4.14 M4-M5 Link project tunnel alignment

In addition to ancillary facilities and the project footprint, evaluation of the proposed M4-M5 Link project tunnel alignment has been undertaken to identify potentially contaminating land uses which may impact soil and groundwater quality in proximity to the tunnel alignment. For the purposes of this working paper, the document has been divided into five sections comprising:

- St Peters to Newtown
- Newtown to Camperdown
- Camperdown to Annandale
- Annandale to Haberfield and Rozelle
- Rozelle to Iron Cove and Balmain.

4.14.1 Tunnel alignment – St Peters to Newtown

Current potentially contaminating land uses

Current and former potentially contaminating land uses identified within 300 metres of the tunnel alignment between St Peters and Newtown are listed in **Table 4-43**.

Table 4-43 Potential Contaminating Land Uses – St Peters to Newtown

Property/area	Activity	Proximity to alignment
Current land uses		
BP Express Service Station 2 Princes Highway, St Peters	Petroleum storage	80 metres east and across topographic gradient of the alignment.
BP Petrol Station 327–339 Princes Highway, Sydenham	Petroleum storage	Directly above the alignment.
Valitel Commercial 310 Princes Highway, St Peters	Dry cleaning (now closed)	300 metres southwest and up topographic gradient of the alignment.
Former land uses		
Former Alexandria Landfill (St Peters interchange)	Former landfill	Adjacent to and south of the alignment.
Sydney Park	Former landfill	60 metres east and down topographic gradient of the alignment.
Former Taubmans Factory 73 Mary Street, St Peters	Paint manufacturing	170 metres northwest and up topographic gradient of the alignment.
Former clay pit 60 Mary Street, St Peters	Uncontrolled filling	170 metres northwest and up topographic gradient of the alignment.
Former brick pit 9 Unwins Bridge Road, St Peters	Uncontrolled filling	300 metres northwest and up topographic gradient of the alignment.
Former brick pit Camdenville Park May Street, St Peters	Uncontrolled filling	25 metres west and up topographic gradient of the alignment.
Industrial and commercial properties along the Princes Highway	Unknown – potentially workshops and manufacturing	Directly above and adjacent to the alignment.

Notified and regulated sites

Sites notified to the NSW EPA under section 60 of the CLM Act or formerly regulated by the NSW EPA under the CLM Act and within 300 metres of the tunnel alignment are listed in **Table 4-44**.

Table 4-44 Contaminated sites notified to or regulated by the NSW EPA – St Peters to Newtown

Property	Status	Proximity to alignment
BP Express Service Station 2 Princes Highway, St Peters	Reported to the NSW EPA under section 60 of the CLM Act. Currently under assessment by the NSW EPA.	80 metres east and across topographic gradient of the alignment.
Former Tidyburn Facility 53 Barwon Park Road, St Peters	Formerly regulated under the CLM Act. Concentrations of naphthalene were present in groundwater on the site at concentrations above the relevant trigger values for the protection of aquatic ecosystems. TPHs were also present in groundwater at elevated concentrations. A Site Audit Statement (SAS) and Site Audit Report (SAR) were prepared certifying that the site was suitable for residential land use with minimal opportunity for soil access, including units. The site has been redeveloped into a high density residential apartment building with basement car park.	Immediately east and across topographic gradient of the alignment.
Camdenville Park May Street, St Peters	Reported to the NSW EPA under section 60 of the CLM Act. NSW EPA assessed the site as not requiring regulation under the CLM Act.	25 metres west and up topographic gradient of the alignment.

Licensed sites

Sites licensed under the POEO Act and within 300 metres of the tunnel alignment are listed in **Table 4-45**.

Table 4-45 POEO Register – St Peters to Newtown

Property	Licence Number	Proximity to alignment
Metropolitan Demolitions And Recycling, 396 Princes Highway, St Peters	EPL 11483	300 metres south and down topographic gradient of the alignment
New M5 St Peters interchange (former Alexandria Landfill)	EPL 4627	Above and adjacent to alignment

Groundwater quality

Groundwater monitoring was undertaken for the New M5 project around the St Peters interchange. Additional monitoring wells were monitored as part of the combined geotechnical and contamination investigations for the M4-M5 Link project (AECOM 2016c). The results are summarised in **Table 4-46** and monitoring well locations are shown in **Figure 4-29**.

Table 4-46 Groundwater quality – tunnel alignment – St Peters to Newtown

Source	Monitoring wells	Summary of results
AECOM, 2015b	MW122 (south Sydney Park)	• Copper (0.003 milligrams per litre) and zinc (0.068 milligrams per litre) exceeded the ANZECC (2000) 95 per cent marine trigger values of 0.0013 milligrams per litre and 0.015 milligrams per litre respectively • Nickel (0.0028 milligrams per litre) exceeded the NHMRC (2015) ADWG of 0.002 micrograms per litre.
	MW115 (northwest Sydney Park)	• Chromium (0.173 milligrams per litre), copper (0.011 micrograms per litre) exceeded the ANZECC (2000) 95 per cent marine trigger values of 0.0044 milligrams per litre and 0.0013 milligrams per litre respectively.
	MW109 (southwest of the former Alexandria Landfill)	• Chromium (0.088 milligrams per litre), copper (0.007 milligrams per litre) and zinc (0.0018 milligrams per litre) exceeded the ANZECC (2000) 95 per cent marine trigger values of 0.0044 milligrams per litre, 0.0013 milligrams per litre and 0.015 milligrams per litre respectively • Chromium also exceeded the NHMRC (2015) ADWG of 0.005 milligrams per litre.
AECOM, 2015d	Former Alexandria Landfill monitoring wells (refer to **section 4.13.7**)	• Concentrations of TRH >C10-C34 fractions, benzene, manganese, nickel, sodium, chloride and TDS exceeded the human-health based criteria in groundwater. TRH >C10-C34 fractions and benzene were detected in the leachate and not in the Botany Sands or bedrock aquifer • Concentrations of cobalt, cadmium, copper, nickel and zinc exceeded the ecological based assessment criteria in leachate and the bedrock aquifer. Concentrations of metals were highest in the leachate and the bedrock aquifer • Concentrations of ammonia exceeded the adopted groundwater ecological based assessment criteria in leachate and slightly exceeded the criteria in the Botany Sands and bedrock aquifers.
AECOM, 2016c	SP_BH02 (east of Sydney Park)	• Nickel (0.012 milligrams per litre) and zinc (0.048 milligrams per litre) exceeded the ANZECC (2000) 95 per cent marine trigger values of 0.07 milligrams per litre and 0.015 milligrams per litre respectively • Benzene (two micrograms per litre) exceeded the NHMRC (2015) ADWG of one microgram per litre • Ethylbenzene (10 micrograms per litre) exceeded ANZECC (2000) low reliability trigger value of five micrograms per litre.

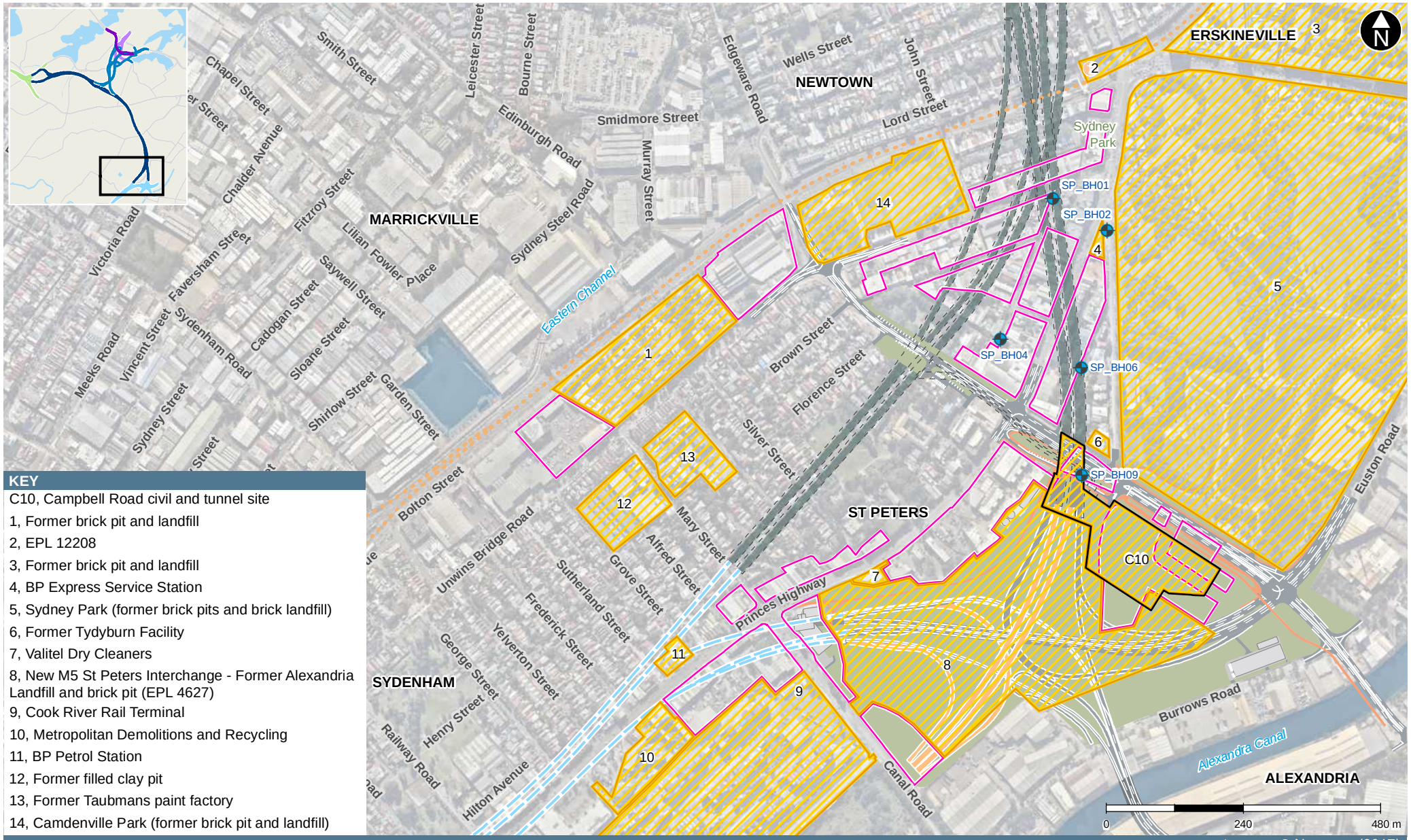


Figure 4-29 Tunnel Alignment - St Peters to Newtown

4.14.2 Tunnel alignment – Newtown to Camperdown

Current and former potentially contaminating land uses

Current and former potentially contaminating land uses identified within 300 metres of the tunnel alignment are listed in **Table 4-47.**

Table 4-47 Current and former potential contaminating land uses – Newtown to Camperdown

Property/area	Activity	Proximity to alignment
Current land uses		
St Peters Laundry 603 King Street, Newtown	Dry cleaning	10 metres east and up topographic gradient of the alignment.
Express Dry Cleaners 583 King Street, Newtown	Dry cleaning	Directly above the alignment.
Laundry Magic 514 King Street, Newtown	Dry cleaning	Directly above the alignment.
Laundrette on King 409 King Street, Newtown	Dry cleaning	20 metres west and up topographic gradient of the alignment.
Aquick Laundry 51 Enmore Road, Newtown	Dry cleaning	80 metres west and up topographic gradient of the alignment.
Enmore Laundrette and Dry Cleaning 139 Enmore Road, Enmore	Dry cleaning	310 metres west and up topographic gradient of the alignment.
Caltex Service Station 26 Enmore Road, Newtown	Petroleum storage	Directly adjacent (west side) and above the alignment.
Former land uses		
Former Industrial Factories 43 Alice Street, Newtown	Unknown – potentially workshops and manufacturing	50 metres west and up topographic gradient of the alignment.
Former Petrol Station 1–11 Enmore Road, Newtown	Petroleum storage	Directly above the alignment.
Former Dry Cleaners 18 Enmore Road, Newtown	Dry cleaning	Directly above the alignment.
Former Petrol Station 333 King Street, Newtown	Petroleum storage	40 metres northeast and up topographic gradient of the alignment.

Notified and regulated sites

Sites notified to the NSW EPA under section 60 of the CLM Act or formerly regulated by the NSW EPA under the CLM Act and within 300 metres of the tunnel alignment are listed in **Table 4-48**.

Table 4-48 Contaminated sites notified or regulated by the NSW EPA – Newtown to Camperdown

Property	Status	Proximity to alignment
Caltex service station 26 Enmore Road, Newtown	Reported to the NSW EPA under section 60 of the CLM Act. Currently under assessment by the NSW EPA.	Directly adjacent (west side) and above the alignment.

Licensed sites

No sites licensed under the POEO Act were within 300 metres of the tunnel alignment.

Groundwater quality

Deep groundwater monitoring wells have been installed at depths ranging between 40 and 50 metres below ground surface to measure groundwater levels and evaluate water quality at the proposed tunnelling depth within the vicinity of the Newtown to Camperdown section of the tunnel alignment. No groundwater monitoring wells have been installed within this section of the tunnel alignment specifically for the purposes of monitoring groundwater contamination as part of the M4-M5 Link project.

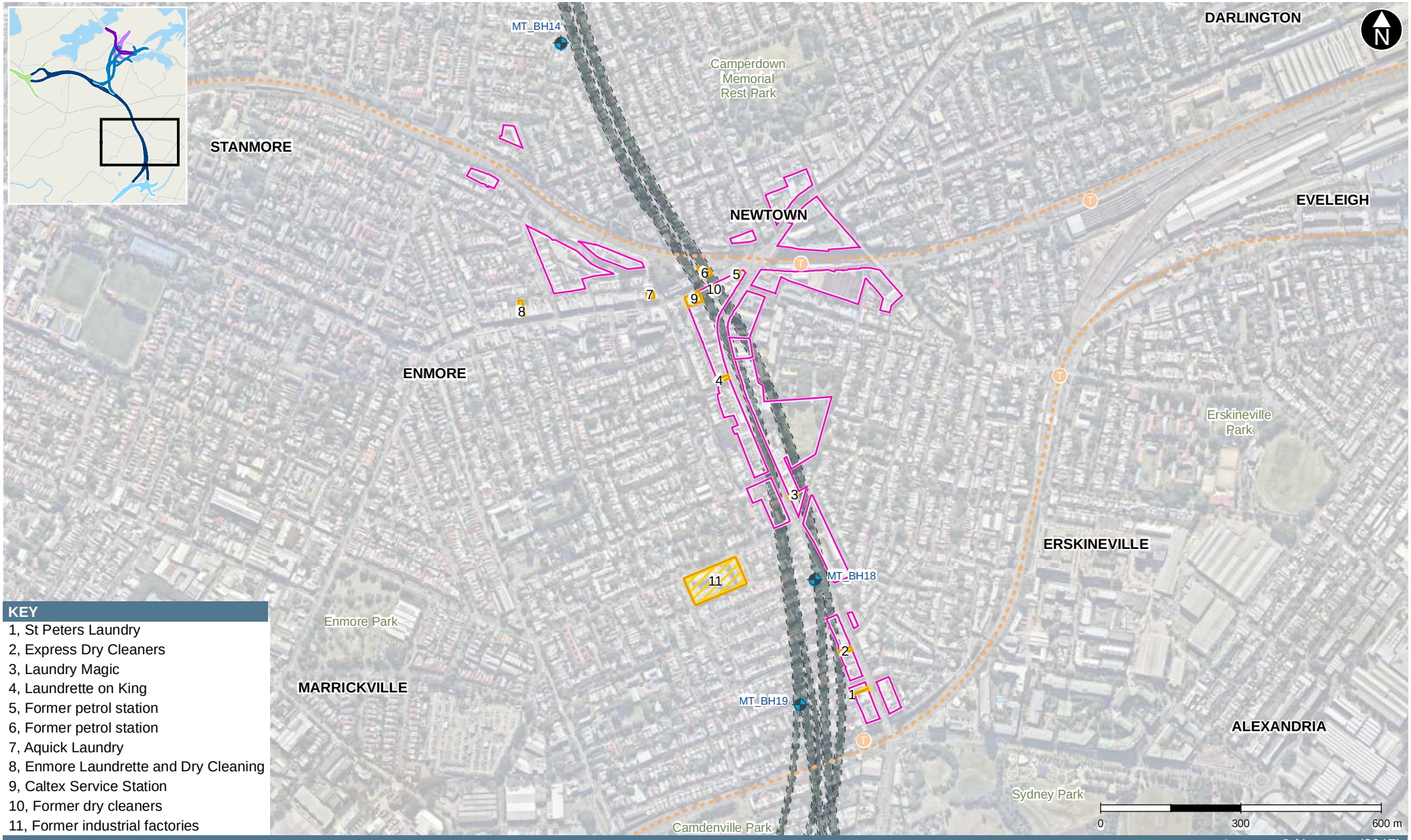


Figure 4-30 Tunnel Alignment - Newtown to Camperdown

4.14.3 Tunnel alignment – Camperdown to Annandale

Current and former potentially contaminating land uses

Current and former potentially contaminating land uses identified within 300 metres of the tunnel alignment are listed in **Table 4-49** and shown in **Figure 4-31**.

Table 4-49 Current and former potential contaminating land uses – Camperdown to Annandale

Property/area	Activity	Proximity to alignment
Current land uses		
7 Eleven 198 Parramatta Road, Camperdown	Petroleum storage	250 metres east and up topographic gradient of the alignment.
Former land uses		
O'Dea Reserve Salisbury Lane, Camperdown	Uncontrolled filling in former clay pit	Directly above the alignment.
Lawrence Dry Cleaners 208 Parramatta Road, Annandale	Dry cleaning	110 metres east and up topographic gradient of the alignment.
Stanmore Industrial Area 5–53 Bridge Road, Stanmore	Various historical manufacturing sites	200 metres west and up topographic gradient of the alignment.
48–52 Nelson Street, Annandale	Various historical manufacturing sites	150 metres north east of the alignment.

Notified and regulated sites

Sites notified to the NSW EPA under section 60 of the CLM Act or formerly regulated by the NSW EPA under the CLM Act and within 300 metres of the tunnel alignment are listed in **Table 4-50**.

Table 4-50 Contaminated sites notified to or regulated by the NSW EPA – Camperdown to Annandale

Property	Status	Proximity to alignment
O'Dea Reserve Salisbury Lane, Camperdown	Formerly regulated under the CLM Act due to PAHs, lead and TPH from uncontrolled backfilling of a former clay-pit with a range of materials.	Directly above the alignment.
Mobil service station (now 7 Eleven) 198 Parramatta Road, Annandale	Reported to the NSW EPA under section 60 of the CLM Act. Currently under assessment by the NSW EPA.	220 metres east and up topographic gradient of the alignment.

Licensed sites

No sites licensed under the POEO Act were within 300 metres of the tunnel alignment.

Groundwater quality

Deep groundwater monitoring wells have been installed at depths ranging between 40 and 50 metres below ground surface to measure groundwater levels and evaluate water quality at the proposed tunnelling depth within the vicinity of the Camperdown to Annandale section of the tunnel alignment. No groundwater monitoring wells have been installed specifically for the purposes of monitoring groundwater contamination as part of the M4-M5 Link project.

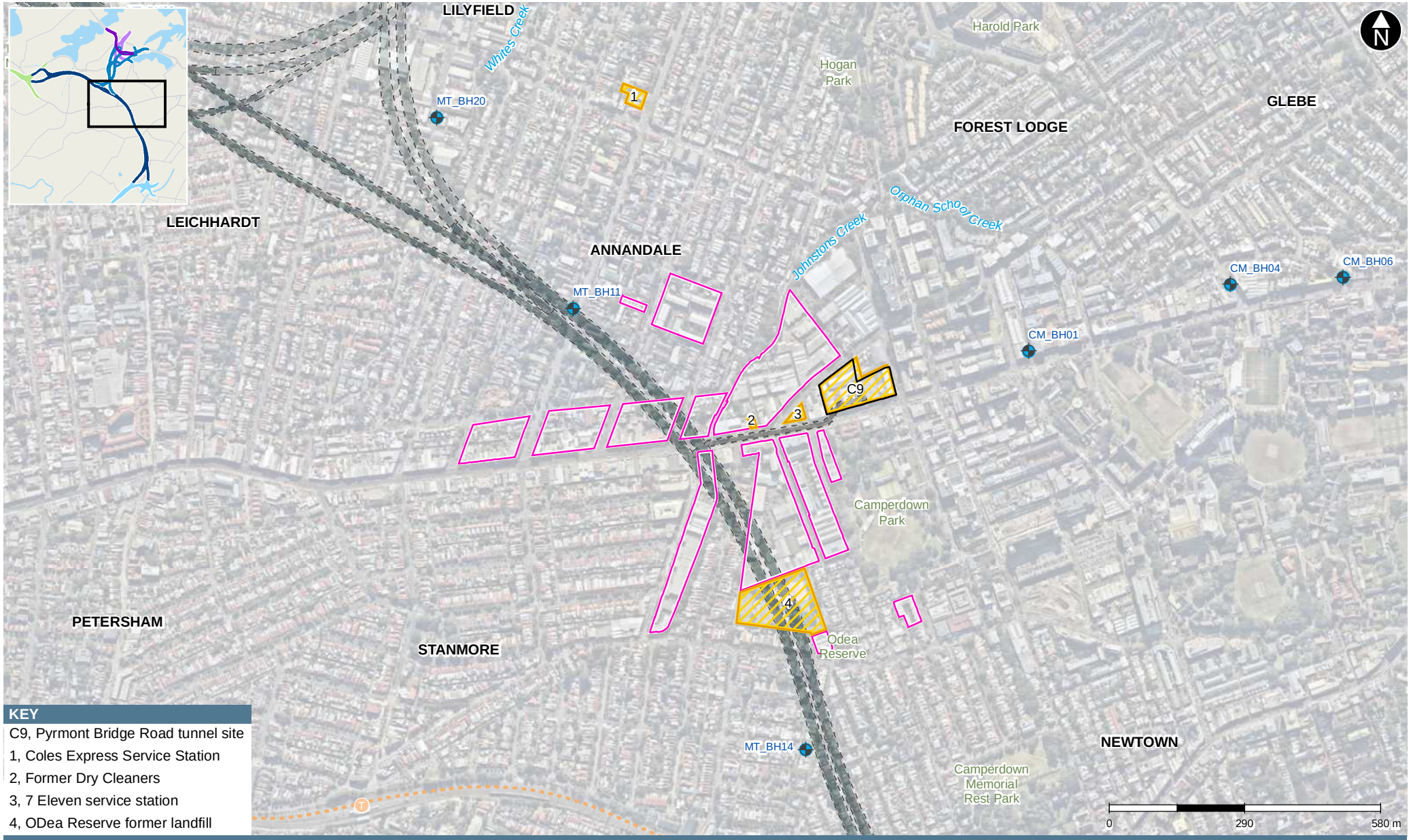


Figure 4-31 Tunnel Alignment - Camperdown to Annandale

4.14.4 Tunnel alignment – Annandale to Haberfield and Rozelle

Current and former potentially contaminating land uses

Current and former potentially contaminating land uses identified within 300 metres of the tunnel alignment are listed in **Table 4-51**.

Table 4-51 Current and former potentially contaminating land uses – Annandale to Haberfield and Rozelle

Property/area	Activity	Proximity to alignment
Current land uses		
Leichhardt Bus Depot Corner Balmain Road and City West Link	Petroleum storage and workshops.	300 metres north of the alignment
Former State Rail Authority Land (now State Transit Authority) Corner William and Derbyshire Streets, Leichhardt. Includes the site and immediately adjacent recreational open space and Bus Depot to the north.	Historical buildings containing hazardous building materials, potential residual contaminated soil and fill material following remediation.	300 metres north of the alignment
RailCorp Leichhardt 7 Darley Road, Leichhardt	Petroleum storage and workshops.	150 metres north of the alignment
Sydney Trains Between Darley Road and Canal Road, Leichhardt	Petroleum storage and workshops.	160 metres north of the alignment
Monza Petrol Station 249–251 Norton Street Leichhardt	Petroleum storage and workshops.	300 metres north of the alignment
Former land uses		
91 Canal Road Lilyfield and Blackmore Park, Leichhardt	Former 5th Ordnance Leichhardt Depot.	200 metres north of the alignment
Sydney Motor Auctions Pty Ltd 29 Derbyshire Road, Leichhardt	Former petroleum storage and workshops.	170 metres north of the alignment
1 Canal Road, Leichhardt	Former Public Works Depot.	Immediately south of the alignment
54–58 Darley Road Leichhardt	Former petrol station.	50 metres north of the alignment
124 James Street, Leichhardt	Former steel manufacturers and boiler makers.	150 metres north of the alignment
Block of land between William Street, Francis Street, North Street and Allen Street, Leichhardt	Former manufacturing including steel and plastic manufacturing.	Directly adjacent to and south of the alignment
120 William Street, Leichhardt	Former metal engineering, electroplating, non-metal founding, timber supplies and panel beaters.	180 metres south of the alignment

Property/area	Activity	Proximity to alignment
Hawthorne Canal	Reclaimed land around Hawthorne Canal.	Directly above the alignment
Algie Park Ramsay Street, Haberfield	Former Cumberland brick pit filled with unknown source (pre-1943).	Directly above and immediately north of the alignment

Notified and regulated sites

Sites notified to the NSW EPA under section 60 of the CLM Act or formerly regulated by the NSW EPA under the CLM Act and within 300 metres of the tunnel alignment are listed in **Table 4-52**.

Table 4-52 Contaminated sites notified to or regulated by the NSW EPA – Annandale to Haberfield and Rozelle

Property	Status	Proximity to alignment
Bus Depot (Area E) Cnr Balmain Rd and City West Link, Leichhardt	Reported to the NSW EPA under section 60 of the CLM Act. Currently under assessment by the NSW EPA.	300 metres north of the alignment
RailCorp Leichhardt 7 Darley Road, Leichhardt	Reported to the NSW EPA under section 60 of the CLM Act. NSW EPA assessed the site as not requiring regulation under the CLM Act.	150 metres north of the alignment

Licensed sites

Sites licensed under the POEO Act and within 300 metres of the tunnel alignment are listed in **Table 4-53**.

Table 4-53 POEO Register – Annandale to Haberfield and Rozelle

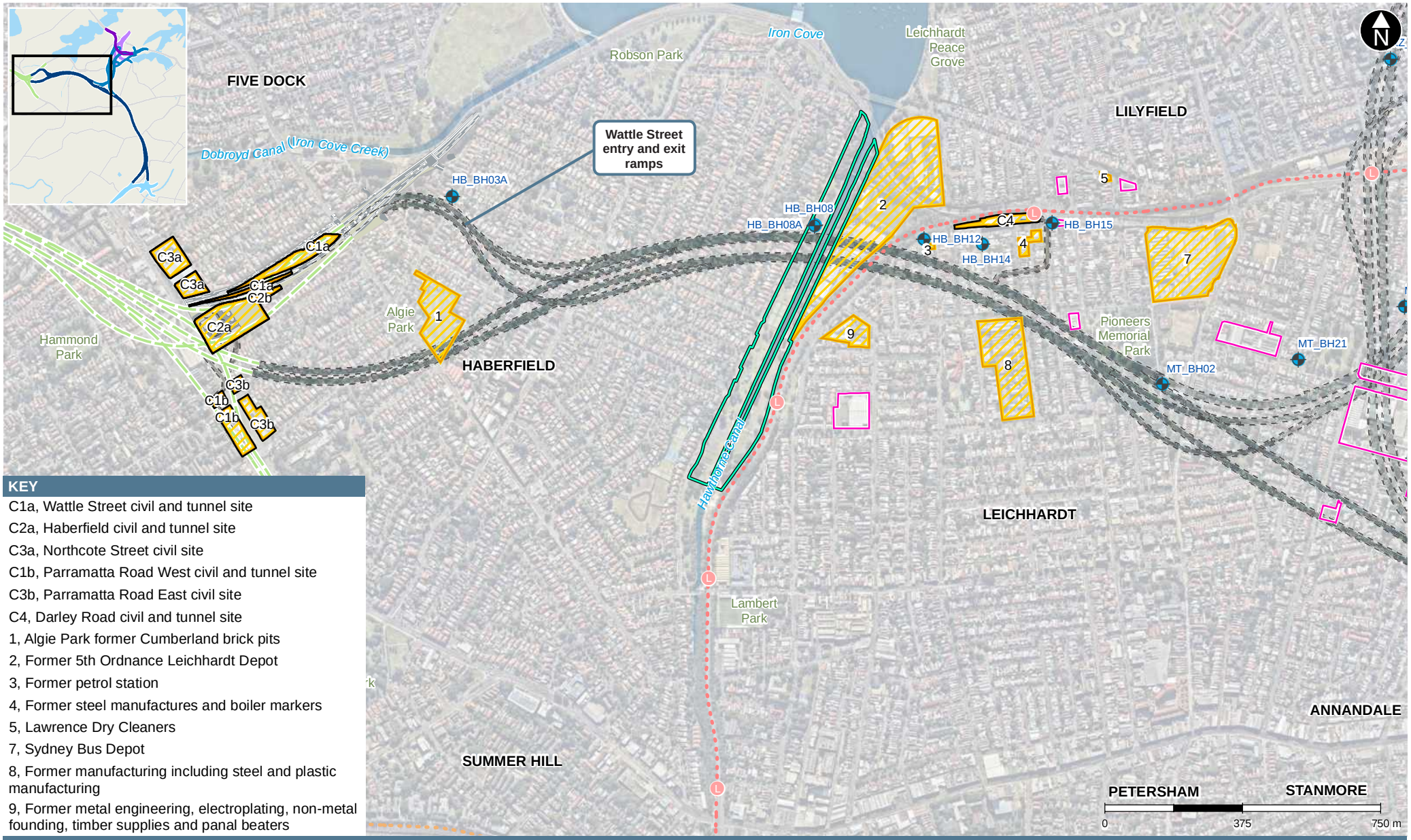
Property	Licence Number	Proximity to alignment
WestConnex M4 East Homebush Bay Drive to Parramatta Road Burwood	EPL 20734	West of alignment

Groundwater quality

Groundwater monitoring was undertaken as part of the combined geotechnical and contamination investigations (AECOM 2016c) for this project (see **Figure 4-32**). Samples were collected and analysed for metals (arsenic, cadmium, chromium, copper, nickel, lead, mercury and zinc), TRH, VOCs and SVOCs. The results are summarised in **Table 4-54**.

Table 4-54 Groundwater quality – tunnel alignment – Annandale to Haberfield and Rozelle

Source	Monitoring wells	Summary of results
AECOM, 2016c	HB_BH08S	• No exceedances
	HB_BH08D	• No exceedances
	HB_BH12	• Zinc (0.016 milligrams per litre) exceeded the ANZECC (2000) 95 per cent ANZECC (2000) 95 per cent marine trigger value of 0.015 milligrams per litre
	HB_BH15	• Nickel (0.15 milligrams per litre) and zinc (0.038 milligrams per litre) exceeded the ANZECC (2000) 95 per cent ANZECC (2000) 95 per cent marine trigger value of 0.07 milligrams per litre and 0.015 milligrams per litre.



KEY

C1a, Wattle Street civil and tunnel site
C2a, Haberfield civil and tunnel site
C3a, Northcote Street civil site
C1b, Parramatta Road West civil and tunnel site
C3b, Parramatta Road East civil site
C4, Darley Road civil and tunnel site
1, Algie Park former Cumberland brick pits
2, Former 5th Ordnance Leichhardt Depot
3, Former petrol station
4, Former steel manufactures and boiler markers
5, Lawrence Dry Cleaners
7, Sydney Bus Depot
8, Former manufacturing including steel and plastic manufacturing
9, Former metal engineering, electroplating, non-metal founding, timber supplies and panal beaters

LEGEND

Existing features
- Railway
- Light rail
- Light rail stop
- Railway station

M4 East
- Tunnel
- Surface road
- Landscaping

Underground construction
- Rozelle interchange tunnel
- Mainline tunnel
- Temporary access tunnel

Land use
- Site land use
- Other current or former industrial/commercial land use within 300m of the tunnel alignment
- Reclaimed land/disturbed terrain

Project features
- Ancillary facilities
- Groundwater monitoring wells

Figure 4-32 Tunnel Alignment - Annandale to Haberfield and Rozelle

4.14.5 Tunnel alignment – Rozelle to Iron Cove and Balmain

Current and former potentially contaminating land uses

Current and former potentially contaminating land uses identified within 300 metres of the tunnel alignment are listed in **Table 4-55**.

Table 4-55 Potential contaminating land uses – Rozelle to Iron Cove and Balmain

Property/area	Activity	Proximity to alignment
Current land uses		
BP service station 86 Victoria Road, Rozelle	Petroleum storage	100 metres south of the alignment.
7 Eleven service station 178–180 Victoria Road, Rozelle	Petroleum storage	Immediately adjacent to the alignment.
United service station 127 Victoria Road, Rozelle	Petroleum storage	30 metres east and topographically up-gradient of the alignment.
Caltex service station, 121 Victoria Road, Rozelle	Petroleum storage	30 metres northeast and topographically down-gradient of the alignment.
Former land uses		
Kwik Dry Cleaners, 127 Victoria Rd, Rozelle Superb Dry Cleaners, 688 Darling St, Rozelle Tasman Dry Cleaners, 693 Darling St, Rozelle Jones, Dry Cleaners Pty. Ltd, 673 Darling St, Rozelle Traynor Dry Cleaners, 684 Darling St, Rozelle	Dry cleaners historically used white spirits, kerosene, carbon tetrachloride, trichloroethylene (TCE), perchloroethylene (Perc), as cleaning solvents until the 1990s. Fluorocarbon based dry cleaning was used in Australia from 1990 until it was banned in 1997 [1,1,2 trichloro-1,2,2-trifluroethane and 1,1,1-Trichloroethane (TCA)].	30 to 140 metres east and topographically up-gradient of the alignment.
F. Voyce Petrol Station, 138 Victoria Road, Rozelle	Petroleum storage	70 metres east and topographically up-gradient of the alignment.
Former manufacturing sites were located up-gradient of the alignment in the block bound by Terry Street and Wellington Street in Rozelle	Use of chemicals and productions of waste in manufacturing processes.	90 metres east and topographically up-gradient of the alignment.
Mars Steel Products Pty Ltd and Swinnertons Pty Ltd, 68 Victoria Road, Rozelle	Metal foundries typically produce metal, petroleum hydrocarbon and PAH contaminants.	30 metres east and topographically up-gradient of the alignment.

Notified and regulated sites

Sites notified to the NSW EPA under section 60 of the CLM Act or formerly regulated by the NSW EPA under the CLM Act and within 300 metres of the tunnel alignment are listed in **Table 4-56**.

Table 4-56 Contaminated sites notified to or regulated by the NSW EPA – Rozelle to Iron Cove and Balmain

Property	Status	Proximity to alignment
White Bay Power Station, Rozelle	Reported to the NSW EPA under section 60 of the CLM Act. NSW EPA assessed the site as not requiring regulation under the CLM Act.	70 metres north and topographically down-gradient of the alignment.
Balmain Power Station, Terry Street, Rozelle	Formerly regulated by the NSW EPA due to a range of contaminants including polychlorinated biphenyl (PCBs) and asbestos. The NSW EPA notices were revoked in August 1997 following remediation of the site.	80 metres north and topographically down-gradient of the alignment.
Former Chemplex Factory, 35 Terry Street, Rozelle	Formerly regulated by the NSW EPA due to metals and organic compounds. The notices were revoked in 1997.	300 metres east and topographically down-gradient of the alignment.
Caltex service station 121 Victoria Road, Rozelle	Currently under assessment by the NSW EPA after being notified under section 60 of the CLM Act 1997.	Immediately adjacent to the alignment.
7 Eleven service station 178–180 Victoria Road, Rozelle	Currently under assessment by the NSW EPA after being notified under section 60 of the CLM Act 1997.	Immediately adjacent to the alignment.

Licensed sites

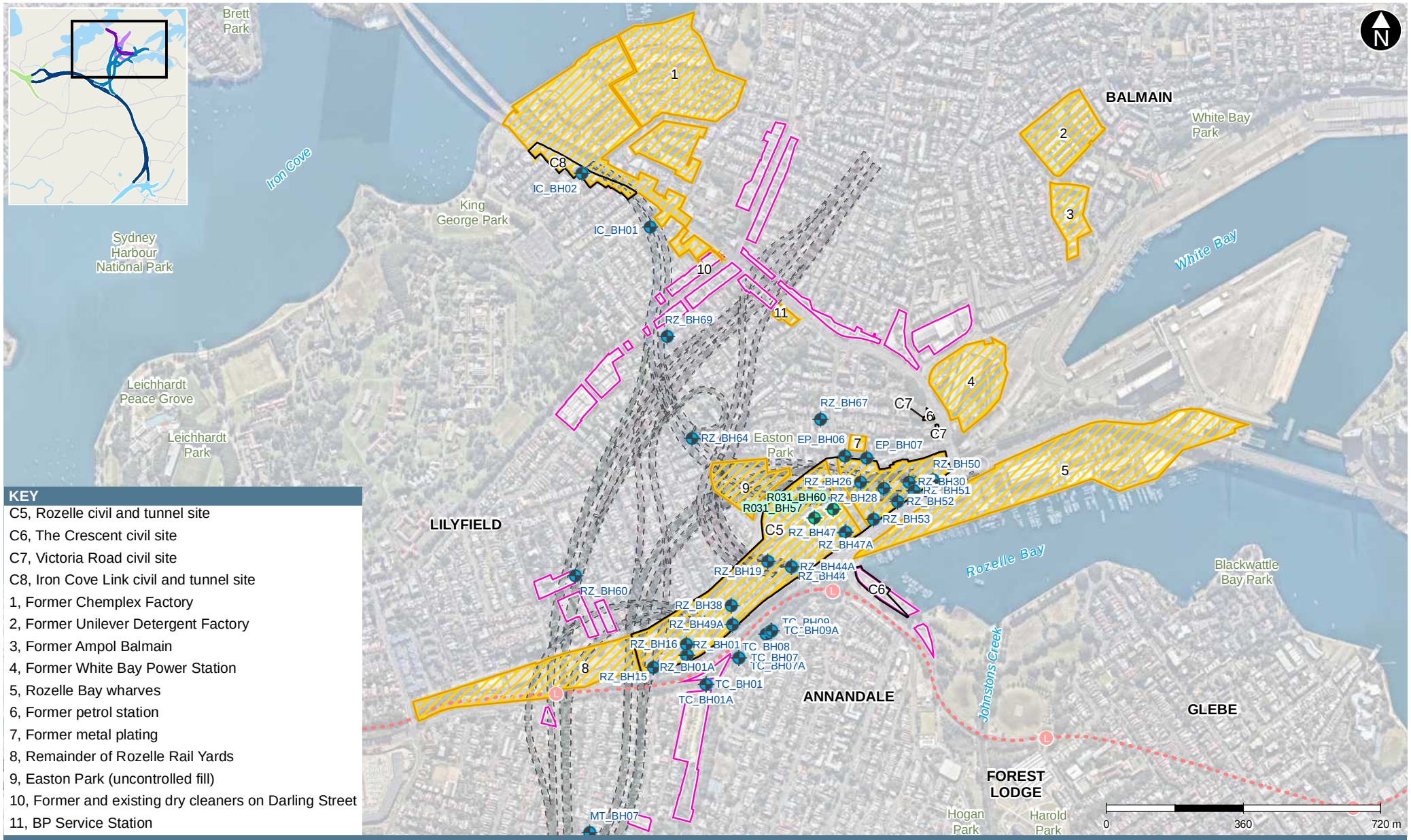
There were no licensed activities identified under the POEO Act and within 300 metres of the tunnel alignment with the exception of construction activities associated with the Sydney Light rail network located to the west of the Rozelle Rail Yards.

Groundwater quality

Groundwater monitoring was undertaken as part of the combined geotechnical and contamination investigations (AECOM 2016c) for this project (see **Figure 4-33**). Samples were collected and analysed for metals (arsenic, cadmium, chromium, copper, nickel, lead, mercury and zinc), TRH, VOCs and SVOCs. The results are summarised in **Table 4-57**. Groundwater monitoring results for Rozelle civil and tunnel site are reported in **section 4.8.8**.

Table 4-57 Groundwater quality – tunnel alignment – Rozelle to Iron Cove and Balmain

Source	Monitoring wells	Summary of results
AECOM, 2016c	TC_BH01S	No exceedances.
	TC_BH06	No exceedances.
	TC_BH07S	Arsenic (0.02 milligrams per litre) exceeded the NHMRC (2015) ADWG of 0.01 milligrams per litre.
	TC_BH08	No exceedances.



KEY

C5, Rozelle civil and tunnel site
C6, The Crescent civil site
C7, Victoria Road civil site
C8, Iron Cove Link civil and tunnel site
1, Former Chemplex Factory
2, Former Unilever Detergent Factory
3, Former Ampol Balmain
4, Former White Bay Power Station
5, Rozelle Bay wharves
6, Former petrol station
7, Former metal plating
8, Remainder of Rozelle Rail Yards
9, Easton Park (uncontrolled fill)
10, Former and existing dry cleaners on Darling Street
11, BP Service Station

LEGEND

Existing features
- Light rail
- Light rail stop

Underground construction
- Rozelle interchange tunnel
- Iron Cove Link tunnel
- Mainline tunnel
- Temporary access tunnel
- Proposed future WHTBL connections (civil construction only)

Land use
- Site land use
- Other current or former industrial/commercial land use within 300m of the tunnel alignment

Project features
- Ancillary facilities
- Groundwater monitoring wells

PB (2003)
- Existing groundwater monitoring wells

Figure 4-33 Tunnel Alignment - Rozelle to Iron Cove and Balmain

5 Assessment of construction impacts

5.1 Ancillary facilities and project footprint

The assessment of impacts for the ancillary facilities and project footprint are presented in **Table 5-1**. It is noted that the risk rankings presented in **Table 5-1** are prior to the implementation of the management measures identified in **section 8**. Following the implementation of management measures, it is anticipated that any identified high or medium risk rankings for the ancillary facilities and project footprint will ultimately present a low risk. The location of each ancillary facility and project footprint are shown in **Figure 2-2**.

Table 5-1 Assessment of construction impacts – ancillary facilities and project footprint

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C1a – Wattle Street civil and tunnel site at Haberfield	• Stockpiling within cut-and-cover structure • Excavations and tunnelling for ramp. The ramp and cut-and-cover structure would be built by the M4 East contractor. The M4-M5 contractor would construct driven tunnel using road headers to connect the ramps with the mainline tunnel. In addition, minor civil and finishing (pavement and line-marking) works on ramps and surface lands along Wattle Street (to Parramatta Road) would be undertaken by the M4-M5 contractor to prepare ramps for use.	No areas of concern were identified within the site or topographically up-gradient of the site with the exception of the demolition of former buildings and use of lead paint which may have resulted in localised areas of ACM fragments and lead paint flakes in soil. Any residual contamination would be managed by the M4 East project construction contractor. An assessment of the site within the project footprint immediately south and adjacent the C1a ancillary facility conducted by Ramboll Environ (2016a) prior to establishment works for the M4 East Eastern Ventilation Facility Tunnel Worksite (C2a or C2b ancillary facility) indicated the presence of friable and bonded asbestos in soils. Management measures including remediation and validation were specified by Ramboll Environ (2016a). The works would include bulk excavation for the construction of the ramp to the tunnel and surface road construction; however no bulk earthworks would be undertaken at the surface. There would be complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Inhalation and ingestion risk to site workers from hazardous building materials (if present) • Inhalation or ingestion of hazardous building materials (via dust) (if present). Cross contamination associated with the incorrect handling or disposal of spoil/unexpected finds is a potential impact during construction if appropriate controls and handling	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Low

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
		procedures are not implemented. The site will be demobilised and earthworks carried out by the M4 East contractor to provide finished levels that are consistent with the original ground surface before being handed over to the M4-M5 Link contractor. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. At the completion of M4-M5 Link construction the landscaping (where applicable) and residual land obligations as detailed in the M4 East Urban Design and Landscape Plan and Residual Land Management Plan would be carried out.			

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C2a – Haberfield civil and tunnel site at Haberfield	• No excavations or tunnelling to be completed (construction completed during M4 East). Tunnel spoil from the proposed M4-M5 Link mainline tunnel would be transported out via the M4 East stubs to M4 East mainline tunnel • Minor civil construction associated with the substation (including shallow excavation) • Deep excavation for vent tunnels, footings etc. will be carried out by M4 East contractor • Use of existing M4 East facilities (currently under construction).	Historical land uses within the western part of the site may have caused soil and potentially groundwater contamination (eg potential former dry cleaners and workshops associated with former car dealerships and mechanics). The remainder of the site was historically residential therefore no other outstanding areas of concern were identified. Isolated soil contamination may be present from demolition or construction of former buildings and use of lead paint which may have resulted in localised areas of ACM fragments and lead paint flakes in surface soil. Demolition activities, use of plant and machinery and excavation activities may mobilise these. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. An assessment of the site conducted by Ramboll Environ (2016a) prior to establishment works for the M4 East Eastern Ventilation Facility Tunnel Worksite indicated the presence of friable and bonded asbestos in soils. Management measures including remediation and validation were specified by Ramboll Environ (2016a). The site will be demobilised and earthworks carried out by the M4 East contractor to provide finished levels that are consistent with the original ground surface before being handed over to the M4-M5 Link contractor. At the completion of M4-M5 Link construction the landscaping (where applicable) and residual land obligations as detailed in the M4 East Urban Design and Landscape Plan and Residual Land Management Plan would be carried out.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Low

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C3a – Northcote Street civil site at Haberfield	• No excavations or tunnelling to be completed for the project (construction completed during M4 East) • Use of existing M4 East facilities (currently under construction).	There are historical land uses within the site which may have caused soil and potentially groundwater contamination (potential former petrol station and workshops). Use of the site as a construction ancillary facility for the M4 East project and associated potential for leaks and spills. Demolition activities, use of plant and machinery and excavation activities. The site will be demobilised and earthworks carried out by the M4 East contractor to provide finished levels that are consistent with the original ground surface before being handed over to the M4-M5 Link contractor. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. At the completion of M4-M5 Link construction the landscaping (where applicable) and residual land obligations as detailed in the M4 East Urban Design and Landscape Plan and Residual Land Management Plan would be carried out by the M4-M5 Link contractor.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Low

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C1b – Parramatta Road West civil and tunnel site at Ashfield	• Demolition of existing buildings and structures • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Establishment of site offices, amenities and temporary infrastructure • Laydown and storage of materials • Delivery of materials, plant and equipment • Construction of an acoustic shed • Construction of a temporary access tunnel • Tunnel excavation of the mainline tunnels and the Wattle Street entry and exit ramps, stockpiling of excavated material and spoil haulage • Mechanical installation and fitout of the tunnels	Historical and current land uses within the C1b – Muirs site may have caused soil and potentially groundwater contamination ie use for car servicing and potential for underground storage tanks. Historical land uses surrounding the site may also have resulted in soil and groundwater contamination (eg potential former dry cleaner and workshops associated with former car dealerships and mechanics). GHD (2015) identified soil contamination (PAHs) on the C3b site located east and opposite the C1b site on Parramatta Road. Historical demolition of residential and/or commercial/industrial buildings may have resulted in contamination in soil from ACM fragments and potential lead paint. The works would include bulk excavation for the construction of the mainline tunnels, entry and exit ramps and surface road construction; however, no bulk earthworks would be undertaken at the surface. Demolition activities, use of plant and machinery and excavation activities are proposed. There would be complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Inhalation and ingestion risk to site workers from hazardous building materials (if present) and PAHs in excavated soil • Inhalation or ingestion of hazardous building materials (via dust) and PAHs in excavated soil (if present). Cross contamination associated with the incorrect handling	Potentially present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Medium

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
	• Finishing works including asphalting • Demobilisation including works to prepare the site for a permissible future use.	or disposal of spoil/unexpected finds is a potential impact during construction if appropriate controls and handling procedures are not implemented. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills.			
C2b – Haberfield civil site at Haberfield	• Establishment of site offices, amenities and temporary infrastructure • Delivery, laydown and storage of materials • Mechanical and electrical fitout of a section of the Parramatta Road ventilation facility (that will be built as part of the M4 East project) • Landscaping • Demobilisation.	Historical land uses within the western part of the site may have caused soil and potentially groundwater contamination (eg potential former dry cleaners and workshops associated with former car dealerships and mechanics). The remainder of the site was historically residential therefore no other outstanding areas of concern were identified. Isolated soil contamination may be present from demolition or construction of former buildings and use of lead paint which may have resulted in localised areas of ACM fragments and lead paint flakes in surface soil. An assessment of the site conducted by Ramboll Environ (2016a) prior to establishment works for the M4 East Eastern Ventilation Facility Tunnel Worksite indicated the presence of friable and bonded asbestos in soils. Management measures including remediation and validation were specified by Ramboll Environ (2016a). Demolition activities, use of plant and machinery and excavation activities are proposed. There would be complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Inhalation and ingestion risk to site workers from hazardous building materials (if present) and PAHs in surface soil inhalation or ingestion of hazardous building	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Low

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
		materials (via dust) and PAHs in surface soil (if present). Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. The site will be demobilised and earthworks carried out to provide finished levels that are consistent with the original ground surface before being handed over to the M4-M5 Link contractor. At the completion of M4-M5 Link construction the landscaping (where applicable) and residual land obligations as detailed in the M4 East Urban Design and Landscape Plan and Residual Land Management Plan would be carried out.			
C3b – Parramatta Road East civil site at Haberfield	• Demolition of existing structures • Establishment of site offices, amenities and temporary infrastructure including temporary noise barriers • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Establishment of site offices and workforce	Historical and current land uses within the C3b – Muirs site may have caused soil and potentially groundwater contamination ie use for car servicing and potential for underground storage tanks. Historical land uses surrounding the site may also have resulted in soil and groundwater contamination (eg potential former dry cleaner and workshops associated with former car dealerships and mechanics). GHD (2015) identified soil contamination (PAHs) on the C3b site. Historical demolition of residential and/or commercial/industrial buildings may have resulted in contamination in soil from ACM fragments and potential lead paint. Demolition activities, use of plant and machinery and excavation activities are proposed. There would be complete	Known to be present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors potentially present and complete either now, during or post construction (without implementation of appropriate controls).	Medium

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
	amenities • Support for the construction of the mainline tunnels and the Wattle Street interchange entry and exit ramps (no tunnelling would occur from the Parramatta Road East civil site (C3b)) • Landscaping • Demobilisation.	pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Inhalation and ingestion risk to site workers from hazardous building materials (if present) and PAHs in surface soil • Inhalation or ingestion of hazardous building materials (via dust) and PAHs in surface soil (if present). Cross contamination associated with the incorrect handling or disposal of spoil/unexpected finds is a potential impact during construction if appropriate controls and handling procedures are not implemented. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills.			
C4 – Darley Road civil and tunnel site at Leichhardt	• Demolition and UST decommissioning • Excavation for construction adit • Stockpiling • Road works • Construction of permanent operational infrastructure (water treatment facility and substation).	Soil investigations and limited groundwater investigations have been undertaken within the C4 Darley Road site. The previous investigations found that the site contained fill with slightly elevated metals and PAHs, however was found to be suitable for ongoing commercial/industrial land use. There was also a UST which required decommissioning. The proposed works within the C4 Darley Road site would involve the temporary exposure of soils during demolition and construction of hardstand. More extensive excavations would be required for the construction adit at the eastern end of the site and for the permanent relocation of the existing open stormwater channel. There would potentially be complete pathways from the source (if present) to the receptor for the following if	Known to be present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors potentially present and complete either now, during or post construction (without implementation of appropriate controls).	Medium

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
		appropriate controls were not implemented: • Direct contact, inhalation and ingestion risk to site workers from contaminated soil or hazardous building materials (if present) • Inhalation or ingestion of contaminated soil or hazardous building materials (via dust) (if present) Discharge of contaminated surface water to stormwater and ultimately Hawthorne Canal and Iron Cove. Incorrect handling or disposal of spoil is a potential impact during construction if appropriate controls and procedures are not implemented. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. There is a high probability of actual or potential acid sulfate soils at the western end of the C4 Darley Road site. Inappropriate management and disposal could lead to adverse impacts on local soil and water quality.			
C5 – Rozelle civil and tunnel site at Rozelle	• Demolition of structures, including buildings • Excavations for tunnel portals and cut and cover tunnels • Road construction • Stockpiling in acoustic sheds	Recent soil investigations have been completed in the site which identified concentrations of metals (lead, arsenic, cadmium and zinc) and PAHs exceeding the land use criteria for open space and commercial/industrial scenarios in fill and also the presence of asbestos in fill. Petroleum sourced LNAPL was detected in the centre of the site and has not been delineated or the source location identified. Identified potential construction impacts include the following: • Impacts on site workers and the local community (eg	Known to be present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction	High

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
	• Construction of temporary carparks, stores, workshops, offices, construction sediment basins, construction water treatment plants and laydown areas • Construction of permanent operational infrastructure including ventilation facility, water treatment facility and substations • Tunnelling (for ventilation/road construction) • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities Drainage infrastructure including upgraded culvert below City West Link to Rozelle Bay.	residents, off-site workers) through contact with contaminants and asbestos released during demolition and ground disturbance works • Exposure of underlying ground surface following removal of vegetation, ballast stockpile and excavated spoil resulting in the potential mobilisation of contamination that may be present within the site • Impacts as a result of sediment basins interacting with groundwater on the site resulting in dewatering and potential contamination of groundwater • Contamination resulting from potential leaks and spills from equipment and plant • Erosion and off-site transport of sediment and contamination via overland flow and stormwater runoff, affecting the water quality of Easton Park drain, Whites Creek and Rozelle Bay • Adverse impacts on the environment as a result of the inappropriate management of waste generated by construction activities. There would potentially be complete pathways from the source (where present) to the receptor for the following if appropriate controls were not implemented: • Direct contact, inhalation and ingestion risk to site workers from contaminated soil or hazardous building materials • Inhalation or ingestion of contaminated soil or hazardous building materials (via dust)		(without implementation of appropriate controls).	

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
		• Discharge of contaminated surface water and extracted groundwater discharged to stormwater and ultimately Rozelle Bay. Incorrect handling or disposal of spoil and other building materials arising from demolition activities is a potential impact during construction if appropriate controls and procedures are not implemented. There is a high probability of actual or potential acid sulfate soils within areas of the site. Inappropriate management and disposal could lead to adverse impacts on local soil and water quality. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. A CEMP and associated sub-plans should be prepared with reference to known soil and groundwater contamination risks and appropriate management measures as mentioned in **Table 8-2**.			

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C6 – The Crescent civil site at Annandale	• Site establishment • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Temporary stockpiling of fill and pavement materials prior to off-site removal • Realignment of The Crescent including construction of a new road bridge over Whites Creek • Widening and improvement works along Whites Creek • Construction of the culvert below City West Link (Easton Park drain) • Construction and dewatering of coffer dam(s) in Rozelle Bay to facilitate the widening of Whites Creek and Easton Park drain	Soil, sediment and groundwater contamination associated with historical filling and more recent industrial/commercial maritime operations, including the refurbishment of vessels and grit blasting activities has been identified during investigations conducted at the C6 Crescent Civil site. A Site Access Management Plan (Jacobs 2015b) is in place to manage identified contamination on part of the Site (Lots 21/22, DP1151746). Identified potential construction impacts include the following: • Impacts on site workers and the local community (eg residents, off-site workers) through contact with contaminants and asbestos released during demolition and ground disturbance works • Exposure of underlying ground surface during excavation resulting in the potential mobilisation of contamination • Contamination resulting from potential leaks and spills from equipment and plant • Erosion and off-site transport of sediment and contamination via overland flow and stormwater runoff, affecting the water quality of Whites Creek and Rozelle Bay • Adverse impacts on the environment as a result of the inappropriate management of waste generated by construction activities. There would potentially be complete pathways from the source (where present) to the receptor for the following if appropriate controls were not implemented:	Known to be present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	High

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
	• Finishing works including asphalting, line marking and signage installation • Excavating, filling and grading of disturbed areas • Landscaping and construction of pedestrian and cycle paths and bridges.	• Direct contact, inhalation and ingestion risk to site workers from contaminated soil and sediment • Inhalation or ingestion of contaminated soil or hazardous building materials such (via dust) • Discharge of contaminated surface water and sediment to Rozelle Bay ecological receptors • Disturbance of contaminated sediment and mobilisation of contamination within Rozelle Bay to ecological receptors. Cross contamination arising from the incorrect handling of contaminated soil, fill, sediment, groundwater and surface water activities are a potential construction impact if appropriate controls and procedures are not implemented. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. There is a high probability of actual or potential acid sulfate soils in soil and sediment within areas of the site. Inappropriate management, exposure during dewatering and disposal could lead to adverse impacts on local soil and water quality and impact on ecological receptors within Rozelle Bay.			

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C7 – Victoria Road civil site at Rozelle	• Demolition of existing buildings • Site sheds, laydown areas and/or site offices would be established on site	There are historical land uses within and surrounding the site which may have caused soil and potentially groundwater contamination. Intrusive investigations would be required to assess the risk posed during construction. The likelihood is low given the C7-A site that was a former petrol station was redeveloped as a commercial building. There would potentially be complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Direct contact, inhalation and ingestion risk to site workers from contaminated soil, groundwater or hazardous building materials (if present) • Inhalation or ingestion of contaminated soil, groundwater or hazardous building materials (via dust) (if present). Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Low
C8 – Iron Cove Link civil site at Rozelle	• Demolition • Bulk excavations for tunnel portals and cut and cover tunnels • Soft ground tunnelling • Road construction works • Construction of permanent operational infrastructure including the Iron Cove Link	There are historical land uses within and surrounding the site which may have caused soil and potentially groundwater contamination. Intrusive investigations would be required to assess the risk posed during construction of areas of potential concern (see **section 4.7.7**). The proposed works would involve the excavation and temporary exposure of soil/fill materials during demolition and construction of the ventilation facility outlet, hardstand and site drainage controls. There is potential for complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Direct contact, inhalation and ingestion risk to site	Potentially present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation	Medium

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
	ventilation facility and a substation • Bioretention facility and formalised car-parking • Utility installation, relocation and protection • Landscaping.	workers from excavated contaminated soil or hazardous building materials (if present) • Inhalation or ingestion of contaminated soil or hazardous building materials (via dust) (if present) • Discharge of contaminated surface water to stormwater and ultimately Iron Cove. Incorrect handling or disposal of spoil is another potential impact during construction if appropriate controls and procedures were not implemented. There is a high probability of actual or potential acid sulfate soils within the northeast corner of the construction zone and within the constructed wetland (W2). Inappropriate management and disposal could lead to adverse impacts on local soil and water quality. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills.		of appropriate controls).	

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C9 Pyrmont Bridge Road tunnel site at Annandale	• Demolition • Excavation for construction adit • Minor road works.	There are historical land uses within and surrounding the site which may have caused soil and potentially groundwater contamination. Intrusive investigations would be required to assess the risk posed during construction. The proposed works would involve the temporary exposure of soils during demolition and construction of hardstand and site drainage controls. More extensive excavations would be required for the driven tunnel (adit) portal in the southwest of the site. There is potential for complete pathways from the source (if present) to the receptor for the following if appropriate controls were not implemented: • Direct contact, inhalation and ingestion risk to site workers from contaminated soil or hazardous building materials (if present) • Inhalation or ingestion of contaminated soil or hazardous building materials (via dust) (if present) • Discharge of contaminated surface water to stormwater and ultimately Johnstons Creek, which discharges to Rozelle Bay. Incorrect handling or disposal of spoil is a potential impact during construction if appropriate controls and procedures are not implemented. Use of the site as a construction ancillary facilities for the M4-M5 Link project has the associated potential for leaks and spills.	Potentially present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	Medium

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
C10 – Campbell Road civil and tunnel site at St Peters	• Road construction works • Tunnelling and associated excavation and stockpiling • Excavation for construction adit to provide construction access to mainline • Construction of cut and cover structures • Construction of permanent operational infrastructure including the Campbell Road ventilation facility.	There are known soil and groundwater contamination and landfill gas and leachate at the site. The remediation and management of the site is being undertaken as part of the construction of the St Peters interchange for the New M5 project. During excavation activities, there is potential for complete pathways from the source to the receptor for the following if appropriate controls during construction are not implemented: • Inhalation risk from landfill gases for site workers and surrounding land users • Explosive risk from landfill gases for site workers and surrounding land users • Direct contact, inhalation and ingestion risk to site workers from leachate, landfill refuse and contaminated soil • Inhalation or ingestion of contamination (via dust) by surrounding human receptors • Discharge of contaminated surface water and groundwater/leachate to Alexandria Canal. Incorrect handling or disposal of spoil is a potential impact during construction if appropriate controls and procedures are not implemented. Use of the site as a construction ancillary facility for the M4-M5 Link project has the associated potential for leaks and spills. There is a high probability of actual or potential acid sulfate soils within parts of the site. Inappropriate management and	Known to be present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors likely to be present and complete either now, during or post construction (without implementation of appropriate controls).	High

Area	Construction works	Potential contamination impacts associated with construction phase	Likelihood of soil or groundwater contamination to be present	Consequence	Risk[1]
		disposal could lead to adverse impacts on local soil and water quality.			

Notes: [1] Refer to Table 3-3 for risk assessment.

5.2 Tunnelling and groundwater treatment and discharge

5.2.1 Potential contamination sources

A review of potential contamination sources along the alignment identified the presence of potential, current and former contamination sources which are summarised in **Table 5-2**.

Table 5-2 Summary of key groundwater contamination sources relevant to proposed tunnelling

Tunnel section	Summary of key groundwater contamination sources	Tunnelling description
St Peters to Newtown Mary Street and the New M5 St Peters interchange at St Peters to Lord Street, Newtown.	• Former controlled and uncontrolled landfills (Alexandria Landfill, Sydney Park Landfill and Camdenville Park) • Service stations • Dry cleaners • Manufacturing.	• At Mary Street, where the tunnel would connect to the New M5 tunnel stub, the tunnel would be at depths of around 40 to 50 metres below ground level • The section of tunnel starting at the New M5 St Peters interchange would dive from the surface to a maximum depth of 50 to 60 metres below ground level at Lord Street, Newtown.
Newtown to Camperdown Lord Street, Newtown to Bishopgate Lane, Camperdown	• Service stations • Dry cleaners • Manufacturing.	• The depth of the tunnel in the section would be around 50 to 60 metres below ground level • No surface portals or adits would be in this section of the tunnel.
Camperdown to Annandale Bishopgate Lane, Camperdown to Whites Creek, Annandale	• Former uncontrolled landfill (O'Dea Reserve) • Service stations • Dry cleaners • Manufacturing.	• The depth of the tunnel in this section would be around 30 to 50 metres below ground level • An adit tunnel would be constructed connecting from the mainline tunnel along Parramatta Road to the C9 Pyrmont Bridge Road compound at the surface.

Tunnel section	Summary of key groundwater contamination sources	Tunnelling description
Annandale to Haberfield Whites Creek, Annandale to Parramatta Road, Haberfield.	• Service stations • Dry cleaners • Manufacturing • Former uncontrolled landfill (Algie Park).	• The tunnel would be at depths 40 to 50 metres and then at depths of around 30 to 40 metres below ground level west of Hawthorne Creek, before the southern branch would connect to the M4 East and the northern branch to the surface cut-and-cover tunnel in Wattle Street • Adit tunnel from C4 Darley Road compound surface to the mainline tunnel near Hubert Street. The adit tunnel would run south beneath James Street before turning west and joining the mainline tunnel at Hubert Street • Parramatta Road west, Ashfield: The temporary access tunnel to the C1b Parramatta Road West civil and tunnel site is generally located within the northern portion of the C1b compound and traverses north along Parramatta Road.
Rozelle to Iron Cove and Balmain City West Link, Annandale to Wellington Street and Theodore Street, Balmain	• Service stations • Dry cleaners • Manufacturing.	• Tunnel depths would range from 10 to 25 metres below ground level to greater than 25 metres below ground level (from 0 metres to around 60 metres) • The tunnels would emerge at the surface at three locations within Rozelle Rail Yards: at the western end (City West Link to New M5), in the middle (City West Link/The Crescent to the proposed future Western Harbour Tunnel), and the eastern end (M4/Iron Cove Link to Anzac Bridge) • The Western Harbour Tunnel portal would emerge just inside Rozelle Rail Yards (south of Lilyfield Road) • Iron Cove Bridge link tunnel would connect to the surface between the northern (eastbound) and southern (westbound) carriageways of Victoria Road.

5.2.2 Potential impacts

During tunnel construction, groundwater would be extracted from the tunnelling process, which would require disposal. The extracted water would be either:

- Treated onsite and then discharged to stormwater under an EPL or to sewer under a trade waste agreement (TWA) by Sydney Water; or
- Transported to a liquid waste facility.

Potential impacts on receiving water bodies and ecological receptors through the disturbance of contaminated sediments associated with the construction of new drainage outlets and drainage infrastructure adjustments and upgrades could occur at the following locations:

- Rozelle Bay
- Iron Cove
- Whites Creek
- Easton Park drain
- Receiving waters of Sydney Harbour.

Potential impacts on workers include exposure to extracted contaminated groundwater from either direct contact or inhalation of vapours or vapours encountered during tunnelling, which would require management in accordance with protocols outlined in a site specific occupational health and safety plan and safe work method statement specific to the work activity being conducted.

There is a potential for shallow tunnelling (such as near portals, adits or cut-and-cover tunnels) to encounter impacted groundwater from sources such as petrol stations with dissolved and undissolved petroleum hydrocarbon plumes or other industrial sources. The identified highest risk locations are:

- Parramatta Road, Annandale: The adit connecting the mainline tunnel to the C9 Pyrmont Bridge Road compound passes directly south of the former 7-Eleven service station (see **Figure 4-32**) that is presently under assessment by the NSW EPA under section 60 of the CLM Act. The adit may be relatively shallow as it passes the service station and could potentially intercept a dissolved or undissolved (ie LNAPL) petroleum plume
- Wattle Street, Haberfield: The Wattle Street entry and exit ramps are located in an area historically occupied for residential land use in the suburb of Haberfield (see **Figure 4-32**). There is potential for asbestos containing materials and lead paint to be present in surface soils
- Darley Road, Leichhardt: The temporary access tunnel to the C4 Darley Road compound passes between historical sites 5 – former manufacturing businesses and 6 - former steel manufacturers and boiler makers (see **Figure 4-13**). There is potential for metals, PAHs, TPH, asbestos, VOCs, SVOCs to be present in shallow surface soils and/or groundwater
- Parramatta Road West, Ashfield: The temporary access tunnel to the C1b Parramatta Road West civil and tunnel site is generally located within the northern portion of the C1b compound and traverses north along Parramatta Road (see **Figure 4-7**). There is potential for asbestos containing materials (from demolition and redevelopment works along Parramatta Road and associated filling) and PAHs (based on data obtained by GHD [2012] and known former car sales yards) to be present in shallow surface soils and/or groundwater
- Rozelle Rail Yards, Rozelle: previously identified LNAPL within the Rozelle civil and tunnel site could be impacted by dewatering for tunnelling around the Rozelle interchange and is likely to be encountered during future tunnelling/portal construction, if not remediated prior
- Victoria Road, Rozelle: The Iron Cove Link tunnel between Darling Street and Terry Street passes beneath or directly adjacent to several service stations, some of which are presently under assessment by the NSW EPA under section 60 of the CLM Act, as well as several former dry cleaners (see **Figure 4-33**)

- St Peters: The tunnel portal area and construction adit within the former Alexandria landfill at the New M5 St Peters interchange due to leachate and landfill gases (see **Figure 4-29**). The tunnel at this section is shallow and would be exposed to landfill leachate if appropriate mitigation measures (such as the Golder (2016) RAP and LCMP) are not implemented.

The likelihood of encountering plumes with high concentrations of contaminants is low given that, with the exception of the former Alexandria Landfill (assessed as part of the New M5 project), deep contamination (greater than 30 metres below ground surface) has not been identified along the proposed M4-M5 Link alignment. The extracted groundwater however is likely to contain concentrations of metals and nutrients above background concentrations and low concentrations of chemical and petroleum hydrocarbon contaminants from the types of sources listed in the previous table. Notwithstanding, tunnels would be drained to construction water treatment facilities prior to discharge to receiving surface water bodies.

Dewatering during construction works may cause changes in the migration of plumes of contaminated groundwater, by changing groundwater gradients and drawing the contamination towards the tunnel. This is most likely in areas where the tunnels are shallow and approaching the surface such as the adit at Parramatta Road, Annandale, and the Iron Cove section near and beneath Victoria Road in Rozelle and is discussed further in **Appendix T** (Technical working paper: Groundwater) of the EIS.

Temporary construction water treatment plants would be located at each construction ancillary facility where tunnelling would occur, and would be designed to treat construction water and groundwater inflows encountered during tunnel construction. The level of treatment would consider the characteristics of the water requiring treatment operational constraints or practicalities and associated environmental impacts, and would be developed in accordance with ANZECC (2000) and with consideration to the relevant NSW Water Quality Objectives as discussed in **Appendix Q** (Technical working paper: Surface water and flooding) of the EIS.

6 Assessment of operational impacts

6.1 Operational sites

For the purposes of this contamination assessment, identified operational impacts primarily relate to the potential contamination of soil, surface water and groundwater arising from vehicle accidents, leaks and spills on constructed M4-M5 Link project roadways including tunnels. To manage spills and leaks associated with vehicle accidents during the operation of the project, spill containment facilities would be located in tunnels and where the risk of impact from spills is high. A risk assessment of all project roads would be carried out during detailed design to determine the final locations of these facilities. Typically they would be located on motorway sections where the chance of vehicle accidents is higher. This risk assessment would also take into account proximity to waterways, where the risk of harm to aquatic environments is assessed to be greater.

Potential contamination impacts associated with the presence of roads and permanent operational infrastructure such as motorway operations complexes and associated infrastructure (ventilation facilities, water treatment plants and substations etc.) is presented in **Table 6-1**.

The construction ancillary facilities that are not anticipated to be used for permanent operational infrastructure would be rehabilitated at the end of construction. Construction facilities that will not include new operational infrastructure are:

- Northcote Street civil site (C3a)
- Parramatta Road West civil and tunnel site (C1b)
- Parramatta Road East civil site (C3b)
- Pyrmont Bridge Road tunnel site (C9).

At the completion of M4-M5 Link construction the landscaping (where applicable) and residual land obligations as detailed in the M4 East and New M5 conditions of approval would be carried out by these respective projects. As such there are no anticipated operational impacts of these construction ancillary facilities during operation and these are not discussed further in this section.

Table 6-1 Assessment of operational impacts – operational sites

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
Wattle Street at Haberfield	• Roadway.	• Contamination impacts associated with the operation of the project include leaks and spills on constructed roadways from vehicles and vehicle accidents.	Low likelihood of concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors may be present in the event of leaks and spills associated with vehicle accidents*	Low
Parramatta Road ventilation facility at Haberfield	• Parramatta Road ventilation facility.	• There are historical land uses within the western part of the site that may have caused soil and potentially groundwater contamination (potential former dry cleaners and workshops associated with former car dealerships and mechanics). Minimal soil or groundwater contamination impacts would be expected from the operation of the ventilation facility. Sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors may be present and complete as a result of minor spills during operation*	Low

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
Darley Road at Leichhardt	• Permanent water treatment facility and substation on western portion of the site.	• Soil investigations and limited groundwater investigations have been undertaken within the site. The investigations identified that the site was suitable for ongoing commercial/industrial land with the exception of a UST which required decommissioning • Potential contamination impacts from the operation of the permanent water treatment facility could include spills of water treatment chemicals or inadequate water treatment prior to discharge.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors may be present and complete as a result of minor spills during operation*	Low

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
Rozelle Rail Yards at Rozelle	• Roads, entry and exit ramps and tunnel portals • Rozelle ventilation facility • Water treatment plant • Constructed wetland • Substations • Workshop facilities/bulky equipment store • Fire pump room and water tanks • Open space.	• Recent soil investigations have been completed on the site which identified concentrations of metals and PAHs exceeding the land use criteria for open space and commercial/industrial scenarios in fill • Potential contamination impacts from the operation of the permanent water treatment facility could include spills of water treatment chemicals or inadequate water treatment prior to discharge • Minimal soil or groundwater contamination impacts would be expected from the operation of the ventilation facility, substation, workshop, water treatment facility and fire pump room and water tanks. Sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations • The end land use for a large portion of the site would be open space. Due to the presence of existing soil and groundwater contamination from historical activities, the area would require further investigation post construction to assess operational land use suitability for recreational open space.	Potentially present at concentrations above the relevant assessment criteria and widespread, if leaks and spills occur.	Exposure pathway for human or ecological receptors may be present and complete as a result of leaks and spills during operation*	Medium

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
The Crescent	• Road infrastructure • Pedestrian and cycle paths.	• Residual contamination would likely be present in underlying soil, fill, groundwater and sediment • Contamination impacts associated with the operation of the project include leaks and spills on constructed roadways from vehicles and vehicle accidents.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent, if leaks and spills occur.	Exposure pathway for human or ecological receptors may be present in the event of leaks and spills associated with vehicle accidents*	Low
Victoria Road at Rozelle	• Road, pedestrian and cycle paths.	• Contamination impacts associated with the operation of the project include leaks and spills on constructed roadways from vehicles and vehicle accidents.	Very unlikely to be present at concentrations above the relevant assessment criteria and limited in extent.	Exposure pathway for human or ecological receptors may be present in the event of leaks and spills associated with vehicle accidents*	Low

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
Iron Cove Link at Rozelle	• Roads, entry and exit ramps and tunnel portals • Iron Cove Link ventilation facility • Substation (land subject to landscaping).	• There are historical land uses within and surrounding the site which may have caused soil and potentially groundwater contamination • Contamination impacts associated with the operation of the project include leaks and spills on constructed roadways from vehicles and vehicle accidents • Minimal soil or groundwater contamination impacts would be expected from the operation of the substation and ventilation facility. Sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations.	Potentially present at concentrations above the relevant assessment criteria.	Exposure pathway for human or ecological receptors may be present and complete as a result of leaks and spills during operation	Medium

Operational area	Operation	Potential contamination impacts associated with operation	Likelihood of soil or groundwater contamination to be present as a result of project operation	Consequence (without implementation of appropriate controls)	Risk (refer Table 3-3)
Campbell Road at St Peters	• Roads, including dive structures, tunnel portals and entry and exit ramps • Campbell Road ventilation facility • Substation • Workshop facilities/bulky equipment store • Open space (to be delivered in accordance with New M5 conditions of approval).	• There are known soil and groundwater contamination and landfill gas and leachate at the site. The remediation and management of the site would commence as part of the construction of the St Peters interchange for the New M5 project. Minimal soil or groundwater contamination impacts would be expected from the operation of the ventilation facility, substation and workshop for the M4-M5 Link project. Sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations • Contamination impacts associated with the operation of the project include leaks and spills on constructed roadways from vehicles and vehicle accidents.	Potentially present at concentrations above the relevant assessment criteria and widespread.	Exposure pathway for human or ecological receptors are unlikely to present during operation assuming appropriate management of historical contamination	Medium

6.2 Tunnel groundwater treatment and discharge

During operation, groundwater seepage would be required to be extracted from the tunnels, treated and discharged to the receiving water bodies. As described in **section 5.2**, groundwater quality may be impacted along parts of the tunnel alignment due to overlying contamination sources impacting groundwater. An assessment of the expected groundwater seepage rates and groundwater drawdown which may have an effect on existing groundwater contamination plumes is provided in **Appendix T** (Technical working paper: Groundwater) of the EIS.

It is noted that some sections of the tunnels would be tanked (see **Table 6-2**). As such, if present, contaminated groundwater would be unable to enter the tunnels at those locations.

Table 6-2 Sections of the tunnels to be tanked

Control line	Start chainage (m)	End chainage (m)	Length (m)	Structure type
Mainline tunnel				
M180	1880	1375	195	Driven tunnel
M190	1175	1390	215	Driven tunnel
Rozelle interchange				
MC4C01	185	335	150	Driven tunnel
MC4D01	1208	1428.8	220.8	Cut and Cover
MC4K01	355	404	49	Trough structure
MC4K01	404	500	96	Cut and Cover
MC4K01	670	760	170	Cut and Cover
MC4M01	2330	2550	220	Cut and Cover
MC4M01	2550	2670	120	Trough structure
MC4M01	2670	2740	70	Trough structure
M4R0 – ventilation adit	0	511	511	Cut and Cover
M4S0 – ventilation adit	0	61	61	Cut and Cover
M4T0 – ventilation adit	0	15	15	Cut and Cover
M4V0 – ventilation adit	500	552	52	Cut and Cover
TOTAL			2144.8	

Impacts associated with the operation of the tunnel would include the following:

- Groundwater ingress
- Stormwater ingress at portals
- Contaminated water ingress events which may occur during the operation of the project including, tunnel wash-down water, fire suppressant deluge or fire main rupture and spillage of flammable and other hazardous materials.

To manage the above operational impacts, separate sumps would be provided at tunnel sags to collect groundwater ingress and other potential water sources. The two tunnel drainage streams from the mainline works would be pumped to a water treatment facility at Darley Road, Leichhardt, with treated flows ultimately discharged to Hawthorne Canal. As the water would be treated prior to discharge, contamination impacts associated with the discharge of treated water to Hawthorne Canal during the operation of the tunnel are considered to be minimal.

Tunnel drainage for Rozelle would be pumped to a water treatment facility and constructed wetland at Rozelle interchange, with treated flows ultimately discharged to Rozelle Bay. Tunnel drainage from around one kilometre of the northbound and 600 metres of the southbound tunnel would be captured by the New M5 drainage system and conveyed to the New M5 operational water treatment plant at Arncliffe, which ultimately drains to the Cooks River. As for Hawthorne Canal, contamination impacts associated with the discharge of treated water to Rozelle Bay during the operation of the project are considered to be minimal (refer to **Appendix Q** (Technical working paper: Surface water and flooding) of the EIS).

7 Assessment of cumulative impacts

7.1 WestConnex and related projects

The M4-M5 Link project is a component of the WestConnex program of works, which would provide a 33 kilometre motorway linking Sydney's west and southwest with Sydney Airport and the Port Botany precinct. The individual components of WestConnex are:

- M4-M5 Link – Haberfield to St Peters (the subject of this EIS)
- M4 Widening – Pitt Street at Parramatta to Homebush Bay Drive at Homebush (planning approval granted and open to traffic)
- M4 East – Homebush Bay Drive, Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield (planning approval granted and under construction)
- New M5 – (planning approval granted and under construction)
- King Georges Road Interchange Upgrade (planning approval granted and open to traffic).

Related projects undergoing concept development and subject to separate planning assessment and approval included in this cumulative assessment include:

- Proposed future Western Harbour Tunnel and Beaches Link
- Proposed future Sydney Gateway.

Based on the construction timeframes for the M4-M5 Link project, there is potential for the construction phases of projects to overlap, particularly with respect to the adjacent New M5 and M4 East projects.

Other component projects, such as the M4 Widening and King Georges Road Interchange Upgrade are located further from the project. The likelihood of significant cumulative contamination impacts being generated as a result of the project, the M4 Widening and King Georges Road Interchange Upgrade is therefore considered to be low.

A summary of the key potential contamination impacts, mitigation measures and residual impacts identified through a review of EIS documents associated with the overlapping WestConnex projects are summarised in the following sections. The following WestConnex EIS documents were reviewed:

- M4 East Environmental Impact Statement, Volume 1B, Chapter 16 (GHD 2015)
- M4 East Environmental Impact Statement, Appendix P, Technical working paper: Soil and land contamination assessment (GHD 2015)
- New M5 Environmental Impact Statement, Volume 1C, Chapter 17 (AECOM 2015)
- New M5 Environmental Impact Statement, Appendix O, Technical working paper: Contamination (AECOM 2015)
- New M5 Environmental Impact Statement, Appendix F, Alexandria Landfill closure management plan (AECOM 2015).

7.1.1 M4 East

The M4-M5 Link project would interface directly with the M4 East at the Wattle Street interchange and Parramatta Road West civil and tunnel site at Ashfield. The impacts of the M4 East project on contamination at the Wattle Street interchange were assessed as part of that EIS and subsequent detailed design. Management measures were identified to mitigate impacts on surrounding properties for both the construction and operational phases with the objective of appropriately managing soil and groundwater (including discharge) contamination by working to achieve the requirements of the planning conditions and handover obligations for the M4 East contractor prior to occupation by the M4-M5 Link contractor.

7.1.2 New M5

The M4-M5 Link project would connect directly to the New M5 at the St Peters interchange which is located on a former landfill and adjacent to contaminated lands. The impacts of the New M5 project on remediation and closure of Alexandria Landfill and adjacent contaminated lands at the St Peters interchange were assessed as part of the New M5 EIS.

Management measures were identified to mitigate impacts on surrounding properties for both the construction and operational phases of the New M5 project. The objective was to reduce environmental harm, by working to achieve the requirements of the planning conditions and to implement the landfill closure requirements to mitigate environmental harm.

In accordance with the conditions of the infrastructure approval for the New M5 project, Golder Associates prepared a soil contamination report, RAP and LCMP for St Peters interchange – Alexandria Landfill and Bradshaw Mountain Sites. The objective of the reports was to assess the site condition and document how the Alexandria Landfill site will be closed, remediated and redeveloped for the purpose of road infrastructure and open space land uses as part of the New M5 project. The RAP noted that the preferred remediation option is for on-site isolation and containment of wastes and other contaminated materials. Golder noted that these measures would be complemented by new, improved and/or upgraded environmental controls for leachate, landfill gas, groundwater management and surface water/stormwater management, which will result in an improved environmental condition at this location.

It is understood that any contamination impacts, including odours, arising from works undertaken as part of the New M5 would be managed to minimise impacts on the environment in accordance with the RAP and relevant project conditions of approval by the New M5 contractor.

7.1.3 Western Harbour Tunnel and Beaches Link

The proposed future Western Harbour Tunnel and Beaches Link contractor would inherit a portion of the Rozelle civil and tunnel site near to the Western Harbour Tunnel and Beaches Link entry and exit ramps when this area is no longer required for construction of the M4-M5 Link project, extending the use of this construction site. Notwithstanding that different projects (M4-M5 Link and the proposed future Western Harbour Tunnel and Beaches Link project) would be utilising the Rozelle civil and tunnel site, all construction activities would be undertaken in a staged and coordinated manner to ensure that there are no adverse impacts on human health or the environment as a result of contamination, and that the site is left in a condition suitable for the proposed land use. While no EIS is available for review for the proposed future Western Harbour Tunnel and Beaches Link, it is assumed that construction activities and the operation of the tunnel would be undertaken with appropriate environmental (including reference to contamination) management measures in place in accordance with legislative requirements to prevent adverse impacts on human and/or ecological receptors. No cumulative impacts from contamination are therefore anticipated.

7.2 Other projects

Cumulative contamination impacts associated with other key projects proposed in the vicinity of the M4-M5 Link project footprint have been considered including:

- The Rozelle Rail Yards Site Management Works
- Transport for New South Wales CBD and South East Light Rail (CSLER) – Rozelle maintenance depot
- The Bays Precinct, Sydney Water stormwater channel renewal/naturalisation works
- Western Harbour Tunnel and Beaches Link.

7.2.1 Rozelle Rail Yards – Site Management Works

Roads and Maritime is proposing to carry out a suite of surface and near surface site management works on part of the Rozelle Rail Yards. These works will be undertaken prior to construction of the M4–M5 Link project. The Rozelle Rail Yards – Site Management Works Review of Environmental Factors (Roads and Maritime 2016) indicates that contaminated soil, fill and groundwater will be progressively managed during construction.

Following completion of the works, the 'finished site' would be managed and maintained in accordance with the management measures outlined in the REF which would manage soil, water, contamination including asbestos, resource use and waste, and other environmental factors until commencement of the construction of the M4-M5 Link project. Therefore no cumulative impacts resulting from residual contamination are anticipated.

7.2.2 CBD and South East Light Rail (CSELR)

The CBD and South East Light Rail – Rozelle maintenance depot is located immediately to the west of the Rozelle Rail Yards. This development has planning approval and works have commenced. Site clearance activities were undertaken in 2016. The CBD and South East Light Rail Project Environmental Impact Statement (Parsons Brinkerhoff 2013) noted that a large suite of management and mitigation measures are proposed to be implemented to reduce the potential adverse contamination impacts associated with the proposal. It was noted that these measures would be incorporated into the CEMP and sub-plans for the proposal and subsequently if necessary, the future operator's environmental management system. Therefore no cumulative contamination impacts are anticipated with the M4-M5 Link project.

7.2.3 The Bays Precinct and Sydney Water stormwater channel renewal/naturalisation

The Bays Precinct ad the Sydney Water stormwater channel renewal/naturalisation projects are in their early planning stages, and as such no environmental assessments were available for review at the time of this assessment.

It is assumed that The Bays Precinct project would incorporate environmental management measures during construction and operation in accordance with legislative requirements to prevent adverse impacts on the common receiving receptors of Whites Creek, White Bay and Rozelle Bay and potential environmental impacts from contamination to surrounding properties. Similarly it is assumed that management measures would be implemented by Sydney Water construction contractors during the construction works at Whites Creek and Johnstons Creek for the naturalisation projects to manage potential impacts on the creeks and downstream environment from both a water quality management perspective.

7.2.4 Summary

This report has assessed contamination conditions across the whole of the M4-M5 Link project footprint including the proposed Western Harbour Tunnel and Beaches Link project at Rozelle Rail Yards. Review of EIS documents for the various approved projects located in proximity to the M4-M5 Link project, including M4 East, New M5, M4 Widening and King Georges Road Interchange Upgrade indicate that the disturbance and management of contaminated soil, fill, sediment, surface water and groundwater as a result of construction and operational activities are unlikely to have a more significant impact on ecological and human health receptors or sensitive environments than they would if undertaken as discrete projects, provided the proposed management and mitigation measures documented in the respective EISs are implemented, maintained and monitored. Furthermore, at some locations, the M4-M5 Link project will be utilising land that has been previously investigated and managed in accordance with the conditions of approval for adjacent projects such as M4 East.

With consideration to the management measures proposed to be implemented as part of the M4–M5 Link project (see **section 8**), there are minimal adverse cumulative contamination impacts anticipated to occur as part of the construction or operation of the project. Risks to human health and the environment would be mitigated through implementation of management measures outlined herein (see **section 8**) and also in **Appendix K** (Technical working paper: Human health risk assessment) of the EIS.

The construction and operation of the M4-M5 Link project is not anticipated to create additional soil or groundwater contamination to that already identified within the project footprint as a result of historical land use activities. Additionally, the appropriate management of contamination and waste materials disturbed during the construction phase of the project would likely result in an overall improvement in the condition of the land at project completion compared with identified contamination conditions at the time of acquisition. The project would incorporate remediation and management of existing

contamination as part of the construction phase, and to make the land suitable for the proposed final land use. Site suitability for the proposed land use(s) would be determined by an independent NSW EPA accredited site auditor engaged for the project.

Further assessment of cumulative impacts associated with surface water and groundwater are discussed in **Appendix Q** (Technical working paper: Surface water and flooding) and **Appendix T** (Technical working paper: Groundwater) of the EIS.

8 Management of impacts

8.1 Management of construction impacts

8.1.1 Ancillary facilities and project footprint

The methods for the management of construction impacts are outlined in the following section and specified for each ancillary facility in **Table 8-2**.

Construction environmental management plan (CEMP)

Procedures and protocols to manage potentially contaminated fill, soil, bedrock and extracted groundwater would be detailed in the CEMP prepared for the project. The CEMP would include procedures and controls applicable to managing contamination related impacts as summarised in **Table 8-1**.

Table 8-1 Construction environmental management plan – contamination component

Management issue	Summary of procedures and controls
Waste	• Waste management plans would include procedures for handling and storing spoil, including potentially or known contaminated soil/fill in accordance with the POEO Act • Protocols for waste classification for off-site disposal or assessment under a resource recovery exemption and waste tracking.
Stockpile management and spoil handling	• Stockpile management procedures for segregating spoil and preventing cross-contamination of clean spoil (VENM or ENM) with contaminated soil • Odour management procedures in the event that odorous material is identified during stockpile management and spoil handling activities.
Surface water runoff erosion of contaminated soils	• Procedures for the prevention of erosion and management of potentially contaminated stormwater runoff would be detailed in the CEMP and soil and water management plan included as an appendix to the CEMP.
Asbestos	• Site specific asbestos management plans would be developed where known or suspected asbestos is present. The plans would be prepared to satisfy the SafeWork Australia Asbestos Codes of Practice and Guidance Notes, NSW legislative requirements and relevant Australian and New Zealand Standards • The AMPs would include procedures for air monitoring and clearance inspections and reports.
Hazardous materials	• A hazardous materials assessment would be undertaken prior to and during the demolition of buildings. Demolition works would be undertaken in accordance with the relevant Australian Standards and relevant SafeWork NSW codes of practice, including the Work, Health and Safety Regulation 2011.
Dangerous goods	• A dangerous goods search of the SafeWork NSW records for licensed dangerous goods would be undertaken for all sites that were former commercial or industrial premises and where subsurface works are planned as part of the project.

Management issue	Summary of procedures and controls
Acid sulfate soil management	• Acid sulfate management plans would be developed in accordance with ASSMAC (1998) guidelines • Acid sulfate soils would be disposed off-site (where required) in accordance with the NSW EPA (2014) Waste Classification Guidelines; Part 4: Acid sulfate soils.
Unexpected finds	• In the event an unexpected find of contamination and/or odorous material is encountered during construction, work in the affected area would cease until an appropriately qualified environmental consultant can inspect the find and provide a recommendation on further investigation, remediation or control measures, as deemed appropriate • Further assessment and management/remediation, where required, would be undertaken in accordance with section 105 of the CLM Act • An unexpected find may include soil discoloration, offensive odours, buried waste or ACM, for example.
Prevention of new/cross-contamination	• Plant and equipment would be maintained and serviced within hardstand areas with adequate spill response kits • Chemicals, oils and fuels would be handled and stored in appropriately bunded areas with adequate spill response kits • Emergency response plans, clean up and reporting procedures would be developed.

Further investigations

Ancillary facilities and areas within the project footprint that have been assessed as low risk do not require further assessment or remediation and would be managed by the implementation of the CEMP. Sites which are assessed as potentially containing soil or groundwater contamination that could pose an unacceptable risk to human or ecological receptors during construction of the project would be further investigated by completing an intrusive site investigation.

Where there is currently insufficient data to prepare a Remedial Action Plan (RAP), sites assessed as either medium or high risk would have a site investigation undertaken prior to commencement of construction.

The site investigation would be designed in accordance with NSW EPA (1995) *Sampling Design Guidelines* and in accordance with the relevant guidelines listed in **section 3**. The consultant would prepare a sampling, analysis and quality plan (SAQP) which would be reviewed by the appointed independent NSW EPA accredited site auditor prior to completion of the site investigation. The final site investigation report prepared would also be reviewed by the appointed independent NSW EPA accredited site auditor.

Remediation

Sites which are assessed as containing soil or groundwater contamination that poses an unacceptable risk to human or ecological receptors would be remediated.

Sites requiring remediation would have a RAP developed prior to the commencement of construction. The RAP would be prepared by a suitably qualified and experienced contaminated lands consultant and independently audited by a NSW EPA accredited site auditor.

Remediation and validation activities would be completed by a contaminated lands consultant, independent to the construction contractor. A validation report would be prepared by the consultant and reviewed by the appointed independent NSW EPA accredited site auditor.

The RAPs would be prepared in accordance with the relevant legislation and guidelines listed in **section 3**.

The need for remediation would be undertaken by considering the risks of undertaking the works. If the risks posed to the environment and human health is greater than the contamination remaining in-situ, then the need for active remediation would be reconsidered and alternative management options such as capping investigated. The RAPs would include the assessment of sustainable remediation options and consideration of the *Waste Avoidance and Resource Recovery Act 2001* (NSW).

Remediation works may need to occur in a staged approach throughout the construction and post construction periods, depending on the final land use following completion of the project.

Table 8-2 Management of construction impacts – ancillary facilities and project footprint

Area	Construction works	Management of construction impacts
C1a – Wattle Street civil and tunnel site at Haberfield	• Stockpiling within cut and cover structure • Excavations and tunnelling for ramp. (It is noted that the ramp and cut-and-cover structure would be built by M4 East contractor). The M4-M5 Link contractor will construct driven tunnel using road headers to connect the ramps with the mainline. In addition, minor civil and finishing [pavement line-marking] ramps and surface lands along Wattle Street [to Parramatta Road] to prepare ramps for use).	• Further contamination investigations are not required for the M4-M5 Link project at this site • CEMP: The potential construction impacts would be managed through the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.
C2a – Haberfield civil and tunnel site at Haberfield	• No excavations or tunnelling to be completed (construction completed during M4 East) • Works would comprise minor civil construction associated with construction of a substation which would require shallow excavation works • This location would service tunnelling, but no spoil would be removed to the surface at this site • Tunnel spoil from the M4-M5 Link mainline would be transported out via M4 East stubs to the M4 East mainline • Minor civil construction associated with the substation (including shallow excavation) • Deep excavation for vent tunnels, footings etc. would be carried out by M4 East Contractor • Use of existing M4 East facilities (currently under construction).	• CEMP: The potential construction impacts would be managed by the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.
C3a – Northcote Street civil site at Haberfield	• Minimal excavation/surface disturbance for parking construction.	• CEMP: The potential construction impacts would be managed by the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.

Area	Construction works	Management of construction impacts
C1b – Parramatta Road West civil and tunnel site at Ashfield	• Demolition of existing buildings and structures • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Establishment of site offices, amenities and temporary infrastructure • Laydown and storage of materials • Delivery of materials, plant and equipment • Construction of an acoustic shed • Construction of a temporary access tunnel • Tunnel excavation of the eastbound and westbound mainline tunnels and the Wattle Street entry and exit ramps using roadheaders, as well as stockpiling of excavated material and spoil haulage • Excavation of benches and cross-passages • Installation of mechanical and electrical services within the tunnels and fitout of the tunnels with additional infrastructure (eg signage) • Finishing works including asphalting, line marking and signage installation • Demobilisation including works to prepare the site for a permissible future use.	• Further contamination investigations are not required for the M4-M5 Link project at this site • CEMP: The potential construction impacts would be managed through the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.

Area	Construction works	Management of construction impacts
C2b – Haberfield civil site at Haberfield	• No excavations or tunnelling to be completed (construction completed during M4 East) • Works would comprise minor civil construction associated with construction of a substation which would require shallow excavation works • This location would service tunnelling, but no spoil would be removed to the surface at this site. Tunnel spoil from the M4-M5 Link mainline would be transported out via M4 East stubs to the M4 East mainline • Minor civil construction associated with the substation (including shallow excavation) • Deep excavation for vent tunnels, footings etc. would be carried out by M4 East Contractor • Use of existing M4 East facilities (currently under construction).	• CEMP: The potential construction impacts would be managed by the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.
C3b – Parramatta Road East civil site at Haberfield	• Demolition of existing structures • Establishment of site offices, amenities and temporary infrastructure including temporary noise barriers • Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Establishment of site offices and workforce amenities • Support for the construction of the mainline tunnels and the Wattle Street interchange entry and exit ramps (no tunnelling would occur from the Parramatta Road East civil site (C3b)) • Landscaping • Demobilisation.	• CEMP: The potential construction impacts would be managed by the development and implementation of the CEMP, which would include mitigation measures for encountering unexpected contamination and management of spoil.

Area	Construction works	Management of construction impacts
C4 – Darley Road civil and tunnel site at Leichhardt	• Demolition and UST decommissioning • Excavation for construction adit • Stockpiling • Road works.	• CEMP: The potential construction impacts would be managed by the development and implementation of the CEMP, with the exception of the existing identified UST • Hazardous materials assessment and management plans would be undertaken for buildings and structures prior to demolition • Waste management: *In situ*/ex-situ waste classification/virgin excavated natural material VENM/ENM assessment of excavated fill, natural soils and rock to evaluate suitability for disposal to landfill or potential reuse • Acid sulfate soils: Management of acid sulfate soils would be undertaken through the development, implementation and adherence to management procedures for acid sulfate soils as part of the CSWMP • RAP: The existing UST would be required to be removed in accordance with a site specific RAP and a validation report prepared.

Area	Construction works	Management of construction impacts
C5 – Rozelle civil and tunnel site at Rozelle	• Demolition of structures, including buildings • Excavations for tunnel portals and cut and cover tunnels • Road construction • Stockpiling in acoustic shed • Construction of temporary carparks, stores, workshops, offices, construction sediment basins, construction water treatment plants and laydown areas • Construction of permanent operational infrastructure including ventilation facility, water treatment facility and substations • Tunnelling (for ventilation/road construction) • Utility installation, relocation and protection • Constructed wetland and other drainage infrastructure including upgraded culvert below City West Link to Rozelle Bay • Upgraded headwall and drainage outfall to Rozelle Bay • Reshaping of Whites Creek and naturalisation works • Construction of new Victoria Road bridge and new The Crescent bridge • Construction of active transport bridges • Earthworks associated with landscaping.	• Site investigations: A grid based *in situ* characterisation of soil and fill materials proposed to be excavated/disturbed as part of future construction activities, where required, to supplement the existing data/fill in data gaps. The lateral extent and depth of intrusive investigation would be determined by the design and location of the ground disturbance and underground infrastructure • Hazardous materials assessment and management plans would be undertaken for buildings and structures prior to demolition • RAP: Based on the investigations, preparation of a RAP for the excavation and off-site disposal of contaminated materials to licensed landfill or on-site treatment/beneficial reuse (if identified and practicable) • Waste management: *In situ* /ex-situ waste classification/virgin excavated natural material (VENM)/excavated natural material (ENM) assessment of excavated fill, natural soils and rock to evaluate suitability for disposal to landfill or potential reuse • Acid sulfate soils: Further investigations to delineate PASS within excavation footprints. Management of acid sulfate soils and sediment would be undertaken through the development, implementation and adherence to management procedures for acid sulfate soils as part of the CSWMP • CEMP: Potential construction impacts including disturbance of surface water and contaminated sediment within Rozelle Bay) would also be managed by the development and implementation of the CEMP.

Area	Construction works	Management of construction impacts
C6 – The Crescent civil site at Annandale	• Utility works including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities • Temporary stockpiling of fill and pavement materials as well as materials generated from construction activities prior to off-site removal • Realignment of The Crescent including construction of a new bridge over Whites Creek • Construction of the culvert (Easton Park drain) below City West Link • Installation of coffer dam(s) and dewatering works within Rozelle Bay to facilitate the widening of Whites Creek and construction of culvert below City West Link • Widening and improvement works along Whites Creek, including naturalisation of a section of Whites Creek between The Crescent and Rozelle Bay • Excavating, filling and grading of disturbed areas • Landscaping and construction of pedestrian and cycle paths and bridges.	• Waste management: *In situ*/ex-situ waste classification of excavated fill, natural soils and sediment to evaluate suitability for disposal to landfill or potential reuse • Acid sulfate soils: management of acid sulfate soils and sediment by the development and implementation of management procedures for acid sulfate soils as part of the CSWMP • RAP: Based on the investigations, if required, preparation of a RAP for the excavation and off-site disposal of contaminated materials to licensed landfill or on-site treatment/beneficial reuse (if identified and practicable) • CEMP: Potential construction impacts (including disturbance of surface water and contaminated sediment within Rozelle Bay) would also be managed by the development and implementation of the CEMP.
C7 – Victoria Road civil site at Rozelle	• Demolition of existing buildings • Site sheds, laydown areas and/or site offices would be established on site.	• Hazardous materials assessment and management plans would be undertaken for buildings and structures prior to demolition • CEMP: Potential construction impacts would also be managed by the development and implementation of the CEMP.

Area	Construction works	Management of construction impacts
C8 – Iron Cove Link civil site at Rozelle	• Demolition • Bulk excavations for tunnel portals and cut and cover tunnels • Soft ground tunnelling • Road construction works • Bioretention facility and formalised car parking around the sides of the wetland • Utility installation, relocation and protection • Landscaping.	• Site investigation: Targeted site investigations would be undertaken to investigate identified areas of concern including groundwater investigations targeting potential up gradient contamination sources • Hazardous materials assessment and management plans would be undertaken for buildings and structures prior to demolition • RAP: If contamination posing a risk to human or ecological receptors was identified a RAP would be prepared • CEMP: If no risk is found, construction impacts would be managed by the development and implementation of the CEMP.
C9 – Pyrmont Bridge Road tunnel site at Annandale	• Demolition • Excavation for construction adit • Minor road works.	• Site investigation: targeted site investigations would be undertaken to investigate identified areas of concern. If contamination posing a risk to human or ecological receptors was identified a RAP would be prepared • Hazardous materials assessment and management plans would be undertaken for buildings and structures prior to demolition • RAP: An interim management plan may be developed for the construction period and remediation commence prior to redevelopment or sale of the land at the end of the construction period • CEMP: If no risk is identified based on the site investigation, construction impacts would be managed by the development and implementation of the CEMP.

Area	Construction works	Management of construction impacts
C10 – Campbell Road civil and tunnel site at St Peters	• Road construction works • Tunnelling and associated excavation and stockpiling • Excavation for construction adit to provide construction access to mainline • Construction of cut and cover structures • Construction of permanent operational infrastructure including ventilation facility.	• Site investigation: Intrusive investigations within areas of potential concern would have been undertaken for the New M5 project • RAP: RAPs would be prepared as part of the New M5 project based on findings of the Site investigations • Landfill Closure Management Plan (LCMP): Construction for the M4-M5 Link project would be undertaken in accordance with the relevant requirements of the Golder (2016), RAP, LCMP and EPL • CEMP: The potential construction impacts for the M4-M5 Link project would be managed by the development and implementation of the CEMP.

8.1.2 Management of construction impacts – tunnelling

Groundwater and surface water captured as a result of tunnelling activities may be contaminated with suspended solids and increased pH due to tunnel grouting activities. Temporary water treatment plants would be constructed at each construction ancillary facilities where groundwater is extracted during dewatering and tunnelling to mitigate adverse water quality impacts arising from the discharge of untreated construction water.

Groundwater reuse would be undertaken in accordance with the policies of sustainable water use of (DPI-Water). The proposed volumes and management of extracted groundwater during construction is detailed in **Appendix Q** (Technical working paper: Surface water and flooding) of the EIS.

8.2 Management of operational impacts

8.2.1 Operational sites

The methods for the management of operational impacts are specified for each operational area in **Table 8-3**.

Table 8-3 Management of operational impacts – operational sites

Area	Operational activities	Management of operational impacts
Wattle Street site at Haberfield	• Roadway • Residual land at Wattle Street would be developed in accordance with the conditions of approval for M4 East project (Wattle Street and Haberfield surface sites would be landscaped as per M4 East Urban Design and Landscape Plan, Northcote Street as per M4 East Residual Land Management Strategy).	• No further management anticipated to be required in relation to contamination following completion of construction.
Northcote Street site at Haberfield	• Developed in accordance with the conditions of approval for M4 East project (rehabilitated, fenced off with future land use to be determined).	• Land use suitability assessment would be required prior to redevelopment: – Site investigation: an assessment of soil to supplement the existing data/fill in data gaps and assess the land suitability for the future land use (if required based on M4 East investigations) – RAP: Preparation of a RAP to make the land suitable for future land use, if required based on the findings of the site investigation.
Parramatta Road at Ashfield	• No M4-M5 Link project operations are proposed to occur on the site after completion of construction • The site would be rehabilitated in preparation for a future permissible use in accordance with the Residual Land Management Plan to be prepared for the project.	• Land use suitability: – Site investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the proposed future land use • RAP: Preparation of a RAP to make the land suitable for open space land use, based on the findings of the site Investigation and future land use/design.

Area	Operational activities	Management of operational impacts
Parramatta Road ventilation facility at Haberfield	• Parramatta Road ventilation facility (being built as part of M4 East. Fitout works only as part of the M4-M5 Link project) • Remaining project land to be landscaped in accordance with the M4 East conditions of approval.	• Land use suitability assessment would be required prior to redevelopment: – Site investigation: an assessment of soil to supplement the existing data/fill in data gaps and assess the land suitability for the future land use (if required based on M4 East investigations) • RAP: Preparation of a RAP to make the land suitable for future land use, if required based on the findings of the site investigation.
Parramatta Road site at Haberfield	• No M4-M5 Link project operations are proposed to occur on the site after completion of construction • The site would be rehabilitated in preparation for a future permissible use in accordance with the Residual Land Management Plan to be prepared for the project.	• Land use suitability: – Site investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the proposed future land use • RAP: Preparation of a RAP to make the land suitable for open space land use, based on the findings of the site Investigation and future land use/design.
Darley Road site at Leichhardt	• Permanent water treatment facility and substation to be built on western portion of the site at the completion of the project. Remainder of the site to be remaining project land, rehabilitated, fenced-off and redeveloped in accordance with existing land use zoning provisions.	• The site would continue as commercial/industrial land use as a water treatment facility. • Operation to be undertaken in accordance with the POEO Act. Management measures include the storage of chemicals and wastes in accordance with NSW regulations in force at the time. Further detail on the operation and management of the operational water treatment facility is provided in **Appendix Q** (Technical working paper: Surface water and flooding) of the EIS • Ongoing maintenance required for remaining project land.

Area	Operational activities	Management of operational impacts
Rozelle Rail Yards at Rozelle	• Water treatment plant • Constructed wetland • Roads and portals • Remaining project land to be redeveloped as open space • Ventilation facility • Substation • Workshop facilities/bulky equipment store • Fire pump room and water tanks • Road verges would be landscaped.	• Land use suitability: – Site Investigation: A grid based in situ characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the future open space land use – RAP: Preparation of a RAP to make the land suitable open land use based on the findings of the Site Investigation and future design • Operation to be undertaken in accordance with the POEO Act. Management measures include the storage of chemicals and wastes and if necessary capture, treatment and discharge of surface water in accordance with NSW regulations in force at the time. Further detail on the operation and management of the operational water treatment plant is provided in **Appendix Q** (Technical working paper: Surface water and flooding) of the EIS.
The Crescent	• Road infrastructure, roadway, pedestrian and cycle paths • Remaining project land would be rehabilitated and returned to current owners • Remaining project land along The Crescent/Whites Creek would be stabilised and soft landscaped.	• The site would continue as commercial/industrial land use • Land use suitability: – Site Investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the future land use – RAP: Preparation of a RAP to make the land suitable for open space land use based on the findings of the site investigation and future design.
Victoria Road site at Rozelle	• Roadway, pedestrian and cycle paths • Road verges to be landscaped • Remaining project land, rehabilitated, fenced-off and redeveloped in accordance with existing land use zoning provisions.	• Land use suitability: – Site investigation: A grid based *in situ* characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess land suitability for the future land use – RAP: Preparation of a RAP to make the land suitable open land use based on the findings of the site investigation and future design.

Area	Operational activities	Management of operational impacts
Victoria Road at Iron Cove	• Roads and portal • Sewer pump station • Substation • Remaining project land to be redeveloped as open space • Road verges to be landscaped.	• Land use suitability: – Site investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the future open space land use – RAP: Preparation of a RAP to make the land suitable for open space land use based on the findings of the site investigation and future design • Operations to be undertaken in accordance with the POEO Act. Management measures include the storage of chemicals and wastes in accordance with NSW regulations in force at the time.
Pyrmont Bridge Road site at Annandale	• Remaining project land, rehabilitated, fenced off and redeveloped in accordance with existing land use zoning provisions.	• Land use suitability: – Site investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the proposed future land use – RAP: Preparation of a RAP to make the land suitable for open space land use, based on the findings of the site Investigation and future land use/design.
Campbell Road site at St Peters	• Roads and portals • Ventilation facility • Ventilation supply facility • Substation • Workshop facilities/bulky equipment store • Portal and roads • Open space (to be delivered in accordance with New M5 conditions of approval).	• Ongoing groundwater, leachate and landfill gas monitoring would be undertaken by the New M5 project for the former Alexandria Landfill during the operational phase of the New M5 project in accordance with the approved Landfill Closure Plan • Land use suitability for areas outside of the EPL premises (former Alexandria Landfill): – Site investigation: Characterisation of soil and fill materials to supplement the existing data/fill in data gaps and assess the land suitability for the future open space land use (if not already completed as part of New M5) – RAP: Preparation of a RAP to make the land suitable for open space land use (if not already completed as part of New M5 project) • Operations to be undertaken in accordance with the POEO Act. Management measures include the storage of chemicals and wastes in accordance with NSW regulations in force at the time.

8.2.2 Management of operational impacts – roadways including tunnels

A risk assessment of all project roads will be carried out during detailed design to evaluate the likelihood of vehicle accidents during the operation of the project. Spill containment facilities would be located where high risk spill/contamination risk areas of roadway are identified.

The tunnel operation water treatment facilities would be designed such that effluent would be of suitable quality for discharge to the receiving environment. The level of treatment would consider the characteristics of the discharge and receiving waterbody, the operational constraints or practicalities and associated environmental impacts, and would be developed in accordance with ANZECC (2000) and with consideration to the relevant NSW Water Quality Objectives.

Treated flows from the Rozelle water treatment plant would be discharged to a constructed wetland within the Rozelle Rail Yards. This would afford some 'polishing' of the effluent, helping to remove residual dissolved constituents such as nitrogen and phosphorus not removed by the operation water treatment plant. The wetland at Rozelle interchange would also be used to treat a portion of stormwater runoff from the project footprint. Opportunities to incorporate other forms of nutrient removal would be investigated during detailed design for the treatment plant at Darley Road, as required.

An OEMP would be developed to manage potential impacts on groundwater and surface water. The OEMP would be a 'live' document with the capacity to be updated if conditions are different to those expected. As part of the OEMP the following plans or protocols would be included:

- Groundwater Management Plan
- Groundwater monitoring program
- Surface water monitoring program
- Drainage system maintenance plan.

8.3 Management of cumulative impacts

An assessment of cumulative impacts associated with other projects in the vicinity of the M4-M5 Link, in particular other WestConnex projects, such as the M4 East and New M5 projects, has been carried out. The assessment also considered other projects such as the CBD and South East Light Rail and potential future Western Harbour Tunnel and Beaches Link projects (see **section 7**). The projects currently under construction all incorporate construction and operation contamination management and mitigation measures to prevent adverse impacts on human health and the environment. Other projects that are still in the planning stages will be required to incorporate similar mitigation measures in accordance with legislative requirements to prevent adverse impacts.

Therefore, with due consideration of the proposed management measures to be implemented as part of the M4-M5 Link project as discussed in **sections 8.1** and **8.2**, there are likely to be minimal adverse cumulative contamination impacts associated with the past, existing and future land uses of these projects.

9 Conclusions

9.1 Key findings

This technical working paper has identified a number of areas and contaminants of concern which require management during the construction and operation of the M4-M5 Link project. Existing identified contamination issues are primarily related to historical land uses which have adversely impacted the quality of soil, fill, groundwater, surface water and sediment within the project footprint.

A number of properties located within the project footprint were identified as having a high risk of contamination which should be investigated during project planning. These properties generally comprise sites that have potentially been the subject of historically contaminating land uses, including:

- Former industrial and transport infrastructure, along with reclamation within the Rozelle Rail Yards
- Commercial/industrial properties present within or adjacent to the project footprint including but not limited to those on the edge of the Rozelle Rail Yards, manufacturing industries, workshops, timber mills and boat yards
- Areas of historical land reclamation (including unregulated filling activities), particularly along the harbour foreshore near Rozelle Bay
- Structures potentially containing hazardous materials that are required to be demolished for the project.

There is also a potential that contamination arising from tunnel construction and associated project works could adversely impact soil, groundwater and surface water if not managed appropriately.

9.2 Construction impacts and mitigation measures

A CEMP would be prepared for the project. The CEMP would include management measures for areas within the project footprint identified as being potentially contaminated.

Ancillary facilities and areas within the project footprint that have been assessed as low risk do not require further assessment or remediation and would be managed through the implementation of the CEMP. Sites which are assessed as potentially containing soil or groundwater contamination that could pose an unacceptable risk to human or ecological receptors during construction of the project would require further intrusive site investigation. The following sites would require the completion of targeted site investigations, waste characterisation and preparation of management procedures for acid sulfate soils and hazardous materials assessment as part of the Construction Soil and Water Management Plan (CSWMP) to inform the appropriate management of contamination during the intrusive construction program:

- Ancillary facilities and associated areas of construction disturbance within the project footprint comprising:
  - Parramatta Road West civil and tunnel site at Ashfield (C1b)
  - The Darley Road civil and tunnel site at Leichhardt (C4)
  - Rozelle civil and tunnel site at Rozelle (C5)
  - The Crescent civil site at Annandale (C6)
  - Iron Cove Link civil site at Rozelle (C8)
  - Pyrmont Bridge Road tunnel site at Annandale (C9)
  - Campbell Road civil and tunnel site at St Peters (C10) (for properties not previously investigated as part of the New M5 project)
- All contamination investigations must be undertaken by a suitably qualified and experienced person in accordance with guidelines made or approved under the CLM Act
- Subject to the outcomes of the additional investigations, Remediation Action Plan (RAPs) may be required and implemented in the event that site remediation is warranted prior to construction

- Intrusive works undertaken within the Campbell Road civil and tunnel site (C10) at St Peters that are within the former Alexandria Landfill Environment Protection Licence (EPL) boundary would be required to comply with the existing Golder (2016) RAP, Landfill Closure Plan, EPL and New M5 conditions of approval
- Groundwater and surface water captured as a result of tunnelling activities or installation of the coffer dam(s) in Rozelle Bay may be contaminated with suspended solids and increased pH due to tunnel grouting or activities associated with installation of the coffer dam(s). Temporary water treatment plants would be constructed at each construction ancillary facility where groundwater is extracted during dewatering and tunnelling. The water encountered during construction and operation would require appropriate monitoring and treatment prior to discharge to receiving water bodies
- The CEMP would incorporate the Roads and Maritime Unexpected Discovery of Contaminated Lands Procedure Roads and an asbestos management plan. The CEMP prepared for implementation during the project and should encompass all construction activities associated with the project. The plan should accurately reflect the conditions likely to be encountered during construction at various locations within the project footprint
- A construction soil and water management plan must be prepared for implementation during construction of the project
- Management procedures for acid sulfate soils as part of the CSWMP would be prepared for implementation during the project which should encompass the management of all potential or actual acid sulfate soils which may be disturbed as part of construction activities associated with the project. The plans should accurately reflect the conditions likely to be encountered during construction at various locations within the project footprint.

9.3 Operation impacts and mitigation measures

Following the completion of construction works, additional site investigations would be required to confirm the suitability of remaining project land proposed to be redeveloped for a more sensitive land use or to meet site handover obligations. In the event that residual contamination is identified, remediation works would be undertaken in accordance with an approved RAP.

The following would be undertaken and implemented prior to the operational phase of the project:

- A NSW EPA Accredited Site Auditor would be engaged to review all contamination reports and evaluate the suitability of a site for a specified use as part of the project
- An Operational Environmental Management Plan (OEMP) must be prepared to manage potential impacts on groundwater and surface water during the operational phases of the project.

9.4 Conclusions

Based on the findings of this technical working paper, there is potential for localised areas of soil, acid sulfate soil, sediment, fill and groundwater contamination associated with historically contaminating land uses to be encountered during construction, and further assessment is warranted in some instances. The discovery of contaminated materials is considered most likely to occur during near surface excavation works associated with road and tunnel construction activities.

Mitigation and management measures for construction and operation have been recommended to ensure risks arising from disturbances of contaminated soils and acid sulfate soil are minimised.

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