SOILS, CONTAMINATION AND WATER QUALITY

CHAPTER EIGHTEEN

SOCIAL IMPACTS AND COMMUNITY INFRASTRUCTURE

CHAPTER NINETEEN

18 Soils, contamination and water quality

This chapter provides an assessment of the potential impact on soils, contamination and water quality as a result of the project, and identifies mitigation measures to address these impacts. In relation to contamination this chapter draws on information in Technical paper 8 – Contamination.

18.1 Secretary's environmental assessment requirements

The Secretary's environmental assessment requirements relating to soils, contamination and water quality and where these requirements are addressed in this Environmental Impact Statement, are outlined in Table 18-1.

Table 18-1 Secretary's environmental assessment requirements – soils, contamination and water quality

Ref.	Secretary's environmental assessment requirements	Where addressed
11. Soils		
11.1	The Proponent must assess the impact of the project on acid sulfate soils (including impacts of acidic runoff offsite) in accordance with the current guidelines.	Acid sulfate soils are addressed in Section 18.4.2.
11.2	The Proponent must assess whether the land is likely to be contaminated and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with current guidelines.	Contamination is addressed in Sections 18.2, 18.3.3 and 18.4.2.
11.3	The Proponent must assess whether salinity is likely to be an issue and if so, determine the presence, extent and severity of soil salinity within the project area.	Salinity is addressed in Sections 18.3.2.
11.4	The Proponent must assess the impacts of the project on soil salinity and how it may affect groundwater resources and hydrology.	Salinity is addressed in Sections 18.3.2.
11.5	The Proponent must assess the impacts on soil and land resources (including erosion risk or hazard). Particular attention must be given to soil erosion and sediment transport consistent with the practices and principles in the current guidelines.	Soils are addressed in Section 18.4.2.

Ref.	Secretary's environmental assessment requirements	Where addressed
18. Water – Quality		
18.1 (a)	The Proponent must: state the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the project, including the indicators and associated trigger values or criteria for the identified environmental values	Water quality objectives are addressed in Section 18.4.1.
18.1(b)	identify all pollutants that may be introduced into the water cycle and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants that pose a risk of non-trivial harm to human health and the environment	Water quality is addressed in Section 18.4.2 and 18.4.3.
18.1 (c)	identify the rainfall event that the water quality protection measures will be designed to cope with	Water quality is addressed in Section 18.4.2.
18.1 (d)	assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes	Water quality objectives are addressed in Section 18.4.1, 18.4.2 and 18.4.3.
18.1 (e)	demonstrate how construction and operation of the project will, to the extent that the project can influence, ensure that: - Where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and - Where the NSW WQOs are not currently being met, activities will work toward their achievement over time	Water quality objectives are addressed in Section 18.4.1.
18.1 (f)	justify, if required, why the WQOs cannot be maintained or achieved over time;	Water quality objectives are addressed in Section 18.4.1.
18.1 (g)	demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented	Water quality is addressed in Section 18.4.2 and 18.4.3.
18.1 (h)	identify sensitive receiving environments (which may include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments	Water quality objectives are addressed in Section 18.3.1.
18.1 (i)	identify indicative monitoring locations, monitoring frequency and indicators of surface and groundwater quality.	Water quality is addressed in Section 18.4.2.
17. Water – Hydrology		
17.2	The Proponent must assess (and model if appropriate) the impact of the construction and operation of the project and any ancillary facilities (both built elements and discharges) on surface and groundwater hydrology in accordance with the current guidelines, including: **a.** natural processes within rivers, wetlands, estuaries, marine waters and floodplains that affect the health of the fluvial, riparian, estuarine or marine system and landscape health (such as modified discharge volumes, durations and velocities), aquatic connectivity and access to habitat for spawning and refuge; **b.** changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources; **c.** direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses;	Hydrology impacts are addressed in Chapter 21 (Flooding and hydrology).

18.2 Assessment methodology

The assessment methodology applied for soils, contamination and water quality involved:

- A review of contamination assessments previously carried out near the project area, where available
- A review of publicly available data and web-based information searches, including:
  - Contaminated Sites Register and Record of Notices (NSW Environment Protection Authority, 2015)
  - Australian Soil Resource Information System (Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2015)
  - Sydney 1:100,000 Geological Series Sheet 9130 (NSW Department of Mineral Resources, 1983)
  - Sydney 1:100,000 Soils Landscape Series Sheet 9130 (Soil Conservation of NSW, 1966)
  - Office of Water Groundwater Database (NSW Department of Primary Industries, 2015)
  - Office of Environment and Heritage NSW Soil and Land Information System (Office of Environment and Heritage, 2015a)
- A review of historical aerial photography to identify potential contamination sources located near the project based on previous land use
- A site inspection to determine potential contamination sources and verify those potential areas of environmental concern identified in the review
- Identification of potential impacts of the project on surface water quality and groundwater quality
- Identification of the potential for the project to disturb acid sulfate soils and the associated impacts
- Consideration of the potential impacts of the project associated with erosion and sedimentation
- Recommendations for additional investigations and / or management of potentially contaminated sites which may be encountered during construction
- Development of mitigation measures to address potential soils, contamination and water quality impacts.

The following guidelines were considered (where relevant):

- *Acid Sulfate Soils Assessment Guidelines* (Department of Planning, 2008)
- *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land* (Department of Urban Affairs and Planning and Environment Protection Authority, 1998)
- *Managing Urban Stormwater: Soils and Construction, Volume 1* (Landcom, 2004)
- *Managing Urban Stormwater: Soils and Construction, Volume 2* (Department of Environment and Climate Change, 2008a)
- *Guidelines for Consultants Reporting on Contaminated Sites* (Office of Environment and Heritage, 2011)
- *Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (Department of Environment and Climate Change, 2009b)
- *Code of Practice for the Safe Removal of Asbestos, 2nd edition* (National Occupational Health and Safety Commission, 2005)
- *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (Department of Environment and Climate Change, 2008b)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC / ARMCANZ, 2000a)
- *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (Department of Environment and Conservation, 2006b).

18.3 Existing environment

18.3.1 Sensitive receiving environments

A sensitive receiving environment has a high conservation or community value or supports ecosystems or human uses of water that are particularly sensitive to pollution or degradation of water quality.

The sensitive receiving environments that would be relevant to the project are Middle Harbour, Sydney Harbour (including Darling Harbour) and groundwater users.

18.3.2 Soils

The project is located within the Sydney Basin, a large depositional geological feature that spans from Batemans Bay to the south, Newcastle to the north and Lithgow to the west. The Sydney 1:100,000 Geological Series Sheet 9130 (NSW Department of Mineral Resources, 1983) indicates that the project area is underlain by:

- Wianamatta Ashfield Shale – generally consisting of black to dark grey shale and laminate
- Hawkesbury Sandstone – generally consisting of medium to coarse-grained quartz sandstone, very minor shale and laminate lenses
- Mittagong Formation – comprising inter-bedded shale and fine-grained sandstone.

The Sydney 1:100,000 Soil Landscape Series Sheet 9130 (Soil Conservation of NSW, 1966) identified a number of soils underlying the project area. These include the Birrong, Blacktown, Deep Creek, Lucas Heights, Gymea, and Disturbed landscape groups to the south of the harbour crossing, and the Hawkesbury, Glenorie, Gymea, and Blacktown landscape groups to the north of the harbour crossing (see Table 18-2 and Figure 18-1).

Table 18-2 Soil units underlying the project area

Soil Unit	Location in relation to the project	Description
Birrong	Around Marrickville dive site (southern)	• Landscape – level to gently undulating alluvial floodplain draining Wianamatta Group shales. Local relief to 5 m, slopes < 3%. Extensively cleared tall open forest and woodland • Soils – deep (> 250 cm) yellow podzolic soils and yellow solodic soils on older alluvial terraces • Limitations – localised flooding, high soil erosion hazard, saline subsoils, seasonal waterlogging, and very low soil fertility.
Blacktown	Around Chatswood, Crows Nest and Central stations	• Landscape – found on gently undulating rises on Wianamatta Group shales with local reliefs of up to 30 m and slopes of < 5% • Soils – shallow to moderately deep hardsetting mottled texture contrast soils, red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and in drainage lines • Limitations – moderately reactive, highly plastic subsoil, with low fertility and poor drainage.
Deep Creek	Around Pitt Street and Central stations	• Landscape – level to gently undulating alluvial floodplain draining the Hawkesbury Sandstone. Local reliefs of < 5 m and slopes of < 3% • Soils – deep (> 200 cm) podzols on well drained terraces, siliceous sands on current floodplain, and humus podzols in low lying areas • Limitations – flooding, extreme soil erosion hazard, sedimentation hazard, localised very low fertility and permanently high water tables.

Soil Unit	Location in relation to the project	Description
Lucas Heights	Around Martin Place and Central stations	• Landscape – gently undulating crests and ridges on plateau surfaces of the Mittagong formation. Local relief to 30 m, slopes of < 10%. Rock outcrop is absent. Extensively or completely cleared, low open forest and woodland • Soils – moderately deep (50 – 150 cm), hardsetting yellow podzolic soils on outer edges of crests • Limitations – stony soil, low soil fertility, low available water capacity.
Glenorie	Around Artarmon substation	• Landscape –undulating to rolling low hills on Wianamatta Group shales with local reliefs of 50 to 80 m and slopes of 20%. Extensively cleared tall open forest • Soils – shallow to moderately deep red podzolic soils on crests, moderately deep red/brown podzolic soils on upper slopes, deep yellow podzolic soils on lower slopes and humic gleys, yellow podzolic soils and gleyed podzolic soils along drainage lines • Limitations – high soil erosion hazard, localised impermeable highly plastic subsoil, and moderately reactive.
Gymea	Around Barangaroo, Martin Place and Victoria Cross stations, and Blues Point temporary site	• Landscape –undulating to rolling low hills on Hawkesbury Sandstone with local reliefs of 20 to 80 m and slopes of 10 to 25% and rock outcrops of < 25 % • Soils – shallow to moderately deep yellow earths and earthy sands on crests and on the inside of benches • Limitations – high soil erosion, rock outcrop, shallow highly permeable soil, and very low soil fertility.
Disturbed	Around Barangaroo Station, Artarmon substation and Chatswood	• Landscape – the topography varies from level plains to undulating terrain and has been disturbed by human activity to a depth of at least 100 cm • Soils – the original soil has been removed, greatly disturbed or buried. Most of these areas have been levelled to slopes of < 5%. Landfill includes soil, rock, building and waste material. The original vegetation has been completely cleared • Limitations – depend on the nature of fill material. Potential for subsidence resulting in a mass movement hazard, and soil impermeability leading to poor drainage and low fertility. Care must be taken when these sites are developed.
Hawkesbury	Around Blues Point temporary site	• Landscape – found on rugged, rolling to very steep hills on Hawkesbury Sandstone with local reliefs of 40 to 200 m, slopes of > 25 % and rock outcrops of > 50% • Soils – shallow (< 50 cm), discontinuous lithosols/siliceous sands associated with rock outcrops, earthy sands, yellow earths and some yellow podzolic soils on the inside of benches and along joints and fractures • Limitations – extreme soils erosion hazard, mass movement (rockfall) steep slopes, rock outcrop, shallow, stony, highly permeable soils with low fertility.

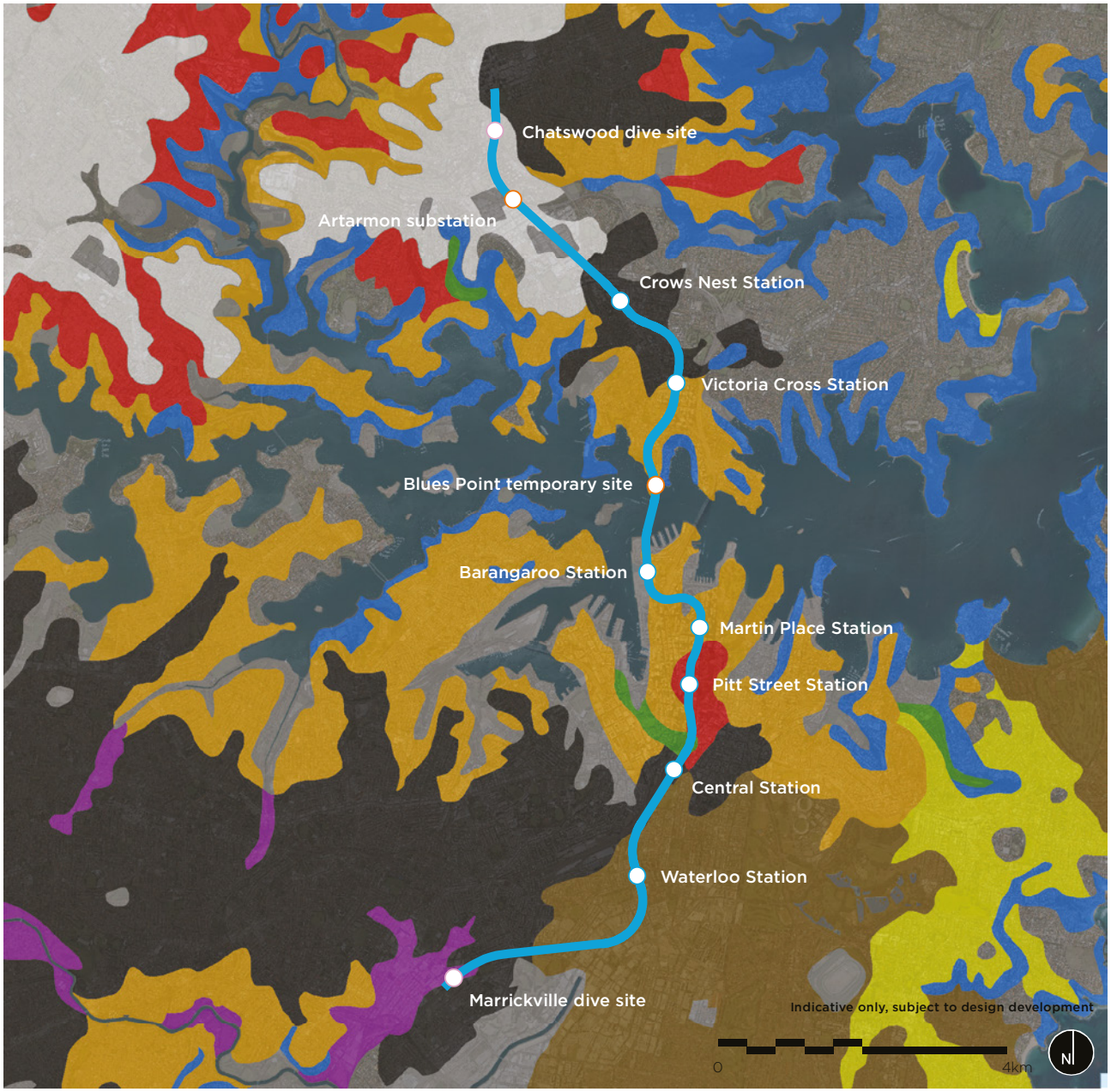

Figure 18-1 Soils units underlying the project area

Soil salinity

Areas prone to salinity are usually at low positions in the landscape, such as floodplains, in valley floors, or at the foot of a ridge. The Office of Environment and Heritage NSW Soil and Land Information System contains data points identifying evidence of soil salinity at areas which have previously been sampled. There was no evidence within this database to suggest soil salinity at any point along the project alignment. According to the Office of Environment and Heritage, urban salinity is of concern in Western Sydney however is not considered to be an issue for areas along the project alignment. As soil salinity is unlikely to be present along the project alignment, salinity related impacts on groundwater resources and hydrology are not expected.

Acid sulfate soils

Acid sulfate soils are the common name given to naturally occurring sediments and soils containing iron sulfides (principally iron sulfide or iron disulfide or their precursors). Exposure of the sulfide in these soils to oxygen as a result of drainage or excavation leads to the generation of sulfuric acid. Areas of acid sulfate soils can typically be found in low-lying and flat locations that are often swampy or prone to flooding.

The Australian Soil Resource Information System (CSIRO, 2015) was searched to identify the probability for acid sulfate soils to be present within the project area. The results of the search are shown in Table 18-3 and Figure 18-2.

Table 18-3 Probability for acid sulfate soils to be present within the project area

Locations	Probability for acid sulfate soil
Chatswood to St Leonards	Low
St Leonards to North Sydney	Extremely low
Sydney Harbour to Barangaroo – only Cockle Bay, opposite Erskineville Street at Barangaroo, Lavender Bay and Darling Harbour. Acid sulfate soils are not known to be present within areas within Sydney Harbour where ground improvement works may occur for the harbour crossing.	High – in specific areas identified Low – in other areas in this location including Sydney Harbour
Barangaroo to Pitt Street	Extremely low
Pitt Street to Central Station	Low
Waterloo Station to Marrickville dive site (southern)	High

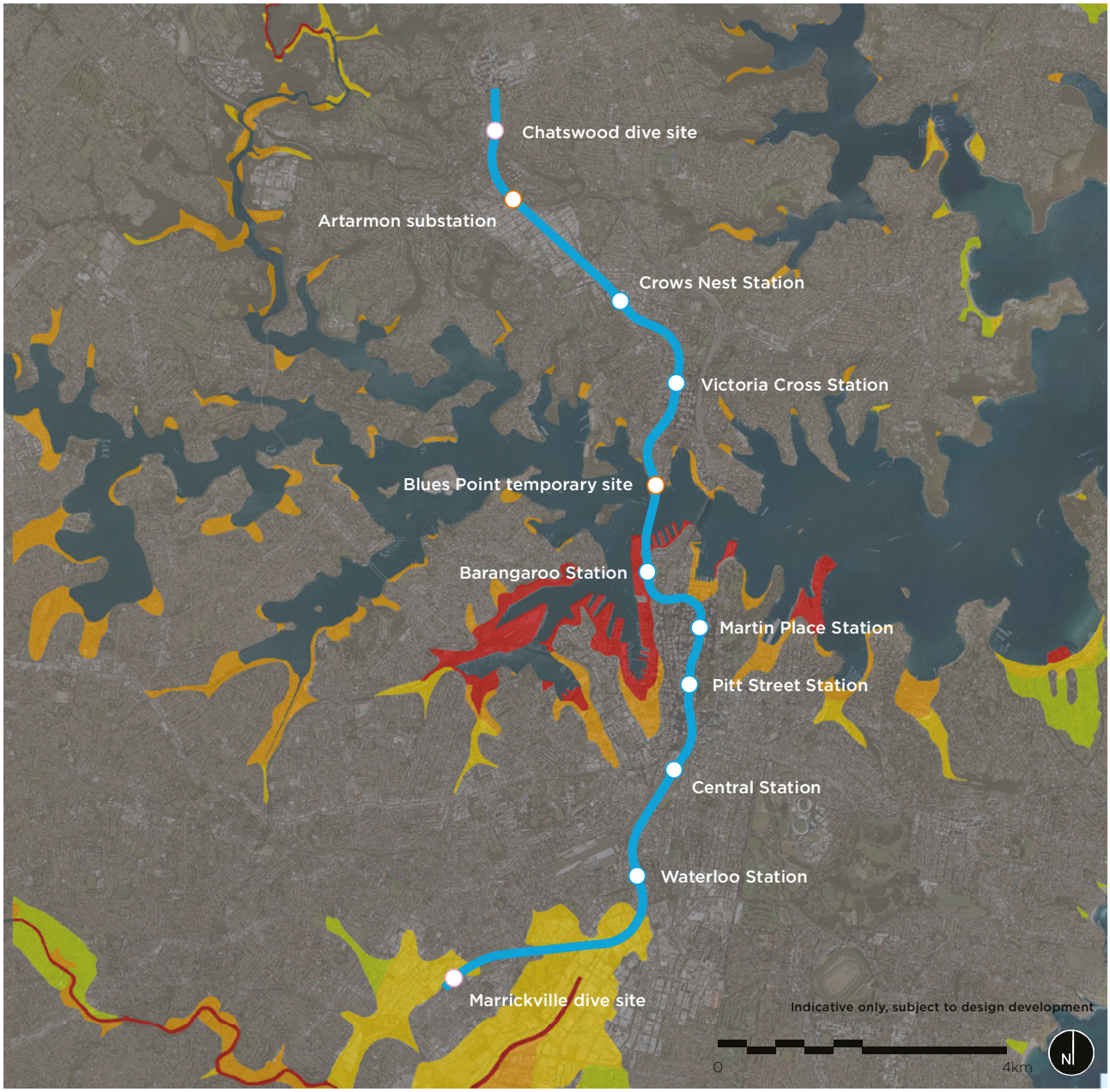

Figure 18-2 Acid sulfate soil classification risk along project alignment

18.3.3 Contamination

The following section has been informed by the Technical paper 8 – Contamination.

Historical aerial photographs

Historical aerial photographs from the NSW Land and Property Management Authority (Land and Property Information Division) were reviewed for the years 1930, 1955, 1965, 1976, 1986, 1994, and 2004. The photographs show that:

- Since the 1930's, the Marrickville dive site, Waterloo Station, Victoria Cross Station, Crows Nest Station and Artarmon substation sites have increasingly changed from residential land use to commercial / industrial uses
- The Barangaroo Station site has seen major industrial developments since the 1950s and 1960s
- The industrial land use on and surrounding the Blues Point temporary site has changed to residential and open space
- Land use surrounding the Marrickville dive site, Barangaroo Station and Artarmon substation sites has seen major extractive or reclamation works within the past 50 years
- The Central Station, Pitt Street Station and Martin Place Station sites have remained within a commercial context since the 1930s.

NSW contaminated sites register

A search of the Contaminated Sites Register and Record of Notices under Section 58 of the *Contaminated Land Management Act 1997* (CLM Act) identified 11 registered sites within 500 metres of the project area that were either regulated or had been notified to the NSW Environment Protection Authority (EPA) (refer to Table 18-4).

Table 18-4 NSW EPA Contaminated Sites Register and Record of Notices

Suburb	Notified site address	Notified site activity	Contamination status	Location in relation to the project
Chatswood dive site (northern)				
Chatswood	607 Pacific Highway	Former Caltex Service Station	Contamination currently regulated under CLM Act	Within the Chatswood dive site footprint
Chatswood	572 Pacific Highway	Caltex Service Station	Under assessment	50m to the west of the Chatswood dive site footprint
Blues Point temporary site				
Lavender Bay	French Street	SRA Land	Regulation under CLM Act not required	About 400m north of the Blues Point temporary site
Barangaroo Station				
Millers Point	30-34 Hickson Road	Former AGL Gasworks	Regulation under CLM Act not required	Adjacent and to the south of Barangaroo Station footprint
Millers Point	36 Hickson Road	Former AGL Gasworks	Contamination currently regulated under CLM Act	Adjacent and to the south of Barangaroo Station footprint
Millers Point	38 Hickson Road	Former AGL Gasworks	Contamination currently managed via the planning process (EP&A Act)	Adjacent and to the south of Barangaroo Station footprint
Millers Point	Berths 5, 6 and 7 (already demolished) and part Hickson Road	Former AGL Gasworks	Contamination currently regulated under CLM Act	Adjacent and to the south of Barangaroo Station footprint
Millers Point	Road reserve fronting 30-38 Hickson Road	Former AGL Gasworks	Contamination currently regulated under CLM Act	Adjacent and to the south of Barangaroo Station footprint
Millers Point	4 Towns Place	Port Services (Moores) Facility	Contamination currently regulated under POEO Act	About 200m north of Barangaroo Station
Pitt Street Station				
Sydney	447 Kent Street	Interpro House (OSP 46581)	Regulation under CLM Act not required	About 320m west of Pitt Street Station
Waterloo Station				
Waterloo	2 John Street	Other industry	Regulation under CLM Act not required	About 200m south of Waterloo Station

Sydney Harbour contamination

A review of the technical report *Sydney Harbour: A systematic review of the science* (Sydney Institute of Marine Science, 2014) indicated that early investigations showed sediments in Sydney Harbour contained high concentrations of a suite of metals (most notably copper, zinc and lead). More recent studies have confirmed that sediments in large areas of Sydney Harbour are not only highly polluted by metals, but also by a wide range of non-metallic contaminants, eg organochlorine pesticides (OCs), polycyclic aromatic hydrocarbons (PAHs) and polychlorinated dibenzo-para-dioxins (dioxins) and dibenzofurans (furans). These organic contaminants have led to restrictions on the consumption of seafood from locations west of the Sydney Harbour Bridge (NSW Department of Primary Industries, 2015).

Sediment samples were collected from two locations as part of geotechnical investigations carried out for the project to a maximum depth of 0.7 metres below the surface of the sediment and analysed for a range of contaminant compounds including:

- Trace metals (Ag, Cd, Cr, Cu, Pb, Hg, Ni, Sb and Zn) and arsenic
- Polychlorinated biphenyls (PCBs)
- Organochlorine (OC) pesticide residues
- Polycyclic aromatic hydrocarbons (PAHs)
- Total petroleum hydrocarbons (TPH)
- Tri-butyltin (and mono- and di-butyltin)
- Sub-samples for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs).

Where available, all results were assessed against the Commonwealth of Australia (2009) *National Assessment Guidelines for Dredging* (NAGD). Concentrations of contaminants in sediment samples were below the NAGD guidelines (where available) with the exception of mercury in surface sediments at both sampling locations.

Further sediment sampling was carried out of the surface sediments (less than one metre below the bed) in the area of the two grout treatment zones. The results of this sediment sampling indicated elevated concentrations (above the applicable guidelines) of lead, mercury, tri-butyltin, polycyclic dibenzo dioxins and furans and polycyclic aromatic hydrocarbons. Contaminant concentrations in sediment at the barge locations are typical of large areas of sediment quality in Sydney Harbour.

18.3.4 Surface water

Catchments

There are two large water catchments within the project area – Sydney Harbour and Parramatta River catchment and Cooks River catchment. Within these two catchments there are five local watercourses that are located along the project alignment. These local watercourses drain into Middle Harbour, Sydney Harbour and Botany Bay. The catchments, watercourses and receiving waters for precincts along the project alignment are described in more detail below, and summarised in Table 18-5 and Table 18-6.

Sydney Harbour and Parramatta River catchment

This catchment includes the Sydney CBD and the significant commercial districts of North Sydney and Parramatta. Sydney's prime tourist attractions – the Opera House, Royal Botanic Garden, Taronga Zoo, Circular Quay, The Rocks, Darling Harbour and the Fish Markets – are all located on the harbour foreshores.

Current uses and environmental values for the Sydney Harbour and Parramatta River system include maintenance of healthy ecosystems, recreation (including swimming, boating, fishing and enjoyment of views) and commercial activities (such as commercial shipping and tourism). There is very limited extraction of fresh water, or reuse of stormwater.

Much of the catchment is urbanised, although significant areas of bushland remain, particularly within the Lane Cove, Garigal and Sydney Harbour national parks. Because of the extent of development, the waterways are affected by poor water quality and a changed flow regime. The waterways have been greatly modified, with creek systems extensively channelised or hard-edged with concrete. Wetlands have been destroyed or degraded and, where natural remnants of vegetation exist, they are often affected by weeds and rubbish.

Table 18-5 Drainage catchments – Sydney Harbour and Parramatta River

Catchment areas	Relevant project elements	Surface water catchment	Receiving waters
Sydney Harbour and Parramatta River	Chatswood dive site (northern)	Scotts Creek and Flat Rock Creek	Middle Harbour
	Artarmon substation	Flat Rock Creek	
	Crows Nest Station		
	Victoria Cross Station	Milson Park	Sydney Harbour
	Blues Point temporary site	N/A	
	Barangaroo Station	City Area (Sydney)	
	Martin Place Station	City Area (Sydney)	
	Pitt Street Station	City Area (Sydney)	
	Central Station	Darling Harbour (Sydney)	

Cooks River catchment

The Cooks River flows for about 23 kilometres from Yagoona to Botany Bay. The Cooks River catchment covers an area of about 100 square kilometres and has been identified as one of the most heavily urbanised and degraded river systems in Australia. Water quality varies across the catchment mainly due to stormwater, fertilisers, industrial discharges and sewage contamination.

The Cooks River Alliance is a partnership of eight councils – Ashfield, Bankstown, Canterbury, City of Sydney, Hurstville, Marrickville, Strathfield and Rockdale – established in 2012, who are working together with communities to carry out projects to improve the health of the Cooks River catchment.

Table 18-6 Drainage catchments – Cooks river

Catchment areas	Relevant project elements	Surface water catchment	Receiving waters
Cooks River	Waterloo Station	Alexandra Canal	Botany Bay (via the Cooks River)
	Marrickville dive site (southern)	Marrickville Valley	

Water quality

Watercourses near the project corridor are heavily urbanised, with surface water generally collected by developed stormwater networks. Surface water quality along the project alignment is largely influenced by 'point source' water pollution (for example, from stormwater drains) and diffuse water pollution (for example, from urban runoff that does not enter stormwater drains).

The NSW Office of Environment and Heritage measures the recreational water quality of Sydney's harbours and surrounding beaches through the Beachwatch program. Rainfall data is used to predict the likelihood of bacterial contamination at sample sites. Relevant samples have been taken at various locations in Middle Harbour, Sydney Harbour and Botany Bay. The closest monitoring sites to the project are Hayes Street Beach at North Sydney in Middle Harbour, Greenwich Baths in Sydney Harbour and Kyeemagh Baths at the mouth of the Cooks River in Port Botany. According to *Central Sydney State of the Beaches 2014–2015* (Office of Environment and Heritage Beachwatch, 2015), the water quality over this 12-month period was considered to be good (refer to Table 18-7).

Table 18-7 Water quality at relevant monitoring sites

Location	Site type	Beach suitability grade	Comments
Hayes Street Beach, North Sydney, Middle Harbour	Estuarine	Good – the water quality is safe for swimming most of the time, but can be susceptible to pollution from contamination.	Enterococci levels increased with increasing rainfall at this site, frequently exceeding the safe swimming limit in response to 10mm of rainfall or more.
Greenwich Baths, Greenwich, Sydney Harbour	Estuarine	Good – the microbial water quality is suitable for swimming most of the time, but can be susceptible to pollution from potential sources of faecal contamination (such as from the Lane Cove River).	Enterococci levels increased with increasing rainfall at this site, regularly exceeding the safe swimming limit in response to 10mm of rainfall or more.
Kyeemagh Baths, Cooks River, Port Botany	Estuarine	Good – the microbial water quality is suitable for swimming most of the time, but can be susceptible to pollution from potential sources of faecal contamination (such as from the Cooks River, and stormwater and sewage overflows).	Enterococci levels increased with increasing rainfall at this site, occasionally exceeding the safe swimming limit in response to light rainfall and frequently exceeding the safe swimming limit after 10mm of rainfall or more.

18.4 Potential impacts

This section provides an assessment of the project against water quality objectives, and an assessment of impacts during operation and construction of the project.

18.4.1 Water quality objectives

Water quality objectives that provide guideline levels to help manage water quality have been developed for each catchment in NSW (Department of Environment and Conservation, 2006). These objectives include community-based values, long term goals, and their associated national criteria drawn from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000b). The objectives aim to improve poor water quality and maintain existing good water quality (Department of Environment and Conservation, 2006). Table 18-8 outlines the water quality objectives for catchments in the study area and the impacts as a result of the project during construction and operation.

Table 18-8 Priority water quality objectives for the relevant surface water

Water quality objective	Indicators	Associated trigger values or criteria	Objective a priority for catchment	Impact as a result of the project during construction and operation
Aquatic ecosystems				
Maintain or improve the ecological condition of waterbodies and their riparian zones over the long term.	Total phosphorus	• Upland rivers: 20 µg/L • Lowland rivers: 25 µg/L for rivers flowing to the coast; • Lakes & reservoirs: 10 µg/L • Estuaries: 30 µg/L	Sydney Harbour and Parramatta River Cooks River	The treatment and discharge of water during construction would comply with the requirements of an environment protection licence issued to the project and during operation would be based on ANZECC freshwater ecosystem protection levels. Therefore the discharge water quality would be higher than existing water quality of the receiving waters.
	Total nitrogen	• Upland rivers: 250 µg/L • Lowland rivers: 350 µg/L for rivers flowing to the coast; 500 µg/L for rivers in the Murray-Darling Basin • Lakes & reservoirs: 350 µg/L • Estuaries: 300 µg/L		
	Chlorophyll-a	• Upland rivers: not applicable • Lowland rivers: 5 µg/L • Lakes & reservoirs: 5 µg/L • Estuaries: 4 µg/L		
	Turbidity	• Upland rivers: 2–25 NTU • Lowland rivers: 6–50 NTU • Lakes & reservoirs: 1–20 NTU • Estuaries: 0.5–10 NTU		
	Salinity (electrical conductivity	• Upland rivers: 30–350 µS/cm • Lowland rivers: 125–2200 µS/cm		
	Dissolved oxygen	• Upland rivers: 90–110% • Lowland rivers: 85–110% • Freshwater lakes & reservoirs: 90–110% • Estuaries: 80–110%		
	pH	• Upland rivers: 6.5–8.0 • Lowland rivers: 6.5–8.5 • Freshwater lakes & reservoirs: 6.5–8.0 • Estuaries: 7.0–8.5		

Water quality objective	Indicators	Associated trigger values or criteria	Objective a priority for catchment	Impact as a result of the project during construction and operation
Visual amenity				
Maintain the aesthetic qualities of waterways.	Visual clarity and colour	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.	Sydney Harbour and Parramatta River Cooks River	The treatment and discharge of water during construction would comply with the requirements of an environment protection licence issued to the project and during operation would be based on ANZECC freshwater ecosystem protection levels. Therefore the discharge water quality would be higher than existing water quality of the receiving waters. The treated discharge water quality would ensure that the aesthetic qualities of downstream waters would not be diminished.
	Surface films and debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter.		
	Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts.		

Water quality objective	Indicators	Associated trigger values or criteria	Objective a priority for catchment	Impact as a result of the project during construction and operation
Secondary contact recreation				
Maintain or improve water quality for activities such as boating and wading, where there is a low probability of water being swallowed.	Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month).	Sydney Harbour and Parramatta River Cooks River	The treatment and discharge of water during construction would comply with the requirements of an environment protection licence issued to the project and during operation would be based on ANZECC freshwater ecosystem protection levels. Therefore the discharge water quality would be higher than existing water quality of the receiving waters. The treated discharge water quality would ensure that secondary contact recreation activities in downstream waters would not be affected.
	Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL).		
	Algae & blue-green algae	< 15 000 cells/mL		
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation.		

Water quality objective	Indicators	Associated trigger values or criteria	Objective a priority for catchment	Impact as a result of the project during construction and operation
Primary contact recreation				
Maintain or improve water quality for activities such as swimming, where there is a high probability of water being swallowed.	Turbidity	A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU).	Sydney Harbour and Parramatta River	The treatment and discharge of water during construction would comply with the requirements of an environment protection licence issued to the project and during operation would be based on ANZECC freshwater ecosystem protection levels. Therefore the discharge water quality would be higher than existing water quality of the receiving waters. The immediate receiving watercourses are not currently used for primary contact recreation activities. The discharge water quality would ensure that primary contact recreation activities in downstream waters would not be affected.
	Faecal coliforms	Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. ANZECC 2000 Guidelines recommend: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month).		
	Enterococci	Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding one month. ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).		
	Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note: it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius).		

Water quality objective	Indicators	Associated trigger values or criteria	Objective a priority for catchment	Impact as a result of the project during construction and operation
	Algae & blue-green algae	< 15 000 cells/mL		
	Nuisance organisms	Use visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable.		
	pH	5.0-9.0		
	Temperature	15°-35°C for prolonged exposure.		
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucus membranes are unsuitable for recreation.		
Aquatic foods				
Protect water quality so it is suitable for the production of aquatic foods for human consumption and aquaculture activities	Algae & blue-green algae	No guideline is directly applicable, but toxins present in blue-green algae may accumulate in other aquatic organisms.	Cooks River	The treatment and discharge of water during construction would comply with the requirements of an environment protection licence issued to the project and during operation would be based on ANZECC freshwater ecosystem protection levels. Therefore the discharge water quality would be higher than existing water quality of the receiving waters. The immediate receiving waters are not currently used for the production of aquatic foods. The discharge water quality would ensure the quality of downstream waters where aquatic food production may take place would not be affected. Sydney Harbour is currently closed to commercial fishing.
	Faecal coliforms	*Guideline in water for shellfish:* The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100 mL. *Standard in edible tissue:* Fish destined for human consumption should not exceed a limit of 2.3 MPN E Coli/g of flesh with a standard plate count of 100,000 organisms/g		
	Toxicants (as applied to aquaculture activities)	Metals: • Copper: less than 5 µgm/L. • Mercury: less than 1 µgm/L. • Zinc: less than 5 µgm/L. Organochlorines: • Chlordane: less than 0.004 µgm/L (saltwater production) • PCB's: less than 2 µgm/L.		
	Physico-chemical indicators (as applied to aquaculture activities)	• Suspended solids: less than 40 micrograms per litre (freshwater) • Temperature: less than 2 degrees Celsius change over one hour		

18.4.2 Construction

The potential pollutants which could be introduced into the water cycle as a result of construction activities include sediment, hydrocarbons, acids and other dangerous goods. The project also has the potential to encounter contaminated sites which could result in existing contamination being mobilised into the water cycle. These potential impacts are considered further below.

Soils

Soil erosion

Construction of the project would temporarily expose the natural ground surface and sub-surface through the removal of vegetation, overlying structures (such as buildings and footpaths) and excavation of construction footprints for stations, structures and foundations. The temporary exposure of soil to water runoff and wind could increase soil erosion potential, particularly where construction is undertaken in soil landscapes characterised by a high and extreme erosion hazard. There is the potential that exposed soils – and other unconsolidated materials, such as spoil, sand and other aggregates – could be transported from the construction sites into surrounding waterways via stormwater runoff.

Given the relatively small areas of surface disturbance anticipated during construction and the overall topography of those parts of the project (generally slightly undulating), it is expected that soil erosion would be adequately managed by in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2* (Department of Environment and Climate Change, 2008a). Measures would be designed for the 80th percentile; 5-day rainfall event.

Acid sulfate soils

Acid sulfate soil risk varies across the project area. There is a high probability of encountering these soils opposite Erskine Street at Barangaroo and in the areas between Waterloo Station and the Marrickville dive site, if excavations in these areas are required.

The exposure of acid sulfate soils during excavation could result in the release of acid sulfates, which would damage surrounding vegetation, or cause acidic runoff offsite which would damage aquatic environments and / or drainage lines.

Further geotechnical testing of underlying sub-soil and rock stratum would be undertaken to determine the composition of rock and soil types likely to be present within excavation areas. If acid sulfate soils are encountered, they would be effectively managed in accordance with the *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee, 1998). The manual includes procedures for the investigation, handling, treatment and management of such soils.

Contamination

Potentially contaminated sites

Based on the review of background information as presented in Section 18.3.2, there is the potential for contamination to be encountered at a number of locations throughout the project. Contaminants that could be encountered during excavation and other ground disturbing activities include contamination associated with:

- Leaks and spills from fuel storage infrastructure (hydrocarbons and heavy metals)
- Processing of heavy end hydrocarbons, heavy metals and metalloids
- Land reclamation and other uncontrolled fill material (metals, hydrocarbons, pesticides, PCB and asbestos)
- Demolition of buildings, such as asbestos
- Former and current industrial land uses (hydrocarbons, heavy metals and metalloids, solvents, phenolics, pesticides, heavy metals and metalloids and asbestos in soil)
- Existing railways and associated activities (metals, hydrocarbons, pesticides, nutrients, phenols, carbamates, pesticides, herbicides and asbestos in soils).

A number of potential areas of environmental interest were identified during the information review and site inspection. Table 18-9 outlines the potential areas of contamination interest in the vicinity of the project area and their associated risks.

Table 18-9 Potential sites of contamination interest

Site	Location relative to site	Potential contamination source	Likely risk
Current Caltex service station, Chatswood	Adjacent to Chatswood dive site	On-site activities associated with fuel use and storage.	Low (possible contamination but no excavation activities proposed)
Ausgrid Depot, Chatswood	Within Chatswood dive site	Possible fuel storage, workshops, storage and electrical transmission	Moderate (possible contamination / major excavation activities proposed)
Former Caltex Service Station, Chatswood	Within Chatswood dive site	Former fuel storage	High (known contamination / major excavation activities proposed)
Existing T1 North Shore line between Chatswood Station and Chatswood dive site	Within railway corridor and construction footprint	On-site activities associated with railway use	Low–moderate (possible contamination / minimal excavation proposed)
Victoria Cross Station	Within footprint of Victoria Cross Station site	Demolition of existing buildings	Moderate (possible contamination / major demolition activities proposed)
Former heavy industrial land use, Blues Point	Within footprint of Blues Point temporary site	Historical industrial activities (possible shipyard)	Moderate (possible contamination / major excavation activities proposed)
Sydney Harbour	Within footprint of harbour ground improvement work	Historical industrial activities	Moderate (known contamination / minor excavation activities proposed)
Reclaimed land within Barangaroo	Adjacent to the Barangaroo Station site	Historical activities and waste / fill material	Moderate–high (known isolated contamination / major excavation activities proposed)

Site	Location relative to site	Potential contamination source	Likely risk
Former gasworks along Hickson Road, Millers Point	Adjacent to the footprint of Barangaroo Station	Historical activities as a gasworks	High (known contamination / major excavation activities proposed)
Martin Place Station	Within footprint of Martin Place Station site	Demolition of existing buildings	Moderate (possible contamination / major demolition activities proposed)
Pitt Street Station	Within footprint of Pitt Street Station site	Demolition of existing buildings	Moderate (possible contamination / major demolition activities proposed)
Former gasworks within Central railyards	Within and adjacent to the footprint of Central Station	Historical activities as a gasworks	Moderate (possible contamination / major demolition activities proposed)
Central Station	Within footprint of Central Station	On site activities associated with railway use	Low (possible contamination / minimal excavation proposed)
Regent Street service station	Adjacent to the proposed Sydney Yard Access Bridge at Central Station site	Leaks and spills from fuel storage infrastructure (hydrocarbons and heavy metals)	Moderate (possible contamination / moderate excavation activities proposed)
Former and current commercial / industrial land use, Waterloo	Within footprint of Waterloo Station	Historical and current commercial / industrial activities (including dry cleaners, automotive industry and substation)	Moderate (possible contamination / major excavation activities proposed)
Railway activities north of Sydenham Station	Within Marrickville dive site footprint	On-site activities associated with railway use	Low–moderate (possible contamination / minimal excavation proposed)

Exposure or disturbance of contaminants during construction of the project may have the following impacts:

- Mobilisation of surface and subsurface contaminants (impacting groundwater, surface water and soils)
- Migration of potential contaminants into surrounding areas (impacting groundwater, surface water and soils) via leaching, overland flow and / or subsurface flow (water and / or vapour)
- Risk of exposure to site workers, site users and site visitors
- Risk of exposure to surrounding environmental receivers (such as, flora, fauna and surrounding ecosystems including groundwater dependent ecosystems).

The sensitive receiving environments could be potentially impacted by contamination (if present) within project area. Sydney Harbour could be impacted by contamination from the Barangaroo Station construction site and Blues Point temporary site, and indirectly from the Pitt Street Station and Martin Place Station construction sites via Cockle Bay. Middle Harbour is unlikely to experience contamination from project sites. Beneficial users of groundwater downslope from the respective sites could also be affected by contamination, however this risk is considered to be negligible.

Sydney Harbour may also be impacted by disturbance of contaminants within the seabed from the ground improvement work. Disturbance of sediment by grouting activities related to the proposed harbour tunnel is likely to mobilise some shallow sediment, possibly creating increased turbidity and resuspension of contaminated sediments during the grout probe insertion and extraction works, and during the placement of anchoring blocks (if used). Considering the contamination concentrations in the sediment which would be disturbed are consistent with sediment quality throughout Sydney Harbour, the risk of spreading contamination to new areas is considered to be low. Consideration of the potential for contaminants to become bioavailable from the proposed works is provided in Chapter 20 (Biodiversity).

As shown in Table 18-9, the project has a high risk of encountering contamination at the following construction sites:

- Chatswood dive site
- Barangaroo (Hickson Road).

However, the risk of impacting on sensitive ecological environments or site workers, users or visitors would be minimised by mitigation measures, as outlined in Table 18-10.

Potentially contaminating construction activities

Construction activities have the potential to result in contamination of soils and / or groundwater due to spills and leaks of fuel, oils and other hazardous materials. These impacts would be readily manageable by implementing standard construction environment mitigation measures as outlined in Table 18-10.

The demolition of buildings and structures also has the potential to result in the disturbance of hazardous materials, including asbestos and / or materials containing lead paint. Mishandling of hazardous material waste has the potential to contaminate soils and to create health risks to construction workers and the community. To manage these potential risks, adequate hazardous material mitigation measures would be developed. These measures are outlined in Chapter 23 (Hazard and risk).

The *Marine Pollution Act 2012* includes provisions to protect the sea and waters from pollution by oil, oil residues and other noxious substances discharged from vessels. Any vessels involved in ground improvement work have the potential to contaminate the water of Sydney Harbour through leaks or spills of liquids, oils and other potentially noxious substances and therefore must comply with the requirements of the *Marine Pollution Act 2012 and the Marine Pollution Regulation 2014*.

Surface water quality

It is anticipated that 550 megalitres of water would be required for tunnelling throughout the construction period. Additional water would be required for other construction activities such as dust suppression. A large proportion of this water would require treatment before being reused or discharged.

Management

Any water discharged from construction sites has the potential to adversely affect the water quality of nearby watercourses and receiving catchments due to potential pollutants such as diesel and oil, paint, solvents, cleaners and other harmful chemicals, and construction debris and dirt. As discussed in Chapter 21 (Flooding and hydrology), potential rainfall and flood events which may affect water quality during construction would be managed through detailed construction planning, including the development of appropriate site layouts and staging of construction activities.

Potential impacts, including the redirection and capture of construction site runoff, would be adequately managed by implementing standard erosion and sediment control measures in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2* (Department of Environment and Climate Change, 2008a), as outlined in Table 18-10.

Monitoring

A monitoring program would be implemented the discharge water quality from the construction water treatment plants. Water quality mitigation controls (such as sediment fences and sediment basins) would be inspected regularly, and after significant rainfall, to detect any breach in performance.

Treatment

The excavation of the tunnels, stations and shafts is likely to intercept groundwater aquifers, resulting in the need to capture, treat and discharge water. Water treatment plants are likely to be installed at all construction sites to treat all intercepted groundwater. The groundwater would be treated to meet the requirements of an environment protection licence issued to the project, which are anticipated to be:

- pH – 6.5 to 8.5
- Total suspended liquids – less than 50 milligrams per litre
- Oil and grease – none visible.

The re-use of treated water would be maximised during construction works by recirculating it to the tunnel cutting face and using it for dust suppression aboveground. Despite this reuse, there would be a surplus of treated water, which would need to be discharged to the local stormwater system or directly to a local surface watercourse. Other options, such as Sydney Water trade waste agreements, would also be investigated during detailed design. As the intercepted groundwater would be treated prior to reuse or discharge, the impact on water quality would be negligible.

Marine water quality

Due to the expected ground conditions underneath Sydney Harbour, ground improvement would be required prior to excavation of the tunnels. Ground improvement is likely to be carried out at the rock – sediment transition zones to reduce construction risks, and allow for maintenance of the tunnel boring machine cutters before driving through the soft sediments.

There may be potential for water quality impacts due to disturbance of the seabed during the initial ground improvements works. In addition, the storage of materials (grout and spoil) would be required on barges on Sydney Harbour, which has the potential for spills or leaks. To minimise potential impacts on the water quality of Sydney Harbour during ground improvement work, mitigation measures outlined in Table 18-10 would be implemented.

In addition, a water quality monitoring program would be implemented to monitor water quality within Sydney Harbour during ground improvement work. The water quality monitoring program would be carried out to detect any potential impacts on the water quality of Sydney Harbour from the ground improvement work and inform management responses in the event any impacts are identified. The specific monitoring locations and frequencies would be determined during the development of the program in consultation with the Environment Protection Authority, however this is likely to involve a combination of water quality monitoring buoys, use of probes and grab samples from various depths within the water column.

18.4.3 Operation

The potential pollutants which could be introduced into the water cycle as a result of operation of the metro include hydrocarbons, acids and other dangerous goods. These potential impacts are considered further below.

Contamination

During operation of the project there would be a minor potential for contamination of soils and / or surface water in the vicinity of the project as a result of spills and leaks of hazardous materials from the operational wastewater treatment plant. Hazardous materials would be controlled and contained in bunded areas (see Chapter 23 (Hazard and risk)) to avoid contamination.

Water quality

The project would include some drained stations and require the ongoing capture and management of groundwater inflows into the tunnels. Groundwater inflows into the drained stations and surface water at the dive structures would be captured and pumped to the water treatment plant located at the southern services facility adjacent to the Marrickville dive structure.

Conservatively, the rate of inflow of water into the tunnel has been calculated as 12.5 litres per second. To accommodate treatment of this inflow and additional volumes of water (for example resulting the event of fire suppression) the water treatment plant design would accommodate an inflow rate of up to 15 litres per second (this equates to about 470 megalitres per year). Based on the anticipated groundwater quality, the water treatment methods would typically involve:

- pH adjustment
- Removal of suspended soils
- Removal of dissolved solids
- Dissolved iron and manganese removal by oxidising the dissolved metals which enables precipitation and physical removal.

Treated water would either be reused or discharged into the local stormwater system which in turn discharges into the Eastern Channel, a tributary which leads into Botany Bay.

The project would be designed to achieve a maximum water discharge quality equivalent to the 90 percent protection level specified for freshwater ecosystems in accordance with ANZECC guidelines (ANZECC / ARMCANZ, 2000b). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during detailed design, taking into consideration the current water quality of the receiving watercourse. The sensitive receiving environments for the project (Middle Harbour and Sydney Harbour) would not be impacted by discharge from the water treatment plant during operation.

Runoff from aboveground project elements (such as station buildings) would be directed to existing stormwater systems (further details are provided in Chapter 21 (Flooding and hydrology)).

18.5 Mitigation measures

The mitigation measures that would be implemented to manage potential soils, contamination and water quality impacts are listed in Table 18-10 and Table 18-11.

Table 18-10 Mitigation measures – soils, contamination and water quality – construction

Reference	Mitigation measure	Applicable location(s)[1]
SCW1	Updated desktop contamination assessments would be carried out for Chatswood dive site, Blues Point temporary site, Barangaroo Station, Central Station and Waterloo Station. If sufficient information is not available to determine the remediation requirements and the impact on potential receivers, then detailed contamination assessments, including collection and analysis of soil and groundwater samples would be carried out. Detailed contamination assessment would also be carried out for the Barangaroo power supply route within Hickson Road and the Marrickville power supply route adjacent to Sydney Park and Camdenville Oval. In the event a Remediation Action Plan is required, these would be developed in accordance with *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land* (Department of Urban Affairs and Planning and Environment Protection Authority, 1998) and a site auditor would be engaged.	CDS, BP, BN, CS, WS, PSR
SCW2	Prior to ground disturbance in high probability acid sulfate areas at Barangaroo Station, Waterloo Station and Marrickville dive site, testing would be carried out to determine the presence of acid sulfate soils. If acid sulfate soils are encountered, they would be managed in accordance with the *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee, 1998).	BN, WS, MDS
SCW3	Erosion and sediment control measures would be implemented in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom, 2004) and *Managing Urban Stormwater: Soils and Construction Volume 2* (Department of Environment and Climate Change, 2008). Measures would be designed as a minimum for the 80th percentile; 5-day rainfall event.	All except metro rail tunnels
SCW4	Discharges from the construction water treatment plants would be monitored to ensure compliance with the discharge criteria in an environment protection licence issued to the project.	All except metro rail tunnels
SCW5	A silt curtain would be used around the Sydney Harbour ground improvement work barges.	GI
SCW6	A water quality monitoring program would be implemented to monitor water quality within Sydney Harbour during ground improvement work. The water quality monitoring program would be carried out to detect any potential impacts on the water quality of Sydney Harbour from the ground improvement work and inform management responses in the event any impactsare identified. Specific monitoring locations and frequencies would be determined during the development of the program in consultation with the Environment Protection Authority.	GI

1 *STW: Surface track work; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement work; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; facility; MDS: Marrickville dive site; Metro rail tunnels: Metro rail tunnels not related to other sites (eg TBM works); PSR: Power supply routes.*

Table 18-11 Mitigation measures – soils, contamination and water quality – operation

Reference	Mitigation measure	Applicable location(s)[1]
SCW7	Discharges from the tunnel water treatment plant would be monitored to ensure compliance with the discharge criteria determined in consultation with the NSW Environment Protection Authority.	MDS

1 *STW: Surface track work; CDS: Chatswood dive site; AS: Artarmon substation; CN: Crows Nest Station; VC: Victoria Cross Station; BP: Blues Point temporary site; GI: Ground improvement work; BN: Barangaroo Station; MP: Martin Place Station; PS: Pitt Street Station; CS: Central Station; WS: Waterloo Station; facility; MDS: Marrickville dive site; Metro rail tunnels: Metro rail tunnels not related to other sites (eg TBM works); PSR: Power supply routes.*