19 Soils and surface water quality – Stage 1

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This chapter provides an assessment of the potential impacts of Stage 1 on soils and surface water quality and identifies mitigation measures to address these impacts. This chapter draws on information in Technical paper 7 (Hydrogeology).

19.1 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements relating to soils and surface water quality, and where these requirements are addressed in this Environmental Impact Statement, are outlined in Table 19-1.

Table 19-1: Secretary's Environmental Assessment Requirements – Soils and surface water quality Stage 1

Reference	Requirement	Where addressed
8. Contamination and soils		
8.1	Commitments made in Section 9.8.2 of the Scoping Report.	Sections 19.6.1 and 19.7
9. Water – Hydrology and flooding		
9.2	A water balance for ground and surface water including the proposed intake and discharge locations, volume, frequency and duration.	Section 19.6.2
10. Water – Quality		
10.1	Surface and groundwater quality impacts including: a. Identifying and estimating the discharge water quality 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;	Section 19.6.2
	b. identifying the rainfall event that the water quality protection measures will be designed to cope with; and	
	c. assessing the significance of any identified impacts including consideration of the relevant ambient water quality outcomes.	
10.2	Demonstrating how Stage 1 will, to the extent that the project can influence, ensure that: a. where the NSW WQOs for receiving waters are currently being met they will continue to be protected; and	Section 19.6.2
	b. where the NSW WQOs are not currently being met, activities will work toward their achievement over time; and	
	c. justify, if required, why the WQOs cannot be maintained or achieved over time.	

19.2 Legislative and policy context

The legislative and policy context for soils and surface water quality is described in Section 8.10 (Soils and surface water quality - Concept).

The following additional guidelines were also considered for Stage 1:

- Acid Sulfate Soils Assessment Guidelines (Department of Planning, 2008)
- Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom, 2004)
- Managing Urban Stormwater: Soils and Construction, Volume 2 (Department of Environment and Climate Change, 2008)
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (Department of Environment and Conservation, 2004)
- Using the ANZECC Guidelines and Water Quality Objectives in NSW (Department of Environment and Conservation, 2006)
- Guidelines for Managing Risks in Recreational Waters (NHMRC, 2008)
- Sydney Harbour Water Quality Improvement Plan (Sydney Metropolitan Catchment Management Authority (SMCMA, 2010).

19.3 Assessment approach

The assessment methodology for the soils and surface water quality impact assessment involved:

- A review of publicly available data and web-based information searches, including:
  - NSW Department of Environment, Climate Change and Water's Soil Landscapes of Sydney 1:100,000 Sheet (Tille et al., 2009)
  - Soil Landscapes of the Penrith 1:100,000 Sheet (Hazelton et al., 2010)
  - NSW Soil and Land Information System (NSW Office of Environment and Heritage, 2019a)
  - Water quality data collected from Sydney Water, Parramatta City Council, Cumberland City Council, University of Western Sydney and the WestConnex M4 East project
- Meeting with the Environment Protection Authority in February 2019, to discuss the approach to the surface water quality assessment
- Identification of sensitive receiving environments, using aquatic habitat as an indicator as assessed against the NSW Department of Primary Industries (DPI) Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) and Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge 2003)
- Identification of the potential for Stage 1 to disturb acid sulfate soils and the associated impacts
- Consideration of the potential impacts of Stage 1 associated with erosion and sedimentation
- Identification of potential impacts of Stage 1 on surface water quality, including an indicative water balance
- Development of mitigation measures to address potential soils and surface water quality impacts.

19.4 Avoidance and minimisation of impacts

The design development of Stage 1 has focussed on avoiding or minimising potential soil and surface water quality impacts. This has included minimising the extent of construction disturbance and avoiding direct impact on watercourses where possible.

19.5 Existing environment

19.5.1 Soils

Soil types

The geology of Stage 1 is dominated by Quaternary Age alluvial/fluvial sediments and fill, along with Wianamatta Group Ashfield Shale and Hawkesbury Sandstone – refer to Chapter 18 (Groundwater and ground movement – Stage 1). The Soil Landscapes of Sydney 1:100,000 Sheet (Tille et al., 2009) and Penrith 1:100,000 Sheet (Hazelton et al., 2010) identifies a number of soil types within Stage 1 derived from the underlying geological units. The soil units and their characteristics are described in Table 19-2 and their location in relation to Stage 1 is shown in Figure 19-1.

Table 19-2: Soil units underlying Stage 1

Soil unit	Location	Description
Birrong	Present along the entire alignment and at all construction sites	• Landscape: found on level to gently undulating alluvial floodplain draining Wianamatta Group shale, with slopes less than three per cent. Broad valley flats and extensively cleared tall open forest and woodland • Soil: deep soils (less than 250 centimetres) on older alluvial terraces and current floodplain • Limitations: localised flooding, high soil erosion hazard, saline subsoils, seasonal waterlogging, and very low soil fertility
Blacktown	Present along the entire alignment and at all construction sites	• Landscape: found on gently undulating rises on Wianamatta Group shales, with slopes of less than five per cent and local reliefs of up to 30 metres • Soils: strongly acidic and hard setting soils • Limitations: low fertility, high aluminium toxicity, localised salinity and sodicity, low wet strength, low permeability, and low available water holding capacity
Disturbed terrain	• Clyde stabling and maintenance facility • Sydney Olympic Park metro station site • The Bays Station site • Tunnel alignment between Westmead and The Bays Station	• Landscape: found on a variety of landscapes ranging from level plain to hummocky terrain that has been extensively disturbed by human activity. Slopes are typically less than five per cent and local reliefs of less than 10 metres • Soils: the original soil has been completely disturbed, removed or buried. Landfill may include soil, rock, building and waste material with a cap of sandy loam. Soil may by strongly acidic to strongly alkaline • Limitations: low fertility, low wet strength, low availability water capability, high permeability, localised toxicity/acidity and/or alkalinity, potential mass movement hazard
Glenorie	Present along the entire alignment and at all construction sites	• Landscape: found on undulating to rolling low hills on Wianamatta Group shales, with slopes typically between five per cent and 20 per cent. • Soils: shallow to moderately deep on crests (less than 100 centimetres) moderately deep on upper slopes (70 centimetres to 150 centimetres) and deep on lower slopes (greater than 200 centimetres • Limitations: high soil erosion hazard, localised impermeable soil and moderate soil reactivity
Gymea	Present along the alignment from Burwood North Station site, eastwards to Five Dock Station, and The Bays Station sites	• Landscape: found on undulating to rolling rises and low hills on Hawkesbury Sandstone, with slopes between 10 per cent and 25 per cent and local relief up to 80 metres • Soils: shallow to moderately deep (30 centimetres to 100 centimetres) • Limitations: localised steep slopes, high soil erosion hazards, shallow highly permeable soil and very low soil fertility
Hawkesbury	Present along the alignment from Burwood North Station site to Five Dock Station, and The Bays Station sites	• Landscape: found on rugged, rolling to very steep hills on Hawkesbury Sandstone, with slopes greater than 25 per cent and local reliefs up to 200 metres • Soils: Shallow (less than 50 centimetres) discontinuous lithosols/siliceous sands associated with rock outcrops, with earthy sands and some yellow podzolic soils on the inside of benches and along rock joints and fractures • Limitations: extreme soil erosion hazard, mass movement hazard, steep slopes, high permeability soil and low soil fertility

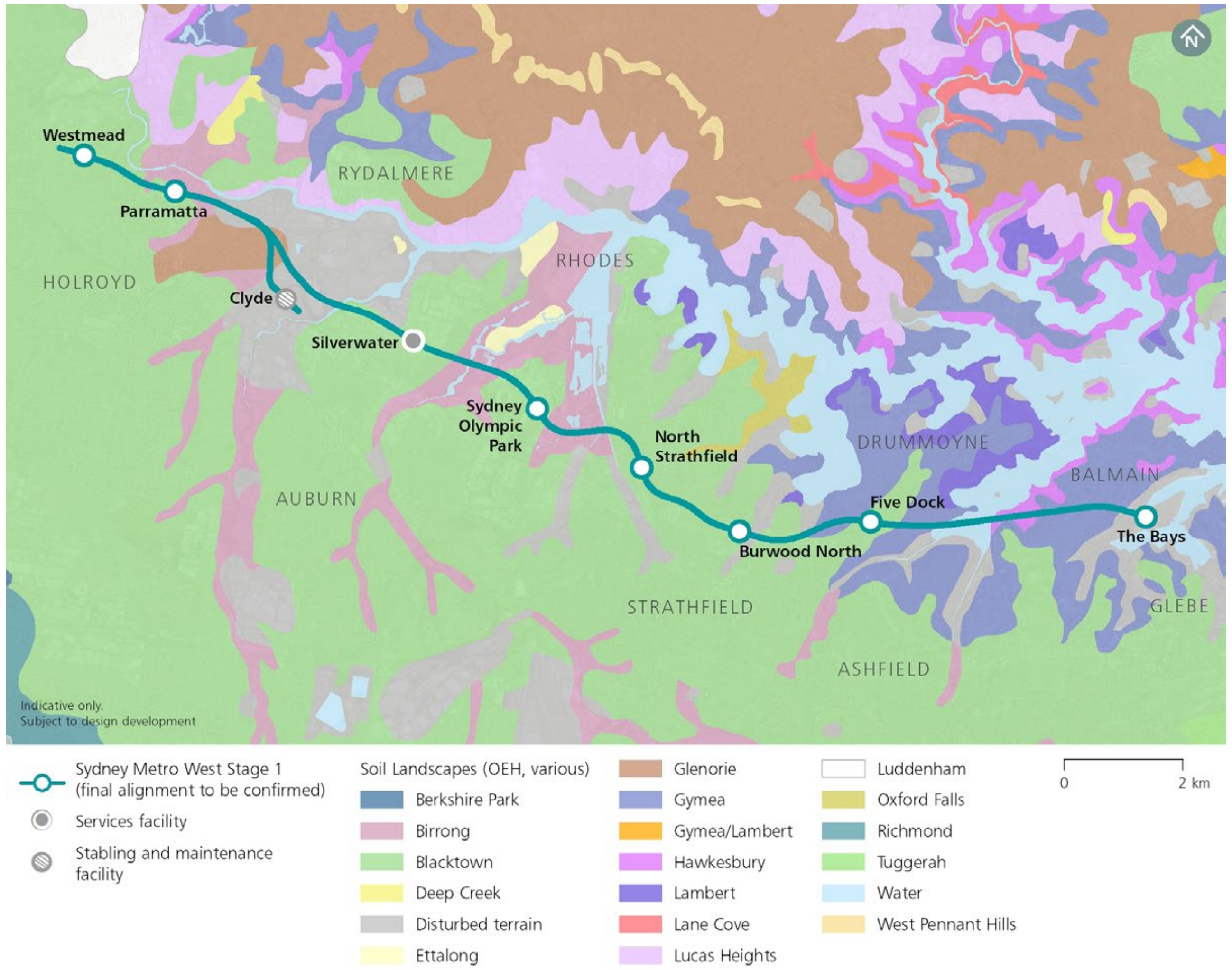

Figure 19-1: Soil units underlying Stage 1

Soil salinity

Soil salinity refers to the movement and concentration of salt in soils as a result of weathering rock materials, historic inland seas and deposition of salt from the ocean onto land by wind or rain. Saline soils can degrade ecosystems and habitats and reduce the productive agricultural capacity of land (Agriculture Victoria, 2017). The NSW Soil and Land Information System and the Salinity Hazard Report for Catchment Action Plan upgrade – Sydney Metropolitan CMA (Winkler et al, 2012) were reviewed to identify the probability for saline soils to be present within Stage 1. The results of the review are shown in Table 19-3.

Table 19-3: Probability of saline soils to be present within Stage 1

Location	Probability for saline soils
Between Westmead metro station and Parramatta metro station sites	• High
Between Parramatta metro station and Burwood North Station sites	• Very high
Between Burwood North Station and The Bays Station sites	• High to very high (elevated areas) • Very low (low elevation areas)

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, groundwater drawdown or excavation leads to the generation of sulfuric acid. Areas of acid sulfate soils are typically found in low-lying and flat locations that are often swampy or prone to flooding.

Acid sulfate soils risk maps from the former NSW Office of Environment and Heritage (now part of NSW Department of Planning, Industry and Environment) were reviewed to assess the probability of acid sulfate soils being present in proximity of Stage 1. As shown in Figure 19-2, most of Stage 1 is located in areas having "no known occurrence" of acid sulfate soils.

Areas around the Parramatta River, Rosehill, Silverwater, Sydney Olympic Park and White Bay are identified as "disturbed terrain". These areas are often located on reclaimed land, within dredged/mined areas, or on fill and/or alluvium and are often associated with the potential presence of acid sulfate soils. Based on this information, there is potential to encounter acid sulfate soils at the following Stage 1 construction sites:

- Parramatta metro station
- Clyde stabling and maintenance facility
- The Bays Station.

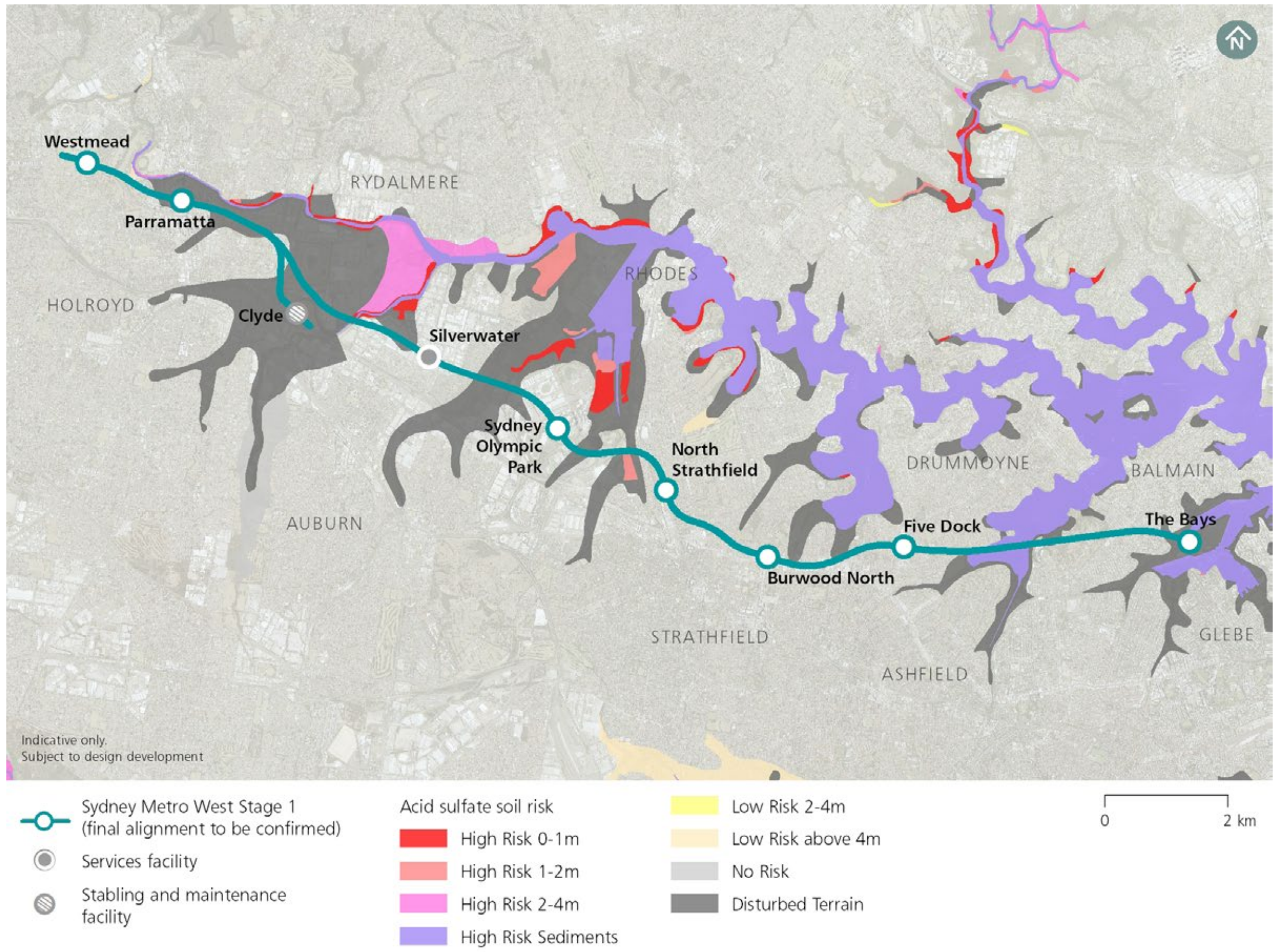

Figure 19-2: Acid sulfate soil classification risk within Stage 1

19.5.2 Surface water

Catchments and watercourses

Stage 1 (except for The Bays Station) is located within the upper estuary of the Parramatta River catchment, one of the main tributaries of Sydney Harbour. The Bays Station drains to White Bay in the lower estuary of Sydney Harbour. The Parramatta River catchment and Sydney Harbour includes the Sydney CBD and significant commercial districts of North Sydney and Parramatta. The catchment is highly urbanised and altered from its natural state, with pockets of open spaces and parkland. These land uses influence the water quality and quantity and speed of flows within the catchment. Most of the catchment is estuarine, up to the tidal limit at Charles Street weir in Parramatta, with freshwater watercourses in the upper catchments of the tributaries of Parramatta River. The catchment lies over the Cumberland Plain and is relatively flat, with elevation ranging from 140 metres Australian Height Datum in the north-west of the catchment to sea level in the east.

Stage 1 would drain to a number of watercourses which are sub-catchments of Parramatta River. Many of the watercourses are greatly modified with creek systems extensively channelised or hard-edged with concrete. Relevant watercourses within the catchment for Stage 1 are shown in Table 19-4 and Figure 19-3.

Table 19-4: Watercourses relevant to Stage 1

Stage 1 construction site	Watercourse	Receiving waters
Westmead metro station	• Domain Creek	• Parramatta River
Parramatta metro station	• Parramatta River • Clay Cliff Creek	• Parramatta River
Clyde stabling and maintenance facility	• Duck River • Duck Creek • A'Becketts Creek	• Parramatta River
Silverwater services facility	• Duck River	• Parramatta River
Sydney Olympic Park metro station	• Haslams Creek	• Homebush Bay
North Strathfield metro station	• Saleyards Creek • Powells Creek	• Homebush Bay
Burwood North Station	• St Lukes Park Canal • Barnwell Park Canal	• Canada Bay • Hen and Chicken Bay
Five Dock Station	• Dobroyd Canal/Iron Cove Creek	• Iron Cove
The Bays Station	• White Bay	• Sydney Harbour

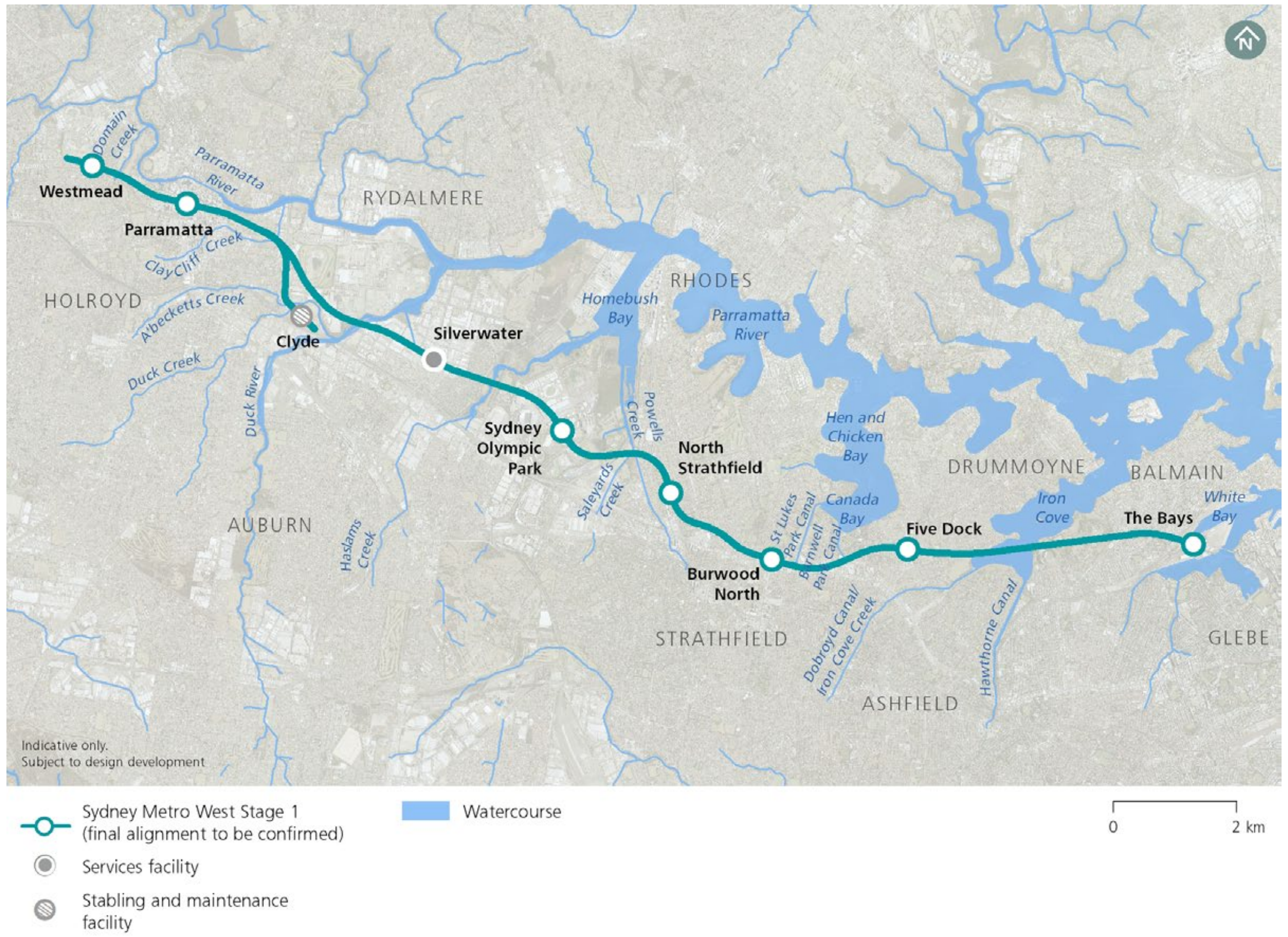

Figure 19-3: Watercourses relevant to Stage 1

Water quality

The NSW Water Quality and River Flow Objectives (NSW Department of Environment, Climate Change and Water, 2006) provide a number of environmental values for the Sydney Harbour and Parramatta River regional catchment as described in Chapter 8 (Concept environmental assessment).

Table 19-5 shows the environmental values assigned to the watercourses relevant to Stage 1.

Table 19-5: Assigned environmental values for watercourses and receiving waters relevant to Stage 1

Watercourse and/or receiving waters	Environmental value				
	Aquatic ecosystems	Visual amenity	Primary contact recreation	Secondary contact recreation	Aquatic foods (cooked)
Domain Creek	●	●			
Parramatta River and Sydney Harbour	●	●	●	●	●
Clay Cliff Creek	●	●		●	
Duck River	●	●		●	
Haslams Creek	●	●		●	
Saleyards Creek		●		●	
Powells Creek	●	●			
St Lukes Park	●	●			
Barnwell Park	●	●			
Dobroyd Canal/Iron Cove Creek	●	●			
White Bay	●	●	●	●	

The water quality of watercourses relevant to Stage 1 is influenced by several factors including:

- Current and historical polluting land uses within the catchments
- Stormwater and sewage overflows and leachate from contaminated and/or reclaimed land
- Urbanisation of the catchments and subsequent reduction in permeable area, increasing run-off and pollutant loads entering waterways
- Illegal dumping.

A review of available existing water quality data collected from Sydney Water, Parramatta City Council, Cumberland City Council, University of Western Sydney and the WestConnex M4 East project indicates the watercourses relevant to Stage 1 are generally in poor condition and are representative of a heavily urbanised system. The water quality of each watercourse as assessed against the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000; Australian and New Zealand Governments and Australian state and territory governments, 2018) is summarised in Table 19-6.

Table 19-6: Existing water quality conditions of watercourses relevant to Stage 1

Watercourse	Water quality characteristics relevant to ANZECC/ARMCANZ (2000) indicators[1]
Domain Creek	• Low dissolved oxygen levels • Elevated nutrient concentrations
Parramatta River (monitoring locations at Johnsons Bridge and Cumberland Hospital)	• Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
Clay Cliff Creek	• No existing data
Duck River	• Low dissolved oxygen levels • Elevated nutrient concentrations • High turbidity
Duck Creek and A'Becketts Creek	• Elevated nutrient concentrations • Elevated concentrations of faecal coliforms
Haslams Creek	• Elevated nutrient concentrations • Elevated concentrations of faecal coliforms
Saleyards Creek	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
Powells Creek	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
St Lukes Park Canal	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
Barnwell Park Canal	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
Dobroyd Canal/Iron Cove Creek	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
Hawthorne Canal	• Low dissolved oxygen levels • Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity
White Bay	• Elevated nutrient concentrations • Elevated heavy metal concentrations • High turbidity

Note 1: Sources: City of Parramatta Council, Sydney Water, Cumberland City Council, WestConnex M4 East.

The Parramatta River Catchment Group is currently working to improve the water quality of Parramatta River. Water sensitive urban design measures implemented to improve water quality include:

- Installation and maintenance of stormwater harvesting and reuse systems, gross pollutant traps, bio-filtration systems along roads and within constructed wetlands
- Erosion and sedimentation controls at development sites to reduce sediment inputs to the catchment.

Water quality appears to be improving as a result of these catchment management measures, however wastewater overflows and stormwater continue to contribute to poor water quality conditions Parramatta River (Parramatta City Council, 2016).

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.

Six watercourses relevant to Stage 1 have been identified as sensitive receiving environments due to their proximity to SEPP Coastal Wetlands and their mapping by DPI (2019) as Key Fish Habitat. These watercourses have 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. These watercourses are outlined in Table 19-7.

Table 19-7: Sensitive receiving environments for Stage 1

Watercourse	Reasons for classification
Parramatta River/Sydney Harbour	• Type 1 Key Fish Habitat • Numerous SEPP Coastal Wetlands • Potential habitat for threatened aquatic species and protected aquatic vegetation
Duck River	• Type 1 Key Fish Habitat • SEPP Coastal Wetlands within 500 metres
Duck Creek	• Type 1 Key Fish Habitat • SEPP Coastal Wetlands within 500 metres
Haslams Creek	• Type 1 Key Fish Habitat • SEPP Coastal Wetlands within 500 metres
Powells Creek	• SEPP Coastal Wetlands within 500 metres
Dobroyd Canal/Iron Cove Creek	• SEPP Coastal Wetlands within 500 metres

19.6 Potential impacts

19.6.1 Soils

Soil erosion

Mitigation measures would be implemented to manage potential impacts of construction of Stage 1 on the soil environment. It is expected that soil erosion would be adequately managed in accordance with measures, given the relatively small areas of surface disturbance anticipated during construction and the overall topography of those parts of Stage 1 (which are generally slightly undulating). Measures would be applied from the 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). Relevant measures would be designed for the 80th percentile; 5-day rainfall event.

Potential impacts could include temporary exposure of the natural ground surface and sub-surface through the removal of vegetation, overlying structures (such as buildings and footpaths) and excavation for stations, ancillary facilities, structures and foundations. The temporary exposure of soil to water runoff and wind erosion could potentially increase soil erosion potential, particularly where construction is carried out 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.

Acid sulfate soils

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.

The exposure of acid sulfate soils during excavation at the Stage 1 construction sites identified in Section 19.5.1 could potentially 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.

19.6.2 Surface water

Standard construction management measures would be implemented to minimise potential and temporary risks to downstream water quality from the construction of Stage 1. Construction works may potentially impact on watercourses through the disturbance and mobilisation of soil or other materials, which may affect the water quality and ecosystem health of receiving environments. Water quality impacts could potentially arise from:

- Surface works, such as demolition, earthworks, stockpiling, vegetation removal, concreting and watercourse realignment works
- Tunnelling and excavation works at station and ancillary facilities construction sites.

Surface works

Mitigation measures in Section 19.7 would be implemented to manage potential impacts to water quality which would be low and temporary, with no long term impacts expected. A summary of potential impacts to surface water quality from surface works is provided in Table 19-8. Surface construction works would generally be carried out in highly modified and urban environments and would not be located within or near waterways, with the exception of the earthworks near the Clyde stabling and maintenance facility.

Table 19-8: Potential surface water quality impacts

Construction works	Potential impacts
Demolition works	The removal of existing buildings and structures would be required at most Stage 1 construction sites. Demolition works have the potential to disturb and/or spread sources of pollutants that could affect water quality. Demolition could also generate dust and airborne pollutants. These pollutants once mobilised could potentially enter stormwater runoff and be distributed to downstream receiving watercourses via the drainage network.
Earthworks and stockpiling	Potential exposure of soils during earthworks (including stripping of topsoil, excavation, removal of existing paved areas, stockpiling and transport of materials), could result in temporary soil erosion and off-site movement of eroded sediments by wind and/or stormwater into receiving waterways. If sediments enter waterways, they could directly and indirectly potentially impact on the aquatic environment by increasing turbidity, reducing dissolved oxygen levels, and increasing the concentration of nutrients and heavy metals.
Realignment and instream works at Duck Creek and A'Becketts Creek	The partial realignment of Duck Creek and A'Becketts Creek has the potential to result in a temporary change in creek flows and velocities. The earthworks could also expose soils or sediments resulting in soil erosion and movement of soils into receiving waterways. Instream works, including the construction of watercourse crossings and installation of drainage structures, has the potential to create instream barriers and interfere with natural flow regimes. Temporary sediment basins, sediment and barrier fences, and stabilised diversion drains/channels would be used to manage potential impacts where appropriate.
Construction of power supply routes	The construction of power supply routes would be carried out to the Westmead metro station, Parramatta metro station, Clyde stabling and maintenance facility, and The Bays Station construction sites. Routes would be constructed using open trenching and underboring methods and has the potential to increase the risk of temporary erosion and sedimentation, particularly in areas near watercourses.
Discharges from construction water treatment plants	Discharge of large volumes of treated wastewater at all Stage 1 construction sites via the local stormwater network has the potential to increase soil erosion through scour and increase the turbidity of downstream watercourses.
Removal of vegetation	The removal of vegetation has the potential to increase the risk of erosion and sedimentation, particularly in areas near watercourses. The clearance of limited landscaped vegetation would be required across most Stage 1 construction sites.
Accidental spills	Accidental spills or leaks could occur from the maintenance or re-fuelling of construction plant and equipment machinery at construction sites, or from vehicle/truck incidents travelling to and from construction sites. Contaminants could potentially be transported downstream to receiving waters via drainage infrastructure.
Disturbance of contaminated land	Potential disturbance of contaminated soils, groundwater, or acid sulfate soils during construction of Stage 1 could result in the mobilisation of contamination or acid sulfate soils by stormwater runoff and subsequent transportation to downstream watercourses, potentially increasing contaminant concentrations in the receiving environment. Areas of risk include Clyde stabling and maintenance facility, Silverwater services facility and The Bays Station sites – refer to Chapter 20 (Contamination – Stage 1). There are isolated areas of potential acid sulfate soils which could potentially affect surrounding watercourses if not managed appropriately (refer to Section 19.5.1).
Concrete activities	Concreting activities during Stage 1 could result in the discharge of concrete dust, concrete slurries or washout water to downstream waterways. This could potentially increase the alkalinity and pH of downstream waterways which can be harmful to aquatic life. Concrete solids contained in the discharge also have the potential to clog stormwater pipes and cause flooding.

Tunnelling and excavation works

During the construction of Stage 1, tunnelling and excavation works would result in wastewater being generated from the following sources:

- Water used in the tunnel boring machine process
- Groundwater ingress
- Rainfall runoff into tunnel portals
- Machinery wash down runoff
- Dust suppression water.

Wastewater would be tested and treated at construction wastewater treatment plants prior to reuse or discharge. Wastewater treatment plants would be configured so that treated water is compliant with the ANZECC/ARMCANZ (2000) guideline values as outlined in Section 19.5.2, which would either maintain or improve the water quality of surface waterways and the marine environment. Discharges from the wastewater treatment plants would be monitored to ensure compliance with any discharge criteria in an environment protection licence(s) issued for Stage 1. As such, the impacts on the water quality of the catchment would be negligible.

Most of this wastewater would be collected from groundwater seepage. Estimated volumes of construction wastewater are included in Table 19-10. Water volumes generated during Stage 1 would vary based on construction works both above and below the ground surface, the amount of groundwater infiltrating into the tunnels and the length of tunnels that have been excavated.

The re-use of wastewater would be maximised during construction works (e.g. dust suppression). and any surplus wastewater would be treated before discharge to the local stormwater system or directly to a local surface watercourse. This would avoid untreated or poorly treated groundwater impacting on the water quality of downstream waterways. It is possible that discharged water could also alter the baseline volume and velocity of receiving watercourses, or result in the build-up of sediment within the watercourses.

Indicative construction wastewater treatment discharges and discharge points are presented in Table 19-9.

Table 19-9: Construction wastewater treatment plants

Wastewater treatment plant location	Indicative capacity (litres per second)	Discharge location	Receiving watercourse
Westmead metro station	30	Local stormwater infrastructure	Domain Creek
Parramatta metro station	15	Local stormwater infrastructure	Parramatta River
Clyde stabling and maintenance facility	30	Local stormwater infrastructure	A'Becketts Creek, Duck Creek
Silverwater services facility	10	Local stormwater infrastructure	Parramatta River
Sydney Olympic Park metro station	15	Local stormwater infrastructure	Haslams Creek
North Strathfield metro station	15	Local stormwater infrastructure	Powells Creek
Burwood North Station	35	Local stormwater infrastructure	St Lukes Park Canal
Five Dock Station	20	Local stormwater infrastructure	Iron Cove Creek
The Bays Station	30	Local stormwater infrastructure	White Bay

Water balance for Stage 1

Acknowledging that until recently, Sydney had been under Level 2 water restrictions, non-potable sources (e.g. treated wastewater and harvested rainwater) would be used to meet construction water demand requirements where possible. The deficit for the non-potable demand and any potable demand would be sought from the Sydney Water supply network. The use of non-potable water over potable would depend on the location and nature of the water use activity as well as the quantity and quality of available water at the time. Water availability would vary as construction progresses as well as seasonally.

Considering the prevailing drought conditions in Sydney and across NSW, Sydney Metro is further investigating options to minimise potable water use and maximise wastewater reuse. This includes investigating opportunities to:

- Increase or extend storage capacity of treated wastewater on site. This would provide additional opportunities for the reuse of water both on site and off site
- Carry out additional treatment of wastewater to enable additional end uses (such as concrete batching, wash down, toilet flushing etc). This would further reduce reliance on potable water supply
- Provide wastewater to others for reuse (e.g. to local councils for parkland and sporting field irrigation, or to nearby golf courses for irrigation). This would reduce reliance on potable water for these uses.

The indicative water balance for the construction of Stage 1 based on average groundwater inflows, and the estimated treated discharge quantities are shown in Table 19-10. Non-potable water uses would include dust suppression, plant wash-down and rock bolting. Some demand activities are consumptive such as water used in the offices which would be discharged to the sewerage network. There would also be minor losses in the system due to evaporation. The remainder would be treated and either re-used or discharged at the proposed discharge locations listed in Table 19-9. The water balance shows that water supply exceeds demand.

Table 19-10: Indicative Stage 1 water balance

Activity	Type	Amount (megalitres per year)	Totals
Supply			
Recycled potable water to meet non-potable demand	Non-potable	86	940
Groundwater inflow (station excavations) to meet non-potable demand	Non-potable	568	
Sydney Water (mains supply) for site offices and to meet any deficit in non-potable water supply	Potable	286	
Demand			
Construction activities associated with the stabling and maintenance facility	Non-potable	40	369
	Potable	35	
Construction activities associated with station and tunnel excavation	Non-potable	43	
	Potable	251	
Losses via consumption			
Consumed by construction activities (e.g. dust suppression, plant wash-down and concrete batching)	Non-potable	83	83
Total discharge			
	Non-potable		515

Surface water availability and flows

The construction of Stage 1 would result in treated wastewater discharges to downstream waterways via the local stormwater network. Discharge of high volumes of treated water also has the potential to scour the waterways and increase turbidity of receiving waters.

Water extraction from surface water is not proposed during construction of Stage 1. However, environmental surface water availability and flows have the potential to be reduced if groundwater drawdown occurs where groundwater flows contribute to baseflow in surface watercourses – refer to Chapter 18 (Groundwater and ground movement – Stage 1).

Impacts on NSW water quality objectives

Table 19-11 outlines the water quality objectives relevant to Stage 1 (refer to Section 19.5.2) and the potential impacts as a result of construction work.

Table 19-11: Assessment of Stage 1 against the relevant water quality objectives

Water quality objective	Indicators	Associated trigger values or criteria	Impact of Stage 1
Aquatic ecosystems			
Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term	Total phosphorus	• Lowland Rivers – 25µg/L • Estuaries – 30µg/L	Wastewater from tunnelling activities would be treated and standard erosion and sediment control measures would be implemented for all surface works areas to minimise pollutant loading to the downstream waterways during construction. Wastewater would be treated to comply with the ANZECC/ ARMCANZ (2000) and ANZG (2018) guidelines and runoff from construction works would be designed to meet the standards outlined in the Blue Book. With the implementation of these management measures, pollutant loading to the receiving waterways would be low with the possibly of better quality where existing water quality does not meet the ANZECC/ ARMCANZ (2000) and ANZG (2018) guidelines. Therefore, Stage 1 construction would not impact aquatic ecosystems of receiving waterways.
	Total nitrogen	• Lowland rivers – 350µg/L • Estuaries – 300µg/L	
	Chlorophyll-a	• Lowland Rivers – 3µg/L • Estuaries – 4µg/L	
	Turbidity	• Lowland Rivers 6 to 50NTUL • Estuaries – 0.5 to 10 NTU	
	Electrical conductivity	• Lowland rivers – 125-2200µS/cm	
	Dissolved oxygen	• Lowland Rivers – 85-100% saturation • Estuaries – 80-110% saturation	
	pH	• Lowland Rivers – 6.5-8.5 • Estuaries – 7-8.5	
	Chemical contaminants or toxicants	• As per table 3.4.1 ANZECC/ ARMCANZ (2000)	
Visual amenity			
Maintaining the aesthetic quality of waters	Visual clarity and colour	Natural visual clarity should not be reduced by more than 20%. Natural hue of 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%.	Wastewater from tunnelling activities would be treated and standard erosion and sediment control measures implemented for all surface works areas to minimise pollutant loading to the downstream waterways during construction. Wastewater would be treated to comply with the ANZECC/ ARMCANZ (2000) and ANZG (2018) guidelines and runoff from construction works would be designed to meet the standards outlined in the Blue Book. With the implementation of these management measures, pollutant loading to the receiving waterways would be low with the possibly of better quality where existing water quality does not meet the ANZECC/ARMCANZ (2000) and ANZG (2018) guidelines. Therefore, Stage 1 construction would not reduce the aesthetic quality of the receiving waterways.
	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 matter 250 µg/L.	
	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	Impact of Stage 1
Primary contact recreation			
Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed	Turbidity	Approximately 6NTU	Wastewater from tunnelling activities would be treated and standard erosion and sediment control measures would be implemented for all surface works areas (refer to Section 19.7.2 to minimise pollutant loading to the downstream waterways during construction. Wastewater would be treated to comply with the ANZECC/ARMCANZ (2000), ANZG (2018) and NHMRC (2008) guidelines and runoff from construction works would be designed to meet the standards outlined in the Blue Book. With the implementation of these management measures, pollutant loading to the receiving waterways would be low and possibly of better quality where existing water quality does not meet the NHMRC (2008) guidelines. While primary contact recreation is not currently undertaken in these downstream waterways, it is a long term goal to make the Parramatta River swimmable by 2025 (Parramatta City Council, 2016). Stage 1 construction would not reduce the ability for Parramatta River to be used for primary contact recreation in future.
	Enterococci	Microbial water quality assessment category (95th percentile – intestinal enterococci/100mL) (NHMRC 2008): • Category A: <40 • Category B: 41-200 • Category C: 201-500 • Category D: >500.	
	Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water.	
	Algae and blue-green algae	NHMRC (2008) recommend freshwater recreational water bodies should not contain: • >10 µg/L total microcystins; >50,000 cells/mL toxic Microcystis aeruginosa; or biovolume equivalent of >4 mm3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume • >10 mm3/L for total biovolume of all cyanobacterial material where known toxins are not present • Cyanobacterial scums consistently present. Estuarine recreational water bodies should not contain: • ≥ 10 cells/mL Karenia brevis and/or have Lyngbya majuscula and/or Pfiesteria present in high numbers.	
	Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts.	
	pH	6.5-8.5	
	Temperature	16-34°C	
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucus membranes are unsuitable for recreation.	

Water quality objective	Indicators	Associated trigger values or criteria	Impact of Stage 1
Secondary contact recreation			
Maintaining or improving water quality of activities such as boating and wading, where there is a low probability of water being swallowed	Enterococci	As per the NHMRC 2008 Guidelines for managing risks in recreational water.	Wastewater from tunnelling activities would be treated and standard erosion and sediment control measures would be implemented for all surface works areas (refer Section 19.7.2 to minimise pollutant loading to the downstream waterways during construction. Wastewater would be treated to comply with the ANZECC/ARMCANZ (2000), ANZG (2018) and NHMRC (2008) guidelines and runoff from construction works would be designed to meet the standards outlined in the Blue Book. With the implementation of these management measures, pollutant loading to the receiving waterways would be low with the possibility of better quality where existing water quality does not meet the NHMRC (2008) guidelines. Therefore, Stage 1 construction would ensure that secondary contact recreation at receiving waterways is not affected.
	Algae and blue-green algae	As per the NHMRC 2008 Guidelines for managing risks in recreational water.	
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation.	
Aquatic foods (cooked)			
Protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities	Algae and blue-green algae	No guideline is directly applicable, but toxins present in blue-green algae may accumulate in other aquatic organisms.	Wastewater from tunnelling activities would be treated and standard erosion and sediment control measures would be implemented for all surface works areas (refer Section 19.7.2 to minimise pollutant loading to the downstream waterways during construction. Wastewater would be treated to comply with the ANZECC/ARMCANZ (2000) and ANZG (2018) guidelines and runoff from construction works would be designed to meet the standards outlined in the Blue Book. With the implementation of these management measures, pollutant loading to the receiving waterways would be low with the possibly of better quality where existing water quality does not meet the ANZECC/ARMCANZ (2000) and ANZG (2018) guidelines. Note: At the time of developing the catchment water quality objectives, consumption of aquatic foods was nominated for protection. However due to contamination, particularly dioxins, current recommendations by the Department of Primary Industries is that no fish or crustaceans caught west of the Sydney Harbour Bridge should be eaten (NSW DPI, 2019).
	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	Metals: • Copper <5 µgm/L • Mercury <1 µgm/L • Zinc <5 µgm/L. • Organochlorines: • Chlordane <0.004 µgm/L (saltwater production) • PCB's < 2 µgm/L.	
	Physico-chemical Indicators	• Suspended solids: less than 40 micrograms per litre (freshwater) • Temperature: less than 2 degrees Celsius change over one hour.	

19.6.3 Cumulative impacts

Potential cumulative impacts were considered for assessment based on the likely interactions of Stage 1 with other projects and plans that met the adopted screening criteria. The approach to assessment and the other projects considered are described further in Appendix G (Cumulative impacts assessment methodology – Stage 1).

Potential cumulative water quality impacts are largely related to the erosion, sedimentation and discharge of wastewater into common waterways. However, cumulative water quality impacts are not expected as these projects would be required to implement the standard construction mitigation measures outlined in the Blue Book and in the water quality guidelines listed in Section 19.2.

19.7 Management and mitigation measures

19.7.1 Approach to management and mitigation

Soils and surface water issues would be managed in accordance with Sydney Metro's Construction Environmental Management Framework – described in Chapter 27 (Synthesis of the Environmental Impact Statement) and Appendix D. The Construction Environmental Management Framework aims to minimise surface water pollution through erosion and sediment control, maintain the existing water quality of surrounding watercourses, and prioritise the use of non-potable water sources where feasible and reasonable. The Construction Environmental Management Framework specifically requires the preparation of a Soil and Water Management Plan and progressive erosion and sediment control plans that would be updated as needed to reflect site conditions.

19.7.2 Mitigation measures

Specific mitigation measures that would be implemented to minimise potential impacts to soils and surface water quality are listed in Table 19-12.

Table 19-12: Mitigation measures – Soils and surface water quality Stage 1

Reference	Impact/issue	Mitigation measure	Applicable location(s)[1]
Soils			
SSWQ1	Acid sulfate soils	Prior to ground disturbance in areas of potential acid sulfate soil occurrence, testing would be carried out to determine the presence of actual and/or potential acid sulfate soils. If acid sulfate soils are encountered, they would be managed in accordance with the Acid Sulfate Soil Manual (ASSMAC, 1998)	PMS, CSMF, TBS
SSWQ2	Soil salinity	Prior to ground disturbance in high probability salinity areas, testing would be carried out to determine the presence of saline soils. If salinity is encountered, excavated soils would not be reused or it would be managed in accordance with Book 4 Dryland Salinity: Productive Use of Saline Land and Water (NSW DECC 2008). Erosion controls would be implemented in accordance with Blue Book (Landcom, 2004).	All
Surface water quality			
SSWQ3	Erosion and sedimentation	Erosion and sediment measures would be implemented at all construction sites in accordance with the principles and requirements in Managing Urban Stormwater – Soils and Construction, Volume 1 (Landcom 2004) and Volume 2D (NSW Department of Environment, Climate Change and Water 2008), commonly referred to as the 'Blue Book'. Additionally, any water collected from construction sites would be appropriately treated and discharged to avoid any potential contamination or local stormwater impacts. Temporary sediment basins would be designed in accordance with Managing Urban Stormwater: Soils and Construction and Managing Urban Stormwater, Volume 2D: Main Road Construction (DECC, 2008).	All
SSWQ4	Working in waterways and surrounding low lying areas	Works in waterways and surrounding low lying areas would be carried out in accordance with progressive erosion and sediment control plans.	CSMF
SSWQ5	Wastewater discharge	The water treatment plants would be designed so that wastewater is treated to a level that is compliant with the ANZECC/ARMCANZ (2000) and ANZG (2018) default guidelines for 95 per cent species protection.	All
SSWQ6	Water quality monitoring	A surface water monitoring program would be implemented to observe any changes in surface water quality that may be attributable to Stage 1 and inform appropriate management responses. The program would be developed in consultation with the EPA and relevant Councils. The program would consider monitoring being undertaken as part of other infrastructure projects such as the M4 WestConnex East monitoring. Monitoring would occur during pre-construction and during construction at all waterways with the potential to be impacted. Monitoring sites could be located upstream and downstream of the potential discharges and would include sampling for key indicators of concern.	All
SSWQ7	Local stormwater capacity	Further design development would confirm the local stormwater system capacity to receive construction water treatment plant inflows. In the event there is a stormwater infrastructure capacity issue with existing infrastructure, mitigation measures such as storage detention to control water outflow during wet weather events would be implemented.	All

Note 1: WMS: Westmead metro station; PMS: Parramatta metro station; CSMF: Clyde stabling and maintenance facility; SSF: Silverwater services facility; SOPMS: Sydney Olympic Park metro station; NSMS: North Strathfield metro station; BNS: Burwood North Station; FDS: Five Dock Station; TBS: The Bays Station; Metro rail tunnels: Metro rail tunnels not related to other sites (eg tunnel boring machine works); PSR: Power supply routes.

19.7.3 Interactions between mitigation measures

Mitigation measures in other chapters that are relevant to the management of potential impacts include:

- Chapter 18 (Groundwater and ground movement – Stage 1), specifically measures which address groundwater levels and the migration of contaminants through groundwater
- Chapter 20 (Contamination – Stage 1), specifically measures which address the disturbance of contaminated land during construction.

Together, these measures would minimise the potential impacts of Stage 1.

There are no mitigation measures identified in the assessment of other environmental aspects that are likely to affect the assessment of soils and surface water quality impacts.

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