NSW GOVERNMENT

SYD Sydney's Airport

Roads and Maritime Services/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Preliminary Draft Major Development Plan

Chapter 16 Surface water

November 2019

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Surface water

This chapter describes the existing surface water environment, including hydrological conditions and water quality, identifies potential impacts during construction and operation, and provides measures to mitigate and manage the impacts identified. Further information is provided in Technical Working Paper 8 (Surface Water).

The SEARs relevant to hydrology and surface water quality are listed below. There are no MDP requirements specifically relevant to surface water, however there is a requirement under section 91(1) of the Airports Act to assess the potential environmental impacts associated with a development (section 91(1)(h)), and to specify how those impacts may be dealt with (section 91(1)(j)).

Full copies of the SEARs and MDP requirements, and where they are addressed in this document, are provided in Appendices A and B respectively.

Reference	Requirement	Where addressed
Key issue SEARs		
10	**Water – hydrology**	
10.1	The Proponent must describe (and map) the existing hydrological regime for any surface and groundwater resource (including reliance by users and for ecological purposes) likely to be impacted by the proposal, including rivers, streams, estuaries and wetlands as described in the BAM.	Section 16.2 and Figure 16.1 Key resources described in the BAM are also considered in Chapter 22 (Biodiversity)
10.2	The Proponent must prepare a detailed water balance for ground and surface water including the proposed intake from all water supply options and discharge locations (including figures showing these locations), volume, frequency, duration and proposed water conservation and reuse measures for both the construction and operation of the proposal.	Sections 16.3.1 (construction) and 16.4.1 (operation)
10.3	The Proponent must assess (and model if appropriate) the impact of the construction and operation of the proposal 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;	Sections 16.3.1, 16.3.2 (for construction impacts) and 16.4.1 and 16.4.2 (for operation impacts) Impacts on aquatic ecology are considered in Chapter 22
	(c) changes to environmental water availability and flows, both regulated/licensed and unregulated/rules-based sources	Not relevant to this project
	(d) direct or indirect increases in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses;	Sections 16.3.1, 16.3.2 and 16.4.1, 16.4.2 Impacts on riparian vegetation are also considered in Chapter 22
	(e) minimising the effects of proposed stormwater and wastewater management during construction and operation on natural hydrological attributes (such as volumes, flow rates) and on the conveyance capacity of the existing stormwater systems where discharges are proposed through such systems; and	Sections 16.3.1 and 16.4.1

Reference	Requirement	Where addressed
	(f) water take (direct or passive) from all surface and groundwater sources with estimates of annual volumes during construction and operation.	No water take (direct or passive) of surface water is proposed. Expected groundwater take is identified in section 15.4.3
10.4	The Proponent must identify any requirements for baseline monitoring of hydrological attributes.	No monitoring of hydrological attributes (Alexandra Canal or Mill Stream) are considered necessary. Baseline water quality monitoring is recommended in section 16.6.1
10.5	The assessment must include details of proposed surface and groundwater monitoring	Section 16.6.1
11.	**Water - quality**	
11.1	(a) Describe the background conditions for any surface and groundwater resources likely to be affected by the proposal including leachate from Tempe Tip;	Section 16.2.3 (surface water). Groundwater conditions and leachate from the former Tempe landfill are considered in Chapter 15 (Groundwater) and Technical Working Paper 16 – Landfill Assessment respectively
	(b) state the ambient NSW Water Quality Objectives (NSW WQO) and environmental values for the receiving waters relevant to the proposal, including the indicators and associated trigger values or criteria for the identified environmental values;	Section 16.1.4 and Table 16.1 Appendix B, Technical Working Paper 8 – Surface Water
	(c) identify and estimate the quality and quantity of all pollutants that may be introduced into the water cycle by source and discharge point and describe the nature and degree of impact that any discharge(s) may have on the receiving environment, including consideration of all pollutants (including contaminated groundwater) that pose a risk of non-trivial harm to human health and the environment;	Sections 16.3.1, 16.3.2 16.4.1 and 16.4.2
	(d) assess the impacts of leachate generation from proposal related activities on the Tempe Tip site and proposed measures for managing potential impacts during construction and operation;	Sections 16.3.2 and 16.4.2
	(e) describe the proposed measures for treating and disposing of construction and operational wastewater flows;	Sections 16.1.4, 16.3.1 and 16.4.1
	(f) identify the rainfall event that the water quality protection measures will be designed to cope with;	Section 7.10.8
	(g) assess the significance of any identified impacts including consideration of the relevant ambient water quality outcomes;	Sections 16.3 and 16.4
	(h) demonstrate how construction and operation of the proposal will, to the extent that the proposal 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;	Sections 16.3.2 and 16.4.2
	(i) justify, if required, why the WQOs cannot be maintained or achieved over time;	Sections 16.3.2 and 16.4.2
	(j) demonstrate that all practical measures to avoid or minimise water pollution and protect human health and the environment from harm are investigated and implemented	Section 16.6

Reference	Requirement	Where addressed
	(k) identify sensitive receiving environments (which y include estuarine and marine waters downstream) and develop a strategy to avoid or minimise impacts on these environments; and	Sections 16.2.3 (identification of sensitive receiving environments) and 16.6 (strategy to minimise impacts)
	(l) identify proposed monitoring locations, monitoring frequency and indicators of surface and groundwater quality	Section 16.6.1 Existing groundwater quality is discussed in Chapter 15 (Groundwater)
11.2	The assessment should consider the results of any current water quality studies, as available, for the catchment areas traversed by the proposal.	Sections 16.1.2, 16.1.4 and 16.2.3

16. Surface water

16.1 Assessment approach

Constructing and operating roads can mobilise pollutants (such as sediment or chemicals), with the potential to affect water quality and/or flows in surrounding watercourses. Understanding the existing characteristics of watercourses and identifying potential impacts associated with construction and operation is an important component of an environmental impact assessment. Identifying potential water quality risks during the project planning phase assists in the development of appropriate management strategies to ensure that potential impacts are appropriately managed.

As the project has the potential to disturb soil and areas of contamination (see Chapter 13 (Contamination and soils)) and affect significant watercourses and waterbodies (including Alexandra Canal), a surface water assessment has been undertaken by experienced specialists. An overview of the approach to the assessment is provided below, including the legislative and policy context and a summary of the assessment methodology.

16.1.1 Legislative and policy context to the assessment

The assessment was undertaken in accordance with the SEARs and MDP requirements (provided in Appendices A and B) and with reference to the following:

- Relevant legislation, including the EP&A Act, the Airports Act and associated regulations, POEO Act, and the *Water Management Act 2000* (NSW)
- *National Water Quality Management Strategy* (Department of Agriculture and Water Resources, 2018)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Governments, 2018)
- *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC/ARMCANZ, 2000)
- *NSW Water Quality and River Flow Objectives* (DECCW, 2006)
- *Managing Urban Stormwater – Soils and Construction* (Landcom, 2004), Volume 2B Waste landfills (DECC 2008a) and Volume 2D Main Road Construction (DECC, 2008b) (collectively referred to as the 'Blue Book' in this chapter)
- *PFAS National Environmental Management Plan* (HEPA, 2018)
- *NSW MUSIC Modelling Guidelines* (BMT WBM, 2015)
- *Botany Bay and Catchment Water Quality Improvement Plan* (Sydney Metropolitan Catchment Management Authority, 2011)
- *Sydney Airport Master Plan 2039* (SACL, 2019a)
- *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b).

16.1.2 Methodology

Study area

The study area for the surface water assessment included the catchment areas within the project site and receiving watercourses, described in section 16.2.

Key tasks

The surface water assessment involved:

- Reviewing existing environmental conditions and water quality data in the study area including (but not limited to):
  - Data from assessments undertaken for other major projects in the study area (the New M5 and M4-M5 Link projects)
  - Baseline water quality monitoring data collected between December 2017 and March 2019
- Identifying assessment criteria for the project based on:
  - *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC/ARMCANZ, 2000) (the ANZECC guidelines) which are the same as those adopted by the new *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (Australian and New Zealand Governments, 2018) (the Water Quality Guidelines)
  - *NSW Water Quality and River Flow Objectives* (DECCW, 2006) for catchments affected by the project
  - Schedule 2 (Water pollution accepted limits) of the Airports (Environment Protection) Regulations 1997 (for watercourses within Sydney Airport land)
- Identifying activities that could affect surface water hydrology and quality during construction and operation
- Assessing potential impacts during construction based on a qualitative desktop assessment
- Assessing potential impacts on hydrology and water quality during operation, including:
  - Identifying existing and future predicted pollutant loads using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) modelling software
  - Assessing future predicted pollutant loads against pollutant load reduction targets in the *Botany Bay and Catchment Water Quality Improvement Plan 2011* (Sydney Metropolitan Catchment Management Authority, 2011)
  - Assessing potential changes to surface water flow by calculating the runoff for the existing and future scenarios using the MUSIC modelling software
  - Assessing potential geomorphological impacts, such as changes in bed and bank stability, based on the findings of flood modelling (see Chapter 14 (Flooding))
- Recommending mitigation and management measures, including water quality monitoring for identified impacts.

16.1.3 Risks identified

An environmental risk assessment was undertaken as an input to the impact assessment (see Appendix G). This involved identifying potential environmental risks during construction and operation, and rating the potential risks according to likelihood, consequence and overall level of risk, in general accordance with *AS/NZS ISO 31000:2009 Risk management – Principles and guidelines*. Risks to surface water hydrology and quality with an assessed risk rating of medium or above, identified by the environmental risk assessment, included:

- Sedimentation of receiving watercourses and waterbodies as a result of increases in velocity of flows, soil disturbance and transport off site
- Impacts on water quality as a result of interaction with potentially contaminated soils and groundwater during construction
- Impacts on water quality in Alexandra Canal as a result of the disturbance of contaminated sediments during construction or scour at discharge outlets during operation
- Impacts on water quality as a result of disturbance of actual or potential acid sulfate soils and/or acid drainage during construction

- Impairment or modification of existing drainage infrastructure resulting in changes to overland flows and drainage pathways during construction or operation
- Impacts on water quality during operation as a result of runoff from road pavement surfaces containing contaminants from vehicle movements (oils, grease, heavy metals etc).

These potential risks and impacts were considered as part of the surface water assessment. Potential risks associated with soils are considered in Chapter 13 (Contamination and soils) and potential risks associated with groundwater are considered in Chapter 15 (Groundwater).

16.1.4 Assessment criteria

Construction water quality

Environmental values associated with water quality

The *NSW Water Quality Objectives* provide the agreed environmental values and long-term goals for NSW's surface waters. The objectives are consistent with the national framework for assessing water quality set out in the Water Quality Guidelines (previously the ANZECC guidelines). The water quality objectives provide environmental values for NSW waters and the Water Quality Guidelines provide the technical guidance to assess the water quality needed to protect those values.

The Airports (Environment Protection) Regulations 1997 also provide accepted limits of pollutants in fresh and marine waters in relation to watercourses on land subject to the Airports Act. These have also been taken into consideration when selecting criteria (known as trigger values for water quality) for the assessment.

Establishing ambient water quality in receiving waters

The Water Quality Guidelines and the Airports (Environment Protection) Regulations 1997 (as relevant) recommend default trigger values associated with the identified environmental values for various physical, biological and chemical pollutants that may be present in water. Trigger values are the criteria used for concentrations that, if exceeded, would indicate a potential environmental problem, and so ‘trigger’ the need for a management response. It is noted that in 2018, the ANZECC guidelines were superseded by the Water Quality Guidelines. The default trigger values for various pollutants in the Water Quality Guidelines are the same as those in the ANZECC guidelines. The trigger values and levels of protection referred to in this chapter are sourced from the ANZECC guidelines.

Water quality data for the receiving waters in the study area indicate that the values for many toxicants regularly exceed the default trigger values specified in the ANZECC guidelines. The data was investigated to define ambient water quality in the receiving watercourses.

Defining ambient water quality for the project generally involved:

- Identifying trigger values (as per the ANZECC guidelines and the Airports (Environment Protection) Regulations 1997) for long-term goals based on relevant environmental values – known as long-term (or default) trigger values
- Comparing the results of baseline monitoring of existing water quality against the default trigger values (see section 16.2.3 for a description of existing water quality for watercourses in the study area)
- Identifying ambient water quality values based on baseline water quality monitoring data – while these values are different to the long-term (default) trigger values, they can indicate whether existing water quality would be affected during, and shortly after, construction, particularly where water quality monitoring results indicate that contaminants currently exceed the default trigger values
- Any discharges for water during construction would be temporary and would be unlikely to inhibit achieving the desired long-term environmental values for the receiving watercourses. Establishing criteria for water to be discharged during construction, based on the ambient water quality values as described above with consideration of ANZECC default trigger values, would ensure that discharges do not affect the receiving watercourse in the short-term.

Relevant environmental values

As the project is located within the sub-catchments of the Cooks River and Georges River (Alexandra Canal and Mill Stream respectively), the relevant environmental values for these catchments, outlined in the *NSW Water Quality Objectives*, are to maintain and improve water quality in order to support aquatic ecosystems. The long-term goal is to return the sub-catchments to a condition where the watercourses are suitable for primary contact activities and aquatic food. The watercourses are, however, highly degraded, and primary contact activities and aquatic food are either not recommended or prohibited. Potential impacts associated with the project would be temporary and unlikely to affect achieving the longer term goals. For the purposes of managing the potential short-term impacts of the project, the primary environmental value is considered to be aquatic ecosystems.

The default trigger values associated with these environmental values depends on the level of protection to be achieved. The ANZECC guidelines recognise that different levels of protection may be appropriate for different waterbodies, corresponding to the condition of the ecosystem and whether the values are already being achieved. In a highly disturbed watercourse, a reduced level of protection may be an appropriate short-term goal with the aim of restoring it to a higher condition.

Establishing appropriate discharge criteria

Some water may need to be discharged during construction. The quality of the water discharged would influence whether there are any impacts on water quality and aquatic ecosystems in the receiving waters.

A detailed list of the indicators and associated default trigger values for all the environmental values associated with the Cooks River and Georges River catchments is provided in Appendix A of Technical Working Paper 8 (Surface Water). These default trigger values are recommended for the evaluation of water quality conditions in the existing environment against long-term water quality goals.

The ambient water quality values would be adopted as the reference state for potential water quality impacts during construction, and in the period after construction until such time as the project site is adequately stabilised, are provided in Appendix B of Technical Working Paper 8 (Surface Water) and are based on water quality monitoring results to date (see section 16.2.3).

Discharge criteria that are protective of ambient water quality values would be set during construction, as follows:

- For physical and chemical stressors – use the least stringent of:
  - The 80th percentile value from the baseline monitoring data; or
  - The default trigger value for aquatic ecosystems in marine waters.
- For non-bioaccumulative pollutants – use the least stringent of:
  - The 80th percentile value from the monitoring data; or
  - The 80 per cent level of protection for species in marine waters.
- For bioaccumulative pollutants – use the least stringent of:
  - The 80th percentile value from the monitoring data; or
  - The 95 per cent level of protection for species in marine waters.

Discharge criteria for construction water (extracted groundwater and contaminated runoff) that is developed using this method would be unlikely to noticeably impact water quality. As discharges of construction water would be temporary, discharges of water that comply with criteria developed in this manner would be unlikely to affect achievement of the long-term water quality goals for the watercourses.

Operation water quality

In the absence of water quality criteria specific to the operation of a roadway, the surface water pollutant reduction targets for development in the *Botany Bay and Catchment Water Quality Improvement Plan 2011* were adopted for the operational impact assessment (see Table 16.1).

Table 16.1 Pollutant reduction targets for Botany Bay catchment

Stormwater pollutant	Pollutant reduction target (%)
Gross pollutants	90
Total suspended solids	85
Total phosphorus	60
Total nitrogen	45

In addition, the management of water quality on Sydney Airport land would need to be consistent with the *Sydney Airport Environmental Strategy 2019–2024*. The key performance indicator adopted in the strategy relevant to surface water quality is that water quality monitoring results for stormwater from the airport should remain the same or improve.

16.2 Existing environment

The existing surface water features that comprise the hydrological regime for the study area are described in the following sections and are shown on Figure 16.1.

16.2.1 Catchments and watercourses

The project site is mainly located within the Cooks River catchment, which is a sub-catchment of the larger Botany Bay catchment. The Botany Bay catchment covers about 1,565 square kilometres and contains several sub-catchments. A small portion of the project site, near the intersection of Sir Reginald Ansett Drive and Keith Smith Drive, drains to the lower estuarine reach of Mill Stream. Mill Stream drains to Botany Bay, which is part of the Georges River catchment.

Both the Cooks River and the Georges River catchments are highly urbanised, meaning the rainfall-runoff response of the catchments has been altered from a natural state. This has resulted in changes to the quantity and speed of runoff within the catchment.

The catchment boundaries and key watercourses within and near the project site are shown on Figure 16.1.

Cooks River catchment

The Cooks River catchment, located in the inner to middle south-western suburbs of Sydney, has an area of about 100 square kilometres. The majority of the catchment is highly developed. The Cooks River is about 23 kilometres long and flows from Chullora in the west to Botany Bay in the east. The river discharges into the north of Botany Bay, near Sydney Airport. The river is tidally influenced as far as South Enfield. In addition to Alexandra Canal, the major tributaries of the river include:

- Coxs Creek
- Cup and Saucer Creek
- Wolli Creek
- Muddy Creek
- Bardwell Creek
- Sheas Creek
- Freshwater Creek.

Parts of the Cooks River remain in a natural state, while other sections were lined with concrete from the 1940s onwards. Sydney Water has undertaken progressive channel naturalisation works at three locations to restore the river closer to its natural state. Between 2008 and 2012, the former Sydney Metropolitan Catchment Management Authority undertook, in consultation with local councils, a number of wetland remediation projects along the Cooks River.

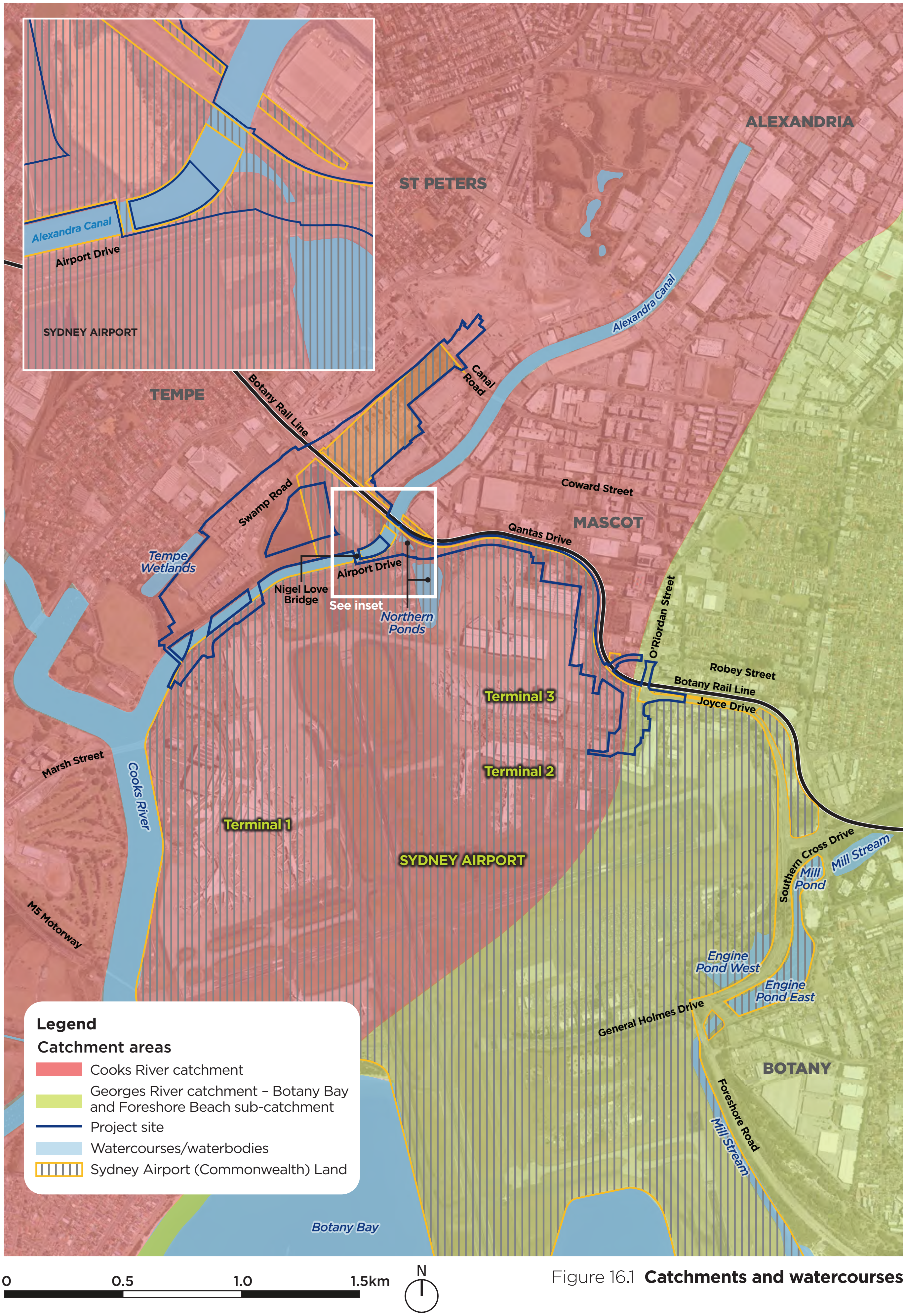

Figure 16.1 **Catchments and watercourses**

Alexandra Canal sub-catchment

The Alexandra Canal catchment is a sub-catchment of the Cooks River catchment and has an area of about 23 square kilometres. It was artificially constructed through dredging and channelisation of the former Sheas Creek, noted above as a major tributary of the Cooks River.

Alexandra Canal is the main watercourse within and in the vicinity of the project site. The canal is a four kilometre long constructed watercourse that discharges to the Cooks River to the south-west of the project site near Tempe Recreation Reserve. Within the project site, its banks are artificial, engineered structures constructed of concrete or sandstone.

A constructed pond, known as the northern ponds, is located on Sydney Airport land and discharges to Alexandra Canal. The pond provides flood mitigation and a spill control function.

Alexandra Canal has historically been contaminated due to the surrounding industrial land use, extensive land reclamation and industries discharging water directly to the canal. Currently contaminants entering via stormwater come from heavy industry, urban areas and road networks.

Older sediments are known to be highly contaminated, and have been overlain by more recent, less contaminated sediments. In 2004, the NSW EPA issued a remediation order (No 23004) under the CLM Act. The order requires any works or activities that would disturb canal sediments occur in accordance with a management plan approved by the NSW EPA.

The former Tempe landfill, which is crossed by the project site, is located in the Alexandra Canal sub-catchment. In 2001, the NSW EPA issued a remediation order (order 23003) to Marrickville Council under Section 23 of the CLM Act due to leachate migrating off site towards Alexandra Canal. Marrickville Council subsequently entered into a voluntary remediation proposal with the NSW EPA. The voluntary remediation proposal is still in place and requires that '... the water quality of Alexandra Canal is not adversely impacted by leachate originating from the site.'

As a result of the remediation order, a barrier wall was constructed in 2004 along the southern, eastern and western boundaries of the former landfill to prevent leachate migrating into Alexandra Canal. Leachate levels within the landfill are maintained by pumping to a leachate treatment plant where it is treated before discharge into Sydney Water's wastewater system.

Further information about contamination within Alexandra Canal is provided in Chapter 13 (Contamination and soils).

Tempe Wetlands

Tempe Wetlands is a local wetland located adjacent to the project site at the Tempe Lands. This wetland is an artificially constructed wetland surrounded by planted vegetation.

Georges River catchment

The Georges River catchment is located in the southern and western suburbs of Sydney and covers an area of about 960 square kilometres. With a population of over one million people, it is one of the most highly urbanised catchments in Australia. Georges River is about 96 kilometres long, and flows from Appin in the south in a northerly direction to Chipping Norton, then in an easterly direction to Botany Bay. The river discharges into the south of Botany Bay, between Sans Souci and Kurnell.

Mill Stream sub-catchment

The Mill Stream sub-catchment has an area of about 36 square kilometres and extends from Centennial Park in the north-east to its outlet into Botany Bay in the south. The upper reach of the catchment is located within the Randwick City Council local government area, while the lower reach is located within the Bayside Council local government area.

Engine Pond and Mill Pond are located south-east of the project site in the lower reaches of the Mill Stream sub-catchment. Mill Pond, Engine Pond and the Mill Stream are collectively known as the Sydney Airport Wetlands and are considered environmentally significant areas by the *Sydney Airport Master Plan 2039*

(SACL, 2019a) (the Master Plan) and *Sydney Airport Environment Strategy 2019–2024* (SACL, 2019b) (the Environment Strategy).

The natural landform of the Mill Stream sub-catchment comprises rounded sand dunes and expanses of gentle slopes with local depressions and exposed water tables. The lower reach of Mill Stream, into which part of the eastern end of the project site drains (see section 16.2.2), is a concrete-lined estuarine channel.

16.2.2 Hydrology

North of Alexandra Canal, the project site generally drains in a south-westerly direction towards the canal.

On the southern side of the canal, the project site also drains to Alexandra Canal, except for a small portion in the south-eastern corner which drains towards Mill Stream.

Flow control in the canal is provided by water levels in the Cooks River and by its tidal-influence which extends to within the project site. Due to these limits, the canal is generally considered to act as a sediment trap with flushing only occurring during large floods.

16.2.3 Water quality

Water quality baseline

Sampling results

Project-specific water quality monitoring was undertaken over a 15 month period during 2018 and 2019. Water samples, which were collected from 11 locations in Alexandra Canal, Mill Stream and Cooks River, were analysed to establish baseline water quality conditions in the study area. These results were supplemented by water quality data obtained from the New M5 Environmental Impact Statement (AECOM, 2015).

A review of this data indicated that both the Alexandra Canal and Mill Stream sub-catchments are in poor condition. The analysis indicates that:

- Samples obtained from the Cooks River and Alexandra Canal frequently exceeded ANZECC guidelines default trigger values for total nitrogen, total phosphorus, aluminium, iron, manganese, mercury, zinc and ammonia
- Samples obtained from Mill Stream frequently exceeded ANZECC guidelines default trigger values for total nitrogen, total phosphorus, aluminium, copper, iron, lead, manganese, mercury, zinc, total suspended solids, turbidity and ammonia, as well as the limits of acceptable contamination specified in Schedule 2 of the Airports (Environment Protection) Regulations 1997.

In relation to PFAS, the results indicate that:

- PFAS compounds, including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), were detected in almost all samples obtained from the Cooks River, Alexandra Canal and Mill Stream
- Concentrations of PFAS were below the 95 per cent level of protection criteria for marine species from the *PFAS National Environmental Management Plan* (HEPA, 2018).

Water quality sampling locations are shown on Figure 16.2. The water quality sampling results were compared to the default trigger values in Table 16.3. Existing exceedances of the default trigger values are shown in red bold font. In Mill Stream, the sampling locations shown on Figure 16.2 were in the freshwater reach of the stream. However, discharge of construction water would most likely occur within the lower estuarine reach as this is where the project would connect with the stormwater system from Sydney Airport's Terminals 2/3 precinct. Given this, water quality sampling has recently commenced within the estuarine reach, and the results from this sampling would be used to establish discharge criteria for Mill Stream.

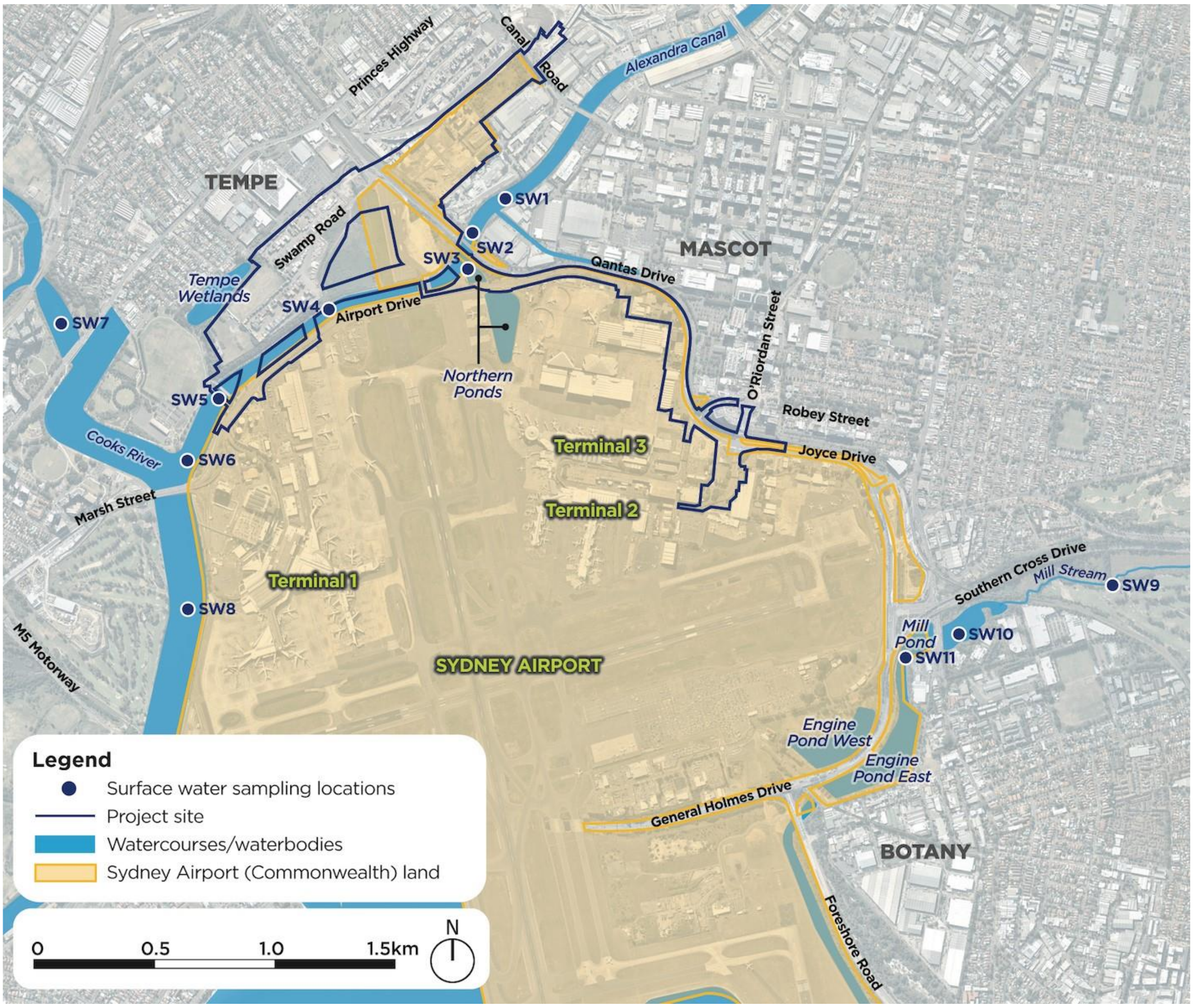

Figure 16.2 Surface water sampling locations

Modelling results

As described in section 16.1.2, modelling was undertaken to estimate existing pollutant loads in the Alexandra Canal and Mill Stream sub-catchments. Estimated annual pollutant loads in the Alexandra Canal and Mill Stream sub-catchments are provided in Table 16.2.

Table 16.2 Existing annual pollutant loads

Sub-catchment	Total suspended solids (kg/yr)	Total phosphorous (kg/yr)	Total nitrogen (kg/yr)
Alexandra Canal	315,000	509	3,777
Mill Stream	4,870	7.84	58.2

Table 16.3 Comparison of baseline water quality and default trigger values

Parameter	Unit	Default trigger value[1]	Alexandra Canal (80th percentile values)								Mill Stream (80th percentile values)		
			SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11
Aluminium (filtered)	µg/L	10	**34.2**	**40.8**	**30.8**	**37.4**	**27.2**	**27.4**	**24.8**	**29.4**	**25.4**	**42**	**189**
Arsenic (filtered)	µg/L	30	1.94	1.94	1.84	2	2.04	2.1	1.96	2	1.3	2.86	1.6
Chromium (filtered)	µg/L	20	0.5	0.54	0.54	0.5	0.5	0.5	0.5	0.5	0.3	0.4	0.8
Copper (filtered)	µg/L	5	2.8	2.4	2.4	2	2	1.4	2	2	2.76	2.12	3.16
Iron (filtered)	µg/L	10	**70**	**58.6**	**54.8**	**55.2**	**74**	**48.8**	**83.8**	**43.8**	**302.4**	**268.4**	**353.4**
Lead (filtered)	µg/L	4.4	0.96	0.98	0.88	0.8	0.56	0.62	0.8	0.94	0.6	1.38	1.16
Manganese (filtered)	µg/L	10	**32.56**	**32.26**	**30.12**	**28.3**	**24.06**	**20.26**	**31.72**	**21.64**	**65.68**	**20.04**	**29.58**
Mercury (filtered)	µg/L	0.4	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.02	**0.41**	0.01	0.01
Nickel (filtered)	µg/L	100	1.04	1.24	1	1.14	0.9	1	0.9	0.94	0.66	0.5	0.8
Zinc (filtered)	µg/L	5	**47.2**	**48.8**	**46.4**	**30.8**	**25.4**	**21.8**	**24.6**	**26.2**	**22.4**	**9.6**	**34.8**
pH (lab)	pH units	7-8.5	7.82	7.84	7.85	7.93	7.98	8	7.94	8.05	7.31	7.93	7.36
Total suspended solids	mg/L	10	**16.6**	**13.8**	**20.4**	**16.6**	**14.8**	**15.2**	**13**	10	**126.8**	**54**	**46**
Turbidity	NTU	10	**13.26**	**11.04**	**12.26**	**13.22**	**13.2**	**11.48**	8.26	7.26	**53.32**	**27.84**	**18.32**
Ammonia (as N)	mg/L	0.01	**0.23**	**0.23**	**0.21**	**0.18**	**0.14**	**0.15**	**0.16**	**0.12**	**0.22**	**0.04**	**0.25**
Nitrate (as N)	mg/L	10	0.3	0.31	0.28	0.27	0.23	0.24	0.19	0.19	0.53	0.16	0.7
Nitrite (as N)	mg/L	0.1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02
Total nitrogen (as N)	mg/L	0.3	**1.21**	**1.23**	**1.1**	**1.07**	**0.98**	**0.9**	**1.13**	**0.93**	**0.93**	**1.47**	**1.4**
Total phosphorus	mg/L	0.03	**0.08**	**0.07**	**0.07**	**0.07**	**0.06**	**0.07**	**0.08**	**0.07**	**0.04**	**0.06**	**0.06**

Parameter	Unit	Default trigger value[1]	Alexandra Canal (80th percentile values)								Mill Stream (80th percentile values)		
			SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8	SW9	SW10	SW11
PFOA	µg/L	220	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
PFOS	µg/L	0.13	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.05	0.07

Notes:
1. 80th percentile is the level or value below which 80% of results are expected to occur. Alternatively, it is the level likely to be exceeded 20% of the time.
2. Default trigger values documented in the ANZECC guidelines are shown in Appendix A of Technical Working Paper 8 (Surface Water).
3. **Red** bold text indicates exceedances of the default trigger values.
4. SWX refers to surface water monitoring locations shown on Figure 16.2.
5. Default trigger values represent the environmental values in the following order of precedence: aquatic ecosystems, secondary contact recreation, primary contact recreation and aquatic foods.
6. Sample locations SW9, SW10 and SW11 are located within Mill Stream's freshwater reach.

Sensitive receiving environments

A sensitive receiving environment is one that has a high conservation value, or supports human uses of water that are particularly sensitive to degraded water quality. For the study area, sensitive receiving environments are considered to include:

- Threatened ecological communities associated with aquatic ecosystems
- Known and potential habitats for threatened fish
- Key fish habitats
- Recreational swimming areas.

The project has the potential to affect a number of sensitive receiving environments including the Cooks River, Mill Stream and Botany Bay.

Botany Bay is used for a range of beneficial purposes, such as recreation and fishing. The Cooks River and Botany Bay are both defined as key fish habitats under the *Fisheries Management Act 1994* (NSW). The biodiversity assessment (see Technical Working Paper 1 (Biodiversity Development Assessment Report)) confirmed that Tempe Wetlands and Alexandra Canal do not provide habitat for threatened species and no threatened aquatic or migratory species were recorded during biodiversity field surveys (see Chapter 22 (Biodiversity) for further information).

16.2.4 Overview of existing hydrology and water quality on Sydney Airport (Commonwealth) land

The northern ponds, which discharge to Alexandra Canal, are located on either side of Airport Drive.

Mill Stream is identified as an environmentally significant area by the Master Plan and Environment Strategy. A small portion of the project site drains in a southerly direction to Mill Stream (see section 16.2.2). Both Alexandra Canal and Mill Stream may potentially receive discharges from the project, either directly from surface runoff or discharge or through the drainage network.

Existing data indicates that both the Alexandra Canal and Mill Stream sub-catchments are in poor condition. Baseline water quality data indicated that the default trigger levels for contaminants were frequently exceeded.

The trigger values provided in Schedule 2 of the Airports (Environment Protection) Regulations 1997 apply to watercourses on Sydney Airport land. The eastern portion of the airport site, between Alexandra Canal and Joyce Drive, drains through the airport’s drainage systems. However, the ultimate destination of this water is Alexandra Canal. As a result, the ANZECC guidelines have been adopted for the purposes of establishing site-specific trigger discharge criteria for this waterway.

As part of Mill Stream is located on Sydney Airport land, the trigger values from both the ANZECC guidelines and Schedule 2 of the Airports (Environment Protection) Regulations 1997 were adopted for Mill Stream for the purposes of establishing site-specific discharge criteria for this waterway.

16.3 Assessment of construction impacts

16.3.1 Hydrology

Water balance

A water balance can be used to ascertain any changes in water flow into and out of a domain or ecosystem. Changes in the water balance may indicate a potential impact on reliant organisms or ecosystems.

The water balance considered potential changes in water and wastewater flows between existing conditions and conditions during construction. The analysis focussed on the Alexandra Canal system, which is the main watercourse within the project site with the potential to receive surface water discharges during construction.

Potential changes to the water balance affecting Alexandra Canal could result from:

- Discharges of extracted groundwater
- Changes to surface runoff from the former Tempe landfill
- Runoff from disturbed areas of the project site.

Each of these and the potential changes as a result of construction is considered below. While some minor changes to the Alexandra Canal system water balance could be expected, the changes are not expected to have an effect on the environment or supporting ecosystems.

Extracted groundwater

Groundwater is likely to be intercepted from a range of construction activities involving excavation within the project site. Modelling indicates that there could be up to 400,000 cubic metres of groundwater extracted per annum with peak extraction rates estimated between 1,100 to 5,000 cubic metres per day (worst case), depending on the required depths of excavations and groundwater levels at the time. These estimates may change as a result of the proposed construction methods to be used by the appointed construction contractors.

One method for managing the estimated volume of extracted groundwater would be to discharge to Alexandra Canal. Assuming the maximum estimated discharge of 5,000 cubic metres per day to Alexandra Canal at low tide, based on a 1.6 kilometre long reach of Alexandra Canal that could be affected, this represents about seven per cent of the volume of water in this reach. This impact would be lower during average and high tide conditions. Discharges would only occur during excavations deep enough to intercept groundwater and where removal of the groundwater is necessary for construction.

As described in Chapter 15 (Groundwater), groundwater in the study area already flows towards Alexandra Canal as well as to Botany Bay. Therefore, the impact of extracted groundwater being discharged to the canal is expected to be minimal, with the only change being the rate at which groundwater would infiltrate into the canal when compared with the existing (slower) infiltration rate through the soil.

Any discharges of groundwater to Alexandra Canal would be undertaken in accordance with discharge requirements agreed with Sydney Water and the NSW EPA and based on the agreed discharge criteria and subsequent monitoring outlined in this document.

Further information is provided in Chapter 15 (Groundwater).

Runoff and leachate from the former Tempe landfill

Within the former Tempe landfill, leachate generation is estimated to increase to between 200 and 450 cubic metres per day (depending on rainfall assumptions) due to the temporary removal of sections of the landfill cap required to facilitate construction. Leachate is currently managed within the landfill site by a collection system. It is discharged to the wastewater system in accordance with a trade waste agreement with Sydney Water.

The additional leachate expected to be generated during construction would be collected and disposed of in the same manner through additional pumping (as required). Any change to surface water runoff at this location would be minimal in relation to the water balance and due to the fact that work at this location would only occur for a portion of the overall construction period.

Runoff from disturbed areas

Runoff from disturbed areas would be managed in accordance with the requirements of the Blue Book and directed to discharge locations following any necessary treatment. The project site is generally flat and lowlying with gentle undulations. As a result, it is unlikely that substantial changes to existing drainage catchments or runoff rates would occur as a result of construction. The need for any sediment basins would be considered by the construction contractor, taking into consideration the limited available site area, presence of contaminated sites, and potential to attract additional groundwater requiring management.

Construction water

Water would be required on site for various activities, including dust control, soil compaction and vegetation establishment. It is estimated that around 87 megalitres of water would be required during construction. Preference would be given to the use of recycled water from the project site over potable water sources where appropriate, to facilitate broader water conservation and reuse objectives.

Watercourses and geomorphology

Potential impacts on landscape health, including the bed or banks of natural watercourses, may result from:

- Direct construction activity adjacent to or within watercourses, including constructing bridge crossings and drainage outlets
- The removal of riparian vegetation
- Temporary increases in runoff and water discharges
- Sediment deposition in receiving watercourses.

There is little to no potential for changes to watercourse bed or banks as a result of hydrological changes from the project, due to the highly engineered nature (concrete or sandstone walls) of Alexandra Canal within the project site, and the lower reach of Mill Stream.

Construction would include works adjacent to the banks of Alexandra Canal, including constructing the proposed bridges. While the construction methods would be confirmed following appointment of the construction contractors, the bridges have been designed with the intention that no permanent structures associated with the bridges would be required in the canal.

Works within Alexandra Canal include constructing new stormwater outlets and upgrade of existing stormwater outlets (see section 7.10.6). Temporary coffer dams would be required. These could temporarily disturb sediments during their installation and removal (see section 8.2.3). These effects would be mitigated by the use of silt curtains installed around the coffer dams during installation and removal. Works on the banks of the canal would be undertaken in accordance with the *Guidelines for controlled activities on waterfront land* (DPI, 2012b).

Coffer dams may alter flow velocities in the immediate vicinity of the dams, which may cause localised scouring of sediments. Due to its size and connection with the Cooks River however, the overall movement of water from Alexandra Canal to the Cooks River is slow and is predominantly associated with daily tidal changes. Generally, the canal acts as a sediment trap with little flushing occurring except during large flooding events. Therefore, any sediment disturbance associated with the installation or removal of coffer dams is likely to be localised. Similarly, for the short period over which coffer dams are installed, it is not expected water movements would result in changes to the sediment distribution within the overall canal or the bed geomorphology. Any changes would be most likely to occur during large flood events when sediments within the canal would already be mobile.

As indicated in the above sections, potential changes to the water balance and the duration of any changes would be limited to the construction phase and individual activities. Discharges of extracted groundwater to Alexandra Canal during the worst case scenario would represent about seven per cent of the total volume of water in this reach of the canal. As such, potential discharges would likely have minimal impact on levels and velocities in the canal, and would be unlikely to affect the geomorphology of the canal bed. The impact would be lower during average or high tide conditions.

General construction activity, including vegetation removal and ground disturbance, has the potential to increase sediment loads in affected watercourses. Soil and water management measures would be implemented in accordance with the Blue Book to minimise erosion from the project site and sedimentation in the receiving waters. Erosion and sediment loads would also reduce as construction is completed and as the disturbed areas are stabilised. As a result, it is not expected that the geomorphology of the canal bed or any natural processes would be affected. No construction works are proposed to be undertaken within or near Mill Stream.

Potential impacts on the hydrological attributes of Alexandra Canal are expected to be short-term and manageable with the application of appropriate mitigation measures provided in section 16.6.

The design has undertaken a review of the capacity of the existing stormwater management system and has proposed upgrades to maintain the efficacy of the stormwater network and where possible, reduce flooding. Mitigation measure HF1 requires the development of a flood mitigation strategy for the construction phase, including confirming the ability of the proposed stormwater systems to accept discharges of construction water if proposed.

16.3.2 Water quality

Discharge criteria

Potentially contaminated groundwater would be intercepted and extracted during construction (described in Chapter 15 (Groundwater)). There is also the potential for construction in contaminated areas within the project site (described in Chapter 13 (Contamination and Soils)) to result in contaminated runoff that would require collection and discharge, although the potential for this would be low with the implementation of standard erosion and sedimentation control measures. The discharge of these waters to Alexandra Canal or Mill Stream would not cause environmental degradation or pollution if it is of suitable quality, relative to existing water conditions.

Preliminary discharge criteria for these site discharges, selected based on the methodology described in section 16.1.4, are provided in Table B2 of Appendix B of Technical Working Paper 8 (Surface Water), and are based on water quality monitoring to date. The criteria adopted for construction would be based on all available water quality monitoring data at the time construction commences, and would also be selected based on the methodology described in section 16.1.4.

The discharge criteria are considered justified on the basis that the construction discharges would be temporary, limited to the construction phase, unlikely to noticeably impact ambient water quality outcomes in the short term, and also unlikely to affect achievement of the long-term water quality goals for the watercourses.

Potential sources of water quality impacts

Construction activities may present a risk to water quality in Alexandra Canal and/or Mill Stream if mitigation and management measures are not effectively implemented throughout the construction period. Potential sources of water quality impacts would include:

- Soil transported off site during rainfall events and from discharge of sediment-laden water
- Disturbance of sediments in the bed and banks of Alexandra Canal during construction of drainage outlets
- Exposure of actual or potential acid sulfate soils, which may generate acidic runoff
- Spills or leaks from construction machinery (including chemicals, oils, grease, and petroleum hydrocarbons) and gross pollutants such as litter
- Leachate and runoff from contaminated sites (including the former Tempe landfill as described in Chapter 13 (Contamination and soils))
- Contaminated groundwater discharged into receiving watercourses (including PFAS, heavy metals and ammonia).

Management of contaminated runoff

As described in Chapter 13 (Contamination and soils), excavation would be required in potentially contaminated soil. Surface water runoff may also come into contact with contaminated materials within the project site.

The potential for contamination of surface waters would be managed in accordance with Blue Book procedures and where possible, by isolating runoff from contaminated land from other surface water runoff. If discharge to surface waters is proposed, the contaminated runoff would need to be treated to meet relevant environmental protection licence conditions or site-specific discharge criteria. Other methods of management for contaminated runoff may include infiltration or off-site disposal. With the implementation of appropriate mitigation measures, the risk of significant water quality impacts due to contaminated runoff would be low.

Management of contaminated groundwater

Groundwater at the site would be intercepted by excavation activities and is known to be contaminated by the following substances, exceeding the proposed surface discharge criteria for Alexandra Canal:

- Metals, particularly aluminium, lead, manganese, mercury and zinc
- Ammonia
- Bicarbonate
- Nitrogen and phosphorus
- pH
- Total suspended solids
- PFOS.

Treatment of extracted groundwater would be required before it can be discharged to watercourses (as one possible management approach), with the treatment process designed to meet the site-specific discharge criteria for the receiving watercourse as outlined in section 16.1.4. Following treatment, and provided that the site-specific discharge criteria are met, the risk of significant water quality impacts from discharge of extracted groundwater would be low.

The proposed surface water management measures provided in section 16.6 aim to minimise impacts on receiving watercourses during construction due to discharge of extracted groundwater. In the context of the overall catchment, and with the implementation of the proposed management measures, any potential short-term impacts are unlikely to impact on ambient water quality within the receiving watercourses. Therefore, the project is likely to have a negligible influence on whether the *NSW Water Quality and River Flow Objectives* are protected (if currently met) or achieved (if currently not met) during construction.

Upgrade of stormwater outlets

Constructing the drainage outlets in Alexandra Canal would involve work below the water surface. This has the potential to disturb contaminated sediments within the canal and affect water quality. The proposed management approaches, including establishing temporary coffer dams within areas protected by silt curtains, would minimise the potential for sediment transport. The use of silt curtains while coffer dams are installed and removed would contain any mobilised sediments within the near vicinity of the work area. Due to the tidal nature of Alexandra Canal and its connection with the Cooks River, mobilised sediments would re-settle close to the location of disturbance, rather than be transported downstream and into other receiving watercourses.

A plan of management would be prepared for works within the canal to define how disturbance and migration of contaminated sediments would be minimised. The plan would be approved by the NSW EPA in accordance with the remediation order (number 23004) for Alexandra Canal. All works in the canal would be undertaken in accordance with the requirements of the plan (see Chapter 13 (Contamination and soils)).

Alexandra Canal does not contain habitat for threatened aquatic species and is not used for primary or secondary contact recreational activities. Therefore, the risk of significant impacts on aquatic species associated with sediment and contaminant disturbance would be minimal.

Table 16.4 summarises the construction activities that have the potential to impact water quality along with the key mitigation and management approach and level of impact expected. With the implementation of appropriate mitigation measures described in section 16.6, potential impacts on water quality would be minimised.

Table 16.4 Potential water quality impacts during construction

Activity with the potential to impact water quality	Potential water quality impact	Likelihood of impact and/or mitigation approach
Earthworks, including vegetation clearing, stripping of top soil and stockpiling	Increased turbidity, lowered dissolved oxygen levels and increased nutrients Potential for increased contaminants in watercourses if soil is contaminated	Low All construction activities would be undertaken in accordance with Construction Soil and Water Management Plan (which would incorporate the requirements of the Blue Book) to limit the potential for off-site soil transport (see section 16.6).
Activities that require groundwater dewatering such as construction of retaining walls, drainage infrastructure and utilities	Increased pollutant discharges to watercourses	Low Impacts would be avoided by setting discharge criteria at levels which are consistent with existing water quality conditions and adhere to identified protection levels for the agreed environmental values.
	Mobilisation of contaminant plumes	Low Given the short duration of excavation and that the groundwater capture zones are small, there is limited potential for movement of contaminated plumes. This potential impact is considered in Chapter 15 (Groundwater).
	Exposure of acid sulfate soils and subsequent acidification of watercourses	Low Further testing and investigations would be conducted within areas of medium and high acid sulfate soil potential during detailed design, and all excavated soils would be subject to the provisions of an acid sulfate soil management plan (see Chapter 13 (Contamination and soils)).
Ground disturbance works at the former Tempe landfill	Increased contaminants, particularly ammonia, released to receiving waterbodies	Low Leachate within the landfill is managed by a perimeter (bentonite) wall and collection system that prevents overflow into Alexandra Canal. Any damage to the existing leachate management systems could result in leachate overflowing into the canal. Leachate levels within the landfill, including any changes resulting from construction works and the quality of discharges would be monitored and managed in accordance with license conditions (see Chapter 13 (Contamination and soils)). Therefore, no water quality impacts are anticipated.
Construction of drainage outlets in Alexandra Canal	Increased turbidity Potential for increased mobilisation of contaminated sediments	Low Coffer dams and silt curtains would to be used to reduce sediment transport. A plan of management would be prepared and implemented to minimise the disturbance and transport of contaminated sediments (see Chapter 13 (Contamination and soils)).

Activity with the potential to impact water quality	Potential water quality impact	Likelihood of impact and/or mitigation approach
Bridge construction	Increased turbidity, lowered dissolved oxygen levels and increased nutrients Potential for increased sediment transport	Low The bridge crossings have been designed with the intention that no physical works would impact the canal walls or be conducted within the canal. Therefore, no impacts are expected.
Enlargement of the northern pond	Bed and bank disturbance, increased turbidity and sedimentation	Low The pond primarily functions as a flood detention device with gates blocking the backflow of waters from Alexandra Canal. Any sediment disturbance as a result of vegetation removal or excavation of the banks would be entirely contained to the pond. Measures would be implemented to ensure the potential for the gates to open during construction is minimised (see section 16.6).
General	Increased gross pollutants (eg litter) Increased pollutants and contaminants in watercourses as a result of contingency events eg spills and leaks	Low Control of gross pollutants and actions to be taken during contingency events would be managed in accordance with standard measures in the CEMP.

16.3.3 Summary of impacts on Sydney Airport (Commonwealth) land

Potential impacts on hydrology and surface water quality on Sydney Airport (Commonwealth) land are discussed in sections 16.3.3 and 16.4.3. The potential impacts include:

- Increased sedimentation and turbidity
- Runoff from contaminated sites and changes to bank conditions of the northern pond where additional storage volume would be created.

The vegetation at the northern pond is exotic and not likely to provide habitat for common species. The water quality is generally low and, as a result, it is unlikely to have high aquatic biodiversity values. Works at the pond would not impact on flow conveyance or scour potential.

A small section of the project site drains to Mill Stream. Discharging of extracted groundwater to Mill Stream is not anticipated during construction. However, in the event discharges are required, consultation with Sydney Airport Corporation and the Department of Infrastructure, Transport, Cities and Regional Development would be undertaken to ensure there are no adverse impacts prior to discharge occurring.

Impacts are expected to be manageable with the application of the proposed construction mitigation measures described in section 16.6. Following implementation of the mitigation measures, the potential impacts on Sydney Airport land are not considered to be significant.

16.4 Assessment of operation impacts

16.4.1 Hydrology

Water balance

The water balance assessment considers changes in flow conditions between existing and future (operating) conditions of the project. An increase in flow generally reflects an increase in impervious area, which could result in increased pollutant loads, increased erosion and sedimentation potential and/or changes to the bed conditions of the watercourses.

The project would result in an increase in impervious areas within the Alexandra Canal sub-catchment of about six hectares due to existing pervious land becoming road surface (from about 21 hectares to 27 hectares). In the Mill Stream catchment, the project would result in an increase in impervious area of about 0.13 hectares (from about 1.03 hectares to 1.16 hectares).

The resulting changes in flows in these watercourses are shown in Table 16.5.

Table 16.5 Existing versus operational flow from impervious surface area in the project site

Sub-catchment	Existing conditions flow (ML/yr)	Operation conditions flow (ML/yr)	Percentage change in flow (%)
Alexandra Canal	249	266	6
Mill Stream	8.9	9.8	10

Table 16.6 shows the percentage change in flow in the wider catchment areas. When the wider catchment areas are considered, the changes to stormwater flow during operation are considered to be negligible.

Table 16.6 Percentage change in flow for larger catchments

Greater catchment	Existing conditions flow (ML/yr)	Operation conditions flow (ML/yr)	Percentage change in flow (%)
Alexandra Canal	1,740	1,750	1
Mill Stream	24.5	25.4	4

Detailed design would include additional modelling to confirm the ability of the receiving drainage systems to effectively convey stormwater discharges.

The project is not expected to consume potable water or generate wastewater during operation. There would be no water take or discharge from operation, other than stormwater runoff.

Impacts on watercourse stability and flows

As indicated above, the project would result in a minor increase in flows as a result of the increase in impervious surfaces. These minor increases would not alter flow velocities significantly or result in impacts on landscape health. Changes in flow velocities are discussed in Chapter 14 (Flooding) and are summarised below:

- During the one per cent annual exceedance probability event, increases in flow velocity within Alexandra Canal would be generally less than 0.2 metres per second
- There would be a minor reduction in flow and velocities in the Tempe Wetlands
- The project would have a negligible impact on peak flows and velocities in Mill Stream.

Appropriate scour protection measures would be incorporated into the design of the upgraded drainage outlets to minimise potential for scouring within Alexandra Canal.

16.4.2 Water quality

Potential sources of impacts

During operation, there is potential for surface water quality to be impacted by the following processes and activities:

- Scour and mobilisation of contaminated sediments at proposed new drainage outlet locations and increased flow to existing locations (Alexandra Canal) impacting on water quality
- Landfill leachate volume exceeding the capacity of the leachate management system and entering watercourses impacting on water quality

- Erosion of recently disturbed areas resulting in the sedimentation of watercourses
- Increase in sediment and pollutant loads in stormwater due to the increase in road surface and vehicular traffic, and associated pavement and tyre wear
- Spills or leaks of fuels and/or oils from vehicle accidents and/or operational facility and equipment.

Potential impacts on surface water quality are described in more detail below.

Predicted stormwater quality and quantity

Water quality

As described in section 16.4.1, the project would increase impervious areas (such as road pavement) that would be exposed to direct rainfall and would therefore increase runoff volume and associated pollutant mobilisation. Runoff from road pavement would typically contain pollutants such as sediments, nutrients, oils and greases, petrochemicals and heavy metals, which could potentially impact on water quality when discharged into receiving watercourses.

The increase in impervious surface area means there is potential for higher pollutant loads to be discharged to the receiving environments of Alexandra Canal and Mill Stream. A number of water quality treatment measures, such as gross pollutant traps, and hydrodynamic separators, are proposed to manage runoff from the project and the associated water quality impacts. Modelling was carried out to assess the performance of the proposed water quality treatment measures against the targets specified in the *Botany Bay and Catchment Water Quality Improvement Plan*. A summary of the modelling results is provided in Table 16.7.

Table 16.7 Modelling results for operational water quality

Pollutant	Operational load (without treatment) (kg/yr)	Operation load with treatment (kg/yr)	Pollutant reduction (kg/yr)	Pollutant load reduction achieved (%)	Reduction target[1] (%)
Alexandra Canal					
Total suspended solids	94,400	46,400	48,000	50.8	85
Total phosphorus	158	112	46	29.1	60
Total nitrogen	638	504	134	21.0	45
Mill Stream					
Total suspended solids	2200	578	1622	73.7	85
Total phosphorus	3.5	2.0	1.6	45.7	60
Total nitrogen	26.4	15.9	10.5	39.8	45

Note: 1. Targets from the *Botany Bay and Catchment Water Quality Improvement Plan*

The modelling results indicate that, although the proposed treatment devices would minimise impacts on water quality during operation, the adopted pollutant reduction targets would not be achieved. For Alexandra Canal, the modelling results indicate the following percentage change in pollutant load:

- A minor reduction for total nitrogen
- A negligible increase for total suspended solids
- A minor increase for total phosphorus.

This indicates a small impact during operation.

The water quality treatment measures proposed would reduce the rate of pollutants entering Mill Stream during operation to below the existing rates. Therefore, although the pollutant reduction targets are not met, the project would result in an overall improvement in water quality in Mill Stream.

The performance of the treatment devices and the type and design of specific stormwater treatment measures across the project would be further refined as part of detailed design with the aim of achieving pollutant reduction targets. Modelling would be updated during detailed design to assess likely system performance. Given the space constraints and the treatment options available however, it is unlikely that the pollution reduction targets would be met.

Soil mobilisation in Alexandra Canal

The proposed new drainage outlets in Alexandra Canal could increase the potential for sediment mobilisation during operation. Modelling performed has indicated that sediments are likely to be mobilised locally at three of the nine outlet locations. Scour protection measures would be provided at the outlets to minimise the mobilisation of contaminated sediments at the base of the canal.

The specific scour protection measures required would be identified during detailed design in consultation with relevant stakeholders, including Sydney Water.

No bridge piers or bridge abutments are proposed in Alexandra Canal. A number of abutments at Terminal Link Bridge, Qantas Drive Bridge and Freight Terminal Bridge are proposed within slow flow velocity zones of floodplains. The likelihood of abutment scour is low and would be further considered during the detailed design stage.

Operation of the project is not expected to result in geomorphological impacts or impacts to landscape health.

Impacts of leachate generation

The assessment undertaken for the former Tempe landfill (refer to Technical Paper 16 (Landfill Assessment)) indicated that the volume of leachate is expected to decrease following the completion of the project and replacement of the landfill capping layer.

Spills and leaks

Motor vehicle operations, maintenance plant and equipment leakages or a vehicle crash may cause spills of oils, lubricants, hydraulic fluids and chemicals. Spills and leakages have the potential to pollute downstream watercourses, as a result of being conveyed to watercourses via the stormwater network. The impact would be minimised by implementing procedures to handle dangerous goods and hazardous materials and manage spills similar to those used for other Roads and Maritime operations. Further discussion on accidental spills is provided in Chapter 13 (Contamination and soils) and Chapter 23 (Health, safety and hazards).

Achieving the water quality objectives

As described above, the proposed treatment devices would result in a minor reduction in total nitrogen, a negligible to minor increase in total suspended solids and total phosphorous within Alexandra Canal and a reduction in pollutants entering Mill Stream during operation. Although the proposed treatment devices would reduce impacts on water quality during operation, the pollution reduction targets would not be achieved for catchments in the study area.

This is largely a result of the urbanised nature of the catchment and the pollutant loads at the project site being generated from across the wider catchment.

There are no sensitive receivers within Alexandra Canal, and the very small predicted impact is not expected to cause any adverse effects. Therefore, the identified increases in pollutant loads are considered to be acceptable and would not interfere with any other pollution reduction initiatives elsewhere in the catchment.

The water quality treatment measures proposed would reduce pollutant loads during operation in the Mill Stream catchment to below the existing levels. So, although the pollutant reduction targets would not be met, an overall improvement in the ambient water quality outcomes for Alexandra Canal and Mill Stream is nonetheless expected.

16.4.3 Summary of impacts on Sydney Airport (Commonwealth) land

Watercourses and waterbodies on Sydney Airport land include the northern ponds and a portion of Mill Stream. These watercourses may receive discharges from the project, either directly from drainage discharges or through the stormwater network.

A small section of the proposed road drainage system would drain to the northern ponds. Since it is not feasible to provide water quality treatment for this small section of the road, there would be a minor impact to water quality from this section. The water quality of the stormwater discharged from Sydney Airport land is unlikely to be impacted by the project.

Modelling of pollutant loadings in Mill Stream during operation indicated that there would be an improvement in water quality in Mill Stream compared to existing conditions.

With implementation of the mitigation measures provided in section 16.6, there is not expected to be any significant impacts on Sydney Airport land associated with surface water quality and hydrology.

Consistency with the Sydney Airport Master Plan

The *Sydney Airport Master Plan 2039* (SACL, 2019a) (the Master Plan) identifies water quality and water use as a key environmental issue. It recognises that activities at Sydney Airport have the potential to impact water quality in surrounding watercourses, and notes the mechanisms that are in place at the airport to manage water quality.

By implementing the Master Plan and the *Sydney Airport Environment Strategy 2019-2024* (SACL, 2019b) (the Environment Strategy), Sydney Airport Corporation plans to manage and reduce potential impacts on the water quality of surrounding watercourses by implementing (amongst other things):

- Use of passive filtrations systems such as swales to absorb pollutants and decrease runoff volumes
- Inclusion of water quality treatment measures
- Spill and emergency response procedures.

The Environment Strategy includes water quality and water use objectives for the next five years. The relevant objectives for the project are:

- Minimising the impact of airport operations and construction on water quality in water bodies on or adjacent to the airport
- Maintaining and improving the water quality and associated biodiversity values of the Sydney Airport Wetlands.

Additionally, a number of items in the five year action plan are relevant, including:

- Incorporate design features in new developments to reduce contaminant loads in stormwater and to align with catchment water quality objectives
- Continue to implement the initiatives contained in the Sydney Airport Stormwater Quality Management Plan, including continuation of regular stormwater quality sampling.

A detailed technical assessment (see Technical Working Paper 8 (Surface Water)) has been undertaken for the impact assessment to demonstrate that the project has considered, for both construction and operation, the importance of water quality. The project includes water treatment devices such as gross pollutant traps and hydrodynamic hydrocarbon and suspended solid separators. Consideration of additional water sensitive urban design features would be undertaken during detailed design, subject to feasibility and space constraints. These and other measures are proposed to ensure protection of the watercourses around Sydney Airport, and associated biodiversity and other values.

Baseline water quality monitoring has been conducted over a period of 15 months and has informed the adoption of site-specific discharge criteria for Mill Stream, should this discharge be required. Setting discharge criteria based on surface water baseline monitoring would ensure existing environmental and other values associated with the watercourses are protected.

The project would not impact on sensitive areas at Sydney Airport, including Sydney Airport Wetlands or the Botany Bay marine environment, and is not in conflict with any of the identified biodiversity actions identified in the Environment Strategy. The key performance indicator relevant to surface water quality for the actions and initiatives in the Master Plan is that water quality monitoring results for stormwater from Sydney Airport stay the same or improve. As described in section 16.4.1, modelling undertaken for the project indicates that during operation, this key performance indicator would be achieved within Mill Stream.

16.5 Cumulative impacts

Cumulative impacts on water quality are generally related to the movement of soil and water across project boundaries. The project would be constructed at the same time as other major projects underway and/or planned in the surrounding area. In particular, construction would interact with the Botany Rail Duplication and M4–M5 Link projects.

16.5.1 Construction

The Botany Rail Duplication has the potential to impact Mill Stream, as it would involve constructing an additional rail bridge (including vegetation clearing, installation of piers and abutments) over Mill Stream. In addition, a large portion of the flow from the Botany Rail Duplication site would discharge to Mill Stream. A very small portion of the Gateway project site is located within the Mill Stream catchment. The EIS for the Botany Rail Duplication indicates that no significant water quality impacts on Mill Stream are predicted. Therefore, with the implementation of appropriate management and mitigation measures, the potential for the Sydney Gateway road project to materially increase cumulative impacts associated with the Botany Rail Duplication is expected to be negligible.

The M4–M5 Link project site is located about 300 to 500 metres from the Sydney Gateway road project site within the Cooks River catchment. The majority of the works are underground, although given the distance, it is unlikely that the discharge of any collected groundwater or surface water discharges would be cumulative with those to Alexandra Canal from the Sydney Gateway road project.

All of the State significant infrastructure projects in planning or under construction generally include measures to ensure that effective soils and surface water management procedures are implemented to prevent adverse impacts on receiving watercourses. Therefore, with the implementation of measures in section 16.6, and if mitigation measures are applied consistently and effectively across projects, minimal cumulative surface water impacts are anticipated.

16.5.2 Operation

During operation, other major projects constructed within the Cooks River and Georges River catchments may impact flow and water quality in the receiving watercourses within the study area. Increases in impervious areas from infrastructure (as well as development projects) may contribute to the increased volumes, rates and pollutant runoff in the area.

Drainage from the Botany Rail Line would flow into the Sydney Airport drainage network and through the northern ponds into Alexandra Canal as well as Mill Stream. However, no change in water quality is expected. Cumulative impacts associated with the project and the Botany Rail Duplication are therefore likely to be negligible.

Sections of the New M5 and small sections of the M4–M5 Link would be constructed in the Georges River and Cooks River catchments to the north and west of the project site. The New M5 EIS concluded that the treatment devices included in the design would result in fewer pollutants entering Alexandra Canal and

Cooks River. Similarly, the EIS concluded that the M4–M5 Link would reduce stormwater pollutant loading to receiving watercourses and have a neutral or beneficial effect.

Therefore, with the implementation of proposed measures in section 16.6, and if mitigation measures are applied effectively to major projects, minimal cumulative surface water impacts are anticipated.

16.6 Management of impacts

16.6.1 Approach

Approach to mitigation and management

The assessment identified that if construction is not adequately managed, including managing the potential for erosion and sedimentation, and managing groundwater during dewatering, it would have the potential to impact water quality in receiving watercourses. Given the known contamination in areas of the site, runoff will need to be adequately managed, including monitoring for specific pollutants, prior to discharge or disposal.

Constructing the drainage outlets in Alexandra Canal also has the potential to disturb contaminated sediments within the canal and affect water quality.

There is limited potential for operation impacts, with the exception of drainage discharges from the stormwater outlets into Alexandra Canal. A preliminary analysis has identified which of these should be subject to controls to avoid further scouring. These would be refined and confirmed during detailed design.

Approach to managing the key potential impacts identified

In accordance with mitigation measure CS5 (see section 13.6), a Construction Soil and Water Management Plan would be prepared as part of the CEMP and implemented during construction. The plan would detail processes, responsibilities and measures to manage potential soil and water quality impacts during construction. The plan would be prepared in accordance with relevant guidelines and standards, including *Managing Urban Stormwater – Soils and Construction*, Volume 1 (Landcom, 2004) Volume 2B Waste landfills (DECC, 2008a) and Volume 2D (DECC, 2008b) (collectively referred to as the 'Blue Book'). The development of mitigation measures in the plan would be guided by the Blue Book to determine the magnitude of rainfall events to which the capacity of the construction mitigation measures should be designed. Further information, including an outline of the plan, is provided in Chapter 27 (Approach to environmental management and mitigation).

Discharge criteria for any extracted groundwater or contaminated runoff would be established by considering long-term default trigger values and baseline water quality data and would be selected based on the following:

- For physical and chemical stressors – use the least stringent of:
  - The 80th percentile value from the baseline monitoring data; or
  - The default trigger value for aquatic ecosystems in marine waters.
- For non-bioaccumulative pollutants – use the least stringent of:
  - The 80th percentile value from the monitoring data; or
  - The 80 per cent level of protection for species in marine waters.
- For bioaccumulative pollutants, including PFAS – use the least stringent of:
  - The 80th percentile value from the monitoring data; or
  - The 95 per cent level of protection for species in marine waters.

Treatment would occur prior to discharge to stormwater or watercourses, as required, to meet the established criteria. For extracted groundwater, data from relevant groundwater wells would be used to determine treatment requirements. If the discharge criteria cannot be met, other management and disposal options would be adopted.

Scour protection measures would be provided at the drainage outlets at Alexandra Canal to minimise potential impacts on the canal, such as mobilisation of contaminated sediments. The necessary measures would be confirmed during detailed design in consultation with relevant stakeholders, including Sydney Water. Additionally, a plan of management would be developed and implemented to manage work within Alexandra Canal that has the potential to disturb sediments. The plan would include strategies such as using silt curtains during installation and removal of the coffer dams, and would be approved by the NSW EPA in accordance with the remediation order (number 23004) for Alexandra Canal. This is described further in Chapter 13 (Contamination and soils).

The effectiveness of the mitigation measures would be monitored by developing and implementing a surface water monitoring program.

Surface water monitoring program

Water quality baseline monitoring would continue to be undertaken and would be refined to include the location of possible discharges in Mill Stream. Any additional indicators or other parameters would also be added to the current suite to ensure full coverage of the indicators recommended.

A program to monitor potential surface water quality impacts would be developed and would include:

- Measurement of water quality parameters at each location for pH, electrical conductivity, temperature, dissolved oxygen, reduction-oxidation potential and turbidity. Flow direction will also be noted.
- Laboratory analysis of all water samples for:
  - Physical properties – pH, total dissolved solids, total suspended solids, turbidity, major anions, cations and alkalinity
  - Nutrients - nitrate, nitrite, total nitrogen, ammonia and total phosphorus
  - Contaminants of concern – per- and polyfluoroalkyl substances, total recoverable hydrocarbons, volatile organic compounds, polycyclic aromatic hydrocarbons, total phenols, organochlorine pesticides, organophosphorus pesticides, total and dissolved heavy metals (lead, zinc, copper, cadmium, chromium, nickel, iron, manganese, mercury, arsenic and aluminium) and tributyltin.

Sampling would be undertaken monthly, during a range of wet and dry conditions (where possible), at the locations shown on Figure 16.2. As a minimum, continued monitoring at locations SW2 and SW6 on Alexandra Canal and SW8 on the Cooks River is proposed, with SW2 and SW6 used to monitor potential water quality impacts due to the project (see Figure 16.2). A new monitoring station would be required on the lower estuarine reach of Mill Stream if groundwater discharge to that watercourse is proposed.

A full list of proposed values for water quality monitoring during construction is tabulated in Appendix B2 of Technical Working Paper 8 (Surface Water). This includes values for physical and chemical stressors, non-bioaccumulative toxicants and bioaccumulative toxicants.

Impact monitoring will continue for a minimum of 12 months following the completion of construction, or until affected watercourses are certified by a suitably qualified and experienced independent specialist as being rehabilitated to an acceptable condition (or as otherwise required by any project conditions of approval).

Approach to managing other impacts

Implementing other relevant measures provided in Chapters 13 and 15 (Groundwater), including the acid sulfate soils management plan, the dewatering management strategy and the leachate management strategy, would also assist in minimising the potential for water quality impacts during construction.

Expected effectiveness

The implementation of erosion and sediment control measures to manage water quality and hydrology impacts would be in accordance with the requirements of the Blue Book. The measures contained in the Blue Book are based on field experience, tailored to particular project types and have been extensively used and demonstrated to be effective. In general, the implementation of measures in accordance with the Blue Book will either result in a reduced potential for the impact to be realised or the impact will be avoided (eg not undertaking works during wet weather and minimising areas of disturbance). Therefore, there is no reason the proposed mitigation measures should not be effective, if implemented in accordance with the Blue Book requirements.

The approach to managing water quality within receiving watercourses has been developed with reference to the water quality management framework defined in the Water Quality Guidelines. This includes the approach to managing discharges of extracted groundwater and contaminated runoff to surface watercourses or other management and disposal methods which may be preferred by the appointed contractors. These guidelines provide a leading practice framework for managing water quality, therefore any mitigation measures developed through consideration of this framework would also be expected to be effective.

Monitoring and auditing would be undertaken during construction to ensure that the CEMP relevant sub-plans, and the monitoring program are being implemented.

16.6.2 List of mitigation measures

Measures that will be implemented to address potential impacts on surface water are listed in Table 16.8.

Table 16.8 Surface water mitigation measures

Impact/issue	Ref	Mitigation measure	Timing
Sedimentation and scour protection at Alexandra Canal	SW1	The potential for scour at bridge abutments will be considered for flow events up to and including the one per cent annual exceedance probability event. Scour protection will be included in the detailed design as required.	Detailed design
	SW2	Discharge outlets will be designed with appropriate energy dissipation and scour protection measures to minimise the potential for scour. Scour protection will be developed in consultation with relevant stakeholders, including Sydney Water.	Detailed design
	SW3	All works within or adjacent to Alexandra Canal will be managed in accordance with *Guidelines for Controlled Activities on Waterfront Land – Riparian corridors* (Department of Industry, 2018).	Construction
Water sensitive urban design	SW4	Appropriate treatment measures, including water sensitive urban design, will be considered in the detailed design with the aim of improving water quality within Alexandra Canal and/or achieving the targets outlined in the *Botany Bay and Catchment Water Quality Improvement Plan* (Sydney Metropolitan Catchment Management Authority, 2011).	Detailed design
	SW5	Surface water drains and associated infrastructure will be designed to prevent scour of soil, erosion and associated sedimentation impacts.	Detailed design
Monitoring water quality	SW6	A water quality monitoring program will be developed and implemented as part of the Construction Soil and Water Management Plan to monitor potential surface water quality impacts. The program will define: ▪ Monitoring parameters ▪ Monitoring locations ▪ Frequency and duration of monitoring.	Construction

Impact/issue	Ref	Mitigation measure	Timing
		The monitoring program will include ongoing baseline monitoring to determine the water quality of potential receiving waters prior to commencement of construction. Proposed discharge will be updated as required prior to construction based on the baseline data at the time. Water quality monitoring will continue for a minimum of 12 months following the completion of construction, or until affected watercourses are certified by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition (or as otherwise required by any project conditions of approval).	
Discharge to stormwater network	SW7	The performance of treatment systems required to treat construction water before discharge will be verified in relation to the established discharge criteria.	Construction
Release of sediment-laden water during works in northern ponds	SW8	Construction planning will ensure that operation of the sluice gate at the northern ponds outlet to Alexandra Canal is not affected by the works.	Construction

16.6.3 Managing residual impacts

Residual impacts are considered to be the impacts of the project that may remain in the medium to long term, after implementation of the design approaches described in Chapters 7 (Project description) and 8 (Construction) and the measures to mitigate and manage the identified potential impacts described in this chapter.

A summary of the potential residual soil and surface water impacts is provided in Table 16.9.

Table 16.9 Residual impacts – surface water

Potential residual impact	Management approach
The implementation of erosion control measures and devices during construction may result in potential impacts on overland flow paths and rates.	Impacts on overland flow paths are considered to be manageable, as all measures will be installed in accordance with the Blue Book.
Operation has the potential to result in an increase in water quality pollutants in Alexandra Canal	The project should aim to develop and implement treatment solutions to minimise impacts on overall water quality in the receiving waters during the detailed design phase.