the site is to be left secure, and with sufficient grading, land-forming, and erosion and sediment control structures to minimise surface water and sediment run-off and dust generation. Following completion of the works, the groundwater dataset should be reviewed with respect to whether the groundwater monitoring wells require reinstatement and sampling. Site suitability is required to consider the condition of the groundwater, and whether on- or off-site receptors may be exposed to unacceptable risks during and post-redevelopment. A long-term environmental management plan is to be prepared to manage residual groundwater contamination. In particular, potential exposure to groundwater during bulk earthworks for redevelopment, and handling dewatered groundwater during redevelopment and future occupation of the site.

Acronyms and Abbreviations

ACM	asbestos containing materials
AF	asbestos fines
AHD	Australian Height Datum
ARCP	asbestos removal control plan
BaP	benzo(a)pyrene
BTEX	benzene, toluene, ethylbenzene and xylenes
CEMP	Construction environmental management plan
CSM	conceptual site model
DNAPL	dense non-aqueous phase liquid
EMP	environmental management plan
ENM	excavated natural material
EPA	Environment Protection Authority
ESL	ecological screening level
FA	friable asbestos
GDE	groundwater dependent ecosystem
GWMW	groundwater monitoring well
GSW	general solid waste
HEPA	Heads of EPAs Australia and New Zealand
HIL	health investigation level
HSL	health screening level
IDE	inflow dependant ecosystem
km	kilometre
LAA	licensed asbestos assessor
LNAPL	light non-aqueous phase liquid
LOR	limit of reporting
m	metre
mBGL	metres below ground level
MGA	Map Grid of Australia
MLP	Master Lease Property
NEPC	National Environmental Protection Council
NEPM	National Environment Protection (Assessment of Site Contamination) Measure

NSW	New South Wales
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PFAS	per- and poly-fluoroalkyl substances
PFAS NEMP	PFAS National Environmental Management Plan 2.0
PPE	personal protective equipment
PSV	passive soil vapour
RAP	remediation action plan
RCE	remediation cost estimate
REF	review of environmental factors
RMS	roads and maritime services
ROA	remediation options assessment
SAQP	sampling, analysis and quality plan
SEPP	State Environmental Planning Policy
SMCS	Sydney Metro – City and Southwest
SPR	source-pathway-receptor
SWMS	safe work method statement
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
TSE	Sydney Metro tunnel and station excavation contractor
UST	underground storage tank
VCH	volatile chlorinated hydrocarbons
VENM	virgin excavated natural material
WA DoH	Western Australian Department of Health

1. Introduction

Nation Partners Pty Ltd (Nation Partners) has been engaged by Sydney Metro to prepare a remediation action plan (RAP) for the property known as the Chatswood Metro site, located at the north-east corner of the Pacific Highway and Mowbray Road, Chatswood, New South Wales (NSW) (the site). The location and boundary of the site are shown in **Figure 1**.

Nation Partners understands Sydney Metro intends to divest the site following completion of the Sydney Metro – City and Southwest (SMCS) project. Nation Partners completed a Data Gap Investigation (Nation Partners, 2021) which has been utilised to prepare this RAP. This RAP has been prepared to inform and guide the remediation and validation required for the potential redevelopment of the Chatswood Metro site.

It is noted that this RAP is general with respect to the overarching approach to the works. This is a result of residual data gaps from the Data Gap Investigation (Nation Partners, 2021) which are required to be investigated and addressed as part of the RAP implementation. See **Section 6.2.4** for further detail.

Due to the anticipated period of several years between this RAP being issued and the works occurring, prior to implementation of this RAP, a suitably qualified person should review and update it as necessary through the preparation of a RAP Addendum.

1.1 Structure of the RAP

This RAP consists of the following sections:

» Section 1 – the background of the site and the objectives of the RAP.

» Section 2 – a description of the site, its location, and the proposed redevelopment.

» Section 3 – a summary of previous investigations undertaken at the site.

» Section 4 – the conceptual site model (CSM), which summarises the potential exposure of receptors (human and environmental) to identified contamination, and residual data gaps which remain in the CSM.

» Section 5 – the remediation options assessment and determination of the preferred strategy.

» Section 6 – the detail of the remediation strategy, including tasks to be undertaken.

» Section 7 – relevant environmental planning and approvals processes for the works.

» Section 8 – site management considerations for undertaking the works.

» Section 9 – the validation process to demonstrate that the site has been remediated and is considered suitable for the proposed use.

» Section 10 – a high level overview of the long-term environmental management considerations for the site.

1.2 Background

The site is part of a larger property owned by Sydney Metro being utilised for construction activities associated with the SMCS project. The eastern portion of the property comprises a dive area for the development of the Sydney Metro project as shown in **Figure 1** and will be retained as an operational part of the Sydney Metro network following the completion of the construction works. As such, the dive portion is not considered part of the site in this RAP. The remainder of the property comprises the site and is currently used for construction staging. However, it is understood that Sydney Metro intends to divest the site, and it will likely be redeveloped by the purchaser.

As part of divestment planning, Sydney Metro engaged GHD Pty Ltd (GHD) to prepare a contamination summary report (GHD, 2020a), a remediation option assessment (ROA) (GHD, 2020b), and a remediation

cost estimate (RCE) (GHD, 2020c). The exact future use of the site is unknown, however for the RCE, GHD considered two potential redevelopment scenarios: a high-density residential land use with basement car parking; and a mixed high-density residential with basement car parking and education land use. The contamination summary report provided an at-the-time understanding of the contamination status of the site and outlined outstanding gaps in the understanding of contamination conditions. The ROA and RCE contained conservative assumptions as a result of the current gaps in understanding the contamination status of the site, leading to estimates of remediation costs that were considered high uncertainty and high cost.

Nation Partners was subsequently engaged to undertake a data gap investigation (Nation Partners, 2021) and prepare an updated draft RCE (Nation Partners, 2020). The data gap investigation (**Figure 2**) refined the CSM for the site, and investigated data gaps identified by GHD (2020a). The updated RCE considered the GHD land use scenarios, in addition to an unrestricted land use, and provided refined cost estimates associated with remediation scenarios, utilising results from the Data Gap Investigation.

Following an evaluation of the RCE options, it is understood that the Unrestricted Development Scheme was the preferred option. This scheme involves the preparation of the site to allow for the most conservative land use in accordance with the National Environment Protection Council (NEPC), *National Environmental Protection (Assessment of Site Contamination) Measure, 1999 (2013 amendment)* (NEPM, 2013), low-density residential with accessible soils.

To facilitate the intended divestment and redevelopment, Sydney Metro have engaged Mr Lange Jorstad from Geosyntec Consultants Pty Ltd as a NSW Environment Protection Authority (EPA) accredited site auditor under the *Contaminated Land Management Act 1997* to undertake a non-statutory site audit for the site. Nation Partners understands that this RAP will form part of the non-statutory site audit.

A number of potentially complete source-pathway-receptor (SPR) linkages were identified in the refined CSM (Nation Partners, 2021) with respect to the preferred redevelopment scheme. It was considered that these linkages warrant remediation for the site to be considered suitable for a potential future low-density residential land use. Additionally, there are several residual data gaps which are required to be addressed to inform the remediation approach outlined herein.

1.3 Objectives

The objective of this RAP is to present a plan of the anticipated remediation that will allow the potential redevelopment of the site to proceed in a manner that protects human health and the environment, and also makes the site suitable for the applicable land use.

1.4 Scope of Work

To meet the objectives stated above, the following scope of works were completed for the development of this RAP:

» Summarised the findings of the Data Gap Investigation, including:

– The site's location current conditions and use, history and environmental setting (including surrounding areas).

– The identified contamination, including CSM, critical data gaps, and priority SPR linkages requiring further assessment or management.

» Assessed applicable remedial technologies and identified a preferred remedial approach.

» Developed a methodology for the preferred option, including the necessary site management.

» The necessary remediation site management requirements were identified including:

– Details of approvals and/or licences that are required by regulatory authorities.

  - Environmental management requirements to be implemented during the remedial works.
  - Roles and responsible of interested parties during the remedial works, including the likely proponent, the remediation contractor, and the validation consultant.
- Developed validation requirements and site-specific validation criteria.
- Developed contingency plans for a range of potential scenarios that could arise during the remedial works.

1.5 Guideline Documents

The RAP was prepared with reference to the following guidance documents:

- Heads of EPAs Australia and New Zealand (HEPA), 2020, *PFAS[1] National Environmental Plan Version 2.0* (PFAS NEMP, 2020).
- NEPM, 2013.
- NSW EPA, 1995, *Sampling design guidelines* (NSW EPA, 1995).
- NSW EPA, 2014, *Waste Classification Guidelines – Part 1: Classifying Waste* (NSW EPA, 2014).
- NSW EPA, 2016, *Addendum to the Waste Classification Guidelines (2014) – Part 1: Classifying Waste* (NSW EPA, 2016).
- NSW EPA, 2017, *Contaminated Land Management, Guidelines for the NSW Site Auditor Scheme (3rd edition)* (NSW EPA, 2017).
- NSW EPA, 2020, *Consultants reporting on contaminated land: Contaminated land guidelines* (NSW EPA 2020).
- SafeWork NSW, 2019, *Code of Practice: How to Manage and Control Asbestos in the Workplace* (SafeWork, 2019a).
- SafeWork NSW, 2019, *Code of Practice: How to Safely Remove Asbestos* (SafeWork, 2019b).
- WorkCover NSW, 2014, *Managing Asbestos In or On Soil* (WorkCover, 2014).
- Western Australian Department of Health 2009 *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (WA DoH, 2009).

[1] Per- and poly-fluoroalkyl substances

2. Site Description

The following sections provide information on the site location, investigation area, current and historical land uses and surrounding land uses.

2.1 Site Location and Identification

The site is located on the north-east corner of the Pacific Highway and Mowbray Road, Chatswood, approximately 7 kilometres (km) north of Sydney Central Business District. The site location is shown on **Figure 1**, and additional site identification details are summarised in **Table 1**.

Table 1: Site Identification Details

Current Site Owner:	Sydney Metro
Address:	Central Portion (Former Ausgrid depot) 339 Mowbray Road, Chatswood Northwest Portion (Former Caltex service and Master Lease Property [MLP] site) 607 Pacific Highway, Chatswood Southwest Portion (Former retail area) 589 Pacific Highway, Chatswood
Co-ordinates (Map Grid of Australia [MGA] Zone 56):	331540 metres (m) East; 6258050 m North (approximate centre of the site)
Legal Identification:	Central Portion (Former Ausgrid depot) Lot 1 / DP243111; Lot 2 / DP221896; Lot 6 / DP66854; Lot 5 / DP524631; Lot 18 / DP60346; Lot 2 DP537580; Lots 4, 5 & 6 / DP65670 Northwest Portion (Former Caltex service and MLP site) Lot 1 / DP537580; Lot 1 / DP503447; Lot 2 / DP1223080; Lot 3 / DP961402; Lots 3 & 4 / DP455907 Southwest Portion (Former retail area) Lot 1 / DP216408; Lot 1 / DP204133; Lot 1 / DP50875; Lot 3 / DP58646; Lot 6 / DP72759
Site Area:	Approximately 18,000 square metres (m^2) excluding the Sydney Metro Dive Site
Location Government Area:	Willoughby City Council
Zoning:	SP2 – Infrastructure, majority of site B2 – Business development, western portion R3 – Medium density residential – boundary with Nelson Street

2.2 Site Features

Observations and comments presented below are reported in previous investigations as summarised in the Data Gap Investigation Report (Nation Partners, 2021):

» The site is currently owned by Sydney Metro and utilised for construction activities associated with the SMCS project.

» The site is relatively flat with elevation that ranges from 102 m Australian Height Datum (AHD) in the north to 104 mAHD in the south. It exists on a gentle slope observed to extend toward the north to north-east and north-west from a high point in the south.

» GHD (2020a) noted that the majority of rainfall across the site is likely to enter the local stormwater system to the north before flowing either east or west. Two likely stormwater discharge points were identified: Scotts Creek, 1.7 km north; or Castle Cove, 3.6 km east of the site.

» Two permanent structures from prior to Sydney Metro's ownership remain on-site. These are the transformer workshop in the central portion of the site, and the heritage-listed Mowbray House in the south-east corner of the site.

» The site is entirely covered with concrete hardstand. The SMCS Tunnel and Station Excavation (TSE) contractor established a layer of clean fill over the original hardstand surface of the carpark, and then established additional concrete slabs, buildings and other infrastructure on top of the clean fill.

2.3 Surrounding Land Use

The land adjacent to the site is characterised by:

» North: Nelson Street, followed by commercial and residential properties.

» East: Dive portion for SMCS, and then the Northern Railway line.

» South: Mowbray Road, followed by a telecommunications tower, electricity substations and water tank reservoirs.

» West: The Pacific Highway, followed by commercial properties, including a Caltex service station and then residential properties.

The surrounding land is characterised primarily by commercial and medium density residential land use.

The nearest water body to the site is Swainess Creek which is approximately 1 km west-northwest of the site. Swainess Creek flows west towards the Lane Cove River, approximately 2 km west of the site.

2.4 Geology and Soils

The site is underlain by Ashfield Shale of the Wianamatta Group from the Triassic period, which is comprised of black to dark grey shale and laminate. Approximately 500 m both east and west of the site is Triassic period Hawkesbury Sandstone, a medium to coarse grained quartz sandstone. Very minor shale and laminate lenses are also present in the surrounding area.

A summary of soils encountered during the Data Gap Investigation (Nation Partners, 2021), is provided in **Table 2**.

Table 2: Site Soil Summary

Approximate Depth Range (mBGL)	Unit/Material	Description
0.0 to 0.2-1.6	Concrete/asphalt	FILL: Concrete was encountered across the entire site. Asphalt was encountered in SRT-PT017, which is located near the former Bryson Road.

Approximate Depth Range (mBGL)	Unit/Material	Description
0.2-1.6 to 0.4-4.5	Fill	FILL: Material generally consisted of road base, dark brown and dark grey gravelly clays and sands, coarse grained. Encountered between concrete slabs across the site.
0.4-4.5 to ≥ 4.5	Reworked natural materials	CLAY: Reworked natural clays and clays with sand, ranging from reddish brown to yellowish brown. Generally soft, dry-moist. Sometimes containing gravel.
	Natural	CLAY: Clay, reddish-brown with some grey or red mottling. Stiff to very stiff with trace gravel.
	Natural	CLAY: Grey clay with red mottling. Generally stiff to very stiff, dry with fine-coarse gravel and ironstone, with silt at times.
≥ 11.0	Natural	SHALE: Grey weathered shale
mBGL – metres below ground level		

Secondary sub-surface concrete slabs of 0.2-0.4 m thickness were also encountered underneath a layer of fill during the Data Gap Investigation. Concrete was encountered to a depth of 4.5 mBGL in SRT-PT014, though this is not considered to be representative of site conditions, and likely attributed to an old footing or pier. Further details including bore logs are available in the Data Gap Investigation Report (Nation Partners, 2021)

2.5 Hydrogeology

During the Data Gap Investigation, two water-bearing zones were identified, consistent with previous investigations:

- An intermittent shallow, semi-confined or perched aquifer at approximately 5 mBGL with water levels recorded at approximately 3-4 mBGL. Water in this zone was inferred to be from rainfall recharge that was perched in the low permeability clay profile.
- A deeper confined or semi-confined aquifer within clay/weathered shale with some gravel and/or silt at approximately 12 – 14.5 mBGL. This water-bearing zone was typically overlain by approximately 6.5 m of low permeability clay.

Groundwater levels were gauged during Stage 1 and Stage 2 groundwater monitoring events. Inferred groundwater contours and flow directions for the deeper aquifer from Stage 1 and Stage 2 are presented on **Figures 3a** and **3b** respectively.

Deeper groundwater levels and flow direction were inferred during both targeted groundwater monitoring events. Observations from Stage 1 indicated that groundwater flow across the site was typically towards the north-east. In contrast, groundwater gauging conducted during Stage 2 indicated that groundwater flow was generally towards the north-west. A number of potential factors behind the change in hydrogeological conditions have been identified in the Data Gap Investigation report, including seasonal changes with significantly higher rainfall levels experienced prior to Stage 1 when compared to Stage 2, and the impact of the tunnel construction, specifically the recovery of groundwater conditions following the completion of tunnel construction/boring.

The hydrogeology on site, according to regional plans in Lotsearch (2020) (within GHD, 2020a), is characterised by extensive, porous aquifers of low to moderate productivity. Groundwater may potentially discharge into Scotts Creek, approximately 1.7 km north east of the site before flowing into Castle Cove, approximately 3.7 km east of the site.

2.6 Sensitive Environmental Receptors

Stormwater and groundwater both potentially discharge into Scotts Creek, approximately 1.7 km north east of the site, and Castle Cove, approximately 3.7km east of the site.

No inflow dependent ecosystems (IDE) or groundwater dependent ecosystems (GDE) exist on the site. Approximately 989 m west of the site is a potential terrestrial GDE, whilst there is a moderate likelihood of an IDE occupying an area within deeply dissected sandstone plateaus, also approximately 989 m west of the site (Lotsearch, 2020).

A search of the NSW BioNet Atlas of the area within 10 km of the site is included in Lotsearch (2020). A number of NSW and federally listed vulnerable and endangered species are identified within the search including birds, mammals, reptiles and plants. It is noted that the site and immediate surrounds are highly disturbed and developed urban land, unlikely to support these species.

2.7 Proposed Land Use

Nation Partners developed a draft RCE (Nation Partners, 2020), which refined assumptions in the GHD RCE (GHD, 2020b) and provided updated cost estimates associated with remediation scenarios developed within the RCE workshops. Incorporated within the draft RCE was an updated ROA which assessed a number of redevelopment schemes and remediation options.

The below (**Table 3)** redevelopment options were considered as part of the RCE. It is noted that due to the depth to groundwater being approximately 15 mBGL, and driver for remediation being surficial soil impacts, consideration of remediating potentially impacted groundwater was excluded from the RCE.

Table 3: Redevelopment Options

Scheme Name	Scheme Summary	Preferred Option (Y/N)
Metro	Two high-density residential developments with basement car parking, down to 15 mBGL. The heritage listed Mowbray House will be retained, and public open space will be present between the two developments and surrounding Mowbray House	N
Education	One high-density residential development with basement car parking to 15 mBGL, and a high-density education development with no basement car parking. Mowbray House would be retained for an education use, and the remainder of the site would be retained as public open space.	N
Unrestricted	With the exception of retaining Mowbray House and its associated heritage curtilage, the site would be rendered suitable for the most sensitive land use, low-density residential, without the restrictions (from a contaminated land perspective) of the other two scenarios, presented as having mixed land uses across the site.	Y

This RAP has been developed to render the site suitable for the unrestricted redevelopment scheme. It is noted that a number of sub-options per redevelopment scenario were provided. For the unrestricted scheme, the preferred strategy is understood to be combination of Options A and B, namely:

» Option A – Off-site disposal of known health-based exceedances in soil.

» Option B – Off-site disposal of all fill across the entire site, to be refined through additional investigation (**Section 6.2.4**). In particular, the potential presence of wide-spread asbestos in soils is a data gap. If wide-spread asbestos in soils is identified, they will require off-site disposal. If they are not identified, the remediation will focus on areas of health-based exceedances.

3. Contamination Status

The presence of contamination at the site was characterised during the Data Gap Investigation via soil, groundwater, and soil vapour sampling. Additionally, the historical investigations summarised in GHD 2020a were reviewed and consolidated. The findings of the Data Gap Investigation are summarised in this section.

3.1 Previous Investigations

GHD undertook a review of 53 previous environmental reports relating to the wider property, and provided a summary of contamination on the site in the context of the indicative future land uses for the site. The historical sampling locations and diagrammatic CSM prepared by GHD (2020a) are presented in **Attachment A**, and exceedances are summarised on **Figure 4**. Key findings included:

- A number of historic businesses occupied areas of the site which presented potentially contaminating activities, including: a former Caltex service station; an auto electrician; a carpet retail business; and Ausgrid (and predecessors) occupied the central and northern portion of the site as an electrical depot facility.
- All known primary sources of contamination, including residual soil impacts, had been removed from the former Caltex in the north-west portion of the site. Total Recoverable Hydrocarbon (TRH) impacted soil from the Caltex was bioremediated and retained in two burial pits (EXC_1 and EXC_MLP). Asbestos Containing Material (ACM) identified during the works was also retained within the two burial pits. During validation works for the Caltex site, the southern, eastern, and western basement walls remained in-situ, so validation of soil behind the walls was not able to be conducted and it is likely that the soil contains residual hydrocarbons. Residual TRH impacts in the soil are thought to be associated with the groundwater smear zone, the basement walls of the former Caltex building, and the bioremediated soil burial pits.
- The presence of 'froth' was noted during the removal of three underground storage tanks (USTs) (numbers 1, 2 and 3) from the former Ausgrid energy depot site and could indicate the presence of surfactants. No sampling to date had occurred to confirm the presence of surfactants including for PFAS in the area.
- An additional three decommissioned USTs (numbers 4, 5, and 6) and associated infrastructure remain in-situ in the centre of the site associated with Ausgrid's former occupation, and may be contributing to contamination in the area. UST 4 is located to the north of Mowbray House, while UST 5 and UST 6 are in southern central portion of the site. The decommissioned USTs have been filled with concrete.
- Historical soil exceedances of the adopted criteria were noted for TRH, benzene, xylene, polycyclic aromatic hydrocarbons (PAHs), lead, and asbestos in the area around the former transformer oil USTs (5 & 6) and associated infrastructure, in the north west portion (former Caltex service station and MLP site), and in one location near the centre of the site (shown on **Figure 4**).
- The former buildings on the energy depot contained hazardous building materials, including ACM, which potentially could act as a source of soil contamination in this portion of the site.
- An asbestos slab (potentially removed by the TSE contractor) was located in the central northern area, near Nelson Street.
- Exceedances of the adopted groundwater investigation levels for TRH and benzene. Light non-aqueous phase liquid (LNAPL) was detected at the former Caltex service station site in 2009. It is noted that dense NAPL (DNAPL) has not previously been detected at the site. Volatile chlorinated hydrocarbons (VCH) have also been detected in groundwater, with one exceedance of the 1,2,3-trichlorobenzene criterion. GHD also noted that all groundwater data was greater than five years old and that some portions of the site had no data.

3.2 Data Gap Investigation

The Data Gap Investigation completed by Nation Partners was undertaken to close out data gaps identified by GHD (2020a). The sampling locations are shown on **Figure 2**, inferred groundwater contours on **Figures 3a and 3b**, soil exceedances on **Figure 4**, and groundwater exceedances on **Figures 5a and 5b**. The investigation comprised:

» A review of the GHD reports (2020a, 2020b, and 2020c).

» Installation of 13 deep groundwater monitoring wells (GWMW) and associated soil sampling.

» Installation of 4 shallow GWMWs.

» Advancement of 12 soil bores and associated soil sampling.

» Installation and sampling of 12 passive soil vapour samplers (PSV).

» Two targeted groundwater monitoring events conducted in July 2020 and October 2020.

The key findings of Data Gap Investigation were:

» The results of the soil sampling identified:

– Exceedances of the adopted human health investigation levels for benzo(a)pyrene (BaP), benzene, lead, PAHs, and TRH.

– Exceedances of the adopted ecological investigation levels for BaP and zinc.

– The majority of exceedances were reported within fill materials and mainly within the western portion of the site, with only three exceedances recorded in natural soils.

» The results of the groundwater sampling identified:

– Exceedances of the adopted human health investigation levels for arsenic, BaP, benzene, lead and PFAS.

– Exceedances of the adopted ecological investigation levels for copper, lead, mercury, nickel, PFAS, and zinc.

– Groundwater in the south-west and south-east portions of the site was typically impacted by PFAS, whilst benzene impacted groundwater was encountered near the north-eastern boundary of the site.

» The results of the PSV sampling identified:

– Whilst historically elevated levels of tetrachloroethene in soil vapour at former vapour monitoring location ‘V01’ had been reported, no exceedances of investigation levels were identified.

– Sampling targeting Mowbray House did not identify any exceedances of investigation levels.

» Based on the concentrations of PFAS observed, and the inferred groundwater flow direction for the site, the potential for PFAS to be migrating onto the site via groundwater from an off-site source cannot be discounted, although further data is required to identify specific PFAS sources. It was noted that the presence of PFAS in groundwater poses a potential risk to human and ecological receptors during construction and ongoing operation of future basements if the basements are deep enough to interact with groundwater.

» Potential pathways for the migration and ingress of groundwater and vapour from surrounding in-situ materials into potential future basements were assessed as part of this investigation. Concentrations of TRH and benzene, toluene, ethylbenzene and xylenes (BTEX) were either below the adopted investigation levels for vapour intrusion; or exceedances were located and delineated such that impacted material would be excavated for the construction of the future basements.

» A preliminary in-situ waste classification was completed for the site, with further details presented in **Section 4.3.3**. Additionally, the refined CSM developed during the investigation is presented in **Section 4.1**.

4. Conceptual Site Model and Data Gaps

This section presents the CSM, developed and refined during the Data Gap Investigation.

4.1 Conceptual Site Model

The CSM shown in **Table 4** includes only SPR linkages that have been assessed to be complete, potentially complete, or currently incomplete that will be addressed in this RAP, in regard to the future redevelopment of the site.

Table 4: Conceptual Site Model

Source	Impacted Media	Pathways	Receptors	Assessment/Rationale	RAP Consideration
Former energy depot (central portion) including transformer workshop area, USTs, vehicle workshop, wash bay and oil storage tanks	Soil impacted by heavy metals, TRH and BTEX	Dermal contact / ingestion of soils	Site workers, contractors, visitors Future site users	No exceedances of the health investigation and screening levels were observed in this area during this investigation, Exceedances of lead and PAH were reported in SRT-PT017, though are attributed to the former Bryson Road. Site constraints meant that soils underneath or near the current building footprint in this area could not be assessed nor has assessment occurred historically. Historical exceedances of lead and PAH have been observed near UST 5 and 6. This SPR linkage is considered **potentially complete**.	The RAP to be developed for the site should include provisions for the sampling of soils in the footprint of the former energy depot buildings. Although not detected to date, given the historical use of the building the future sampling should include analysis for polychlorinated biphenyls (PCBs).
			Ecological receptors that inhabit or forage in public open space parkland areas proposed for the site	One zinc exceedance of the ecological screening level (ESL) was observed within the footprint of this area during the investigation, and exceedances of TPH have been observed historically in the vicinity of former pipework associated with USTs 5 and 6 (VA1, VA2 and VA3). This SPR linkage is considered to be **currently incomplete** due to the lack of ecological receptors on the site. There is the potential for the SPR linkage to be **potentially complete** in the future redevelopment. However, exceedances of the adopted investigation levels presented in this report will likely be excavated or future public open space areas will utilise imported soil.	Validation or further sampling of public open space areas of the site are to consider ecological receptors during the assessment.
		Dust and fibre inhalation	Site workers, contractors, visitors	Impacted fill and buried asbestos impacted material poses a potential risk to site workers, contractors and visitors if materials are exposed. Historic investigations indicate the presence of chrysotile asbestos (**Figure 6**) within the footprint of the former energy depot, though currently the site is covered by hardstand. This SPR linkage is considered to be **currently incomplete**.	The RAP is required to consider the known and potential presence of asbestos in soils.

Source	Impacted Media	Pathways	Receptors	Assessment/Rationale	RAP Consideration
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	PFAS exceedances, including exceedances of the PFAS NEMP Freshwater 95% and Drinking Water criteria were observed in this area. Froth observed during the removal of USTs 1, 2 and 3 could potentially be linked to the presence PFAS within groundwater (**Section 4.3.2**), though no PFAS were detected above the limit of reporting (LOR) in soils during the investigation. Should PFAS impacted groundwater be abstracted from this area there is the **potential** for a **complete** pathway to exist.	The potentially complete pathway to be considered during remedial planning and future redevelopment.
Former Caltex service station and MLP site including former bulk fuel storage and USTs	Soil impacted by heavy metals, TRH and BTEX	Dermal contact / ingestion of soil	Site workers, contractors, visitors Future site users	Exceedances of human health investigation and screening levels were observed in 3 soil samples including exceedances of TRH and lead as part of this investigation, with additional lead, TRH and BTEX exceedances observed historically. Elevated concentrations of TRH were also observed in other soil samples in the area. This SPR linkage is considered to be **currently incomplete**, as contaminated soils are currently located under hardstand. This SPR linkage could be **potentially complete**, during the redevelopment of the site.	The RAP is required to consider the presence of TRH and BTEX in soils.
			Ecological receptors that inhabit or forage in public open space parkland areas proposed for the site	Exceedances of the ESL for total petroleum hydrocarbons (TPH) have been observed in this area in a number of occasions in historical investigations, and two exceedances were observed as part of this investigation (SRT-PT016). The majority of exceedances were reported at depths of 2 mBGL or deeper (with the exception of one sample) at the time of each respective investigation. This SPR linkage is considered **potentially complete** and should be reassessed based on the design of any proposed public open space areas.	Validation or further sampling of public open space areas of the site are to consider ecological receptors during the assessment.
		Dust and fibre inhalation	Site workers, contractors, visitors	Impacted fill and buried asbestos impacted material (including asbestos pits) poses a potential risk to persons working on the redevelopment of the site if disturbed. This SPR linkage is considered to be **currently incomplete**.	The RAP is required to consider the known and potential presence of asbestos in soils.

Source	Impacted Media	Pathways	Receptors	Assessment/Rationale	RAP Consideration
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	PFAS was reported in concentrations above the drinking water and ecological criterion in groundwater in SRT-MW018 and should groundwater be abstracted from this area there is the **potential** for a **complete** pathway to exist. The former Caltex service station and MLP site is considered to be an unlikely source of PFAS observed across the site, based on concentrations of PFAS observed and the inferred groundwater flow across the site.	The potentially complete pathway to be considered during remedial planning and future redevelopment.
Former Total Quality Centre where waste solvents, reagents and oils were stored	Soil	Dust and fibre inhalation	Site workers, contractors, visitors	Impacted fill and buried asbestos impacted material (including potential asbestos slab) poses a potential risk to persons working on the redevelopment of the site. This SPR linkage is considered to be **currently incomplete**, though will require consideration within the RAP, with regard to asbestos.	The RAP is required to consider the known and potential presence of asbestos in soils.
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	Exceedances of the adopted investigation levels for heavy metals and PFAS were observed in GWMWs located near the area where the Former Total Quality Centre was located, though typically lower than the remainder of the site. PFAS was reported in concentrations above the drinking water and ecological criterion in groundwater in SRT-MW022 and SRT-MW024, and should groundwater be abstracted from this area there is the **potential** for a **complete** pathway to exist.	The potentially complete pathway to be considered during remedial planning and future redevelopment.
	Air	Inhalation of soil and groundwater derived vapours in indoor air	Site workers, contractors, visitors Future site users	The exceedance of the health screening level for benzene observed in SRT-PT020 could potentially be linked to historical contamination associated with the Former Total Quality Centre. No other exceedances including historical have been observed. This SPR linkage is considered to be **currently incomplete**, as the site is currently covered by hardstand.	The pathway is to be considered during remedial planning.

Source	Impacted Media	Pathways	Receptors	Assessment/Rationale	RAP Consideration
Former Retail Area	Soils impacted by heavy metals	Dermal contact / ingestion of soil	Site workers, contractors, visitors Future site users	Exceedances of the health investigation levels were observed in 2 soil samples for lead within fill material in this area. This SPR linkage is considered to be **currently incomplete**, as contaminated soils are currently located under hardstand. This SPR linkage could be **potentially complete**, during the redevelopment of the site.	The RAP is required to consider the potential dermal contact / ingestion of soil risk.
	Groundwater impacted by PAH and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	PFAS was detected in concentrations above the drinking water and ecological freshwater criteria in numerous GWMW, with the highest concentrations observed in the up-gradient south-western portion of site. PFAS is likely from an on-site source, though this is yet to be confirmed. BaP was detected above the drinking water criterion in SRT-MW009S during stage 1 of the investigation only. This was the only detection above LOR for BaP across the site, and was potentially due to leaching from BaP impacted fill within the water column. Should impacted groundwater be abstracted, including for any potential future basement scenario, there is a **potentially complete** pathway which exists.	The potentially complete pathway to be considered during remedial planning and future redevelopment.
TSE and historically imported fill from unknown sources and unknown contamination within areas not assessed	Soil impacted by TRH, BTEX, PAH and asbestos or other contaminants	Dermal contact / ingestion of soil	Site workers, contractors, visitors. Future site users	This SPR linkage is considered to be **currently incomplete**, though during the redevelopment of the site, the removal of hardstand could expose previously undetected contaminated fill.	The RAP is required to consider the potential dermal contact / ingestion of soil risk.
		Dust inhalation	Site workers, contractors, visitors. Future site users	Impacted fill material poses a potential risk to persons working on the redevelopment of the site. This SPR linkage is considered to be **currently incomplete**.	The RAP is required to consider the potential dust inhalation risk.

Source	Impacted Media	Pathways	Receptors	Assessment/Rationale	RAP Consideration
		Inhalation of asbestos fibres	Site workers, contractors, visitors Future site users	No asbestos was detected during the investigation, though, as soil was sampled and assessed via boreholes, only a small proportion of the site was assessed. Large amounts of asbestos have previously been discovered in fill material on the site during the remediation of the former Caltex service station. Currently any potential asbestos impacted fill is covered by hardstand. Therefore, this SPR linkage is considered to be **currently incomplete**.	The RAP is required to consider the known and potential presence of asbestos in soils.

4.2 Data Gaps

The following data gaps were identified following the Data Gap Investigation (Nation Partners, 2021) in relation to the key SPR linkages discussed in the CSM and the site dataset:

- Further groundwater data is required to assess groundwater conditions including changes in flow directions and levels, groundwater contamination, and the extent of natural attenuation. Groundwater conditions appeared to have change in a relatively short period of time during the Data Gap Investigation, and may not be indicative of futures conditions. Further information is required to assess the impact this may have on potential future pathways and receptors.
- The potential for PFAS in shallow groundwater within remediation excavations is unlikely to present a risk to remediation site workers. However, an assessment of the likelihood for shallow groundwater to be generated should be undertaken to provide an additional line of evidence to close out the data gap.
- Further data is required to identify specific sources of PFAS to understand potential SPR linkages associated with the abstraction of groundwater and future basement scenarios.
- ACM has previously been reported to be present in the fill soils at the site, however the entire site has not been investigated in a sufficient manner to determine the potential wide-spread presence of ACM or friable asbestos/asbestos fines (FA/AF).
- The potential for asbestos in soils was identified, based on previous investigations. The potential for widespread asbestos beneath the existing site hardstand requires further investigation.
- Preliminary waste classifications indicated that the fill across the site is likely general solid waste (GSW), with the underlying soil likely excavated natural material (ENM). Exceptions to these classifications are the historic asbestos burial pits, potential asbestos slab, soil in the vicinity of USTs, potential for wide-spread asbestos, and exceedances of the ENM absolute maximum for TPH C_{10}-C_{36} and BaP. During site remediation and redevelopment, additional waste classification sampling and analysis is required to confirm waste classifications prior to off-site disposal.

4.3 Summary of Identified Exceedances

Based on available assessment data, identified concentrations of contaminants exceeding adopted criteria are summarised on **Figures 4, 5a,** and **5b**, and in the following sections.

4.3.1 Soil

The identified exceedances are predominantly TRH and BTEX compounds in the vicinity of former UST infrastructure, and in shallow fill. In particular, the majority of exceedances are in validation samples from the previous remediation excavations at the former Caltex. Isolated PAH and lead exceedances are also present across the site. A summary table of the identified impacts is presented in **Attachment B**.

4.3.2 Groundwater

Exceedances of the adopted human health investigation criteria for arsenic, BaP, benzene, lead, and PFAS were reported in groundwater in the Data Gap Investigation (Nation Partners, 2021). Groundwater in the south-west and south-east portions of the site were typically impacted by PFAS, whilst benzene impacts were encountered near the north-eastern boundary of the site. Heavy metal concentrations were noted to be generally consistent across the site.

Potential pathways for the migration of and ingress of groundwater and vapour from surrounding in-situ materials into potential future basements were assessed (Nation Partners, 2021). Concentrations of hydrocarbons and BTEX were either below the adopted investigation levels for vapour intrusion, or where exceedances were reported for benzene in soil, they were located and delineated such that impacted material

would be excavated for the construction of the future basements. Hydrocarbons and BTEX were not considered to pose a risk to potential future site users in a basement scenario, however the presence of PFAS in groundwater poses a potential risk to human and ecological receptors during construction and ongoing operation of future basements.

Although PFAS has been detected in the shallow and deep groundwater at the site, a qualitative review identified that it presented a low potential risk to human and ecological receptors. In particular, the concentrations are below the relevant screening level for intrusive workers. Additionally, shallow groundwater is unlikely to be present in significant volumes, however, requires further assessment to confirm this.

The depth to deep groundwater of approximately 15 mBGL means intrusive maintenance workers are unlikely to encounter deep groundwater. Additionally, the presence of reticulated mains water means abstraction of water is very unlikely. Further, there is a lack of off-site receptors in the vicinity of the site. The only realistic pathway for exposure to groundwater is on-site abstraction or contact during deep bulk excavation, which is unlikely under the current land use, and unknown under the proposed future land use.

As a specific source of PFAS in groundwater was unable to be identified during the Data Gap Investigation, targeted source removal is considered unfeasible, and remediation of groundwater has not been considered further. Whilst PFAS in groundwater poses a direct contact risk if encountered during construction or dewatering works, the current uncertainty with respect to the design of future basements means the presence of PFAS in groundwater is required to be considered during redevelopment planning. In particular, the basement design should consider whether groundwater will be intercepted and require ongoing management post-construction.

A suitably qualified environmental practitioner should be consulted with respect to groundwater management or remediation following completion of the additional sampling (see **Section 6.2.4**), and once the approved or issued for construction design documentation for the basements has been issued. If necessary, a specific groundwater remediation action plan should be developed.

4.3.3 Preliminary Waste Classification

Preliminary in-situ waste classification undertaken during the Data Gap Investigation (Nation Partners, 2021) in accordance with the *Waste Classification Guidelines, Part 1 – Classifying Waste* (NSW EPA, 2014), indicated that the fill across the site is preliminarily classified as GSW, with the underlying natural soil preliminarily classified as ENM. The exceptions to these classifications being:

- **Historic asbestos burial pits**: two burial pits are known to be present, based on previous reports (shown on **Figure 2**). The pits are associated with previous remediation works of the Former Caltex service station and MLP site. Petroleum hydrocarbon impacted soil was land-farmed and retained on-site in the pits. During the remediation works, ACM in the form of bonded ACM sheet fragments was observed in soils. These soils were also retained within the burial pits. Therefore, the material within these pits is preliminarily classified as GSW (special-asbestos).
- **Potential asbestos slab**: previous reports indicate the potential presence of an asbestos slab, shown on **Figure 2**. The slab and surrounding soils (nominally 0.2 m) are preliminary classified as GSW (special-asbestos).
- **Soil in the vicinity of USTs**: three of the six known USTs (1, 2 and 3) at the site have been removed and validated, with the other three (UST 4, 5 and 6) decommissioned in-situ by filling with cement. These three USTs require removal should redevelopment of the site occur. It is assumed that potentially TRH impacted soil surrounding the USTs is classified as GSW.
- **Wide-spread asbestos**: ACM has previously been reported to be present in fill soils at the site, however the entire site has not been investigated in a sufficient manner to determine the potential wide-spread presence of ACM. As such, it is assumed that fill in unspecified areas across the site may need to be classified as GSW (special-asbestos).

- **Exceedances of the ENM Absolute Maximum**: Exceedances of TPH C_{10}-C_{36} and BaP above the allowable ENM Absolute Maximum was reported in five soil samples at depths of 3.4 mBGL, 7.0 mBGL, 9.4 mBGL and 11.7 mBGL across the site, shown on **Figure 6**. The average maximum of all contaminants are below the allowable maximum average. While the majority of natural soil across the site is preliminary classified as ENM, exceedances of the absolute maximum demonstrate that some natural soils at depth are classified as GSW.

Waste classification conducted as part of the Data Gap Investigation are considered to be preliminary only, and do not provide a sufficient sampling density to achieve assurance. Further, the majority of soil sampling undertaken to date has been via borehole, which is generally considered insufficient to detect asbestos in soils.

4.3.4 Extent of Remediation and Volume Estimate

The draft RCE (Nation Partners, 2020) included conservative estimates on the extent and volume of material requiring remediation (exclusive of additional investigation for asbestos in soils), as shown in **Attachment C** and summarised in **Table 5** below. It is noted that the preferred strategy is a combination of Options A and B, outlined below, and that the actual volume will likely between the two options.

» Option A – Off-site disposal of known health-based exceedances in soil.

» Option B – Off-site disposal of the unknown extent of asbestos fill across the entire site, to be refined through additional investigation (**Section 6.2.4**). If asbestos in soils is identified, they will require off-site disposal. If they are not identified, the remediation will focus on areas of health-based exceedances.

Table 5: Remediation Volumes for Off-Site Disposal

Material	Approximate Material Volume (m^3)	
	Option A	Option B
Hardstand	3,450	6,581
GSW	9,834[a]	30,898[b]
ENM	1,117	1,117
a – if asbestos in soils are not identified. **b – Special Waste (asbestos) if widespread asbestos in soils are identified.**		

The following assumptions were made in calculating the remediation volumes:

» The excavation extents, interpolation of data, and associated estimates were modelled in Mudshark™ software, and the estimates are limited by the capability of the software.

» Where possible, the vertical extent of contamination found in investigation boreholes was applied on a worst-case scenario. Where vertical delineation of contamination was not defined, it was assumed that the vertical extent was 1 m below the detected exceedance.

» Excavation of asbestos burial pits (EXC 1 and EXCMLP) has been included to a minimum of 1 m below their surveyed depths.

» Excavation of UST4 (north of Mowbray House) is assumed to be to a depth of 4 mBGL taking into account temporary works on-site by TSE.

» All hardstand across the site will require removal during remediation. An average surface hardstand thickness of 0.2 m was assumed for the calculation.

- Second slabs at depth across the site are assumed to be co-mingled with soil and will be disposed of as GSW.
- Known health-based soil exceedances across the site will be excavated and disposed of as GSW (Special-Asbestos), pending the results of the additional sampling and waste classification works. All fill within the excavation footprints is preliminarily classified as GSW (Special-Asbestos).
- Natural soils underlying fill are classified as ENM. ENM soils will be excavated and disposed of off-site as part of the over-excavation of known exceedances.

5. Remediation Options Assessment

The remediation options suitable for application to the site were first evaluated by GHD (2020c) and have since been adopted by Nation Partners. The options are driven by the following practical considerations associated with the future use of the site:

» The presence of asbestos within fill material may present a risk to human health during redevelopment and under future land use scenarios.

» The presence of minor exceedances of human health and ecological investigation levels in fill material may represent an unacceptable risk to future users of the site.

» In order to facilitate the proposed land use, identified soil exceedances and unsuitable materials must be managed to reduce the risk of exposure to human and ecological receptors to acceptable levels.

The following sections summarise the remediation options that were considered for the site, with detail on the chosen method provided in **Section 6**.

5.1 Remediation Objectives

The objective of the remedial works detailed in this RAP is to render the site suitable for the proposed land use, low-density residential with-out any restrictions on land use to meet divestment requirements. If required, the site suitability may be achieved through remediation in conjunction with the adherence to an appropriate long-term environmental management plan (EMP).

5.2 Remediation Policy

The remediation hierarchy for this RAP is in accordance with the NSW EPA (2017) *Guidelines for the NSW Site Auditor Scheme (3rd Edition)*, which references the preferred hierarchy in s.6(16) Assessment of Site Contamination Policy Framework of Schedules A and B of the NEPM 2013. The preferred order of options for site remediation and management are:

» *Onsite treatment of the contamination so that it is destroyed or the associated risk is reduced to an acceptable level; and*

» *Offsite treatment of excavated soil, so that the contamination is destroyed or the associated risk is reduced to an acceptable level, after which soil is returned to the site; or,*

If the above are not practicable,

» *Consolidation and isolation of the soil on site by containment with a properly designed barrier; and*

» *Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material;*

or,

» *Where the assessment indicates remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.*

During option assessment and selection, sustainability (environmental, economic and social) should be considered, in terms of achieving an appropriate balance between the benefits and effects of undertaking the option.

Where there is no readily available, or sustainable, economically feasible method available for remediation, the adoption of appropriate regulatory or institutional controls may be possible.

5.3 Determination of the Preferred Remediation Strategy

A detailed options assessment was undertaken by GHD (2020c) and is presented in **Attachment D**, with Nation Partners' summary in **Table 6** below. In summarising the remediation options, Nation Partners considered whether the results of the Data Gap Investigation have changed or reinforced the options assessment. The assessment considered items including: policy issues; reliability; practicability; capital cost; sustainability; ongoing liabilities; regulatory approvals; human health and ecological risk; complexity; data gaps; and implementation timeframe.

Table 6: Remediation Options Assessment Summary

Option	Summary	Evaluation
Treatment	Applicable to chemical contamination and unsuitable for asbestos.	High capital and operational costs. Range of different contaminants which would be difficult for a single treatment method. Unsuitable for asbestos. Not considered further.
Landfill Disposal	Disposal of impacted materials to a licensed facility.	Feasible but with costs associated with disposal, and additional data will be required. Suitable as it facilitates the proposed future land use.
Physical Barrier	Place visible marker layer over existing fill then lay capping material, or placement of impacted material within an on-site containment cell, with ongoing management according to a long-term EMP.	Feasible and suitable as the physiochemical properties of the impacts are relatively immobile and non-volatile. Unsuitable as it results in restrictions in the proposed land use.
Institutional Controls	Include measures such as land use restriction through zoning and access restrictions.	Not feasible for divestment of the site.

An off-site disposal strategy is still considered to be an economical, reliable, and risk adverse management measure to address the identified concentrations requiring remediation. It will achieve the objective of an unrestricted land use for divestment, from a contaminated soil perspective. Further, the site will likely require bulk excavation and earthworks for redevelopment, and the removal of surficial fill will likely represent cost and time savings for the prospective developer.

The strategy should incorporate additional investigation to refine the extent requiring off-site disposal. Noting the site is proposed to be divested and bulk excavation is likely occur during redevelopment, it is not intended to import material to replace the balance of material removed during remediation. The remediated surface of the site is proposed to be graded with appropriate erosion and sediment controls to manage the site in the interim prior to redevelopment.

6. Remediation Strategy

Based on the remediation objectives and options assessment, excavation and off-site disposal to landfill has been selected as the preferred remediation strategy. The following sections detail the tasks and works methodology based on the selected preferred strategy.

6.1 Objective

The objective of the works detailed in this RAP is to remediate the site in order for it to be considered suitable for a low-density residential land use.

6.2 Remediation Tasks

The physical remediation tasks required are summarised in **Table 7** below, and detailed in **Sections 6.2.1** to **6.2.10**.

Table 7: Remediation Task Summary

Task No.	Description	Details
1	Site establishment	**Section 6.2.1**
2	Liaison with Roads and Maritime Services (RMS) and Council regarding protection of their assets, and the installation of sheet piling to support excavation adjacent to the Pacific Highway.	**Section 6.2.2**
3	Removal of buildings and hardstand.	**Section 6.2.3**
4	Asbestos in soil investigation and additional waste classification.	**Section 6.2.4**
5	UST and associated infrastructure removal.	**Section 6.2.5**
6	Removal and disposal of asbestos impacts.	**Section 6.2.6**
7	Removal and disposal of chemical impacts.	**Section 6.2.7**
8	Stockpile management	**Section 6.2.8**
9	Materials tracking	**Section 6.2.9**
10	Interim site management	**Section 6.2.10**

Details on site management provisions during remediation works are provided in **Section 8**.

6.2.1 Site Establishment

In order to undertake the remediation works, the following works are to be completed:

» Preliminaries – preparation and submission of plans for Quality, Environmental, and Work, Health, and Safety (WHSP) (including a Construction Environmental Management Plan [CEMP]) and Safe Work Method Statements (SWMS).

» Services – location of underground services, termination of redundant services, relocation of services within the remediation area, establishment of temporary construction services.

» Mobilisation – establishment of site facilities, floating of plant, provision of stabilised site access.

» Establishment – of site fencing (where necessary), environmental controls, site access routes, and preparation of equipment staging and materials handling areas.

» Protection – existing groundwater monitoring wells outside of remediation footprints are to be protected and maintained during the works, and repaired and made good on completion of the works. If more practicable, it may be preferred to decommission existing groundwater monitoring wells and reinstall at the conclusion of the works. Decommissioning is to be in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (National Uniform Drillers Licensing Committee, 2020).

6.2.2 Protection of Off-Site Roads

The RCE (Nation Partners, 2020) identified that sheet piling adjacent to Pacific Highway and Nelson Street would be required to be installed to protect the respective RMS and Council assets. The remediation contractor is to liaise with RMS and Council regarding the protection of their assets. Additionally, the remediation contractor is required to design and install appropriate sheet piling with respect to the proposed remediation footprints.

6.2.3 Removal of Buildings and Hardstand

It is assumed that for the divestment of the site Sydney Metro will be handing over a vacant site with a grassed surface. To facilitate this, the remediation contractor is required to demolish and remove all existing aboveground infrastructure, with the exception of heritage listed Mowbray House, and remove existing concrete and bitumen hardstand surfaces. Prior to demolition, a hazardous building materials assessment is required to be completed by a suitably qualified person. The outcomes of the assessment are to inform the controls to be implemented during demolition.

The removal of hardstand surfaces and exposure of fill materials should be appropriately managed with respect to the potential for fill soils across the site to contain asbestos. Some examples of appropriate management could include:

» Prevent the disturbance of asbestos to the extent practicable (i.e. wetting of surfaces).

» Air monitoring for asbestos fibres, in accordance with **Sections 8.3.4** and **8.4**

» Trafficable roadways constructed of crushed concrete (or similar) should be laid to a minimum depth of 10 cm. Concrete sourced from site demolition activities could be used for this purpose. However, its suitability for use should be assessed first.

» Trafficable roadways constructed from validated soils sourced from the site (e.g., from a borrow pit).

» Consider leaving hardstand at strategic locations, and removing it in a staged process to minimise/avoid the need for adoption of other measures.

6.2.4 Additional Sampling

The Data Gap Investigation (Nation Partners, 2021) and RCE (Nation Partners, 2020) defined the indicative extent of remediation (shown in **Attachment C**), and assigned preliminary waste classifications of General Solid Waste, with some areas of General Solid Waste (Special Waste-Asbestos). However, residual data gaps remain with respect to: (1) the potential for shallow groundwater to be present in significant quantities; (2) deep groundwater flow directions and levels, groundwater contamination, and the extent of natural attenuation; (3) the potential for fill across the site to be impacted by asbestos; (4) the footprint of the former energy depot buildings not having previously investigated; and (5) the preliminary nature of the waste classifications.

Data Gaps 1 and 2

To address data gap 1, it was previously demonstrated that PFAS concentrations are below the recreational criteria, which presents the most likely exposure scenario for remediation site workers (Nation Partners, 2021). As such, a multiple lines of evidence approach is recommended to close the data gap. In particular, existing

shallow groundwater wells should be purged dry with recovery monitored over a period of 4 weeks, preferably by installing pressure transducers, otherwise by manual dipping. If it is identified that the shallow wells do not recharge it can reasonably be assumed that the shallow groundwater is intermittent and unlikely to be present in significant quantities.

If the wells are observed to recharge, sampling and analysis for PFAS should be undertaken to determine if concentrations remain below the recreational criteria. Pending the results of the sampling (if undertaken), PFAS specific controls for managing accumulated groundwater in shallow excavations would need to be developed and implemented by the remediation contractor.

To address data gap 2, additional groundwater monitoring events over time should be undertaken to better assess pathways and potential impacts on receptors. In particular, pressure transducers should be installed in key wells across the site to assess for temporal changes to groundwater levels and provide greater confidence in the groundwater flow direction. Additionally, monitoring of natural attenuation parameters should be undertaken to determine the extent of potential biodegradation of contaminants.

It is noted that due to the likely need to decommission the groundwater monitoring well network (**Section 6.2.1**), the additional groundwater monitoring may need to take place post-remediation (**Section 6.2.10**).

Data Gaps 3, 4, and 5

To address data gaps 3, 4, and 5, following removal of site hardstand, an asbestos in soils investigation, sampling of the former energy depot building footprint, and refined preliminary waste classification sampling should be undertaken. Indicative investigation areas are shown on **Figure 7**. In particular, the following should be taken into consideration:

» Excavation of test pits or trenches so that potential buried asbestos can be more readily identified.

» An appropriate sampling density with reference to WA DoH (2009), NSW EPA (1995), and NEPM (2013). In particular, the following is recommended[2]:

  – Former Energy Depot Building – systematic grid-based sampling at 6 locations, across the approximately 1,000 m^2 footprint, with additional judgemental targeted sampling based on field observations for potential contamination.

  – Asbestos in Soils Investigation – systematic grid-based sampling at 50 locations, across the approximately 16,000 m^2 footprint.

» Qualitative and quantitative assessment for ACM, AF, and FA. Qualitative presence/absence sampling should be undertaken to inform waste classification, in addition to quantitative sampling to determine land use suitability.

» Collection and analysis of samples from within the former energy depot building footprint for ACM, AF, FA, TRH, BTEX, PAHs, VCHs, heavy metals, PCBs, and PFAS.

» Screening of soil samples against investigation levels outlined in the NEPM (2013 amendment) for the appropriate land use scenario (i.e., low-density residential, unless redevelopment plans showing an alternative land use have been finalised and approved).

» Analysis of samples for waste classification, with reference to the Waste Classification Guidelines (NSW EPA, 2014), to supplement the existing waste classification dataset. The intent of this sampling is to refine

[2] Whilst it is noted that draft sampling design guidelines have been prepared by NSW EPA circa 2020, they have not been formally issued and endorsed. As such, the recommended sampling densities have been derived from *Contaminated Sites, Sampling Design Guidelines* (NSW EPA, 1995) and *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia* (WA DoH, 2009). Prior to implementation, the recommended RAP Addendum should assess the sampling design and density.

the preliminary in-situ waste classifications across the site. Ex-situ sampling of excavated stockpiles should be undertaken to finalise the waste classifications prior to off-site disposal.

Following completion of the additional sampling, the environmental consultant should evaluate the need for a RAP Addendum to be prepared. A RAP Addendum should document the revised remediation extent with respect to asbestos in soils (or other unexpected finds), and the in-situ waste classification(s).

6.2.5 UST Removal

Three decommissioned USTs (4 to 6) and associated pipework remain in-situ on site. It is understood that UST 4 was decommissioned in-situ in 1996 by Sydney Electricity being filled with concrete and remaining on site, but no report regarding its decommissioning have been provided (GHD 2020a). UST 5 and UST 6 were decommissioned in-situ in 2014 and filled with concrete.

All decommissioned USTs and associated pipework will require excavation and removal. The environmental consultant should observe the condition of the features after being exposed and prior to excavation/demolition. The observations should focus on the structural integrity and therefore, the potential for each feature to represent a contaminant source.

After removal of each feature, excavation of adjacent soils should be undertaken in the presence of the environmental consultant. Excavation should continue until field observations/screening techniques indicate that potentially contaminated soils have been excavated.

Field screening techniques include:

» Observations for hydrocarbon odours.

» Observations for unusual colouration or staining of soils.

» Collection of soil samples into snaplock plastic bags, followed by screening of the vapour headspace for volatile compounds using a calibrated photoionization detector (PID).

At the completion of excavation, validation sampling should be undertaken, as outlined in **Section 9**. Excavated soils from UST removal works are to be stockpiled separately and sampled for an ex-situ waste classification.

6.2.6 Excavation of Asbestos Impacted Soil

Excavation of asbestos (including asbestos containing soils) from the site will require an appropriate class of asbestos removal licence issued by SafeWork NSW, to be determined following the results of the Additional Sampling (i.e., whether there is AF/FA present). The licensed removalist must develop an Asbestos Removal Control Plan (ARCP) and nominate an asbestos removal supervisor who must be readily available to any worker carrying out asbestos removal work, whenever the work is being carried out. All asbestos workers at the site must be appropriately trained in asbestos works and in the ARCP.

Further details on asbestos management are provided in **Sections 7.6.1** and **8.4**.

6.2.7 Excavation of Chemically Impacted Soil

In general, the excavation strategy will be to remove impacted soil from across the site, as shown in **Attachment C**, or as refined in a RAP Addendum. The extent and depth of excavation will be driven by previously identified exceedances, and guided by visual and olfactory observations, and collection of field screening measurements during the excavation works. The indicative extents identified are:

» Remediation Area A – targeting the former burial pits and lead, TRH and PAH exceedances – an area of approximately 3,650 m^2, to depth of up to 4 mBGL at the deepest point.

» Remediation Area B – targeting the former asbestos slab – an area of approximately 22 m by 12 m, to a depth of 2 mBGL.

» Remediation Area C – targeting UST 4 – an area of approximately 17 m by 14 m, to a depth of 4 mBGL.

» Remediation Area D – targeting USTs 5 and 6, and lead, TRH, and PAH exceedances – an area of approximately 22 m by 18 m, to a depth of 4 mBGL.

» Remediation Area E – targeting lead and PAH exceedances – an area of approximately 22 m by 11 m, to a depth of 0.5 mBGL.

» Remediation Area F – targeting a lead exceedance – an area of approximately 19 m by 12 m, to a depth of 1 mBGL.

The following points detail the excavation methodology:

» Material is excavated from the indicative extent shown in **Attachment C**.

» Excavated material is placed into stockpiles to confirm waste classification, per **Section 6.2.8**.

» Stockpiled material is loaded into trucks for transport off-site following confirmation of waste classification.

» Validation samples are collected from the walls and the base of the excavation in accordance with the validation plan presented in **Section 9**.

» Temporary barricades and signage are installed around the periphery of the excavations in accordance with the *Work Health and Safety Act 2011* (WHS Act) and *Work Health and Safety Regulation 2017* (WHS Regulation).

» If validation samples indicate failure, continue excavating the validation grid square in 100 mm increments until validation samples indicate validation has been achieved.

6.2.8 Stockpile Management

Excavated soils should be stockpiled and managed in accordance the requirements of *Managing Urban Stormwater: Soils and Construction 4th Edition – Vol. 1* (the 'Blue Book') (Landcom, 2004). In particular: constructed at least 10 m from the edge of open excavations, waterways, or roads; stabilised if they are to be kept in place for more than 10 days; protected from run-on water by installing water diversion structures upslope; installation of downslope sediment filters; and have a maximum slope of 2:1 and maximum height of 2 m.

Stockpiles should be separated according to their preliminary in-situ waste classification or source (such as asbestos impacted fill, UST backfill material, natural soils, or chemically impacted fill).

Stockpiles should be sampled at a density in accordance with Victoria Environment Protection Authority 2009 *Industrial Waste Resource Guideline: Soil Sampling* (IWRG 702), inclusive of the existing dataset for the material. Samples are to be analysed with reference to the Waste Classification Guidelines (NSW EPA, 2014). The purpose of the ex-situ stockpile sampling is to confirm (or otherwise reclassify) the in-situ classifications.

The footprints of excavated stockpiles are required to be sampled and validated in accordance with **Section 9.3**.

6.2.9 Materials Tracking

Given the scope of work to be completed, accurate tracking of excavations, excavated materials, and stockpiled materials will be vital to the remediation process. Further, as a Site Audit requirement per NSW EPA (2017), the volume of material disposed of off-site must be reconciled with the tonnage on the weighbridge dockets at the receiving facility. Each truckload of asbestos waste must have a WasteLocate consignment number documented and included in the reconciliation. There must be a back-up of documentation and it must be clearly summarised by the environmental consultant preparing the validation report, for inclusion in the Site Audit.

Prior to initiation of remediation activities, it is recommended that the environmental consultant and Remediation Contractor discuss and agree on the nomenclature and system to be adopted.

A Materials Tracking System should include the following components:

» Accurate description of the material.

» The approximate volume of the material.

» Date of excavation and/or placement.

» Contamination status.

» Date sampled.

» Date of authorisation to move materials.

» Name of authoriser.

» Date materials moved.

» Destination of materials.

Tracking and record keeping of materials disposed to landfill must be 'cradle-to-grave'. The remediation contractor must dispose of the material to an appropriately licensed facility and retain all weighbridge dockets to validate that materials were disposed of appropriately.

6.2.10 Interim Site Management

Following completion of the works, it is not currently proposed to import material to replace the balance removed during remediation. It is recognised that the development plans may not be finalised or approved prior to completion of the remediation works. As such, the contractor is to develop and implement an erosion and sediment control plan for the interim period prior to redevelopment.

In particular, it is anticipated that the site will be graded so that surface water run-off is minimised and directed towards the centre of the site, or a dedicated retention basin, to encourage infiltration. Swales, berms, and sediment fencing should be used to direct surface water drainage to prevent off-site migration. Further, measures to minimise erosion are to be implemented, in addition to sediment control. Surface soils should be stabilised by treatment (such as spray seeded) or covering (such as by grass or hydromulch) to assist in minimising dust generation and sediment run-off. The site should also be left securely fenced with locked access and egress points. Keys for the locks are to be provided to Sydney Metro.

It is noted that the interim period presents an opportunity for groundwater monitoring wells to be reinstated to facilitate additional groundwater monitoring, if required following the additional sampling outlined in **Section 6.2.4**.

During the interim period, Sydney Metro will be responsible for undertaking periodic inspections of the interim site management controls, and undertaking rectification works, or dewatering of surface water, as required.

7. Environmental Planning and Approvals

A preliminary review of relevant planning approval instruments has been undertaken and is outlined in the following sections. As Sydney Metro is the current site owner, and the owner following divestment is currently unknown, the following section has been prepared on the assumption that Sydney Metro will be the proponent for the remediation works. If the site is divested prior to remediation and an alternate site owner or proponent is undertaking the works, a RAP Addendum should be prepared, including a review of relevant planning and approval controls. This is particularly pertinent as the new site owner or proponent may undertake associated relevant activities such as request for re-zoning of the land, or submit a development consent for the redevelopment of the site.

7.1 Regulatory Framework

It is assumed that Sydney Metro will prepare a Review of Environmental Factors (REF) in accordance with Part 5 of the *Environmental Planning and Assessment Act 1979* to gain regulatory approval for the works, with Sydney Metro being both the proponent and determining authority.

If Sydney Metro are not the proponent, the new proponents RAP Addendum should assess whether they hold a position of determining authority, or whether alternate regulatory approval is required.

7.2 State Environmental Planning Policy 55 – Remediation of Lands

SEPP 55 provided details on whether remediation works require development consent, Category 1 remediation works, as defined in SEPP 55, require consent, while Category 2 works do not require consent.

With respect to the regulatory framework which overrides SEPP 55, development consent is not required, and as such SEPP 55 is not applicable.

If Sydney Metro are not the proponent, the new proponents RAP Addendum should review SEPP 55 in the context of the regulatory requirements and Council approval. It is noted that the works are likely to be Category 1 works which require consent.

7.3 Willoughby City Council

As Sydney Metro is a public authority, they do not need development consent from Council for the project under SEPP (Infrastructure) clauses 109(1) which overrides SEPP 55. Therefore, the work will be assessed by a REF to be prepared by Sydney Metro.

If Sydney Metro are not the proponent, the new proponents RAP Addendum should refer to the Willoughby City Council Willoughby Development Control Plan, and *Willoughby City Council – Management of Contaminated Land Policy, 9 June 2020*. Council is required to consider whether land is contaminated and whether the proposed remediation of any identified contamination on-site will satisfactorily render the land suitable for the intended land use. However, a person may carry out Category 2 remediation work without Council consent. If the remediation is deemed to be Category 2 works, and can be undertaken prior to the submission of a development application, involvement of Council is not required. If a development application is made prior to remediation, Council will likely be involved and issue the consent with relevant remediation requirements.

7.4 NSW EPA

Soil being removed from the site for off-site disposal will need to be classified in accordance with the Waste Classification Guidelines (NSW EPA, 2014). Asbestos waste transported from the site is required to have a NSW EPA WasteLocate consignment number.

No scheduled activities under the *Protection of the Environment Operations Act 1997* are considered relevant to the remediation works. As such, it is not considered necessary to obtain an Environment Protection Licence for the works.

7.5 Roads and Maritime Services

As identified in Section 6.2.2, excavation adjacent to RMS assets, in particular the Pacific Highway, will require protection, such as sheet piling. The remediation contractor should liaise with RMS regarding permits, approvals, and requirements for working adjacent to, and protecting RMS assets.

7.6 SafeWork NSW

7.6.1 Asbestos

Remediation works will include the removal of fill impacted with non-friable asbestos. Whilst FA/AF have not been detected to date, the Additional Sampling may identify it. If AF/FA is identified, the works must be undertaken or supervised by a Class A licence holder. If only non-friable asbestos is identified, then a Class B licence holder will suffice. The Remediation Contractor must notify SafeWork a minimum of five working days prior to the commencement of earthworks.

During non-friable asbestos removal, air monitoring is not mandatory but may be considered. This would comprise air monitoring by a Licensed Asbestos Assessor (LAA) for airborne asbestos fibres at the boundaries of the asbestos work area prior to (for background purposes) and during (to assess adequacy of removal control measures) asbestos removal works. A clearance inspection and clearance certificate, however, must be provided by either a LAA or a competent person prior to re-occupation of the site.

An ARCP should be prepared to detail the controls and requirements during the works, see **Section 8.4**.

7.6.2 Underground Storage Tanks

Based on a review of the *Guidelines for Implementing the Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019*, removal of the USTs should be undertaken in accordance with Australian Standard AS4976-2008 *The Removal and Disposal of Underground Petroleum Storage Tanks* and AS1940-2004 *Storage and Handling of Flammable and Combustible Liquids*.

The works must be carried out by a duly qualified person as defined in the *Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2019*. Additionally, SafeWork must be notified of the UST removal within seven days using the prescribed approval form, so the tanks can be removed from their database.

8. Remediation Site Management

This section provides an overview of the requirements for management of the site during the remediation works. It will be the responsibility of the remediation contractor to ensure that they have the appropriate plans in place.

8.1 Roles and Responsibilities

The primary stakeholders who will be involved in the remediation are provided in **Table 8.**

Table 8: Roles and Responsibilities

Stakeholder	Role and responsibilities
Sydney Metro (or subsequent owner / proponent)	Proponent and site owner, responsible for community liaison, and the appointment of the remediation contractor and environmental consultant.
NSW EPA	Regulatory authority with involvement in the management of the site.
Remediation Contractor	Responsible for obtaining relevant licences and permits for the remedial works, preparation and implementation of a site specific WHSP and CEMP and completion of remediation works in accordance with this RAP.
Environmental Consultant	Responsible for providing remediation oversight and validation on behalf of Sydney Metro to assess compliance with this RAP.
Site Auditor	Responsible for reviewing the deliverables prepared by the validation consultant and providing a site audit statement.

Specific persons and responsibilities with respect to the primary stakeholders are to be identified in a CEMP following award of the roles by Sydney Metro.

8.2 Health and Safety Management

A site-specific WHSP should be prepared by the remediation contractor and environmental consultant and should include all details necessary to identify, assess and manage health and safety risks posed by the remedial works. Details on asbestos management are provided in **Section 8.4**

The WHSP should be prepared in accordance with the WHS Act and WHS Regulation, and any requirements from SafeWork NSW.

The WHSP should include task specific SWMS which should be reviewed each day prior to commencing works and amended as necessary for any changed conditions or if improved controls are deemed necessary.

The WHSP should also detail the names and contact details of key project personnel.

8.3 Environmental Management

A CEMP should be prepared by the remediation contractor to manage risks to the environment posed by the remediation works. The main environmental aspects are presented in the following sections and will summarise the necessary controls that must be addressed. Additional controls may be required by Sydney Metro.

8.3.1 Hours of Operation, Noise and Vibration

Noise will be required to be managed in order to prevent disturbance to the community and site workers. As such, reasonable noise mitigation measures will be implemented during the works to assist in avoiding excessive noise, which may result in complaints. Specific controls include:

» Remediation work (including haulage and deliveries) shall only be conducted within the following hours:

  – Monday to Friday 7am – 6pm.

  – Saturday 8am – 1pm.

  – No work is permitted on Sundays or Public Holidays (unless it is emergency work).

» Maintenance checks to be conducted daily on plant and other equipment to ensure noise mitigation measures such as mufflers/acoustic enclosures are installed where necessary.

Work shall comply with appropriate NSW construction noise guidelines. Equipment and machinery shall be operated in an efficient manner to minimise the emission of noise. The use of any plant and/or machinery shall not cause vibrations in excess of the relevant NSW guidelines and Australian Standards.

8.3.2 Erosion and Sediment Controls

The CEMP shall include appropriate soil and water management in accordance with the requirements of the 'Blue Book' (Landcom, 2004).

The following factors should be considered with respect to erosion and sediment control:

» Sediment and erosion control measures will need to be installed prior to any remedial activities. This may consist of straw bales or silt fences erected around soil stockpiles or site boundary fencing to prevent the migration of soil particles.

» The area of soil exposure will be minimised as much as much as possible at any time and land disturbances will occur for the shortest possible time.

» Any material that requires temporary storage will be stockpiled in a dedicated area and covered by geofabric or high-density polyethylene sheeting.

» Areas of the site not undergoing remedial works, including Mowbray House, should be segregated to avoid the transport of potentially contaminated soil onto them.

8.3.3 Surface Water Drainage

The surface water management measures to be implemented during the remedial works should include, but not be limited to:

» Perimeter drainage control measures (which may include straw bales, diversion drains, ditches and slit fences) to prevent clean water from entering the work areas. The diverted water will be directed away (and/or around) the work area, through a series of sediment and erosion control devices.

» Sediment control mechanisms to be place over/around all identified existing drainage pits.

» Spill control equipment to be available in the event of a fuel or oil spill at the site.

» Drainage in the construction area to be managed to minimise discharge of potentially contaminated surface water from the area.

8.3.4 Air Quality and Dust Controls

The remedial actions shall be performed in such a way to minimise the generation of dust from the site. This may include measure such as: installing dust screens around the perimeter of the work area or site; covering

stockpiles of contaminated soil if remaining in place for more than 24 hours; covering any loads entering or exiting the site; applying water sprays to suppress; and suspension of works during periods of high wind.

As asbestos has been identified at the site, SafeWork (2019a) states that '*a competent person, independent from the person responsible for the removal work, should determine all air monitoring requirements*'. It is recommended that these requirements are developed by a suitably qualified person in accordance with industry standards.

8.3.5 Traffic Management

The CEMP should include a plan for managing traffic associated with the works, in regard to the safety and welfare of the general public and to alleviate the impact of additional traffic volumes on other activities at the site. This includes traffic control measures such as establishment of designated haul routes on- and off-site.

All vehicular movements should follow this route to minimise the potential for collision and dust generation and erosion. If soil accumulates on roads adjacent to the access point it must be regularly removed by sweeping or shovelling.

Haulage routes to and from the site shall be selected to meet the following objectives:

» Comply with all road traffic rules.

» Minimise noise, vibration and odour to adjacent premises.

» Minimise use of local roads.

All truck drivers carting materials from the site should be given a safety instruction briefing. The briefing should detail the procedures to be following by the truck driver should an incident occur. These will include, but not limited to:

» Vehicle accident.

» Mechanical breakdown.

» Rain commencing during transportation.

» Payload (or other) loss.

8.3.6 Emergency Response

The CEMP should include a plan for emergency response, which will identify possible emergency situations that might occur throughout the remedial works, both on- and off-site. At a minimum, it should address the following:

» Assignment of responsibilities to nominated key personnel.

» Assessment of the potential on- and off-site impacts of hazards.

» Emergency reporting procedures, including on-site reporting lines of communication and procedures for reporting relevant issues to appropriate authorities.

» Emergency response procedures for the site including:

  – Fires.

  – Spills and leaks of hazardous materials.

  – Traffic accidents involving the transportation of contaminated materials.

  – Rupture of buried services.

  – First aid for injured personnel.

– Evacuation of on-site personnel.

– Incident investigation procedures.

8.4 Asbestos Management

As ACM has been identified at the site, an ARCP prepared by an appropriately qualified person should be prepared for the remedial works. The ARCP must include the following:

» Exposure monitoring.

» Methods of control, including personal protective equipment (PPE) and respirators.

» Training on the hazards of asbestos and control measure.

» Record keeping requirements.

In accordance with SafeWork NSW 2019b, the required actions for air monitoring are shown in **Table 9**.

Table 9: Asbestos Air Monitoring Required Actions (SafeWork NSW 2019b)

Action Level (airborne asbestos fibres/mL)	Control	Action
Less than 0.01	No new control measures are necessary	Continue with control measures
≥ 0.01 and ≤ 0.02	1. Review	Review control measures
	2. Investigate	Investigate the cause
	3. Implement	Implement controls to eliminate or minimise exposure and prevent further release
> 0.02	1. Stop Work	Stop removal work
	2. Notify the Regulator	Notify by phone followed by fax or written statement that the work has ceased and the results of the air monitoring
	3. Investigate the cause	Conduct thorough inspection of the works area and associated equipment in consultation with all workers involved with the removal work
	4. Implement controls to eliminate or minimise potential exposure and prevent further release	Extend the isolated/barricaded area around the removal area as far as reasonably practicable (until fibre are <0.01 fibres/mL)
	5. Do not recommence removal work until further air monitoring is conducted	Do not recommence until fibre levels are at or below 0.01 fibres/mL

If the air monitoring indicates potential exposure at the action level concentrations, the remediation contractor must ensure that control measures for managing asbestos have been adequately addressed. Other exposure control measures include:

» Entrance to the work area is not allowed unless training, controls and PPE requirements have been met.

» Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in exposure areas.

» Avoid skin and eye contact with asbestos.

» Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained.

» Review available regulatory fact sheets as part of ensuring clear awareness and understanding exists among the workforce.

» Do not disturb waste or other materials labelled 'Danger – Asbestos Fibres'.

Contractors performing asbestos removal works at the site are required to obtain all necessary licences and permits and have a written compliance plan. Contractors are required to provide proof that all asbestos workers are qualified, trained, and are competent to complete their assigned tasks before work begins. The works are to be undertaken in accordance with SafeWork NSW requirements, outlined in **Section 7.6.1**.

8.5 Community Relations

The surrounding properties should be notified of the upcoming remediation works, including the nature of the works, expected duration, and impacts (if any) during works). It is assumed that Sydney Metro will manage issues of perception in relation to remediation workers potentially wearing PPE (e.g., Tyvek suits, respirators etc.).

The remediation contractor must keep a record of all complaints during the works. The protocols for community engagement should be outlined in the WHSP and CEMP, or a separate community engagement plan. It is understood that Sydney Metro will take ownership of community engagement.

8.6 Contingency Plan

The conditions encountered during remedial works can be uncertain, as such, potential contingencies which may be encountered during the works have been identified and are outlined in **Table 10**, below.

Table 10: Remedial Works Contingency Planning

Potential Issues	Proposed Corrective Action
Increased volumes of waste or contaminated volumes	Throughout the remediation works, the remediation contractor will monitor the quantity of waste materials encountered. If evidence suggests that the level and extent of contamination is significantly greater than estimated, further investigation would be performed to determine its extent. In the case of a significant increase in the estimated volume of contaminated material to be excavated, Sydney Metro will be informed immediately, and a review of the remediation strategy will be undertaken.
Different waste classifications to preliminary classifications	**Section 6.2.4** outlines that additional sampling prior to off-site disposal of material commences. Throughout the remediation works, the remediation contractor or environmental consultant will monitor the type of waste materials encountered. If evidence suggests that waste is present which is different to what has been classified, further waste classification sampling is to be performed to determine the correct classification, and volume/tonnage of material. In the case of a significant variation to waste classifications, Sydney Metro will be informed immediately, and a review of the remediation extent and strategy will be undertaken.
Unexpected Finds	In the event that in-ground features are identified and are considered to represent potential contamination sources, the following protocol will be adopted: • All works within the vicinity (nominally a 10 m radius) will cease, Sydney Metro and the Site Auditor will be contacted, and the area of concern will be appropriately barricaded. • If required, appropriate sampling and analysis will be undertaken by the environmental consultant. • The requirement for any additional remediation works will be assessed by the environmental consultant and undertaken as required.

	• The above works will be documented in the validation report. Work, health and safety, and environmental protection requirements may need to be reviewed, depending on the type of unexpected finds encountered.
Spills and leaks	Spills and leaks are to be proactively managed by refuelling activities only taking place on hardstand. Controls are to be outlined in the CEMP, however, in the event of a fuel leak or spill, the spill/leak is to be controlled and managed by: • Shutting off the source. • Plugging the spill/leak. • Utilise spill kit materials to limit the extent affected. • For loss of containment onto exposed soil, earthmoving equipment may be used to create an earthen bund to contain the loss. • All spills/leaks are to be cleaned up using appropriate materials, and if necessary, dispose of the contaminated materials in accordance with relevant waste regulations. • If required, notify relevant regulatory authorities.
Rain	Daily pre-starts are to include a review of the weather forecast. Erosion and sediment control requirements are detailed in the CEMP. During rain events, erosion and sediment controls are to visually inspected hourly, with corrective actions undertaken as required. Prior to significant rain events, exposed soil surfaces are to be covered to the extent practicable to minimise erosion and sediment generation.
High wind / excessive dust	Controls relating to high wind / excessive dust are to be outlined in the CEMP. Wherever possible, dust generation shall be kept to a minimum by undertaking a staged approach to excavation and emplacement, thereby minimizing the size of the disturbed area. Direct excavation and loading of materials for haulage will also be adopted where possible to minimise materials handling requirements. Dust generation will be controlled through the use of water sprays and mists. If necessary, the area under direct excavation will be wetted with sprays. In the event that additional measures are required, the remediation contractor shall modify potential dust generating operations to achieve acceptable air quality levels. Modifications may include: • Reduction in the area of disturbed surfaces. • Installation of perimeter sprays on the site boundary fencing. • Limiting works to more favourable weather conditions. • Modifying the manner in which excavation works are conducted.
Excessive stormwater	Minimise active contaminated work area; improve stormwater diversion.
Excessively wet materials	Stockpile and dewater on site or add absorbents
Excessive noise	Noise barrier (hoarding) installation. Augment, muffler systems on excavation machinery or haulage truckers.
Excessive vibration	Reassess vehicle movement routes and speeds. Static roll backfilled areas requiring compaction.
Equipment failures	A proactive approach to equipment maintenance is to be undertaken by the remediation contractor. All equipment is to be maintained and regularly serviced, with maintenance and servicing records maintained, in addition to daily pre-starts. Common spare parts are to be kept on-site, in addition, the remediation contractors work plan is to nominate emergency equipment repair service providers and maintain a list of nearby rental options. In the event equipment cannot be repaired on-site or replaced, works involving the particular equipment are to be rescheduled until repairs are made.

8.7 Remediation Schedule

The remediation contractor will be responsible for preparing and submitting a remediation schedule to Sydney Metro and the environmental consultant. The schedule will involve, but not be limited to, the following:

» Review and update of this RAP (if necessary).

» Obtain relevant permits and approvals for the works.

» Prepare and finalise a WHSP, CEMP and associated subplans, piling design, and relevant work plans and documentation. The work plans should:

  – Include staging methodology to minimise exposed asbestos impacted soils.

  – Include work-flow instructions regarding contaminated materials.

  – Steps to avoid cross-contamination of materials.

» Undertake the remediation works, in accordance with the RAP, WHSP, CEMP, piling design, and work plans.

» The environmental consultant to produce a validation report detailing the remediation works as undertaken and conclude on the site's suitability.

» Prepare a long-term EMP (if required).

Documentation including a RAP Addendum or update (if undertaken), CEMP and associated subplans, validation report, and long-term EMP (if required), are required to be reviewed and endorsed by the Site Auditor prior to implementation.

9. Validation Plan

This section provides a description of the validation methodology to be adopted by the environmental consultant during the remediation works.

The information presented herein is of a summary nature only. If required, specific details are to be documented in a Sampling, Analysis, and Quality Plan (SAQP).

9.1 Project Team

The project team must be from a suitably qualified consultant with expertise working on contaminated sites, and trained in the requirements of this RAP.

9.2 Remedial Goals

The remedial goal at the site is to remove identified contamination sources by excavation and off-site disposal.

9.3 Validation of Excavated Surfaces

Following soil excavation, validation sampling will be conducted to verify that materials have been removed in accordance with the RAP. Sampling will demonstrate that material above the validation criteria has been removed, or provide baseline conditions at boundaries where further excavation is not possible. The validation criteria are presented in **Section 9.4**.

Surface validation soil samples will be collected at the following minimum rates:

» Excavation walls – 1 sample per 10 m linear distance (minimum of one per wall). If multiple distinct lithologies are observed through the depth or length of walls, collect a wall sample from each lithology, or at a minimum of 1 m vertical intervals.

» Excavation floors – 1 sample per 100 m^2 in a grid-based system.

» Stockpile footprints – 1 sample per 25 m^2 in a grid-based system.

» UST infrastructure footprints (such as pipe trenches) – 1 sample per 5 lineal metres.

» Haul road footprints, at the completion of the works – 1 sample per 100 m^2 in a grid-based system.

Provided the validation dataset is large enough, statistical assessment in accordance with the NEPM (2013) recommended approaches will be conducted. This will include review of: maximum concentrations against 250% of the validation criteria; 95% upper confidence limit concentrations against validation criteria; and the standard deviation of the dataset against 50% of the validation criteria.

Validation sampling must be completed by appropriately qualified and trained environmental consultants and adopt sampling and quality assurance/quality control techniques in accordance with NSW EPA (1995). For the validation sampling of asbestos impacts, samples are to undergo quantitative analysis with respect to land use suitability validation criteria.

A photographic record of excavations will be made. The extent (lateral and vertical) of any excavation will be accurately measured by the remediation contractor or the validation consultant via survey or other means. The dimensions of excavated areas will be reduced to Map Grid of Australia (MGA) Zone 56 coordinates and mAHD levels so they can be accurately transferred as necessary.

9.4 Validation Criteria

It is understood that the site will be divested as an unrestricted land use, which is broadly considered to align with a low-density residential land use as defined in the NEPM (2013), the most sensitive potential land use in

terms of the potential human receptors (including young children and aged persons) and the potential for exposure (i.e., accessible soil in gardens). Validating the site to such criteria will allow the site soils to be considered suitable for a low-density residential land use from a human health perspective. The site will therefore also be validated for less sensitive uses, including high-density residential, open space, and commercial/industrial. With respect to ecological receptors, the proposed unrestricted land use is broadly considered to align with an urban residential area and public open space scenario. Similar to the rational for human receptors, validating the site to such criteria will allow the site soils to be considered suitable for urban residential area or public open space from an ecological health perspective.

It is recognised that the NEPM (2013) outlines that health investigation levels (HILs), health screening levels (HSLs), ecological investigation levels (EILs), and ecological screening levels (ESLs) are not clean-up criteria. Therefore, for sites where measured contaminant concentrations exceed the generic screening criteria, a process must be followed to determine appropriate validation criteria.

For this site, a review of the site-specific scenarios has indicated that a number of assumptions incorporated into the HILs, HSLs, EILs, and ESLs which must be retained in the development of validation criteria. In particular: exposure parameters for the future land use; site layout for areas of accessible soil; depth and location of residual impacts; and soil properties for accessible soil. On the basis of these conservative assumptions that must be retained, it is considered that the definition of site-specific criteria as part of a site-specific risk assessment will not be warranted for the site, as the criteria developed using such an approach are likely to remain similar to the screening criteria adopted for a generic low-density residential land use.

Additionally, with respect to the uncertainty regarding the final future development plans, site-specific remediation criteria are currently unable to be derived. Therefore, the HIL-A and HSL-A screening criteria can be adopted for use as the human health validation criteria. These criteria are presented in Schedule B1 of the NEPM (2013). For ecological validation criteria, EILs for an urban residential area and public open space for aged contaminants, within an old suburb with high traffic, are to be adopted. Relevant site-specific criteria were derived in the Data Gap Investigation (Nation Partners, 2021), summarised in **Table 11** below. The generic criteria are presented in Schedule B1 of the NEPM (2013).

Table 11: Site-Specific EILs

Contaminant	Ecological investigation level (mg/kg)
Arsenic	100
Copper	230
Lead	1,260
Chromium (III)	410
Nickel	230
Zinc	540

9.5 Materials Tracking

The remediation contractor will be responsible for tracking all material removed from the site and imported onto the site as outlined in **Section 6.2.9**.

The material tracking documentation will be audited by the environmental consultant as part of the validation activities. Material tracking information will be documented in the validation report as appropriate. It must be reconciled and clearly summarised in the validation report. It is noted that a “data dump” of materials tracking at the completion of the works will likely be rejected by the Site Auditor.

9.6 Imported Material

Due to the likelihood of the site being redeveloped following divestment, including the potential for bulk excavation, it is not anticipated for material to be imported with respect to maintaining the net balance of site levels. Detail on the condition of the site post-remediation is provided in **Section 6.2.10**.

If the remediation contractor determines that imported material is required, such as for constructing stabilised site access or maintaining site roadways, then imported material is to comprise either virgin excavated natural material (VENM), ENM, or certified landscaping material (e.g., for topsoil or mulch) and shall be assessed using the validation criteria and the criteria listed in the Excavated Natural Material Order 2014.

Furthermore, the materials shall be sampled prior to importation (at an appropriate frequency, dependent on the volume imported from a particular source) and assessed as being aesthetically suitable and free of odours, staining, asbestos, demolition rubble or waste and chemically suitable of use on the site.

The remediation contractor must provide documentation from the quarry or other source to certify the origin of the material. The environmental consultant must attend the source of the material and, if the documentation available from the source site is deemed inadequate, collect samples to confirm suitability.

If, during the inspection of the imported material, the validation consultant observes that the material is either different from that observed at the source, has evidence of potential contamination, or if appropriate documentation is not received from the source site, then the material will be rejected, and an alternate source must be obtained.

Imported materials tracking documentation is to be included in the validation report, and will be subject to review by the Site Auditor.

9.7 Validation Report

Following the completion of remedial works, a validation report will be prepared by the environmental consultant in accordance with the requirements of the NSW EPA (2020). The report will contain an overview of the remediation objectives conducted and details of the following:

» Volumes of excavated material and location of excavations.

» Tracking of materials disposed off-site, and brought on-site.

» Validation field methods.

» Plan of sampling locations.

» Site photographs.

» Analytical results of validation and characterisation soil samples and quality assurance and quality control sampling.

» Landfill disposal and VENM (if required) certificates.

» Verification of regulatory compliance.

» An updated CSM taking into account the site condition post-remediation.

» Demonstration that groundwater quality is suitable (possibly subject to management) for the intended land use(s), and is not and will not foreseeably pose a risk to off-site receptors.

» A clear statement on whether the site is considered suitable for its intended land use and whether it is considered to present an unacceptable risk to human health and the environment.

» Any limitations, assumptions and uncertainties relevant to the conclusions of the report.

10. Long-Term Environmental Management Plan

The remediation and validation outlined within this RAP is considered sufficient to manage the identified risks relating to soil impacts at the site in accordance with relevant guidance made or approved by the NSW EPA and to achieve the project objectives. The extent of remediation proposed is such that the Source-Pathway-Receptor risks with respect to soil are addressed via the elimination of the source.

It is noted that residual groundwater contamination is likely to remain post-remediation, and to ensure the ongoing protection of potential receptors during redevelopment and future use, a long-term EMP will be required at the completion of the remediation. The content of the long-term EMP will be dictated by groundwater SPR risks, however as a minimum should include:

» Controls to be implemented during bulk earthworks intercepting groundwater.

» Controls on the handling of dewatered groundwater during redevelopment and future occupation of the site.

11. Limitations

Nation Partners produces technical and advisory documents in the course of providing its services, which includes this document.

The contents of this document and any related findings reflect industry practice based on information available to Nation Partners at the time of creation and the scope of services, methodologies, and resources to which this document relates. Nation Partners has also relied upon information provided by the recipient and, except as expressly provided, has not carried out any separate verification of such information provided.

This document is therefore innately limited in respect of such available information and the scope of related services and resources, as well as a result of inherent uncertainties that exist in relation to environmental conditions that relate to any information in this document (if applicable).

This document must be read in its entirety and must not be copied, distributed or referred to in part only, and no excerpts are to be taken as representative of the findings.

Nation Partners does not represent or warrant that this document contains all requisite information needed to determine a future course of action, to guarantee results, and/or to achieve a particular outcome. The interpretation, application and general use of the information contained in this document, including by any third party that the recipient shares it with, is at the recipient's own risk.

This document has been prepared for the exclusive use of the recipient and Nation Partners accepts no liability or responsibility for any use or reliance on this document by any other third party.

References

GHD (2020a) *Sydney Metro, Chatswood Metro, Corner of Pacific Highway and Mowbray Road, Chatswood, Contamination Summary Report.* April 2020.

GHD (2020b) *TfNSW Sydney Metro Chatswood Dive Site – Budget Remediation Cost Estimate – Version 1*. April 2020.

GHD (2020c) *Sydney Metro, Chatswood Metro, Corner of Pacific Highway and Mowbray Road, Chatswood. Remediation Options Assessment*. May 2020

Lotsearch (2020) *Lotsearch Enviro Professional Report, 607 Pacific Highway, Chatswood, NSW 2067, LS010925* (within GHD 2020a).

Nation Partners (2020) *Sydney Metro Chatswood Site – Draft Remediation Cost Estimate*. 10 September 2020.

Nation Partners (2021) *Data Gap Investigation Report – Chatswood Site, Sydney Metro*. January 2021.

HEPA (2020) *PFAS National Environmental Management Plan Version 2.0*.

NEPC (2013) *National Environment Protection (Assessment of Site Contamination) Measure 1999, 2013 Amendment* (NEPM 2013).

NSW EPA (1995) *Sampling design guidelines*.

NSW EPA (2014) *Waste Classification Guidelines – Part 1: Classifying Waste*.

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

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

NSW EPA (2020) *Consultants reporting on contaminated land: Contaminated land guidelines*.

Landcom (2004) *Managing Urban Stormwater: Soils and Construction 4th Edition – Vol. 1*.

SafeWork NSW (2019a) *Code of Practice: How to Manage and Control Asbestos in the Workplace*.

SafeWork NSW (2019b) *Code of Practice: How to Safely Remove Asbestos*.

Department of Urban Affairs and Planning (1998) *Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land*.

VIC EPA (2009) *Industrial Waste Resource Guideline: Soil Sampling* (IWRG 702).

WA DoH (2009) *Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.*

Willoughby City Council (2018) *Development Control Plan*.

Willoughby City Council (2020) *Contaminated Land Policy*.

WorkCover NSW (2014) *Managing Asbestos In or On Soil*.

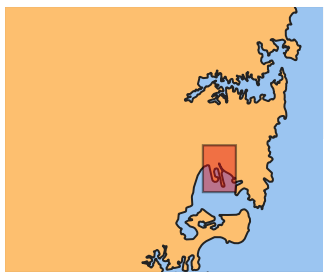
Figures

Figure 1: Site Location

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Dive Portion
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Mowbray House Heritage Buildling
- Areas of Interest
- Former Road



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

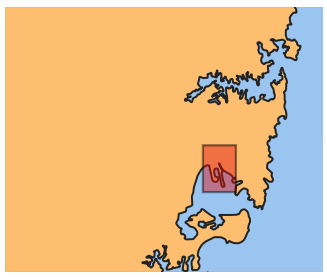
nation partners

Figure 2: Data Gap Investigation Sampling Locations

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Stage 1 Sampling Areas
- Mowbray House Heritage Building
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Monitoring Well - Stage 1
- Soil Vapour - Stage 1
- Soil Borehole - Stage 1
- Monitoring Well - Stage 2



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

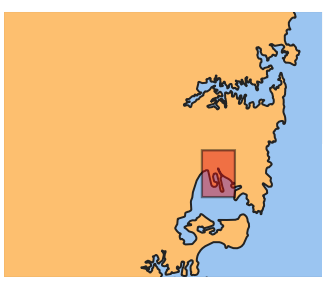
nation partners

Figure 3a: Stage 1 Inferred Groundwater Levels

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Monitoring Wells
- Inferred Groundwater Level - 2 July 2020 (mAHD)
- Approximate Groundwater Flow Direction
- Underground Storage Tanks



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

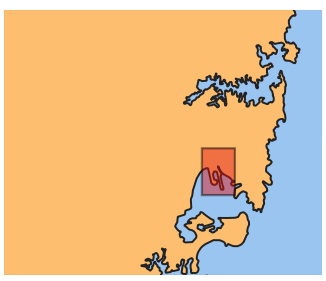
nation partners

Figure 3b: Stage 2 Inferred Groundwater Levels

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Monitoring Wells
- Inferred Groundwater Level - 7 October 2020 (mAHD)
- Approximate Groundwater Flow Direction
- Underground Storage Tanks



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

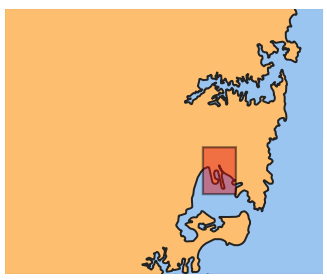
nation partners

Figure 4: Soil Exceedances

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Underground Storage Tanks
- Asbestos Pit Location
- Possible Asbestos Slab
- Exceeds NEPM 2013 HIL A
- Exceeds NEPM 2013 HSL A/B
- Exceeds NEPM 2013 ESL for Urban Residential
- Asbestos detected



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

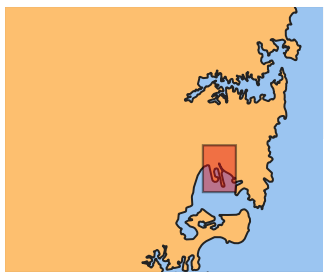
nation partners

Figure 5a: Stage 1 Groundwater Exceedances

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Groundwater Monitoring Wells



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

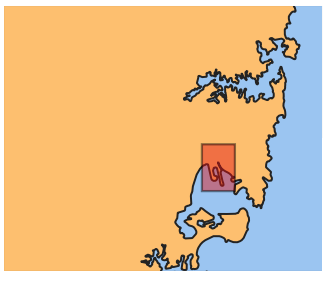
nation partners

Figure 5b: Stage 2 Groundwater Exceedances

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Groundwater Monitoring Wells



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

nation partners

SRT-PT025	9.4m	11.7m
Chromium	280 mg/kg	-
TPH C10-C36	800 mg/kg	590 mg/kg

SRT-PT017	7.0m
BaP	1.3 mg/kg

SRT-PT026	3.5m
TPH C10-C36	670 mg/kg

SRT-PT025
SRT-PT017
SRT-PT026
UST 1
UST 2
UST 3
UST 4
UST 5
UST 6
Pacific Highway
Mowbray Road

Exceeds NSW 2014 Excavated Natural Material (Absolute Maximum)
Only materials identifed as natural soils in borelogs were assessed

Figure 6: ENM Classification

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Soil Borehole Location

DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

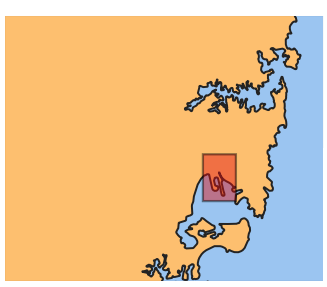
nation partners

Figure 7: Additional Sampling Areas

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Mowbray House Heritage Buildling
- Asbestos in soils investigation
- Footprint of the former energy building



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

nation partners

Attachment A – GHD (2020a) Figures

Paper Size A3

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Soil sample location
- Soil sample locations SS01 to SS17 (area)
- Remediation Excavation Footprint
- Site boundary
- Through site road
- Cadastre

Sydney Metro

Historical Soil Sampling Points and Remediation Excavation Footprint

Job Number	21-25273
Revision	-
Date	26 Mar 2020

Figure 5A

G:\21\25273\GIS\Maps\Deliverables\ChatswoodMetro\21_25273_Z022_ChatswoodMetro_GeotechHistoricalInvestigations_SoilBH.mxd

Data source: Aerial imagery - sixmaps 2016, General topo - NSW LPI DTDB 2012. Created by:eibbertson

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Paper Size A3

0 5 10 20

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Monitoring well location
- Soil vapour probe location
- Remediation Excavation Footprint
- Site boundary
- Through site road
- Cadastre

Sydney Metro

Historical Groundwater Monitoring and Soil Vapour Points and Remediation Excavation Footprint

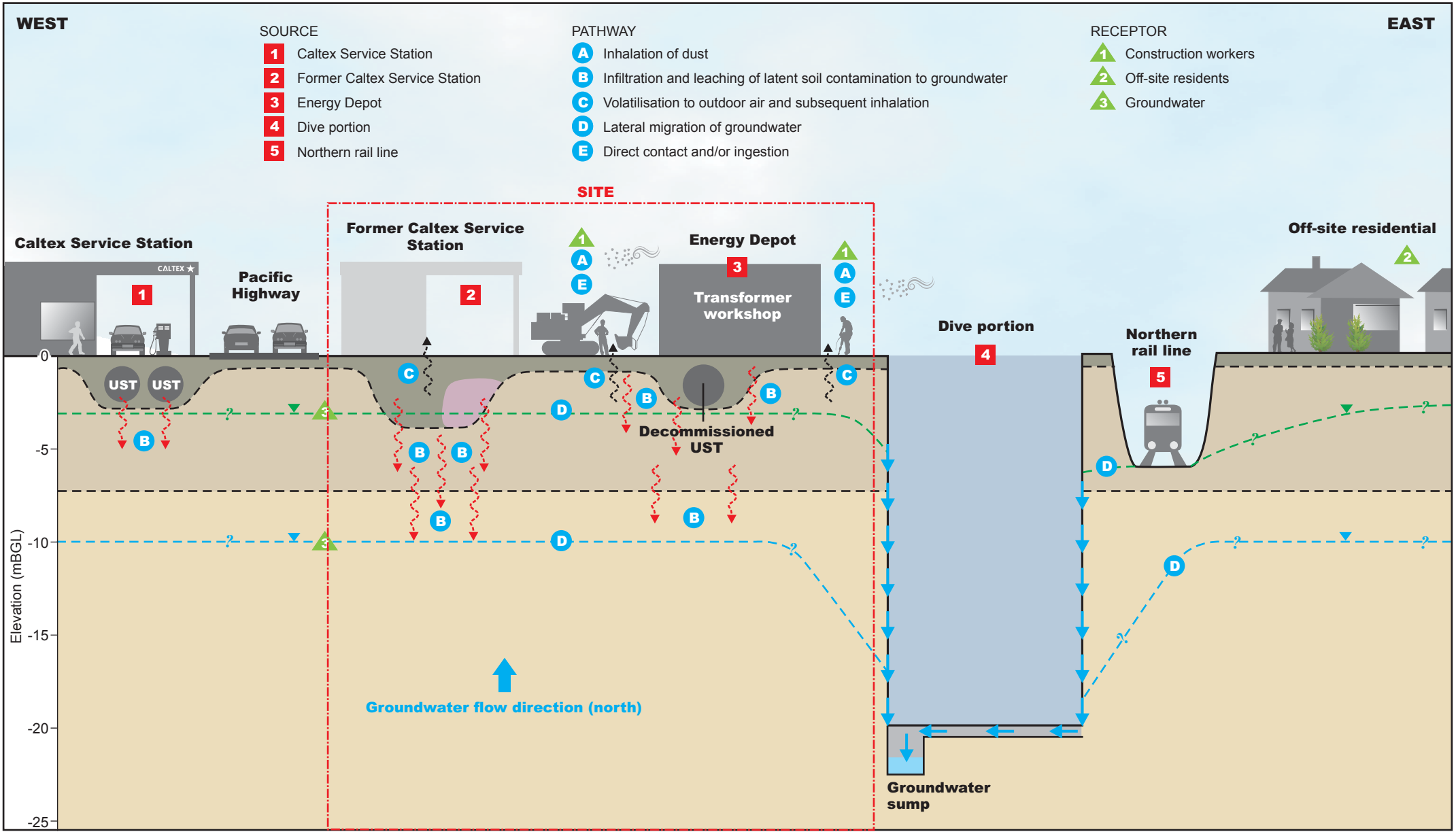
Job Number 21-25273
Revision -
Date 26 Mar 2020

Figure 5B

G:\21\25273\GIS\Maps\Deliverables\ChatswoodMetro\21_25273_Z023_ChatswoodMetro_GeotechHistoricalInvestigations_GWSV.mxd

Data source: Aerial imagery - sixmaps 2016, General topo - NSW LPI DTDB 2012. Created by:eibbertson

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au



Conceptual diagram only - scale is approximate

LEGEND

- Fill
- Residual soil
- Ashfield Shale
- Buried asbestos
- Shallow groundwater table
- Deep groundwater table
- Volatilisation
- Migration

Sydney Metro Project: Contamination Summary Report

Conceptual Site Model Pre-Redevelopment Phase

Job Number	21-25273
Revision	0
Date	30 Mar 2020

Figure 7

GHD\Launceston\Projects\21\25273\2125273_LTN_01.cdr

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

Attachment B – Soil Impacts Summary

Location	Depth (mBGL)	CoPC	Concentration (mg/kg)	Criterion (mg/kg)	
PT008	0.25	BaP	1.4	ESL	0.7
		Lead	320	HIL-A	300
PT009	0.6	BaP	1.5	ESL	0.7
PT016	3.2	TRH C_6-C_{10} (F1-BTEX)	120	HSL-A	40
PT016	3.5	TRH C_6-C_{10} (F1-BTEX)	160	HSL-A	40
PT017	1	BaP-TEQ	73	HIL-A	3
		Lead	560	HIL-A	300
		Total PAHs	554.8	HIL-A	300
		TRH C_{16}-C_{34} (F3)	2,700	ESL	300
		Zinc	750	EIL	540
PT017	3	Lead	770	HIL-A	300
PT017	3.3	BaP-TEQ	9.6	HIL-A	3
PT020	1	Benzene	2.4	HSL-A	0.6
PT026	0.2	Lead	470	HIL-A	300
PT026	2.7	Lead	480	HIL-A	300
TP1	0.5	BaP-TEQ	3.3	HIL-A	3
TP3	0.5	BaP	1.1	ESL	1
		Lead	390	HIL-A	300
TP4	0.5	BaP-TEQ	9.7	HIL-A	3
		Lead	350	HIL-A	300
TP4	4	TPH C_6-C_9*	380	HSL-A	40
		TPH C_{10}-C_{14}*	930	HSL-A	230
TP8	0.5	BaP-TEQ	10.4	HIL-A	3
TP11	0.5	BaP	1.1	ESL	1
		Lead	470	HIL-A	300
TP14	0.6	Benzene	1.4	HSL-A	0.6
TP14	2	Xylenes	68.8	HSL-A	95
TP27	2	Benzene	2.6	HSL-A	0.6
		Xylenes	549	HSL-A	95
TP27	3	Benzene	2.6	HSL-A	0.6

Location	Depth (mBGL)	CoPC	Concentration (mg/kg)	Criterion (mg/kg)	
		Xylenes	91	HSL-A	95
TP28	1	Lead	450	HIL-A	300
TP30	0.5	Lead	1,300	HIL-A	300
TP30	1	Lead	380	HIL-A	300
TP30	2	Benzene	2.7	HSL-A	0.6
BH2	3	TRH C_6-C_{10} (F1-BTEX)	420	HSL-A	40
BH5	2.8	TRH C_6-C_{10} (F1-BTEX)	360	HSL-A	40
BH22	0.5	Lead	472	HIL-A	300
BH25	0.3	Lead	460	HIL-A	300
		BaP-TEQ	27.5	HIL-A	3
BH27	0.8	BaP	1	ESL	1
Exc1_VA 4	2.5	TRH C_6-C_{10} (F1-BTEX)	140	HSL-A	40
Exc1_VA11	2.5	TRH C_6-C_{10} (F1-BTEX)	230	HSL-A	40
Exc1_VA12	2.5	TRH C_6-C_{10} (F1-BTEX)	570	HSL-A	40
Exc1_VA17	2.5	TRH C_6-C_{10} (F1-BTEX)	720	HSL-A	40
Exc1_VA18	2.5	TRH C_6-C_{10} (F1-BTEX)	210	HSL-A	40
Exc1_VA20	2.0	TRH C_6-C_{10} (F1-BTEX)	210	HSL-A	40
Exc1_VA23	2.5	TRH C_6-C_{10} (F1-BTEX)	280	HSL-A	40
Exc1_VA26	1.0	TRH C_6-C_{10} (F1-BTEX)	210	HSL-A	40
		TRH >C_{10}-C_{16} (F2-naphthalene)	120	HSL-A	230
ExcMLP_V11	2.5	TRH C_6-C_{10} (F1-BTEX)	250	HSL-A	40
ExcMLP_V15	2.5	TRH C_6-C_{10} (F1-BTEX)	110	HSL-A	40
ExcMLP_V28	1.5	TRH C_6-C_{10} (F1-BTEX)	240	HSL-A	40
ExcMLP_V33	1.5	TRH C_6-C_{10} (F1-BTEX)	130	HSL-A	40
		Benzene	1	HSL-A	0.6
VA1	**	TRH >C_{10}-C_{16} (F2-naphthalene)	390	HSL-A	230
VA2	**	TRH >C_{10}-C_{16} (F2-naphthalene)	830	HSL-A	230
VA3	**	TRH >C_{10}-C_{16} (F2-naphthalene)	830	HSL-A	230

Location	Depth (mBGL)	CoPC	Concentration (mg/kg)	Criterion (mg/kg)

CoPC – contaminant of potential concern.

* Samples were analysed pre-NEPM 2013 and were reported as TPH fractions, TRH fraction criteria have been applied as a conservative measure.

** Unknown sample depth.

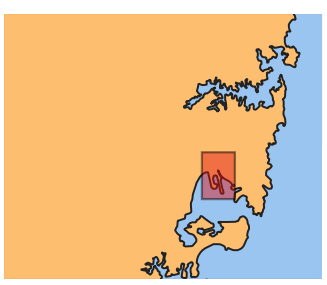
Attachment C – RCE (NP, 2020) Outputs

Appendix C-1: Indicative Extent of Remediation

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Indicative Extent of Remediation



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

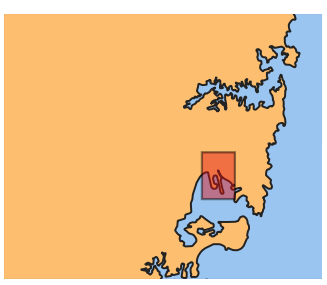
nation partners

Appendix C-2: Indicative Extent of Remediation

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Indicative Extent of Remediation



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

nation partners

Area F
178m2
11.5m
18.7m
Area D
232m2
21.3m
17.8m
UST 5
UST 6
Area B
257m2
21.5m
11.6m
59.4m
77.2m
Area A
3650m2
92.4m
49.7m
Pacific Highway
Area C
227m2
16.8m
13.3m
UST 4
Mowbray Road
UST 1
UST 2
UST 3
Area D
232m2
21.3m
17.8m
UST 5
UST 6
Area F
178m2
11.5m
18.7m
Area E
142m2
22m
10.4m
Area E
142m2
22m
10.4m

Appendix C-3: Indicative Extent of Remediation

Sydney Metro - Remediation Action Plan
Chatswood Site

Legend

- Site Boundary
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Indicative Extent of Remediation

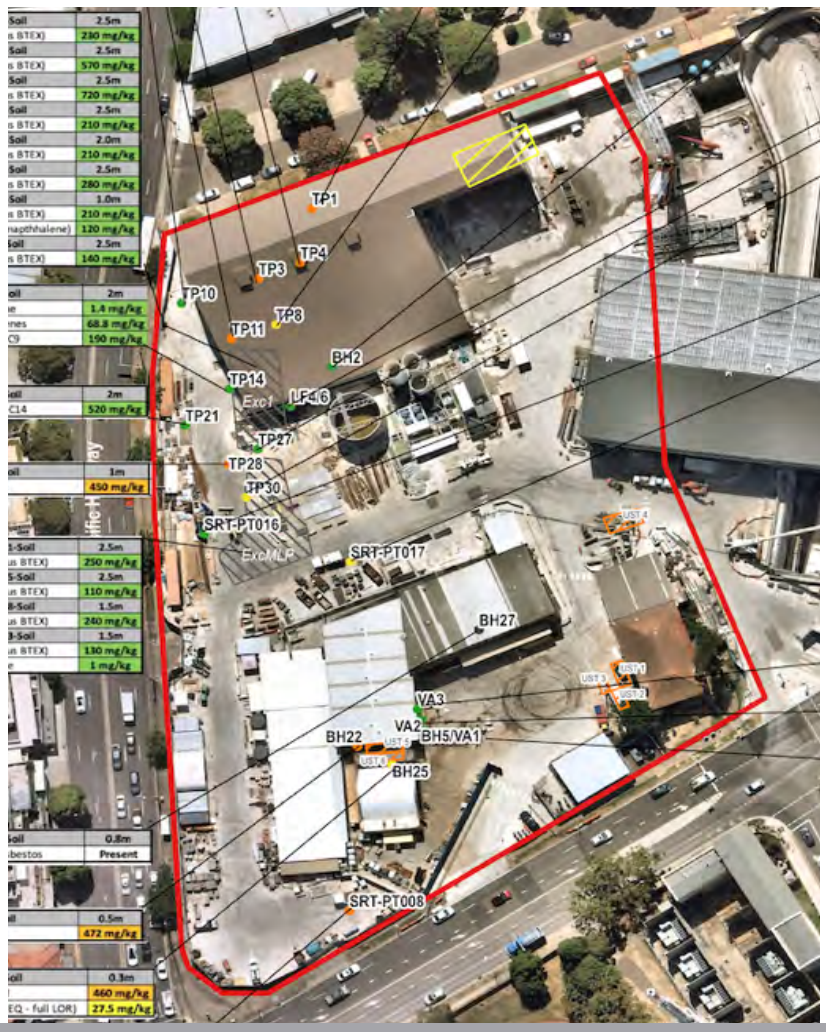
DATA SOURCES
Imagery: Nearmaps, 2020

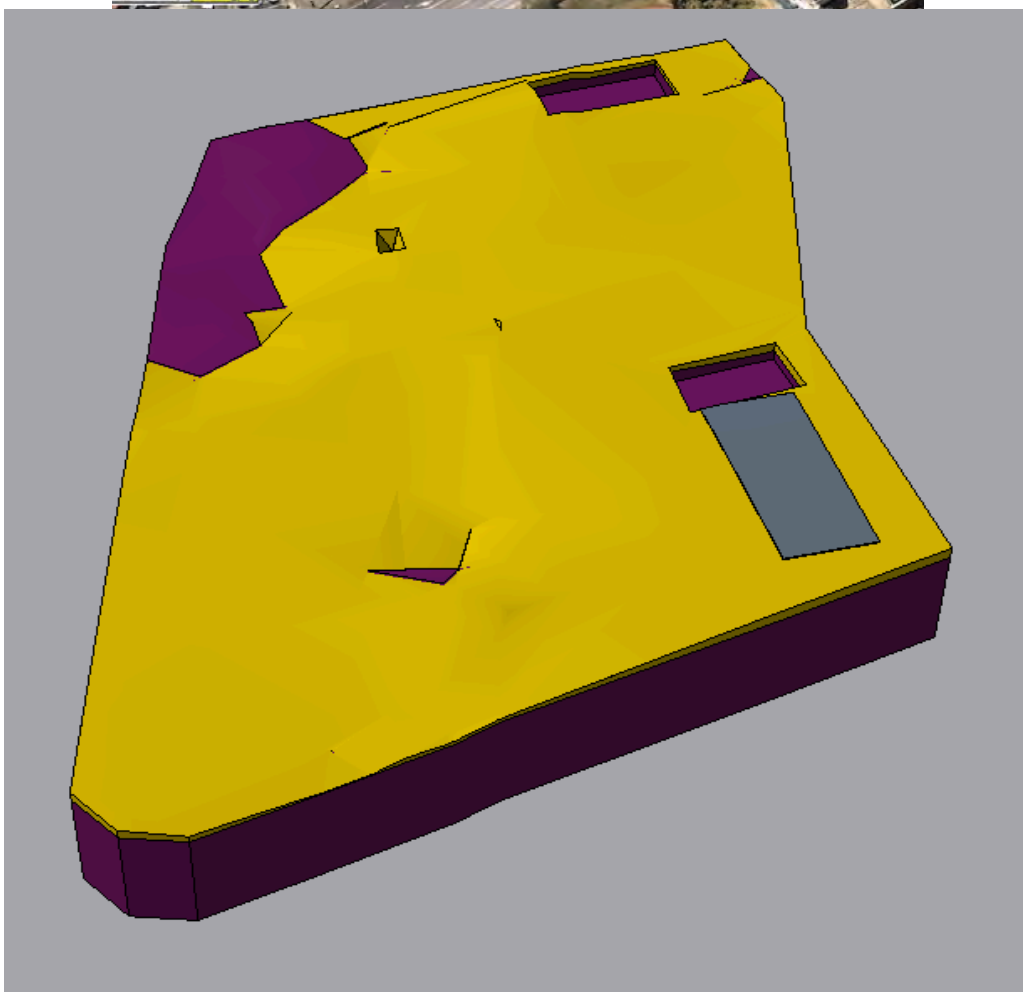
SCALE 1:1000

5 0 5 10 15 20 25 m

nation partners

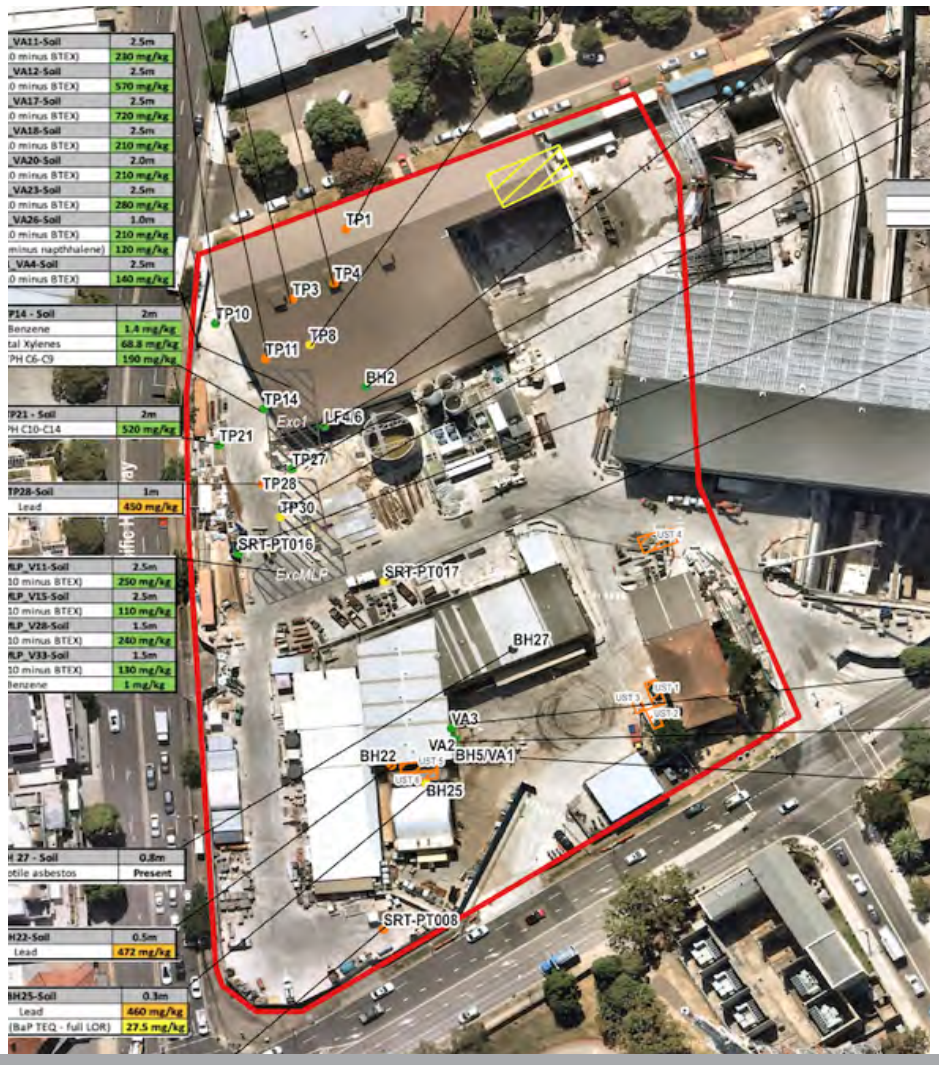
Scenario 3 - Unrestricted Redevelopment		
Option 3A **Off-Site Disposal of Known Contaminated Fill Across Entire Site**		
Excavate and dispose of health-based soil exceedances across entire site to achieve suitability for low density residential land use		
Waste Classification - Offsite Disposal		
Concrete	3450.46	m3
GSW	9834.15	m3
ENM	1116.65	m3
TOTAL	14401.26	m3
Approximate max excavation depth	4.5	mbgl
Approximate excavation area	8282.985	m2

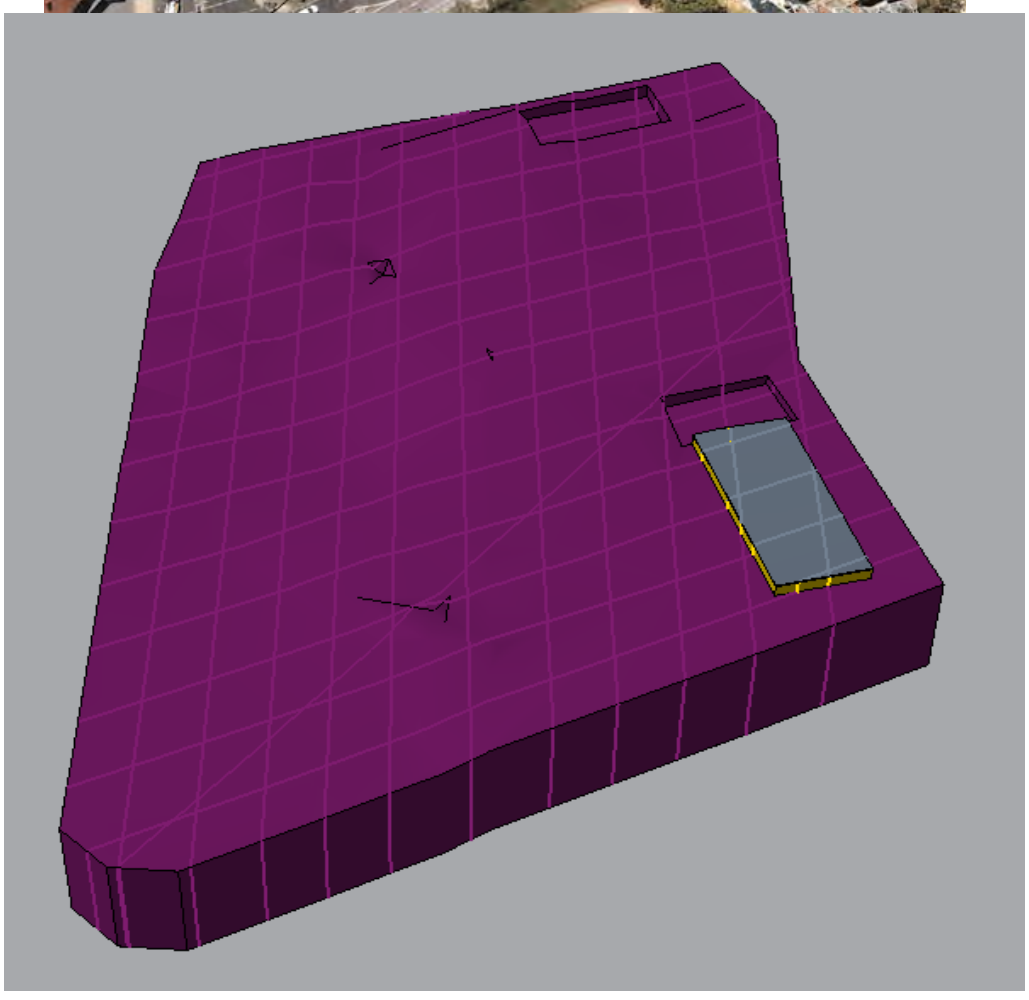




Concrete	
GSW	
Fill material	
ENM	

Scenario 3 - Unrestricted Redevelopment		
Option 3B **Off-Site Disposal of all Fill Across Entire Site**		
Excavate and dispose of all fill across entire site to achieve suitability for low density residential land use		
Waste Classification - Offsite Disposal		
Concrete	6580.802	m3
GSW	30897.597	m3
ENM	1116.652	m3
TOTAL	38595.051	m3
Approximate max excavation depth	4.5	mbgl
Approximate excavation area	16023.899	m2





Concrete	
GSW	
Fill material	
ENM	

nation partners

SOLUTIONS FOR
COMPLEX PROJECTS

Attachment D – GHD (2020c) Remediation Options Assessment

Table 9 – Remedial options assessment – Schemes 1 and 2

	Option 1: Excavate and disposal of contaminated soil including the buried asbestos (off site) and removal of UPSS infrastructure.	Option 2: Excavate and offsite disposal of the majority of known contaminated soil, removal of all UPSS infrastructure and onsite encapsulation of special waste and special GSW, with the preparation of an EMP	Option 3: Option 1 or 2 with leaving UST 4 in-situ and implementation of an EMP	Option 4: Do nothing
Policy issue	Meets the EPA policy requirement by removing the contamination sources.	Meets the EPA policy requirement by removing the contamination sources and by eliminating pathways.	Meets the EPA policy requirement by removing the contamination sources and/or by eliminating pathways.	Would not meet EPA policy.
Reliability	The site would be suitable for use with no ongoing requirement for an EMP (for contamination purposes).	The site would be suitable for use, however, a long-term EMP (for contamination purposes) will be required, and limitations would be placed on the future site use to prevent exposure (for either buried asbestos underneath roadways or open space).	The site would be suitable for use, however, a long-term EMP (for contamination purposes) will be required and limitations would be placed on the future site use to prevent exposure (associated with possible residual contamination).	The site would not be suitable for use.
Practicability	No significant practicability issues have been identified.	Given the extensive excavation of basement areas across Scheme 1, roadways only occupy 1,764 m^2, therefore the encapsulation of 15,041 m^3 of asbestos impacted soil in roadway areas is not considered practical.	No significant practicability issues have been identified.	No significant practicability issues have been identified.
Capital cost	Very significant cost.	Very significant cost (slightly reduced).	Very significant cost (slightly reduced).	No cost.
Sustainability	High consumption of resources (energy, landfill, labour). High impact to surrounding land uses associated with large scale	Moderate to high consumption of resources (energy, landfill, labour).	High consumption of resources (energy, landfill, labour). High impact to surrounding land uses associated with large scale	The economic benefit of the do nothing approach is not considered to outweigh the sustainability disadvantages

	Option 1: Excavate and disposal of contaminated soil including the buried asbestos (off site) and removal of UPSS infrastructure.	Option 2: Excavate and offsite disposal of the majority of known contaminated soil, removal of all UPSS infrastructure and onsite encapsulation of special waste and special GSW, with the preparation of an EMP	Option 3: Option 1 or 2 with leaving UST 4 in-situ and implementation of an EMP	Option 4: Do nothing
	civil works (increased noise and traffic). Moderate risk to environment during excavation and disposal of soils (assuming well controlled civil activities), including possible releases of ground gases and vapours, contaminated dust, asbestos fibres and odour generation.	High impact to surrounding land uses associated with large scale civil works (increased noise and traffic). Moderate risk to environment during excavation and disposal of soils (assuming well controlled civil activities), including possible releases of ground gases and vapours, contaminated dust, asbestos fibres and odour generation.	civil works (increased noise and traffic). Moderate risk to environment during excavation and disposal of soils (assuming well controlled civil activities), including possible releases of ground gases and vapours, contaminated dust, asbestos fibres and odour generation.	associated with not remediating the site.
Ongoing liabilities	No ongoing liabilities as the sources have been removed.	Some ongoing liability associated with on-site containment of asbestos within soils. These risks would require long-term management, which would limit future use of the site and could affect value of property.	Some ongoing liability associated with possible residual contamination associated with a UST remaining insitu at the site. These risks would require long-term management, which would limit future use of the site and could affect value of property.	The site would remain an ongoing liability.
Regulatory approvals	Would be considered a Category 1 remediation and would require a Site Audit Statement and development of an SEE.	Would be considered a Category 1 remediation and would require a Site Audit Statement and development of an SEE.	Would be considered a Category 1 remediation and would require a Site Audit Statement and development of an SEE.	Unlikely to get approvals.
Human health and ecological	Removal of contamination sources.	Some ongoing human health risks and liability associated with encapsulation, leaving a long-	Some ongoing human health risks and liability associated with possible residual contamination	The existing human health and environmental risks associated with site would not be addressed.

	Option 1: Excavate and disposal of contaminated soil including the buried asbestos (off site) and removal of UPSS infrastructure.	Option 2: Excavate and offsite disposal of the majority of known contaminated soil, removal of all UPSS infrastructure and onsite encapsulation of special waste and special GSW, with the preparation of an EMP	Option 3: Option 1 or 2 with leaving UST 4 in-situ and implementation of an EMP	Option 4: Do nothing
risk of exposure to contamination	Long-term benefit to human health and environment.	term liability that must be managed appropriately.	associated with a UST remaining insitu at the site, leaving a long-term liability that must be managed appropriately.	
Human health and ecological risk of remediation activities	Human health: appropriate health and safety protocols would be required to minimise any risk from dust, silt run-off, odour, ground gas/vapours noise etc. No ecological risk during remediation activities.	Human health: appropriate health and safety protocols would be required to minimise any risk from dust, silt run-off, odour, ground gas/vapours, noise etc. No ecological risk during remediation activities.	Human health: appropriate health and safety protocols would be required to minimise any risk from dust, silt run-off, odour, ground gas/vapours, noise etc. No ecological risk during remediation activities.	No impacts.
Complexity	Relatively low technological complexity.	Relatively low technological complexity.	Relatively low technological complexity.	No technological complexity.
Implementation timeframe	Short timeframe.	Short timeframe. Long term EMP.	Short timeframe. Long term EMP.	Not applicable.
Implications of data gaps	Significant data gaps remain onsite relating to soil, groundwater and soil vapour. The major implications relate to unknown degree and extent of contamination across certain areas of the site and associated implications on volumes of different waste classifications of soil for disposal. The requirement for a vapour barrier to underlie the school in Scheme 2 is unknown.	Significant data gaps remain onsite relating to soil, groundwater and soil vapour. The major implications relate to unknown degree and extent of contamination across certain areas of the site and associated implications on volumes of different waste classifications of soil for disposal.	Significant data gaps remain onsite relating to soil, groundwater and soil vapour. The major implications relate to unknown degree and extent of contamination across certain areas of the site and associated implications on volumes of different waste classifications of soil for disposal.	No impacts.

	Option 1: Excavate and disposal of contaminated soil including the buried asbestos (off site) and removal of UPSS infrastructure.	Option 2: Excavate and offsite disposal of the majority of known contaminated soil, removal of all UPSS infrastructure and onsite encapsulation of special waste and special GSW, with the preparation of an EMP	Option 3: Option 1 or 2 with leaving UST 4 in-situ and implementation of an EMP	Option 4: Do nothing
		The requirement for a vapour barrier to underlie the school in Scheme 2 is unknown. The actual amount of asbestos impacted soil is unknown, which will affect how feasible it is to encapsulate the soil onsite.	The requirement for a vapour barrier to underlie the school in Scheme 2 is unknown. The extent of contamination associated with UST 4 is unknown, therefore it is unclear whether leaving the UST insitu, represents a risk to future human health or ecological receptors.	

nation partners

SOLUTIONS FOR
COMPLEX PROJECTS

nation partners

14 December 2023

Eric Gotla
Land Development Analyst
Property & Place
Sydney Metro

Level 43, 680 George Street
Sydney NSW 2000

Chatswood Metro Site – Remediation Action Plan Addendum

Introduction

Nation Partners Pty Ltd (Nation Partners) previously prepared a Remedial Action Plan[1] (RAP) for the Sydney Metro property known as the Chatswood Metro site, located at the north-east corner of the Pacific Highway and Mowbray Road, Chatswood (the Site). The RAP (Nation Partners, 2021a) was informed by data collected during the Nation Partners Data Gap Investigation[2] (DGI) and identified several data gaps in relation to the preferred remediation option. A subsequent Pre-Remediation Investigation (PRI) was planned to address these data gaps, in particular:

1. A potential for shallow groundwater impacted by per- and poly-fluoroalkyl substances (PFAS) to be present. Investigation of the likelihood for shallow groundwater is required, in addition to an assessment of potential exposure risk to site workers (if present).
2. Uncertainty regarding the groundwater flow direction of deep groundwater, and natural attenuation of heavy metal and hydrocarbon impacts.
3. Waste classification conducted as part of the DGI (Nation Partners 2021b) was preliminary only and did not provide a sufficient sampling density to achieve assurance. Additional in-situ waste classification sampling is required to refine the waste classifications (noting that ex-situ classification will be required by the future remediation contractor prior to off-site disposal).
4. Asbestos containing material (ACM) has previously been reported in the fill soils at the site, however the entire site has not been investigated in a sufficient manner to determine the potential wide-spread presence of ACM or friable asbestos/asbestos fines (FA/AF). An asbestos in soils investigation of the entire site is required to inform this data gap and refine the remediation approach.
5. The footprint of the former energy depot building footprint has not been investigated to date. It is required to be investigated to inform the remediation approach.

Investigation of data gaps 3, 4 and 5 has been completed, with the results provided in a letter titled *Chatswood pre-remediation investigation – Asbestos in soils and energy depot investigation* dated 17 November 2023 (Nation Partners, 2023).

This RAP Addendum has been prepared to document revisions to the RAP (Nation Partners, 2021a) with respect to the results to-date of the PRI (Nation Partners, 2023)

---

1 *Sydney Metro Chatswood Site – Remediation Action Plan* dated 27 April 2021 (Nation Partners, 2021a)

2 *Data Gap Investigation – Chatswood Site, Sydney Metro* dated April 2021 (Nation Partners, 2021b)

Objectives

The objective of the remediation is to render the Site suitable for the proposed land use, low-density residential without any restrictions on land use (to meet divestment requirements).

The objective of this RAP Addendum is to consider the results of the PRI to-date (Nation Partners, 2023) and provide a revised extent of the soils to be removed for the Site to be considered suitable for a low-density residential land use.

Pre-Remediation Investigation

Nation Partners were engaged to undertake a PRI to close out the data gaps outlined in the RAP (Nation Partners, 2021a). The fieldworks for the soil component were completed in October 2023, with the results summarised in Nation Partners (2023). The results of the investigation are shown on **Figures 1** and **2**, and it was summarised that:

- ACM fragments were identified at seven locations, with Asbestos Fines also being identified at three of the locations.
- ACM fragments and Asbestos Fines were identified in a fill layer containing construction demolition waste.
- Lead concentrations in fill at four locations exceeded the low-density residential Human-Health Investigation Level (HIL-A) criterion.
- A benzo(alpha)pyrene (BaP) concentration in fill at one location exceeded the HIL-A criterion.
- Whilst there were exceedances of the General Solid Waste (GSW) Contaminant Threshold criteria at several locations for lead, nickel, and BaP, the leachable concentrations were low and able to be classified as GSW using the Specific Contaminant Concentration criteria.

Updated Conceptual Site Model and Data Gap Analysis

The Conceptual Site Model (CSM) from the RAP (Nation Partners, 2021) has been updated in **Table 1**, and a data gap analysis undertaken on Source-Pathway-Receptor (SPR) linkages that have been assessed to be complete, potentially complete, or currently incomplete regarding the remediation works.

Table 1: Updated Conceptual Site Model and Data Gap Analysis

Source	Impacted Media	Pathways	Receptors	RAP Assessment/Rationale	Data Gap Analysis
Former energy depot (central portion) including transformer workshop area, USTs, vehicle workshop, wash bay and oil storage tanks	Soil impacted by heavy metals, TRH and BTEX	Dermal contact / ingestion of soils	Site workers, contractors, visitors and future site users	No exceedances of the health investigation and screening levels were observed in this area during the DGI. Exceedances of lead and PAHs were reported in nearby SRT-PT017, though PAHs are attributed to the former Bryson Road. Site constraints meant that soils underneath or near the current building footprint in this area could not be assessed nor has assessment occurred historically. Historical exceedances of lead and PAH have been observed near underground storage tank (UST) 5 and 6. This SPR linkage was considered **potentially complete**. It was determined that the RAP should include provisions for the sampling of soils in the footprint of the former energy depot buildings. Although not detected to date, given the historical use of the building the future sampling should include analysis for polychlorinated biphenyls (PCBs).	The PRI investigated this SPR linkage and identified exceedances of HIL-A for lead at three locations. Therefore, this SPR linkage is considered **potentially complete**. The remediation extent has been slightly expanded to include this area, as outlined in the section below and shown in Figure 4.
			Ecological receptors that inhabit or forage in public open space parkland areas potentially proposed for the site	This SPR linkage was considered to be **currently incomplete** due to the lack of ecological receptors on the site. There is the potential for the SPR linkage to be potentially complete in the future redevelopment. However, exceedances of the adopted investigation levels will likely be excavated or future public open space areas will utilise imported soil. Validation or further sampling of public open space areas of the site are to consider ecological receptors during the assessment.	No change
	Soil impacted by asbestos	Dust and fibre inhalation	Site workers, contractors and visitors	Impacted fill and buried asbestos impacted material poses a potential risk to site workers, contractors and visitors if materials are exposed. Historic investigations indicate the presence of chrysotile asbestos within the footprint of the former energy depot, though currently the site is covered by hardstand. This SPR linkage was considered to be **currently incomplete**. It was determined that the RAP should consider the known and potential presence of asbestos in soils within this area.	The PRI investigated this SPR linkage and identified asbestos at two locations. Therefore, this SPR linkage is considered **complete**. The remediation extent has been expanded to include this area, as outlined in the section below and shown in Figure 4.

Source	Impacted Media	Pathways	Receptors	RAP Assessment/Rationale	Data Gap Analysis
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, stream/rivers and groundwater dependant ecosystems (GDEs)	PFAS exceedances, including exceedances of the PFAS NEMP Freshwater 95% and Drinking Water criteria were observed in this area. Froth observed during the removal of USTs 1, 2 and 3 could potentially be linked to the presence PFAS within groundwater (Section 4.3.2), though no per- and polyfluorinated substances (PFAS) were detected above the limit of reporting (LOR) in soils during the investigation. Should PFAS impacted groundwater be abstracted from this area there is the potential for a complete pathway to exist. The **potentially complete** pathway to be considered during remedial planning and future redevelopment.	The groundwater investigation component of the PRI has not been completed. Therefore, this data gap is yet to be addressed.
Former Caltex service station and MLP site including former bulk fuel storage and USTs	Soil impacted by heavy metals, TRH and BTEX	Dermal contact/ingestion of soil	Site workers, contractors, visitors Future site users	Exceedances of human health investigation and screening levels were observed in 3 soil samples including exceedances of TRH and lead as part of the DGI, with additional lead, TRH and BTEX exceedances observed historically. Elevated concentrations of TRH were also observed in other soil samples in the area. This SPR linkage was considered to be **currently incomplete**, as contaminated soils are currently located under hardstand. It was determined that the RAP should consider the known and potential presence of TRH, benzene, toluene, ethylbenzene and xylene (BTEX) and lead in soils within this area, as this SPR linkage could be **potentially complete**, during the redevelopment of the site.	No change.
			Ecological receptors that inhabit or forage in public open space parkland areas proposed for the site.	Exceedances of the ESL for TPH have been observed in this area in a number of occasions in historical investigations, and two exceedances were observed as part of the DGI (SRT-PT016). The majority of exceedances were reported at depths of 2 mBGL or deeper (with the exception of one sample) at the time of each respective investigation. This SPR linkage is considered **potentially complete** and should be reassessed based on the design of any proposed public open space areas. Validation or further sampling of public open space areas of the site are to consider ecological receptors during the assessment.	

Source	Impacted Media	Pathways	Receptors	RAP Assessment/Rationale	Data Gap Analysis
	Soil impacted by asbestos	Dust and fibre inhalation	Site workers, contractors, visitors	Impacted fill and buried asbestos impacted material (including asbestos pits) poses a potential risk to persons working on the redevelopment of the site if disturbed. This SPR linkage was considered to be **currently incomplete**. It was determined that the RAP should consider the known and potential presence of asbestos in soils.	The PRI investigated this SPR linkage and identified asbestos at two locations. Therefore, this SPR linkage is considered **complete**. The remediation of this area is to be undertaken in accordance with Section 6.2.6 of the RAP.
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	PFAS was reported in concentrations above the drinking water and ecological criterion in groundwater in SRT-MW018 and should groundwater be abstracted from this area there is the potential for a complete pathway to exist. The former Caltex service station and MLP site was considered to be an unlikely source of PFAS observed across the site, based on concentrations of PFAS observed and the inferred groundwater flow across the site. The **potentially complete** pathway to be considered during remedial planning and future redevelopment.	The groundwater investigation component of the PRI has not been completed. Therefore, this data gap is yet to be addressed.
Former Total Quality Centre where waste solvents, reagents and oils were stored	Soil impacted by asbestos	Dust and fibre inhalation	Site workers, contractors and visitors	Impacted fill and buried asbestos impacted material (including potential asbestos slab) poses a potential risk to persons working on the redevelopment of the site. This SPR linkage was considered to be **currently incomplete**, though will require consideration within the RAP, with regard to asbestos.	No change.
	Groundwater impacted by heavy metals, BTEX and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	Exceedances of the adopted investigation levels for heavy metals and PFAS were observed in GWMWs located near the area where the Former Total Quality Centre was located, though typically lower than the remainder of the site. PFAS was reported in concentrations above the drinking water and ecological criterion in groundwater in SRT-MW022 and SRT-MW024, and should groundwater be abstracted from this area there is the potential for a complete pathway to exist. The **potentially complete** pathway to be considered during remedial planning and future redevelopment.	The groundwater investigation component of the PRI has not been completed. Therefore, this data gap is yet to be addressed.
	Air	Inhalation of soil and groundwater derived vapours in indoor air	Site workers, contractors, visitors Future site users	The exceedance of the health screening level for benzene observed in SRT-PT020 could potentially be linked to historical contamination associated with the Former Total Quality Centre. No other exceedances including historical have been observed. This SPR linkage was considered to be **currently incomplete**, as the site is currently covered by hardstand. It was determined that this SPR linkage is to be considered during remedial planning.	No change.

Source	Impacted Media	Pathways	Receptors	RAP Assessment/Rationale	Data Gap Analysis
Former Retail Area	Soils impacted by heavy metals	Dermal contact / ingestion of soil	Site workers, contractors, visitors Future site users	Exceedances of the health investigation levels were observed in 2 soil samples for lead within fill material in this area during the DGI. This SPR linkage is considered to be currently incomplete, as contaminated soils are currently located under hardstand. This SPR linkage could be **potentially complete** during the redevelopment of the site and is to be considered during remedial planning.	No change.
	Groundwater impacted by PAH and PFAS	Groundwater use or consumption	Nearby groundwater bores, streams / rivers and GDEs	PFAS was detected in concentrations above the drinking water and ecological freshwater criteria in numerous GWMW, with the highest concentrations observed in the up-gradient south-western portion of site. PFAS is likely from an on-site source, though this is yet to be confirmed. BaP was detected above the drinking water criterion in SRT-MW009S during stage 1 of the DGI only. This was the only detection above limit of reporting (LOR) for BaP across the site, and was potentially due to leaching from BaP impacted fill within the water column. Should impacted groundwater be abstracted, including for any potential future basement scenario, there is a **potentially complete** pathway which exists and should be considered during remedial planning and future development.	The groundwater investigation component of the PRI has not been completed. Therefore, this data gap is yet to be addressed.
TSE and historically imported fill from unknown sources and unknown contamination within areas not assessed	Soil impacted by TRH, BTEX, PAH and asbestos or other contaminants	Dermal contact/ingestion of soil	Site workers, contractors, visitors. Future site users	This SPR linkage was considered to be **currently incomplete**, though during the redevelopment of the site, the removal of hardstand could expose previously undetected contaminated fill. It was determined that the RAP should consider the potential dermal contact / ingestion of soil risk.	No change.
		Dust inhalation	Site workers, contractors, visitors. Future site users	Impacted fill material poses a potential risk to persons working on the redevelopment of the site. This SPR linkage was considered to be **currently incomplete** and should be considered during remedial planning and future development. It was determined that the RAP should consider the potential dust inhalation risk.	
		Inhalation of asbestos fibres	Site workers, contractors, visitors Future site users	No asbestos was detected during the investigation, though, as soil was sampled and assessed via boreholes, only a small proportion of the site was assessed. Large amounts of asbestos have previously been discovered in fill material on the site during the remediation of the former Caltex service station. Currently any potential asbestos impacted fill is covered by hardstand. Therefore, this SPR linkage was considered to be **currently incomplete**. It was determined that the RAP should consider the potential dust inhalation risk.	

Revised Remediation Extent

Excavation and off-site disposal to landfill is still the preferred remediation strategy as outlined in the RAP (Nation Partners, 2021). Sections 4.3.4, 6.2.5, 6.2.6, and 6.2.7 of the RAP outline the proposed remediation extent, which has been refined in this RAP Addendum as detailed in **Table 2** below.

Table 2: Revised Remediation Extent with Reference to RAP (Nation Partners, 2021) Extent

Remediation Area	RAP Extent (Figure 3)	RAP Addendum Extent (Figure 4)
Area A	Targeting the former burial pits and lead, TRH, and PAH exceedances. An area of approximately 3,650 m^2 to a depth of up to 4 mbgl at the deepest point.	Split into Remediation Areas: A1 – Targeting the former burial pits and asbestos identified during the PRI (Nation Partners, 2023). An area of approximately 2,192 m^2 to a depth of up to 4 mbgl at the deepest point. A2 – Targeting lead, TRH, and PAH exceedances, where asbestos was not identified during the PRI (Nation Partners, 2023). An area of approximately 1,957 m^2 to a depth of up to 3 mbgl.
Area B	Targeting the former asbestos slab. An area of approximately 22 m by 12 m, to a depth of 2 mbgl.	No change
Area C	Targeting UST 4. An area of approximately 17 m by 14 m, to a depth of 4 mbgl.	No change
Area D	Targeting USTs 4 and 6, and lead, TRH, and PAH exceedances. An area of approximately 22 m by 18 m, to a depth of 4 mbgl.	Expanded to include lead impacts within the footprint of the former energy depot. An area of approximately 919 m^2, to a depth of up to 4 mbgl.
Area E	Targeting lead and PAH exceedances. An area of approximately 22 m by 11 m, to a depth of 0.5 mbgl.	No change
Area F	Targeting a lead exceedance. An area of approximately 19 m by 12 m, to a depth of 1 mbgl.	No change

There is the potential for Remediation Area A1 to expand based on visual observations of asbestos in fill material beyond the indicative extent, which should be informed by the asbestos removal supervisor in accordance with Section 6.2.6 of the RAP (Nation Partners, 2021).

Remediation Approach

The remediation approach and methodologies remain consistent with the RAP (Nation Partners, 2021).

Closure

We trust this RAP Addendum assists Sydney Metro in progressing the remediation of the Site. If you have any queries, please do not hesitate to contact the undersigned.

Sincerely,

Nelson Philips
Consultant

Liam Gooley
Principal

I acknowledge the Traditional Custodians of the land on which I work and live, and recognise their continuing connection to land, water, and community. I pay my respects to Elders past, present and emerging.

Document Approvals

Document title: Chatswood Site – Remediation Action Plan Addendum				
Version	**Date**	**Comment**	**Prepared by**	**Approved by:**
V1.0	14 Dec 2023	First draft for review	Nelson Philips / Liam Gooley	Luke Clements

Limitations

Nation Partners produces technical and advisory documents in the course of providing its services, which includes this document.

The contents of this document and any related findings reflect industry practice based on information available to Nation Partners at the time of creation and the scope of services, methodologies, and resources to which this document relates. Nation Partners has also relied upon information provided by the recipient and, except as expressly provided, has not carried out any separate verification of such information provided.

This document is therefore innately limited in respect of such available information and the scope of related services and resources, as well as a result of inherent uncertainties that exist in relation to environmental conditions that relate to any information in this document (if applicable).

This document must be read in its entirety and must not be copied, distributed or referred to in part only, and no excerpts are to be taken as representative of the findings.

Nation Partners does not represent or warrant that this document contains all requisite information needed to determine a future course of action, to guarantee results, and/or to achieve a particular outcome. The interpretation, application and general use of the information contained in this document, including by any third party that the recipient shares it with, is at the recipient's own risk.

This document has been prepared for the exclusive use of the recipient and Nation Partners accepts no liability or responsibility for any use or reliance on this document by any other third party.

Appendix A: Figures

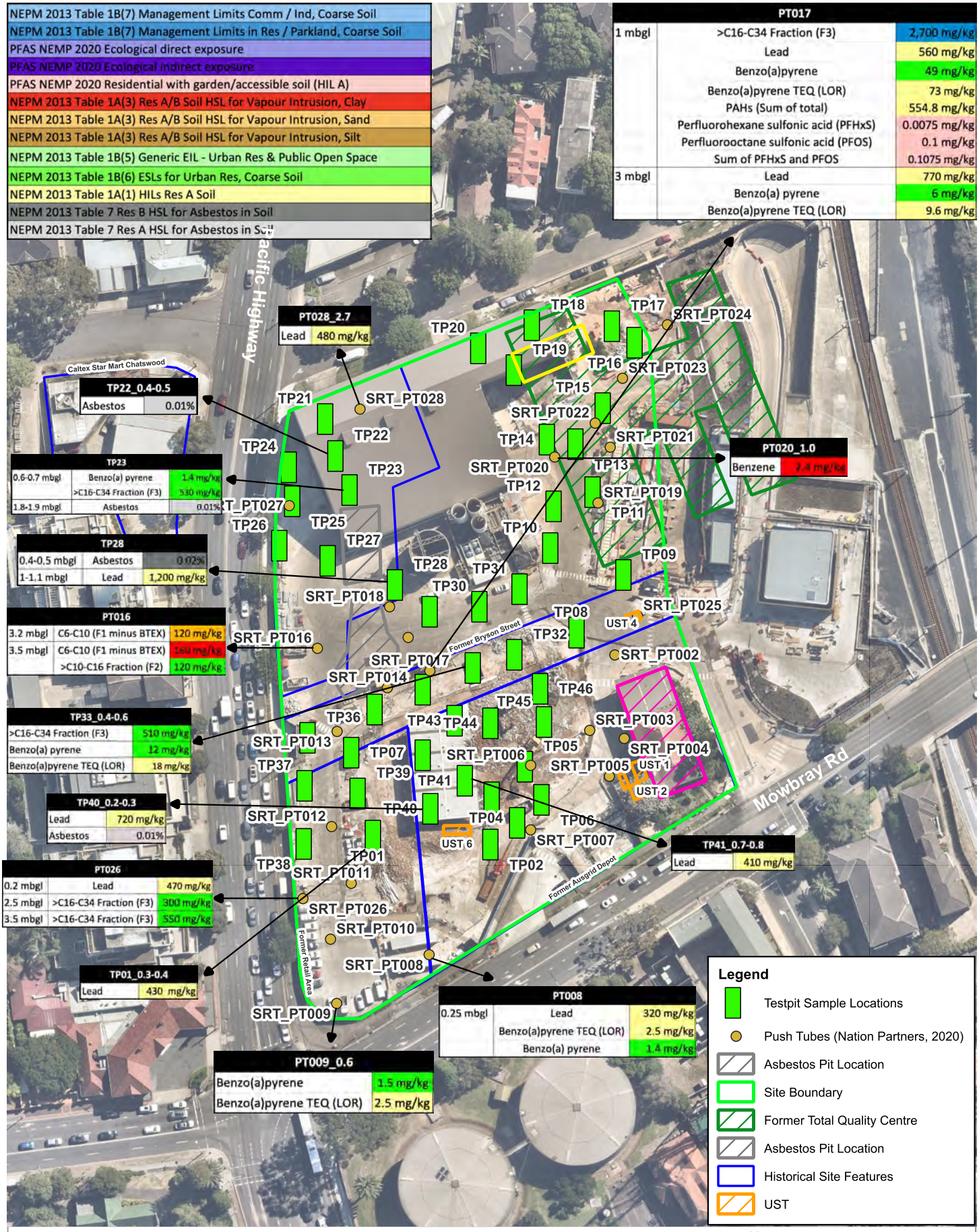


Figure 1: Human Health and Ecological Exceedances

Chatswood Pre-Remediation Investigation - Remedial Action Plan Addendum

nation partners

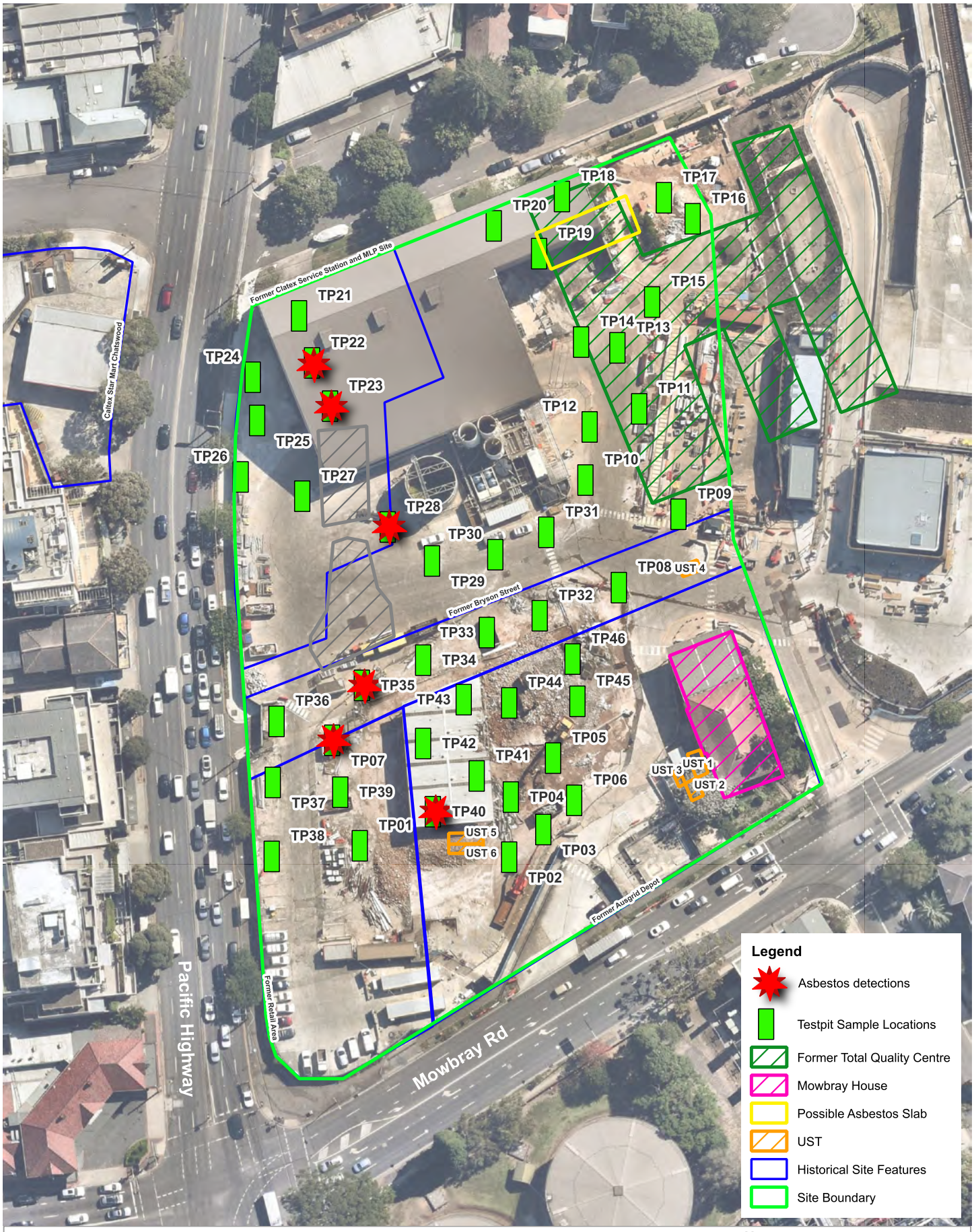


Figure 2: Asbestos Detections

Chatswood Pre-Remediation Investigation
Remedial Action Plan Addendum

N

DATA SOURCE
Imagery: Nearmap, 2023

SCALE
0 10 20 30 40 m

nation partners

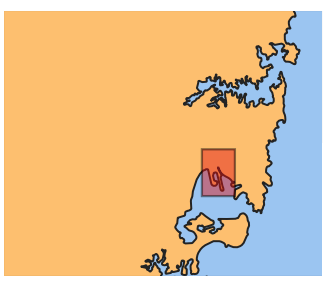
Figure 3: Previous Remediation Extent

Chatswood Pre-Remediation Investigation

Remedial Action Plan Addendum

Legend

- Site Boundary
- Asbestos Pit Location
- Underground Storage Tanks
- Possible Asbestos Slab
- Indicative Extent of Remediation



DATA SOURCES
Imagery: Nearmaps, 2020

SCALE 1:1000

5 0 5 10 15 20 25 m

nation partners

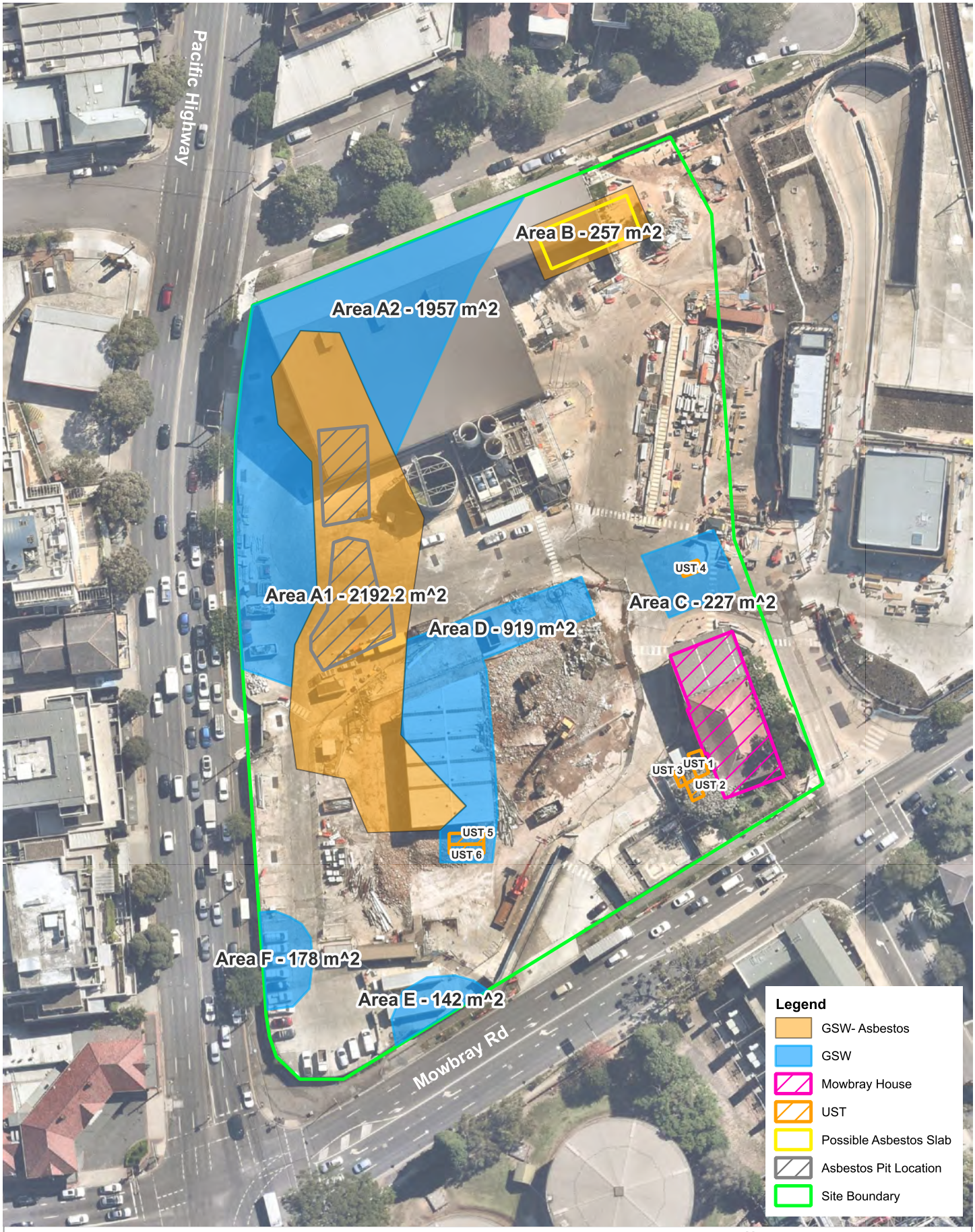


Figure 4: Indicative Extent of Remediation - Option A

Chatswood Pre-Remediation Investigation
Remedial Action Plan Addendu

N

DATA SOURCE
Imagery: Nearmap, 2023

SCALE
0 10 20 30 40 m

nation partners

Department of Planning and Environment

Our ref: SSI-7400-PA-394

Fil Cerone
Director of Sustainability, Environment and Planning
Sydney Metro
PO Box K659
HAYMARKET NSW 1240

Attention: Dylan Jones

29/6/2023

Subject: C2S – Chatswood Dive – Approval of E68 Extension Request

Dear Mr Cerone

I refer to your request for an extension of time, under Condition A7, to the submission of Site Audit Statement and Site Audit Report for residual land at the corner of Mowbray Road and Pacific Highway Chatswood (the land), as required by condition E68 of SSI-7400.

The Department notes:

- the Site Audit Statement for Chatswood Dive (dated 20 October 2020) identified that contaminants on the site have a low risk of migrating onto the Chatswood Dive site
- there is a public interest in not delaying the operation of the Sydney Metro Chatswood to Sydenham line
- the site will not be used as part of the operation of the CSSI
- remediation of the site is expected to commence in July 2023 to facilitate a transfer of the land to Property and Development NSW on 31 July 2024

Accordingly, as nominee of the Planning Secretary, I grant an extension to the timeframe required by Condition E68 of CSSI 7400 to the first of:

a) **31 July 2024,** or

b) **one month prior to the use of the land,** or

c) **one month prior to the transfer of the land**.

If there are any inconsistencies between the document and the conditions of approval, the conditions prevail.

Please make this letter publicly available on the project website as soon as possible.

If you wish to discuss the matter further, please contact Grant Rokobauer at grant.rokobauer@dpie.nsw.gov.au

Yours sincerely

Grant Rokobauer
Acting Team Leader – Rail
Infrastructure Management

As nominee of the Planning Secretary