Roads and Maritime Services/Sydney Airport Corporation Limited

Sydney Gateway Road Project

Environmental Impact Statement/ Preliminary Draft Major Development Plan

Technical Working Paper 5

Contamination and Soils

November 2019

Roads and Maritime Services

Sydney Gateway Road Project

Technical Working Paper 5 – Contamination and Soils

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Glossary

Acid sulfate soils (ASS)	Naturally occurring soils, sediments or organic substrates (eg peat) that are formed under waterlogged conditions. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, acid sulfate soils are benign. However, if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid.
ACM	Asbestos containing material
AEPR	Airports (Environment Protection) Regulation 1997
AHD	Australian height datum
Airports Act	*Airports Act 1996* (Commonwealth)
Alignment	The geometric layout (eg of a road or railway) in plan (horizontal) and elevation (vertical)
ANZECC (2000) Guidelines	Outlines the important principles, objectives and philosophical basis underpinning the development and application of the guidelines; • outlines the management framework recommended for applying the water quality guidelines to the natural and semi-natural marine and fresh water resources in Australia and New Zealand; • provides a summary of the water quality guidelines proposed to protect and manage the environmental values supported by the water resources; • provides advice on designing and implementing water quality monitoring and assessment programs; • has been revised using data, relevant literature, and other information available to at least 1996.
ANZG	Australian and New Zealand Guidelines 2018
Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater or water bearing rock
ASRIS	Australian Soils Resource Information System
ASSMAC	Acid sulfate soils Management Advisory Committee
ASSMP	Acid sulfate soils management plan
Botany rail line	A dedicated freight rail line that forms part of the Sydney Freight Network. The line extends from near Marrickville Station to Port Botany
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CEnvP(SC)	Environment Institute of Australia and New Zealand's Certified Environmental Practitioner (Site Contamination) scheme
CLM Act	*Contaminated Land Management Act 1997*
CMP	Contamination Management Plan
Construction	Includes all physical work required to construct the project.
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to, construction work areas, sediment basins, temporary water treatment plants, pre-cast yards and material stockpiles, laydown areas, parking, maintenance workshops and offices, and construction compounds.

Construction environmental management plan (CEMP)	Site-specific plan developed for the construction phase of the project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that the environmental risks are properly managed.
COPC	Contaminants of potential concern
CSM	Conceptual Site Model
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own.
Detailed design	The stage of design where project elements are design in detail, suitable for construction.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m_3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (eg metres per second (m/s)).
DPI	(NSW) Department of Industry
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
Drawdown	Reduction in the height of the water table caused by changes in the local environment.
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.
EIS	Environmental impact statement
Embankment	An earthen structure where the road (or other infrastructure) subgrade level is about the natural surface.
EPA	NSW Environmental Protection Authority
EP&A Act	*NSW Environment Planning & Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environmental Protection License
Erosion	Natural process where wind or water detaches a soil particle and provides energy to move the particle.
GSV	Gas Screening Values
Groundwater	Water that is held in rocks and soil beneath the earth's surface.
Hydraulic conductivity	A characteristic of soil that describes how easily water moves through it. Low hydraulic conductivity would indicate poor water transmitting properties.
Hydrology	The study of rainfall and surface water runoff processes.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil.
JOSF	Joint Oil Storage Facility
JUHI	Joint User Hydrant Installation

Leachate	Liquid that 'leaches' (drains) from a r stockpile.
LEP	Local Environmental Plan
LNAPL	Light non-aqueous phase liquid
Localised flooding	Localised flooding occurs when components of the drainage system are undersized or blocked and cannot accommodate the incoming overland surface flows, resulting in the flooding of a localised area.
LOR	Limit of reporting
LPI	NSW Government Land and Property Information
LTEMP	Long term environmental management plan
MDP	Major development plan
Methodology	The method for analysis and evaluation of the relevant subject matter.
mAHD	Metres Australian Height Datum
mBGL	Metres below ground level
mBGS	Metres below ground surface
NEPM 2013	The National Environment Protection (Assessment of Site Contamination) Measure 1999 (the ASC NEPM) amended 2013
New M5	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction).
NWQMS	The National Water Quality Management Strategy
OCP	Organochlorine pesticides
onsite	Within the confines of the project boundary
OPP	Organophosphorus pesticides
PAH	Polycyclic aromatic hydrocarbons
Pavement	The portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
PCB	Poly-chlorinated biphenyls
PFAS	Per-and poly-fluoroalkyl substances, which are manufactured chemicals used in products that resist heat, oil, stains and water. There are many types of PFAS, with the best-known examples being perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which were used in some fire-fighting foams.
PFAS NEMP	Heads of the EPA 2018 PFAS National Environmental Management Plan
PFHxS	perfluorohexane sulfonate
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.
Probability	A statistical measure of the expected chance or likelihood of occurrence.
Project	The construction and operation of the Sydney Gateway road project.
Project site	The area that would be directly affected by construction (also known as the construction footprint). It includes the location of operational project infrastructure, the area that would be directly disturbed by the movement of construction plant and machinery, and the location of the storage areas/compounds etc, that would be used to construct that infrastructure.

RAP	Remedial action plan
Risk	Chance of something happening that would potentially have an undesirable effect. It is measured in terms of consequence and likelihood.
Runoff	The amount of rainfall that ends up as streamflow, also known as rainfall excess.
Secretary's environmental assessment requirements (SEARs)	Requirements and specifications for an environmental assessment prepared by the Secretary of the Department of Planning and Environment under the *Environmental Planning and Assessment Act 1979* (NSW).
SEPP	State Environmental Planning Policy
Soil Water Management Plan (SWMP)	Key element in the overall Construction Environmental Management Plan and describes how to manage obligations and performance with regards to aspects and potential impacts associated with soil and water during the construction of the project.
Spoil	Material generated by excavation.
St Peters interchange	A component of the New M5 project, located at the former Alexandria Landfill site at St Peters. In its ultimate configuration, it would connect the New M5, the M4–M5 Link and the Sydney Gateway road project with Euston Road and Gardeners Road.
Stockpile	Temporary stored materials such as soil, sand, gravel and spoil/waste.
Study area	The study area is defined as the wider area including and surrounding the project site, with the potential to be directly or indirectly affected by the project (eg by noise and vibration, visual or traffic impacts). The actual size and extent of the study area varies according to the nature and requirements of each assessment and the relative potential for impacts.
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
SVOC	Semi-volatile organic compound
SWMP	Soil and water management plan
SWMS	Safe work method statement
Sydney Airport	Sydney Kingsford Smith Airport
Sydney Gateway	A NSW Government initiative to respond to the forecast growth of Sydney Airport and Port Botany. Sydney Gateway comprises road connections to Sydney Airport's domestic and international airport terminals from the Sydney motorway network at St Peters interchange (being delivered by Roads and Maritime).
Total Nitrogen	The sum of total kjeldahl nitrogen (ammonia, organic and reduced nitrogen) and nitrate-nitrite. It can be derived by monitoring for organonitrogen compounds, free-ammonia, and nitrate-nitrite individually and adding the components together.
Total Phosphorus	An essential nutrient of plant, animal and human. In water, it exists primarily as orthophosphate (PO43-) or in organic compounds. The parameter total phosphorus (TP) defines the sum of all phosphorus compounds that occur in various forms.
Total suspended solids	Total suspended solids is the dry-weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter that is analysed using a filtration apparatus.
TRH	Total recoverable hydrocarbons
VCH	Volatile chlorinated hydrocarbons

VENM	Virgin excavated natural material
VOC	Volatile organic compound
VRP	Voluntary remediation proposal
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).
WestConnex	WestConnex is a 33 kilometre-long, predominantly underground, motorway currently under construction in Sydney. The WestConnex program of works includes widening and extension of the M4 Western Motorway (the M4 Widening project); construction of two tunnels connecting Homebush Bay Drive with Wattle Street and Parramatta Road at Haberfield (M4 East); a new section of the M5 South Western Motorway including a new interchange at St Peters (the New M5 project); and a new inner western bypass of the Sydney central business district connecting the M4 and M5 (the M4–M5 Link project).

1. Introduction

1.1 Overview

1.1.1 Sydney Gateway and the project

Sydney Kingsford Smith Airport (Sydney Airport) and Port Botany are two of Australia's most important infrastructure assets, providing essential domestic and international connectivity for people and goods. Together they form a strategic centre, which is set to grow significantly over the next 20 years. To support this growth, employees, residents, visitors and businesses need reliable access to the airport and port, and efficient connections to Sydney's other strategic centres.

The NSW and Australian governments are making major investments in the transport network to achieve this vision. New road and freight rail options are being investigated to cater for the forecast growth in passengers and freight through Sydney Airport and Port Botany. Part of this solution is Sydney Gateway, which comprises the following road and rail projects:

- Sydney Gateway road project (the subject of this assessment)
- Botany Rail Duplication.

Sydney Gateway would expand and improve the road and freight rail networks to Sydney Airport and Port Botany to keep Sydney moving and growing. The Sydney Gateway road project forms part of the NSW Government's long-term strategy to invest in an integrated transport network and make journeys easier, safer and faster.

Roads and Maritime and Sydney Airport Corporation propose the Sydney Gateway road project (the project). The project comprises new direct high capacity road connections linking the Sydney motorway network at St Peters interchange with Sydney Airport's terminals and beyond. It involves constructing and operating new and upgraded sections of road connecting to the airport terminals, four new bridges over Alexandra Canal, and other operational infrastructure and road connections

The project and its location is shown on Figure 1-1.

1.1.2 Overview of approval requirements

The project is subject to approval under NSW and Commonwealth legislation. Parts of the project located on Commonwealth-owned land leased to Sydney Airport (Sydney Airport land) are subject to the Commonwealth *Airports Act 1996* (the Airports Act). In accordance with the Airports Act, these parts of the project are major airport development. A major development plan (MDP), approved by the Australian Minister for Infrastructure, Transport and Regional Development, is required before a major airport development can be undertaken at a leased airport.

Parts of the project located on other land are State significant infrastructure in accordance with the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). As State significant infrastructure, these parts of the project require approval from the NSW Minister for Planning and Public Spaces. An environmental impact statement (EIS) is required to support the application for approval for State significant infrastructure under the EP&A Act.

A combined EIS and preliminary draft MDP is being prepared to:

- Support the application for approval of the project in accordance with NSW and Commonwealth legislative requirements
- Address the environmental assessment requirements of the Secretary of the Department of Planning and Environment (the SEARs), issued on 15 February 2019
- Address the MDP requirements defined by section 91 of the Airports Act.

This report was prepared on behalf of Roads and Maritime and Sydney Airport Corporation to support the combined EIS/preliminary draft MDP.

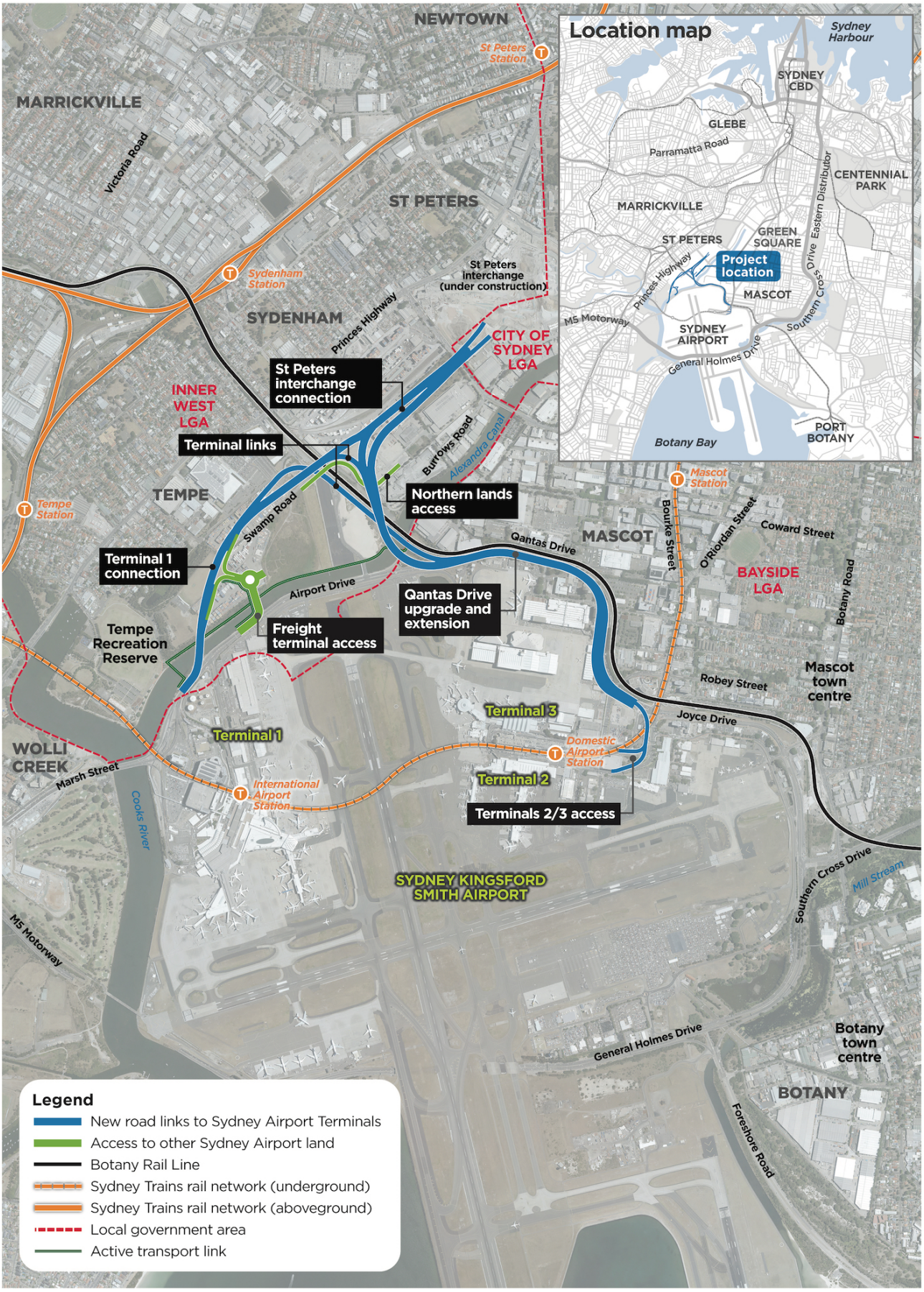


Figure 1-1 Location of the project

1.2 Purpose and scope of this report

The purpose of this technical working paper is to undertake an assessment of site contamination to consider whether the site is suitable for the proposed development and to identify the need for remediation. The assessment follows the policy framework for the assessment of site contamination in the National Environment Protection (Assessment of Site Contamination) Measure 1999 amended 2013 (NEPM 2013) approved by NSW Environmental Protection Authority (EPA) under section 105 of the *Contaminated Land Management Act 1997*.

This technical working paper is one of a number of technical documents that forms part of the combined EIS/preliminary draft MDP. This report addresses the SEARs relevant to matters of contamination and the MDP requirements according to the Airports Act in Table 1-1 and Table 1-2 respectively. To address the requirements of the combined EIS/preliminary draft MDP, the report identifies the potential impacts of the project and as necessary, outlines mitigation measures during detailed design, construction and operation of the project.

The objectives of the technical working paper are to:

- Identify and define areas of historical contamination within the project site which include:
  - The former Tempe Tip site
  - Alexandra Canal
  - Airport Land
- Identify impacts associated with these areas and determine whether remediation is required
- Outline mitigation and management measures for potential impacts during construction and operation associated with contamination.

The methodology for the assessment is described in section 3.

This report has not addressed occupational health and safety aspects for workers and contractors involved in the construction and operation of the project. Occupational health and safety aspects of the project would be managed separately under current occupational health and safety regulations and guidelines as outlined and enforced by SafeWork NSW.

Table 1-1 Secretary's Environmental Assessment Requirements relevant to this report

Requirements	Where addressed in this report
12. Contamination	
1. The Proponent must assess the potential for contamination and any impacts associated with the management of contaminated soils and water resources including, but not limited to: a) a detailed assessment of the extent and nature of any contamination of the soil, groundwater and soil vapour including from activities on Tempe Tip and PFAS; b) an assessment of potential risks to human health and the environmental receptors in the vicinity of the site c) a description and appraisal of any mitigation and monitoring measures; and d) consideration of whether the site is suitable for the proposed development.	(a) The existing extent and nature of contamination is provided in section 4 and in further detail in Appendices G to K. Refer to Technical Working Paper 16 – Landfill Assessment for further consideration of landfill gas within the former Tempe Tip site. (b) Potential risks during construction are provided in Table 6-1. Potential risks and impacts to human health from contamination are also considered in Technical Working Paper 15 – Human Health. (c) Section 9. (d) Section 5.3.

Requirements	Where addressed in this report
2. Any assessment of contamination must be in accordance with relevant guidelines produced or approved under the *Contaminated Land Management Act 1997*.	Section 2 describes the legislative and policy context relevant to the assessment of contamination across the project.
3. All reports prepared for the assessment of contamination must be prepared, or reviewed and approved, by a consultant certified under either the Environment Institute of Australia and New Zealand's Certified Environmental Practitioner (Site Contamination) scheme (CEnvP(SC)) or the Soil Science Australia Certified Professional Soil Scientist Contaminated Site Assessment and Management scheme.	Section 1.5
4. The Proponent must assess whether the land is likely to be contaminated and identify if remediation of the land is required, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses. Where assessment and/or remediation is required, the Proponent must document how the assessment and/or remediation would be undertaken in accordance with current guidelines.	A conceptual site model for individual study areas within the project are presented in Figure 5-1, Figure 5-2, Figure 5-3, Figure 5-4 and appendices section G8, H9, I8, J8 and K4. Section 5.3 presents an assessment of whether remediation is required. Section 9.4 outlines requirements for undertaking remediation.
13. Soils	
1. The Proponent must verify if the project is on land marked as Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map or within 500 m of adjacent Class 2, 3 or 4 land that is below 5 m Australian Height Datum (AHD) and where the project is likely to lower the water table in this adjacent land below 1 mAHD.	Section 4.5. Potential impacts on land where the water table is likely to be lowered is also addressed in Technical Working Paper 7 – Groundwater.
2. The Proponent must assess the impact of the project on acid sulfate soils (including the impacts of acidic runoff offsite) in accordance with the current guidelines.	Section 6.1.2. Technical Working Paper 7 – Groundwater.
3. The Proponent must assess whether salinity is likely to be an issue and if so, determine the presence, extent and severity of soil salinity within the project area.	Section 4.4.5.
4. The Proponent must assess the impacts of the project on soil salinity and how it may affect groundwater resources and hydrology.	Section 6.1.3.
5. The Proponent must assess the impacts on soil and land resources (including erosion risk or hazard). Particular attention must be given to soil erosion and sediment transport consistent with the practices and principles in the current guidelines.	Technical Working Paper 8 – Surface Water section 6.2, 7.2 and 7.5.
16. Hazard and Risk	
1. c) include a preliminary risk screening completed in accordance with SEPP 33.	Table 6-1 for construction impacts. Additional considerations during operation are discussed in Technical Working Paper 16 – Landfill Assessment)

Table 1-2 MDP requirements relevant to this assessment

MDP Key issues	Requirements	Where addressed in this report
Assessment of environmental impacts	(d) if a final master plan for the airport is in force—whether or not the development is consistent with the final master plan.	Section 6.3 and section 7.3.
Assessment of environmental impacts	(h) the airport-lessee company's assessment of the environmental impacts (soil and groundwater quality) that might reasonably be expected to be associated with the development.	Sections 6 and 7.
Plans for dealing with environmental impacts	(j) the airport-lessee company's plans for dealing with the environmental impacts (contamination) mentioned in paragraph (h) (including plans for ameliorating or preventing environmental impacts).	Section 9.

1.3 The Project

1.3.1 Location

The project is located about eight kilometres south of Sydney's central business district and to the north of Sydney Airport on both sides of Alexandra Canal. The northern extent of the project is located at St Peters interchange, which is currently being constructed to the north of Canal Road in St Peters. The western extent of the project is located near the entrance to Sydney Airport Terminal 1 on Airport Drive, to the north of the Giovanni Brunetti Bridge and south-west of Link Road. The eastern extent of the project is located near the intersection of Joyce Drive, Qantas Drive, O'Riordan Street and Sir Reginald Ansett Drive.

The project is located mainly on government owned land in the suburbs of Tempe, St Peters and Mascot, in the Inner West, City of Sydney and Bayside local government areas.

1.3.2 Key design features

The project provides a number of linked road connections to facilitate the movement of traffic between the Sydney motorway network, Sydney Airport Terminal 1 (Terminal 1) and Sydney Airport Terminals 2 and 3 (Terminals 2/3). The project would connect Terminal 1 and Terminals 2/3 with each other and with the Sydney motorway network. The project would also facilitate the movement of traffic towards Port Botany via General Holmes Drive. It would provide three main routes for traffic:

- Between the Sydney motorway network and Terminal 1, and towards M5 motorway and Princes Highway
- Between the Sydney motorway network and Terminals 2/3, and towards General Holmes Drive, Port Botany and Southern Cross Drive
- Between Terminal 1 and Terminals 2/3.

The key features of the project include:

- Road links to provide access between the Sydney motorway network and Sydney Airport's terminals, consisting of the following components:
  - St Peters interchange connection – a new elevated section of road extending from St Peters interchange to the Botany Rail Line, including an overpass over Canal Road
  - Terminal 1 connection – a new section of road connecting Terminal 1 with the St Peters interchange connection, including a bridge over Alexandra Canal and an overpass over the Botany Rail Line
  - Qantas Drive upgrade and extension – widening and upgrading Qantas Drive to connect Terminals 2/3 with the St Peters interchange connection, including a high-level bridge over Alexandra Canal

  - Terminal links – two new sections of road connecting Terminal 1 and Terminals 2/3, including a bridge over Alexandra Canal
  - Terminals 2/3 access – a new elevated viaduct and overpass connecting Terminals 2/3 with the upgraded Qantas Drive
- Road links to provide access to Sydney Airport land:
  - A new section of road and an overpass connecting Sydney Airport's northern lands either side of the Botany Rail line (the northern lands access)
  - New section of road, including a signalised intersection with the Terminal 1 connection and a bridge connecting Sydney Airport's existing and proposed freight facility either side of Alexandra Canal (the freight terminal access)
- An active transport link approximately 1.3 kilometres in length along the western side of Alexandra Canal to maintain connections between Sydney Airport, Mascot and the Sydney central business district
- Intersection upgrades or modifications
- Provision of operational ancillary infrastructure including maintenance bays, new and upgraded drainage infrastructure, signage and lighting, retaining walls, noise barriers, flood mitigation basin, utility works and landscaping.

1.3.3 Construction overview

A conceptual construction methodology has been developed based on the preliminary project design to be used as a basis for the environmental assessment process. Detailed construction planning, including programming, work methodologies, staging and work sequencing would be undertaken once construction contractor(s) have been engaged.

1.3.3.1 Timing and work phases

Construction of the project would involve four main phases of work. The indicative construction activities within each phase are outlined below.

Table 1-3 Construction work phases

Phase	Indicative construction activities
Enabling works	▪ Construction of the temporary active transport link ▪ Modification of various road intersections to facilitate main construction works.
Site establishment	▪ Installing site fencing, hoarding and signage ▪ Establishing construction compounds, work areas and site access routes.
Main construction works	▪ Clearing/ trimming of vegetation ▪ Removal (or partial removal) of a number of buildings and other existing infrastructure, e.g. concrete hardstand areas, drainage infrastructure, sheds, advertising structures, containers, etc ▪ Roadworks, including bridge and viaduct construction and drainage works ▪ Utility works.
Finishing works	▪ Erecting lighting, signage and street furniture, landscaping works and site demobilisation and rehabilitation in all areas.

Specific construction issues which would require careful planning and management and close co-ordination with relevant stakeholders include:

- Works within the prescribed airspace of Sydney Airport
- Works interfacing with the Botany Rail Line
- Piling in the vicinity of the T8 Airport and South line underground rail tunnels
- Works within the former Tempe Tip site and Alexandra Canal which are subject to remediation orders and specific management plans
- Excavation, storage and handling of contaminated soils generally within the project site and contaminated groundwater from the Botany Sands aquifer.

Construction is planned to start in mid-2020, subject to approval of the project, and is expected to take about three and a half years to complete. Further information on construction is provided in Chapter 8 (Construction) of the EIS.

The project would include work undertaken during recommended standard hours as defined by the Interim Construction Noise Guideline (DECC, 2009):

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no work.

It would also include work outside these hours (out-of-hours work) to minimise the potential for aviation and rail safety hazards.

1.3.3.2 Construction footprint

The land required to construct the project (the construction footprint) is shown on Figure 1-2. The construction footprint includes the land needed to construct the proposed roadways, bridges and ancillary infrastructure and land required for the proposed construction compounds. Utility works to support the project would generally occur within the construction footprint; however, some works (such as connections to existing infrastructure) may be required outside the footprint.

1.3.3.3 Compounds, access and resources

Construction would be supported by five construction compounds located to support the main construction works (shown on Figure 1-2). Construction compounds would include site offices, staff amenities, storage and laydown areas, workshops and workforce parking areas.

Materials would be transported to and from work areas via construction haul routes, which have been selected to convey vehicles directly to the nearest arterial road.

The construction workforce requirements would vary over the construction period based the activities underway and the number of active work areas. The workforce is expected to peak at about 1,000 workers for a period of about 13 months, indicatively from the fourth quarter of 2021. Either side of this peak, workforce numbers are expected to reduce to about two thirds.

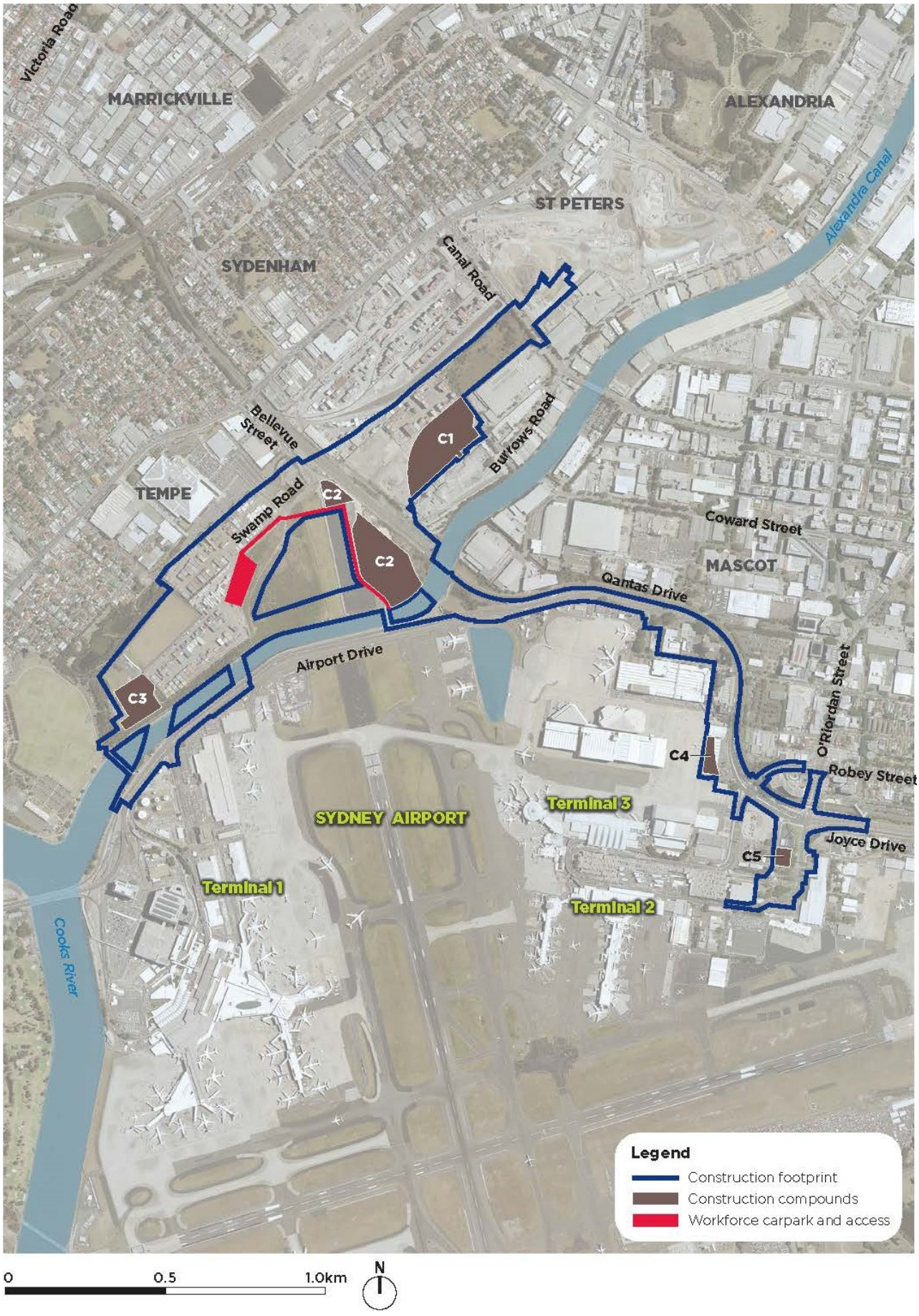


Figure 1-2 Construction footprint and facilities

1.4 Structure of this report

The structure of the report is outlined below.

- **Section 1 – Introductio**n – Provides an introduction to the report
- **Section 2 – Legislative and policy context** – Describes the legislative and policy framework governing the assessment of contamination impacts in NSW, including on land owned by the Australian Government (Commonwealth land)
- **Section 3 – Methodology** – Describes the methods and assessment criteria adopted in this report to characterise and assess potential contamination impacts on the project
- **Section 4 – Existing environment** – Describes the existing environment including surface water, groundwater, geomorphology, salinity, acid sulfate soils, water quality conditions, sensitive receptors, known contaminated sites and summary of previous contamination investigations (with evaluation of contamination presented in Appendix G to K)
- **Section 5 – Contamination assessment** – Describes the extent of investigation undertaken to date across the project site, provides a conceptual site model and identifies the need for additional assessment and/or remediation
- **Section 6 – Construction impacts** – Identifies and assesses potential contamination impacts from construction of the project
- **Section 7 – Operational impacts** – Identifies and assesses potential contamination impacts from operation of the project
- **Section 8 – Cumulative impacts** – Details combined impacts from construction and operation of the project as well as other infrastructure projects occurring in the surrounding area
- **Section 9 – Recommended mitigation and management measures** – Details recommended mitigation and management measures to reduce contamination impacts
- **Section 10 – Conclusion** – Overview of the key findings of the report.

The appendices also contain information relevant to the assessment and findings of this report.

1.5 Personnel

This investigation and report was prepared by Julie Porter and Dr Yliane Yvanes-Giuliani, with Technical Review undertaken by Andrew Kohlrusch and Stefan Charteris, a Certified Environmental Practitioner by the Environment Institute of Australia and New Zealand. Qualifications and years of experience of the authors are presented in Table 1-4.

Table 1-4 Author qualifications and experience

Name	Position/Role on project	Qualifications	Relevant experience (years)
Andrew Kohlrusch	Senior Technical Director Technical review	BSc (Geology Hons) NSW EPA and WA DWER Auditor	25+
Julie Porter	Principal Environmental Engineer Assessment and reporting	BEng (Civil Hons)	20+
Dr Yliane Yvanes-Giuliani	Environmental Scientist Investigation and reporting	PhD BSc (Environmental Hons)	5+

2. Legislative and policy context to this assessment

2.1 Commonwealth legislation

2.1.1 Airports Act 1996 and associated legislation

The project site includes areas of Commonwealth-owned land leased by Sydney Airport Corporation. The Airports Act and associated regulations provide the assessment and approval process for development on Commonwealth-owned land for the operation of Sydney Airport.

Section 89 of the Airports Act specifies types of development that constitute 'major airport development'. A major development plan (MDP) approved by the Australian Minister for Infrastructure and Transport is required before major airport development can be undertaken at a leased airport.

The Airports Act and regulations are the statutory controls for ongoing regulation of development activities on Commonwealth-owned land leased from the Australian Government for the operation of Sydney Airport. Section 70 of the Airports Act requires there to be a final master plan for the airport that has been approved by the Australian Minister for Infrastructure and Transport.

Part 5 of the Act also requires that each airport develop an environment strategy which is included in its master plan. Once approved, Sydney Airport and all persons who carry out activities at the airport are obliged to take all reasonable steps to ensure compliance with the environment strategy.

2.1.1.1 Sydney Airport Master Plan 2039

As part of the planning framework established by the Airports Act, airport operators are required to prepare a master plan for the coordinated development of their airport. Sydney Airport Master Plan 2039 (Master Plan 2039) outlines the strategic direction for Sydney Airport's operations and development over the next 20 years. It acknowledges that the continued growth of Sydney Airport is vital to achieving local, state and national employment, tourism and development objectives. In accordance with the requirements of the Airports Act, Master Plan 2039:

- Establishes the strategic direction for efficient and economic development at Sydney Airport over the planning period
- Provides for the development of additional uses of the Sydney Airport site
- Indicates to the public the intended uses of the Sydney Airport site
- Reduces potential conflicts between uses of the Sydney Airport site, to ensure that uses of the site are compatible with the areas surrounding the airport
- Ensures that operations at Sydney Airport are undertaken in accordance with relevant environmental legislation and standards
- Establishes a framework for assessing compliance with relevant environmental legislation and standards
- Promotes continual improvement of environmental management at Sydney Airport.

The Master Plan refers to the following Environmental Objectives for Contaminated Land:

- Prevent pollution from on-airport activities
- Actively manage and prevent soil and groundwater contamination
- Manage known and suspected contaminated sites.

2.1.1.2 Sydney Airport Environment Strategy 2019–2024

The Airports Act requires that airport operators provide an assessment of the environmental issues associated with implementing the airport master plan and the plan for dealing with those issues. This is documented in an environment strategy that forms part of the airport's master plan. The Sydney Airport Environment Strategy 2019–2024 (the Environment Strategy), which forms part of Master Plan 2039, provides strategic direction for the environmental performance and management of Sydney Airport for the five-year period between 2019 and 2024. The purpose of the Environment Strategy is to:

- Establish a framework for assessing compliance and ensuring that all operations at Sydney Airport are undertaken in accordance with relevant environmental legislation and standards
- Promote the continual improvement of environmental management and performance at Sydney Airport and build on the achievements and goals of previous strategies
- Realise improvements in environmental sustainability, by minimising Sydney Airport's environmental footprint and working towards a more efficient and resilient airport.

The Sydney Airport site is known to be impacted by per- and poly-fluoroalkyl substances (PFAS). The predominant known source of PFAS on the airport is historic use of certain foams used by firefighting service providers during fire training exercises. Due to the widespread use of PFAS within a number of industrial applications, there is potential that PFAS found on the airport site are from other sources, including those originating from off-site.

The soil and land management five-year action plan (Sydney Airport Environmental Strategy section 3.11.5) presented for contamination includes the following action items relevant to the project:

- Buildings and infrastructure would be planned and designed to minimise disturbance and potential impacts on soil and contaminated land where possible
- Ensure each site has a comprehensive conceptual site model
- Continue to ensure that fill material is reused and managed where appropriate in accordance with the Heads of the EPA 2018 PFAS National Environmental Management Plan, PFAS NEMP (2018) and the Airports (Environment Protection) Regulations 1997 or disposed of in line with applicable waste classification guidelines under the *NSW Protection of the Environment Operations Act 1997*
- Where required, assess potential soil quality and contaminated land impacts and identify appropriate management measures for both the construction and operational phase of developments
- Undertake training of tenants, contractors and project managers in relation to the identification and management of soil and land contamination.

The overall key performance indicator adopted for contamination is reduction (through management/remediation) of the number of contaminated sites.

2.1.2 Airports (Environment Protection) Regulations 1997

The objective of the Airports (Environment Protection) Regulations 1997 (the regulations) is to establish a system of regulation for activities at airports that generate or have potential to generate pollution or excessive noise. The regulations impose a general duty to prevent or minimise environmental pollution and have as one of their objects the promotion of improved environmental management practices at Commonwealth-leased airports. The regulations contain detailed provisions setting out:

- Definitions, acceptable limits and objectives for air, water and soil pollution, and offensive noise
- General duties to prevent or minimise pollution, preserve significant habitat and cultural areas, and to prevent offensive noise
- Monitoring and reporting requirements for existing pollution.

Part 2 of the regulations defines pollution in relation to air (including odour), water, soil and offensive noise. Schedule 2 and Schedule 3 of the regulations provide the acceptable limits of pollutants in water and soil, which, in conjunction with other national environment protection measures, provide the system of environmental regulation at airports.

The guideline contains two sets of limits applicable to groundwater contamination, presented in Schedule 2 water pollution accepted limits. The values presented in Schedule 2 water pollution acceptable limits for marine waters (AEPR groundwater) were considered as water from the project would ultimately discharge into Alexandra Canal, Cooks River and Botany Bay which are affected by tidal waters.

The guideline contains two sets of limits applicable to soil contamination, presented in Schedule 3 soil pollution acceptable limits. The values presented in Schedule 3, Table 1 for areas of an airport generally (AEPR soil) have been considered since the project does not encroach on any Sydney Airport designated areas of environmental significance.

2.1.3 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is administered by the Australian Department of the Environment and Energy and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as 'matters of national environmental significance'.

Under the EPBC Act, proposed actions (ie activities or projects) with the potential to significantly impact matters protected by the EPBC Act must be referred to the Australian Minister for the Environment to determine whether they are controlled actions, requiring approval from the Minister. The following matters are defined as protected matters by Part 3 of the EPBC Act:

- Matters of national environmental significance
- The environment of Commonwealth land
- The environment in general if they are being carried out by an Australian Government agency.

As part of the assessment of the draft MDP, the Department of Infrastructure, Transport, Cities and Regional Development (DITCRD) would, on behalf of the Minister for Infrastructure, Transport and Regional Development, seek advice from the Australian Minister for Environment (NSW) under section 160(1) of the EPBC Act.

The EPBC Act has been considered in this assessment through an assessment of whether project activities are likely to have significant impacts on the environment. The Department of Sustainability, Environment, Population Water and Communities 2013 '*Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies significant impact guidelines 1.2 Environment Protection and Biodiversity Conservation Act 1999*' (DSEPWC 2013), Step 4 identifies a list of criteria are intended to provide general guidance on the types of actions that are likely to have a significant impact on the environment. For this paper (contamination) the assessment considers with respect to pollutants, chemicals, and toxic substances present on the land whether there is a real chance or possibility that the project would:

- Generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality
- Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal
- Substantially disturb contaminated or acid-sulphate soils.

2.2 State legislation

2.2.1 Environmental Planning and Assessment Act 1979 (NSW)

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is administered by the NSW Department of Planning, Industry and Environment and includes provisions for the assessment of development and infrastructure projects.

State Significant Infrastructure (SSI) projects are high priority infrastructure projects that are essential to the State for economic, social or environmental reasons. SSIs must receive ministerial approval under Division 5.2 of the Act.

Under the EP&A Act and regulations, the planning secretary is required to issue environmental assessment requirements (SEARs) when an application for approval of an SSI project is made. The Act also requires that an EIS be prepared by the proponent according to the SEARs.

The project meets the definition of SSI in accordance with Division 5.2 of the EP&A Act, and by operation of clause 14(1) and Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011, and clause 94 of State Environment Planning Policy (Infrastructure) 2007.

SEARs were issued for the project on 15 February 2019. The SEARs section relevant to this assessment are addressed in Table 1-1.

2.2.2 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) is part of the management framework for contaminated land in NSW. The Act enables the EPA to respond to and manage site contamination when it considers that contamination is significant enough to require regulation. Site contamination requires regulation under the Act when a site is declared 'significantly contaminated land' or when land is subject to a management order on an approved voluntary management proposal.

Section 105 of the CLM Act allows the EPA to make or approve guidelines for the purposes connected with the objectives of the Act (refer, to NSW EPA website - contaminated land for current list of endorsed guidelines).

Contaminated sites not regulated by EPA can be managed through the planning process by the relevant planning consent authority (normally local councils).

2.3 National guidelines and strategies

2.3.1 National Environment Protection (Assessment of Site Contamination) Measure 1999

The NEPM 2013 is given effect by individual legislation and guidelines in each state and territory. The purpose of the NEPM is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, land owners, developers and industry.

Authorities that consent to developments, or changes in land use, should ensure a site that has a history of use that is indicative of potential contamination, is suitable for its intended use.

With respect to assessing site investigation results, health and ecological criteria suitable for generic land uses have been provided in *Schedule B1, Investigation Levels for Soil and Groundwater* (NEPM, 2013). The criteria for a commercial/industrial land use have been considered for the project. The investigation and screening levels presented in the NEPM are not clean-up or response levels, nor are they desirable soil quality criteria. Investigation levels presented in the NEPM may not be protective of intrusive or construction workers on the site. Assessment for intrusive or construction workers would be undertaken in accordance with responsibilities under relevant Occupational Health and Safety legislation and relevant industry guidelines.

2.3.2 PFAS National Environmental Management Plan

Per- and poly-fluoroalkyl substances, also known as PFAS, are a group of manufactured chemicals that have been used since the 1950s in a range of common household products and specialty applications, including in the manufacture of non-stick cookware; fabric, furniture and carpet stain protection applications; food packaging; some industrial processes; and in some types of fire-fighting foams. There are many types of PFAS, with the best known examples being perfluorooctane sulfonate, known as PFOS, and perfluorooctanoic acid, known as PFOA and perfluorohexane sulfonate, known as PFHxS.

Because these chemicals have been used for decades, PFAS are found widely in the land and water environments around the world. People are exposed to small amounts of PFAS in everyday life through exposure to dust, indoor and outdoor air, food, water and contact with consumer products that contain these chemicals. For most people food is thought to be the primary source of exposure[1].

More recently, PFAS have been found at sites where there has been historic use of fire-fighting foams that contained PFAS. Over time, these chemicals have worked their way through the soil to contaminate surface and ground water, and have migrated into adjoining land areas. The release of PFAS into the environment is an emerging concern, because these chemicals are highly persistent, have been shown to be toxic to fish and some animals, and can accumulate in the bodies of fish, animals and people who come into contact with them. However, there is currently no consistent evidence that exposure to PFAS causes adverse human health effects[2].

The Heads of EPA of Australia and New Zealand (HEPA) PFAS National Environmental Management Plan 2018 (PFAS NEMP) provides governments with a consistent, practical, risk-based framework for the environmental regulation of PFAS contaminated materials and sites. The PFAS NEMP has been developed as an adaptive plan, able to respond to emerging research and knowledge.

The PFAS NEMP is a reference on the state of knowledge related to the environmental regulation of PFAS. It represents a how-to guide for the investigation and management of PFAS contamination and waste management, including recommended approaches, which would be called upon to inform actions by the EPA and other regulators.

With respect to assessing site investigation results, health and ecological criteria suitable for generic land uses have been provided in Table 1 to Table 5 of the PFAS NEMP. The soil criteria for a commercial/industrial land use in Table 2 and Table 3 of the PFAS NEMP has been considered for the project.

The target water quality objectives outlined in Technical Working Paper 8 – Surface Water are; 80 per cent protection of marine water ecosystems for Alexandra Canal and Mill Pond. A conservative target of 95 per cent protection of marine water ecosystems will be adopted for chemicals that bioaccumulate in wildlife. The Stockholm Convention scientific body, the Persistent Organic Pollutants Review Committee, has concluded that perfluorohexane sulfonate (PFHxS) meets the screening criteria for persistence and bioaccumulation. As a precautionary approach, the 95 per cent protection of marine water ecosystems will be adopted as groundwater assessment criteria for all PFAS compounds.

2.3.3 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) aims to protect the nation's water resources by improving water quality while supporting the businesses, industry, environment and communities that depend on water for their continued development. The main policy objective of the NWQMS is to achieve sustainable use of water resources, by protecting and enhancing their quality, while maintaining economic and social development.

The NWQMS includes water quality guidelines that define desirable ranges and maximum levels for certain parameters that can be allowed (based on scientific evidence and judgement) for specific uses of waters or for protection of specific values. They are generally set at a low level of contamination to offer long-term protection of environmental values. The NWQMS water quality guidelines include the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) and the Australian Drinking Water Guidelines (NHMRC, 2011).

[1] *enHealth Guidance Statements on Perfluorinated Chemicals*
[2] *https://www.health.gov.au/internet/main/publishing.nsf/Content/ohp-pfas.htm*

2.3.4 Australian and New Zealand Guidelines for fresh and marine water quality

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) were prepared as part of the NWQMS. The guidelines provide a process for developing water quality objectives required to sustain current or likely future environmental values for natural and semi-natural water resources.

The ANZECC (2000) guidelines use a number of terms to refer to levels of assessment for water quality:

- Water quality guidelines – A water quality guideline is a numerical concentration limit or narrative statement recommended to support and maintain a designated water use or environmental value
- Water quality objectives – A water quality guideline was defined above as a numerical concentration limit or descriptive statement recommended for the support and maintenance of a designated water use or environmental value. Water quality objectives take this a step further. They are the specific water quality targets agreed between stakeholders, or set by local jurisdictions, that become the indicators of management performance. For this project these objectives were defined by the NSW Water Quality and River Flow Objectives (DECCW, 2006) described in section 4.4.2.
- Guideline trigger values – The ANZECC (2000) guidelines adopt a risk-based approach that is intended to improve the application of guidelines to all Australian and New Zealand aquatic environments. It uses decision frameworks (particularly for the protection of aquatic ecosystems) that help users tailor water quality guidelines to local environmental conditions. As such, the old 'single number' triggers (see ANZECC 1992) are regarded as guideline trigger values that can be modified into regional, local or site-specific guidelines.

Guideline trigger values are concentrations that, if exceeded, would indicate a potential environmental problem, and so 'trigger' a management response, eg further investigation and changes to site practices and controls in response to exceedances. Subsequent refinement of the guidelines according to local conditions may be required.

The ANZECC (2000) guidelines acknowledge that different levels of protection may be appropriate for different water bodies. For aquatic ecosystems, the ANZECC (2000) guidelines provide more detailed guidance on the level of protection to be achieved by the selected water quality guidelines. For aquatic ecosystems, three categories of ecosystem condition are identified:

- High conservation or ecological value systems
- Slightly to moderately disturbed systems
- Highly disturbed systems.

It should be noted that in 2018, the ANZECC (2000) guidelines were revised to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). The updated guidelines are available at www.waterquality.gov.au/anz-guidelines. As at January 2019, the default guideline values for various toxicants in ANZG 2018 are the same as the ANZECC (2000) guidelines.

The environmental values and water quality objectives adopted for the project are provided in Technical Working Paper 8 – Surface Water (section 4). The target water quality objectives outlined in Technical Working Paper 8 – Surface Water is 80 per cent protection of marine water ecosystems for Alexandra Canal and Mill Pond.

The ANZECC 2000 establishes a guide for setting water quality objectives for surface water resources required to sustain environmental values and the guideline values represent target concentrations within the surface water resource (or surface water body). The ANZECC 2000 guidelines have been considered as a conservative trigger value for groundwater. Alexandra Canal is the receiving surface water body for groundwater within the project site therefore criteria for an 80 per cent protection of marine water ecosystems (for a highly disturbed system) has been considered (ANZECC). For bioaccumulative toxicants, based on the precautionary principle, a more stringent 95 per cent level will be considered. Bioaccumulative toxicants include PFAS, polychlorinated biphenyls (PCBs), some pesticides, lead, cadmium, mercury, dioxins, furans, benzo(a)pyrene, hexachlorobenzene and chlorobenzenes.

2.4 Other guidelines and strategies

2.4.1 Acid Sulfate Soils Assessment Guidelines

The management of acid sulfate soils (ASS) is coordinated by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC). This committee is made up of representatives from various government organisations and other affected parties. The Committee published the Acid Sulfate Soil Guidelines (ASSMAC, 1998) to provide best practice guidance in the assessment and management of projects in areas potentially affected by ASS in NSW. The guidelines set out a stepwise process to decide whether ASS are present on site, how to mitigate potential impacts and how to prepare documentation to gain approval for works disturbing ASS.

2.4.2 Managing Asbestos in or on Soil

Managing Asbestos in or on Soil (SafeWork NSW, 2014) provides general guidance on the assessment of asbestos in soil. Managing asbestos in soil has implications for the current and future occupants of the land/or any worker employed on the site. The principles underlying the guidance in this document are those endorsed by the NSW Heads of Asbestos Coordination Authorities (HACA) and contained in the NSW Asbestos Blueprint (SafeWork NSW, 2017). Work health and safety, land use planning and environmental legislation, and NEPM 2013 are referenced where they apply.

The objective of the guideline is to ensure that proportionate and practicable controls are applied in accordance with regulatory requirements and in a manner commensurate with actual risk.

The NEPM 2013 emphasises that the assessment and management of asbestos contamination should take into account the condition of the asbestos materials, the potential for damage, and resulting release of asbestos fibres. Bonded asbestos in sound condition represents a low human health risk. However, both friable and fibrous asbestos materials have a significantly higher potential to generate, or be associated with, free asbestos fibres, and may represent a significant human health risk if disturbed and fibres are made airborne.

2.4.3 Guideline for the Assessment and Management of Sites Impacted by Hazardous Ground Gases

The Guideline for the Assessment and Management of Sites Impacted by Hazardous Ground Gases (EPA, 2012) provides guidance for assessment and management of ground gas conditions that may emanate from potentially contaminated sites. The guideline provides a risk assessment framework to determine the level of risk posed by ground gas for a site. The guideline presents six risk rankings referred to as characteristic gas situations (ranking from 1 to 6) with characteristic gas situation 1 being the lowest risk.

Under the guideline, the completion of a preliminary gas risk assessment for a proposed development requires the calculation of a gas screening value (GSV) to generate a characteristic gas situation such that the level of gas protection measures required may be defined. The GSV is equivalent to the maximum borehole flow rate (L/hr) multiplied by the maximum gas concentration (per cent) and is required to be calculated for both methane and carbon dioxide with the worst case adopted.

3. Methodology

3.1 Approach

This section outlines the methodology for the assessment of contamination at the project site, to consider whether the site is suitable for the proposed development and to identify the need for remediation or any other mitigation measures.

The assessment follows the framework for the assessment of site contamination outlined in the NEPM 2013. As stated in the NEPM, the purpose of site assessment is to determine whether site contamination poses an actual or potential risk to human health or the environment, either on or off the site. The objective of the assessment is to determine whether the contamination is of sufficient magnitude to warrant remediation, based on the proposed land use.

The NEPM 2013 states that 'the preliminary investigation and initial assessment of site contamination should consider the possibility of all forms of potential contamination based on past use. The preliminary investigation should be sufficient to identify whether contamination exists on the site. A detailed site investigation is required when the results of preliminary investigation are insufficient to enable site management strategies to be devised. Depending on the proposed use and the results of initial site history investigations, the assessment of a site may involve both preliminary and detailed investigations. Many site investigations proceed in multiple stages due to the complexity of the site and the discovery of unexpected contamination.' For the purpose of this technical working paper, the staged process presented in NEPM 2013 is summarised in Figure 3-1.

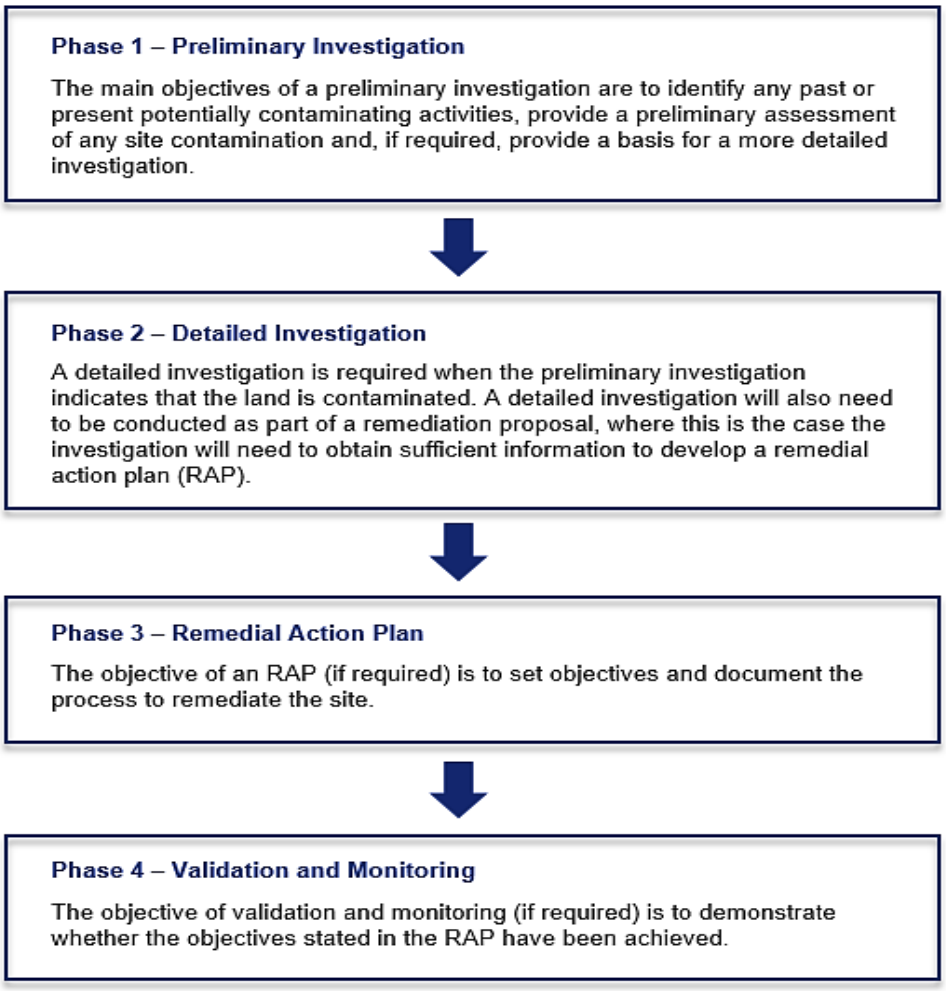


Figure 3-1 Staged site investigation process

This report comprises a preliminary (also referred to as Phase 1) investigation which assesses the potential for contamination to exist based on a desktop study and review of over 60 previous detailed site investigation (also referred to as Phase 2) reports/assessments. Numerous guidelines and screening values have been adopted in the previous reports which are referenced in Appendix A. This report also documents the results of a targeted (Phase 2) intrusive site investigation at 66 soil bore locations within the project site undertaken by Roads and Maritime between November 2018 and May 2019.

The approach to contamination outlined in the AEPR 1997 is consistent with the NEPM 2013. The assessment of site contamination should include a consideration of risks to water resources and other ecological risks. During the assessment, the on-site and off-site impacts of contamination should be appropriately managed to prevent adverse impacts, particularly impacts relating to air emissions, surface water and groundwater.

3.2 Contamination assessment

The contamination investigation has comprised the following:

- A preliminary screening of information pertaining to historical contamination, and subsequent identification of individual contamination assessment areas based on specific characteristics and issues
- A review of available information to identify potentially current or historical contaminating land uses
- An inspection of the project site by an environmental scientist to compare site conditions to the conditions documented in historical reports and to identify potential sources of contamination along the road alignment
- A review of previous investigation reports undertaken within the project site (listed in Appendix A)
- A review of intrusive investigations undertaken by Roads and Maritime along the road alignment. Tier 1 screening of the results was conducted using the guidelines presented in Appendix B. This investigation included sampling at 66 soil bore locations. The investigation also included the installation of 34 groundwater monitoring wells and 20 landfill gas monitoring wells
- Development of a preliminary conceptual site model (CSM) for the individual contamination assessment areas identifying potential contamination sources, receptors and exposure pathways associated with the current land use. The CSM is a key component of contaminated site assessment and provides the framework for identifying how potential receptors may be exposed to contamination from historical or current site sources
- Identify and assess additional CSM pollution linkages associated with the construction and operation of the project to inform the impact assessment of the project
- Preparation of this technical working paper documenting the desktop and intrusive investigation results, the impact assessment and mitigation measures.

In preparing this technical working paper, the following sources of information were reviewed:

- A selection of relevant historical aerial photographs from NSW Government Land and Property Information covering the project site
- NSW EPA register of contaminated sites and list of notified sites under Section 58 or Section 60 of the *CLM Act* within 500 metres of the project site
- EPA publicly available records under Section 308 of the *Protection of the Environment Operations (POEO) Act 1997* relating environmental protection licences (EPLs) within 500 metres of the project site
- Maps published by the Geological Survey of NSW, former Department of Conservation and Land Management and Australian Soils Resource Information System (ASRIS) of the area to gain an understanding of surface and subsurface conditions (eg geology, hydrogeology, soil landscape, topography etc)
- WaterNSW database for registered groundwater bores within the project site and in the vicinity of the project site

- Existing investigation reports relevant to the project site (as made available by Roads and Maritime)
- Results for investigations undertaken by Roads and Maritime between November 2018 and May 2019 completed at 66 soil bore locations.

3.2.1 Definition of individual contamination assessment areas

Based on a preliminary review of the contamination history across the project site, five contamination assessment areas have been defined for assessment purposes. The areas were divided to separate Commonwealth and State land which are subject to different legislation and criteria. Also, the extent of existing investigation, assessment and remediation reporting available for individual areas was considered.

The five individual contamination assessment areas identified for assessment are described below:

- **Project Area 1 – former Tempe Tip site** – extending from Holbeach Avenue/Smith Street in the west and to the high intensity approach lighting strip of Sydney Airport in the east. The former tip extends to Alexandra Canal in the south and towards South Street in the north. (State land)
- **Project Area 2 – Sydney Airport northern lands car park** – extending from former Tempe Tip site in the west towards the Botany Rail Line corridor and Swamp Road in the east. The car park extends to Alexandra Canal in the south and Swamp Road in the north. (Sydney Airport Land)
- **Project Area 3 – Sydney Airport northern lands** – extending from the Botany Rail Line in the west and Canal Road in the east. The project area is bound by the rail siding tracks for the Cook River Intermodal Terminal in the north and extends to Alexandra Canal in parts in the south. (Sydney Airport Land). The extent of this project area encroaches slightly beyond the Sydney Airport land boundary to the north into Cooks River terminal and to the southwest into Boral Concrete.
- **Project Area 4 – Sydney Airport land** – extending south of Alexandra Canal along Airport Drive and Qantas Drive. (Sydney Airport Land)
- **Project Area 5 – Alexandra Canal** – between the footbridge connecting Airport Drive to Tempe Recreation Reserve in the west and the Port Botany bridge crossing in the east. (State land).

The following additional land parcels located within the project site are discussed in this report, however a dedicated contamination assessment has not been conducted. An assessment for these areas is presented in section 5.3; however, a separate background study section is not provided.

- **Rail Corridor** – **ARTC Land –** extending from Alexandra Canal in the south and as far as the Ikea premises to the north. No previous contamination assessment reports were made available for this section of rail corridor
- **New M5 – Interchange tie-in -** a portion of the project site extends beyond Canal Road to the north-east, referred to as St Peters Interchange tie-in. In this area, limited ground disturbance would be required with activity primarily comprising tie-in to existing infrastructure being constructed by a separate consortium - the New M5 project. The New M5 project has already been assessed and approved as part of the New M5 project determination.

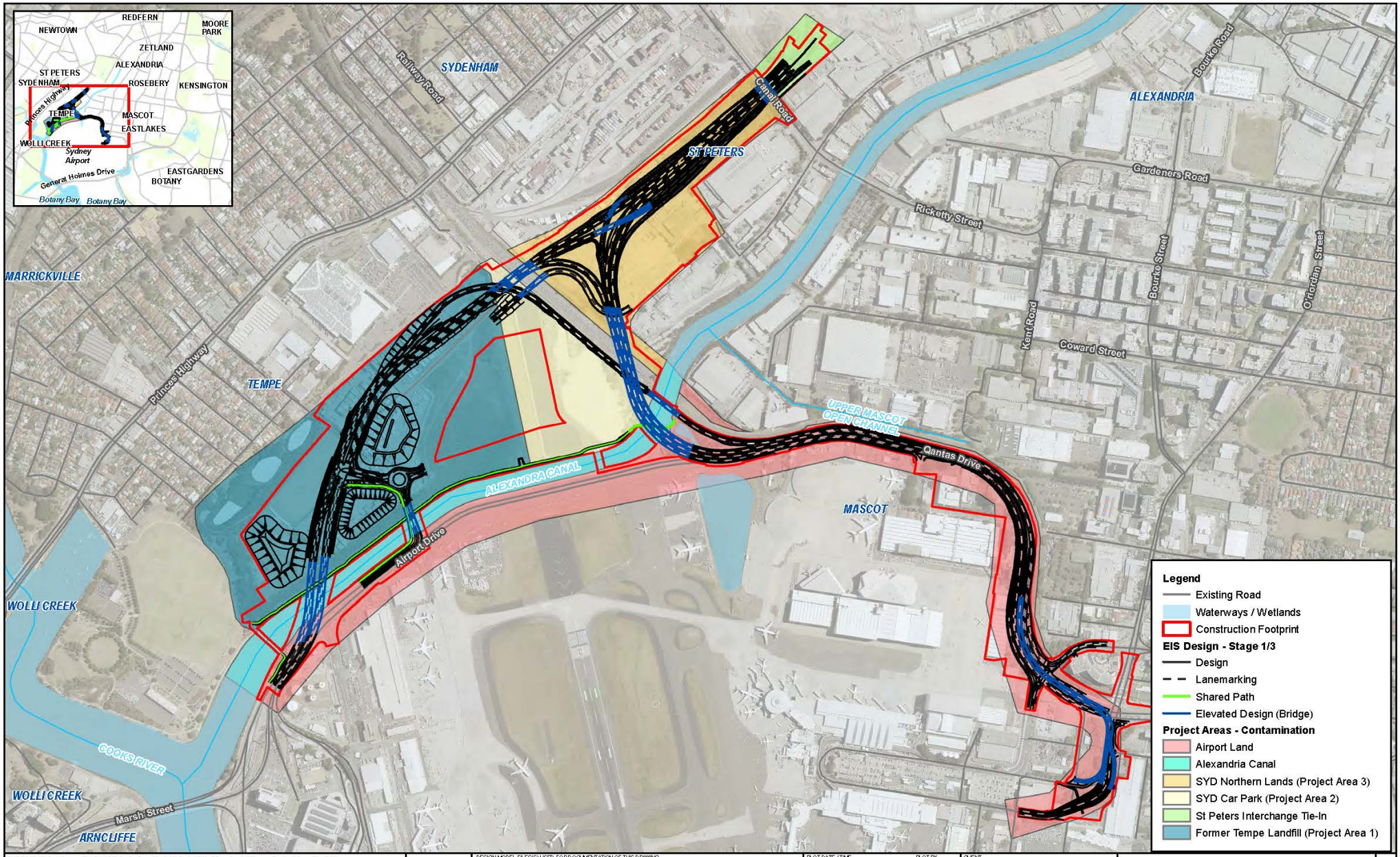
Contamination assessment areas are shown on Figure 3-2 overleaf.

3.2.2 Impact assessment and mitigation

As detailed in the NEPM 2013, the development of a CSM is a key component of contaminated site assessment and provides the framework for identifying how potential receptors may be exposed to contamination and the relevant data needs. The preliminary CSM for each individual contamination assessment area is used to inform the assessment of construction impacts, operational impacts and site suitability. Additional source-pathway-receptor linkages associated with construction and operation are highlighted in the assessment.

The construction phase impact assessment sets out to identify potential contamination impacts based on the current understanding of the likely construction methodology. A qualitative risk ranking is used to identify the potential severity of the impact. Mitigation measures are proposed to minimise, mitigate and manage potential impacts, as relevant.

To assess potential impacts during operation of the project, the impact of a change in land use, site suitability and potential constraints for implementing future remedial action (if required) were considered.



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DESIGN LOT CODE

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

PLOT DATE / TIME 31/07/2019 9:43:33 AM

PLOT BY DN

CLIENT

SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A1	08/05/2019	Contaminated Sites
A2	08/07/2019	Contamination Assessment Areas
A3	31/07/2019	Contamination Assessment Areas

MW R No.

APPROVAL

SCALES ON A1 SIZE DRAWING

0 75 150 m

1:8,500

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY

wsp GHD

DRG No.

	TITLE	NAME	DATE
DRAWN	D NAIKEN		31.07.2019
DRG CHECK	Y.YVANES-GILLIAN		31.07.2019

PREPARED FOR

Transport Roads & Maritime Services

Contamination Impact Assessment

Figure 3-2

Contamination Assessment Areas

RMS REGISTRATION No.

PART

ISSUE STATUS: FOR INFORMATION

EDMS No.

SHEET No.

ISSUE: A3

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4. Existing environment

4.1 Surrounding land use

The information in the following section is based on publicly available information and observations made during the project site inspection on 5 December 2018.

The Sydney Gateway road project spans approximately six kilometres along Qantas Drive and Airport Drive in Mascot and between the New M5 St Peters interchange and Airport Drive in St Peters and Tempe in south-eastern Sydney.

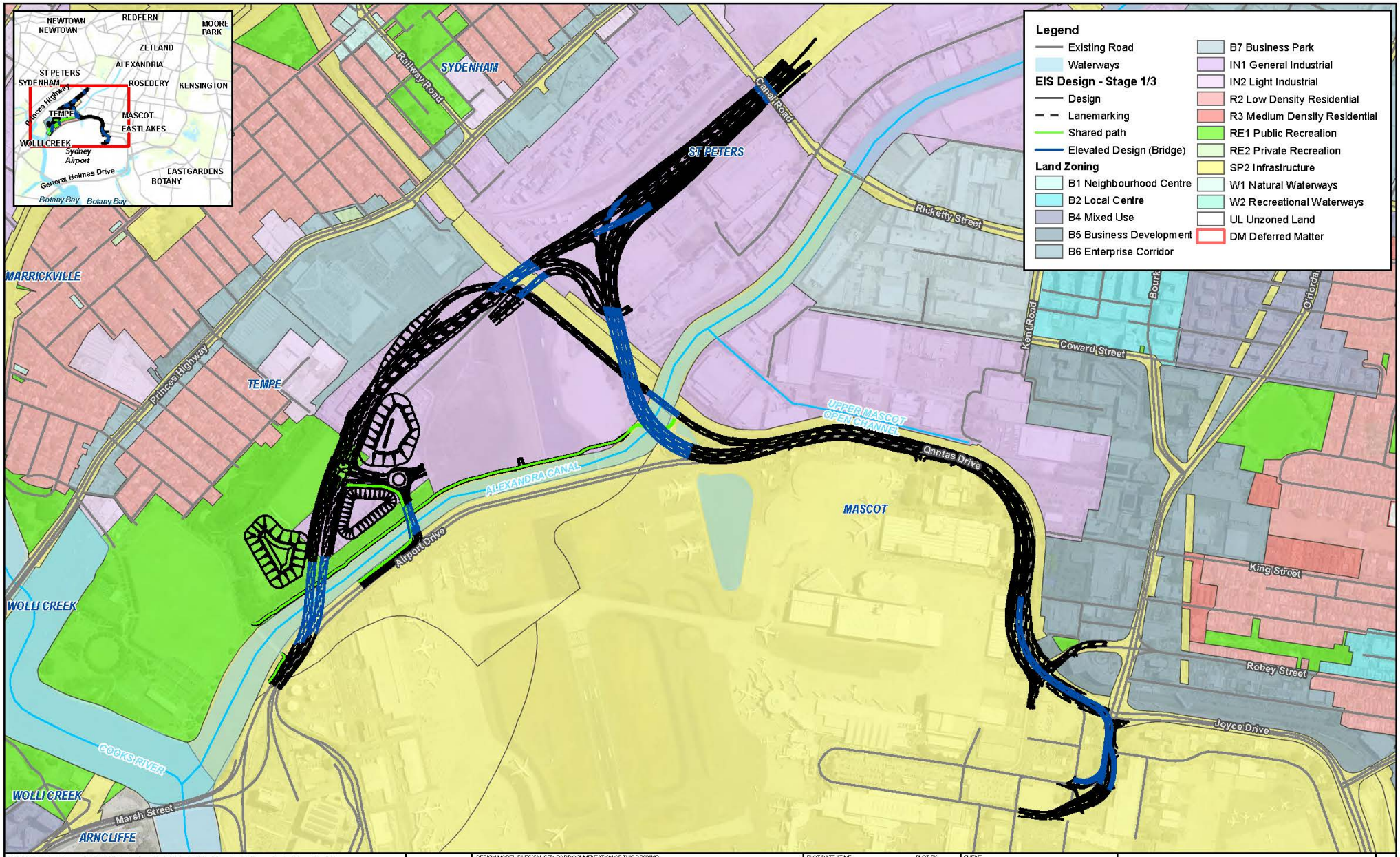
The project site lies within a range of land zonings as classified under the Marrickville Local Environmental Plan (LEP) 2011, the City of Sydney LEP (2012) and the Botany Bay LEP (2013):

- SP2 – Infrastructure, Airport
- SP2 – Infrastructure, Classified Road
- SP2 – Infrastructure, Stormwater Management
- SP2 – Infrastructure, Air transport facilities
- SP2 – Infrastructure, Rail Infrastructure facilities
- RE1 – Public Recreation
- IN1 – General Industrial.

The surrounding area comprises mixed land uses such as residential (low density residential), recreational (public and recreational waterways), commercial (enterprise corridor, business development and neighbourhood centre) and industrial (general and light industrial) land uses. Land uses surrounding the project site are shown on Figure 4-1.

Under the current Sydney Airport Master Plan 2039, the project site lies within the following Sydney Airport land zones:

- AD2 – Airport terminal and support services
- AD3 – Airport logistics and support
- BD1 – Business Development.



DATA SOURCE: Aerial Imagery © AUSIMAGE - Jacobs Group (Australia) Pty Ltd 2018, © Department of Finance, Services & Innovation 2018

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PLOT BY: DN

CLIENT: Transport Roads & Maritime Services (NSW Government)

SYDNEY GATEWAY

A3

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MWR No.

APPROVAL

SCALES ON A1 SIZE DRAWING: 0 75 150 m, 1:8,500

DRAWINGS / DESIGN PREPARED BY: WSP, GHD

	NAME	DATE
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DRAWN	D NAIKEN	11/07/2019
DRG CHECK	Y YVANES-GIULIANI	11/07/2019

PREPARED FOR

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRG No.

Figure 4-1
Land Zoning

RMS REGISTRATION No.

PART

ISSUE STATUS: FOR INFORMATION

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SHEET No.

ISSUE: A1

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4.2 Topography

The project site is located in a highly modified landscape that features industrial, commercial and transport related development. The topography is generally flat at elevations less than 10 metres Australian height datum (AHD). Areas of higher elevations are also present across the former Tempe Lands (approximately 12 to 15 mAHD). The project site is relatively flat to the east of Alexandra Canal and rises towards the west of Alexandra Canal towards the Princes Highway.

The surrounding topography generally slopes gently upwards from zero metres AHD at Botany Bay in the south and Cooks River/Alexandra Canal to the west and north-west to elevations of 30 to 40 metres AHD to the north-east, east, and south-east of the project site.

4.3 Surface water features

The project site is largely located within the Cooks River catchment, a sub-catchment of the larger Botany Bay catchment. The Botany Bay catchment covers about 1165 square kilometres. The Botany Bay catchment encompasses surface water features near and within the project site including Alexandra Canal, the Botany Wetlands (including Lachlan Swamps and Mill Stream, also known as Sydney freshwater wetlands) and Botany Bay to the south-east. The mouth of the Cooks River is located to the south of the project site. The project site is located at the lower portion of the Cooks River catchment. There is a small wetland located to the west of Alexandra Canal and adjacent to South Street known as the Tempe Wetlands. These wetlands are constructed and approximately 2.8 hectares in size. Surface water features in the vicinity of the project site are presented in Figure 4-2.

The Cooks River catchment covers around 100 square kilometres in Southern Sydney and discharges to Botany Bay. This catchment is fed by nine tributaries including Alexandra Canal, which intersects the project. Alexandra Canal is a 4-kilometre-long artificial waterway (formerly Sheas Creek), and is characterised by its channelled route, defined edges, and sandstone embankment walls. It drains to the west into Cooks River at Tempe, and into Botany Bay. Both Cooks River and Alexandra Canal are tidally influenced waterways.

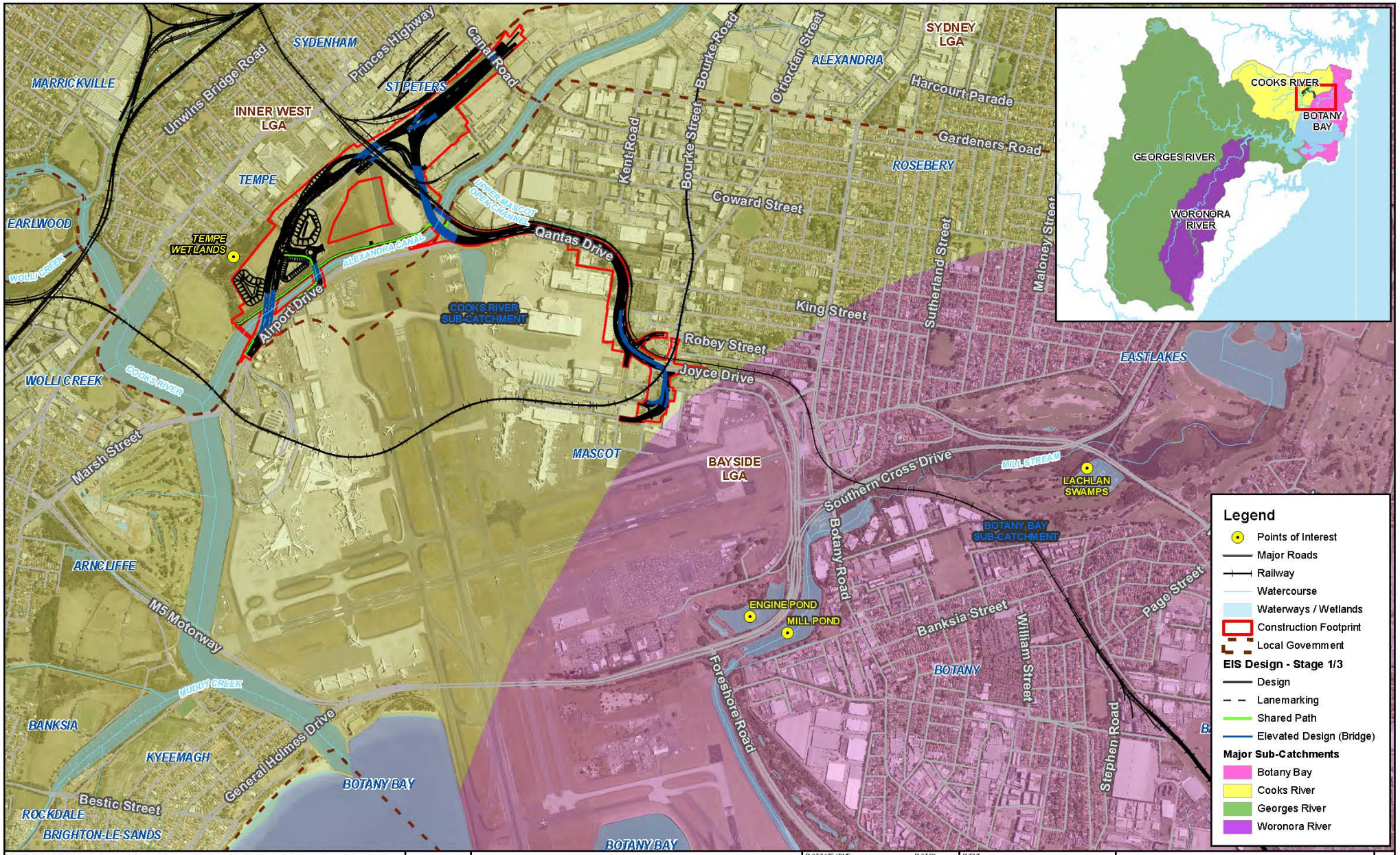
Other waterways near the project site are Wolli Creek and Muddy Creek, both located about one kilometre to the north-west and west and drain into Cooks River.

To the east and south-east of the project site is Engine Pond. Thick reeds and aquatic vegetation border the majority of the pond. Engine Pond acts as a sink for surface water runoff from the surrounding local area. While a locally and regionally significant surface water feature, it is not considered to be a pristine environment. Engine Pond and Mill Stream are designated as Environmentally Significant Areas under a range of registers, including the Sydney Airport Master Plan 2039 and national Wetlands Program. The Botany Wetlands (Sydney freshwater wetlands), are listed as an endangered ecological community in the *Biodiversity Conservation Act 2016*. The Botany Bay area provides summer habitat for a number of migratory wading birds that are listed under the EPBC Act, and the ponds may also be used on occasion by these species.

Botany Bay is used for a range of beneficial purposes such as recreation and fishing despite the DPI prohibition of commercial fishing in Botany Bay and Cooks River under the Fisheries Management (General) Regulation, 2010. Recreational fishing is prohibited in the area between the airport runways extending into Botany Bay but is not prohibited in and around Mill Stream and the broader Botany Bay area.

NSW DPI released a recreational fishing guide in December 2013 that states no fishing is to be undertaken in Alexandra Canal. In regards to the Cooks River and its tributaries, the guide states that only rod and reel can be used and all fish and shellfish caught in this area should be released, not eaten.

Tempe Wetland, located to the north-west of the project, is a constructed habitat, previously being the site of a shale quarry, greyhound racing track and rubbish tip. Extensive work was undertaken by the then Marrickville Council to remediate the site and the area was opened as new parklands in 2005.



REFERENCE SOURCE: © Botany Bay & Catchment Water Quality Improvement Plan. Sydney: Botany Bay Water Quality Improvement Program, Sydney Metropolitan Catchment Management Authority 2011.

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A1	11/12/2018	Surface Water Features		
A2	16/01/2019	Surface Water Features		
A3	10/07/2019	Surface Water Features		
A4	31/07/2019	Surface Water Features		

SCALES ON A1 SIZE DRAWING: 0 150 300 m, 1:17,000

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: WSP, GHD

DRG No.

	NAME	DATE
DRAWN	D NAIKEN	31/07/2019
DRG CHECK	Y.YIANNES-GIULIANI	31/07/2019

CLIENT: NSW Government, Transport Roads & Maritime Services

PREPARED FOR

SYDNEY GATEWAY

A3

Contamination Impact Assessment
Figure 4-2
Surface Water Features

RMS REGISTRATION No.

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ISSUE: A4

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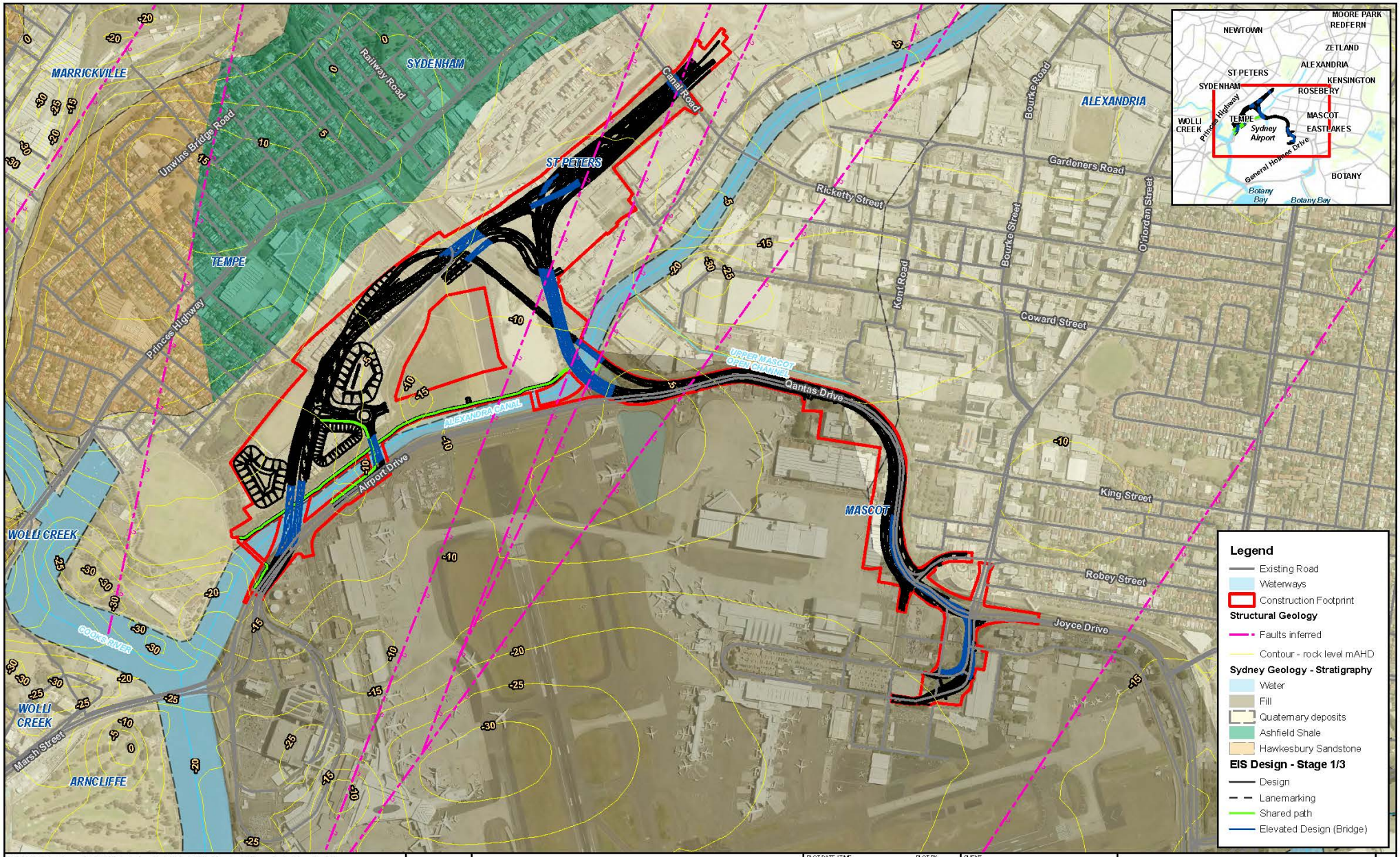
4.4 Geology and soils

4.4.1 Regional geology

The Permo-Triassic Sydney Basin is a convergent margin foreland sedimentary basin located along Australia's central eastern coast. It covers 64,000 square kilometres, with the onshore basin centred in Sydney, while the offshore basin extends eastward with 5,000 square kilometres between the coast and the outer edge of the continental shelf (Stewart and Alder, 1995). It is characterised by a lower sequence of interbedded marine-deposited strata, followed by local Permian coal-bearing sequences, which are then finally overlain by additional marine and terrestrial strata. The Permo-Triassic sedimentary succession is intruded by igneous bodies of Jurassic to Tertiary in age, and overlain by unconsolidated Quaternary alluvium. The basement of the Sydney Basin includes the Lachlan Fold Belt and Late Carboniferous volcanoclastic sediments. The project site in the context of the regional geology is presented in Figure 4-3.



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CLIENT: Transport for NSW – Roads & Maritime Services

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
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A2	16/01/2019	Regional Geology		
A3	08/05/2019	Regional Geology		
A4	08/07/2019	Regional Geology		
A5	31/07/2019	Regional Geology		

SCALES ON A1 SIZE DRAWING: 0 100 200 m, 1:10,000

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: WSP, GHD

DRG No.

	TITLE	NAME	DATE
DRAWN	D.NAIKEN		31.07.2019
DRG CHECK	Y.YVANES-GIULIANI		31.07.2019

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Contamination Impact Assessment
Figure 4-3
Regional Geology

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4.4.2 Site geology

The 1:100,000 Sydney Region Geological Map (Department of Mineral Resources and Energy, 1991) states that the regional geology consists of Triassic Hawkesbury Sandstone and Ashfield Shale overlain by Quaternary sediments (unconsolidated sands with minor peat, silts and clays and hard iron-cemented layers known as waterloo rock). The Quaternary sediments infilled drowned river valleys that were incised into the bedrock. These sediments, referred to locally as the Botany Sands, are composed of predominantly unconsolidated to semi-unconsolidated permeable sands. These are interspersed with lenses and layers of peat, peaty sands, silts and clays (low permeability), which become more common at greater depths. The stratigraphic units encountered in the project site are discussed below.

Hawkesbury Sandstone

The Hawkesbury Sandstone is composed of medium to coarse-grained quartz sandstone, with very minor shale and laminate lenses. It is divided into three intervals: a lower sequence of medium to coarse sandstones, a middle sequence of clayey sandstones, siltstones and shales, and an upper sequence of medium to coarse sandstones similar to the lower sequence. This unit is exposed about 400 metres north of the project site.

Ashfield Shale

The Ashfield Shale of the Wianamatta Group is composed of black to dark grey shale and laminates, and overlies the Hawkesbury Sandstone. The nearest exposure is located about 70 metres north-west of the project site.

Quaternary sediments

The project site located north of Alexandra Canal is underlain by peat, sandy peat, and mud (Qhs). This unit is deposited through fluvial processes in freshwater swamps and extends south of the canal, east of Qantas Drive.

Botany Sands are aeolian deposits comprising well-sorted, poorly cemented, and fine to medium-grained quartz sands. Lenses and bands of inter-dunal peat and organic clay are also present within the unit. The average thickness of the Botany Sands is 15 to 20 metres (Hatley, 2004).

4.4.3 Structural geology

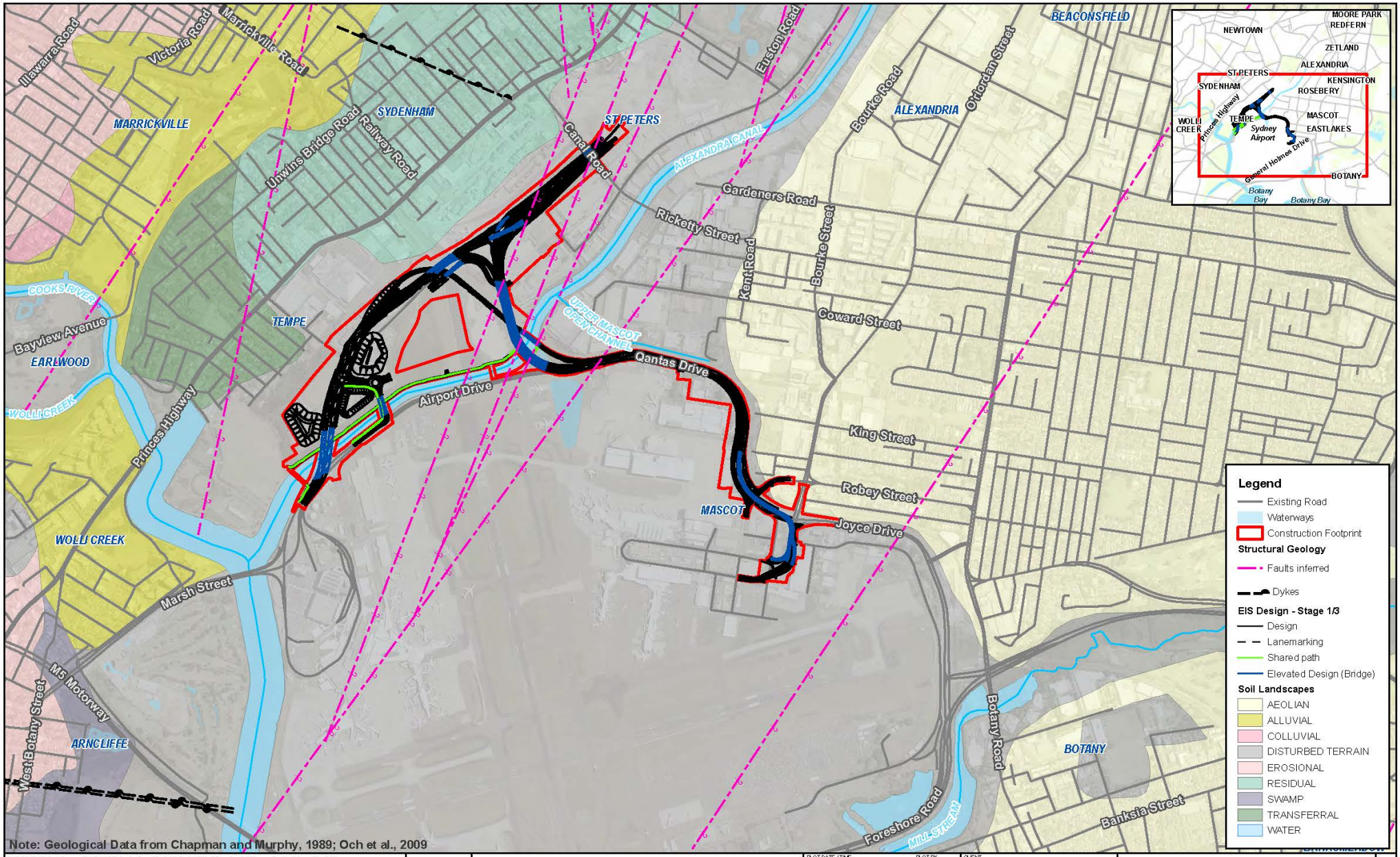
Several north–south trending structures intersect the Sydney Basin. These include the Lapstone Monocline and Kurrajong Fault in the west, and Lochinvar and Kulnura Anticlines and Lake Macquarie Syncline in the north-east (Stewart and Adler, 1995). According to Och et al (2009), two main fault sets are prominent in the Sydney Basin: steeply dipping, strike-slip, north-north-east trending faults, and north-west trending dip-slip normal faults.

There are a number of north-east to south-west faults cutting across the project site (WSP, 2010). The Woolloomooloo fault zone, consisting of a number of north-east trending unnamed faults, is cutting across project area 3 (WSP, 2010). Pells (2015) suggests that the Woolloomooloo fault zone is a complex series of sub-vertical and low angle thrust structures (Golder, 2017). These fault lines are shown on Figure 4-4.

The structural geology is less significant for groundwater issues on this project due to infrastructure primarily intersecting shallow unconsolidated sediments.

4.4.4 Soil landscape

Based on the Soil Landscapes of Sydney Sheet 9130 (Chapman and Murphy, 1989), the project site extends over two types of soil landscapes – Disturbed Terrain (DTX) and the Aeolian Tuggerah (AEtg) in the vicinity of the Robey Street intersection. A map of the soil landscapes encountered along the project site is presented in Figure 4-4.



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PLOT DATE / TIME 31/07/2019 9:21:31 AM

PLOT BY DN

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A1	10/07/2019	Soil Landscapes and Inferred Faults
A2	31/07/2019	Soil Landscapes and Inferred Faults

MWR No.

APPROVAL

SCALES ON A1 SIZE DRAWING

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CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	NAME	DATE
DRAWN	D.NAIKEN	31.07.2019
DRG CHECK	Y.YVANES-GIULIANI	31.07.2019

CLIENT: NSW Government Transport Roads & Maritime Services

PREPARED FOR

SYDNEY GATEWAY

A3

Contamination Impact Assessment
Figure 4-4
Soil Landscapes and Inferred Faults

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4.4.5 Soil salinity

Urban salinity is caused by the mobilisation of salts in the soil profile by surface water or groundwater. Salts naturally occur in soil from sources such as weathering of rock and soil, soils formed on old sea beds, salt lakes or other saline soils, or from the ocean via wind and rain.

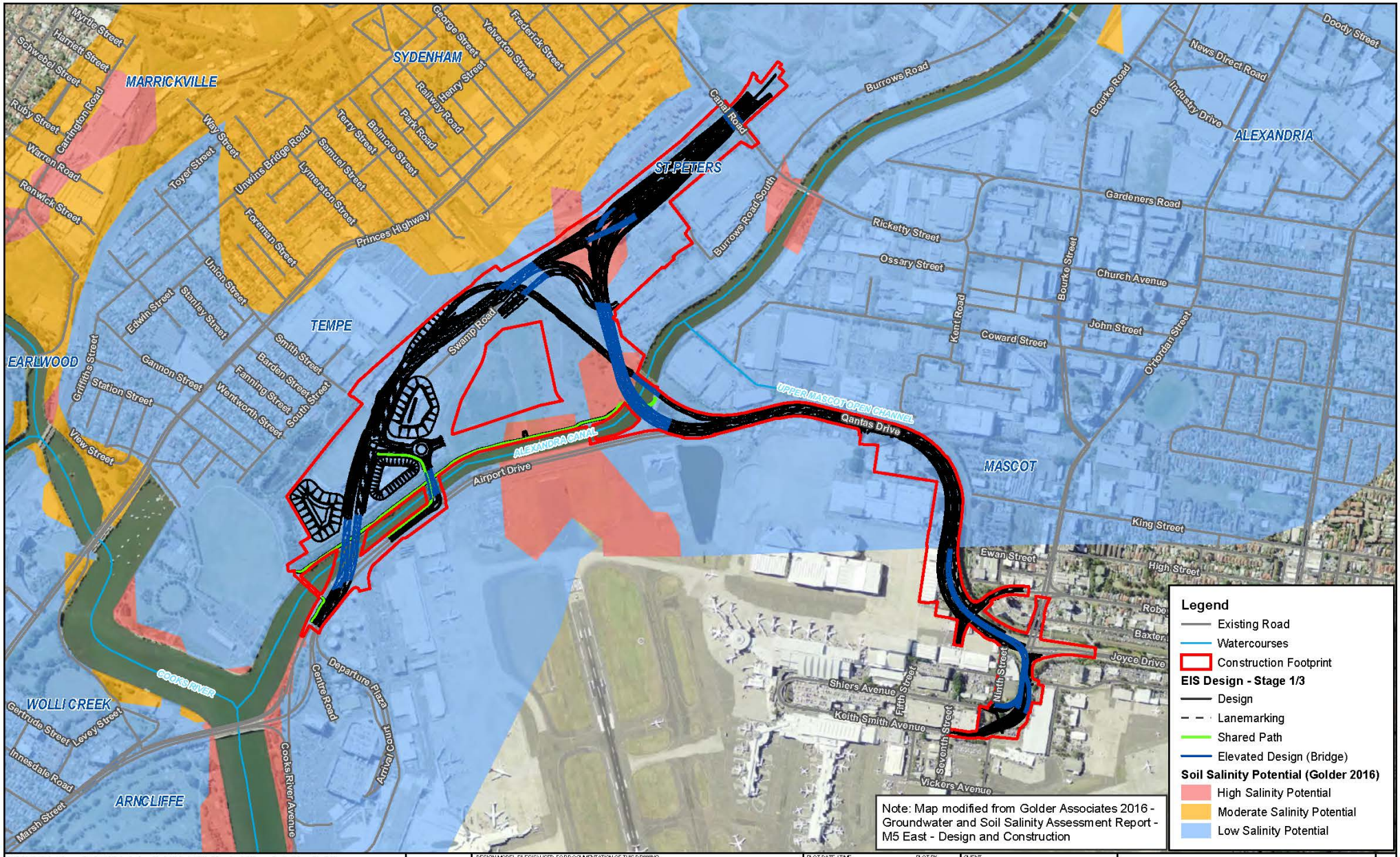
Development of bushland for urban use can change the movement of surface and groundwater resulting in a change in the way salts and other minerals interact. When the water table rises close to the surface, it carries dissolved salts that are normally locked in the soil and rock profile to the surface. The project is located in an urbanised area. Based on the historical aerial photograph review, the project site had been developed for commercial/industrial activity by 1961 with the majority of natural vegetation striped between 1930 and 1941.

Saline soils are typically present in areas along tidal waterways, such as Alexandra Canal. A soil salinity assessment completed by Golder Associates (2016) for the New M5 project was conducted across the majority of the project site with the exception of the south-eastern portion of the proposed alignment. The area to the south of Ewan Street (approximately 600 metres) has not been characterised as part of the Golder Associates (2016) investigations (refer to Figure 4-5, shading depicts areas included in the Golder 2016 investigation). The salinity assessment in the vicinity of the St Peters Interchange included data from 23 groundwater bores and 19 soil samples. Exposure classification for concrete and steel structures were assessed in accordance with AS 3600:2001 and AS 2159:2009. Exposure classification ranged from non-aggressive to severe for concrete and steel based on both soil and groundwater chemistry data. It was noted that low electrical resistivity values in groundwater samples were increasing the severity of the exposure classification for steel.

Most of the proposed alignment is classified as a low salinity potential area. Two zones were classified as having a high salinity potential:

- Within Sydney Airport northern lands areas, to the west of the St Peters interchange (within project area 3)
- Within Sydney Airport northern lands car park, immediately north of Alexandra Canal (within project area 2).

The classification presented in Golder Associates (2016) was based on guidance provided in the NSW Department of land and Water Conservation (2002) *Site Investigations for Urban Salinity* (DWLC, 2002). A map of the salinity potential along the proposed project is presented in Figure 4-5.



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SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No	APPROVAL
A1	10/07/2019	Soil Salinity Potential		
A2	31/07/2019	Soil Salinity Potential		

SCALES ON A1 SIZE DRAWING: 0 100 200 m, 1:10,000

DRAWINGS / DESIGN PREPARED BY: WSP, GHD

	TITLE	NAME	DATE
DRAWN	D NAIKEN		31/07/2019
DRG CHECK	Y.YVANES-GIULIANI		31/07/2019

CO-ORDINATE SYSTEM: MGA ZONE 56 | HEIGHT DATUM: AHD | DRG No.

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Contamination Impact Assessment
Figure 4-5
Soil Salinity Potential

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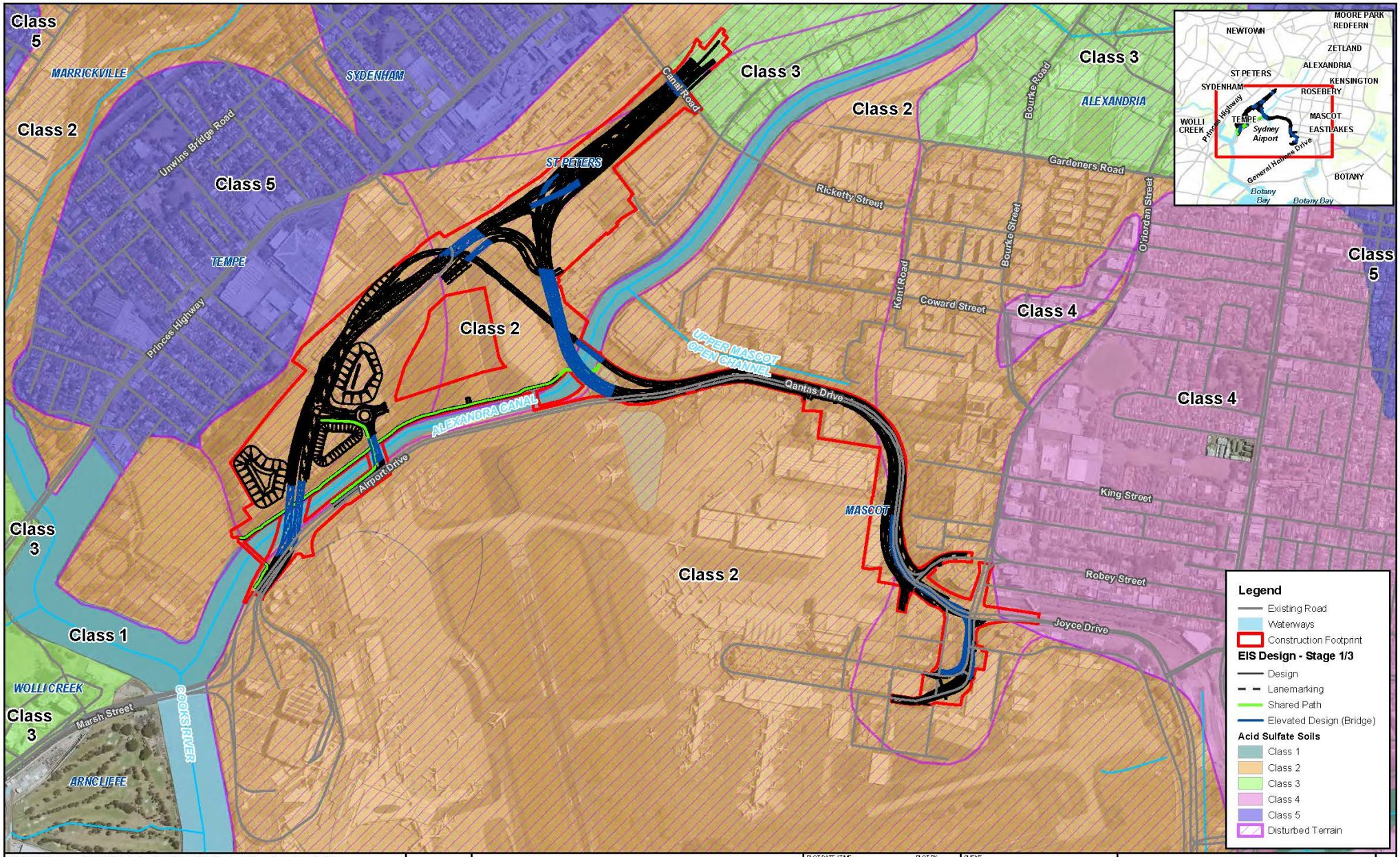
4.5 Acid sulfate soils

Acid sulfate soils or sediments (ASS) are naturally occurring soils and sediments containing iron sulfides. The predominant ASS sulfidic minerals are pyrite (FeS_2) and iron disulfide. The exposure of pyrite and other sulfides to oxygen during disturbances can lead to the generation of sulfuric acid. The subsequent acidic runoff can then lead to mobilisation of heavy metals such as aluminium and iron into water bodies. Drainage waters from areas of ASS may affect water quality, and can lead to the death or disease of aquatic organisms. ASS are typically found in estuarine, low lying environments up to 10 mAHD and generally consist of clays and sands containing pyritic material. They can also be found in flood plains and swamps.

The CSIRO Australian Soil Resource Information System (ASRIS) indicates that there is a low probability of ASS occurrence within the project site except for bottom sediments in Alexandra Canal. The ASS risk map for Botany Bay published by the Department of Land and Water Conservation (1997) generally concurs with the information in ASRIS but also indicates that disturbed terrain occurs within the project site. Disturbed terrains need to be further assessed to establish the presence of ASS.

ASS risk maps (DLWC, 1997) are used to derive planning maps presented in local environmental plans (LEPs). The project site is located on Class 1, Class 2 and Class 3 land on the Marrickville LEP ASS (2011), the Sydney LEP ASS (2012) and the Botany Bay LEP ASS maps (2013). ASS classes of land are shown in Figure 4-6.



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PLOT BY DN

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A1	10/12/2018	Acid Sulfate Soils		
A2	16/01/2019	Acid Sulfate Soils		
A3	20/05/2019	Acid Sulfate Soils		
A4	08/07/2019	Acid Sulfate Soils - Planning Class		
A5	31/07/2019	Acid Sulfate Soils - Planning Class		

SCALES ON A1 SIZE DRAWING

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CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY

DRG No.

	NAME	DATE
TITLE		
DRAWN	D NAIKEN	31/07/2019
DRG CHECK	Y.YVANES-GIULIANI	31/07/2019

CLIENT

Transport Roads & Maritime Services

PREPARED FOR

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A3

Contamination Impact Assessment
Figure 4-6
Acid Sulfate Soils - Planning Class

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Table 4-1 summarises the types of work proposed to be carried out on these classes of land within the project site.

Table 4-1 Acid sulfate soil classification on Marrickville LEP (2011), Sydney LEP (2012) and Botany Bay LEP (2013) for different areas of the project

Class of land (LEP ASS MAPS 2013)	Project location(s)	Works requiring management procedures	Works expected to be conducted in project area
1	Alexandra Canal	▪ Any works	▪ Outlet connections for stormwater discharge.
2	Tempe Landfill, Sydney Airport northern lands car park, Sydney Airport northern lands and Sydney Airport land	▪ Works below the natural ground surface ▪ Works by which the water table is likely to be lowered.	▪ Excavation for footings for reinforced soil walls within project area 3, ~1.5 metres below ground surface (mBGS) ▪ Piling for Canal Road bridges (eastern side), ~15 mBGS ▪ Piling for piers and abutments for bridge over Qantas Drive (~15 mBGS) ▪ Piling for piers and abutments for bridges over Botany Rail Line and Airport Drive (~15 mBGS) ▪ Excavation for footings for retaining wall between bridge and the Tempe Landfill cut off wall and west of bridge (~2 mBGS) ▪ Piling for piers and abutments for bridges over Alexandra Canal from Tempe Tip to Airport Drive (~15 mBGS) ▪ Excavation for footings for retaining walls along Airport Drive and Qantas Drive (~2 mBGS) ▪ Excavation for footing for retaining walls between Canal Road bridge (SB01) and bridges over Botany Rail Line and Alexandra Canal (~2 mBGS) ▪ Piling for piers and abutments for bridges over Botany Rail Line and Alexandra Canal (~15 mBGS) ▪ Excavation for footing for retaining walls between SB31 and Qantas Drive (~2 mBGS) ▪ Piling for piers and abutments for bridge over Botany Rail Line and Alexandra Canal (~15 mBGS) ▪ Services upgrade trenches (~1-3 mBGS)
3	Connection with the St Peters Interchange east of Canal Road	▪ Works more than 1 mBGS ▪ Works by which the water table is likely to be lowered more than 1 mBGS.	▪ Excavation for footings for reinforced soil walls between St Peters Interchange and Canal Road (eastern side, ~1.5 mBGS) ▪ Excavation for footings for reinforced soil walls under Canal Road bridges (eastern side, ~1.5 mBGS) ▪ Piling for Canal Road bridges (eastern side, ~15 mBGS).

Works conducted in all areas of the project site would require an ASS Management Plan (ASSMP). The ASSMP would need to be prepared in accordance with the Acid Sulfate Soils Management Advisory Committee (1998) *Acid Sulfate Soils Manual*. The ASSMP would include the results of ASS investigations, procedures to minimise the impacts of the work as well as handling and testing procedures.

4.6 Hydrogeology

There are two main groundwater systems beneath the site, a deeper confined groundwater system associated with the Triassic aged, fractured/porous Hawkesbury Sandstone and a shallow, unconfined/semi confined system within Quaternary aged marine sands. The main focus of this section is the aquifer associated with the shallow saturated portion of the Botany Bay Sands, referred to as the Botany Sands Aquifer (Hatley, 2004).

The Botany Sands is considered an unconfined, high permeability aquifer. The flow directions within Botany Sands are generally controlled by topography. From the recharge areas located at higher elevations north-east of the Botany basin, groundwater flows south and south-west towards rivers and other tributaries and into Botany Bay.

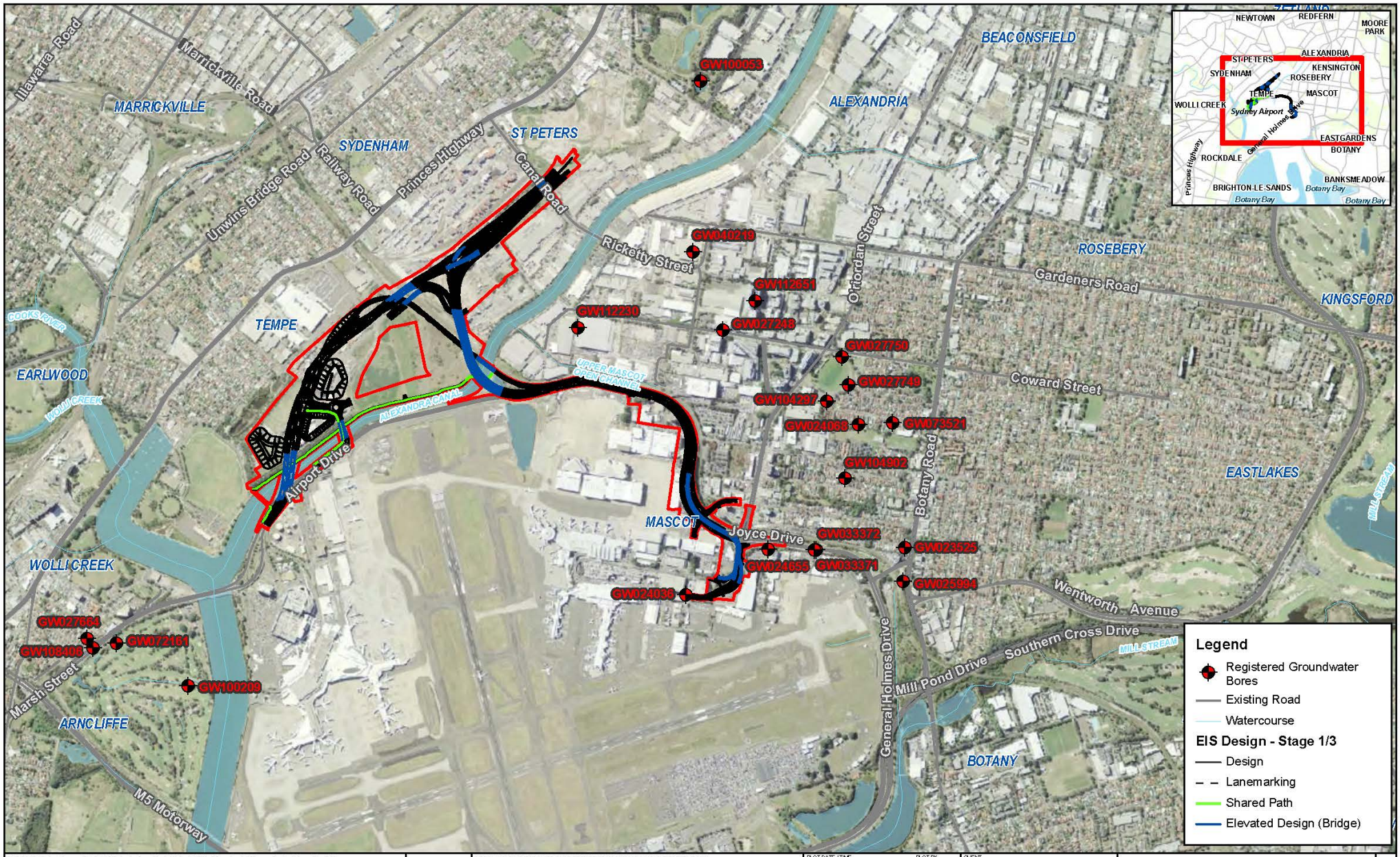
Ongoing monitoring is undertaken by NSW DPI-Water in the Botany Sands aquifer at ten bores within the project site. The data are summarised below:

- Average variation in elevations – Following the topography of the area, groundwater is intercepted at higher elevations (24 metres AHD) in the north-west, and at lower elevations (<5 metres AHD) to the south near Botany Bay
- General depth to groundwater – Groundwater at bores located at the north and north-west of the Botany Sands is recorded at shallow depths, ranging from approximately 1–4 metres below ground. All bores are screened in sandy material. At the former Tempe Tip site, the groundwater level within the uncontrolled fill is located at an average 12 metres below ground surface
- Response to rainfall characteristics – Based on annual rainfall records for Bureau of Meteorology Sydney Station 66037, the available data shows that groundwater is generally stable, with spikes noted in periods with above average rainfall. However, the groundwater elevations show little response during periods of below average rainfall.

Refer to Technical Working Paper 7 – Groundwater for further details.

4.6.1 Registered groundwater users and water use restrictions

Review of available data from NSW DPI-Water identified 23 registered groundwater wells used for domestic, recreational, and commercial purposes within a one-kilometre radius of the project. The majority of the wells are shallow (<20 metres in depth) and screened within the Botany Sands aquifer and are shown on Figure 4-7.



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CLIENT: NSW Government Transport Roads & Maritime Services

SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A1	10/12/2018	Registered Groundwater Users within 1km of Project Site
A2	22/01/2019	Registered Groundwater Users within 1km of Project Site
A3	08/07/2019	Registered Groundwater Users within 1 km
A4	31/07/2019	Registered Groundwater Users within 1 km

MWR No.

APPROVAL

SCALES ON A1 SIZE DRAWING: 0 150 300 m, 1:15,000

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	TITLE	NAME	DATE
DRAWN		D.NAIKEN	31/07/2019
DRG CHECK		Y.YUANES-GILLIAN	31/07/2019

PREPARED FOR:

Contamination Impact Assessment
Figure 4-7
Registered Groundwater Users within 1 km

RMS REGISTRATION No.

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ISSUE: A4

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A restriction on groundwater extraction was implemented by the NSW Government in 2006 on parts of Botany, which is underlain by the Botany Sands aquifer. Under the current Temporary Water Restrictions Order for the Botany Sands Groundwater Source 2018 (issued by the NSW Department of Industry, 2018), prohibitions are stipulated for two designated zones (Area 1 and Area 2). As shown in Figure 4-8 below, the project is partly located within designated zone Area 2.

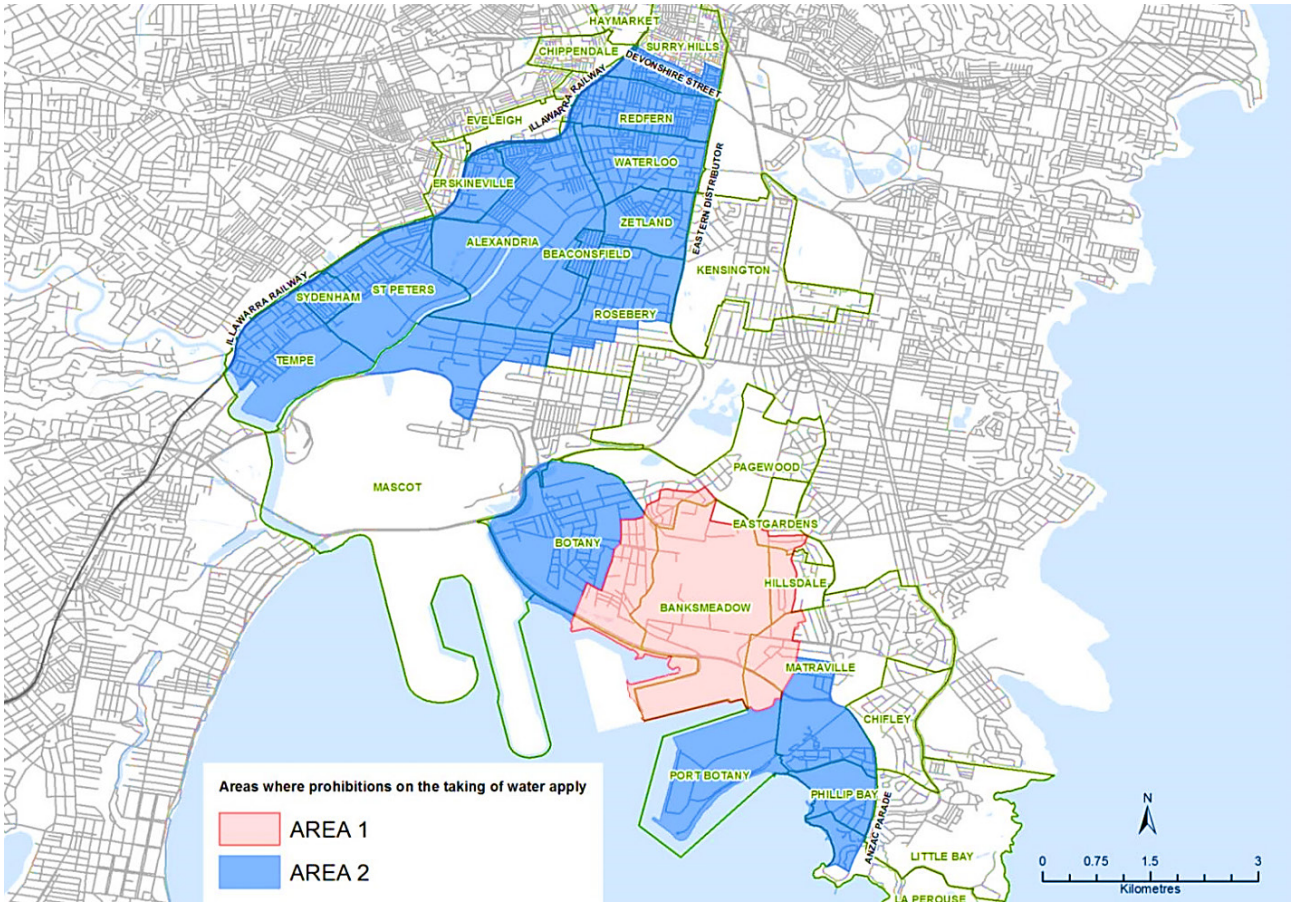


Figure 4-8 Restriction areas under the current Temporary Water Restrictions Order issued by the NSW Department of Industry for the Botany Sands Groundwater Source (2018)

Under the 2018 Restrictions Order, groundwater extraction in designated zone Area 2 is prohibited for domestic use, and monitoring is required for industrial and irrigation purposes. In designated zone Area 1 taking of water from the Botany Sands groundwater source is prohibited.

Under the Order, water extracted for purposes other than remediation, temporary construction dewatering, testing or monitoring purposes, must be fit for purpose. To be fit for purpose, the water extracted must be:

- Sampled, tested and treated in accordance with a certified water testing plan
- Certified in writing by a consultant as being safe and suitable for its intended use.

4.6.2 Former gas works sites

A search of NSW EPA List of former gasworks was carried out on 2 July 2019 (www.epa.nsw.gov.au/your-environment/contaminated-land/other-contamination-issues/former-gasworks-sites). There are no former gas works sites noted within a 500-metre radius of the project.

4.7 NSW contaminated sites register

The NSW EPA records of contaminated sites and records of notices were searched for sites within or in the vicinity of the project site.

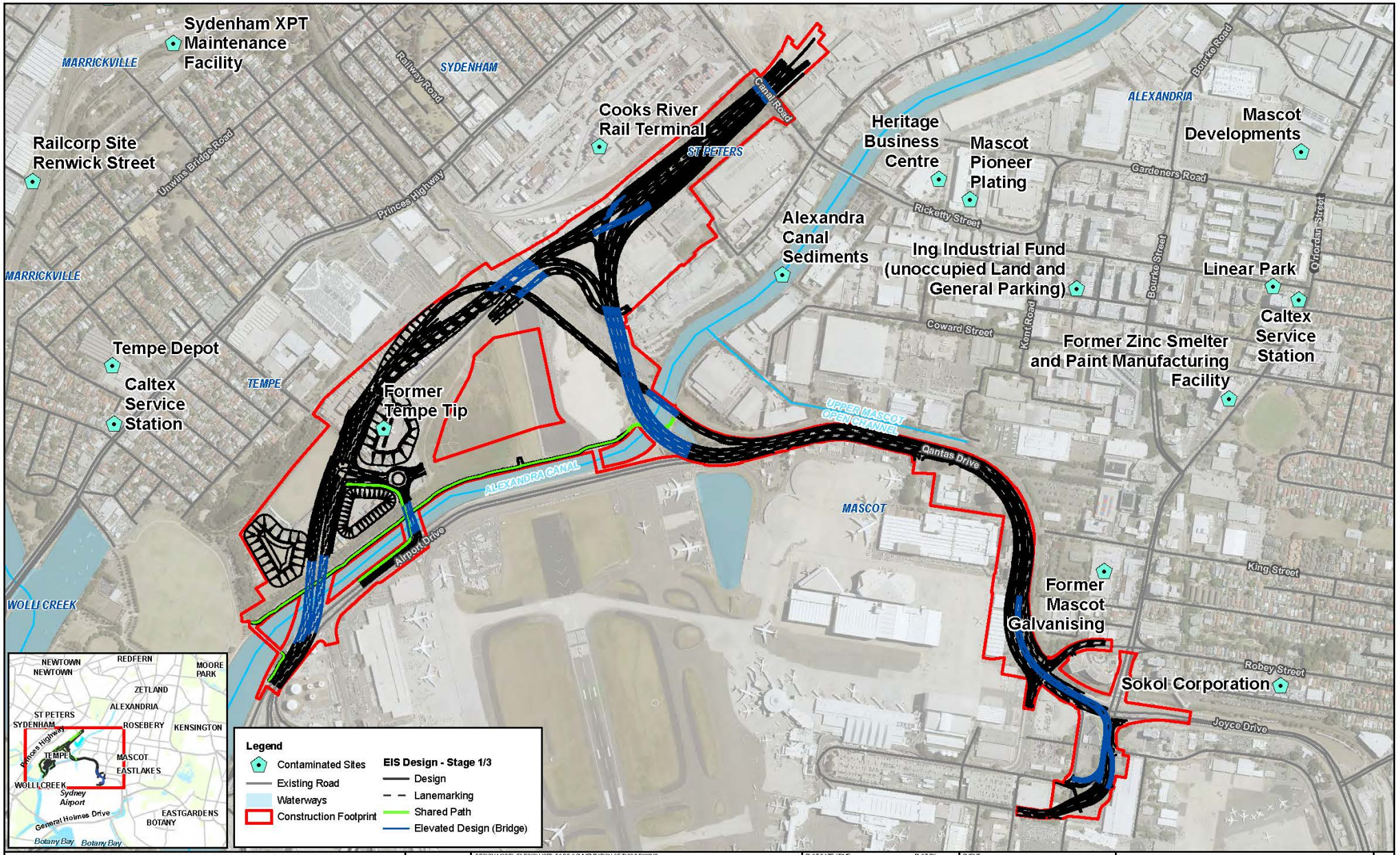
4.7.1 Contaminated sites notified to the EPA

The EPA holds records of sites that have been notified under Section 60 of the CLM Act or otherwise reported to the EPA. The list of sites was reviewed to identify sites which may impact soil and/or groundwater quality within the project. The list was last updated by the EPA on 19 June 2019. Contaminated sites in the vicinity of the project site and current status are presented in Table 4-2 and shown on Figure 4-9.

Table 4-2 Contaminated sites on the NSW EPA register within 500 m of the project site

Site name	Site address and distance to the Project Area	Site activity notified to the EPA	Contamination status
Former Tempe Tip site	South Street, Tempe Within the project area	Landfill	Contamination currently regulated under the CLM Act
Cooks River Rail Terminal	20 Canal Road, St Peters Adjacent to the north	Unclassified	Regulation under CLM Act not required
Former Mascot Galvanising	336–348 King Street, Mascot Approximately 170 m east	Metal Industry	Contamination currently regulated under CLM Act
Ing Industrial Fund	19–33 Kent Road, Mascot Approximately 465 m north-east	Landfill	Regulation under CLM Act not required
Heritage Business Centre	5–9 Ricketty Street, Mascot Approximately 470 m south-east (on the other side of Alexandra Canal)	Unclassified	Regulation under CLM Act not required
Sokol Corporation	50–56 Robey Street, Mascot Approximately 470 m north-east	Other Industry	Regulation under CLM Act not required
Alexandra Canal Sediments	Off Huntley Street, Alexandria	Unclassified	Contamination currently regulated under CLM Act

Most of the sites listed above do not require regulation under the CLM Act and therefore it is assumed that the EPA has not identified significant contamination migrating off-site at levels that could pose a risk to human health or the environment. The former Tempe Tip site is also the subject of notices which are listed in section 4.7.2. Contamination at the former Tempe Tip site is discussed further in Appendix G.



DATA SOURCE: Aerial Imagery © AUSIMAGE - Jacobs Group (Australia) Pty Ltd 2018, © Department of Finance, Services & Innovation 2018

DESIGN LOT CODE

DESIGN MODEL FILES(S) USED FOR DOCUMENTATION OF THIS DRAWING

PLOT DATE / TIME 31/07/2019 9:38:00 AM

PLOT BY DN

CLIENT: NSW Government Transport Roads & Maritime Services

SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MW R No.	APPROVAL
A1	08/05/2019	Contaminated Sites		
A2	11/07/2019	Contaminated Sites		
A3	31/07/2019	Contaminated Sites		

SCALES ON A1 SIZE DRAWING: 0 75 150 m, 1:8,500

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	TITLE	NAME	DATE
DRAWN	D NAIKEN		31/07/2019
DRG CHECK	Y.YVANES-GIULIANI		31/07/2019

PREPARED FOR

Contamination Impact Assessment
Figure 4-9
Contaminated Sites

RMS REGISTRATION No.

PART

ISSUE STATUS: FOR INFORMATION

EDMS No.

SHEET No.

ISSUE: A3

Document Path: \\corp.pbwan.net\WA2\Projects\PS109315_Sydney_Gateway\5_Shared\GIS\64_Production\Maps\PS109315_GIS_287_A3.mxd

4.7.2 Contaminated sites with notices

The NSW EPA holds records of written notices issued by The Environment, Energy and Science Group (formerly known as the Office of Environment and Heritage) under Section 58 of the CLM Act. The record of notices also contains site audit statements provided to The Environment, Energy and Science Group under Section 52 of the CLM Act, management orders issued under Part 3 of the CLM Act as well as approved voluntary management proposals under Section 17 of the CLM Act. There are two sites on the record within 500 metres of the project site, in addition the Alexandra Canal sediments are the subject of a NSW EPA Remediation Order. Details about the site are included in Table 4-3.

Table 4-3 NSW EPA record of notices within 500 m of the project site

Site name	Site address and distance to the Project SITE	Notice type and status	Contamination type
Former Tempe Tip site	South Street, Tempe Within the project site	Site declared as a remediation site 1 current voluntary remediation proposal	▪ Ammonia ▪ Groundwater contamination is an ongoing source of contamination to Alexandra Canal.
Former Mascot Galvanising	336–348 King St, Mascot, 150 m east of the project site at the nearest point	Site declared as a remediation site 4 current remediation orders	▪ Zinc, lead and chromium in soil and groundwater ▪ Low groundwater pH ▪ Groundwater plume migrating offsite ▪ Potential sources of PFAS.
Alexandra Canal Sediments	Off Huntley Street, Alexandria	Site declared as a remediation site 1 current remediation orders	▪ Chlorinated hydrocarbons, organochlorine pesticides, polychlorinated biphenyls and metals.

The former Mascot galvanising site located on King Street in Mascot is hydraulically up-gradient of the project. Since the latest notice was issued for the site (in 2004), the site buildings and infrastructures have been removed (as evidenced by historical aerials from 2017 and 2018) and earthworks (most likely to remediate the site) appear to have been conducted between 2005 and 2015. The site has since been redeveloped and is currently a high-rise hotel and car park. There is a potential that groundwater impacts from the former Mascot galvanising site may have migrated beneath the project site. There is the potential that PFAS may have been utilised in the galvanising process historically (i.e. associated PFAS uses include corrosion protection, tin electroplating and post-plating cleaner).

4.8 Environmental protection license search

Under Section 308 of the POEO Act, the NSW EPA has to record and make available to the public details about EPLs. The information recorded includes new applications, transfers or changes to existing licences, exemptions as well as any penalty notices issued by the EPA.

4.8.1 EPLs within vicinity of project areas

At the time of preparing this report (July 2019), the record holds over 4600 active licenced activities for NSW. There are eight licenced facilities within 500 metres of the project site. Details about the facilities and activities they are licenced for are included in Table 4-4.

Table 4-4 Record of licenced facilities within 500 metres of the project site

Facility name	Licence number	Site address and distance to the project SITE	Activity type	Potential contamination
Sydney Airport East Precinct	20851	Port Botany Freight Rail Corridor at General Holmes Drive 500 m east	Railway systems activity	Unknown
TG2	20728	Shiers Avenue, Mascot 200 m south and west	Generation of electrical power from gas	Emission of volatile organic compounds (VOCs) to air
Enwave Mascot Pty Ltd	20246	10 Bourke Street, Mascot 335 m north-east	Generation of electrical power from gas	Emission of VOCs to air
SPRC	13142	6–10 Burrows Street South, St Peters 160 m south and south-east	Waste storage/Waste processing (non-thermal)	▪ Metals ▪ PAHs ▪ Asbestos ▪ Other contaminants.
Visy Paper	13069	6–10 Burrows Road South, St Peters 170 m south-east	Resource recovery/Waste storage	unknown
Boral Recycling	12418	25 Burrows Road South, St Peters Within the project site	Waste storage, transfer, separation and processing/ Recovery of general waste	▪ Asbestos ▪ Other contaminants.
Metropolitan Demolitions and Recycling	11483	396 Princes Highway, St Peters 320 m north-west	Waste storage, transfer, separating or processing (non-thermal)/Recovery of general waste	Unknown
New M5 St Peters interchange (former Alexandria landfill)	4627	10–16 Albert St, St Peters Immediately east	Solid and inert waste landfilling/Crushing, grinding or separating/ Road construction	▪ Leachate release to the environment ▪ Ammonia.

4.8.2 EPL non-compliance and clean up notices

The public record also contains information pertaining to revoked and/or surrendered licences, audits, notices or pollution studies. The record holds information for 19 facilities within a 500-metre radius of the project site including the former Tempe Tip site and former Alexandria Landfill (now the St Peters interchange construction zone). Table C1 in Appendix C summarises the information for these facilities.

4.9 Unexploded ordnance contamination

The Australian Department of Defence holds a record of unexploded ordnance (UXO) in Australia. Areas of known or suspected UXO occurrence have been categorised and mapped with the records available online at www.defence.gov.au/UXO/Where/Default.asp . At the time of preparing this report, there are no records of UXOs within or in the vicinity of the project.

4.10 Contamination within the project site

Historic aerial imagery has been reviewed for the project site and surrounding area and a summary of relevant observations is provided in Appendix D. An inspection of the project site was undertaken on 5 December 2018. A photographic log of the inspection is provided as Appendix E. A number of potential contamination issues (current and historic) have been identified. Further information on these and other areas of existing contamination are provided in desktop review of documents summarised in Appendix G to Appendix K.

4.10.1 Former Tempe Tip site (project area 1)

The former Tempe Tip site was used for municipal waste landfill between about 1910 and 1990. Reported contaminants of concern include landfill gases, heavy metals, nutrients, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAH), phenols, pesticides, volatile organic compounds VOCs, ammonia, polychlorinated biphenyls (PCBs) and asbestos.

In July 2000, the NSW EPA declared the former Tempe Tip site a Remediation Site (declaration 21005) under section 21 of the CLM Act due to leachate migrating off-site towards Alexandra Canal. In March 2001, the EPA issued a Remediation Order (order 23003) to Marrickville Council under Section 23 of the CLM Act. The Order required that a Remedial Action Plan (RAP) be prepared to address the contaminant migration into Alexandra Canal and that a Site Auditor review the RAP. Marrickville Council subsequently entered into a voluntary remediation proposal (VRP) with the EPA. The VRP is still in place and requires that “the proposed remediation is to ensure that the water quality of Alexandra Canal is not adversely impacted by leachate originating from the site”.

As a result of the Order, a barrier wall was constructed in 2004 along the southern, eastern and western boundaries of the former tip to prevent leachate migrating into Alexandra Canal (Coffey Geosciences, 2005). A leachate collection system and treatment system were also installed to treat leachate before discharge. Between 2004 and 2006, the site surface was regraded and capped to minimise water infiltration into the waste mass and provide a barrier between human receptors and the waste mass.

4.10.2 Alexandra Canal (project area 5)

Alexandra Canal has been subject to historical contamination as a result of direct discharge and runoff from the numerous industries and other land uses located along the canal from the late 1800s. As a result, the beds of the canal are highly contaminated.

Alexandra Canal was declared a remediation site (number 21008) on 25 August 2000 by the NSW EPA, due to bed sediments contaminated with chlorinated hydrocarbons including organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs) and metals. A Remediation Order (number 23004) was also issued by the NSW EPA to Sydney Water Corporation on 10 May 2004.

4.10.3 Sydney Airport northern lands car park (project area 2)

Project area 2 has been used for commercial/industrial activity since as early as 1930. A bulk fuel storage depot operated at the site from 1930 until between 1950 and 1970 (Background Review, AECOM 2015). In the 1970 and 1982 historic aerial photographs, a number of small buildings/storage sheds are visible across the area. The area is currently used as a parking area for Sydney Airport and storage.

A number of contamination investigations of this site, located to the west of Alexandra Canal, have been undertaken by Sydney Airport. Asbestos containing material within fill materials were identified across the site. The site is impacted by gases originating from the adjoining former Tempe Tip site.

A portion of the area has been remediated by Sydney Airport Corporation. The remediation scope included removal of lead and PAH contaminated soil, followed by installation of an engineered gas venting system (western portion only) and capping layer designed to mitigate potential risks associated with the remaining soil contamination and landfill gas. A site environmental management plan (EMP) has been prepared for the western portion of the site area (WSP December 2017) to document gas system maintenance. The EMP requires hot works permitting for any persons accessing the gas extraction system and any pits on the site.

4.10.4 Sydney Airport northern lands (project area 3)

A large liquid petroleum gas (LPG) fuel tank explosion occurred at the former Boral gas plant (Lot 1 in DP 866946) in 1990. Buildings on the adjacent airport site (Lot 2 in DP 802342), originally built as wool stores with significant asbestos containing materials, were damaged by the explosion.

Previous investigations undertaken by HLA-Envirosciences within the airport site (in lot 2 in DP 802342) reported elevated concentrations of PAH and heavy fraction petroleum hydrocarbons. Potential free tar and fragments of asbestos containing materials (ACM) were also observed.

4.10.5 Sydney Airport (project area 4)

Project area 4 is located on the periphery of Sydney Airport. Mascot was declared an aerodrome in 1920 when it was known as Sydney Airport. In 1953, it was renamed Sydney (Kingsford Smith) Airport. By 1943, the airport had been developed to incorporate three runways, with further expansion commencing in 1959 to extend the runway into Botany Bay. In the mid-1960s, Sydney Airport was further developed to include an international terminal which was opened in 1970. The airport is a primary hub for Qantas as well as a secondary hub for Virgin Australia and Jetstar Airways. The current Qantas Jet Base is located within the north-eastern corner of Sydney Airport, north of the domestic terminal.

Joint User Hydrant Installation (JUHI) operates a bulk fuel storage terminal adjacent to Airport Drive on Sydney Airport land. The JUHI site is impacted by hydrocarbons that are being managed under a remedial action plan.

There are a number of known contaminated groundwater plumes within Qantas's lease areas, including the Qantas Jet Base (located on Airport Drive). Site investigations identified a number of contaminants in the soil and/or groundwater, including petroleum hydrocarbons, PAH, PFAS and heavy metals.

5. Contamination assessment

5.1 Contamination investigations

The project site has a documented history of site contamination and has been subject to numerous contamination investigations (refer to Appendix A).

During site investigation, contamination has been identified at concentrations above adopted assessment criteria within all of the project areas assigned in this technical working paper. The sampling locations associated with the current Roads and Maritime investigation are presented in Appendix F. The extent of investigation and current stage of assessment differ across the project areas; a summary of the status for each project area is presented in Table 5-1.

Table 5-1 Summary of contamination investigations and assessment

Project Area (Figure 3-1)	Phase 1 preliminary investigation	Phase 2 detailed investigation	Phase 3 RAP	Phase 4 Validation
1	Completed	Completed	Completed (Coffey, May 2003)	Completed Environ, 2008 (Tempe Tip Site Audit Report GN35-2)
2	Completed	Completed	Completed (Zoic November 2017)	Partially complete Remediation has been completed for one portion of the project area (WSP, January 2016). Outstanding action required for the remaining area
3	Completed	Discrete parcels of land have been investigated, predominantly commissioned for lease entry/exit assessment or waste classification Limited targeted investigation along proposed alignment	No	No
4	Completed	Limited targeted investigation along proposed alignment only	No	No
5	Completed	Completed	No	No

5.2 Conceptual site model

The CSM is a key component of contaminated site assessment and provides the framework for identifying how potential receptors may be exposed to contamination from previous or current site sources. For an ecological or human health risk from contamination to be present, there must be a possible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway).

In the CSM assessment, where the data confirms that the contamination has impacted the receptor (ie the pathway if proven to have occurred) the pollutant linkage is referred to as a complete exposure pathway.

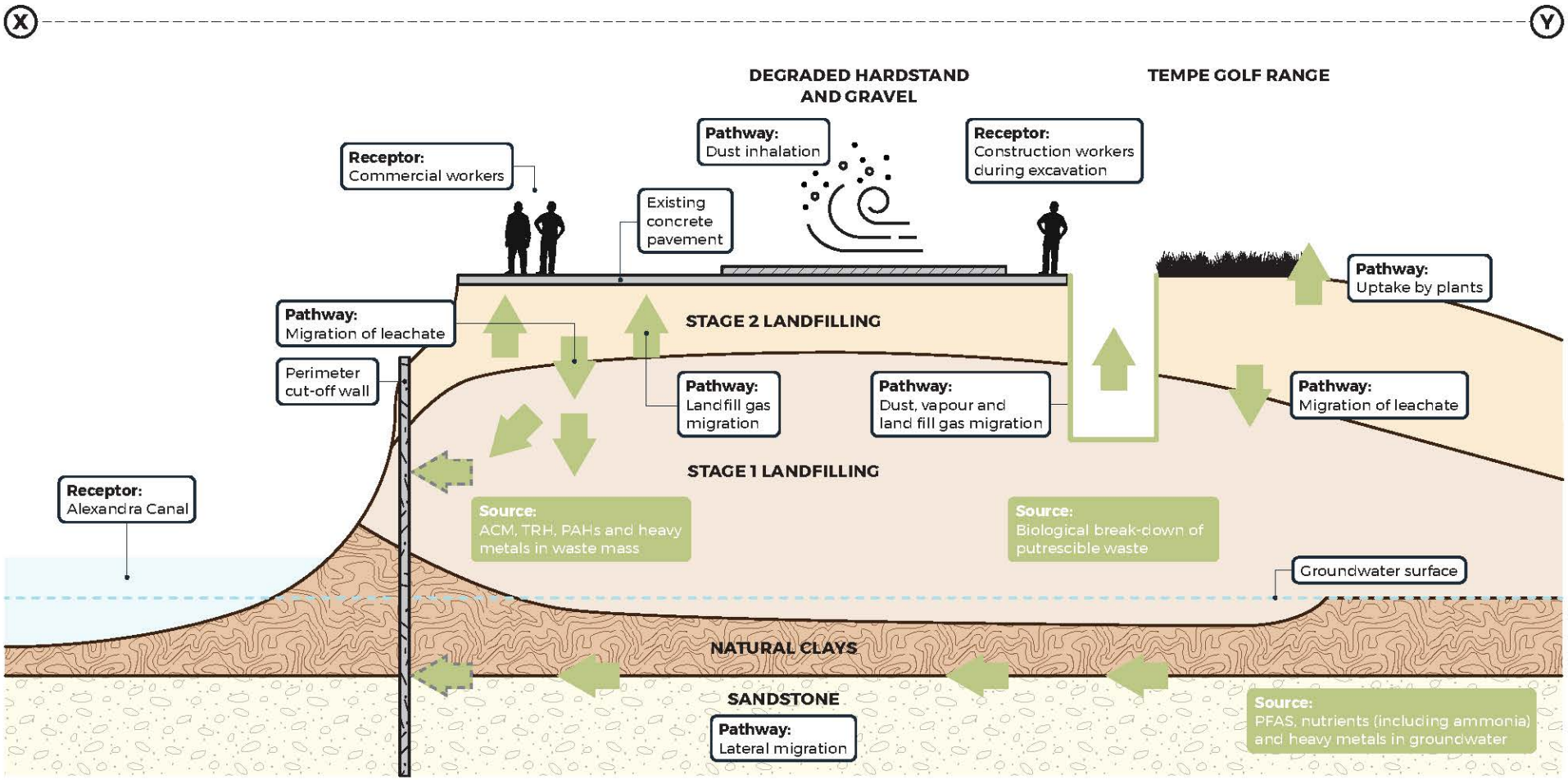
A preliminary CSM for the project areas identifying potential contamination sources, receptors and exposure pathways associated with the current land use has been developed based on a review of the historic and current investigations listed in Appendix A. A pictorial representation of the CSMs developed for the project site based on current land use are presented in Figure 5-1, Figure 5-2, Figure 5-3 and Figure 5-4.

In summary.

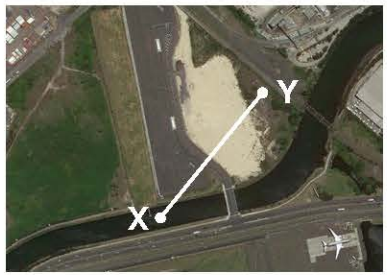
- Figure 5-1 illustrates a CSM across the former Tempe landfill (project area 1). The CSM shows the potential sources of contamination in this area are ACM, TRH, PAH, heavy metals in waste mass and biological break-down of putrescible waste. Other sources in groundwater include PFAS, nutrients and heavy metals. Pathways including lateral mitigation of groundwater, landfill gas migration, dust inhalation and migration of leachate. The main receptors include Alexandra Canal, commercial and construction workers. The figure shows the lateral migration of groundwater is protected by a perimeter cut-off wall
- Figure 5-2 illustrates a CSM across the Sydney Airport northern lands carpark (project area 2). The CSM shows the main sources of contamination in this area are ACM in fill and landfill gas. Other sources in groundwater include PFAS, nutrients and heavy metals. Pathways including lateral mitigation of groundwater, landfill gas migration and dust inhalation. The main receptors include Alexandra Canal, commercial and construction workers. The figure shows the migration of landfill gas is managed in the western portion by a passive gas venting system
- Figure 5-3 illustrates a CSM across the Sydney Airport northern lands (project area 3). The CSM shows the main sources of contamination in this area are ACM, PAH, PCBs and heavy metals in soil. Other sources in groundwater include PFAS, nutrients and heavy metals. Pathways including lateral mitigation of groundwater and dust inhalation. The main receptors include Alexandra Canal, commercial and construction workers
- Figure 5-4 illustrates a CSM across Qantas Drive (project area 4). The CSM shows the main sources of contamination below the project site are heavy metals and PAH in soil. The downgradient area is further contaminated with light non-aqueous phase liquids (LNAPL), PFAS and dissolved phase TRH. Pathways within the project site include lateral mitigation of groundwater and dust inhalation. Additional pathways associated with the downgradient contamination include vapour migration and accelerated migration along underground utilities. The main receptors include Cooks River, commercial and construction workers.

The findings from the background review of investigation reports which has been used to develop the CSM for each project area is provided in Appendix G, Appendix H, Appendix I, Appendix J and Appendix K.

X - Y CSM Cross Section Layer



Contamination Impact Assessment
Figure 5-1
Conceptual Site Model - Project Area 1



X - Y CSM Cross Section Layer

Legend

- Migration pathway
- Source of contamination

X

Y

DEGRADED HARDSTAND AND GRAVEL

Receptor: Construction workers during excavation

Receptor: Commercial workers

Receptor: Maintenance worker

Asphalt pavement

Passive gas system manhole

Pathway: Dust inhalation

Receptor: Alexandra Canal

Passive gas system pipework

Source: ACM in fill

Pathway: Landfill gas migration

Pathway: Dust and landfill gas migration

Pathway: Migration of soil impacts

EXISTING FILL

Groundwater surface

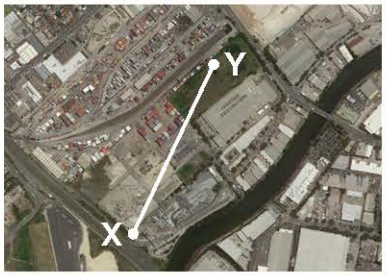
Pathway: Lateral migration

NATURAL SANDS

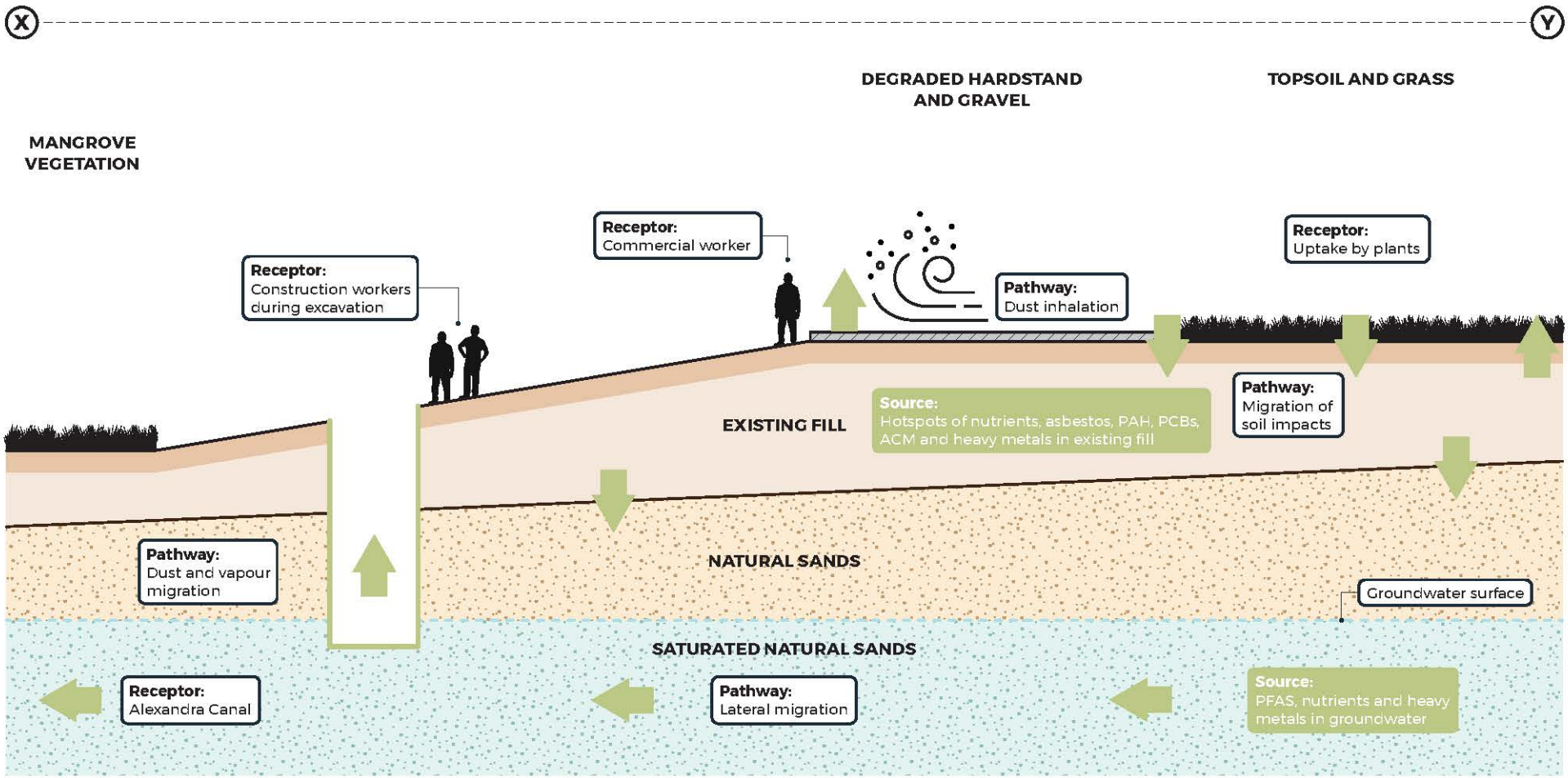
Source: PFAS, nutrients (including ammonia) and heavy metals in groundwater

NATURAL CLAYS

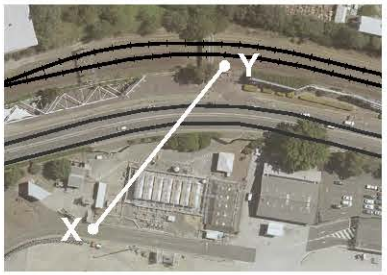
Contamination Impact Assessment
Figure 5-2
Conceptual Site Model - Project Area 2



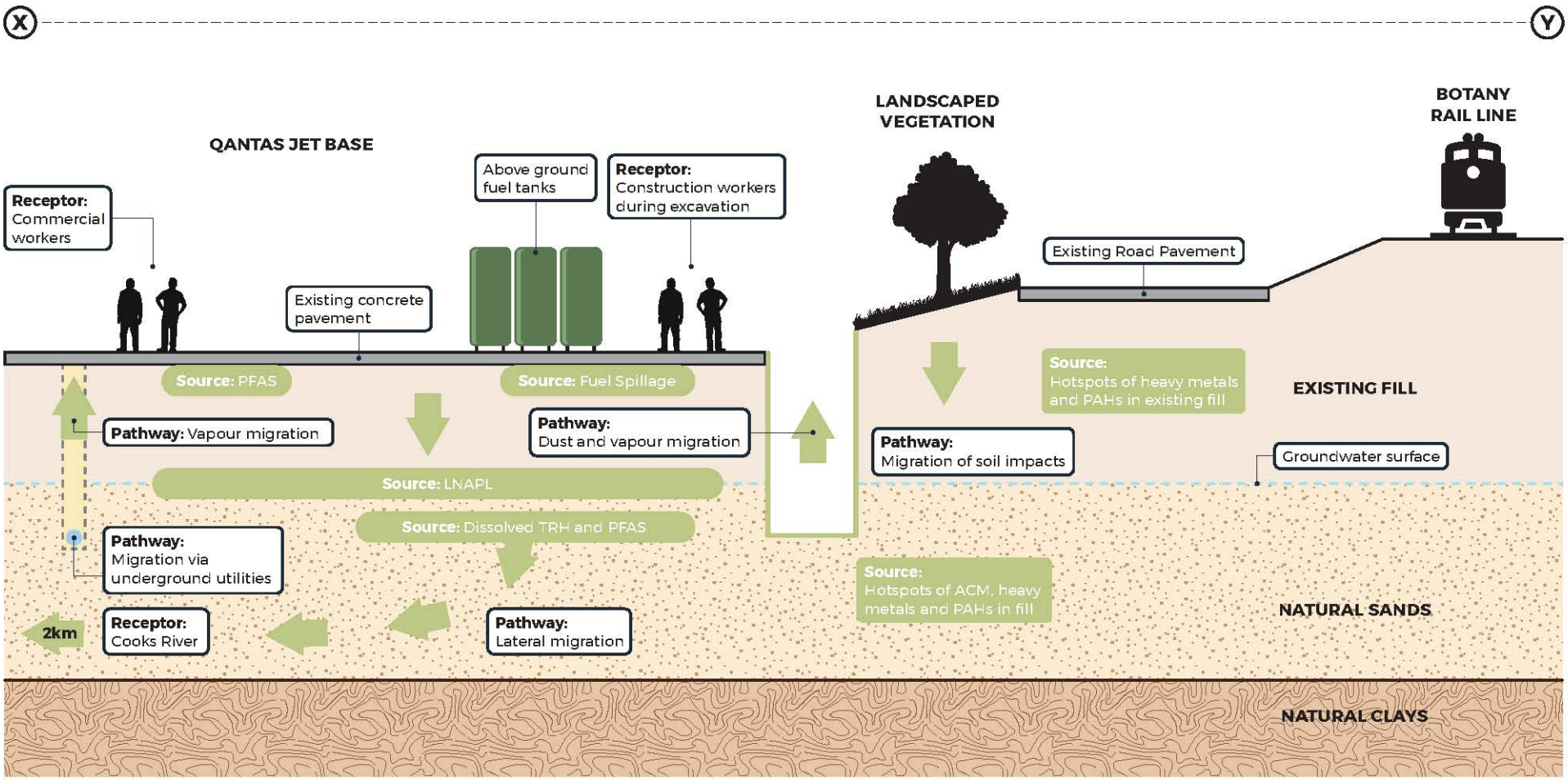
X - Y CSM Cross Section Layer



Contamination Impact Assessment
Figure 5-3
Conceptual Site Model - Project Area 3



X - Y CSM Cross Section Layer



Contamination Impact Assessment
Figure 5-4
Conceptual Site Model - Project Area 4

The day-to-day future activities of the project site following construction for the roadway should not result in exposure of users to contaminated soil or groundwater. However, disturbing the soil and groundwater during construction would involve risk of exposure to potentially contaminated soils. The potential impacts related to this disturbance are presented in section 6.

The profile of the project site would be altered during construction for the road network and the associated interaction with CSM linkages would need to be managed through the design and construction process. Overall no significant change to the CSM is anticipated. The following would need to be considered to minimise contamination impacts from the project:

- Project area 1 – The project would be designed to comply with the objectives of the current VRP issued for Tempe Landfill
- Project area 2 – The project would be designed to comply with the objectives of the existing RAP (Zoic November 2017)
- Project area 3 – The design would include a drainage system (including a flood mitigation basin) that is impermeable or that minimises leakage
- Project area 4 – The design would include a drainage system that is impermeable or that minimises leakage
- Project area 5 – Continued regulation under EPA Remediation Order (number 23004).

5.3 Data gaps and site suitability

A summary of the contamination assessment in relation to suitability of the project site for the proposed development is presented in Table 5-2. The assessment has been completed with regard to guidelines made or approved under the CLM Act. The trigger values in Schedule 2 and Schedule 3 of the AEPR were also considered.

It is noted that the recommendation for additional investigation relates to site characterisation to inform the CSM. Waste classification as per NSW EPA guidelines is also necessary for all material to be removed from site.

Table 5-2 Contamination assessment summary

Project Area	CSM, Source-pathway/receptor linkage assessment	Data gaps/additional investigation required	Remediation required/ site suitability
Project Area 1	Potential: Waste>dust inhalation>worker/users of recreational facilities Concentrations of TRH, PAH and heavy metals, OCP and PCBs in soil were found to be greater than assessment criteria. Contamination beneath the road pavement and landfill cap would not be accessible to humans post construction, but a long term environmental management plan (LTEMP) would need to be prepared. Potential: Landfill gas>migration/accumulation>worker/recreational user On-going landfill gas management is required. The maximum gas screening value (GSV) recorded within the site falls into EPA 2012 "characteristic gas situation 2" low risk conditions (well SG-BH-106, January 2019) but methane and carbon dioxide concentrations are high. Potential: Soil contamination>vapour migration> maintenance worker Hydrocarbon concentrations were indicative of a potential vapour intrusion risk for commercial workers and/or intrusive workers at five locations (GW8, SG-BH-103, SG-BH-104, SG-BHTT-01 and SG-BHTT-04). A LTEMP would need to be prepared. Potential: Leachate>lateral migration>receiving water bodies Concentrations of ammonia, phosphate, heavy metals and PFAS compounds in groundwater exceeded assessment criteria. Groundwater impacts are likely associated with leachate. Leachate is currently managed on site by a barrier wall and leachate collection system. The objectives of the associated VRA need to be met during the project. Complete: Landfill gas>migration/accumulation>existing vegetation Literature studies indicate that landfill gas can inhibit plant growth on landfill covers. The landfill cap has been in place for over 10 years. Vegetation cover is prevalent indicating tolerant plants have established and adapted to current conditions. Potential for accelerated lateral migration via underground service trenches Drainage to be designed to mitigate risk.	No further contamination investigation required. Soil requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	The design, implementation and ongoing management of the emplacement mounds would be detailed in a landfill management plan, prepared in consultation with relevant stakeholders. Modifications to the existing leachate and gas management system required to facilitate the project would also be documented in the plan. On-going monitoring and maintenance (by responsible party) for landfill gas, cut-off wall and leachate treatment system would be required post-construction (refer to Technical Paper – Landfill Assessment). An environment management plan would need to be prepared for long term management. The environmental management plan would be approved by an independent site auditor accredited under the site auditor scheme under the CLM Act. Current known contamination status does not impede suitability of the site for the proposed development (subject to project design adopting the objectives of the VRP).

Project Area	CSM, Source-pathway/receptor linkage assessment	Data gaps/additional investigation required	Remediation required/ site suitability
Project Area 2	Complete: Soil contamination>dust inhalation>worker Asbestos in soil identified within fill with some concentrations of TRH, PAH and lead in soil in excess of assessment criteria. Contamination beneath the road pavement or remedial capping would not be accessible to humans post construction, but a LTEMP would need to be prepared. Potential: Landfill gas>migration/accumulation>worker Ground gas including methane have been detected within the subsurface. The maximum GSV recorded falls into EPA 2012 "characteristic gas situation 3" moderate risk conditions. A passive gas mitigation system has been installed beneath the northern lands carpark area. Complete: Groundwater contamination>lateral migration>receiving water bodies Ammonia, phosphate, heavy metals and PFAS compounds were in excess of assessment criteria. Groundwater impacts are likely associated with off-site sources. Groundwater would not be accessible to humans' post construction. Potential for accelerated lateral migration via underground service trenches. Drainage to be designed to mitigate risk, including lining of flood retention ponds.	No further contamination investigation required. Soil requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	Project area is currently managed by Sydney Airport under a site-specific environmental management plan (EMP). Sydney Airport Corporation has also commissioned two RAPs, associated actions are partially complete. Where the project has the potential to damage and/or remove the existing Sydney Airport systems or impact on their effectiveness a remedial action plan would be developed that describes the reinstatement of these systems as part of the construction phase such that they continue to operate effectively post construction. On-going monitoring and maintenance of the existing passive gas system would be required. Current known contamination status does not impede suitability of the site for the proposed development (subject to management under an RAP).

Project Area	CSM, Source-pathway/receptor linkage assessment	Data gaps/additional investigation required	Remediation required/ site suitability
Project Area 3	Complete: Soil contamination>dust inhalation>worker TRH, PAH, BTEX and heavy metals and asbestos were in excess of soil assessment criteria. Contamination beneath the road pavement would not be accessible to humans post construction, but a LTEMP would be required. Potential: Soil contamination>vapour migration>worker Seepage of coal tar at a single location observed during historic investigation. Coal tar impact not identified during subsequent investigation, as such assumed to be an isolated hotspot in the CSM. MW3RR historically reported TRH above assessment criteria but was destroyed in 2012. Further delineation investigation required to assess potential risk associated with a vapour pathway. Complete: Groundwater contamination>lateral migration>receiving water bodies Ammonia, phosphate, heavy metals and PFAS compounds were in excess of groundwater assessment criteria. On-site and off-site sources may be contributing to the groundwater impacts. Groundwater would not be accessible to humans post construction. Potential for accelerated lateral migration via underground service trenches Drainage to be designed to mitigate risk (i.e. project flood retention pond to be lined).	Additional soil sampling required to inform construction due to limited soil characterisation across the area. Additional groundwater monitoring in vicinity of lost well MW3RR. Soil requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	An RAP is required to manage contamination in this project area. Site investigators should ensure that recommended further investigation is sufficient to enable site management strategies to be devised. Current known contamination status does not impede suitability of the site for the proposed development (subject to management under an RAP).

Project Area	CSM, Source-pathway/receptor linkage assessment	Data gaps/additional investigation required	Remediation required/ site suitability
Project Area 4	Potential: Soil contamination>dust inhalation>worker Concentrations of PAH and heavy metals above soil assessment criteria. Contamination beneath the road pavement would not be accessible to humans post construction, but a LTEMP would be required. Complete: Groundwater contamination>lateral migration>receiving water bodies Heavy metals in groundwater exceeded assessment criteria. Groundwater impacts are likely attributable to background concentrations or off-site sources. Groundwater would not be accessible to humans' post construction. Potential for accelerated lateral migration via underground service trenches Drainage to be designed to mitigate risk. Groundwater contamination>vapour migration> worker LNAPL has been identified and TRH, chlorinated solvents, PAH, ammonia, sulphide and heavy metals concentrations in groundwater exceed assessment criteria in downgradient airport areas. Further delineation investigation required to prove that these plumes would not be intercepted during the project.	Additional groundwater monitoring adjacent to the airport boundary. Soil requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	An RAP is required to manage contamination in this project area. Site investigators should ensure that recommended further investigation is sufficient to enable site management strategies to be devised. Downgradient, sources of groundwater contamination could be disturbed during construction dewatering. Downgradient sources of contamination identified (including Qantas Jet Base), project would not impede remediation of the associated land by other parties if required in the future.
Project Area 5	Contaminated sediments>disturbance and subsequent dispersion>marine ecosystem Bed sediments contaminated with chlorinated hydrocarbons, OCPs, PCBs and metals. A Remediation Order (number 23004) was also issued by the NSW EPA to Sydney Water Corporation on 10 May 2004. Mitigation associated with potential sediment disturbance may be required during construction.	No further contamination investigation required. Sediment requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	By order from the EPA, if work is proposed in Alexandra Canal, Sydney Water Corporation must submit, for the EPA's approval, a written plan directed at minimising disturbance and migration of contaminated sediments at the site.
Rail Corridor	No investigation reports were available for review. There is a potential for uncontrolled filling to have occurred in the rail corridor.	Limited access into the rail corridor is required during the project. Activity would be restricted to piling for the bridge piers. Targeted soil investigation is recommended in the vicinity of the proposed structures.	No change of land use proposed.
St Peters tie-in	Under the New M5 infrastructure approval, a soil contamination report must be prepared and where remediation is required the report must be accompanied by a Site Audit Statement prepared by an accredited site auditor.	Verify that the contamination commitments under the New M5 project have been met. Soil requiring off-site disposal needs to be classified in accordance with NSW EPA Waste Classification Guidelines 2014.	Verify site suitability on completion of the New M5 tie-in construction.

6. Construction impacts

6.1 Impacts on Sydney Airport (Commonwealth) land

6.1.1 Contamination

The presence of soil and groundwater with chemicals at concentrations in excess of adopted assessment criteria has been identified across all project areas 2, 3 and 4. Additional contamination issues identified include:

- Landfill gases recorded in project area 2
- Light non-aqueous phase liquid (LNAPL) and volatile chlorinated hydrocarbons (VCH) in down-gradient Qantas Jet Base.

Contaminated land on and/or adjacent to the project site, if not managed appropriately, could potentially impact the environment or site workers during construction. There is also a potential for cross contamination (or incorrect waste classification) associated with incorrect handling or disposal of contaminated soils if appropriate management procedures are not implemented. Disturbance of contaminated land (soil, groundwater and sediments) during construction has the potential to:

- Mobilise contaminants impacting nearby soils, surface water, and groundwater
- Increase the migration of contaminants into surrounding areas via leaching, overland flow and/or subsurface flow (water and/or vapour), or dust with the potential to impact on receiving environments such as Alexandra Canal
- Increase the risk of exposure to contaminants (direct contact and/or inhalation) by site workers, visitors and the local community.

Based on the nature and extent of identified contamination the following potential exposure scenarios need to be managed during construction:

- Direct contact and ingestion by construction workers (Source: contaminated soil, contaminated groundwater or contaminated surface water)
- Risk of on-site dust and/or asbestos exposure to site workers, site users and site visitors (Source: contaminated soil, ACM within soil material)
- Risk of off-site dust and/or asbestos exposure to members of the public (Source: contaminated soil, ACM within soil material)
- Off-site transport of contaminants via vehicle/plant movements (Source: contaminated soils or contaminated sediments)
- Surface water runoff and discharge into receiving environment (Source: rainfall infiltration through contaminated soil)
- Discharge of contaminants into receiving environment during dewatering activities (Source: contaminated soil or contaminated groundwater)
- Mobilisation (drawdown) of groundwater contamination during dewatering (Source: contaminated off-site groundwater)
- Sediment dispersion into the receiving environment (Source: contaminated sediment)
- Landfill gas migration and accumulation in confined space excavations or service pits which need to be accessed during construction (Source: landfill gas)
- Volatilisation of total recoverable hydrocarbon (TRH) and VCH impacts (Source: contaminated soil or contaminated groundwater)

- Groundwater/surface water quality impacts – dewatering large volumes of groundwater may result in mobilisation of contaminants in groundwater, such as that present at the Qantas Jet Base and taxi ranks on Sir Reginald Ansett Drive, into project excavations where workers may be exposed. The groundwater might be extracted and discharged into surface water bodies were contamination may be spread (Source: contaminated groundwater).

Soil contamination could also be encountered during construction work at locations not previously investigated. An unexpected finds protocol would need to be developed as part of the construction environmental management plan (CEMP).

It is noted that for demolition activities, the Work Health and Safety Regulation 2011 (NSW) requires that all hazardous materials are properly removed from buildings prior to any demolition works occurring. This is to prevent workers and the public from being exposed to these materials and contaminants during the demolition and other construction works. Hence there is no further discussion in this technical paper on hazardous building materials that could be encountered during construction activities.

A qualitative assessment and ranking of construction risk has been completed in Table 6-1 by assessing the pollutant linkages in the CSM and identifying a range of potential hazards. Potential risk associated with unexpected contamination finds have not been assessed. The following risk categories have been assigned:

- **Low risk**: impact can be managed by implementing standard construction management practices in accordance with relevant guidelines
- **Medium risk**: contamination specific management plans and controls are required
- **High risk**: engineered controls and/or environmental/health monitoring are required.

The receptors considered in Table 6-1 are defined as follows:

- Receiving water bodies – direct or indirect (via stormwater infrastructure) discharge into Alexandra Canal or Mill Stream
- Receiving environment – includes (as applicable) dust deposition in public areas, sediment build up on public roadways, groundwater and surface water discharge onto vegetated areas
- Construction workers – individuals directly related to the project construction phase
- Off-site public – includes (as applicable) adjacent commercial/industrial worker, adjacent construction worker, commercial user, recreational user, residents.

It is noted that the risk rankings presented in Table 6-1 are prior to the implementation of the recommended management measures identified in section 9.

Following the implementation of recommended management measures, it is anticipated that any identified high or medium risk rankings would ultimately present a low risk of exposure.

Table 6-1 Construction impact assessment on Sydney Airport land

Area of Relevance (Figure 3-2)	Construction activity	Source→pathway→receptor linkage	Hazard	Risk (without mitigation)
All areas (Sydney Airport land)	Installation of drainage and utilities	Groundwater contamination>dewatering>receiving water bodies	Discharge of pollutants into Alexandra canal.	High
		Groundwater contamination>potential groundwater reinjection during dewatering>receiving water bodies	Option for management of groundwater during dewatering includes reinjection to groundwater. Reinjection may result in mobilisation of contaminants in groundwater	Medium
		Soil/groundwater contamination> direct contact or ingestion during dewatering>construction worker	Incidental contaminated soil or groundwater ingestion/dermal contact.	Low
	Piling	Groundwater contamination>groundwater displacement>receiving water bodies	Discharge of pollutants into Alexandra canal.	Medium
		Contaminated soil>sediment dispersion>receiving water bodies	Sediment runoff into stormwater.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
	General excavation activity	Contaminated soil>sediment dispersion>receiving water bodies	Sediment runoff into stormwater.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
	Temporary soil stockpiling	ACM>airborne asbestos fibres>construction worker	Asbestos exposure exceeding occupational health levels.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
		Soil contamination>offsite dust transport>off-site public	Off-site migration of nuisance dust.	Low
		ACM>airborne asbestos fibres>off-site public	Off-site migration of asbestos fibres	Low
		Contaminated soil>sediment dispersion>receiving water bodies	Rainfall may cause sediment runoff.	Low

Area of Relevance (Figure 3-2)	Construction activity	Source→pathway→receptor linkage	Hazard	Risk (without mitigation)
		Contaminated soil>surface runoff>receiving water bodies	Rainfall infiltration may generate runoff that may be contaminated.	Medium
	Construction compound facilities	ACM>airborne asbestos fibres>construction worker	Asbestos exposure exceeding occupational health levels.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs	Low
		Soil contamination>transport via vehicle movement> receiving environment/construction worker	Vehicles tyres tracking sediment into public roadways.	Low
			Movement of soiled construction equipment and clothing causing cross-contamination of welfare compound areas.	Medium
Project Area 2	Construction compound facilities	Landfill gas>migration>construction worker	Accumulation of gases in indoor air creating an explosive atmosphere. Depleting oxygen levels inside workplace buildings.	High
	Cut for final road pavement levels	ACM>airborne asbestos fibres>construction worker/off-site public	Asbestos exposure exceeding occupational health levels (on-site/off-site). Dust exposure exceeding occupational health levels for COPCs.	High
		Soil contamination>offsite dust transport>off-site public	Offsite migration of nuisance dust.	Medium
	Installation of drainage and utilities	Landfill gas>accumulation>construction worker	Accumulation of landfill gases in confined space work areas.	High
Project area 3	Excavation for flood retention pond	ACM>airborne asbestos fibres>construction worker/off-site public	Asbestos exposure exceeding occupational health levels (onsite/offsite). Dust exposure exceeding occupational health levels for COPCs.	High
		Soil contamination>offsite dust transport>offsite public	Offsite migration of nuisance dust.	Low

Area of Relevance (Figure 3-2)	Construction activity	Source→pathway→receptor linkage	Hazard	Risk (without mitigation)
Project Area 4	Cut for final road pavement levels	Soil contamination>volatilisation of TRH/VCH>construction worker	Release of volatile contaminants in soil during excavation creating odour nuisance. Volatile contaminants exceeding occupational health levels.	Medium
		Soil contamination>dust transport>off-site public	Dust exposure exceeding occupational health levels for COPCs.	Low
		Soil contamination>dust transport>off-site public	Offsite migration of nuisance dust.	Low
	Installation of drainage and utilities	Soil/groundwater contamination>volatilisation>construction worker	Accumulation of volatile contaminants in confined space work areas.	Medium
		Groundwater contamination>drawdown>receiving water bodies	Potential to mobilise contamination from downgradient sources (Qantas Jet Base).	Medium

6.1.2 Acid sulfate soils

The risk of ASS being present within the project site was identified in section 4.5 which describes project areas and specific activities requiring ASSMPs. The area immediately adjacent to Alexandra Canal is a Class 1 ASS risk area which would require an ASSMP for all activities.

Table 6-2 presents an assessment of impact associated with the disturbance of ASS based on Figure 2.1 of the Acid Sulphate Soil Manual, NSW Acid Sulphate Soil Management Advisory Committee (ASSMAC), 1998 (Acid Sulphate Manual). The treatment categories presented in Table 4.5 of the ASSMAC Acid Sulphate Soil Manual have been used to define the severity of the potential impact associated with ASS.

Table 6-2 Acid Sulfate Soil impact summary

ASSMAC Figure 2.1 reference	Project Area 1	Project Area 2	Project Area 3	Project Area 4	Project Area 5
Step 1 – establish works characteristics	No significant excavation into natural material. Potential ASS disturbance during piling for bridge piers.	Excavation for stormwater drainage up to 4 mBGL. Potential ASS disturbance during piling for bridge piers.	Excavation for stormwater drainage and retention basin up to 4 mBGL. Potential ASS disturbance during piling for overpass.	Limited excavation into natural material. Excavation for stormwater drainage up to 3 mBGL. Potential ASS disturbance during piling for bridge piers.	Outfall connections for stormwater discharge.
Step 2 – establish if ASS is present	Class 1 adjacent to Alexandra Canal and Class 2 elsewhere.	Class 1 adjacent to Alexandra Canal and Class 2 elsewhere.	Class 2	Class 1 adjacent to Alexandra Canal and Class 2 elsewhere.	Class 1
Step 3 – results from Roads and Maritime Investigation	Net acidity (sulfur units) 0.09–1.7%S	Net acidity (sulfur units) 0.04–0.56%S	Net acidity (sulfur units) 0.05–1.1%S	Net acidity (sulfur units) 0.04–0.68%S	Net acidity (sulfur units) 0.24–1.72%S
Step 4 – treatment category (Table 4.5 ASSMP)	High	Medium	High	Medium	High
Step 4: impact of acid runoff offsite	High	High	High	High	High

Technical Working Paper 7 – Groundwater has identified the potential for ASS to be exposed when dewatering. This activity can expose sulfide to oxygen producing sulphuric acid, sulfur dioxide and hydrogen sulphide. The generation of sulphuric acid can lower pH and release toxic concentrations of aluminium and iron into the groundwater systems and receiving environments. Any dewatering activities would need to manage this potential impact appropriately.

6.1.3 Soil salinity

High salinity soil can reduce or preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel. Most of the proposed road alignment is classified as a low salinity potential area. Two zones within the proposed alignment are classified as having a high salinity potential, impacts associated with these areas are presented in Table 6-3.

Table 6-3 Salinity impact summary

High salinity impact zone	Proposed construction activity	Groundwater constraints	Potential saline soil disturbance	Design constraints	Soil management requirements
Within Sydney Airport northern land area, to the west of the St Peters Interchange (project area 3)	Construction of flood retention basis ~ 2 mBGL. Piling for bridge/overpass piers ~ 15 mBGL	Shallow groundwater encountered < 1.5 mBGL. Groundwater likely to be subject to tidal influence and influenced by saltwater intrusion from Alexandra Canal.	Excavation for flood retention pond. Minor disturbance during piling.	Liner required to prevent groundwater inflow into flood retention pond. Marine grade concrete and salt tolerant vegetation required in areas exposed to saline groundwater (no additional controls required for saline soils).	Saline soils should not be reused in low salinity areas.
Within Sydney Airport northern lands car park, immediately north of Alexandra Canal (project area 2)	Construction of at-grade road pavement (eastern edge). Piling for bridge piers (adjacent to Alexandra Canal).	Shallow groundwater encountered < 1.5 mBGL. Groundwater likely to be subject to tidal influence, increasing salinity observed adjacent to Alexandra Canal.	Cut for Road pavement < 2.0 mBGL. Minor disturbance during piling.	Marine grade concrete required in areas exposed to saline groundwater (no additional controls required for saline soils). Remediation capping layer previously installed across the area (2015–2017). Design to comply with the objective of the RAP (Zoic November 2017).	Saline soils should not be reused in low salinity areas.

The current hydrogeological model would temporarily alter during construction. Potential influences include:

- Increased rainfall infiltration during removal of landfill cap
- Interception of groundwater during excavation activities
- A change of natural drainage patterns as a consequence of construction.

Given that these changes would be temporary no significant impact on soil salinity is anticipated.

Elevated total dissolved solids (TDS) is an indicator of salinity. Elevated TDS concentrations in groundwater have been recorded within the high salinity potential zones with a maximum TDS concentration of 20,000 mg/L recorded in GW25s. Considering existing groundwater quality, disturbance of high salinity soils during construction is unlikely to affect groundwater resources.

6.2 Significance of impacts on Sydney Airport land

In accordance with the Significant Impact Guidelines 1.2, the environmental aspects listed in Table 6-4 have been assessed to determine if the project would likely result in a significant impact (as defined under the EPBC Act) on Commonwealth land.

Table 6-4 Significance of impacts on Commonwealth land

Environmental effect	Likelihood of occurring	Related activities	Significance of impact
Generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality	Unlikely that the road infrastructure project would generate smoke or fumes. Potential for groundwater treatment technologies to generate chemical/nutrient by-products.	Groundwater dewatering.	Potential volumes that could be generated are unlikely to substantially reduce local air quality or water quality.
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal	Storage and handling of fuels for equipment/ vehicles would be required during construction. Contaminated soil and potentially groundwater would be stored, transported and disposed during project construction.	Excavation, dewatering, piling and installation of services.	Storage of fuels brought onto site would be managed under general construction legislation and guidance. Contaminated soil and groundwater impacts are widespread in the project area. High risk hazards identified include, asbestos exposure, groundwater discharge and landfill gas accumulation in buildings/confined spaces. Engineering control and monitoring required to prevent significant impacts.
Substantially disturb contaminated or acid-sulphate soils	Likely – contaminated shallow soil associated with fill material is widespread. Likely – ASS has been identified in natural soils across project area 2 and 3 and adjacent to Alexandra Canal in project area 4.	Excavation for utilities and piling.	Opportunity for existing shallow contaminated soils to be remediated via off-site disposal and/or encapsulation. Long term impact is considered negligible. ASS management required during construction to prevent significant impacts.

Overall, provided the recommended mitigation is adopted outlined in section 9, the impacts of the project are unlikely to be significant.

6.3 Consistency with the Sydney Airport Master Plan 2039 and Environment Strategy 2019–2024

The project is consistent with the airport planning framework for soil and land management detailed in the Sydney Airport Master Plan 2039 and Environment Strategy 2019–2024. In particular, the project mitigation measures in section 9 focus on ensuring that the infrastructure would be planned and designed to minimise disturbance and potential impacts on soil and contaminated land where possible.

Provided the recommended mitigation is adopted outlined in section 9, the project would not prevent the ability for Sydney Airport to manage contamination in adjacent land parcels to achieve the land use outcomes envisaged under the Master Plan.

6.4 Impacts on State land

Project areas 1 and 5 are located on State land. The potential construction impacts presented in Table 6-1 are also applicable for State land. Additional hazards associated with project areas 1 and 5 are presented in Table 6-5.

Table 6-5 Construction impact assessment on State land

Area of Interest	Construction activity	Source→pathway→receptor linkage	Hazard	Risk
All areas (including rail corridor)	Installation of drainage and utilities	Groundwater contamination>dewatering>receiving water bodies	Discharge of pollutants into Alexandra Canal.	High
		Soil/groundwater contamination> direct contact or ingestion during dewatering>construction worker	Incidental contaminated soil or groundwater ingestion/dermal contact.	Low
		Groundwater contamination>potential groundwater reinjection during dewatering>receiving water bodies	Option for management of groundwater during dewatering includes reinjection to groundwater. Reinjection may result in mobilisation of contaminants in groundwater	Medium
	Piling	Groundwater contamination>groundwater displacement>receiving water bodies	Discharge of pollutants into Alexandra Canal.	High
		Contaminated soil>sediment dispersion>receiving water bodies	Sediment runoff into stormwater.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
	General excavation activity	Contaminated soil>sediment dispersion>receiving water bodies	Sediment runoff into stormwater.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
	Temporary soil stockpiling	ACM>airborne asbestos fibres>construction worker	Asbestos exposure exceeding occupational health levels.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
		Soil contamination>offsite dust transport>off-site public	Off-site migration of nuisance dust.	Low
		ACM>airborne asbestos fibres>off-site public	Off-site migration of asbestos fibres.	Low
		Contaminated soil>sediment dispersion>receiving water bodies	Rainfall may cause sediment runoff.	Low

Area of Interest	Construction activity	Source→pathway→receptor linkage	Hazard	Risk
		Contaminated soil>surface runoff>receiving water bodies	Rainfall infiltration may generate runoff that may be contaminated.	Medium
	Construction compound facilities	ACM>airborne asbestos fibres>construction worker	Asbestos exposure exceeding occupational health levels.	Medium
		Soil contamination>onsite dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Low
		Soil contamination>transport via vehicle movement> receiving environment/construction worker	Vehicles tyres tracking sediment into public roadways.	Low
			Movement of soiled construction equipment and clothing causing cross-contamination of welfare compound areas.	Medium
Project area 1	Pavement excavation	Exposed solid waste>surface water infiltration>receiving water bodies	Potential for increased rainfall infiltration when current cap is removed. Additional volumes may exceed current leachate system capacity.	Medium
		Exposed solid waste>nuisance odour>off-site public	Generation of nuisance odours during excavation into landfill materials.	Medium
		ACM>airborne asbestos fibres>construction worker/off-site public	Asbestos exposure exceeding occupational health levels (on-site/off-site).	High
		Exposed solid waste>on-site dust transport>construction worker	Dust exposure exceeding occupational health levels for COPCs.	Medium
		Exposed solid waste>off-site dust transport>off-site public	Offsite migration of nuisance dust.	Medium
		ACM>airborne asbestos fibres>off-site public	Offsite migration of asbestos fibres.	Medium
	Construction compound facilities	Landfill gas>migration>construction worker	Accumulation of gases in indoor air creating an explosive atmosphere. Depleting oxygen levels inside workplace buildings.	High
	Installation of drainage and utilities	Landfill gas>accumulation>construction worker	Accumulation of landfill gases in confined space work areas.	High
	Piling	Groundwater contamination>lateral migration>receiving water bodies	Damage to existing barrier cut-off wall or leachate system during construction	Low

Area of Interest	Construction activity	Source→pathway→receptor linkage	Hazard	Risk
	Construction of the emplacement mounds	Exposed solid waste>surface water infiltration>receiving water bodies	Potential for surfaces water runoff across exposed solid waste as material is applied to the new waste cells.	Medium
		Exposed solid waste>nuisance odour>off-site public	Solid waste would be exposed as material is applied to the new waste cells.	Medium
		ACM>airborne asbestos fibres>construction worker/off-site public	Solid waste would be exposed as material is applied to the new waste cells.	High
		Exposed solid waste>on-site dust transport>construction worker	Solid waste would be exposed as material is applied to the new waste cells.	Medium
		Exposed solid waste>off-site dust transport>off-site public	Solid waste would be exposed as material is applied to the new waste cells.	Medium
Project area 5	Disturbance of bed sediments (stormwater channel construction)	Contaminated sediment>dispersion>receiving water bodies	Disturbance may mobilise contaminated sediment into the canal waters impacting aquatic ecosystem.	High

6.4.1 Former Tempe Tip site

The construction works would impact the existing remediation system at the former Tempe Tip site (remediation order 23003). The construction works would need to be designed, staged and managed to ensure that the project complies with the objectives of the VRP. Where the project has the potential to damage and/or remove the existing remediation systems or impact on their effectiveness a RAP would be developed that describes the reinstatement of these systems as part of the construction phase such that they continue to operate effectively post construction. Detailed design will seek to avoid interactions with the bentonite cut-off wall.

Any waste retained on site would be emplaced on new cells constructed above the current landfilling. Design would be in accordance with the EPA's Solid Waste Landfill Guidelines 2016. The design, implementation and ongoing management of the emplacement mounds would be detailed in a landfill management plan, prepared in consultation with relevant stakeholders. Modifications to the existing leachate and gas management system required to facilitate project construction would also be documented in the plan. The construction works would be carried out in accordance with the plan.

Additional regulatory requirements associated with the NSW EPA POEO Waste Regulation 2014 would also need to be addressed. These additional requirements are discussed in Technical Working Paper 16 – Landfill Assessment which provides a detailed study of current conditions and operational performance at the former Tempe Tip site. The working paper also provides a summary of potential project construction impacts and mitigation measures associated with works within the former tip.

6.4.2 Alexandra Canal sediments

The following primary chemicals of concern in sediment within Alexandra Canal have been identified:

- pH
- Petroleum hydrocarbons
- PAH
- PCBs
- Pesticides
- Asbestos
- Metals
- Speciated nitrogen
- Organotin compounds
- PFAS.

The Remediation Order (number 23004) issued by the NSW EPA to Sydney Water Corporation on 10 May 2004 would need to be considered for any works potentially disturbing Alexandra Canal bed sediments. Prior to permitting any work activities disturbing the bed sediments in Alexandra Canal Sydney Water must prepare and submit for the EPA's approval a written plan directed at minimising the disturbance and migration of contaminated sediments at the site.

The project has been designed to avoid disturbance of the Alexandra Canal bed sediments. The structural supports and foundations associated with the bridge crossings have been positioned outside of the canal walls.

The new stormwater drainage associated with the project would connect into Alexandra Canal. The associated outlets would most likely be constructed by first constructing coffer dams around the outlet locations. The coffer dam could be constructed by installing interlinked sheet piling into the bed and banks to create a box around the outlet location. The water inside the coffer dam could then be pumped out to create a dry area in which to construct the stormwater outlets without further sediment disturbance. The strips of canal wall above and below water level would have to be removed to allow the sheet piling through the bank. Additional excavation of the bank material (below the canal walls) might be required if there is refusal of sheet piles.

Where disturbance of sediments is unavoidable, management to prevent adverse water quality impacts to the surrounding environment would be required. Notice to and approval from Sydney Water Corporation (owner) and the EPA is likely to be required. The mitigation measures to manage contaminated bed sediments during construction would need to address:

- Prevent the dispersion of turbid plumes potentially containing elevated levels of COPC into Alexandra Canal
- Prevent the generation of ASS and therefore minimising the potential creation of sulfuric acid as a product of ASS.

A management plan which provides details of controls for any works that may disturb the Alexandra Canal sediments is required. The management plan would need to incorporate an ASSMP due to the presence of ASS within the bed sediments. The ASSMP would identify treatment options for sediment requiring off-site disposal. For on-site treatment, a designated treatment area would need to be nominated and designed to include suitable provision for the management of acidic runoff.

7. Operation impacts

7.1 Operational road network

The day-to-day future use of the project (both State and Commonwealth land) would not result in exposure of users to potentially contaminated soil or groundwater.

The primary operational impact related to the project is the potential contamination of soil, surface water and groundwater arising from intermittent vehicle accidents, leaks and spills on the roadway. State emergency services would be responsible for the management of spills and leaks associated with vehicle accidents.

The engineered pavement design for project area 1 includes a passive landfill gas venting system to minimise the potential for landfill gas from the former Tempe Tip site to accumulate in any confined spaces that may need to be accessed during maintenance activity. An occupational health and safety management plan would be required for future maintenance activity. The plan would need to document monitoring requirements associated with future confined space works.

The project is unlikely to impede the future remediation of groundwater in the area if it were desired to do so in the future due to the permeable nature of soil across the project site.

7.1.1 Soil remediation (encapsulation)

Where remediation via encapsulation (and not remediation via removal of contaminated soil) is adopted during the project, it could trigger a requirement for ongoing management of the encapsulated material during operation of the road. The requirement for management and/or monitoring of potential contamination risks during operation would be dependent on the final design of construction elements.

Where encapsulated contamination is considered to pose a potential risk during operation (ie during maintenance works), a LTEMP would be required. The LTEMP would need to identify risk and associated mitigation measure for future maintenance activities.

7.1.2 Groundwater

There would be an ongoing diffuse (stormwater) and acute (accidents/spills) risk of impacted runoff from the project leaking to underlying groundwater and migrating to surrounding surface water receptors. This is consistent with all other road infrastructure projects.

The project is not expected to cause long term changes to groundwater levels and is therefore not expected to affect known or potential salinity affected areas.

Once operation of the project commences, drawdown activities and thus risks associated with groundwater drawdown or losses are expected to be absent.

7.1.3 Former Tempe Tip site (State land)

The former Tempe Tip site would be managed by the responsible party long term in accordance with the EPA's Solid Waste Landfill Guidelines 2016. The key environmental management components of the landfill would include:

- Landfill gas management
- Leachate management
- Groundwater cut-off wall
- Landfill monitoring and management requirements.

The project would be designed to comply with the objectives of the VRP issued for the former Tempe Tip site.

An environment management plan would need to be prepared for long term management. The environmental management plan would be approved by an independent site auditor accredited under the site auditor scheme under the CLM Act.

A detailed study of current conditions and operational performance at the former Tempe Tip site are presented in Technical Working Paper 16 – Landfill Assessment. This working paper provides a summary of mitigation measures required during operation of the project.

7.2 Significance of impacts on Sydney Airport land

In accordance with the Significant Impact Guidelines 1.2, the environmental aspects listed in Table 7-1 have been assessed to determine if the project would likely result in a significant impact on Sydney Airport land.

Table 7-1 Significance of impacts on Sydney Airport land

Environmental effect	Likelihood of occurring	Related activities	Significance of impact
Generate smoke, fumes, chemicals, nutrients, or other pollutants which will substantially reduce local air quality or water quality.	Unlikely to be generated from land contamination. Emission from vehicles would occur.	Vehicle transport	Potential generation volumes associated with the built-form are unlikely to substantially reduce local air quality or water quality. For details of the predicted generation associated with increased traffic volumes refer to Technical Working Paper 4 – Air Quality.
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal.	Potential for release from vehicle accidents, leaks and spills on the roadway.	Vehicle transport	Impact would be intermittent. Unlikely to be significant.
Substantially disturb contaminated or acid-sulphate soils.	Unlikely	Not applicable	Not significant

The environmental effects indicated in Table 7-1 could also occur on sections of the project which are on State land and would have the same level and significance as impacts on Commonwealth land.

7.3 Consistency with Sydney Airport Master Plan 2039 and Environment Strategy 2019–2024

The project is consistent with the airport planning framework for soil and land management detailed in the Airport Master Plan 2039 and Environment Strategy 2019–2024. In particular, the project mitigation measures in section 9 focus on ensuring that land contamination is appropriately remediated during the project. A LTEMP would be required for any contamination encapsulated during the project.

Provided the recommended mitigation is adopted outlined in section 9, the project would not prevent the ability for Sydney Airport to manage contamination in adjacent land parcels to achieve the land use outcomes envisaged under the Master Plan.

8. Cumulative impacts

8.1 Botany Rail Duplication

The Botany Rail Duplication involves duplicating around three kilometres of rail line from Port Botany to the Qantas Link Bridge past Robey Street. The project includes track realignment, modifications to rail and road bridges and embankments, and all associated ancillary works. The Botany rail line runs along the length of Qantas Drive and Joyce Drive and as such is located immediately next to the Gateway road project site.

Disturbance of contaminated soil or groundwater during construction is not expected to have a cumulative impact as long as appropriate mitigation measures are implemented (Table 9-1).

As the Botany Rail Duplication project is a duplication of the existing rail line, sources of contaminants are already likely to be present and entering the receiving environment. The potential for the duplication to increase the level of contaminants is expected to be negligible.

The project would be constructed within the existing rail corridor and so would not involve significant new areas of impervious surface. Cumulative impacts associated with the Botany Rail Duplication are therefore likely to be negligible.

8.2 Other proposed major developments

Major developments currently under construction in the vicinity of the project include:

- M4–M5 Link and New M5
- Sydney Metro Southwest
- Airport North upgrades – O'Riordan Street
- Airport East upgrades – General Holmes Drive, Botany Road, Joyce Drive.

Other developments in the vicinity of the project, proposed but not yet approved, include the F6 Stages 1 and 2.

Based on the CSM exposure assessment presented in section 6.1.1, disturbance of contaminated soil or groundwater during construction is not expected to have a cumulative impact as long as appropriate mitigation measures are implemented (Table 9-1).

9. Recommended mitigation and management measures

The proposed infrastructure should be planned and designed to minimise disturbance and potential impacts on contaminated land where possible.

During construction of the project, contamination risks need to be managed to ensure there is no unacceptable risk to human health or the environment. The known areas of contamination will need to be documented and a management framework developed for addressing soil, sediment, ground gas and groundwater contamination during construction.

The potential contamination and soil impacts should be minimised by:

- Managing contamination in accordance with relevant legislative and policy requirements, as described in section 2
- Implementing further staged investigation/assessment (where required) to ensure that the available information is sufficient to enable effective site management strategies to be devised, including measures and investigations described in Table 9-1 and Table 9-3
- Designing, constructing and operating the project to minimise impacts from soil and groundwater issues
- Implementing the contamination mitigation measures described in section 9.1
- Implementing the mitigation measures described in relevant related reports (including Technical Working Papers for Groundwater, Surface Water Quality and Landfill Assessment).

Additional contamination assessments are required to address current data gaps (refer section 9.3). The project is unlikely to impede any proposed remediation of groundwater in the future. There are a number of current access constraints associated with existing land use, as such it is considered appropriate to undertake any additional investigations in a staged approach.

9.1 Management measures

Protocols should be developed for handling and storing material, including potentially or known contaminated soil/fill in accordance with the POEO Act. Protocols should also be developed for waste classification for off-site disposal and waste tracking in accordance with the POEO Act.

Construction activities should be undertaken in accordance with on-site practice, reflected in the Blue Book (Landcom, 2004). Mitigation measures that should be implemented as part of the project are provided in Table 9-1.

Table 9-1 Recommended mitigation measures

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Contaminated Land Management			
Investigation data gaps (Phase 2)	Undertake further staged investigation and assessment (including specific recommendations in Table 9-2) in accordance with NEPM 2013.	Project Area 3 and 4	Commonwealth Land
Potential for Unidentified ACM (Phase 2)	Undertake further staged investigation and assessment in accordance with NEPM 2013 and WA Department of Health (DoH) 2009, Guidelines for the Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.	Project Area 3 and 4	Commonwealth Land
Interface with former Tempe Tip site	Undertake the project in accordance with the objectives of the existing Voluntary Remediation Proposal. Where the project has the potential to damage and/or remove the existing remediation systems or impact on their effectiveness a remedial action plan would be developed that describes the reinstatement of these systems as part of the construction phase such that they continue to operate effectively post construction. The design of final landfill capping (including road pavement) and gas management system should be approved by a suitably qualified and experienced consultant, as defined in Schedule B9 of the NEPM. Refer to Technical Paper – Landfill Assessment.	Project Area 1	State Land
Outstanding Sydney Airport RAP (Zoic November 2017) requirements (Phase 3)	Where the project has the potential to damage and/or remove the existing Sydney Airport systems or impact on their effectiveness a remedial action plan should be developed that describes the reinstatement of these systems as part of the construction phase such that they continue to operate effectively post construction.	Project Area 2	Commonwealth Land
Actual or potential contamination risk identified to warrant remediation (not previously subject to a RAP) (Phase 3)	Develop a site remedial action plan in accordance with NEPM 2013. Remedial action plan on Commonwealth land to be endorsed by the Airport Environmental Officer. The remedial action plan should be developed during detailed design.	Project Area 3 and 4.	Commonwealth Land

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Ongoing Sydney Airport EMP (WSP November 2017) gas mitigation requirements (Phase 4)	Implement the requirements of the existing Sydney Airport environmental management plan or prepare a project specific environmental management plan endorsed by the Airport Environmental Officer.	Project Area 2	Commonwealth Land
Undertake remediation and validation (Phase 4)	Remediation to be undertaken during general construction programme in accordance with the endorsed remedial action plans. This should be developed during detailed design. Validation report to be prepared by a suitably qualified environmental consultant and reviewed and approved by an independent site auditor accredited under the site auditor scheme under the CLM act. Long term environmental management plan to be prepared by a suitably qualified environmental consultant (if required). and reviewed and approved by an independent site auditor accredited under the site auditor scheme under the CLM act.	All	Commonwealth Land and State Land
Potential disturbance of Alexandra Canal Sediment	In accordance with Remediation Order (number 23004) prepare and submit for the EPA's approval a written plan directed at minimising the disturbance and migration of contaminated sediments.	Project Area 5	State Land
Design/Pre-Construction			
Groundwater quality	Groundwater discharge should be managed to prevent any adverse effect on the environment from groundwater contamination. Groundwater treatment technologies are readily available for all of the COPCs identified during previous investigation. Detailed construction planning should include an options assessment for groundwater management for the project area. Additional groundwater investigation should be required to inform dewatering strategy and disposal options. Refer to Technical Paper 7 – Groundwater and Technical Paper 8 – Surface Water.	All	Commonwealth Land and State Land
PFAS impacted soil and groundwater	PFAS contaminated materials should be managed in accordance with the risk-based framework presented in the PFAS NEMP. Reuse of PFAS-contaminated soil and/or water must be undertaken following consultation with the relevant regulators, as reuse activities may require specific approval. If soil and/or water containing PFAS is proposed for reuse, the proposed reuse must not result in an unacceptable or increased risk to human health and/or the environment. A health and environmental risk assessment (HERA) would be required for any project reuse.	All	Commonwealth Land and State Land

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Excavation of landfill waste	The preferred strategy for the management of waste which is generated during earthworks is to retain the waste within the landfill boundary and build new landfill cells over the existing closed landfill in consultation with the EPA. The design, implementation and ongoing management of the emplacement mounds should be detailed in a landfill management plan, prepared in consultation with relevant stakeholders. Landfill capping in accordance to EPA, Environmental Guidelines Solid Waste Landfill, 2nd edition, 2016. Refer to Technical Paper – Landfill Assessment	Project Area 1	State Land
Acid sulfate soils	During detailed design an acid sulfate soil management plan (ASSMP) should be developed in accordance with the ASSMAC 1998 Acid Sulfate Soils Manual. The ASSMP should detail the processes to manage actual and potential acid sulfate soil and sediment disturbed during construction. The ASSMP should include a summary of the available acid sulfate soil information relevant to the proposal area and identify any further soil/water analysis required as a precursor to implementation of the management plan. Acid sulfate soils should be disposed off-site (where required) in accordance with the NSW EPA (2014) Waste Classification Guidelines; Part 1 and Part 4: Acid sulfate soils.	All	Commonwealth Land and State Land
High salinity potential	Design surface drainage to minimise surface water ponding and route/alleviate potential floodwaters. Specify marine grade concrete and salt tolerant vegetation for retention pond and drainage infrastructure constructed in high salinity soil areas.	(refer to Figure 4.5).	Commonwealth Land
ACM impacted soils	An asbestos management plan should be developed to outline the management of contaminated material. Preferred strategy is the retention of asbestos containing material within the project site.	All. Widespread impacts identified in project area 1 and 2.	Commonwealth Land and State Land

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Construction			
Stockpile management and soil handling.	Designated 'contaminated areas' should be identified and communicated to all project personnel. Designated contaminated areas should be clearly delineated and have suitable warning signs posted. Hygiene facilities incorporating a high standard of washing facilities and storage area for contaminated clothing/footwear should be provided for all works that have the potential to interactions with contaminated substances. A decision process should be developed to inform the stage at which normal site procedures can commence and unnecessary fencing and decontamination facilities can be removed. Stockpile management procedures for segregating soil and preventing cross-contamination of clean soil with contaminated soil should be developed and implemented.	All	Commonwealth Land and State Land
Surface water runoff and erosion of contaminated soils	Surface water and erosion controls should consider and minimise the potential for contamination of runoff, with consideration of guidance in relevant volumes of the Blue Book.	All	Commonwealth Land and State Land
Impact to groundwater quality	Site specific mitigation measures are presented in Technical Working Paper 7 – Groundwater.	All	Commonwealth Land and State Land
Excavation and temporary stockpiling of landfill waste	Manage in accordance with the requirements of the EPA Solid Waste Guidelines 2016. An environment management plan should be prepared for long term management. The environmental management plan should be approved by an independent site auditor accredited under the site auditor scheme under the CLM Act. Site specific mitigation measures are presented in Technical Working Paper 16 – Landfill Assessment.	Project Area 1	State Land
Ground gas intrusion	Protocols to address and manage ground gases, including appropriate occupational monitoring, should be developed and implemented during construction. The protocols should consider confined spaces and appropriate engineering controls where required (ie forced ventilation).	Project Area 1 and 2	Commonwealth Land and State Land
Management of PFAS impacted soil	Develop and implement protocols for the temporary storage of soils that have been identified as PFAS contaminated. Alternatively, the Contractor could remove PFAS contaminated soil directly off-site to an appropriately licensed waste storage or disposal facility. Storage and containment design for PFAS contaminated soils should not create any pathways for environmental or human health exposure, thereby minimising the likelihood of environmental contamination.	All	Commonwealth Land and State Land

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Temporary stockpiling of leachable soil contamination	Storage and containment systems should be impervious to the materials stored, resistant to fire and managed and maintained to prevent any release of liquids and contaminated runoff to stormwater drains, waters and land. Where they are not impervious, contaminated runoff management systems should be incorporated into the design.	Project area 3 and 4.	Commonwealth Land
Temporary stockpiling of asbestos impacted soil.	Stockpile management should include appropriate cover or stabilisation to prevent dust generation.	Project Area 1, 2 and 3	Commonwealth Land and State Land
High salinity potential	Mitigate soil and sediment erosion using appropriate stormwater controls and water sensitive design measures eg containment bunds, silt traps, sediment basins and fences. Employ in accordance with best on site practice, reflected in the Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004), section 3.2.13.	(refer to Figure 4.5).	Commonwealth Land
Potential disturbance of sediment	A soil and water management plan (SWMP) should be prepared. Erosion and sediment control measures would be implemented in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004), chapter 6. Measures to reduce the spread of sediment plumes may include a sediment curtain or similar installed around the potentially affected areas taking into consideration tidal influence. The type of sediment control device should be detailed in the SWMP and would be subject to approval by Sydney Water and the EPA. The SWMP should include detail of how the effectiveness of the sediment control would be monitored and provide a contingency plan to manage any breaches.	Alexandra Canal	State Land
Unexpected contamination	In the event that indicators of contamination are encountered during construction (such as odours, asbestos containing material or visually contaminated materials), work in the area would cease, and the finds would be managed in accordance with an unexpected contamination finds procedure.	All	Commonwealth Land and State Land
Tempe Landfill, gas and leachate.	Mitigation measures are presented in Technical Working Paper 16 – Landfill Assessment	Project Area 1	State Land
Operation			
Tempe Landfill	Mitigation measures are presented in Technical Working Paper 16 – Landfill Assessment	Project Area 1	State Land
Utilities maintenance	Manage through occupational exposure controls in accordance with work health and safety (WHS) legislation.	Project Area 1	State Land

Impact/Issue/ Phase of NEPM Site Assessment	Mitigation measures	Relevant locations	State/ Commonwealth land
Containment of contaminated soils	Ongoing management measures should be implemented for any areas where contamination remains following construction. These management measures should be documented in a long term environmental management plan.	Project Area 1, 2 and 3	Commonwealth Land and State Land
Soil erosion and sedimentation	During any maintenance work where soils are exposed, sediment and erosion control devices should be installed in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004).	All	Commonwealth Land and State Land

9.2 Contamination management plan controls

A summary of applicable control measures associated with the identified contamination are provided below. The list is a guide only and is not exhaustive of all activities and hazards that require management to ensure exposure to COPCs does not occur.

- Prior to commencement of construction works a precautionary asbestos “emu pick” should be undertaken
- Prepare Safe Work Method Statement (SWMS). Appropriate occupational health and safety measures should be developed and implemented to minimise risk of exposure to contamination. The SWMS should include as a minimum the following contamination control measures:
  - Employ confined space entry procedures for excavations and utility pits prior to entry
  - Workers wear appropriate personal protective equipment (eg wear gloves/eye and respiratory protection). Use of disposable overalls when work occurs in an area where ACM was identified, which should be disposed of appropriately at completion of each work shift
  - Avoid creating dust (eg use of light water sprays, avoid working in hot and windy conditions). Where dust is unavoidable wear respiratory protection
  - Use of a photo-ionisation detector and a lower explosive limit meter when conducting excavation works in contaminated areas. The SWMS should establish trigger levels for atmospheric monitoring which dictate upgrade of personal protective equipment and/or requirements to cease work during unsafe conditions
  - Clean excavation tools at end of each work shift. Ensure surplus materials returned to stockpile areas and avoid spreading potentially contaminated materials across site
  - All stockpiled soil/fill materials excavated from the site should be bunded and sediment retention measures put in place immediately after the stockpile is formed
  - Potentially contaminated soils are managed so as not to generate dusts
  - Employ odour management procedures in the event that odorous material is identified during stockpile management and soil handling activities
  - Potentially contaminated soil requiring off-site disposal should be sampled, assessed and classified in accordance with the requirements of NSW EPA Waste Guidelines
  - For all intrusive works reference should be made to the relevant SafeWork NSW requirements for asbestos works which may trigger a requirement for air monitoring.

9.3 Further investigations

Based on a review of the available information and consolidation of the findings into a CSM, the additional investigation presented in Table 9-2 would be undertaken.

Table 9-2 Recommended additional investigation

Project area	Data gap	Investigation objectives
3	The reports reviewed for this project area targeted small specific portions of land predominantly commissioned for lease entry/exit assessment or waste classification. Soil condition has not been consistently characterised across the project area. Groundwater well MW3RR historically impacted with TRH was destroyed in 2012.	Provide additional soil characterisation. Investigation to be designed in accordance with NEPM 2013. Install targeted groundwater monitoring wells in the vicinity of MW3RR during geotechnical detail design investigations.
4	LNAPL, chlorinated solvents, and PFAS groundwater plumes have been identified within downgradient Sydney Airport areas (Qantas Jet Base and former JOSF site). No information was available for review for the Sydney Airport JUHI site.	Install targeted groundwater monitoring wells within the project boundary adjacent to Sydney Airport areas (Qantas, JOSF and JUHI) during geotechnical detail design investigations.
All	Detailed design should investigate groundwater management and groundwater monitoring for the proposal area and any indirectly affected areas. Additional groundwater investigation would be required to inform dewatering strategy and disposal options.	Additional groundwater investigation would be required to inform dewatering strategy and disposal options.

9.4 Remediation

In general, to achieve the desired environmental outcome, the process of the assessment of site contamination should be placed within the context of the broader site assessment and management process. In particular, in assessing contaminated site management options, the NSW EPA preferred hierarchy of options for site clean-up and/or management as outlined in Table 9-3 should be followed.

Table 9-3 Hierarchy of clean-up options

Preference	Option
1	On-site treatment of the contamination so that it is destroyed, or the associated risk is reduced to an acceptable level.
2	Off-site treatment of excavated soil, so that the contamination is destroyed, or the associated risk is reduced to an acceptable level, after which soil is returned to the site.
If the above are not practicable:	
3	Consolidation and isolation of the soil on site by containment with a properly designed barrier.
4	Removal of contaminated material to an approved site or facility, followed, where necessary, by replacement with appropriate material.
Where the assessment indicates that remediation would have no net environmental benefit or would have a net adverse environmental effect, implementation of an appropriate management strategy.	

No appropriate on- or off-site treatment methods are available for asbestos in soil which has been identified as a primary contaminant across Project Areas 1, 2 and 3. Therefore, the preferred remediation strategy is management through consolidation and isolation on-site using an appropriately constructed barrier to prevent exposure.

Utilisation of final road pavement (encapsulation) and installation of additional capping (where required) across non-paved surfaces is considered to be the most environmentally sustainable method of remediation for soils across the project. It is considered most appropriate to undertake remediation concurrently with the project construction. It is envisaged that a staged approach would be adopted for implementation of the RAP.

Groundwater contamination identified in project areas 2, 3 and 4 is consistent with groundwater quality in the broader aquifer. As such, remediation of groundwater beneath the road alignment would have no net environmental benefit. Groundwater in project area 1 should continue to be managed utilising the existing barrier cut-off wall.

Individual RAPs required for the project should be prepared in accordance with the RAP Framework presented in Figure L-1 of Appendix L.

10. Conclusion

This report assesses the impacts of potential or known contamination that could be faced during construction and operation of the project. The assessment has included a desktop review of over 60 existing contamination assessment reports, review of current targeted investigations by Roads and Maritime and consolidation of the data into a CSM. The Roads and Maritime investigation included sampling at 66 soil bore locations. The investigation also included the installation of 34 groundwater monitoring wells and 20 landfill gas monitoring wells.

Existing identified contamination issues are primarily related to historic industrial/commercial land uses which have impacted the quality of soil/fill material within the project site. Additional, specific contamination issues relating to the project include landfilling at former Tempe Tip site and PFAS impacts associated with potential historic use of firefighting foam during an historic explosion at the Northern Lands and on the down-gradient Sydney Airport site.

Contamination has been identified at concentrations above adopted assessment criteria within all of the assigned project areas. The dominant COPCs identified in soil exceeding adopted assessment criteria are heavy metals, TRH, PAH and asbestos. The dominant COPCs identified in groundwater exceeding adopted assessment criteria are ammonia, phosphate, heavy metals, TRH, PAH and PFAS. Volatile contaminants including LNAPL and VCH have been identified in the down-gradient Qantas Jet Base. Elevated concentrations of landfill gas have been recorded in project areas 1 and 2.

Construction of the project has the potential to impact the remediation systems that are currently in place in project area 1 and 2. Where the project has the potential to damage and/or remove these existing systems or impact on their effectiveness a remedial action plan would be developed that describes the reinstatement of these systems as part of the construction phase such that they continue to operate effectively post construction. Remediation would be required within portions of project areas 2, 3 and 4 to address potential risk of human health exposure to contaminated soils including asbestos which has been identified within the site fill material. Remediation in project area 2 would be undertaken in consideration of the current RAP's. Remediation options would be identified and selected using the sustainability hierarchy adopted in the NEPM (2013), for the project encapsulation is the preferred remediation methodology.

No active remediation of groundwater is anticipated, however groundwater in project area 1 should continue to be managed utilising the existing barrier cut-off wall in accordance with the objectives of the VRP. The engineered pavement design for project area 1 includes a passive landfill gas system to minimise the potential for landfill gas to accumulate in service pits (and other confined spaces) that may need to be accessed during maintenance activity.

Areas identified as requiring additional characterisation would be further investigated during detailed design and investigation sampling plans would be informed by existing data and project design. All contamination investigations would be required to be undertaken by a suitably qualified and experienced person in accordance with guidelines made or approved under the *Contaminated Land Management Act 1997* (NSW).

Where impacts have been identified a range of mitigation measures have been proposed to minimise such impacts. It is expected that impacts would be managed with mitigation measures to ensure risks arising from the disturbance of soil and groundwater contamination and ASS would be mitigated. Following adoption of the mitigation and management measures during construction and operation of the project the environmental objectives for contaminated land in the Sydney Airport MDP could be achieved, namely:

- Prevent pollution from on-airport activities
- Actively manage and prevent soil and groundwater contamination
- Manage known and suspected contaminated sites.

Based on the findings of this technical working paper, it is concluded that existing contamination of the project site does not preclude the suitability of the site for the proposed development subject to effective implementation of mitigation measures and project specific RAPs which minimises direct contact with contaminated soil. The project is unlikely to impede the future remediation of groundwater in the area if it were desired to do so in the future due to the permeable nature of soil across the project site.

11. Bibliography

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Appendix A
Previous contaminated land investigation reports

A1. Project Area 1

The following reports have been reviewed for the project area 1:

- AECOM "Background Review, Proposed Gateway Roadway Alignment, St Peters to Mascot, NSW"
- Coffey May 2003, "Remediation and development of Tempe Lands – Geotechnical Investigation Report"
- Coffey Geosciences, April 2005 "Tempe Lands Remediation – Revised Final Cut-off Wall Validation Report"
- Coffey, October 2005 "Remediation and Development of Tempe Lands – Landfill Gas Investigation"
- Coffey Environments, January 2007, "Annual Groundwater Quality Monitoring Report – Tempe Lands, Tempe"
- Uminex, January 2018 "Landfill Gas Monitoring at the Former Tempe Lands"
- Tenix, May 2006 "Tempe Lands Site Environmental Management Plan for Areas 4 to 11".

A number of Site Audit reports summarise the findings of previous investigations undertaken between 1998 and 2007. The following Site Audit reports were reviewed:

- Environ, 2001 "Tempe Tip Site Audit Report GN35 – Remedial Action Plan Tempe Lands, Tempe"
- Environ, 2004 "Tempe Tip Site Audit Report GN35B – Tempe Lands Remediation Project Appropriateness of Detailed Design"
- Environ, 2005 "Tempe Tip Site Audit Report GN35C – Tempe Lands Remediation Project Site Validation"
- Environ, 2008 "Tempe Tip Site Audit Report GN35-2 – Validation of Remediation for Areas 4 to 11 of Tempe Lands".

A2. Project Area 2

A2.1 Stage 1

- WSP March 2015, Environmental Investigation for Proposed Development at Northern Lands Precinct Sydney Airport (WSP March 2015)
- WSP May 2015, Reuse Letter – Stockpile at Northern Lands Precinct Sydney Airport (WSP May 2015a)
- WSP May 2015, Waste Classification, Stockpile at Northern Lands Precinct Sydney Airport (WSP May 2015b)
- JBS&G June 2015, Stage 1, Northern Lands Precinct, Asbestos Quantification Assessment, Mascot, NSW (JBS&G June 2015)
- WSP January 2016, Validation Report, Sydney Airport, Northern Lands Precinct, Vehicle Storage Area, NSW (WSP January 2016)
- WSP February 2016, Validation Services Related to the Remediation of Sydney Airport Northern Lands Precinct, Vehicle Storage Area – Gas Monitoring Results Summary (Version 2) (WSP February 2016)
- Greencap-NAA (Greencap) September 2016, WSP Landfill Gas Report Interpretation (Greencap September 2016)
- WSP September 2016, Quarterly Letter (Q1) May to August 2016, Ongoing Landfill Gas Monitoring: Stage 1 of the Northern Lands Precinct, Tempe, NSW (WSP September 2016)
- WSP, January 2017, Environmental Management Plan, Sydney Airport, Northern Lands Precinct, Vehicle Storage Area, NSW (WSP January 2017) (**Superseded by WSP December 2017**)

- WSP March 2017, Quarterly Letter (Q2) November 2016 to February 2017, Ongoing Landfill Gas Monitoring: Stage 1 of the Northern Lands Precinct, Tempe, NSW (WSP March 2017)
- WSP June 2017, Quarterly Letter (Q3) February to April 2017, Ongoing Landfill Gas Monitoring: Stage 1 of the Northern Lands Precinct, Tempe, NSW (WSP June 2017)
- WSP October 2017, Annual Report (Q4) 2017: Landfill Gas Monitoring, Stage 1 of the Northern Lands Precinct, Tempe, NSW (WSP October 2017)
- Douglas Partners, November 2017, Geotechnical Investigation Proposed Development, Northern Airport Precinct, Sydney Airport (DP November 2017)
- WSP December 2017, Environmental Management Plan, Sydney Airport, Northern Lands Precinct, Staff Car Park, NSW (WSP December 2017)
- Zoic Environmental Pty Ltd (Zoic) March 2018, Stockpile Characterisation for Northern Lands Precinct, Tempe NSW (Zoic March 2018)
- WSP August 2018, Quarterly Report (Q2) Landfill Gas Monitoring, Stage 1 of the Northern Lands Precinct, Tempe, NSW (WSP August 2018).

A2.2 Stage 2

- JBS&G February 2016, Stage 2 and 3, Northern Lands Precinct Investigation, Swamp Road, Tempe, NSW (JBS&G February 2016)
- ADE Consulting Group (ADE) February 2016, Asbestos Materials Clearance Report Northern Airport Precinct Stage 2, Tempe, NSW (ADE February 2016a)
- ADE February 2016, Asbestos Management Plan, Stage 2, Northern Lands Airport Precinct, Tempe NSW (ADE February 2016b)
- ADE February 2016, Remediation Action Plan, Stage 2, Northern Lands Airport Precinct, Tempe NSW (ADE February 2016c)
- WSP December 2016, Validation Report, Sydney Airport Northern Lands Precinct, Stage 2 Capping Works (WSP December 2016)
- Zoic November 2017, Remediation Action Plan, Stages 2 and 3 Northern Lands Precinct (Zoic November 2017)
- Douglas Partners, November 2017, Geotechnical Investigation Proposed Development, Northern Airport Precinct, Sydney Airport (DP November 2017)
- WSP, January 2017, Environmental Management Plan, Sydney Airport, Northern Lands Precinct, Vehicle Storage Area, NSW (WSP January 2017)
- Zoic Environmental Pty Ltd (Zoic) March 2018, Stockpile Characterisation for Northern Lands Precinct, Tempe NSW (Zoic March 2018)
- Zoic October 2018, Northern Lands Landfill Gas Monitoring Results, North Precinct Road, Tempe, NSW (Zoic October 2018).

A2.3 Stage 3

- JBS&G May 2017, Stage 3, Northern Lands Precinct Investigation, Sydney Airport, Mascot, NSW (JBS&G May 2017)
- Zoic November 2017, Remediation Action Plan, Stages 2 and 3 Northern Lands Precinct (Zoic November 2017)
- Douglas Partners, November 2017, Geotechnical Investigation Proposed Development, Northern Airport Precinct, Sydney Airport (DP November 2017)
- Zoic Environmental Pty Ltd (ZOIC) March 2018, Stockpile Characterisation for Northern Lands Precinct, Tempe NSW (Zoic March 2018).

A2.4 Groundwater monitoring (Area B and Area C)

- WSP, July 2016, Groundwater Monitoring December 2015, Northern Lands, Sydney Airport Mascot, NSW (WSP July 2016a)
- WSP, July 2016, Groundwater Monitoring December 2015, Northern Landing Lights, Sydney Airport Mascot, NSW (WSP July 2016b)
- WSP, February 2017, Groundwater Monitoring December 2016, Northern Lands, Sydney Airport Mascot, NSW (WSP February 2017a)
- WSP, February 2017, Groundwater Monitoring December 2015, Northern Landing Lights, Sydney Airport Mascot, NSW (WSP February 2017b)
- WSP, September 2018, Groundwater Monitoring 2017, Northern Landing Lights, Sydney Airport Mascot, NSW (WSP September 2018.

A2.5 General

- AECOM “Background Review, Proposed Gateway Roadway Alignment, St Peters to Mascot, NSW.”

A3. Project Area 3

The following reports have been reviewed for Project Area 3:

- AECOM “Background Review, Proposed Gateway Roadway Alignment, St Peters to Mascot, NSW”
- Greencap NAA Pty Ltd (Greencap), September 2015, Asbestos Investigation, Burrows Road South, St Peters NSW (Greencap September 2015)
- Greencap March 2016, Asbestos Clearance Certificate, Lot 2, DP802342 Burrows Road South, St Peters NSW (Greencap March 2016)
- WSP, July 2016, Groundwater Monitoring December 2015 former Pacific Power Site, Sydney Airport, Mascot NSW (WSP July 2016)
- WSP, March 2017, Groundwater Monitoring December 2016 and February 2017 former Pacific Power Site, Sydney Airport, Mascot NSW (WSP March 2017)
- WSP, September 2017, Works Compounds Exit Assessment, Site 5561, 6-10 Burrows Road, St Peters (WSP September 2017)

- Arcadis, September 2018, Site Exit Report, SPRC Pty Ltd, 6-10 Burrows Road South, St Peters, NSW (Arcadis, September 2017)
- WSP, November 2017, Sydney Airport Soil Testing at the Northern Precinct - Maritime Container Services Yard - 20 Canal Road, St Peters (WSP November 2017)
- EP Risk, February 2018, Stockpile SACL01 - Onsite Re-Use Assessment, 20 Canal Road St Peters (EP Risk February 2018)
- WSP, February 2018, Soil Assessment Site 05578, 6-10 Burrows Rd, St Peters (WSP, February 2018)
- EP Risk March 2018, Preliminary Soil Contamination Assessment, 20 Canal Road, St Peters, NSW (EP Risk March 2018)
- WSP May 2018, Waste Classification - Stockpile SP1 Located at Burrows Road South, St Peters (WSP May 2018)
- WSP, September 2018, Soil Assessment Site 05576, 6-10 Burrows Rd, St Peters (WSP, September 2018a)
- WSP, September 2018, Groundwater Monitoring 2017 former Pacific Power Site, Sydney Airport, Mascot NSW (WSP September 2018b)
- WSP October 2018, Soil Assessment and Insitu Waste Classification, Ausgrid Infrastructure Repairs, Sydney Airport (WSP October 2018).

A4. Project Area 4

The following reports have been reviewed for the Project Area:

- Douglas Partners, December 2014 Report on Preliminary Site Investigation (PSI) of Contamination, Sydney Airport Terminal 2/3 Ground Access Solutions and Hotel Major Development Plan (Douglas Partners December 2014)
- Environmental Strategies (ES), November 2015, Groundwater Monitoring Event Qantas Jet Base, Sydney Airport (ES November 2015)
- WSP August 2017, PSH Recovery, Quarter 1 (2017), Taxi Parking Area, Sydney Domestic Airport, NSW (WSP August 2017a)
- WSP August 2017, PSH Recovery, Quarter 2 (2017), Taxi Parking Area, Sydney Domestic Airport, NSW (WSP August 2017b)
- WSP November 2017, Environmental Assessment of Unigas LPG Refuelling Facility, Sydney Airport, NSW (WSP November 2017)
- WSP December 2017, PSH Recovery, Quarter 3 (2017), Taxi Parking Area, Sydney Domestic Airport, NSW (WSP December 2017)
- WSP March 2018, PSH Recovery, Quarter 4 (2017), Taxi Parking Area, Sydney Domestic Airport, NSW (WSP March 2018)
- Douglas Partners (DP), June 2018, Contamination Investigation Zone Substation Upgrade, Qantas Drive, Sydney Airport (DP June 2018)
- Zoic Sept 2018, Review of Contamination Status Ninth St Hotel & Ground Transport Interchange Project, Sydney Airport, NSW (Zoic, September 2018).

A5. Project Area 5

- AECOM, “Sediment Investigation, Gateway, Alexandra Canal” Reference 60559345_RPEM_0010A dated 15 February 2018 (AECOM 2018).

Appendix B
AECOM adopted Tier 1 screening criteria

B1. AECOM Tier 1 screening criteria

Tier 1 screening of the investigation results was conducted by AECOM in report AECOM (2019). Sydney Gateway Project – Stage 2 Investigation – Interim Soil Contamination Data Report. Soil results were screened against the criteria provided in the following guidelines:

- Airports (Environment Protection) Regulations 1997 – Soil pollution accepted limits (AEPR Soil)
- CRC CARE 2011 – Health screening levels for petroleum hydrocarbons in soil and groundwater, commercial/industrial land use, direct contact
- CRC CARE 2011 – Health screening levels for petroleum hydrocarbons in soil and groundwater, intrusive maintenance workers, shallow trench (in sand)
- NEPM 2013 – Ecological screening levels, commercial/industrial land use, coarse and fine soils (ESL-D)
- NEPM 2013 – Generic ecological investigation levels, commercial/industrial land use (EIL-D)
- NEPM 2013 – Health investigation levels, commercial/industrial land use (HIL-D)
- NEPM 2013 – Health investigation levels, recreational land use (HIL-C)
- NEPM 2013 – Health screening levels, commercial/industrial land use, shallow sand (0–1 m; HSL-D)
- NEPM 2013 – Petroleum management limits, commercial/industrial land use, coarse and fine soil
- US EPA 2017 – Regional screening levels, industrial soils (target hazard quotient of 0.1 adopted)
- PFAS NEMP 2018 – Human health screening values, public open space land use
- PFAS NEMP 2018 – Human health screening values, industrial/commercial land use (**NEMP Health**)
- PFAS NEMP 2018 – Interim soil ecological screening values, public open space land use
- PFAS NEMP 2018 – Interim soil ecological screening values, industrial/commercial land use (**NEMP ecological**).

Tier 1 screening of the investigation results was conducted by AECOM in report AECOM (2019). Sydney Gateway Project – Stage 2 Investigation – Interim Groundwater and Landfill Gas Data Report. Groundwater results were screened against the criteria provided in the following guidelines:

- Airports (Environment Protection) Regulations 1997 – Accepted limits for freshwater
- Airports (Environment Protection) Regulations 1997 – Accepted limits for marine water (**AEPR Groundwater**)
- ANZG (2018) Trigger values for toxicants – freshwater, 80 per cent species protection including (low and medium reliability values)
- ANZG (2018) Trigger values for toxicants – freshwater, 95 per cent species protection including (low and medium reliability values)
- ANZG (2018) Trigger values for toxicants – marine water, 80 per cent species protection including (low and medium reliability values)
- ANZG (2018) Trigger values for toxicants – marine water, 95 per cent species protection including (low and medium reliability values)
- NHMRC (as amended 2018) – Recreational Water, aesthetic guideline value (10 factor recreation)
- NHMRC (as amended 2018) – Recreational Water, human health guideline value (10 factor recreation)
- US EPA 2017 – Regional screening levels, Tapwater (factor of 10 applied for recreation)
- WHO 2008 – Drinking water guidelines (factor of 10 applied for recreation)
- WHO 2011 – Guideline value, drinking water quality (factor of 10 applied for recreation)
- NEPM 2013 – Health screening levels, commercial/industrial land use, sand (depth 2-4 m; HSL-D)
- PFAS NEMP 2018 – Freshwater guideline values, 95 per cent species protection
- PFAS NEMP 2018 – Interim marine guideline values, 95 per cent species protection (**NEMP Ecological**)
- PFAS NEMP 2018 – Freshwater guideline values, 80 per cent species protection
- PFAS NEMP 2018 – Interim marine guideline values, 80 per cent species protection
- PFAS NEMP 2018 – Health based guidance values, recreational water.

Sediment results were screened against the criteria provided in the following guidelines:

- Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand. Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000)
- Simpson S.L., Batley, G.E. and Chariton, A.A. (2013) Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines Technical Report, CSIRO Land and Water Science, May 2013
- Simpson, SL, Batley, GE, Chariton, AA, Stauber JL, King, CK, Chapman, JC, Hyne, RV, Gale, SA, Roach, AC and Maher, WA, 2005. Handbook for Sediment Quality Assessment (CSIRO:Bangor, NSW)
- Commonwealth of Australia, Canberra, 2009. National Assessment Guidelines for Dredging (NADG 2009).

For the purpose of screening sediment quality, the results have been compared to the sediment quality guideline (SQG) values and SQG-High values in Table 2 of the revised ANZECC/ARMCANZ Sediment Quality Guidelines Technical Note (2013). The SQG revision builds on the original ANZECC (2000) document with the tiered, decision-tree approach adopted for the interim sediment quality guideline values (SQGVs) maintained, and guidance is provided for use of a weight-of-evidence (WOE) framework to improve the assessment of the potential impacts of contaminated sediments for more complex risk assessments.

In addition, analytical data were compared against the following guidelines in respect to PFAS related compounds, including the extended suite of Perfluorinated Compounds (PFCs) (including key sulfonates):

- CEMG (2016) Australian Government, Department of Environment and Energy, Commonwealth Environmental Management Guidance on Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) – health-based screening levels (commercial/industrial)
- Food Standard Australia and New Zealand, April 2017 – health-based screening levels (commercial/industrial)
- WA DER (2017) Interim Guideline on the Assessment and Management of Perfluoroalkyl and Perfluorooctanate Substances (PFAS), Contaminated Sites Guidelines – health-based screening levels (commercial/industrial).

Appendix C

Record of notices, audits, revoked or surrendered licences or pollution studies within 500 m of the Project Area

Table C-1 Record of notices, audits, revoked or surrendered licences or pollution studies for facilities within 500 m of the Project Area

Facility name	Licence number	Site address and distance to the project area	Activity incident type	Notice/incident type	Potential contamination
Tip Fast	11673	5A Canal Road, St Peters Immediately east	Crushing, grinding or separating/Waste storage, transfer, separating or processing	Multiple licence variations (2005–2009) Licence surrendered in January 2010	▪ Unknown
Sydney Airport	7288	241 O'Riordan Street, Mascot 25 m north	Hazardous, Industrial or Group A Waste Generation or Storage	Multiple licence variations (2004–2005) Licence no longer in force	▪ Hydrocarbons ▪ PFAS compounds
SPRC	13142	6–10 Burrows Street South, St Peters 160 m south and south east	Waste storage/ Waste processing (non-thermal)	Multiple licence variations (2010–2015) Penalty notice issued in April 2015 (breach of license)	▪ Metals ▪ PAHs ▪ Asbestos ▪ Other contaminants
Bitupave Ltd (BORAL Asphalt)	7590	Burrows Road South, St Peters 200 m south-east	Bitumen pre-mix or hot-mix production	Licence variation in 2001 Licence surrendered in February 2003	▪ Hydrocarbons ▪ PAHs
Visy Paper	13069	6–10 Burrows Road South, St Peters 170 m south-east	Resource recovery/ Waste storage	Multiple licence variations (2012–2019) Penalty notice issued in December 2017 for failure to provide monthly report	▪ Unknown
BORAL Recycling/ former City of Sydney Council Depot	12418/ 5923	25 Burrows Road South, St Peters Immediately east, north and north-east	Waste storage, transfer, separation and processing/ Crushing, grinding or separating	Multiple licence variations (2001–2017) Licence 5923 surrendered in September 2015	▪ Asbestos ▪ Other contaminants
BORAL Concrete	1183	25 Burrows Road South, St Peters Immediately east, north and north-east	Concrete works	Multiple licence variations (2001,2008)	▪ Unknown

Facility name	Licence number	Site address and distance to the project area	Activity incident type	Notice/incident type	Potential contamination
New M5 St Peters Interchange (former Alexandria landfill)	4627/ 12594	10–16 Albert Street, St Peters Immediately east	Solid and inert waste landfilling/Crushing, grinding or separating/Road construction	Multiple licence variations (2002, 2018) Multiple clean-up notices and variations to clean-up notices (2002–2017) Prevention notice (2016) Multiple pollution studies (2012–2017) Penalty notices issued for odour emissions (2017 and 2018) Penalty notice issued in 2012 (unknown reason) Surrender of licence 12594 in April 2016	■ Leachate release to the environment ■ Ammonia
J A Bradshaw	119	2 Albert Street, St Peters 470 m north-east	Crushing, grinding or separating	Licence variation (2001) Licence surrendered in February 2004	■ Unknown
Metropolitan Demolitions and Recycling	11483	396 Princes Highway, St Peters 320 m north-west	Crushing, grinding or separating/Waste storage, transfer, separating or processing	Multiple licence variations (2002–2016) Clean-up notice issued in May 2018 for PCB contamination in DGB produced at facility	■ PCBs
Tidyburn	6208	15 Campbell Street, St Peters 500 m north-east	Hazardous, industrial or group A waste generation or storage	Multiple licence variations (2001–2002) Licence surrendered in June 2005	■ Hydrocarbons ■ PAHs
Tempe Waste Depot	6665	Bellevue Street, Tempe	Landfilling	Multiple licence variations and variation to surrender conditions (as part of the landfill closure plan, 2002–2010)	■ Faecal coliforms ■ Hydrocarbons ■ Metals ■ Asbestos
Sealed Air Australia	5523	3 Burrows Road, St Peters 150 m north-east	Hazardous, industrial or group A or group B waste generation or storage or processing/Waste activities	Licence variation issued in 2005	■ Organic solvents ■ Halogenated solvents ■ Metals ■ Mineral oils ■ Hydrocarbons
Qantas Jet Base	12152	Sydney Airport, Mascot 50 m south	Hazardous, Industrial or Group A Waste Generation or Storage	Multiple licence variations (2006–2008) Licence no longer in force	■ Metals ■ Acids ■ Solvents ■ Hydrocarbons

Facility name	Licence number	Site address and distance to the project area	Activity incident type	Notice/incident type	Potential contamination
Industrial Galvanizers Corporation Pty Ltd	6728	342 King Street, Mascot 170 m east	Hazardous, Industrial or Group A Waste Generation or Storage	Licence surrendered in 2001	▪ Metals ▪ Acids ▪ Solvents ▪ Cyanide ▪ Volatile hydrocarbons
Enwave Mascot Pty Ltd	20246	10 Bourke Street, Mascot 335 m north-east	Generation of electrical power from gas	2 licence variations (2014–2017) 1 mandatory environmental audit (pending)	Emission of VOCs to air
Gate Gourmet Flight Kitchen	10332	Keith Smith Avenue & Sixth Street, Mascot 10 m north	Hazardous, Industrial or Group A Waste Generation or Storage	Licence revoked in 2002	Unknown
Q Catering Riverside Pty Ltd	4729	300 Coward Street, Mascot 430 m north	Hazardous, restricted solid, liquid, clinical and related waste and asbestos waste Non-thermal treatment of waste	Multiple licence variations (2003–2009) Licence surrendered in April 2011	Unknown
SIMS Group Limited	2009	283 Coward Street, Mascot 90 m north	Hazardous, Industrial or Group A Waste Generation or Storage Scrap metal processing	Multiple licence variations (2001–2002) Licence surrendered in May 2004	▪ Metals ▪ Hydrocarbons ▪ Suspended solids ▪ Acids ▪ PCBs ▪ PAHs

Appendix D
Aerial photograph review

D1. Historical aerial photography

Historical aerial photographs were obtained from the NSW Department of Finance, Services and Innovation, Spatial Services Division. Photographs for the years 1930, 1943, 1961, 1970, 1986, 1994 and 2005 were reviewed. The findings of the historical aerial photography review for each study area are summarised in Table D-1.

Table D-1 Historical aerial photography review

Site	Summary
Project Area 1 (Tempe Landfill)	In the 1930 aerial the project site primarily consisted of exposed sand, a quarry is located to the north east adjacent to Princes Highway. In 1943, excavation occurred within the project site at the end of Swamp Road. By 1961 the quarry area had been backfilled and a number of access roads/paths had been constructed across the former Tempe Tip site area. By 1986 significant filling occurred across the site and vegetation was visible across portions of the project site, the site to the north east was being utilised to store shipping containers. In the 1994 aerial the project site was heavily vegetated. By 2001 the central portion had been developed into a shipping container yard and the Tempe Recreational Reserve had been developed to the west.
Project Area 2 (Sydney northern lands car park)	In the 1930 aerial the project site primarily consisted of exposed sand, two bulk storage tanks and several small buildings were present to the southeast adjacent to Alexandra Canal. In 1943 two additional bulk storage tanks had been added and the storage area had been fenced, and a wharf and additional buildings had also been constructed. By 1970 the bulk storage tanks and wharf had been demolished, and several new industrial buildings had been constructed. In the 1986 aerial the western portion of this project site was being utilised for container storage. In 1994, the current northern lights strip had been constructed.
Project Area 3 (Sydney Airport northern lands)	In the 1930 aerial the project site primarily consisted of exposed sand, the freight rail line and rail siding to the east were present with two small buildings visible in the siding. In 1943 additional small buildings had been constructed in the siding and over 20 larger warehouse buildings had been constructed to the east of the project site. By 1961 warehouse buildings were present across the entire project site. In the 1991 aerial the buildings across the eastern portion had been demolished.
Project Area 4 (Sydney Airport)	In the 1930 aerial the western area primarily consisted of exposed sand, and areas to the east comprised residential properties and cleared agricultural land. By 1943 the residential properties had been developed and replaced with commercial buildings and airport runway infrastructure was being constructed to the west. In 1961 the Sydney Airport was now visible including runways and terminal infrastructure. By 1970 further expansion of the Sydney Airport site had occurred including the construction of new runways into Botany Bay. In the 1994 aerial a third runway had been constructed into Botany Bay.
Project Area 5 (Alexandra Canal)	In the 1930 aerial the section of Alexandra Canal directly south of Swamp Road and upstream of the rail line was present in its current alignment. At the end of Swamp Road the canal ends and feeds into Cooks River. By 1970 major changes had occurred with Cook's River diverted for land reclamation and Alexandra Canal extended to the west to join Cooks River at the edge of the current Tempe Recreational reserve.

Appendix E
Photographic log

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
1	05.12.2018

Description

Project Area 1

View of Tyne Containers and the desalination pipe easement from Airport Drive facing north west.

Photo No.	**Date**
2	05.12.2018

Description

Project Area 2

View of the landing light strip from Airport Drive facing north

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
3	05.12.2018

Description

Project Area 2

View of the staff car park from Airport Drive facing north. The containers visible in the background are from the western portion of the Qube site (Project Area 3).

Photo No.	**Date**
4	05.12.2018

Description

Project Area 2

View of the surface of the Northern Lands staff car park facing west.
The lighting land strip and vacant

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
5	05.12.2018

Description

Project Area 2

View over the eastern portion of Sydney Airport Corporation Ltd. Northern Lands, facing north east. Sydney Airport Corporation Ltd. leased area leased to Boral can be seen in the background (Project Area 3).

Photo No.	**Date**
6	05.12.2018

Description

Project Area 2

Uncovered soil stockpile in the north eastern portion of the Northern Lands facing north east.

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
7	05.12.2018

Description

Project Area 2

Covered stockpile (to the left) and uncovered stockpile (background of the photo) in the north eastern portion of the Northern Lands facing east. A monitoring well can be seen

Photo No.	**Date**
8	05.12.2018

Description

Project Area 2

Mound covered with breached geofabric in the eastern portion of the northern Lands, facing south east.

	PHOTOGRAPHIC LOG

Client Name	**Site Location**	**Project**
RMS PS109315	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
9	05.12.2018

Description

Project Area 3

Vacant vegetated area in the area leased by Qube, facing north east.

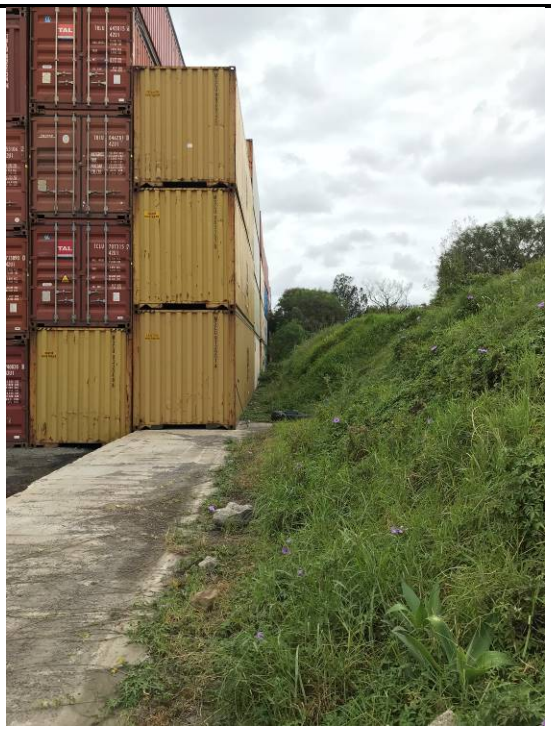


Photo No.	**Date**
10	05.12.2018

Description

Project Area 3

Vacant vegetated area in the area leased by Qube, facing east.

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
11	05.12.2018

Description

Project Area 3

Material at the surface of the vegetated area in the area leased by Qube.

Photo No.	**Date**
12	05.12.2018

Description

Project Area 3

One of the stockpiles observed in the vacant vegetated area in the area leased by Qube.

wsp	**PHOTOGRAPHIC LOG**

Client Name	Site Location	Project
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	Date
13	05.12.2018

Description

Project Area 3

One of the monitoring wells observed in the vacant vegetated area in the area leased by Qube, facing east.

Photo No.	Date
14	05.12.2018

Description

Project Area 3

Vegetable oil spill visible along the vacant vegetated area in the area leased by Qube, facing north.

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
15	05.12.2018

Description

Project Area 4

Fenced-off portion of the grassed area between Alexandria Canal, Airport Drive and Port Botany rail corridor, facing south.

Photo No.	**Date**
16	05.12.2018

Description

Project Area 4

Small soil stockpiles in the road reserve along Airport Drive opposite North Pond, facing north.

	PHOTOGRAPHIC LOG	
Client Name ***RMS*** ***PS109315***	**Site Location** Gateway Road Project, Mascot, St Peters and Tempe NSW.	**Project** Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
17	05.12.2018

Description

Project Area 4

Ballast at the surface in the road reserve along Airport Drive opposite North Pond, facing north.

Photo No.	**Date**
18	05.12.2018

Description

Project Area 4

Asphalt sealed surface underneath billboards along Airport, facing east.

wsp	**PHOTOGRAPHIC LOG**

Client Name	**Site Location**	**Project**
RMS ***PS109315***	Gateway Road Project, Mascot, St Peters and Tempe NSW.	Sydney Gateway Road Project – Road EIS

Photo No.	**Date**
19	05.12.2018

Description

Project Area 4

Two monitoring wells in the road reserve along Airport Drive opposite North Pond, facing north.

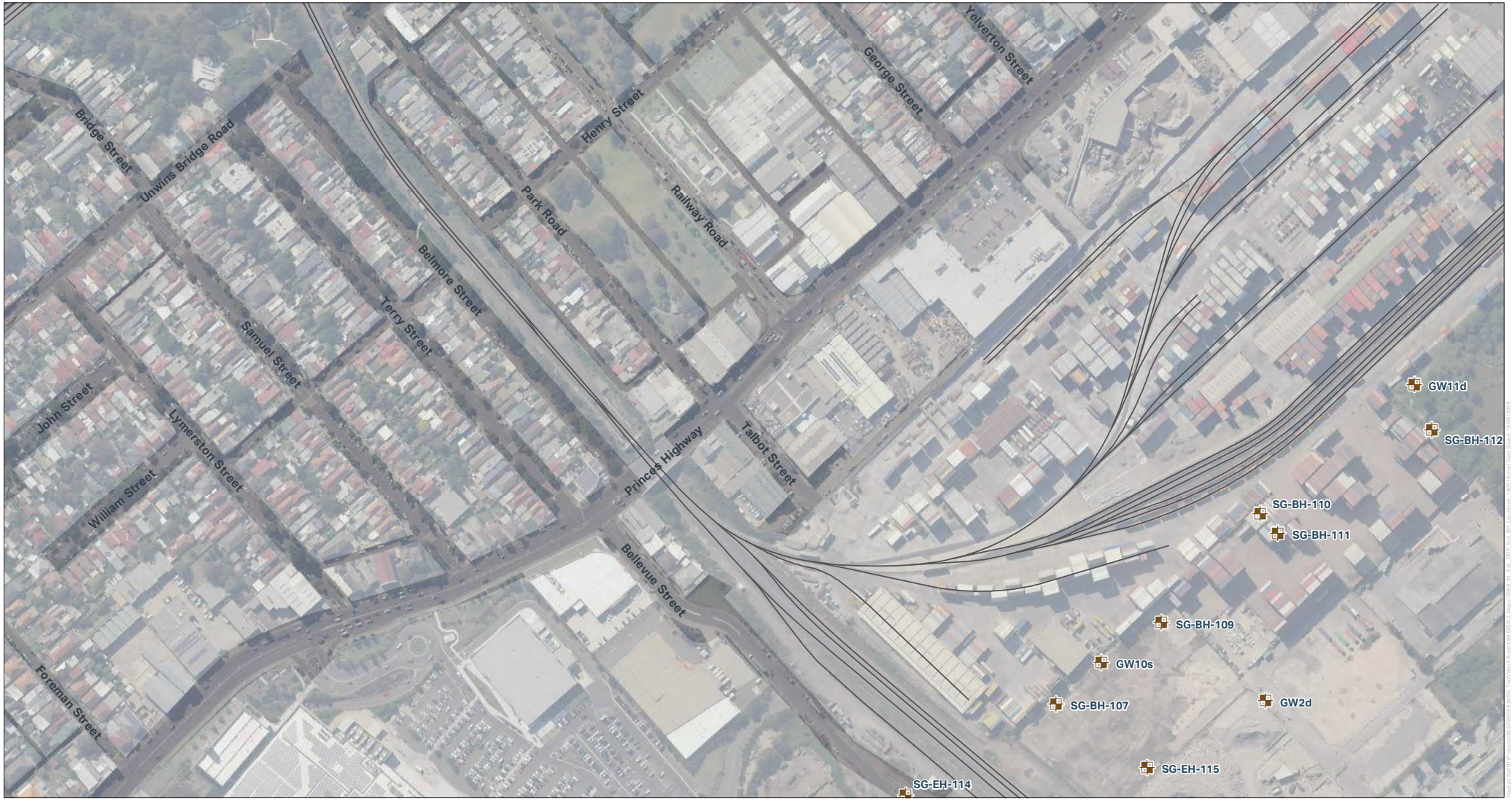
Photo No.	**Date**
20	05.12.2018

Description

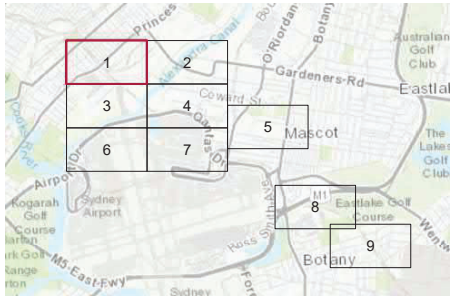
Project Area 4

Four of the fuel ASTs and the water AST from the fuel storage area, facing south west.

Appendix F
Current investigation locations



BOREHOLE LOCATIONS - SHEET 1



AECOM

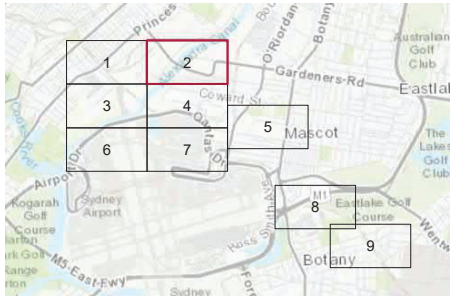
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 2



AECOM

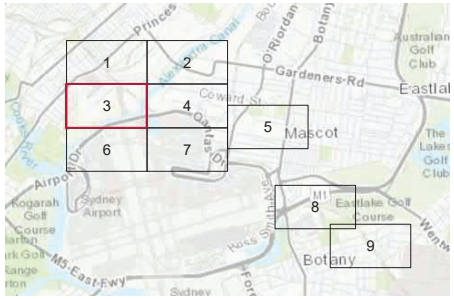
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 3



AECOM

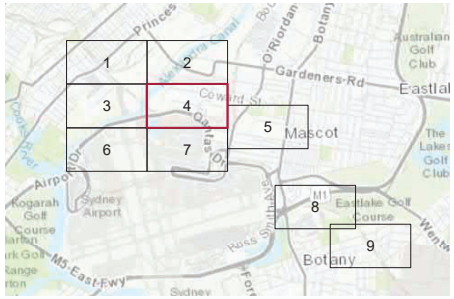
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 4



AECOM

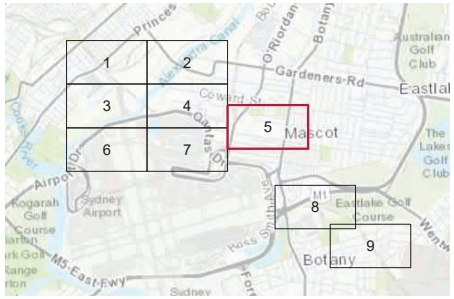
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 5



AECOM

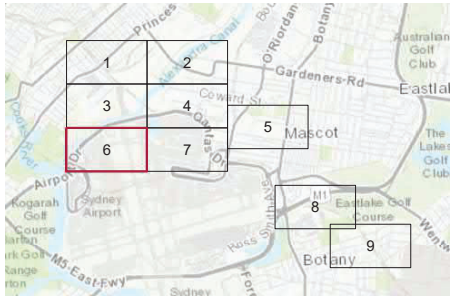
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 6



AECOM

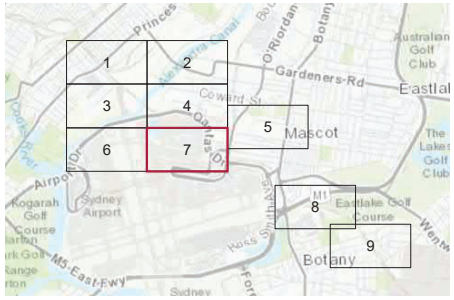
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 7



AECOM

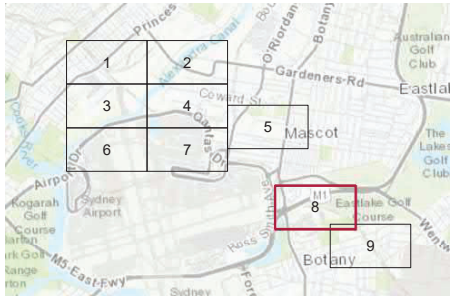
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 8



AECOM

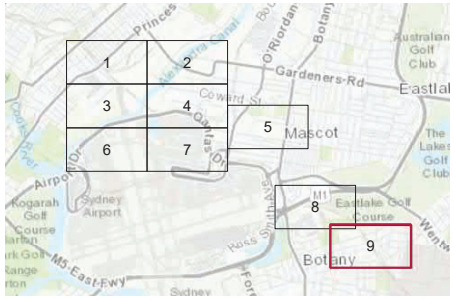
N

0 40 80 m

Legend

- Borehole location
- Railway

BOREHOLE LOCATIONS - SHEET 9



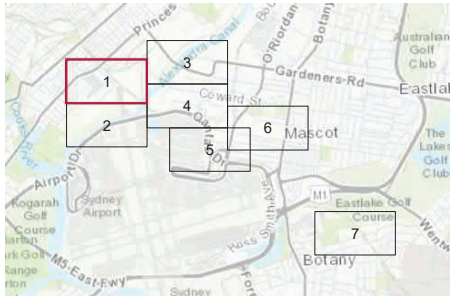
AECOM

0 40 80 m

Legend

- Borehole location
- Railway

GROUNDWATER LOCATIONS - SHEET 1



AECOM

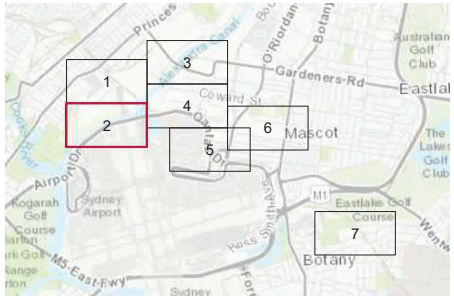
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 2



AECOM

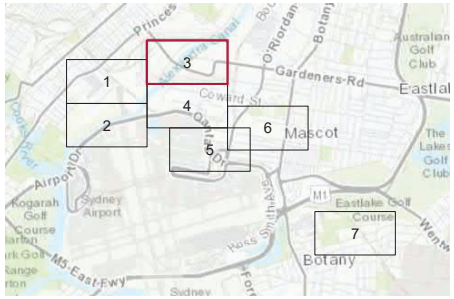
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 3



AECOM

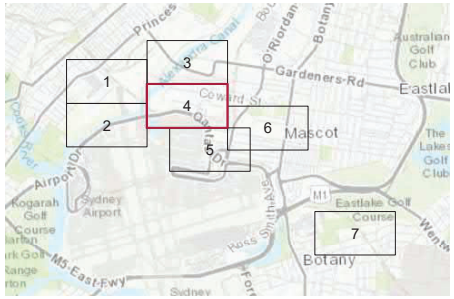
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 4



AECOM

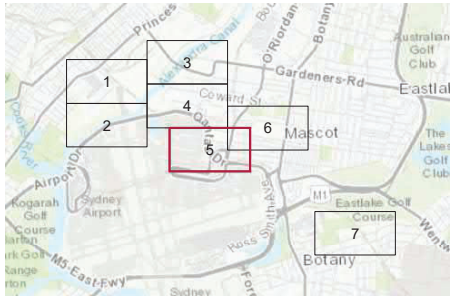
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 5



AECOM

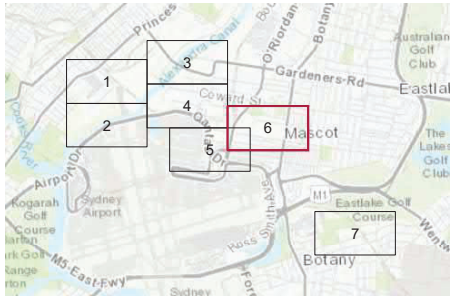
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 6



AECOM

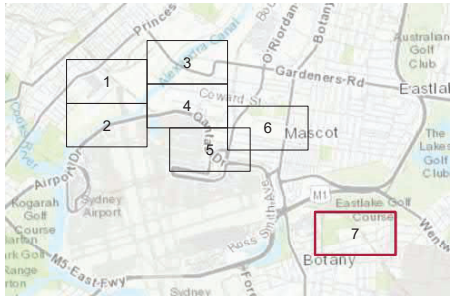
N

0 40 80 m

Legend

- Existing groundwater well
- New groundwater well
- Railway

GROUNDWATER LOCATIONS - SHEET 7



AECOM

N

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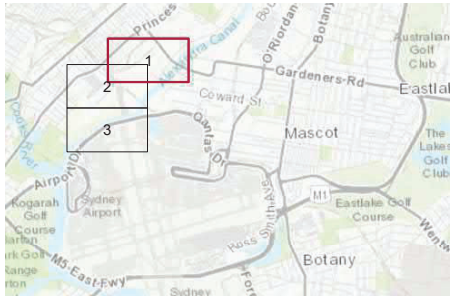
Legend

- Existing groundwater well
- New groundwater well
- Railway

LAND GAS MONITORING LOCATIONS - SHEET 1



AECOM

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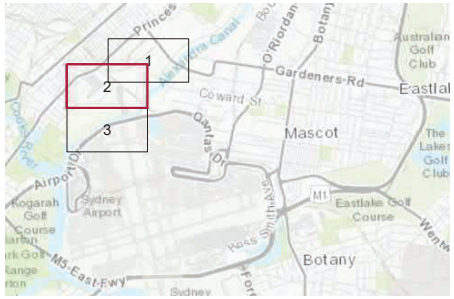
Legend

- Land fill gas monitoring location
- Railway

LAND GAS MONITORING LOCATIONS - SHEET 2



AECOM

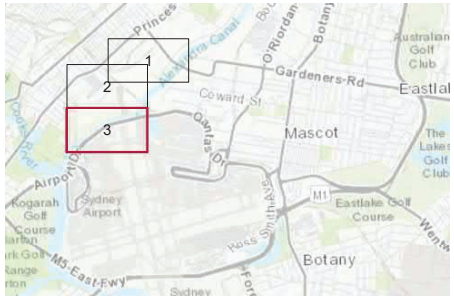
N

0 40 80 m

Legend

- Land fill gas monitoring location
- Railway

LAND GAS MONITORING LOCATIONS - SHEET 3



AECOM

N

0 40 80 m

Legend

- Land fill gas monitoring location
- Railway

Appendix G

Contamination in the former Tempe Tip site – Project area 1

G1. Site description

Project area 1 incorporates a portion of Tempe Landfill, extending from Holbeach Avenue/Smith Street in the west and to the high intensity approach lighting for Sydney Airport in the east. The tip extends to Alexandra Canal in the south and towards South Street in the north. The project area is located entirely on State Land and includes the Tempe Lands. The site description for this project area is presented in Table G-1.

Table G-1 Site description

Item	Project area
Lot & Deposited Plan (DP)	Lots 303, 304 and 305 in DP 1136081, Lot 202 DP 1097238, part of Lot 1 DP621535, Lots 723, 724, 725 and 726 DP 48012, Lot 5 DP107811, Lots 1 and 2 in DP 869306 and part of Lot 25 DP 1227132
Site Area	Approximately 30.5 hectares (ha)
Current Owner	Inner West Council and Sydney Airport (State Land)
Current Site Use	Recreational use (Tempe Golf Range, Tempe Dog Park, Tempe Lands walking paths and wetland), desalination plant pipeline easement, Tyne Containers freight storage
Zoning	IN1 General Industrial and RE1 Public Recreation
Elevation	Approximately 3 to 16 mAHD

G2. Historic summary

Table D-1 in Appendix D summarises the findings of a historical aerial photography review.

In the late 1800s and start of the 1900s, parts of project area 1 were quarried for natural shale material. Tempe Lands were used as a council operated landfill from approximately 1910 and received a wide range of wastes including general domestic waste, liquid waste, industrial waste, hazardous waste, etc. until the early to mid-1970s. This is referred to as “Stage 1 filling” in the Environ site audit reports (Environ 2004, 2005 and 2008). From 1972, filling was restricted to waste generated by council works (eg green waste, demolition waste from road works and building maintenance as well as council clean-up waste). This is referred to as “Stage 2 filling” in the Environ site audit reports (Environ 2004, 2005 and 2008). In the early 1990s, the site was reportedly mainly filled with ‘hard clean’ material although reports also mention that some of this fill may have been ash from the former Bunnerong Power Station and fill from the airport terminal extension. Landfilling operations are reported to have ceased in the 1990s. The current Tyne Container storage facility started operating in the late 1990s with the remainder of the site vacant and unsealed with an irregular surface.

In July 2000, the NSW EPA declared the former Tempe Tip site a ‘Remediation Site’ (declaration 21005) under section 21 of the CLM Act 1997 due to leachate migrating off-site towards Alexandra Canal. In March 2001, the EPA issued a Remediation Order (order 23003) to Marrickville Council under Section 23 of the CLM Act. The order required that a remedial action plan (RAP) be prepared to address the contaminant migration into Alexandra Canal and that a Site Auditor review the RAP. Marrickville Council subsequently entered into a voluntary remediation proposal (VRP) with EPA. The VRP is still in place and requires that “the proposed remediation is to ensure that the water quality of Alexandra Canal is not adversely impacted by leachate originating from the site.”

As a result of the Order, a barrier wall was constructed in 2004 along the southern, eastern and western boundaries of the tip to prevent leachate migrating into Alexandra Canal (Coffey Geosciences, 2005). Refer to Figure G-1 for the extent of the former tip and location of the cut-off wall. A leachate collection system and treatment system were also installed to treat leachate before discharge. Between 2004 and 2006, the site surface was regraded and capped to minimise water infiltration into the waste mass and provide a barrier between human receptors and the waste mass. The cap composition and thickness varied between areas of the former tip based on the expected end use. The capping layer generally comprised inert waste (from site, concrete, sandstone, etc) and virgin excavated natural material (VENM) finished with either bitumen/asphalt or topsoil and turf or other vegetation. With the exception of the wetland basins for which only minimal clay lining was undertaken, the capping layer was between 250 mm (Swamp Road) and 800 mm thick (landscaped batter near golf driving range), refer to Tenix, 2006.

G3. Previous investigations

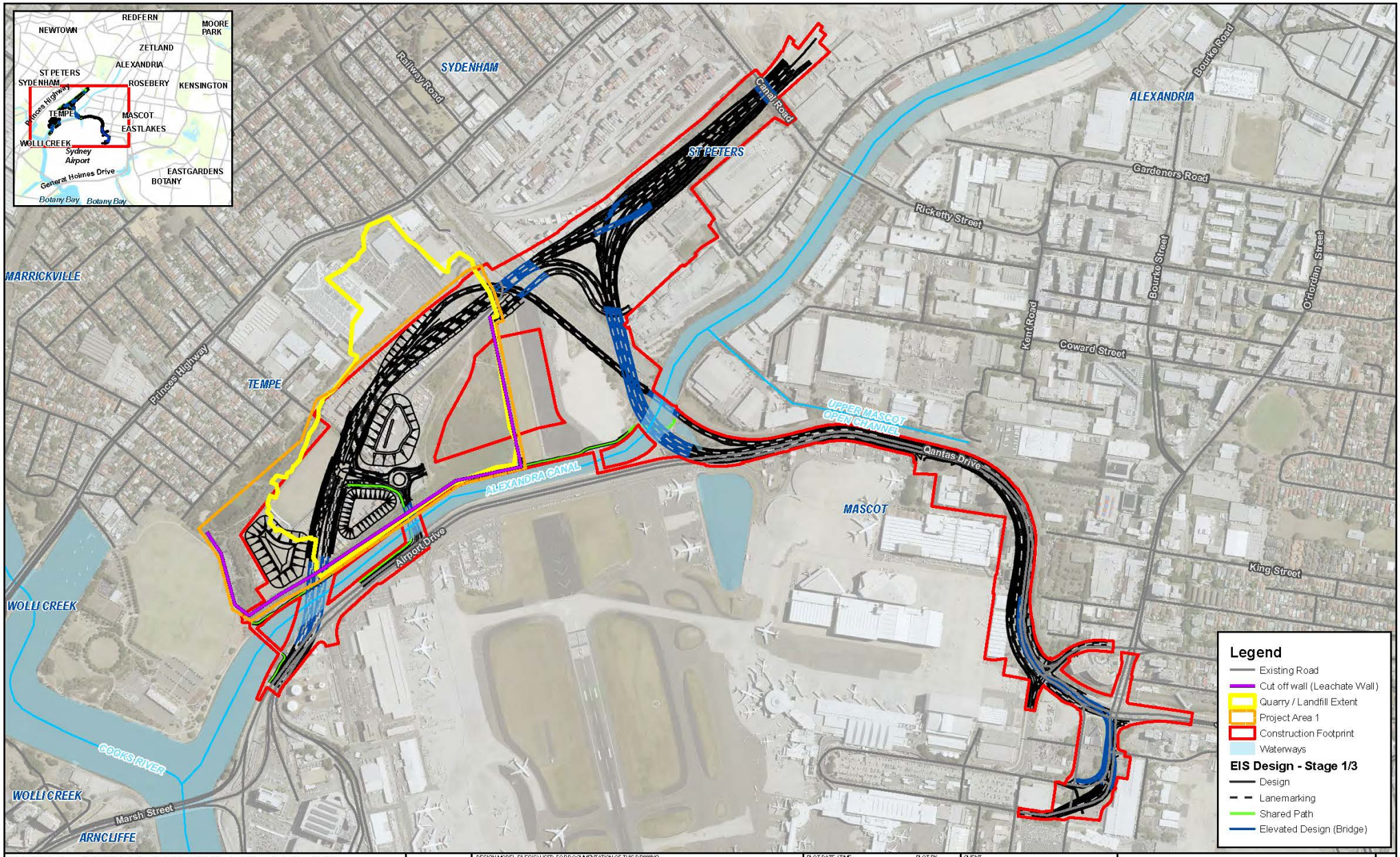
Details of the reports which have been reviewed for project area 1 are presented in Appendix A1.

A number of other reports pertaining to the operation and maintenance of the leachate treatment system, barrier wall and gas management measures are discussed in Technical Paper 16 – Landfill Assessment.

G4. Contaminants of potential concern (COPC)

The former Tempe Tip site was filled with various types of wastes over a 90-year period. Based on review of available historical information, contaminants of potential concern (COPC) related to filling at the former Tempe Tip site include the following:

- Total recoverable hydrocarbons (TRH)
- Polycyclic aromatic hydrocarbon (PAH)
- Heavy metals
- Asbestos
- Phenols
- Polychlorinated biphenyls (PCBs)
- PFAS
- Organochlorine pesticides (OCPs) and organophosphorus pesticides (OPPs)
- Volatile organic compounds (VOCs)
- Semi volatile organic compounds (SVOCs)
- Nutrients (in groundwater)
- Landfill gases (carbon monoxide, carbon dioxide, hydrogen sulfide and methane).



DATA SOURCE: Aerial Imagery © AUSIMAGE - Jacobs Group (Australia) Pty Ltd 2018, © Department of Finance, Services & Innovation 2018

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DESIGN MODEL FILES(S) USED FOR DOCUMENTATION OF THIS DRAWING

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CLIENT

SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION	IWP No.	APPROVAL
A1	11/03/2018	Extent of former Quarry and Tempe Tip and leachate cut-off wall		
A2	10/07/2019	Extent of former Quarry and Tempe Tip and leachate cut-off wall		
A3	31/07/2019	Extent of former Quarry and Tempe Tip and leachate cut-off wall		

SCALES ON A1 SIZE DRAWING: 0 75 150 m, 1:8,500

CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	TITLE	NAME	DATE
DRAWN	D.NAIKEN		31/07/2019
DRG CHECK	Y.YVANES-GUILIANI		31/07/2019

PREPARED FOR:

Transport Roads & Maritime Services

Contamination Impact Assessment
Figure G-1
Extent of former Quarry and Tempe Tip and leachate cut-off wall

RMS REGISTRATION No.

PART

ISSUE STATUS: FOR INFORMATION

EDMS No.

SHEET No.

ISSUE: A3

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G5. Extent of CoPCs identified in historic investigations

G5.1 Soil

Previous investigations within project area 1 predominantly targeted fill from Stage 2 filling. Only limited investigations results were provided for review. Based on the information included in the Site Audit Statements and other reports reviewed, contaminant concentrations in the project area are highly variable due to the heterogeneity of the waste material. Hot spots of petroleum hydrocarbons, PAHs and lead were encountered across the project area.

Analysis of PFAS compounds in soils has not been undertaken at the site based on the reports reviewed.

G5.2 Groundwater

Groundwater within the project area consists of leachate generated by rainfall infiltration, groundwater migration and waste decomposition. Groundwater has previously been observed within fill material and residual soils at depths ranging from 0.8 metres below ground level (mBGL) to 15.4 mBGL (Coffey, 2003). Coffey has noted that the groundwater flows in the project area are likely complex and affected by the permeability of the fill material. Leachate is expected to migrate towards Alexandra Canal.

As part of the VRP, groundwater monitoring has been undertaken inside and outside the cut-off wall. Leachate was found to be impacted mainly by metals and ammonia. Leachate is currently intercepted and treated in accordance with the VRP.

Ongoing operational performance monitoring associated with the VRP is discussed in Technical Working Paper 16 – Landfill Assessment.

Based on the reports reviewed, PFAS analysis has not been undertaken historically as part of groundwater monitoring on site.

G5.3 Landfill gas

Landfill gas testing has historically been confined to the northern, north-western and north-eastern site boundaries.

Landfill gas monitoring was undertaken at the site between 2005 and 2009 with results indicating that off-site gas migration was occurring through the north-western boundary (Coffey, 2005; Uminex, 2018). Following the installation of a passive interception and venting trench, further gas monitoring was undertaken. Limited sampling undertaken by Uminex between 2016 and 2018 in the vicinity of the interception trench indicated that flow rates were generally low outside the interception trench (Uminex, 2018). As a result, maximum gas screening values (GSVs) recorded outside the passive trench were generally low. GSVs reported by Uminex for 2016, 2017 and 2018 were within characteristic gas situation 2 – low risk conditions (NSW EPA 2012) both inside and outside the interception trench.

G6. Project site inspection

An inspection of the project area was undertaken for the project on 5 December 2018. A photographic log of the inspection is provided in Appendix E.

Project area 1 includes properties located in the footprint of the former Tempe Tip site including several recreational facilities (Tempe Golf Range, Tempe Dog Park, Tempe Lands walking paths and wetland), Tyne Containers and vacant bush land south-east of Tyne Containers and an easement for the desalination pipeline along Alexandra Canal. The eastern portion of the project area was accessed via a driveway off Holbeach Avenue and footpaths off South Street. The area is raised compared to the street level of Holbeach Avenue. The recreational facilities mainly comprise unsealed landscaped or turfed areas with access driveways and a car park.

The Golf Range also include a shed and amenities in demountable blocks. Maintenance work was being conducted on the desalination pipeline (immediately north of Alexandra Canal) during the site inspection and that portion of the site was not accessed. Tyne Containers is an operational container storage, cleaning and logistics hub which could not be accessed during the site walkover. Most of the footprint is occupied by stored shipping containers and driveways mainly on sealed surfaces. Some areas appear to be unsealed. The ground level of Tyne Containers and vacant land immediately south-east is raised (about 5 metres) compared to the edge of Alexandra Canal and the adjacent high intensity approach lighting and project area 2 (refer to Photo 1 and Photo 4, Appendix E).

Vacant land to the south-east of Tyne Containers could not be accessed due to safety concerns as the area was heavily overgrown.

G7. Current investigations

A programme of geotechnical and environmental site investigations is currently being undertaken by Roads and Maritime. Figures presenting the completed sampling locations are provided in Appendix F. The following provides a summary of results as provided by Roads and Maritime (referred to herein as the project investigations). The results have been incorporated into the conceptual site model (CSM) presented in section G8.

Over 220 soil samples were collected from over 20 locations in the former Tempe Tip site during the combined geotechnical and contamination investigations. Heavy metals were detected in all soil samples. The lead concentrations exceeded the NEPM health-based criteria for commercial workers and/or recreational users at approximately a dozen locations. Exceedances were detected in both Stage 1 and Stage 2 filling horizons. TRH fractions were detected in most samples and exceeded NEPM ecological screening levels at ten locations. Hydrocarbon concentrations were indicative of a potential vapour intrusion risk for commercial workers and/or intrusive workers at five locations (GW8, SG-BH-103, SG-BH-104, SG-BHTT-01 and SG-BHTT-04). Concentrations of hydrocarbons also exceeded the NEPM petroleum management limits at six locations. PAHs were detected in approximately 75 per cent of the samples collected. Benzo(a)pyrene was detected at concentrations exceeding the NEPM ecological screening levels at multiple locations across several horizons. Benzo(a)pyrene toxicity equivalent quotient exceeded the NEPM human health criteria for recreational users and/or commercial workers at eleven locations. The total PAH concentration exceeded the NEPM human health criteria for recreational users in one location only. OCPs and PCBs were detected in less than 5 per cent of the samples. The total PCB concentration in eleven samples exceeded the NEPM human health criteria for recreational users and/or commercial workers. Halogenated benzenes were detected in five samples. A small subset of samples were tested for the presence of PFAS compounds. Low levels of PFAS compounds were detected in most soil samples. All PFAS concentrations were below the PFAS NEMP health criteria for recreational users and commercial workers. Phenols, phenolic compounds, halogenated phenols, halogenated hydrocarbons, chlorinated hydrocarbons, solvents or OPPs were not detected in any of the soil samples collected within the former Tempe Tip site.

Elevated contaminant concentrations were encountered across the site and at varying depth which is consistent with the nature of the fill material and the results of previous investigations.

Sampling of 36 groundwater wells was undertaken. Ammonia concentrations were elevated at levels exceeding the ANZECC ecological (80 per cent protection) criteria in all wells inside and outside the cut-off wall. Aluminium, cadmium, copper, lead, nickel and/or zinc exceeded the ANZECC ecological (80 per cent protection) criteria in six wells (MPE_5A, MPI_15, BHTT-03, GW7, GW23d and GW28A). Boron was detected above the ANZECC ecological (80 per cent protection) criteria in three wells inside the cut-off wall (MPI-13, MPI-15 and MPI-18). Dissolved hydrocarbons were detected during at least one monitoring round in 29 of the 35 wells sampled. Concentrations were generally low and below the ecological criteria. PAHs were detected in six wells at concentrations below the assessment criteria. Phenols were only detected in three wells (GW7, GW23d and MPI_2). OCPs were only detected in two wells (GW8 and GW9). Halogenated benzenes and/or some monoaromatic hydrocarbons were detected in samples from eight wells at concentrations below the ecological criteria (where available). OPPs, PCBs, VOCs and chlorinated hydrocarbons were not detected in any of the samples. Low levels of PFAS were detected in all groundwater samples with concentrations generally below the NEMP ecological (95 per cent protection) criteria with the exception of concentration recorded from GW7, GW8, GW28A, MPI_2, MPI_3A, MPI_4A, MPI_5 and MPI_6A located inside the cut-off wall and 34_TL3 and MPE_4 located outside the cut-off wall.

In summary, the results obtained from the current rounds of sampling are consistent with historical information and ammonia and metals are the primary contaminants in groundwater inside and immediately surrounding the landfill. PFAS had not been tested for in historical investigations but in view of the current findings, is also considered to be a contaminant of concern for former Tempe Tip site.

Landfill gas monitoring has been undertaken as part of the investigations in January and April 2019 at ten locations within the proposed road footprint or immediate vicinity. At two locations, no positive flow rates were detected (GW8 and SG-BH-101) and therefore low GSV values were derived. For all other locations, GSVs were indicative of characteristic gas situation 2 – low risk conditions. It's noted that this is based on the low flow rates recorded. Methane and carbon dioxide concentrations detected were high.

G8. Conceptual site model

For an ecological or human health risk from contamination to be present, there must be a plausible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway). A tabular depiction of the preliminary conceptual site model (CSM) for the project area based on current conditions is presented in Table G-2 below.

Table G-2 Conceptual site model for project area 1

Site aspect	Details			
Potential sources of contamination	■ Large scale land-filling of the site during 90 years of operation as a landfill ■ Asbestos containing material (ACM) in waste mass ■ Current freight storage activity in a portion of the site ■ Historic weed and insect control on vacant areas.			
Geology	**Capping layer (site and imported fill)** ■ Gravelly sands, gravel and sandy clays with boulders and cobbles. Tile fragments and other anthropogenic debris found in some locations. Thickness observed during the project investigations varies across the site and can be difficult to differentiate from historic "Stage 2 filling".	**Stage 2 Fill Material** ■ Sandy clay or silty sand with gravel boulders, sandstone, concrete, metal, wood, plastic, etc ■ Encountered during project investigations typically extending from approximately 1 to 6 mBGL.	**Stage 1 Fill Material** ■ Heterogenous waste mass comprising putrescible waste (green waste and domestic waste) as well as concrete, plastic, paper, wood, ceramic. Encountered during project investigations extending from approximately 6 to 11 mBGL and up to 5 m in thickness (GW23d).	**Natural Soils** ■ Residual soils and alluvium (Botany sands). Predominantly grey high plasticity silty clays, with some bands of fine to medium grained sand. The thickness of residual soils encountered during the project investigations varied between 4 (SG-BH-104) and 8 m (GW23d) ■ Weathered shale. Encountered from depths of 19.5 mBGL (GW23d) in the project investigations ■ Weathered Hawksbury sandstone. Encountered at some locations during project investigations at depths between 17.5 mBGL (GW9) and 23 mBGL (GW8).
Depth and flow of groundwater	**Shallow aquifer** ■ Groundwater at the site consists of leachate within the waste mass and/or perched above less permeable materials in the fill ■ Standing water levels on site were recorded between 0.02 and 1.7 mBGL adjacent to Alexandra Canal. Further into the landfill area, the depth to groundwater increases with topography with depths recorded up to 12 mBGL ■ Inferred groundwater flow is expected to be towards Alexandra Canal.			

Site aspect	Details
Influences on groundwater conditions at the Site	■ Leachate flow within the landfill is complex. Leachate is currently collected along the cut-off barrier wall. Recent monitoring data indicates that leachate is mounding inside the barrier wall with standing water elevations generally 1 to 2 m higher inside the wall (Technical Working Paper-Landfill Assessment) ■ The barrier wall along the canal would limit saltwater intrusion from Alexandra Canal ■ Groundwater in the surrounding area is generally subject to tidal influence. The barrier wall limits tidal influence within the project area ■ Regional groundwater flow in the Botany Sands Aquifer (Hatley 2014) discharges predominantly towards Cooks River and Botany Bay.
Nature of soil contamination	■ Hotspots of TRH, PAH and metals in fill materials (Stage 1 and Stage 2 fill materials) ■ Potential ACM in waste mass.
Nature of groundwater contamination	■ Ammonia and heavy metals in groundwater ■ Low levels of hydrocarbon and PFAS.
Other issues	■ Landfill gas concentrations recorded across the project area ■ The maximum gas screening value (GSV) recorded within the site falls into EPA 2012 'characteristic gas situation 2' low risk conditions (well SG-BH-106, January 2019) but methane and carbon dioxide concentrations are high.
Potential transport mechanisms and exposure pathways	■ Outdoor inhalation of soil derived dust ■ Ingress of landfill gas in buildings or service trenches/pits ■ Landfill gas accumulation and pressure gradients (leading to changes in lateral migration) ■ Volatilisation of TRH impacts in soil and subsequent contaminant movement through soil (limited hotspots) ■ Leaching of soil contaminants/waste into groundwater ■ Direct dermal contact or ingestion of contaminants in soil and/or groundwater ■ Lateral migration of contamination in groundwater or Alexandra Canal (limited due to the cut-off wall).

Site aspect	Details					
Potential receptors	**Onsite Ecological** ■ Vegetated open space ■ Golf driving range.	**Offsite Ecological** ■ Alexandra Canal ■ Tempe Wetlands.	**Onsite Workers** ■ Commercial.	**Onsite Community** ■ Recreational users (Council public land).	**Construction Workers** ■ Construction ■ Maintenance	**Adjacent Offsite Community** ■ Commercial worker ■ Airport users ■ Groundwater bore users. (no residential properties within 150 m)
Complete S>P>R exposure pathways*	Yes, landfill gas inhibits plant growth on landfill covers (vegetation cover is prevalent indicating tolerant plants have adapted to current conditions).	No, if cut-off barrier wall integrity is maintained and leachate recovery system operational. Yes, if the cut-off barrier wall is breached or leachate collection system fails, groundwater would likely flow towards Alexandra Canal.	No for outdoor areas, while the cap and passive gas venting system are maintained. Yes, if the cap is breached or existing gas venting system not in place anymore (gas accumulation in confined spaces).	No, while the cap and passive gas venting system are maintained. Yes, if the cap is breached or existing gas venting system not in place anymore (gas accumulation associated with confined spaces).	Yes, ACM, TRH, PAH and heavy metals identified in soil. Yes, ammonia, TRH, heavy metals and PFAS identified in shallow groundwater and leachate. Yes, landfill gas detected across the site.	No, while the cap and passive gas venting system are maintained. No, groundwater extraction restricted under 2018 order (ie water used for industrial use must be fit for purpose).

S>P>R = Source -> Pathway ->Receptor

*Performance of the current landfill gas and leachate management systems is being reviewed and discussed in Technical Working Paper 16 – Landfill Assessment.

It is considered that all future intrusive or construction works on the site would be undertaken in accordance with responsibilities under relevant Occupational Health and Safety legislation and relevant industry guidelines. Therefore, intrusive activities would be expected to be carried out under an appropriate site health and safety plan and as such, the potential risk of exposure to contaminants present on this site would be addressed accordingly.

Appendix H

Contamination in Sydney Airport northern lands car park – Project area 2

H1. Site description

This project area includes the Sydney Airport northern lands extending from former Tempe Tip site in the west towards the Botany Rail Line in the east. The northern lands extend to Alexandra Canal to the south and Swamp Road to the north. The project area is located on Commonwealth Land and having undergone extensive investigation, has been subject to previous remediation works by Sydney Airport. The site description for this project area is presented in Table H-1.

Table H-1 Site description

Item	Project Area 2
Lot & DP	Lot1 DP826101, Lot 2 DP790186, Lot 12 and Lot 15 DP825649, Lot 643 DP727045, part of Lot 724 DP 48012, part of Lot 1 DP869306
Site Area	Approximately 8.3 hectares (ha)
Current Owner	Sydney Airport
Current Site Use	Sydney Airport northern lands car park for staff parking, Sydney Airport storage
Zoning	IN1 General Industrial (Commonwealth Land)
Elevation	Approximately 1.5 to 3 mAHD

H2. Historic summary

Table D-1 in Appendix D summarises the findings of a historical aerial photography review.

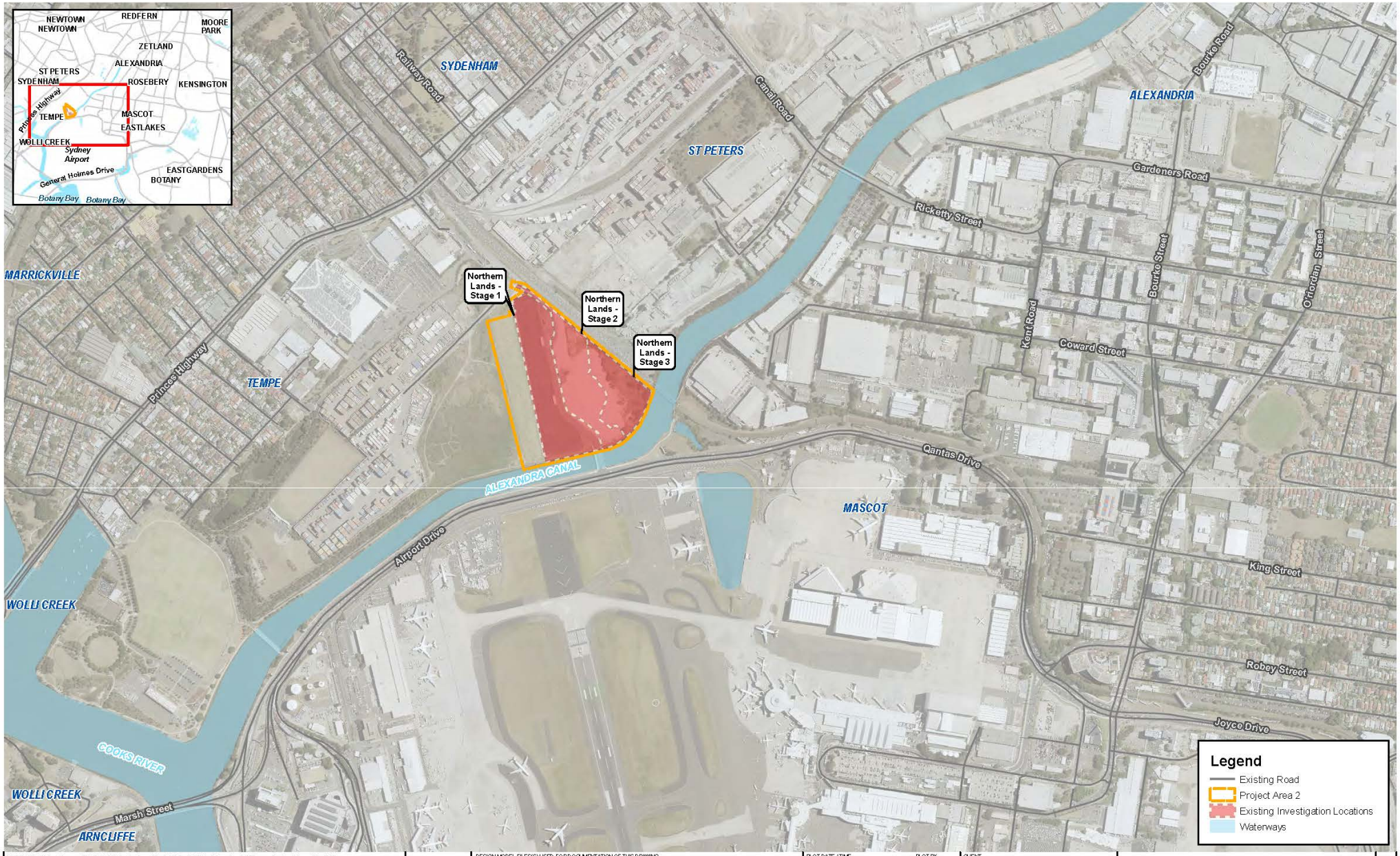
The area has been used for commercial/industrial activity since as early as 1930. A bulk fuel storage depot operated at the site from 1930 until between 1950 and 1970 (Background Review, AECOM 2015). In the 1970 and 1982 historic aerial photographs, a number of small buildings/storage sheds are visible across the area. The area is currently used as a parking area for Sydney Airport and storage.

H3. Previous investigations

Details of the reports which have been reviewed for this project area are presented in Appendix A2.

Investigation works by Sydney Airport have been undertaken in a staged manner. For soil sampling and ground gas characterisation the Sydney northern lands car park has been split into three investigations areas; Stage 1, Stage 2 and Stage 3 (refer to Figure H-1). Investigation works across the three areas have included the collection of soil samples from over 150 discrete sample locations. Remediation activities have been completed in Stage 1 and Stage 2 with Stage 3 (refer to section H6) the subject of an on-going RAP.

A groundwater monitoring programme is being implemented by Sydney Airport across the project area with separate reports commissioned for land parcels defined as Area B and Area C (refer to Figure H-2).



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DRAWINGS / DESIGN PREPARED BY: wsp GHD

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HEIGHT DATUM: AHD

DRG No.

PREPARED FOR

Transport Roads & Maritime Services

SYDNEY GATEWAY

A3

Figure H-1
Project Area 2 - Northern Lands Historical Soil Investigation Areas

RMS REGISTRATION No.

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EDMS No.

SHEET No.

ISSUE: A1

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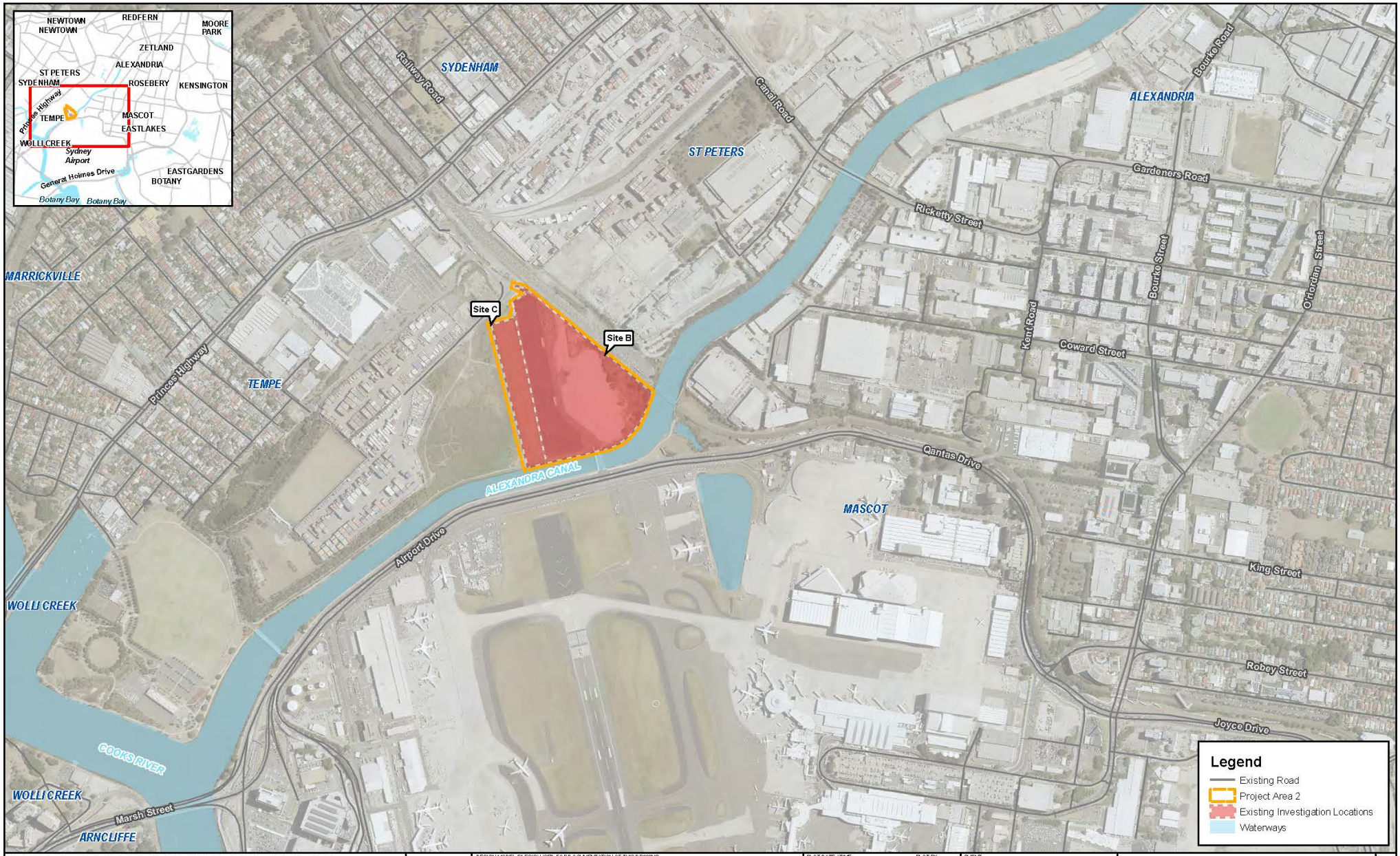

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CLIENT: Transport Roads & Maritime Services NSW GOVERNMENT

SYDNEY GATEWAY

A3

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A1	11/03/2019	Project Area 2 - Northern Lands Historical Groundwater Investigation Areas		

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CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: WSP, GHD

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	NAME	DATE
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PREPARED FOR

Figure H-2
Project Area 2 - Northern Lands Historical Groundwater Investigation Areas

RMS REGISTRATION No.

PART

ISSUE STATUS: FOR INFORMATION

EDMS No.

SHEET No.

ISSUE: A1

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H4. Contaminants of potential concern (COPC)

A number of historic and current potentially contaminating activities were outlined in the reports listed in Appendix A2. These included historic bulk fuel storage, historic general commercial/industrial activity, historic uncontrolled site filling, potential firefighting activity, freight storage activity and adjacent landfill activities (former Tempe Tip site). Contaminants of potential concern (COPC) related to the activities conducted at the Sydney Airport car park area include the following:

- TRH
- PAH
- Heavy metals
- Asbestos
- Phenols
- Landfill gases
- Nutrients (including ammonia)
- PFAS.

H5. Extent of COPCs identified in historic investigations

Fill material has been encountered underlying the Stage 1, Stage 2 and Stage 3 areas, generally comprising heterogeneous gravelly sand, brown with inclusions of ACM, ash, metal, sandstone and building rubble. Based on the extent of ACM identified and given the inherent heterogeneous nature of asbestos as a contaminant, the investigations have been consistent in the conclusion that asbestos management and/or remediation is required across all three areas.

Concentrations of TRH, total PAH, lead and Benzo(a)pyrene (B(a)P) have been recorded in soil exceeding the AEPR criteria. Analysis for PFAS compounds in soil has been undertaken in Stage 3 only. All PFAS concentrations were below the laboratory limit of reporting (JBS&G May 2017).

Concentrations of ammonium, phosphate, TRH, PAH and heavy metals have been reported in groundwater exceeding the AEPR groundwater criteria and PFAS compounds have exceeded NEMP ecological (95 protection) criteria at one groundwater monitoring well location (B-MW4R (B)).

During landfill gas monitoring, elevated concentrations of methane have been recorded underlying the Stage 1, Stage 2 and Stage 3 areas. The maximum gas screening value (GSV) recorded falls into EPA 2012 ‘characteristic gas situation 3’ – moderate risk conditions.

H6. Previous remediation activities

H6.1 Stage 1 remedial works

Remedial works were undertaken in 2015 to render the site suitable for the proposed use as a staff car park. The remediation scope included removal of lead and PAH contaminated soil, followed by installation of an engineered gas venting system and capping layer designed to mitigate potential risks associated with the remaining soil contamination and landfill gas. Assessment and remediation of groundwater was not included in the scope as it was not considered to affect upon the suitability of the site for its intended use (on the basis that groundwater would not be accessed during use of the site as a car park).

The capping layer installed comprised an engineered geotextile layer as well as a capping layer of virgin excavated natural material (VENM) followed by the site surface (sealed).

The remediation was validated by WSP (WSP January 2016). The validation scope included a review of site documentation and reports including waste classification, as-built diagrams provided by the remediation contractor and documentation confirming that the soil was VENM.

A site environmental management plan (EMP) has been prepared for the Stage 1 site area (WSP December 2017) to document gas system maintenance and on-going mitigation measures. The EMP requires hot works permitting for any persons accessing the gas extraction system and any pits on the site.

H6.2 Stage 2 remedial works

Remediation in the form of capping was recommended (Zoic November 2017) to address identified contamination within fill material beneath the site. The main contamination issues identified were the presence of ACM within the fill and some localised areas of TRH C_{10}–C_{36} and PAH soil contamination. Ammonia, TRH and PAH concentrations above AEPR groundwater criteria were also identified in groundwater. Groundwater remediation was not undertaken on the basis that groundwater would not be accessible to humans except for monitoring purposes or construction.

Seymour Whyte Constructions constructed a remedial cap between February 2016 and September 2016. The cap consisted of a geotextile marker layer topped with a layer of VENM approximately 0.2 to 0.8 m thick. The capping was designed to minimise the possibility of asbestos becoming airborne and to provide a barrier to human contact to other contaminants in fill.

The remedial works were validated by WSP (WSP December 2016). The validation scope included a review of site documentation and reports including waste classification, as-built diagrams provided by Seymour Whyte Constructions and documentation confirming that imported soil was VENM. Post remediation gas monitoring (Zoic October 2018) was also undertaken. Gas measurements indicated a higher risk than was previously anticipated by JBS&G (JBS&G February 2016 and May 2017). Zoic recommended that landfill gas protection measures should be employed according to the respective short-term and long term uses of the site. The risk associated with landfill gas was considered to be acceptably low under the current vacant site conditions, subject to future management under an EMP with preparation of a site specific safe work method statement recommended during any future excavation activities which penetrate the cap.

An EMP for Stage1, 2 and 3 was subsequently prepared by WSP in January 2017 (WSP January 2017) following implementation of the remedial works. For the Stage 1 area, this has been superseded by an updated EMP (WSP December 2017). The EMP (WSP January 2017) outlines detailed controls to be implemented for works that would breach the cap. The EMP requires ongoing inspection of the Stage 2 area to monitor erosion of the cap and the presence of landfill gas.

H6.3 Stage 3 remedial works

It is understood that remediation within the Stage 3 area is pending, and the site contamination is currently being managed under the site EMP (WSP January 2017).

H7. Project site inspection

An inspection of the project area was undertaken on 5 December 2018. A photographic log of the inspection is provided in Appendix E.

The high intensity approach lighting strip could not be accessed during the site walkover. Observations were made from the southern side of Alexandra Canal. The strip is fully fenced and unsealed (grass cover) throughout (Photo 2). The area appeared to be well maintained and no breach in the fence could be observed from a distance. Immediately to the east of the lighting strip is the recently built northern land staff car park. The staff car park was accessed via North Precinct Road off Airport Drive. A small strip of vegetation is located between Alexandra Canal and the staff car park (Photo 3). The entire car park is otherwise fully sealed with asphalt (Photo 4). Gas vents are present along the western boundary of the car park and are spaced approximately every 25 m. The area seemed to be in good condition and well maintained.

To the east of the car park was an unsealed and fenced off area which could not be accessed (Photo 4). While the area could not be accessed, it was visible for the most part from North Precinct Road and from a footpath along Alexandra Canal. The area was mostly flat with a steep slope towards Alexandra Canal in the southern portion of the area. Most of the area seemed to have recently undergone extensive earthworks. A number of stockpiles were present on site which mainly comprised bare dirt with the exception of the area closest to Alexandra Canal (south) and immediately west of the Botany Rail Line (Photo 6 and Photo 7). Some of the stockpiles had been covered with geofabric material (Photo 7) and some were uncovered with vegetation growing over them (Photo 6 and Photo 7).

Eleven recently installed stick up monitoring wells (groundwater or gas) were observed in this area as well as 205 litre drums (presumed to be drilling waste). The area closest to Alexandra Canal was partially covered in geofabric material. The material was not in good condition and soil was visible in several areas and vegetation growing through the geofabric (Photo 8).

H8. Current investigations

A programme of geotechnical and environmental site investigations is currently being undertaken on behalf of Roads and Maritime. Figures showing the associated sampling locations are provided in Appendix F. The following provides a summary of results. The results provided in these tables have been incorporated into the CSM presented in section H9.

The investigation has included the drilling of four additional boreholes (GW5, GW25s, SG-EH-105 and SG-EH-114) targeting locations directly beneath the proposed road infrastructure. Two of these boreholes were converted into groundwater monitoring wells (GW5 and GW25s).

A concentration of lead was reported above the AEPR soil criteria at GW5. Hydrocarbons were detected in approximately half of the samples but below the AEPR soil criteria. PAHs were detected in approximately 50 per cent of the samples. The concentration of benzo(a)pyrene and/or total PAHs exceeded the AEPR soil criteria in two samples from SG-EH-114. PFAS compounds were only detected above the laboratory limit or reporting in one sample out of eight analysed. Concentrations of PFAS in soil (and the limit of reporting for each compound) were reported below the NEMP ecological and human health criteria.

The concentration of nitrate in GW25s exceeded the AEPR groundwater criteria. The concentration of cadmium in GW5s and zinc in GW5s and GW25s also exceeded the AEPR groundwater criteria. PFAS concentrations were detected in both monitoring wells, however concentrations were below the NEMP ecological (95 per cent protection) criteria.

The concentration of ammonia in GW5s and GW25s exceeded the AEPR groundwater criterion (freshwater protection) in samples collected from all monitoring wells. The AEPR does not provide a marine protection criteria for ammonia.

Landfill gas monitoring has been undertaken as part of the investigations in January and/or April 2019 at two locations within the project area. No positive flow rates were detected in January in GW25sv and in GW5sv in April and therefore low GSV values were derived. A GSV indicative of characteristic gas situation 1 – very low risk conditions was derived for GW5sv in January 2019. It is noted that this is based on the low flow rates recorded. Methane concentrations detected were high.

H9. Conceptual site model

For an ecological or human health risk from contamination to be present, there must be a plausible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway). A tabular depiction of the preliminary CSM for the project area based on existing conditions is presented in Table H-2 below.

Table H-2 Conceptual site model for project area 2

Site aspect	Details	
Potential sources of contamination	■ Historic bulk fuel storage ■ Historic general commercial/industrial activity ■ Historic uncontrolled site filing ■ ACM in soil ■ freight storage activity ■ Off-site adjacent landfill activities (former Tempe Tip site).	
Geology	**Fill material** ■ Fill generally present at depths between 0.5 and 2.2 mBGL. Matrix generally described as heterogeneous brown gravelly sand with, building rubble observed at most locations ■ A layer of black ballast/ gravels was observed between 1.0 and 1.4 mBGL at three locations within Stage 1 ■ Deeper fill (up to 5 mBGL) encountered at northern extremity (GW5d).	**Natural soils** ■ Grey/red sand to black clayey sand (up to 7 mBGL) ■ Sandy clay encountered at 7 mBGL (GW5d) ■ Weathered shale encountered at 14 mBGL (GW5d).
Depth and flow of groundwater	**Shallow aquifer** ■ Depth to groundwater on site recorded between 1.0 and 2.2 mBGL ■ Inferred groundwater flow is to the south-east direction from Area C and a south-west direction from Area B with contours indicating flow towards Alexandra Canal.	
Influences on groundwater conditions at the Site	■ The groundwater becomes increasingly saline in the southern portion of the site adjacent to Alexandra Canal ■ Groundwater beneath the project area is likely to be subject to tidal influence ■ Regional groundwater flow in the Botany Sands Aquifer (Hatley 2014) discharges predominantly towards Cooks River and Botany Bay.	
Nature of soil contamination	■ Asbestos in soil identified within fill material across the area ■ Hotspots of TRH, PAH and lead in fill material exceed AEPR soil criteria.	
Nature of groundwater contamination	■ Ammonia, phosphate and heavy metals exceed AEPR groundwater criteria. ■ PFAS detected in groundwater. Concentrations reported in one monitoring well location (B-MW4R (B)) exceed NEMP drinking water and ecological (95%) criteria.	

Site aspect	Details				
Other issues	■ Landfill gas concentrations recorded across the project area ■ The maximum gas screening value (GSV) recorded falls into EPA 2012 'characteristic gas situation 3' moderate risk conditions. While flow rate are low, methane concentrations are high.				
Potential transport mechanisms and exposure pathways	■ Outdoor inhalation of soil derived dust ■ Leaching of soil contaminants into groundwater ■ Direct dermal contact or ingestion of contaminants in soil and/or groundwater. ■ Lateral migration of contamination in groundwater. ■ Accelerated lateral groundwater migration via underground service trenches. ■ Migration of landfill gases through underground service trenches. ■ Landfill gas accumulation and pressure gradients (leading to changes in lateral migration).				
Potential receptors	**Onsite Ecological** ■ None, majority of this project area is capped.	**Offsite Ecological** ■ Alexandra Canal.	**Onsite Workers** ■ Commercial.	**Construction Workers** ■ Construction ■ Maintenance.	**Adjacent Offsite Community** ■ Commercial worker ■ Sydney Airport users ■ Groundwater bore users. (no residential properties within 300 m)
Existing complete S>P>R exposure pathways	No	Yes, groundwater flow towards Alexandra Canal.	Yes, ACM in Stage 3 investigation area has not been capped.	Yes, ACM in Stage 3 investigation area has not been capped. Yes, landfill gas detected across the site.	No, groundwater extraction restricted under 2018 order (ie water used for industrial use must be fit for purpose).

S>P>R = Source ->Pathway ->Receptor

It is considered that all future intrusive or construction works on the site would be undertaken in accordance with responsibilities under relevant Occupational Health and Safety legislation and relevant industry guidelines. Therefore, intrusive activities would be expected to be carried out under an appropriate site health and safety plan and as such, the potential risk of exposure to contaminants present on this site would be addressed accordingly.

Appendix I

Contamination in Sydney Airport northern land – Project area 3

I1. Site description

Project area 3 includes the Sydney Airport leased areas extending from the Botany Rail Line in the west to Canal Road in the east. The project area is bound by freight tracks to the north and extends to Alexandra Canal in parts to the south. The project area is located on Commonwealth land. In comparison to project area 2 only limited soil and groundwater investigation has been conducted and no remediation works are known to have occurred. The site description for this project area is presented in Table I-1.

Table I-1 Site description

Item	Project Area 3
Lot & DP	Lot 1 and Lot 2 DP186164, Lot 2 DP830952, Lot 2 DP802342, Lot 3 and Lot 4 DP555771, Lot 3 DP825649, Lot 22 in DP1069118
Site Area	Approximately 13.6 ha
Current Owner	Commonwealth Land leased to Sydney Airport. The extent of this project area encroaches slightly beyond the Sydney Airport land boundary to the north into Cooks River terminal and to the southwest into Boral Concrete.
Current Site Use	Occupied by commercial/industrial tenants including Maritime Container Services (MCS), Qube and Boral's St Peters recycling and concrete facilities.
Zoning	IN1 General Industrial (Commonwealth Land)
Elevation	Approximately 2 to 5 mAHD

I2. Historic summary

Table D-1 in Appendix D summarises the findings of historical aerial photography review.

Project area 3 has had an extensive industrial history and has been filled with uncontrolled fill. Some of this fill was reportedly from the former Bunnerong Power Station in Matraville. Additionally, buildings to the south built as wool stores contained significant ACM (and potentially other hazardous building materials ie PCBs, lead) and were damaged by a large gas explosion in 1991 (Background Review, AECOM 2015).

AECOM 2015 refers to a report prepared by HLA-Envirosciences (HLA, now part of AECOM), which included a historical site review, review of existing reports and soil sampling from 27 test pits across Lot 2 in DP 802342 (referred to as Site H on Figure 2). The subject site was located on the north side of the Botany Rail Line, owned by Sydney Airport and occupied by Boral's St Peters facilities. The site was formerly occupied by the following organisations:

- Minister for Public Works of the State of NSW (1925–1962)
- Mount Frome Lime Limited (1929–1930), (operated in the lime industry)
- Wilsons Limited (1930–1942), business unknown
- Central Wool Committee/Australian Wool Realisation Commission (1942–1962)
- Pacific Power/Electricity Commission of NSW (1962–2001), which stored transformers in the vicinity of the site.

I3. Previous investigations

Details of the reports which have been reviewed for this project area are presented in Appendix A3.

I4. Areas and contaminants of potential concern (COPC)

A number of historic and current potentially contaminating activities were outlined in the reports reviewed. These included historic general commercial/industrial activity, historic uncontrolled site filling (including possible ash), current freight storage activity and potential impacts (ACM/firefighting foam/transformers) associated with a former gas explosion. Based on review of available historical information, contaminants of potential concern (COPC) related to the activities conducted at the Sydney Airport leased areas include the following:

- TRH
- PAH
- Heavy metals
- Asbestos
- Phenols
- Polychlorinated biphenyls (PCBs)
- PFAS
- Pesticides.

I5. Extent of COPCs identified in historic investigations

I5.1 Soil

The reports reviewed for project area 3 have been related to targeting small specific portions of land (refer to Figure I-1), predominantly commissioned for lease entry/exit assessment or waste classification. Concentrations of TRH, PAH, BTEX and heavy metals above AEPR soil criteria and asbestos have been recorded. Seepage of tar-like material was observed at 1.5 mBGL in one location within Lot 2 in DP 802342 in the southwest portion of this project area.

Analysis for PFAS compounds in soil has been undertaken during the more recent investigations (reports issued post November 2017). PFAS concentrations were generally below the laboratory limit of reporting, however PFAS compounds have been reported above the NEMP ecological criteria (commercial/industrial) within two investigation parcels; Site 05561 (WSP September 2017) and Site 05578 (WSP February 2018).

I5.2 Groundwater

Groundwater is generally encountered between 1.2 and 2.5 mBGL. Historical groundwater contours indicate groundwater flow is in a south-easterly direction towards Alexandra Canal. The conductivity of groundwater (WSP September 2018b) indicates that the site is likely being influenced by saltwater intrusion from Alexandra Canal to the south.

In summary, the results from the 2015, 2016 and 2017 monitoring rounds conducted by WSP indicated that TRH, BTEX, PAH and most heavy metals concentrations were less than the AEPR groundwater criteria. It is noted that MW3RR has historically had TRH above AEPR groundwater criteria but was destroyed in 2012. Zinc in groundwater at MW4R exceeded the AEPR groundwater criteria (ammonium exceeded the adopted AEPR freshwater criteria in groundwater collected from all wells), and phosphate exceeded the AEPR groundwater criteria in groundwater at MW4RR and MW9RRR.

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SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
A1	11/03/2019	Project Area 3 - SACL Leased Areas Historical Soil and Groundwater Investigation Areas		

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Figure I-1
Project Area 3 - SACL Leased Areas Historical Soil and Groundwater Investigation Areas

RMS REGISTRATION No.

PART

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EDMS No.

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ISSUE: A1

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Semi volatile organic compounds (SVOCs), PCBs and phenols data from 2006 to 2011 were below the laboratory limit of reporting and were subsequently removed from the monitoring programs conducted since 2012.

In the 2015 monitoring, groundwater collected from monitoring wells MW2RR and MW4R was analysed for PFAS compounds. Perfluorooctanoic Acid (PFOA) was detected in MW4R and perfluorooctane sulfonate was detected in both wells. The concentration of PFOS in MW4R (0.58 µg/L) was above the NEMP ecological (95 per cent protection) criteria.

In the 2016 GME, groundwater collected from monitoring wells MW2RR and MW10R were analysed for PFAS compounds. PFHxS and PFOA were detected in MW10R, PFOS was detected in both wells. Concentrations were below the NEMP ecological (95 per cent protection) criteria.

I6. Project site inspection

An inspection of the project area was undertaken on 5 December 2018. A photographic log of the inspection is provided in Appendix E.

Project area 3 comprises land leased by Qube and Boral. Land leased by Boral could not be accessed. Most of the land leased by Qube could not be accessed either due to heavy traffic and safety concerns. Qube is an operational logistic and shipping hub. Most of the footprint is occupied by stored shipping containers and driveways with large unsealed areas. A vacant, vegetated area located immediately east of Canal Road on the Qube site was inspected during the site walkover. The area was accessed via an access gate into Qube off Canal Road. The vegetated area was raised by approximately three metres compared to the rest of the Qube site (Photo 9). The area was densely vegetated (Photo 10) and appeared to have been artificially raised using fill materials (Photo 11). A number of soil, gravel and concrete stockpiles were observed within the vegetated area but could not be fully assessed due to dense vegetation (Photo 12). Three groundwater monitoring wells were identified within the vegetated area (Photo 13). A vegetable oil spill was observed along approximately 150 metres of the vegetated area and puddles of oil were visible (Photo 13). Some absorbent material had been placed in some areas but had been driven over by trucks and was not containing the spill.

I7. Current investigations

A programme of geotechnical and environmental site investigations is currently being undertaken on behalf of Roads and Maritime. Figures summarising the associated sampling locations are provided in Appendix F. The following provides a summary of results. The results provided in? by Roads and Maritime have been incorporated into the CSM presented in section I8.

The investigation has included the drilling of fifteen additional boreholes (GW2d, GW4d, GW10s, GW11d, GW24s, SG-BH-107, SG-BH-109, SG-BH-110, SG-BH-111, SG-BH112, SG-BH113, SG-BH-118, SG-EH-103, SG-EH-104 and SG-EH-115) targeting locations directly beneath the proposed road infrastructure. Five of these boreholes were converted into groundwater monitoring wells (GW2s/d, GW4i/d, GW10s, GW11d and GW24s). Groundwater samples were also collected from one existing monitoring well WCX_GTY_BH_027.

Anthropogenic material was observed within the fill material. Anthropogenic material observed included fragments of tile, buildings rubble, concrete, brick, coke slag, molten plastic, asphaltic type material, and pieces of iron. Fill was generally encountered at depths between 0.5 and 1.0 mBGL, with fill extending deeper (between 2.6 and 5.5 mBGL) in the north-east corner.

Concentrations of B(a)P exceeded the AEPR soil criteria at nine sample locations, with concentrations of total PAH also exceeding at six of these locations. Concentrations of TRH C_{10}–C_{36} fraction were reported above the AEPR soil criteria at SG-BH-109 and SG-EH-115. Concentrations of PCBs were reported above the AEPR soil criteria at SG-EH-113. A fragment of ACM was identified at GW24s (ACM_0.5).

PFAS concentrations in soil were reported below the NEMP ecological and human health criteria (commercial/industrial).

Concentrations of heavy metals (including aluminium, copper, lead, mercury, nickel and zinc) were reported above the AEPR groundwater criteria at three locations (GWs/d, G11d and GW24s). Concentrations of total PAH were reported above the AEPR groundwater criteria at GW24s and GW4i. PFAS concentrations were detected in all monitoring wells. The PFOS concentrations exceeded the NEMP ecological (95 per cent protection) criteria at GW10s and GW24s.

Concentrations of ammonia in groundwater were reported above the AEPR groundwater criteria (freshwater protection) in samples collected from all monitoring wells. The AEPR does not provide a marine protection criteria for ammonia.

I8. Conceptual site model

For an ecological or human health risk from contamination to be present, there must be a plausible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway). A tabular depiction of the preliminary CSM for the project area based on existing conditions is presented in Table I-2 below.

Table I-2 Conceptual site model project area 3

Site aspect	Details	
Potential sources of contamination	■ Historic general commercial/industrial activity ■ Historic uncontrolled site filing ■ ACM in soil (historic building explosion in 1991) ■ PCBs in soil (historic building explosion in 1991) ■ Current freight storage activity.	
Geology	**Fill material** ■ Shallow fill (<0.5 mBGL) generally described as brown gravelly sand with, building rubble inclusions observed at most locations ■ Deeper fill encountered in the northeast corner extended to depths between 2.6 and 5.5 mBGL (SG-BH-112, SG-BH-113, SG-EH-103, SG-EH-104 and GW11d), from 1.4 m fill described as sandy with anthropogenic inclusions.	**Natural soils** ■ Grey sand to yellow/brown clayey sand (up to 11 mBGL). ■ Orange brown/grey clay between 4.5 and 16.5 mBGL (GW11d).
Depth and flow of groundwater	**Shallow aquifer** ■ Depth to groundwater on site was recorded between 1.2 and 2.5 mBGL ■ Inferred groundwater flow is to the south-east direction with contours indicating flow towards Alexandra Canal.	
Influences on groundwater conditions at the Site	■ Groundwater conductivity indicates that the site is likely being influenced by saltwater intrusion from Alexandra Canal to the south ■ Groundwater beneath the project area is likely to be subject to tidal influence ■ Regional groundwater flow in the Botany Sands Aquifer (Hatley 2014) discharges predominantly towards Cooks River and Botany Bay.	
Nature of soil contamination	■ Tar-like material was observed in one location (TP04) in the southwest portion of the site ■ Hotspots of TRH, PAH and ACM in fill material ■ PCBs at SG-EH-113 ■ PFAS concentrations reported above the NEMP ecological criteria (discrete areas only).	

Site aspect	Details				
Nature of groundwater contamination	■ Ammonia, phosphate and heavy metals in groundwater ■ PFAS concentrations in groundwater. MW4R, GW10s and GW24s above NEMP ecological (95% protection) criteria ■ MW3RR has historically had TRH above AEPR groundwater criteria but was destroyed in 2012.				
Other issues	■ None identified.				
Potential transport mechanisms and exposure pathways	■ Outdoor inhalation of soil derived dust and asbestos fibres ■ Volatilisation of TRH and coal tar impacts in soil and subsequent contaminant migration into indoor air/confined spaces (limited hotspots) ■ Leaching of soil contaminants into groundwater ■ Direct dermal contact or ingestion of contaminants in soil and/or groundwater ■ Lateral migration of contamination in groundwater ■ Accelerated lateral groundwater migration via underground service trenches.				
Potential receptors	**Onsite Ecological** ■ Mangrove vegetation (isolated strip adjacent to Botany Rail line).	**Offsite Ecological** ■ Alexandra Canal.	**Onsite Workers** ■ Commercial Industrial.	**Construction Workers** ■ Construction ■ Maintenance.	**Adjacent Offsite Community** ■ Commercial worker ■ Sydney Airport users ■ Groundwater bore users. (no residential properties within 300 m).
Existing complete S>P>R exposure pathways	Yes, however the biodiversity study indicates that the mangrove is in poor condition (note 1).	Yes, groundwater flow towards Alexandra Canal. Ammonia, TRH, heavy metals and PFAS identified in shallow groundwater.	Yes, TRH, PAH, PCBs and ACM identified in soil.	Yes, ACM, TRH. PAH and heavy metals identified in soil. Potential for volatilisation into confined spaces (limited hotspots). Yes, Ammonia, TRH, heavy metals and PFAS identified in shallow groundwater.	No, groundwater extraction restricted under 2018 order (i.e. water used for industrial use must be fit for purpose).

S>P>R = Source -> Pathway -> Receptor

It is considered that all future intrusive or construction works on the site would be undertaken in accordance with responsibilities under relevant Occupational Health and Safety legislation and relevant industry guidelines. Therefore, intrusive activities would be expected to be carried out under an appropriate site health and safety plan and as such, the potential risk of exposure to contaminants present on this site would be addressed accordingly.

note 1 Refer to Technical Working Paper 14 – Biodiversity Development Assessment Report Section 5.2.1, "*This vegetation type occurs in a poor condition class and is considered opportunistic regrowth.*"

Appendix J

Contamination on Sydney Airport Land – Project area 4

J1. Site description

Project area 4 includes Sydney Airport land extending south of Alexandra Canal along Airport Drive and Qantas Drive The project area is located on Commonwealth Land adjacent to Sydney Airport. The site description for this project area is presented in Table J-1.

Table J-1 Site description

Item	Project area
Lot & DP	Lot 8 DP1050923, Lot 95 DP1157632, Lot15 DP787029
Length of linear infrastructure	Approximately 2.5 kilometre
Current Owner	Sydney Airport
Current Site Use	Sydney Airport. Classified Road
Zoning	SP2 Infrastructure (Commonwealth Land) AD2 – Airport terminal and support services and AD3 – Airport logistics and support (Sydney Airport Master Plan 2033).
Elevation	Approximately 0.5 to 6 mAHD

J2. Historic summary

Table D-1 in Appendix D summarises the findings of historical aerial photography review. The project area is located on the periphery of Sydney Airport. Mascot was declared an aerodrome in 1920 when it was known as Sydney Airport. In 1953, it was renamed Sydney (Kingsford Smith) Airport after Charles Kingsford Smith. By 1943, the airport had been developed to incorporate three runways, with further expansion commencing in 1959 to extend the runway into Botany Bay. In the mid-1960s, Sydney Airport was further developed to include an international terminal which was opened in 1970. The airport is a primary hub for Qantas as well as a secondary hub for Virgin Australia and Jetstar Airways. The current Qantas Jet Base is located within the north-eastern corner of Sydney Airport, north of the domestic terminal.

J3. Previous investigations

Details of the reports which have been reviewed for this project area are presented in Appendix A3.

J4. Areas and contaminants of potential concern (COPC)

Based on review of available historical information, contaminants of potential concern related to the activities conducted at Sydney Airport area include the following:

- TRH
- PAH
- Heavy metals
- Asbestos
- Phenols
- Polychlorinated biphenyls (PCBs)
- Volatile halogenated compounds (VHC)
- PFAS.

J5. Extent of COPCs identified in historic investigations

A number of investigations have been reviewed for areas within Sydney Airport located adjacent (down-hydraulic gradient) to the project (refer Figure J-1). Although these site areas are predominantly outside of the project site, small sections of Sydney Airport land would be required to facilitate the project.

J5.1 Soil

Concentrations of TRH, PAH, BTEX and heavy metals above AEPR soil criteria and asbestos have been recorded within the investigation areas with contamination recorded to be more widespread within the Qantas Jet Base.

A single hotspot of TRH and BTEX at 0.1 m depth was reported in the Zoic September 2018 summary report for Ninth Street Hotel, corner of Seventh Street and Qantas Drive (Zoic September 2018). No exceedances of the AEPR soil criteria were reported in the Douglas Partners June 2018 Contamination Investigation Zone Substation Upgrade, Qantas Drive, (Douglas Partners June 2018). Both assessments concluded that based on the respective proposed developments soil investigation results were not likely to present an unacceptable/adverse risk to human health or the environment.

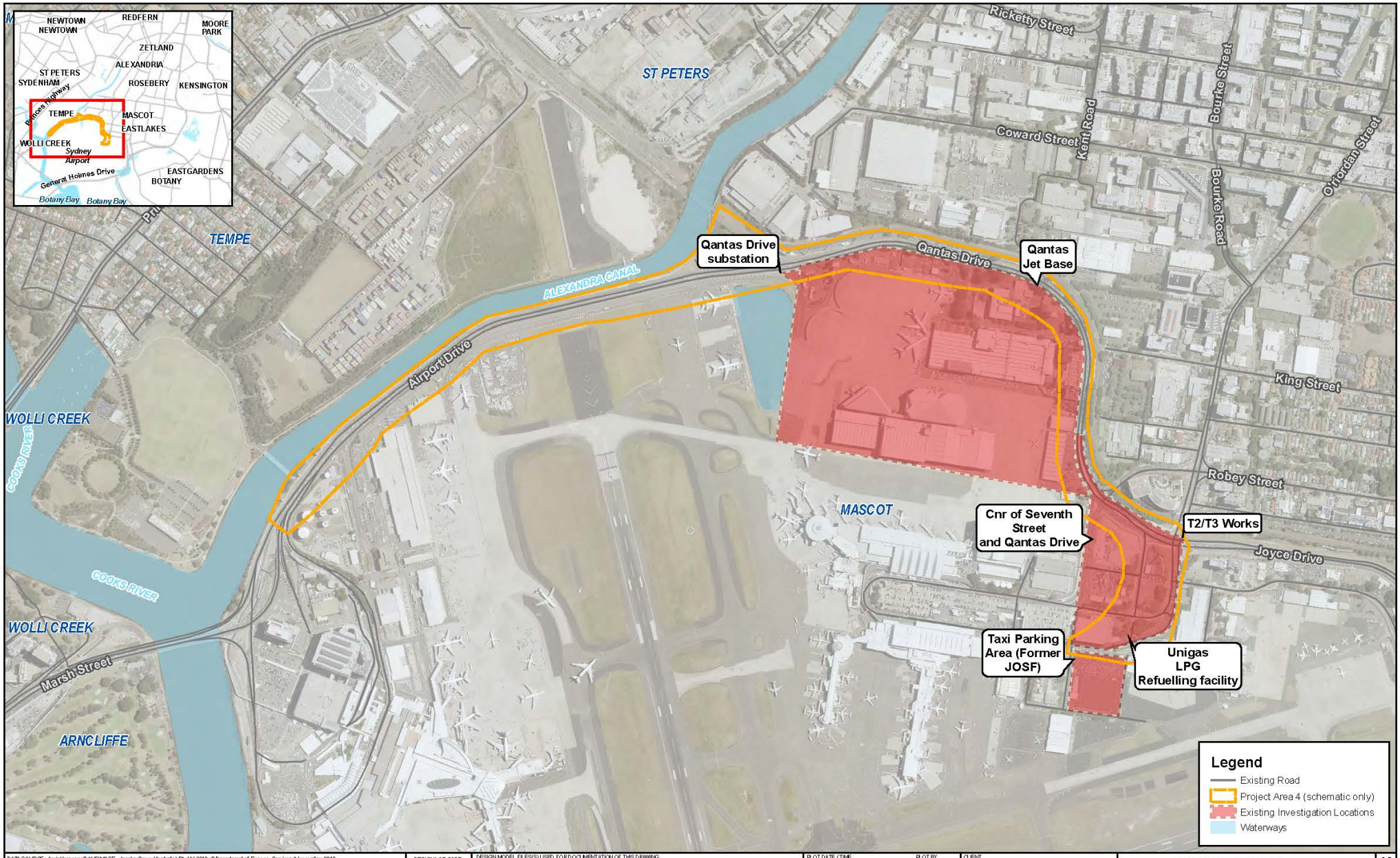
The Douglas Partners December 2014 preliminary site investigation report for the Sydney Airport T2/T3 Ground Access Solutions (Douglas Partners 2014) reported heavy metals and PAH within the fill encountered at hangar 96. Douglas Partners concluded that the potential for widespread soil and groundwater contamination to be encountered as part of the proposed works is considered low to moderate, although there is a possibility of encountering pockets of contamination. A detailed site investigation was recommended across the areas proposed for excavation.

Analysis for PFAS compounds in soil has been undertaken during the more recent investigations (reports issued post November 2017). Where analysed, PFAS concentrations were reported below the NEMP criteria. No PFAS in soil sampling has been cited for the Qantas Jet Base.

J5.2 Groundwater

The Sydney Gateway road project EIS scoping report (Roads and Maritime 2018) states that the Qantas lease areas at Sydney Airport have known contaminated groundwater plumes including the Jet Base. Reported contaminants include TRH, chlorinated solvents, light non-aqueous phase liquid (LNAPL), PAH, ammonia, sulphide, PFAS and heavy metals.

The monitoring conducted at the Qantas Jet Base (Environmental Strategies November 2015) included the gauging of 31 wells with subsequent groundwater sampling completed at 27 wells. Light non-aqueous phase liquid (LNAPL) was recorded in six of the monitoring wells gauged at thickness ranging between 0.1 m and >0.5 m. One of these monitoring wells is located to the north of the bulk storage tanks (adjacent to Qantas Drive), while the other four monitoring wells are located on the apron between the North Pond and the main hangar building.



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DESIGN MODEL FILES(S) USED FOR DOCUMENTATION OF THIS DRAWING

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CLIENT: Transport NSW Roads & Maritime Services

SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION
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MW R No.

APPROVAL

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CO-ORDINATE SYSTEM: MGA ZONE 56

HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	NAME	DATE
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DRG CHECK	Y V A E S-GUIJANI	1 1/0 3/2 0 1 9

PREPARED FOR

Figure J-1
Project Area 4 - Airport Land Historical Soil and Groundwater Investigation Areas

RMS REGISTRATION No.

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SHEET No.

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Sampling for PFAS compounds was undertaken at nine locations (Environmental Strategies November 2015). The following provides a comparison against the NEMP criteria:

- PFOS exceeded the NEMP recreational water criteria at one location
- PFOS exceeded the ecological (95 per cent protection) marine criteria at four locations.

Other contaminants exceeding the AEPR groundwater criteria included, naphthalene, zinc, TRH, copper, nickel, chlorobenzenes, ammonia and sulphide.

Douglas Partners (2014), reported on groundwater contamination near the Terminal 2/3 upgrade. The preliminary site investigation summarised groundwater results from an investigation undertaken by URS in 2001 which included sampling at 11 groundwater monitoring wells. Exceedances of the AEPR for lead, nickel, zinc and copper were reported. At one location TRH C_6–C_9 also exceeded the AEPR.

Zoic (September 2018) reported that a single groundwater monitoring well MW06 located in the centre of the Ninth Street project footprint (corner Seventh Street and Qantas Drive) exceeded the AEPR for TRH C_6–C_9 (420 µg/L). PFAS in groundwater was less than the NEMP 2018 ecological (95 per cent protection) marine criteria at all locations sampled.

Extracts from the Sydney Airport Annual Environmental Reports for 2017 indicate that Sydney Airports tenant JUHI manage known contamination within their leased site. Remediation is reported to include removal of liquid hydrocarbons. No reports have been made available to review for this site.

J5.3 Previous remediation activities

At the taxi parking area (former JOSF) located between Ninth and Seventh streets, there is a phase separated hydrocarbon plume recovery system in place. WSP (2018) reported that there is a passive recovery system that was installed in December 2014. Oxygen replenishing compound has also been added into the groundwater system. A total of 139L of light aqueous phase hydrocarbons was removed during February 2017 to February 2018.

J6. Site inspection

An inspection of the project area was undertaken on 5 December 2018. A photographic log of the inspection is provided as Appendix E.

Sydney Airport land could not be accessed with the exception of a small piece of land, triangular in shape, located between Alexandra Canal (west), Airport Drive (south) and the Botany Rail Line (east). This area is located opposite the Northern Pond (across Airport Drive). The western portion of this area is unsealed and comprises the Alexandra Canal cycleway, a grassed area and a channel connecting Sydney Airport Northern Pond to Alexandra Canal. Most of the area is fenced off. One newly installed well and two 205 L drums (presumed to be drilling waste) were observed within the fenced off area (Photo 15). A number of small soil stockpiles and ballast are present in the road reserve along this triangular area (Photo 16 and 17). The eastern portion of this triangular area is sealed with asphalt and leads to billboards located in the easement between Airport Drive and the Botany Rail Line (Photo 18). This area is fenced off but can be partially accessed via a swing gate. Two wells were present in the road reserve just outside of the fenced off area (Photo 19).

Observations onto the remainder of Sydney Airport land (south of Airport Drive and Qantas Drive) were made from Airport Drive and Qantas Drive as Sydney Airport land was not accessible. There is a fuel storage area in the most western portion of Sydney Airport land, west of Link Road. The area appeared to comprise at least five above ground storage tanks, one water storage underground storage tank and a fill up station. A hedge along Airport Drive blocked visibility into the area (Photo 20).

Qantas freight: warehousing facility, car park were only visible from the road. A hedge blocked visibility.

J7. Current investigations

A programme of geotechnical and environmental site investigations is currently being undertaken on behalf of Roads and Maritime, Figures summarising the associated sampling locations are provided in Appendix F. The following provides a summary of results. The results provided in these tables have been incorporated into the CSM presented in Section J8.

The investigation has included the drilling of 14 additional boreholes (GW12, GW13, GW14, GW15, GW27, SG-BH-128, SG-BH-129, SG-BH-131, SG-BH-132, SG-BH-133, SG-BH-147, SG-EH-106, SG-EH-107 and SG-EH-118) targeting locations directly beneath the proposed road infrastructure. Five of these boreholes were converted into groundwater monitoring wells (GW12, GW13, GW14, GW15 and GW27). Additionally, monitoring well GW104 was installed down hydraulic gradient of the road alignment within the Qantas Jet Base.

A concentrations of TRH C_{10}–C_{36} exceeded the AEPR soil criteria in a sample collected from SG-BH-128. Concentrations of B(a)P exceeded the AEPR soil criteria at five locations (GW12, GW27s, SG-BH-107, SG-BH-118 and SG-BH-131) with concentrations of total PAH also exceeding at two of these locations. PFAS concentrations in soil were reported below the NEMP ecological and human health criteria (commercial/industrial).

Concentrations of heavy metals in groundwater including zinc, chromium, copper, lead and nickel were reported exceeding the AEPR groundwater criteria. A concentrations of TRH C_{10}-C_{36} exceeded the AEPR groundwater criteria at GW14d. PFAS concentrations were detected in samples collected from all monitoring wells. PFOS concentrations at GW15s and down-gradient monitoring well GW104 exceeded the NEMP ecological (95 per cent protection) criteria.

Concentrations of ammonia in groundwater were reported above the AEPR groundwater criteria (freshwater protection) in samples collected from all monitoring wells. The AEPR does not provide a marine protection criteria for ammonia.

J8. Conceptual site model

For an ecological or human health risk from contamination to be present, there must be a plausible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway). A tabular depiction of the preliminary CSM for the project area based on existing conditions is presented in Table J-2 below.

Table J-2 Conceptual site model project area 4

Site aspect	Details	
Potential sources of contamination	■ Historic uncontrolled site filing ■ Historic general and Sydney Airport commercial/industrial activity ■ Fuel storage and fire-fighting training ■ Qantas Jet Base (down-hydraulic gradient of the road alignment) ■ Taxi Parking Area LNAPL Plume (down-hydraulic gradient of the project site).	
Geology	**Fill material** ■ Fill up to 2.2 mBGL, generally described as brown medium to coarse grained sand with, trace angular gravel at some locations.	**Natural soils** ■ Grey sand to yellow/brown clayey sand (up to 7 mBGL) ■ Grey silty clay encountered at 7 mBGL up to 20 mBGL.
Depth and flow of groundwater	**Shallow aquifer** ■ Depth to groundwater on site was recorded between 1.0 and 3.4 mBGL ■ Inferred groundwater flow is to the south south-west towards Cooks River.	

Site aspect	Details				
Influences on groundwater conditions at the Site	■ Groundwater beneath the project area is likely to be subject to tidal influence ■ Regional groundwater flow in the Botany Sands Aquifer (Hatley 2014) discharges predominantly towards Cooks River and Botany Bay.				
Nature of soil contamination	■ TRH hotspot at SG-BH-128 directly beneath project footprint ■ PAH impacts in fill material directly beneath project footprint ■ TRH, BTEX, PAH, heavy metals and asbestos impacts in fill material within adjacent Sydney Airport land.				
Nature of groundwater contamination	■ Heavy metals directly beneath project footprint ■ PFAS exceeded NEMP criteria at location GW15s directly beneath project footprint ■ LNAPL in Qantas Jet Base and former JOSF site (down-hydraulic gradient of the project site) ■ TRH, chlorinated solvents, PAH, ammonia, sulphide and heavy metals exceed AEPR criteria in Qantas Jet Base (down-hydraulic gradient of the project site) ■ PFAS exceeded NEMP criteria in Qantas Jet Base (down-hydraulic gradient of the project site). Maximum PFOS concentration of 4.5 µg/L recorded at location GW104.				
Other issues	■ None identified.				
Potential transport mechanisms and exposure pathways	■ Outdoor inhalation of soil derived dust ■ Volatilisation of TRH and VCH impacts in groundwater ■ Leaching of soil contaminants into groundwater ■ Direct dermal contact or ingestion of contaminants in soil and/or groundwater ■ Lateral migration of contamination in groundwater ■ Accelerated lateral groundwater migration via underground service trenches.				
Potential receptors	**Onsite Ecological** ■ None, area is heavily industrialised.	**Offsite Ecological** ■ Cooks River ■ Alexandra Canal ■ Sydney Airport Northern Ponds ■ Mill Pond ■ Engine Pond.	**Onsite workers** ■ Commercial.	**Construction workers** ■ Construction ■ Maintenance.	**Adjacent offsite community** ■ Residential ■ Commercial worker ■ Sydney Airport users ■ Groundwater bore users.
Existing complete S>P>R exposure pathways	No	Yes, groundwater flow towards Cooks River. Ammonia, TRH, heavy metals, VCH and PFAS identified in shallow groundwater.	No, majority of area is paved. Volatile contaminants (LNAPL, VCH) have only been recorded down-hydraulic gradient.	Yes, potential TRH, PAH, PFAS, asbestos and heavy metals in soil. Heavy metals, ammonia and PFAS identified in shallow groundwater.	Yes, Volatile contaminants (LNAPL, VCH) have been recorded down-hydraulic gradient.

Appendix K
Contamination in Alexandra Canal – Project area 5

K1. Background

Alexandra Canal was constructed from a natural watercourse called Sheas Creek through dredging and canalisation of the Creek. It flows into the Cooks River near the north-western corner of Sydney Airport before it discharges into Botany Bay to the west of the Sydney Airport. It is owned and operated by the Sydney Water Corporation (Sydney Water) and is listed on the State Heritage Register.

Dredging and canalisation of Sheas Creek started in the 1880s and was mostly complete by 1900. Its size and tidal action resulted in the canal acting as a sediment trap. Dredging was undertaken until the 1950s and the last major works on the canal were carried out in the 1970's when the north-south runway for Sydney Airport was built (DPWS, 2004).

Alexandra Canal was declared a remediation site (number 21008) on 25 August 2000 by the NSW Environment Protection Authority (EPA), due to bed sediments contaminated with chlorinated hydrocarbons including organochlorine pesticides (OCPs), polychlorinated biphenyl's (PCBs) and metals. A Remediation Order (number 23004) was also issued by the NSW EPA to Sydney Water Corporation on 10 May 2004.

By order from the EPA, if work is proposed in Alexandra Canal, Sydney Water Corporation must submit, for the EPA's approval, a written plan directed at minimising disturbance and migration of contaminated bed sediments at the site.

Table D1 in Appendix D summarises the findings of an historical aerial photography review.

K2. Sediment investigation

A sediment investigation was undertaken at selected locations within Alexandra Canal. The investigation involved the collection of bed sediment and surface water samples from Alexandra Canal at 12 locations.

Samples were analysed for heavy metals (As, Cd, Cr, Cu, Pb, Ni, Hg and Zn), total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylenes and naphthalene (BTEXN), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), organophosphorus pesticides (OPPs), polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs) dioxins, furans, PFAS and asbestos.

Elutriate testing was performed for ammonia, heavy metals, PAHs, Phenols, OCP and PCB to assess the amount of contaminants that could potentially be released from the sediments during dredging and disposal of the sediments.

Observations of potential contamination were recorded during the sediment sampling, with hydrocarbon odours recorded at 10 locations ranging in intensity from moderate to strong. A hydrocarbon sheen was also recorded at seven of the locations. Surface water was observed to be clear with no turbidity and no odour noted at all 12 locations.

The following summarises the sediment analytical results following comparison to guideline values adopted by AECOM (refer to Appendix B):

- Concentrations of metals, TPH, PAH, PCBs and pesticides in sediment exceeded the ecological criteria
- Asbestos was detected in 13 of the sediment samples collected
- PFAS compounds were detected above the laboratory limit of reporting, however concentrations were below the adopted guidelines values
- Organotin compounds including tributyltin, monobutyltin and dibutyltin were detected above the laboratory limit of reporting. Organotin waste materials are subject to a chemical control order (CCO) created under Part 3, Division 5 of the *Environmentally Hazardous Chemicals Act 1985* (EHC Act)
- The action criteria for acid sulfate soils was exceeded at eight locations.

The following summarises the elutriate and surface water analytical results following comparison to 95 per cent marine water trigger levels adopted by AECOM:

- Elutriate results for ammonia, lead and zinc exceeded the ecological marine criteria
- Concentrations of zinc exceeding the ecological marine criteria were reported in all surface water. samples except SW11_2. One exceedance of copper was also reported at SW8_1
- PFAS concentrations reported during traditional analysis were below the laboratory limit of reporting. Total Oxidisable Precursor Assay (TOPA) analysis reported PFAS concentrations above the laboratory limit of reporting (0.01 µg/L) at six locations.

K3. Surface water quality

K3.1 M4–M5 Link

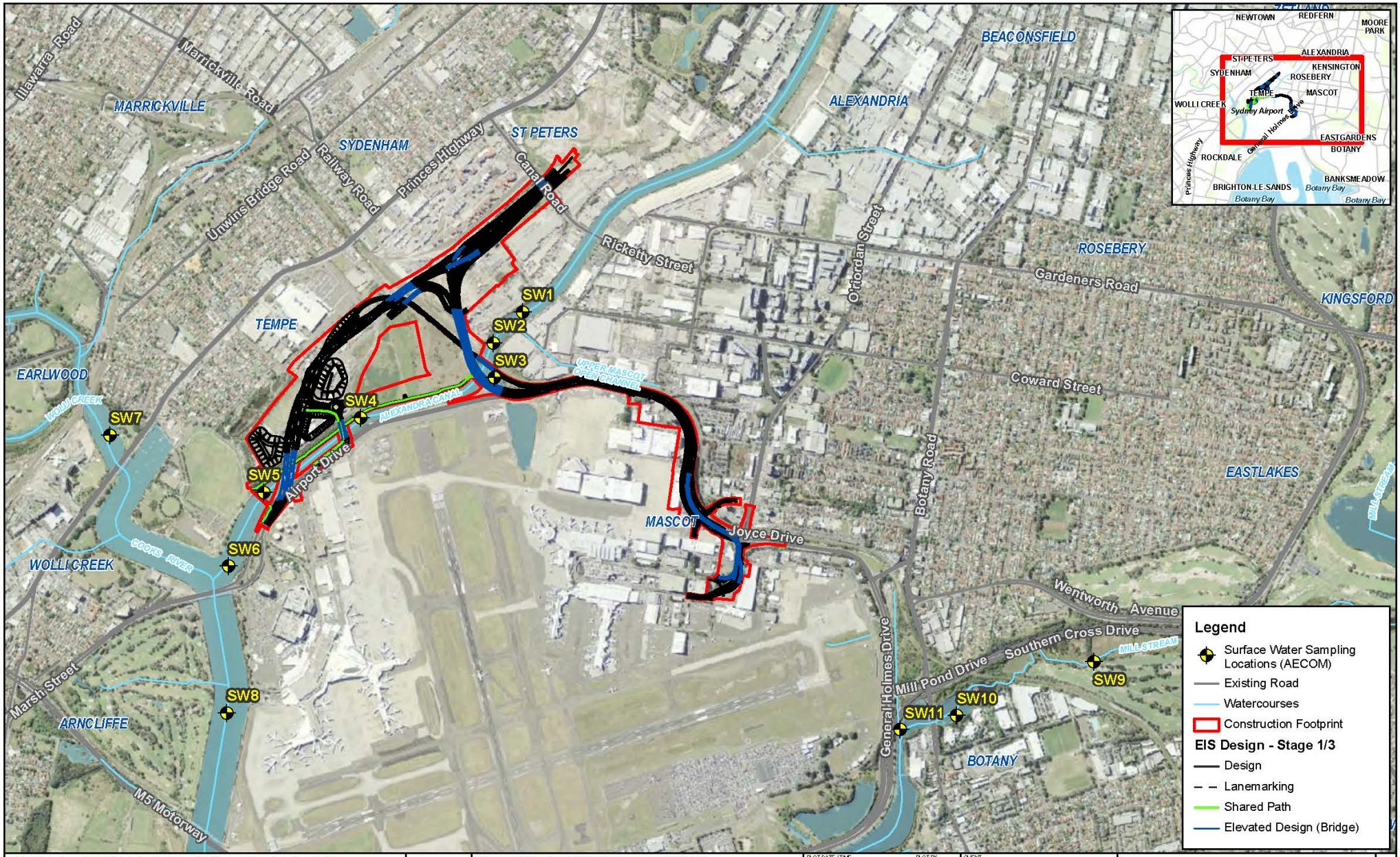
As part of the Environmental Impact Assessment (EIS) for the M4–M5 Link (AECOM, 2017), water samples were collected from Alexandra Canal and tested for a suite of analytes. The test results indicated elevated pH, high turbidity, and elevated concentrations of metals (copper, lead, chromium, nickel, manganese, and zinc), nitrogen, nitrate and phosphorous.

K3.2 New M5

Surface water quality monitoring was conducted as part of the New M5 Environmental Impact Assessment (EIS). (AECOM, 2015) Results for Alexandra Canal indicate metal concentrations (cadmium, chromium, lead, nickel, mercury, and ammonia) in the upper reaches to be below the ANZECC criteria, and elevated zinc and copper concentrations.

K3.3 Monthly baseline surface water monitoring – Sydney Gateway Road Project

Roads and Maritime has been sampling the surface water within the project site to obtain site-specific data since January 2018. A total of nine months of data (data December 2017–January 2019, missing February 2018 and May 2018) has been reviewed. Over this period there are 11 sampling events for SW1–SW5, 12 sampling events for SW6, 16 for SW7, SW8, SW10 and SW11 and nine for SW9. Because of limited data wet and dry events were combined to provide the average, median and maximum values. Samples that were below limit of detection were not included in the calculation of the mean, median and maximum. A summary table highlighting the mean, median and maximum values for the key physical properties, nutrients and contaminants of concern is presented in Technical Paper 8 – Surface Waste Quality (Appendix B).



DATA SOURCE: Aerial Imagery © AUSIMAGE - Jacobs Group (Australia) Pty Ltd 2018, © Department of Finance, Services & Innovation 2018. © Water NSW - DPI Water, 2018.

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SYDNEY GATEWAY

A3

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A1	16/01/2019	Surface Water Sampling Locations
A2	10/07/2019	Surface Water Sampling Locations
A3	31/07/2019	Surface Water Sampling Locations

WMR No.

APPROVAL

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HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY: wsp GHD

DRG No.

	NAME	DATE
TITLE		
DRAWN	D NAIKEN	31/07/2019
DRG CHECK	Y.YVANNES-GIULIANI	31/07/2019

PREPARED FOR

Contamination Impact Assessment
Figure K-1
Surface Water Sampling Locations

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ISSUE STATUS: FOR INFORMATION

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The contaminants are assessed against the ANZECC (2000) water quality objectives. These water quality objectives were determined from the environmental values and recommended trigger values in the ANZECC (2000) guidelines. The contaminants were assessed against the most stringent values. A summary of key observations is below:

- Total nitrogen, aluminium, iron, manganese, zinc and ammonia mean, median and maximum exceed ANZECC (2000) guidelines for all sites, apart from SW5 filtered iron median, SW8 median manganese and SW9 median filtered manganese
- Phosphorus mean, median and maximum exceed ANZECC (2000) guidelines value for all sites apart from medians at SW1, SW3, SW4, SW7, SW8, SW9, SW10 and SW5 mean and median
- Sulphate, TDS, and chloride mean, median and maximum values are exceeded for SW1–SW8
- Total suspended solids exceed guideline values for all data points apart from SW1 and SW7 medians
- All maximums and SW10 average and median and SW11 average field measured turbidity 80th percentiles exceed ANZECC (2000) guidelines
- All copper maximums apart from SW3 and SW9 exceed ANZECC (2000) guidelines. SW5, SW8 and SW11 mean copper values exceed ANZECC (2000) guidelines
- All lab turbidity maximums and SW6, SW10 and SW11 lab turbidity mean exceed ANZECC (2000) guidelines.

In summary, sampling points within the Cooks River and Alexandra Canal (SW1–SW8) frequently exceed ANZECC (2000) guideline values for sulphate, TDS, total suspended solids, chloride total nitrogen, aluminium, iron, manganese, zinc and ammonia.

Sampling points in Mill Stream (SW9–SW11) frequently exceeded ANZECC (2000) guidelines for total nitrogen, aluminium, iron, manganese, zinc, ammonia and turbidity.

Contaminants not discussed above either do not exceed ANZECC (2000) guidelines trigger values or do not have ANZECC (2000) guidelines trigger values provided.

With respect to assessing site investigation results for PFAS, ecological criteria provided in Table 5 of the PFAS NEMP have been considered. The target water quality objectives outlined in Technical Working Paper 8 – Surface Water are; 90 per cent protection of marine water ecosystems for Mill Pond and 80 per cent protection of marine water ecosystems for Alexandra Canal. To apply a precautionary approach for PFAS in this assessment, conservative criteria for 95 per cent protection of marine water ecosystems has been considered specifically for the project. A summary of key observations is below.

- Detections of PFAS compounds including PFOS and PFOA have been recorded in sampling points within the Cooks River, Alexandra Canal and Mill Pond. Concentrations were below the PFAS MEMP (95 per cent protection) marine criteria
- Detections of PFOS were recorded in up-gradient sampling points, the maximum concentrations reported were 0.0257 µg/L in SW1, 0.0133 µg/L in SW7 and 0.0325 µg/L in SW9.

K4. Conceptual site model

For an ecological or human health risk from contamination to be present, there must be a plausible pollutant linkage between the source of contamination and a receptor by means of a transport mechanism (pathway). Based on the current contamination associated with the Alexandra Canal bed sediments, activities which disturb the sediments have the potential to disperse contaminants directly into the receiving environment.

Appendix L
Remedial Action Plan (RAP) framework

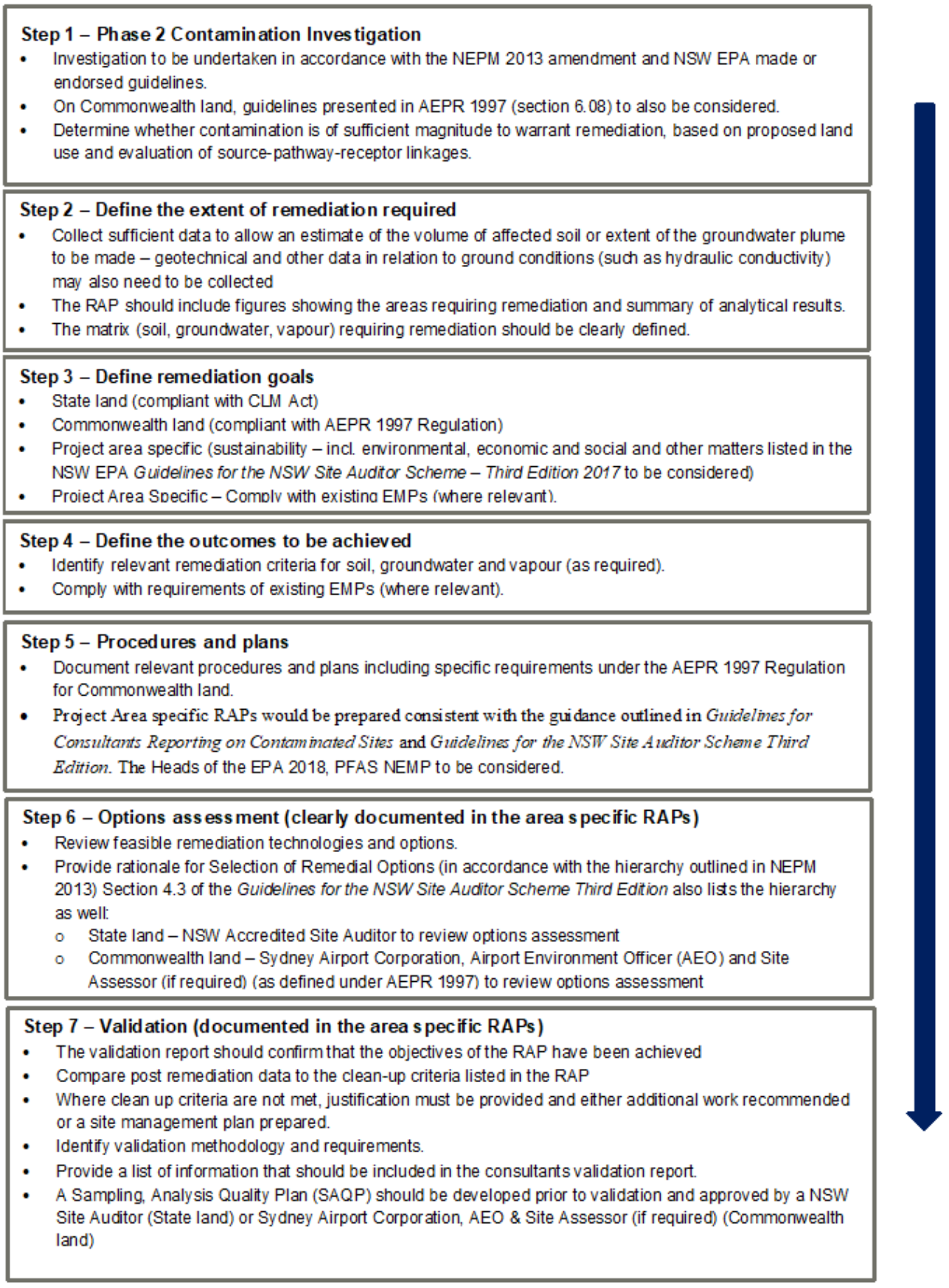

Figure L-1 Remedial Action Plan (RAP) framework

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