

Hickson Road Remediation Works (SSD 6617) Environmental Impact Statement



Hickson Road, Barangaroo

Remediation of Hickson Road - Part of EPA Remediation
Site 21122

August 2015 ■ 14152

Reproduction of this document or any part thereof is not permitted without prior written permission of JBA Urban Planning Consultants Pty Ltd.

JBA operates under a Quality Management System that has been certified as complying with ISO 9001:2008. This report has been prepared and reviewed in accordance with that system. If the report is not signed below, it is a preliminary draft.

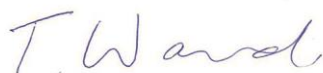
This report has been prepared by:

A handwritten signature in blue ink, appearing to read 'H. Quartermain', with a stylized flourish at the end.

Harry Quartermain

18/08/2015

This report has been reviewed by:

A handwritten signature in blue ink, appearing to read 'T. Ward', with a stylized flourish at the end.

Tim Ward

18/08/2015

Contents

Glossary of Acronyms / Abbreviations	1
1.0 Introduction	5
1.1 Planning Background	6
1.2 Site Contamination	9
1.3 Summary of Approval Sought	10
1.4 Environmental Assessment and Approvals Process	11
1.5 Project Team	11
2.0 Site Analysis	12
2.1 Barangaroo Location and Context	12
2.2 SSD DA Site Description	13
2.3 Land Ownership and Legal Description	13
2.4 Historical Uses	14
2.5 Existing Development and Structures	15
2.6 Traffic and Transport	16
2.7 Physical Characteristics	16
2.8 Surrounding Development	19
3.0 Legislative Framework	21
3.1 Legislation	21
3.2 Statutory Planning	23
3.3 Strategic Planning	25
3.4 Barangaroo Concept Plan	26
4.0 Consultation	27
5.0 Description of the Development	31
5.1 Introduction	31
5.2 Summary of Remedial Strategy	31
5.3 Description of In-situ Remediation Works	33
5.4 Description of Ex-situ Remediation Works	37
5.5 Selection of Remediation Technology	40
5.6 Working Hours	41
5.7 Site Access	41
5.8 Indicative Project Staging	42
6.0 Consideration of Alternatives	44
7.0 Environmental Assessment	47
7.1 Relevant EPIs and Policies	51
7.2 Assessment of Contamination	52
7.3 Waste Management	62
7.4 Asbestos Containing Materials	64
7.5 Health Impact Assessment	66
7.6 Acid Sulphate Soils	70
7.7 Water Quality and Management	71
7.8 Air Quality	80
7.9 Noise and Vibration	88
7.10 Traffic and Transport	96
7.11 European Heritage	102

Contents

7.12	Indigenous Heritage	104
7.13	Tree Removal and Arboriculture	105
7.14	Visual Impact Assessment	106
7.15	Hazardous Substances	109
7.16	Infrastructure and Utilities	113
7.17	Climate Change and Ecologically Sustainable Development	116
7.18	Off Site Transportation	117
7.19	Environmental Management	119
7.20	Cumulative Assessment	119
8.0	Environmental Risk Assessment	122
9.0	Mitigation Measures	126
10.0	Justification of the Proposal	134
10.1	Social and Economic	134
10.2	Biophysical	134
10.3	Ecologically Sustainable Development	134
11.0	Conclusion	137

Figures

1	Locality Plan – Barangaroo	12
2	Plan of Hickson Road Remediation Area, the EPA Declaration Area, and the Site	13
3	Remediation Area typical section plan (Remediation Area marked in red)	17
4	Indicative location of wells	34
5	The Extent of Contamination Requiring Remediation within the Unsaturated Soil Zone	58
6	Extent of Contamination requiring Remediation within the Saturated Soil Zone	59
7	Location of gasholder annuli and tar tanks	60
8	Access arrangements to western side of Hickson Road Remediation Area	100
9	Access arrangements to western side of Hickson Road Remediation Area	100
10	Recent Visual Context of the site (from the east)	107
11	Recent visual context of the site (from the south)	107
12	The potential off site impacts for the In-situ remediation of the eastern half of Hickson Road	111
13	The potential off site impacts for the in-situ remediation of the western half of Hickson Road	112
14	Risk Assessment Matrix	122

Contents

Tables

1	Land Ownership	14
2	Summary of Consultation	29
3	Indicative Project Programme and Staging	42
4	SEARs and cross-reference for where requirements are addressed	47
5	Soil and Groundwater SSTCs for Hickson Road	55
6	Marine Water Quality Criteria	55
7	Ambient Pollutant Concentrations, Rozelle Monitoring Station	81
8	AQIA Modelling Results.	84
9	Background Noise and Construction Noise Management Levels	89
10	Noise Impacts on Residential Receivers	90
11	Noise Impacts on Residential Receivers	92
12	Forecast Truck Movements associated with the proposed in-situ works	97
13	Forecast Truck Movements associated with the proposed In-situ works	98
14	Potentially Hazardous Chemicals	109
15	Mitigation Measures	126

Appendices

A	Secretary's Environmental Assessment Requirements <i>DP&E</i>
B	Voluntary Management Proposal <i>Environment Protection Agency</i>
C	EPA Letter on VMP RAP <i>Environment Protection Agency</i>
D	BDA Letter on Proposed Remediation Strategy <i>Barangaroo Delivery Authority</i>
E	Site Plans and Sections <i>Lend Lease</i>
F	Remediation Overview and Staging Plans <i>ARUP</i>
G	Remediation Action Plan <i>AECOM</i>
H	VMP Remediation Extent <i>AECOM</i>
I	Site Audit Report - VMP <i>Environ</i>

Contents

J	Overarching RAP	<i>ERM</i>
K	Site Audit Report – Overarching RAP	<i>Environ</i>
L	Human Health and Ecological Risk Assessment – VMP Area	<i>AECOM</i>
M	Health Impact Assessment	<i>AECOM</i>
N	Acid Sulphate Soil Management Plan	<i>AECOM</i>
O	Soil and Water Impact Assessment Ex-situ	<i>Worley Parsons</i>
P	Soil and Water Impact Assessment In-situ	<i>AECOM</i>
Q	Air Quality Impact Assessment	<i>AECOM</i>
R	Noise and Vibration Impact Assessment	<i>Wilkinson Murray</i>
S	Traffic Impact Assessment	<i>ARUP</i>
T	Heritage Impact Statement	<i>Casey and Lowe</i>
U	Aboriginal Archaeology	<i>Comber Consultants</i>
V	Arboricultural Impact Assessment	<i>Tree Wise Men</i>
W	ESD and Climate Change	<i>Worley Parsons</i>
X	Waste Management Plan	<i>AECOM</i>
Y	Construction EMP	<i>Land Lease</i>

Contents

Z	Preliminary ISCO Workplan	<i>AECOM</i>
AA	Pilot Trial Success Parameters Report	<i>AECOM</i>
BB	Preliminary Hazard Assessment	<i>AECOM</i>
CC	Data Gap Investigation	<i>AECOM</i>
DD	Supplementary Data Gap Investigation	<i>AECOM</i>
EE	Tree Root Mass Investigation	<i>AECOM</i>
FF	SISCO Lab Trial	<i>VeruTek</i>
GG	SISCO Proving Phase Report	<i>AECOM</i>
HH	Geotechnical Report	<i>Coffey</i>
II	Groundwater Discharge Study	<i>AECOM</i>
JJ	Certificate of CIV	<i>Rider Levett Bucknall</i>
KK	Off-Site Transportation and Treatment Methodology Statement	<i>AECOM</i>
LL	Off-Site Transportation and Treatment – Site Auditor’s Review	<i>Environ</i>

Statement of Validity

Development Application Details

Applicant name	Lend Lease (Millers Point) Pty Ltd
Applicant address	L4, 30 Hickson Road, Millers Point, NSW, 2000
Land to be developed	Part of Hickson Road, Millers Point
Proposed development	Remediation of part of Hickson Road, as described in Section 5 of this Environmental Impact Statement.

Prepared by

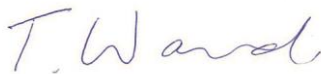
Name	Tim Ward
Qualifications	BSc, Masters of Environmental Management
Address	Level 7, 77 Berry Street, North Sydney
In respect of	State Significant Development - Development Application

Certification

I certify that I have prepared the content of this EIS and to the best of my knowledge:

- it is in accordance with Schedule 2 of the Environmental Planning and Assessment Regulation 2000;
- all available information that is relevant to the environmental assessment of the development to which the statement relates; and
- the information contained in the statement is neither false nor misleading.

Signature



Name

Tim Ward

Date

18/08/2015

Executive Summary

Background

In May 2009 the Environment Protection Authority (EPA) declared part of Millers Point to be a remediation site (Remediation Site No. 21122) under the *Contaminated Land Management Act 1997* (the EPA Declaration). The land to which the EPA Declaration relates (the EPA Declaration Area) coincides with the known footprint of the former Millers Point gasworks, and is located on land known as part Blocks 4A–C, Block 5 and part of the Southern Cove within the Barangaroo development site, as defined by the Barangaroo Concept Plan (refer **Figure 2**), and part of Hickson Road.

The reason for the declaration by the EPA is because the EPA considered that the EPA Declaration Area is *‘contaminated in such a way as to present a significant risk of harm to human health and the environment’*. The EPA Declaration states that *“The EPA believes that the site is contaminated with gasworks waste and particularly waste tar as a result of the previous use of the site as a gasworks plant.”*

The Barangaroo Delivery Authority entered into a Voluntary Management Proposal (VMP) with the NSW EPA (No. 20101719) to address the EPA Declaration on 23 July 2010.

Purpose of this Report

This Development Application for State Significant Development (SSD DA) and Environmental Impact Statement (EIS) is submitted by Lend Lease (Millers Point) Pty Ltd on behalf of the Barangaroo Delivery Authority (BDA) to seek approval for the remediation of contaminated land within that part of the EPA Declaration Area that relates to land within Hickson Road within Barangaroo.

This report:

- Outlines the existing contamination associated with the EPA Declaration Area.
- Describes the investigations that have been carried out to determine the remediation strategy for the Hickson Road Remediation Area and the remediation works associated with this strategy.
- Provides an assessment of the environmental impacts of the proposed development.

It is noted that remediation of the remaining parts of the EPA Declaration Area (being ‘Block 4’, which comprises part Blocks 4A–C and part of the Southern Cove, and Block 5, of the Barangaroo site) have been the subject of separate Development Applications, and accordingly remediation works in these areas are not the subject of this SSD DA.

The site – existing use and development

The 22 hectare Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Central Barangaroo and Barangaroo South. The Barangaroo site, as defined under *State Environmental Planning Policy (Major Development) 2005*, also includes part of Hickson Road.

The Remediation Area that is subject of this EIS constitutes part of Hickson Road within the Barangaroo site, adjacent to:

- Parts of Central Barangaroo and parts of Barangaroo South being part of Lot 100 DP 1204946 and part of Lot 200 DP 124948;
- 30 – 34 Hickson Road being Lot 11 DP1065410;

- 36 Hickson Road being Lot 5 DP873158 and Lot 12 DP1065410; and
- 38 Hickson Road being SP72797, Millers Point.

As shown in **Figure 2**, this SSD DA applies to:

- Parts of Hickson Road that are to be used to support the remediation works, including for the establishment of a site compounds, storage areas, temporary traffic management and local access (as necessary).
- Parts of Central Barangaroo comprising Block 5, Block 6 and land to the west of these blocks for the purpose of providing ancillary infrastructure and facilities, including the potential wastewater treatment plant.

Hickson Road is currently used as a public road and will continue to be used as a public road during and following the proposed remediation activities.

Project outline

This SSD DA seeks approval for carrying out remediation of contaminated land in Hickson Road, within Barangaroo, that forms part of the EPA Declaration Area, in accordance with a Remedial Action Plan (RAP) prepared as part of the approved Voluntary Management Proposal.

The objective for this SSD DA is to enable the NSW EPA Declaration to be removed, insofar as it applies to Hickson Road. In order to progress to achievement of this objective, a detailed remedial strategy has been developed for the whole EPA Declaration Area site. This remedial strategy forms part of a holistic approach to the management and remediation of contamination across the EPA Declaration Area.

The remediation strategy for Hickson Road proposes two alternative remediation methodologies. The ultimate methodology used will be selected based upon the results of a pilot trial that has been separately approved (MP10_0087, approved 3 March 2011). The two methods of remediation that are considered in this EIS are:

- In-situ remediation (preferred method) using in-situ chemical oxidation remedial technology; and
- Ex-situ remediation (alternate method).

The proposed in-situ chemical oxidation (ISCO) remediation method involves:

- Installation of a covered treatment compound incorporating reagent storage, injection pumps, safety shower and eyewash stations and extraction pumps.
- Installation of wells, injection of chemicals into the groundwater to oxidise the contaminated materials, extraction of the reacted chemicals/groundwater, and monitoring of groundwater, including installation of a soil vapour extraction (SVE) system for the duration of the in-situ chemical oxidation activities.
- Supplementary localised excavation for off-site disposal may also be undertaken.

Ex-situ remediation would require the excavation of contaminated soils, transport to a licenced off-site facility for treatment (where required for the material to meet landfill disposal criteria) and disposal at a suitably licenced landfill facility. The excavations would be backfilled with suitable imported fill (i.e. fill that meets the criteria established in the RAP), and compacted prior to reinstatement of Hickson Road.

Depending on the selected remediation method, the remediation is forecasted to commence in June 2016 (subject to development consent) with an estimated timeframe of up to 21 months.

The proposed remediation strategy is documented in a RAP (**Appendix G**) which has been reviewed and approved by an independent, NSW EPA-accredited Site Auditor, Mr Graeme Nyland (**Appendix I**). The Site Auditor has determined that if the remediation is carried out in accordance with the RAP, as is proposed, then the EPA Declaration Area (which includes the site that is subject of this SSD DA) can be remediated to a standard that will allow removal of the EPA Declaration.

The Proponent

The proponent for this application is Lend Lease (Millers Point) Pty Ltd on behalf of the BDA. Lend Lease is currently carrying out construction works associated with the delivery of development on land adjacent to the site at Barangaroo South. In addition to developing Barangaroo South, Lend Lease has been contracted by the BDA to undertake remediation associated with the EPA Declaration Area.

The BDA is the Roads Authority for Hickson Road and has given landowners consent for the lodgement of this application.

The BDA entered into a Voluntary Management Proposal (VMP) with the NSW EPA (No. 20101719) to address the EPA Declaration. If required, a Phase 2 VMP will be prepared that will provide for the carrying out of the specific remediation works, including those that are the subject of this SSD DA for Hickson Road.

Planning Context

The remediation of part of Hickson Road, as described in this SSD DA, is required so that it may cease to be significantly contaminated land for the purposes of the *Contaminated Land Management Act 1997* to enable the EPA Declaration over it to be revoked. It is understood revoking the EPA Declaration will occur following satisfactory remediation of all areas of the EPA Declaration (i.e. Block 5, 'Block 4' and Hickson Road), unless otherwise agreed by the EPA.

The proposed remediation works are not intended to facilitate any future additional land uses at the site. Hickson Road will continue to be used as a public road throughout remediation, subject to the application of road controls that will limit traffic on Hickson Road to a single-lane in each direction.

The SSD DA will not prevent the future development of Barangaroo consistent with the approved Concept Plan MP 10_0162 (as modified) and is therefore considered to be consistent with the Concept Plan (as modified).

Environmental Impacts

The EPA Declaration states: *'Contaminated groundwater is likely to be migrating from the site to Darling Harbour and could ultimately affect aquatic ecosystems'*. These contaminants include human carcinogens and substances toxic to aquatic ecosystems and could ultimately be affecting aquatic ecosystems. The proposed remediation works will remediate the principal sources of contamination from Hickson Road. As such, the remediation works are expected to result in an improvement to water quality and aquatic ecosystems in the vicinity of the site.

The assessment of the remediation works, presented in this EIS and technical appendices, has demonstrated that with the application of robust management measures, the proposed works will not result in significant adverse environmental effects and the environmental impacts will remain within the acceptable limits set out in relevant guidelines and policies.

Lend Lease has demonstrated an ability to undertake significant remediation and materials handling activities on Barangaroo South with substantial plant and

equipment numbers within acceptable environmental limits. In particular, Lend Lease already has in place, and regularly updates, a comprehensive Construction Framework Environmental Management Plan (CFEMP) and associated sub-plans for Barangaroo South works and is carrying out those works subject to strict environmental controls, including a suite of monitoring programs.

Lend Lease will expand the area of application of the Barangaroo South CFEMP to incorporate the proposed Hickson Road remediation works and supplement the updated CFEMP with a set of works-specific mitigation and management measures as set out in **Section 9**.

Glossary of Acronyms / Abbreviations

AASS	Actual Acid Sulfate Soils
ACM	Asbestos Containing Materials
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ANZECC	Australia and New Zealand Environment Conservation Council
ARC	Asbestos Removal Contractor
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AQIA	Air Quality Impact Assessment
ARI	Annual Recurrence Interval
ASS	Acid Sulfate Soil
As	Arsenic
AS	Australian Standard
ASS	Acid Sulfate Soil (being AASS and/or PASS)
Ba	Barium
B(a)P	Benzo-a-pyrene
BCLG	Business Construction Liaison Group
BDA	Barangaroo Delivery Authority
Bgl	Below ground level
BTEX	Benzene, Toluene, Ethylene and Xylene
CCLG	Community Construction Liaison Group
Cd	Cadmium
CFEMP	Construction Framework Environmental Management Plan
CIM	Confirmed Impacted Material
CLM Act	<i>Contaminated Land Management Act 1997</i>
CO₂	Carbon Dioxide
Co	Cobalt

CoPC	Contaminant of Potential Concern
Cr	Chromium
CSM	Conceptual Site Models
Cu	Copper
DA	Development Application
dBA	Decibel (A-weighted)
DECCW	Department of Environment, Climate Change and Water
DNAPLs	Dense Non Aqueous Phase Liquids
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	<i>Environment Planning and Assessment Act 1979</i>
EP&A Regulation	<i>Environmental Planning and Assessment Regulation 2000</i>
EPA	Environment Protection Authority (NSW)
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPL	Environment Protection Licence
ERA	Ecological Risk Assessment
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
FHA	Final Hazard Analysis
GAC	Granulated Activated Carbon
GMP	Groundwater Monitoring Plan
GPS	Global Positioning System
Hg	Mercury
HHERA	Human Health and Ecological Risk Assessment
HIA	Health Impact Assessment
ISCO	In-situ Chemical Oxidation
LGA	Local Government Areas
LOS	Level of Service
OEH	Office of Environment and Heritage

Mn	Manganese
MWQC	Marine Water Quality Criteria
NAPLs	Non Aqueous Phase Liquids
Ni	Nickel
PAH	Poly Aromatic Hydrocarbons
PASS	Potential Acid Sulfate Soils
Pb	Lead
PHA	Preliminary Hazard Analysis
PM	Particulate Matter
POEO Act	<i>Protection of the Environment Operations Act 1997</i>
RAP	Remedial Action Plan
RBL	Rating Background Level (noise-related)
REF	Review of Environmental Factors
REP	Regional Environmental Plan
RMS	Roads and Maritime Services
RTA	Roads and Traffic Authority
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SREP	Sydney Regional Environmental Plan
SPGWT	Separate Phase Gasworks Waste and Tar (defined in the RAP)
SSD	State Significant Development
SSD DA	State Significant Development Application
SSESC	Site specific ecological screening criteria
SSTC	Site-Specific Treatment Criteria
SVE	Soil Vapour Extraction
SWMP	Soil and Water Management Plan
TCLP	Toxicity Characteristic Leaching Procedure
TIA	Traffic Impact Assessment

TPH	Total Petroleum Hydrocarbons
TPZ	Tree Protection Zone
TSP	Total Suspended Particulates
VMP	Voluntary Management Proposal
Vn	Vanadium
VOC	Volatile Organic Compound
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i>
WMP	Waste Management Plan
WTP	Wastewater Treatment Plant
Zn	Zinc

1.0 Introduction

This Development Application for State Significant Development (SSD DA) and Environmental Impact Statement (EIS) is submitted to the Minister for Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The SSD DA relates to the remediation of that part of the land at Millers Point that has been declared by the Environment Protection Authority (EPA) to be a Remediation Site (No. 21122) (the EPA Declaration) under the *Contaminated Land Management Act 1997* (CLM Act) that is located within Hickson Road. The land, to which the EPA Declaration relates (the EPA Declaration Area), coincides with the known footprint of the former Millers Point gasworks and is located within part of the Barangaroo site known as (as defined by the Barangaroo Concept Plan) part Blocks 4A–C, Block 5, part of the Southern Cove and part of Hickson Road.

The land proposed to be remediated under this SSD DA is part of Hickson Road, adjacent to

- Parts of Central Barangaroo and parts of Barangaroo South being part of Lot 100 DP 1204946 and part of Lot 200 DP 124948;
- 30 – 34 Hickson Road being Lot 11 DP1065410;
- 36 Hickson Road being Lot 5 DP873158 and Lot 12 DP1065410; and
- 38 Hickson Road being SP72797, Millers Point.

The site is described in detail in **Section 2** of this EIS, and is shown in **Figure 2**.

This report has been prepared by JBA Urban Planning Consultants Pty Ltd, for the proponent, Lend Lease (Millers Point) Pty Limited (Lend Lease) on behalf of the Barangaroo Delivery Authority, and is based on technical documents provided by an expert consultant team.

This EIS:

- Describes the site, the site's environs and the proposed development.
- Outlines the existing contamination associated with the EPA Declaration Area and within the site.
- Describes the investigations that have been carried out to determine the preferred remediation strategy, and describes the proposed remediation works associated with this strategy.
- Provides an assessment of the environmental impacts of the proposal in accordance with the Secretary's Environmental Assessment Requirements for the EIS (SEARs) issued under the EP&A Act on 18 August 2014 (which are provided in **Appendix A**).

The EIS should be read in conjunction with the information contained within and appended to this report. The studies appended to this EIS provide a technical assessment of the environmental impacts of the proposed development, and recommend proposed mitigation measures to manage potential environmental impacts associated with the proposal.

Remediation of that part of the EPA Declaration Area that is outside Hickson Road (referred to throughout this EIS as the 'Block 4' and 'Block 5' Remediation Areas)

is the subject of separate development applications (SSD 5897 and SSD 6533 respectively). Accordingly remediation works in these areas do not form part of this SSD DA. Once completed, the works proposed collectively under SSD 5897, SSD 6533 and this project (SSD 6617) are aimed at allowing the EPA to remove the EPA Declaration.

This EIS should be read in conjunction with the EIS for the Remediation of 'Block 4' (SSD 5897) (note: at the time of the application the 'Block 4' comprised part of Block 3, part of Blocks 4A-C and part of the Southern Cove – but the block arrangements were subsequently amended to remove Block 3) and the EIS for the Remediation of Block 5, Barangaroo Central (SSD 6533) as well as the Barangaroo Concept Plan Approval (MP06_0162 MOD 7) and the original State Significant Site Study prepared by JBA (dated February 2007) – which are all available for review on the Department of Planning and Environment's major project register: <http://majorprojects.planning.nsw.gov.au/page/>.

Following the remediation, the use of the site will be retained as a public road. This SSD DA will therefore not prevent the future development of Barangaroo consistent with the approved Concept Plan.

1.1 Planning Background

1.1.1 Planning History

An international urban design competition for the East Darling Harbour site (now known as Barangaroo) was held in 2005, attracting 139 entries from around the world. The winning design by Hill Thalys Architecture +Urban Projects, Paul Berkemeier Architects and Jane Irwin Landscape Architecture was announced in March 2006.

The Barangaroo Concept Plan (based on the winning Hill Thalys scheme) was approved in February 2007 (MP06_0162). The Concept Plan covers urban design and policy initiatives and is the statutory planning approval to guide the urban renewal of Barangaroo.

A number of development applications have subsequently been approved on the Barangaroo site and works have substantially commenced at Barangaroo South (see Section 1.1.4 below).

1.1.2 Approved Concept Plan

A Concept Plan for development at Barangaroo was approved under the former Part 3A of the EP&A Act. The Barangaroo Concept Plan was prepared by the Sydney Harbour Foreshore Authority and approved by the Minister for Planning on 9 February 2007. On 12 October 2007, the land was rezoned to facilitate its redevelopment.

Since the Concept Plan was originally approved on 9 February 2007, it has been modified six times and the Statement of Commitments has been revised accordingly. The most recent modification is Concept Plan Modification 7 (Mod 7) (Modification 5 was withdrawn) which was approved on 11 April 2014. Further modifications to the Concept Plan are currently being proposed (Mod 8), however these further modifications do not affect the need for this project or the findings of this EIS.

The envisaged development at the Barangaroo site includes a mixed use precinct that features tourist and retail uses, as well as commercial and residential floor space and new public domain.

The 22 hectare Barangaroo development site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Stage 2 (Central Barangaroo) and Barangaroo Stage 1 (Barangaroo South). Hickson Road forms the western edge of these development areas.

Lend Lease was successfully appointed as the preferred proponent to develop Barangaroo South on 20 December 2009.

The Concept Plan, as originally approved and modified, identified the requirement to carry out substantial remediation activities to remediate the land in accordance with the future land use set out in the Concept Plan. The Concept Plan was supported by an over-arching Barangaroo-wide Remedial Action Plan (Overarching RAP) which identified the nature of the contaminants and the need for remediation of the contamination at Barangaroo.

The Overarching RAP has been submitted with previous applications, is available on the Barangaroo website, and is attached as **Appendix J** (<http://www.barangaroo.com/media/14465/over%20arching%20rap%20final%20june%202010.pdf>).

In March 2015 an application to modify the Concept Plan was lodged with DP&E, this modification is known as Concept Plan (Mod 8). Concept Plan (Mod 8) does not alter the provisions of the Concept Plan relating to the area of land that is proposed to be remediated under this SSD DA.

In addition to developing Barangaroo South, Lend Lease has been contracted by the BDA to undertake remediation works to enable the EPA Declaration to be removed.

In summary, the remediation of the land as described in this SSD DA will enable the EPA Declaration to be removed insofar as it relates to Hickson Road (once remediation works are completed across the whole Declaration Area), and will not impact upon the future development of Barangaroo in accordance with the approved Concept Plan (as modified). This SSD DA is therefore considered to be consistent with the Concept Plan.

1.1.3 Barangaroo Delivery Authority

The Barangaroo Delivery Authority (BDA) was established under the *Barangaroo Delivery Authority Act 2009* to manage the redevelopment of Barangaroo and to deliver world class benchmarks in urban design, public domain and sustainability.

The BDA has contracted Lend Lease (Millers Point) Pty Ltd to undertake remediation associated with the removal of the EPA Declaration. This SSD DA relates to proposed remediation activities to be undertaken by Lend Lease on behalf of the BDA at the Hickson Road site.

The BDA is the Roads Authority and land owner and, in these capacities, has provided consent to the lodgement of this SSD DA on its behalf.

1.1.4 Project Approvals at Barangaroo

A number of project approvals and development consents have been obtained for works at Barangaroo, including:

- MP10_0023 for bulk excavation and the construction of an integrated building basement for Blocks 1-3.
- MP10_0025 for commercial building C4.
- MP10_0227 for commercial building C5.
- MP11_0044 for commercial building C3.
- MP11_0002 for residential buildings R8 and R9.
- MP10_0087 for pilot trial of in-situ chemical oxidation remediation.
- MP10_0047 and MP10_0048 for works associated with the Headland Park and Northern Cove.
- SSD 5967 for a temporary concrete batching plant at Barangaroo South.
- SSD 5374 for Central Barangaroo Waterfront Promenade and Interim Public Domain.
- SSD 5897 for remediation works at 'Block 4' (which at the time of submission of SSD 5897 comprised part of Block 3, Blocks 4A-C and part of the Southern Cove), Barangaroo South.
- SSD 6303 for the Stage 1A Public Domain at Barangaroo South

Other applications and approvals at Barangaroo include:

- Wynyard Walk: Following consideration of a Review of Environmental Factors (REF) the Wynyard Walk project was approved by Transport for NSW in July 2012 under Part 5 of the EP&A Act. Wynyard Walk will provide a world class, fully accessible pedestrian link between Wynyard Station and Barangaroo, and includes a pedestrian Bridge across Hickson Road / Sussex Street into the southern end of the Barangaroo site, known as Transport Place.
- City Walk Bridge: Following consideration of a REF, the City Walk Bridge project was approved by the Barangaroo Delivery Authority in October 2014 under Part 5 of the EP&A Act. The City Walk Bridge will provide an alternative pedestrian bridge over Hickson Road from Wynyard Walk at Napoleon Street.
- Hickson Road Levels: An REF for adjustments to the levels of Hickson Road and associated tree removal and landscaping to address stormwater and interface issues with the Barangaroo South site has been prepared and consultation is currently occurring with key stakeholders. This REF is yet to be determined.
- Cassion Wall: Following consideration of a REF, the structural reinforcement of the cassion wall within Barangaroo South was approved by the Barangaroo Delivery Authority in September 2014 under Part 5 of the EP&A Act.

Construction work has commenced at Barangaroo South and the Headland Park under these project approvals and development consents and the majority of Barangaroo is now a construction site.

SSD DAs within Barangaroo South have also been lodged, but are yet to be determined for:

- Retail Building R1 (SSD 6513).
- Retail Building R7 (SSD 6623).
- Commercial Building C2 and C6 (SSD 6425).

1.1.5 Secretary's Environmental Assessment Requirements

This EIS responds to the Secretary's Environmental Assessment Requirements (SEARs) issued by a nominee of the Secretary of the Department of Planning and Environment (DP&E) on 18 August 2014. The SEARs issued by the DP&E for SSD 6617 relate to the Remediation of part of Hickson Road at Millers Point within the NSW EPA Remediation Declaration Area (i.e. this development).

The DP&E consulted with relevant agencies in the preparation of the SEARs, and the SEARs incorporate inputs from the following agencies:

- Environment Protection Authority;
- Transport for NSW;
- Sydney Water; and
- City of Sydney Council.

A copy of the SEARs (including agency attachments) is provided in **Appendix A**.

1.2 Site Contamination

In May 2009 the EPA Declaration of Remediation Site (No.21122) was made under the CLM Act. The EPA Declaration Area coincides with the known footprint of the former Millers Point gasworks, and includes:

- Part Lot 200 DP 1204948 and Lot 101 DP 1204946 (formerly Lot 5 and Part Lot 3 in Deposited Plan (DP) 876514), Hickson Rd, Millers Point (being the 'Block 4' and Block 5 Remediation Areas).
- The part of Hickson Road adjacent to the following properties (being the Hickson Road Remediation Area):
 - 30 – 34 Hickson Road being Lot 11 DP1065410;
 - 36 Hickson Road being Lot 5 DP873158 and Lot 12 DP1065410; and
 - 38 Hickson Road being SP72797, Millers Point.

The EPA Declaration is in place because the EPA considered the EPA Declaration Area to be *'contaminated in such a way as to present a significant risk of harm to human health and the environment'* for the following reasons:

- The EPA Declaration Area is contaminated with gasworks waste and particularly waste tar as a result of the previous use of the site as a gasworks plant. The chemical composition of gasworks waste includes the following contaminants: polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, ethylene and xylene (BTEX); total petroleum hydrocarbon (TPHs); ammonia; phenol and cyanide.
- Groundwater within the EPA Declaration Area has been found to be contaminated by TPHs, PAHs, BTEX, ammonia, phenol and cyanide at concentrations significantly exceeding the relevant trigger values for the protection of human health and aquatic ecosystems in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000).
- These groundwater contaminants include human carcinogens and substances toxic to aquatic ecosystems.

- The contaminated groundwater is impacting on the surrounding areas including the basement of a residential building adjacent to the EPA Declaration Area and has the potential to expose humans in that building to harmful vapours; however it is currently being effectively controlled.
- Contaminated groundwater is likely to be migrating from the EPA Declaration Area to Darling Harbour and could ultimately affect aquatic ecosystems.

In July 2010 the EPA approved a Voluntary Management Proposal (VMP) submitted by the BDA that established a performance schedule for the carrying out of investigations, and the preparation and implementation of a Remedial Action Plan. A copy of this VMP is included as **Appendix B**. Correspondence from the EPA relating meeting the requirements of the VMP is provided at **Appendix C** and correspondence from the Barangaroo Delivery Authority summarising the proposed remediation strategy for the VMP area.

A Phase 2 VMP is likely to be required in order to carry out the works the subject of this SSD DA, and will be agreed between the BDA and the EPA, including target milestones, prior to the commencement of works.

At the completion of the works that are the subject of this SSD DA, an Interim Audit Advice will be obtained from a NSW EPA Accredited Site Auditor, to confirm successful completion of the Hickson Road works as per the RAP. At the completion of all remediation works to address the EPA Declaration, a Section B Site Audit Statement will be obtained from a NSW EPA Accredited Site Auditor, to confirm successful completion of works.

1.3 Summary of Approval Sought

This SSD DA seeks approval for carrying out remediation of contaminated land beneath Hickson Road, which is situated within the EPA Declaration Area (Site 21122), within Barangaroo. Remediation will be carried out in accordance with the RAP (AECOM 2013, **Appendix G**) prepared as part of the VMP.

Following remediation, Hickson Road will be retained as a public road. The SSD DA will not prevent the future development of Barangaroo consistent with the approved Concept Plan MP 10_0162 (as modified and proposed to be modified) and is therefore considered to be consistent with the Concept Plan.

The remediation strategy for the site is based on two possible technologies for remediation. These technology options are:

- On-site (in-situ) remediation; and
- Excavation for off-site (ex-situ) treatment and disposal.

The preferred remediation technology is to undertake in-situ remediation. A pilot trial of this method has been approved (MP10_0087) and the results of the future pilot trial will determine which remediation option is employed for Hickson Road. The description of the development is presented in **Section 5** of this EIS, and the RAP (at **Appendix G**). An assessment of the impacts of the in-situ and ex-situ remediation options is provided in **Section 7**.

The RAP (**Appendix G**) envisaged the staged remediation of the EPA Declaration Area (see Sections 1.8 and 19.2.1 of the RAP). Remediation of Hickson Road under this SSD DA does not remove obligations for remediating remaining parts of the EPA Declaration Area in separate stages, being the areas known as 'Block

4' and Block 5 Remediation Areas. The individual Remediation Areas associated with the EPA Declaration No, 21122 are shown in **Figure 2**.

The VMP agreed between the BDA and the EPA will ensure that all required Remediation Areas will be suitably remediated in due course in accordance with the CLM Act and EP&A Act. The RAP envisaged that remediation of the EPA Declaration Area may occur in stages (at Sections 1.8 and 19.2.1 of the RAP) and was prepared so as to facilitate the sequential remediation, validation and NSW EPA Accredited Site Auditor sign-off of the specified remediation areas.

1.4 Environmental Assessment and Approvals Process

1.4.1 SSD DA Approval Process

This report constitutes the EIS addressing the SEARs for the SSD 6617. The Minister for Planning (or delegate) will be responsible for determining the SSD DA. **Section 3.2.2** of this report describes the basis for the development being deemed to be State Significant Development under the EP&A Act and *State Environmental Planning Policy (State and Regional Development) 2011*.

In accordance with clause 3B(2)(d) of Schedule 6A of the EP&A Act the SSD DA must be generally consistent with the terms of the approval of the Concept Plan Approval MP06_0162 (as modified). The SSD DA is consistent with the terms of approval of the Concept Plan (as modified) as it will not prevent the development of Barangaroo consistent with the approved Concept Plan (as modified).

1.5 Project Team

An expert project team has been formed to deliver the project and includes:

Proponent	Lend Lease
Contamination Investigations, HHERA, Offsite Treatment Statement and RAP	AECOM
Site Auditor	Mr. Graeme Nyland (Environ)
Urban Planning	JBA
Soil and Water	Worley Parsons
Traffic and Transport	Arup
European Heritage	Casey and Lowe
Indigenous Heritage	Casey and Lowe
Air Quality	AECOM
Noise	Wilkinson Murray
Waste	AECOM
ESD and Climate Change	Worley Parsons

2.0 Site Analysis

2.1 Barangaroo Location and Context

Barangaroo is located on the north western edge of the Sydney Central Business District (CBD), bounded by Sydney Harbour to the west and north; the historic precinct of Millers Point for the northern half, The Rocks and the Sydney Harbour Bridge approach to the east; and by a range of new development dominated by large CBD commercial tenants, and the King Street Wharf/Cockle Bay precinct to the south.

The 22ha Barangaroo site is generally rectangular in shape and has a 1.4 kilometre harbour foreshore frontage, with an eastern street frontage to Hickson Road. The location of Barangaroo is shown at **Figure 1**. The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Central Barangaroo and Barangaroo South to the west of Hickson Road, and has been subject to multiple investigations that detail its physical and natural characteristics. This application related to land on Hickson Road adjacent to the Barangaroo South and Central development sites.

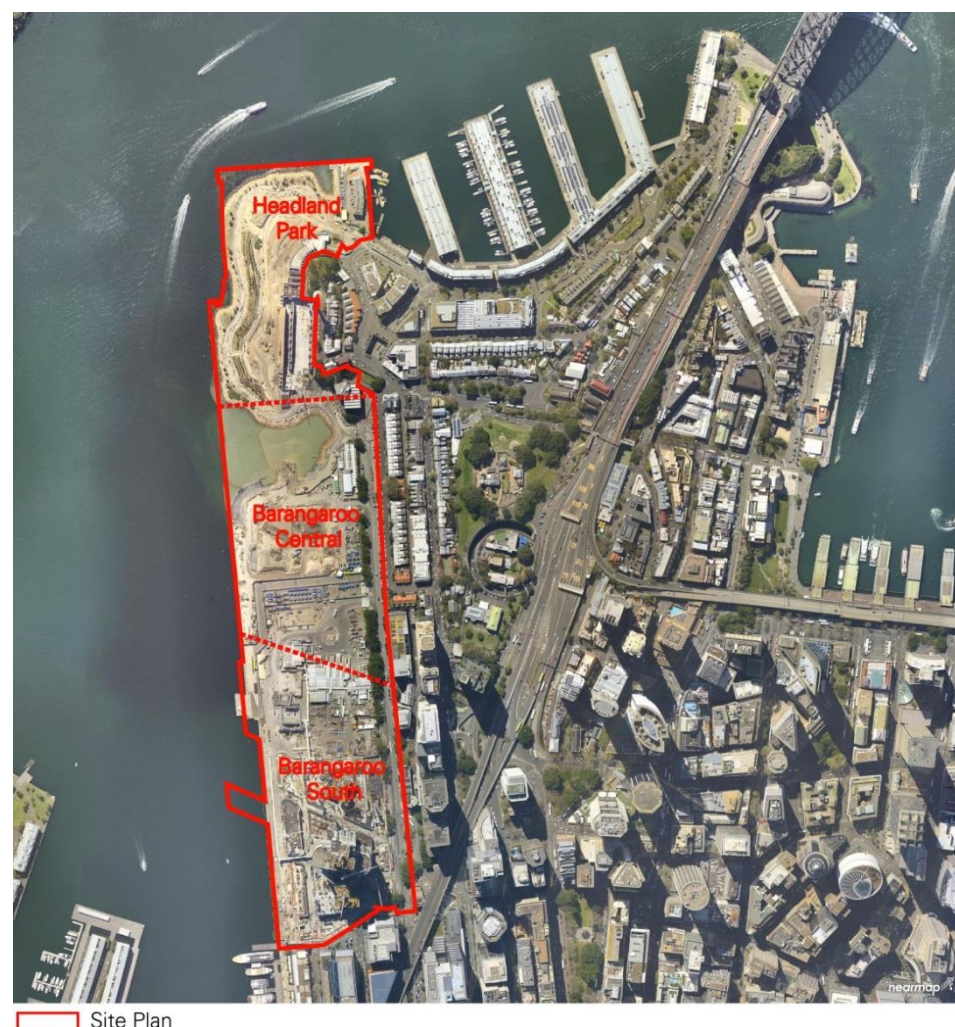


Figure 1 – Locality Plan – Barangaroo

2.2 SSD DA Site Description

As shown in **Figure 2**, the site for SSD DA (SSD 6617) relates to:

- An area of approximately 1,800m² within the EPA Declaration Area that is situated within Hickson Road, (being the carriageway and adjacent footpath), north of the intersection with Napoleon Street, generally located adjacent to 30 and 38 The Bond.
- Parts of Hickson Road that are to be used to support the remediation works, including for the establishment of site compounds, storage areas, temporary traffic management and local access (as necessary).
- Parts of Central Barangaroo comprising Block 5, Block 6 and land to the west of these blocks for the purpose of providing ancillary infrastructure and facilities, including the potential wastewater treatment plant.

Appendix E includes detailed drawings of the site. **Figure 2** shows the extent of the site for the proposed Hickson Road remediation works in the context of the EPA Declaration Area and the Barangaroo block boundaries.

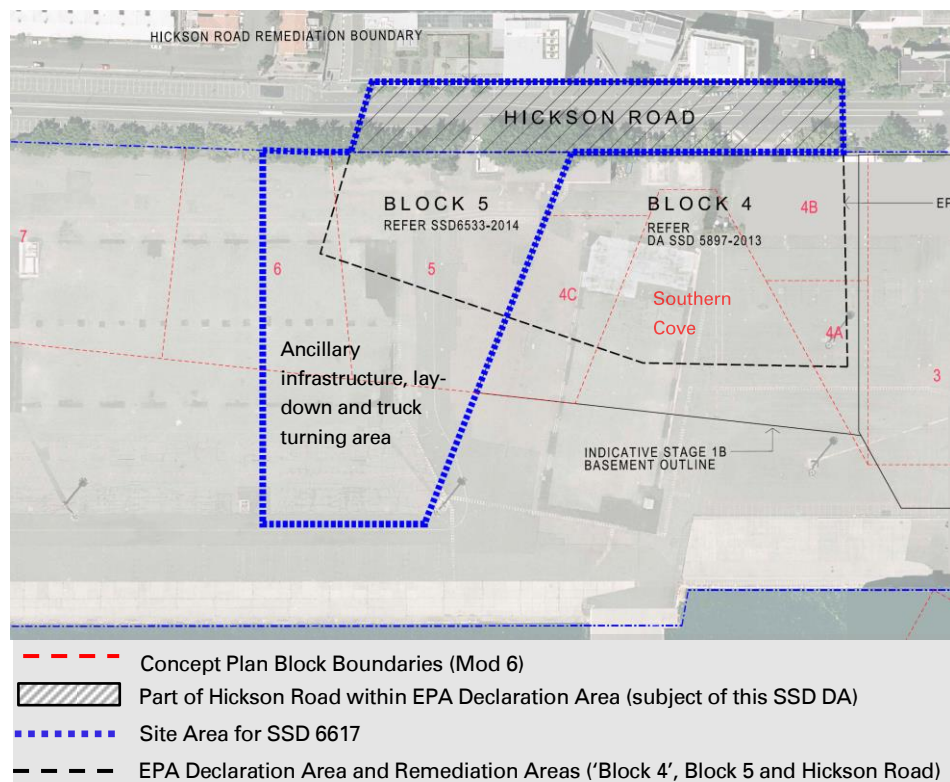


Figure 2 – Plan of Hickson Road Remediation Area, the EPA Declaration Area, and the Site

2.3 Land Ownership and Legal Description

A site survey plan is included as part of **Appendix E**.

The Barangaroo site is legally described as Lot 1 DP876514, Lot 100 DP838323, Lot 7 DP43776, Lot 4 DP876514, Lot 6 DP869022, Lot 7 in DP869022, Lot 2 DP 876514, Lot 101 DP1204946, Lot 200 DP1204948, Lot 205 DP1204948, Lot 201 DP 1204948 and part of Hickson Road. The Barangaroo Delivery Authority owns the

majority of the Barangaroo site, however small areas are owned by other Government agencies including the Marine Ministerial Holding Corporation, the Maritime Services Board of NSW (NSW Maritime) and the Crown. Site ownership is outlined in **Table 1**

Table 1 – Land Ownership

Legal Description	Land ownership
Lot 1 in DP 876514	Barangaroo Delivery Authority
Lot 2 in DP 876514	Sydney Ports Corporation
Lots 4 in DP 876514	Barangaroo Delivery Authority
Lots 7 in DP 43776 (Munn Street Reserve)	State of NSW
Lot 100 in DP 838323	Barangaroo Delivery Authority
Darling Harbour (Vol 5018 Fol 1) adjacent to the above listed lots	Maritime Authority of NSW
Lot 6 in DP869022	Maritime Authority of NSW
Lot 7 in DP869022	State of NSW
Lot 200 DP 1204948	Barangaroo Delivery Authority
Lot 101 DP 1204946	Barangaroo Delivery Authority

The SSD DA site comprises part of Hickson Road and part of Lot 100 Deposited Plan (DP) 1204946 and part of Lot 200 DP 124948 (being within Central Barangaroo). The BDA is the Roads Authority and owner of the land the subject of the SSD DA. The BDA has issued landowner's consent, as evidenced by the completed Application Form submitted under separate cover.

2.4 Historical Uses

The former AGL (now Jemena) gasworks historically occupied part of the Barangaroo site identified within the Barangaroo Concept Plan (as currently modified by Mod 7) as 'Block 4' and Block 5 and extended to the area now occupied by Hickson Road. The estimated footprint occupied by the former gasworks was approximately 5,420m², comprising the following infrastructure:

- Retort House;
- Meter House;
- Tar tank;
- Engine House;
- Gasholders; and
- Purifier Beds.

Previous investigations and remediation works (undertaken at The Bond site at 30 Hickson Road) have identified that existing gasworks infrastructure extend across Hickson Road, including part of the annulus of the former main gasholder, a smaller secondary gasholder and a tar tank.

The land located adjacent to the Hickson Road Remediation Area, within Block 5, was subsequently used as a container shipping port. The EPA Declaration as it applies to Block 5 is not addressed under this application and is addressed under SSD 6617.

2.5 Existing Development and Structures

2.5.1 Built Form

Hickson Road is a two lane road, which connects to Sussex Street to the south, and extends northwards towards Millers Point, passing under the southern landing of the Sydney Harbour Bridge before meeting George Street to the north.

Hickson Road is situated within the Barangaroo site as defined within the *State Environmental Planning Policy (Major Development) 2005*. The Barangaroo site is currently being developed or used for construction laydown and storage areas associated with construction works at Barangaroo South.

Hickson Road will be retained as a public road following the development of the Barangaroo precinct.

Block 5 and Block 6 are located within Central Barangaroo and are currently being used for construction laydown and storage areas associated with construction works at Barangaroo South.

2.5.2 Infrastructure and Services

Hickson Road is known to contain a large number of services and currently provides access to the adjacent residential and commercial buildings. **Appendix E** includes site survey plans which, identifies the location existing infrastructure of utilities and services.

Stormwater

The existing stormwater network is characterised by a series of transverse piped stormwater systems (typically between 300mm to 1200mm in diameter) draining Hickson Road and other external catchments through the Barangaroo site directly to the Harbour. This information is also provided in the site survey plans provided in **Appendix E**.

Potable Water

Existing potable water supplies to Barangaroo are supplied from a 300mm diameter Sydney Water main in Hickson Road.

Sewer

There is an existing sewer network traversing the site, including a 400mm diameter rising main and 450mm diameter gravity fed sewer line, which connect to an existing Sydney Water sewage pumping (Station SP1129) located at Central Barangaroo.

Electricity

There is a number of existing 5kV HV Energy Australia supplies to Barangaroo.

Telecommunications

A telephone exchange is located in Kent Street, and existing Telstra copper lines feed into the Barangaroo site at various locations along Hickson Road and Dalgety Road. There are mobile phone equipment shelters located near Hickson Road.

Natural Gas

There is an existing 110mm low pressure (7kiloPascals) nylon gas main along Hickson Road and a high pressure gas main located at the corner of Sussex and Napoleon Streets. There is no existing high pressure main connection serving the Barangaroo site, however, there are small low pressure connections.

2.6 Traffic and Transport

2.6.1 Vehicular and Pedestrian Access

Hickson Road connects into Sussex Street south of Napoleon Street and is the predominant north-south access road for the Barangaroo site. Local road access to Barangaroo is provided as follows:

- From the CBD via Napoleon Street;
- From Millers Point via Dalgety Road;
- Via George Street from the north east;
- Via Sussex Street/Kent Street/Napoleon Street from the southern CBD;
- Via Harbour Street, Wheat Road (through King Street Wharf) to Shelley Street from the south; and
- Via the east-west alignment of Napoleon Street and Margaret Street.

Pedestrian Access

Pedestrian access is available along all local roads, which are footpath lined, including Hickson Road. Pedestrian access is also available across the Barangaroo site and along the waterfront via fenced routes. Despite the high degree of pedestrian footpaths and thoroughfares, there are currently generally low levels of pedestrian activity adjacent to the site. However, during the proposed remediation works pedestrian numbers may increase above current levels due to the occupation of parts of Barangaroo South.

Bicycles

A bicycle lane exists along Hickson Road between Circular Quay and Napoleon Street which is utilised by both commuter and recreational cyclists. Cycling connections to the site have been improved through the construction of separated cycleways along King Street and Kent Street. The impact of this application on the existing cycle routes is assessed in **Section 7.10**.

2.7 Physical Characteristics

2.7.1 Topography

The ground surface of the entire site is at an elevation of approximately 2m (AHD). The site is generally covered in hardstand (concrete and bitumen). The surrounding landform to the east of Hickson Road rises rapidly, with a 10m high sandstone cliff.

2.7.2 Geology and Geomorphology

Information from previous investigations indicates that the former 1880s shoreline ran approximately along the western edge of Hickson Road. The area to the west of Hickson Road is understood to have been progressively reclaimed from the 1950s to the 1980s. Contamination has been identified in fill and natural soils and at the bedrock interface in this area.

Information suggests that Hickson Road is typically founded on Hawkesbury Sandstone bedrock where the road passes through the EPA Declaration Area. An igneous dyke (a Pittman LIV Dyke) is also known to pass through the southern extent of Hickson Road in a general east west direction.

A typical section of the ground conditions through Hick Road is shown in **Figure 3**.

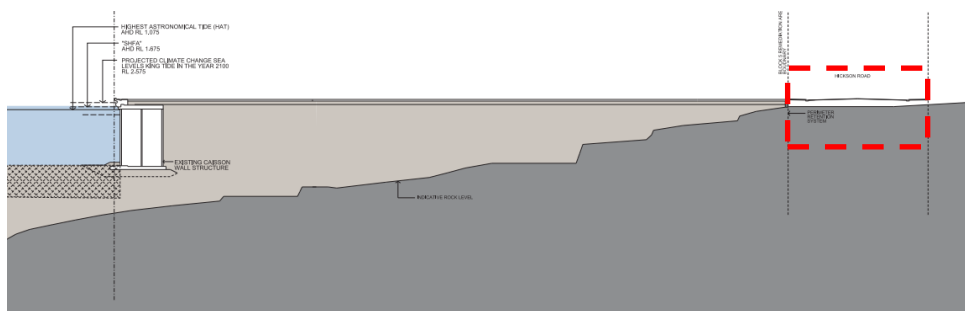


Figure 3 – Remediation Area typical section plan (Remediation Area marked in red)

2.7.3 Groundwater and Hydrology

Groundwater is present beneath the site. As set out in the RAP (**Appendix G**) groundwater was encountered at depths ranging from 1.38 to 2.92 m bgl and was subject to tidal fluctuation.

A search of the NSW Department of Natural Resources groundwater bore data base reported 32 registered groundwater bores within a 4 km radius of Barangaroo. Groundwater bore information indicated that the bores were registered for either recreation, irrigation or monitoring purposes.

2.7.4 Contamination in the EPA Declaration Area

A number of historical studies and environmental investigations have been undertaken to assess the extent and nature of contaminants within the Barangaroo site as a whole, as well as within the Hickson Road site area specifically.

Concentrations of lead, total petroleum hydrocarbons (TPHs), benzene, xylenes and polycyclic aromatic hydrocarbons (PAHs) in the soil variably exceed criteria levels. The contamination is largely associated with the operation of the former gasworks.

In May 2009, the EPA Declaration was made, relating to land within Hickson Road, land within part of Barangaroo South (referred to as the Block 4 Remediation Area) and land within part of Central Barangaroo (referred to as the Block 5 Remediation Area), as shown in **Figure 2**. This SSD DA relates to the section of Hickson Road that is part of the EPA Declaration Area. The remediation of the Block 4 and Block 5 Remediation Areas have been covered by separate development applications and do not form part of this SSD DA.

ERM has prepared an Overarching RAP for the Barangaroo site for the BDA (**Appendix J**). The Overarching RAP presents a summary of the contamination issues identified on the Barangaroo site and outlines an approach to the remediation of the Barangaroo site as a whole. A Site Auditor's Statement has been received in relation to the Overarching RAP (**Appendix K**).

The Overarching RAP requires that a site specific Remedial Action Plan (RAP) be developed for the EPA Declaration Area. **Appendix G** provides the site-specific RAP prepared for the EPA Declaration Area by AECOM. The RAP also addresses remediation at 'Block 4' and Block 5.

The extent of contamination as a result of the former gas works (i.e. the EPA Declaration Area) is detailed in the RAP (provided in **Appendix G**) and can be summarised as follows:

- Contaminants of potential concern, including lead, TPH, (C6-C9 and C10-C36), BTEX compounds, PAHs (including benzo(a)pyrene [B(a)P]) and sulphate, have been generally identified in proximity to and down gradient of the former gasworks infrastructure in concentrations exceeding the adopted site investigation criteria.
- Separate Phase Gasworks Waste and Tar (SPGWT) was identified at eighteen locations within the EPA Declaration Area confirming the former gasworks as a source of contamination. SPGWT is defined in the RAP (**Appendix G**), and includes tar containing materials with greater than 10% visible coal tar and/or high concentrations of PAHs or B(a)P, as well as Dense Non Aqueous Phase Liquids (DNAPLs).
- Elevated concentrations of contaminants of potential concern were also reported outside the EPA Declaration Area, particularly to the west and south. SPGWT has also been identified at seven locations to the west of the EPA Declaration Area in areas down hydraulic gradient of the former gasworks area.
- Toxicity Characteristic Leaching Procedure (TCLP) analysis conducted on soil samples collected within the EPA Declaration Area indicate concentrations of metals including As, Ba, Cd, Cr, Co, Cu, Hg, Pb, Mn, Ni, Vn and Zn and PAHs including acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene and pyrene were reported to be leaching at concentrations above laboratory limits of detection.
- The most significant groundwater contamination was identified in the immediate vicinity of the former gasworks infrastructure and contamination, including BTEX, naphthalene, PAHs, metals and ammonia, was present in both dissolved phase and SPGWT. Concentrations of contaminants in excess of the assessment criteria were also identified in wells down-gradient of the gasworks footprint, indicating the westerly migration of contamination. The results of the investigations indicate that the variable nature and distribution of fill materials at the EPA Declaration Area has caused localised variations in groundwater flow and associated contaminant migration, which is further complicated by tidal influences.
- SPGWT has been identified as likely at eight locations within Hickson Road and 'Block 4' (which is not part of the site) in the vicinity of the tar tank, purifying beds and 1870 gasholder indicating these locations are the main source areas of contamination. Consistent with historical reports SPGWT was also identified within the Barangaroo site at other locations, beyond the historic gasworks infrastructure.
- SPGWT was observed within wells installed at varied depths throughout the profile, indicating dense non aqueous phase liquid (DNAPL) is present at the site within the fill materials and natural sediments.

Full details of the soil and groundwater contamination and exceedance levels within the EPA Declaration Area are documented in the RAP included at **Appendix G**.

2.7.5 Vegetation

Hickson Road is largely devoid of existing vegetation except for existing street trees present along both sides of the road. The street trees are predominantly *Ficus micocarpa* var. *Hillii* (Hills Fig), with a small number of *Ficus Macrophylla* (Moreton Bay Fig) and *Washingtonia filifera* (Fan Palm). It is noted that other applications and approvals for works that adjoin the development include the removal of a number of these trees.

An Arboricultural Impact Assessment report prepared by Tree Wise Men (**Appendix V**) provides a detailed species list of existing vegetation within the Remediation Area.

2.7.6 Heritage and Archaeology

Non Indigenous Heritage and Archaeology

Neither the site, nor any building/structure/element within it, is listed as a local or State heritage item.

A Non-Indigenous Archaeological Assessment undertaken by Casey and Lowe for the overall EPA Declaration Area is provided at **Appendix U**, which identifies the following historical items:

- Some remains of pre-gasworks relating to later phases of timber ship building dating to the 1840s and 1870s.
- Evidence of the original landform although this is likely to be highly modified in the northern area due to the presence of rocky cliffs along the original foreshore which were cut down during the construction of Hickson Road.
- Remains of the eastern part of the gasworks of all phases where it was not removed by the 1920s remodelling of the foreshore for wharves.

It is noted that these items are not within the Hickson Road Remediation Area.

Indigenous Heritage and Archaeology

A search of the Office of Environment and Heritage's (OEH's) Aboriginal Heritage Information Management System (AHIMS) indicates that no known Aboriginal sites have been previously recorded within or in the vicinity of the site or the broader Barangaroo site.

Casey and Lowe have nonetheless undertaken an Aboriginal Archaeological and Cultural Heritage Assessment, which is provided at **Appendix T**.

2.8 Surrounding Development

The redevelopment of the Barangaroo site adjacent to the area proposed to be remediated will be subject to future development applications. A description of the existing development and future proposed development envisaged under the approved Concept Plan (as modified) is outlined below.

2.8.1 To the North

The northern portion of Hickson Road, Central Barangaroo including but not limited to Block 5, Block 6 and Block 7, and the site of the new Headland Park further beyond. Works currently progressing in this area include the development of the Headland Park. Works to Central Barangaroo have not yet commenced and will be subject to future development applications. However,

Central Barangaroo is currently being used as a construction staging area for the construction works within Barangaroo South.

2.8.2 To the East

To the immediate east of the site is development fronting Hickson Road comprising commercial and high density residential buildings with Jenkins Street beyond.

2.8.3 To the South

South of the site is the southern portion of Hickson Road followed by Sussex Street (public roads). Other development located south of the application site includes the Sussex Hotel, Westpac buildings and other commercial development along Sussex Street, as well as development associated with King Street Wharf and Barangaroo South.

2.8.4 To the West

Blocks 1-3 of Barangaroo are currently a construction site the subject of Project Approvals for a range of commercial buildings, and an integrated basement, as well as for residential buildings and public domain works, all in accordance with the approved Concept Plan (as modified).

Remediation works to 'Block 4' were approved as part of SSD DA 5897-2013 (being remediation works to remove the EPA Declaration as it relates to 'Block 4' as well as remediation works to make the site suitable for proposed future uses at 'Block 4'). The proposed development the subject of SSD DA 5897-2013 also includes the construction of a groundwater retention wall system and bulk earthworks associated with the future development of Stage 1B at Barangaroo South.

Block 5 is currently the subject of SSD DA 6533-2014 for the carrying of remediation works (being remediation works to remove the EPA Declaration as it relates to Block 5). Further to the west is land zoned for recreational uses followed by Darling Harbour.

3.0 Legislative Framework

3.1 Legislation

3.1.1 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) deals with sites where contamination is identified that is significant enough to warrant regulation by the EPA.

The general objective of the CLM Act, as set out in Section 3(1) of that Act, is to establish a process for investigating and, where appropriate, remediating land that the EPA has reason to believe is contaminated, where that contamination is considered significant enough to warrant regulation under the CLM Act.

The particular objectives of the CLM Act, as set out in Section 3(2) of that Act, are to:

- Set out accountabilities for managing contamination if the EPA considers the contamination is significant enough to require regulation.
- Set out the role of the EPA in the assessment of contamination and the supervision of the investigation, remediation and management of contaminated sites.
- Provide for the accreditation of site auditors of contaminated land to ensure appropriate standards of auditing in the management of contaminated land.
- Ensure that contaminated land is managed with regard to the principles of ecologically sustainable development.

This SSD DA relates to land that is subject of a declaration made by the EPA under Division 2 of the CLM Act in May 2009, being Declaration Number 21122 (the EPA Declaration) and Area Number 3221 (the EPA Declaration Area), as well as other land (discussed in Section 2.2).

The EPA Declaration Area coincides with the known footprint of the former Millers Point gasworks, and is located on land known as (as defined within the Barangaroo Concept plan) part 'Block 4' (comprising part Block 4A–C and part of the Southern Cove), Block 5, and part of Hickson Road.

The reason for the EPA Declaration is because the EPA considered that the EPA Declaration Area is *'contaminated in such a way as to present a significant risk of harm to human health and the environment'* In the EPA Declaration, the EPA state that *"The EPA believes that the site is contaminated with gasworks waste and particularly waste tar as a results of the previous use of the site as a gasworks plant."*

The BDA entered into a Voluntary Management Proposal (VMP) with the NSW EPA to address the EPA Declaration in July 2010 in accordance with Section 17 of the CLM Act (Approval No. 20101719). The VMP is attached at **Appendix B**.

This SSD DA relates to the carrying out of remediation works which are described within the VMP as it pertains to the Hickson Road part of the Declaration Area.

3.1.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides, amongst other things, the legislative framework for the assessment and approval of development.

In accordance with Division 4.1 of Part 4 of the EP&A Act, this EIS has been prepared in to address:

- The SEARs issued under Schedule 2 of the *Environmental Planning and Assessment Regulations 2000* (EP&A Regulations) for SSD 6617.
- The general provisions of Schedule 2 of the EP&A Regulations.

The Department of Planning and Environment will assess the SSD DA in accordance with Section 89H and 79C of the EP&A Act. Pursuant to Sections 89D and 89E of the EP&A Act the Minister for Planning is the consent authority and will determine the SSD DA.

3.1.3 Protection of Environmental Operations Act 1997

The *Protection of the Environment Operations Act 1997* (PoEO Act) provides for the prevention of pollution, including the licencing of activities with a higher potential for causing pollution by the EPA.

Section 48 of the PoEO Act requires a person to obtain an environmental protection licence (EPL) from the EPA before carrying out any of the premises-based activities described in Schedule 1 of that Act. The relevant provisions of Schedule 1 are Clauses 15 and 15A which relate to contaminated soil treatment works and contaminated groundwater treatment respectively. These are addressed below.

Clause 15 of Schedule 1 includes the following activity:

Contaminated soil treatment works, on-site or off-site (including, in either case, incineration or storage of contaminated soil but excluding excavation for treatment at another site) that:

- has the capacity to treat more than 1,000 cubic metres per year of contaminated soil received from off site; or
- where it treats contaminated soil originating exclusively on site, it has a capacity
 - to incinerate more than 1,000 cubic metres per year of contaminated soil, or
 - to treat (otherwise than by incineration) and store more than 30,000 cubic metres of contaminated soil, or
 - to disturb more than an aggregate area of 3 hectares of contaminated soil.

Should the preferred option of in-situ remediation be undertaken, the remediation works for the site will involve the treatment of up to a maximum of 16,000m³ of contaminated soil originating on site. This is below the 30,000m³ threshold and therefore would not trigger the requirement for an EPL. Despite this, following consultation with the EPA, Lend Lease may elect to vary the existing EPL for Barangaroo South (EPL 13336) to include the proposed remediation.

Should the method of ex-situ remediation be carried out, the works would involve the excavation of contaminated soil and its transport to a site that will hold the appropriate licence from the EPA for treatment and disposal. This method is excluded from Clause 15 of Schedule 1 and therefore would not trigger the requirement for an EPL.

Clause 15A of Schedule 1 includes the treatment of contaminated water if it has the capacity to treat more than 100 megalitres per year of contaminated water. Both remediation methods the subject of this EIS (i.e. preferred and alternate) will involve the treatment of contaminated water on-site. However it is unlikely that the volume of water to be treated will exceed the 100 megalitre per year threshold. Therefore it is unlikely that the proposed treatment of contaminated water on-site would trigger the requirement for an EPL. Despite this, following consultation with the EPA, Lend Lease may elect to vary the existing EPL for Barangaroo South (EPL 13336) to include the proposed remediation.

3.2 Statutory Planning

3.2.1 State Environmental Planning Policy (Major Development) 2005

Part 12 of Schedule 3 of *State Environmental Planning Policy (Major Development) 2005* (Major Development SEPP) provides land use zoning and development controls which apply to Barangaroo. The Barangaroo site is zoned a combination of Zone B4 Mixed Use and Zone RE1 Public Recreation.

The Hickson Road Remediation Area is zoned B4 Mixed Use.

Clause 8 of Division 12 of Schedule 3 of the Major Development SEPP describes the permissibility of land uses within Zone B4. Clause 8, (2) provides that development for any purpose may be carried out with consent on land within Zone B4 Mixed Use unless prohibited by subclause (3) or provided for elsewhere in the Major Development SEPP. Remediation of contaminated land is not listed as prohibited within Zone B4 under clause 8(3) or elsewhere in the Major Development SEPP. Therefore, in accordance with clause 8(2) remediation is permissible with development consent.

3.2.2 State Environmental Planning Policy (State and Regional Development) 2011

The *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP S&RD) identifies development that is State Significant Development (SSD).

Clause 8(1) of the S&RD SEPP provides that development listed in Schedule 2 that is not permissible without development consent under Part 4 of the EP&A Act is declared to be SSD.

Clause 3 of Schedule 2 of the SEPP S&RD specifies development that has a capital investment value of more than \$10 million within the Barangaroo Site for the purposes of Clause 8. As the proposed remediation works have a capital investment value in excess of \$10 million, they are SSD.

3.2.3 State Environmental Planning Policy No. 55 Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP 55) sets out a State-wide planning approach to remediation of contaminated land which includes ensuring that remediation work is permissible throughout the State.

In particular, clause 7 of SEPP 55 requires the consent authority to consider whether the land is contaminated, and if so, then to consider whether the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out.

Clause 9(d) of SEPP 55 provides that 'Category 1' remediation works include development for which another State environmental planning policy or a regional environmental plan requires development consent. The proposed development is Category 1 remediation work because the Major Development SEPP requires development consent for the proposed remediation works.

Clause 8(2) of SEPP 55 reiterates that Category 1 remediation works require consent from the consent authority.

Further, Clause 12 of SEPP 55 provides that the consent authority must not refuse consent for Category 1 remediation work unless:

- There would be a more significant risk of harm to human health or the environment from the carrying out of the remediation work than there would be from the lawful use of the land in the absence of the work; and/or
- The concurrence of a person specified under by operation of an environmental planning instrument or Section 79B (3) of the Act is required and has not been granted.

As already described, the EPA considered the land to be '*contaminated in such a way as to present a significant risk of harm to human health and the environment*', in so making the EPA Declaration.

The proposed remediation works would not result in a significant risk of harm for the following reasons:

- Comply with the relevant guidelines in terms of short term impacts associated with the emission of pollutants to air and water during the works period.
- Address the significant risk of harm to human health and the environment identified by the EPA Declaration through the removal of contaminant mass.
- Contribute to a long term improvement of ground water quality which is leaving the Site and provide for an improvement to the environmental conditions in the vicinity of the site.
- Result in a net public interest benefit in the long term through the removal of the historical legacy of contamination at the Site.

Not carrying out remediation on the development site would allow the contamination to remain in place and therefore allow the significant risk of harm to human health and the environment (as declared by the EPA) to continue in perpetuity.

As such, as described within this EIS, the effects and impacts of carrying out the proposed remediation can be appropriately managed and are therefore less significant than the potential impact of leaving the existing contamination in place. Consideration of Clause 12 of SEPP 55 should therefore inform the determination of this SSD DA.

A RAP (**Appendix G**) has been prepared based on a comprehensive Human Health and Ecological Risk Assessment (**Appendix L**) which has determined acceptable site specific treatment criteria. The objective of the proposed remediation works is to enable the EPA Declaration to be removed insofar as it relates to Hickson Road.

An EPA accredited Site Auditor has reviewed the RAP and determined that if the remediation is carried out in accordance with the RAP, as is proposed, then the EPA Declaration Area (which includes the part of Hickson Road that is subject of this SSD DA) can be remediated to a standard that will allow removal of the EPA Declaration.

3.2.4 State Environmental Planning Policy Number 33 Hazardous and Offensive Development

State Environmental Planning Policy Number 33 – Hazardous and Offensive Development (SEPP 33) applies to certain development that are classified as 'hazardous' or 'offensive' or 'potentially hazardous' or 'potentially offensive' to surrounding receptors. Developments that are 'potentially hazardous' must complete a Preliminary Hazard Analysis (PHA).

A PHA for in-situ remediation was completed by AECOM and is included as **Appendix BB**. The PHA found that the proposed remediation (in-situ) can be carried out in such a way that it would not be classified as a hazardous development.

3.2.5 Sydney Regional Environmental Plan (Sydney Harbour Catchment 2005)

Sydney Regional Environmental Plan (Sydney Harbour Catchment 2005) (Sydney Harbour REP) sets out planning principles and controls on development within the Sydney Harbour Catchment.

The proposed remediation works are consistent with the planning principles set out in clause 13 of the Sydney Harbour REP as follows:

- The remediation works have been designed to improve the quality of groundwater egressing from the site, and so contributing positively to the objective of improving the hydrology and ecology on which the health of the catchment depends.
- The remediation works constitute action to achieve the targets set out in *Water Quality and River Flow Interim Environmental Objectives: Guidelines for Water Management: Sydney Harbour and Parramatta River Catchment* (published in October 1999 by the EPA), with such action to be consistent with the guidelines set out in *Australian Water Quality Guidelines for Fresh and Marine Waters* (published in November 2000 by ANZECC).

3.3 Strategic Planning

The SEARs require demonstration that the project is consistent with the following strategic planning documents:

- NSW 2021 – A Plan to Make NSW Number One,
- Draft Metropolitan Plan for Sydney [to] 2031
- Draft Sydney Subregional Strategy, NSW;
- Barangaroo Integrated Transport Plan; and
- Sydney City Centre Access Strategy.

These strategic plans and strategies do not refer specifically to development for the purposes of remediation. The proposed remediation works the subject of this SSD DA are required to address the EPA Declaration and will result in an improvement to the environmental conditions surrounding the site.

It is noted that the planned construction works associated with the construction of the light rail on George Street may have an impact on Hickson Road. At the time of writing insufficient information is available to assess this impact.

The proposed remediation works the subject of this SSD DA do not provide for any change in use at Hickson Road.

This SSD DA is therefore consistent with these documents.

3.4 Barangaroo Concept Plan

Section 1.1.2 provides a description of the Barangaroo Concept Pan (as modified) and demonstrates that the proposed Hickson Road remediation works are consistent with it.

4.0 Consultation

Over the past two years, Lend Lease, in conjunction with the BDA, has embarked on a program of community engagement on the remediation activities associated with Barangaroo South and the EPA Declaration Area. This has been aimed at educating the community and key stakeholders about the historic nature of the contamination at the site and the importance of remediation works, the type of works proposed and to provide a forum for community feedback.

A number of consultation avenues have been utilised during this engagement program including:

- presentations to interested stakeholders;
- face to face meetings with key community groups and stakeholders to provide one-on-one briefings about the remediation;
- holding large scale community information sessions jointly between Lend Lease and the Authority;
- issue of Fact Sheets on remediation to relevant stakeholders and included on the Authority website - www.barangaroo.com ; and
- newsletter updates and letterbox notifications.

These communications tools have provided an opportunity to present factual information about the nature of the contamination and remediation works and ensured the community could raise any issues of concern.

Lend Lease's community engagement program for the project has also included establishing a Business Construction Liaison Group (BCLG) and a Community Construction Liaison Group (CCLG), in conjunction with the BDA. The purpose of these groups is to brief key representatives from both the local commercial and residential communities on key aspects of the project, relating to construction, as early as possible in the planning process. To date, both of these forums have received extensive briefings on the proposed remediation activities at Barangaroo and remain keenly interested in further progress updates in the future. Representatives of these groups then assist in actively disseminating information back to their respective networks on the status of the project. It is intended that further presentations will be given to these two groups as the plans for remediation activities progress.

All consultation has been carried out in line with the principals and methodologies outlined in the Lend Lease Community & Stakeholder Engagement Strategy (May 2012). Prior to undertaking full scale remediation works, Lend Lease will develop a Remediation Community Engagement Sub Plan, which will summarise ongoing engagement to be undertaken with the community. Engagement will continue, both prior to and during remediation activities, to ensure the community are fully informed of the remediation activities at the site, and have an opportunity to provide feedback and raise any queries or concerns they may have. The BDA will also continue to liaise with Jemena in relation to the remediation.

Communication strategies proposed by Lend Lease for engagement with the community in relation to Barangaroo South projects include:

- 1300 Community Enquiry Line: A key channel for the community to raise issues, ask questions and speak directly to a member of the Community Relations team. A 24 hour after hours service has also been established to

ensure any issues occurring outside of business hours are addressed in a timely manner.

- **Barangaroo South Website:** www.barangaroosouth.com.au – this is the central portal for all information about the project. It is the one stop-shop for everything the community and stakeholders will need to know about the remediation works including electronic copies of all newsletters, notifications and press releases. The website also contains a simple 'contact us' section which can be used by the community to engage with a member of the project team.
- **Newsletters:** To provide ongoing updates about the planning process and progress of works on site. This will be a key means of ensuring information transparently flows to the community and stakeholders about the remediation work.
- **Stakeholder one-on-one briefings:** Where applicable, to ensure that stakeholders in close proximity to the work are consulted with and informed about the project.
- **Notifications:** To ensure all residents and businesses potentially impacted by site works are informed in advance of key work commencing. Notifications will be used to inform the community of key issues such as the timing of noisy work, out of hours construction and traffic impacts.
- **Door knocking:** To personally discuss concerns raised by the local business community face-to-face on a one-on-one basis, proactively address any issues and provide assurances about the work.
- **Signage:** To inform the community about who is responsible for the site activities and the contact details for further information about the work.
- **Commercial Property Notice Boards:** When appropriate, general information about the overall project will be included on the notice boards in commercial properties. This will also contain the contact details of the Lend Lease Barangaroo South Community Relations team should they require any further information about the work.
- **Hoardings:** Hoardings may be used as a strategic communication tool to ensure the community and public are up to date with information regarding the construction). The relevant contact numbers (including the 24 hour Community Enquiry Line) will be displayed on the hoarding at all times.

Table 2 summarises specific consultation activities that have occurred to date regarding the proposed remediation works under SSD 6617-2014.

Table 2 – Summary of Consultation

Stakeholder	Date	Summary of Consultation
Authority		
EPA	29/2/12 2/7/12 13/11/12 13/2/13 21/8/13 5/9/13 10/12/13 27/2/14 27/5/14 16/12/14	Regular meetings and Technical Working Groups have been held between Lend Lease, BDA and EPA to discuss proposed remediation works, including Hickson Rd.
City of Sydney Council	25/6/14	Lend Lease and the BDA met with City of Sydney Council and provided a presentation on the proposed remediation works.
Transport for NSW Roads and Maritime Services	19/11/14	Lend Lease and the BDA met with Transport for NSW and Roads and Maritime Services (RMS) and provided a presentation with discussion on the proposed Hickson Rd Remediation Works.
Ausgrid	24/11/14	Lend Lease consulted with Ausgrid providing information and overview of proposed works
Sydney Water	19/5/14	Lend Lease and the BDA have met with Sydney Water and provided a presentation with discussion on the proposed works for Hickson Rd.
Community		
Construction Community Liaison Group	Various 2013/2014	Discussion with the CCLG on proposed remediation works generally for the Declaration Area (including Hickson Rd works), at a regular monthly meeting.
Business Community Liaison Group	12/6/14	Presentation and discussion to the BCLG on proposed remediation works, at regular monthly meetings.

The following provides a summary of some of the key issues raised during consultation to-date, and how they have been addressed in the proposed works:

1. During initial assessment, consideration was originally given to submitting a single development application that sought development consent for the remediation of all areas of EPA Declaration Area (i.e. 'Block 4', Block 5 and Hickson Rd). However, following consultation with NSW EPA, Lend Lease decided to prepare separate DAs for each area.
2. For the preferred, in-situ method, the EPA advised the need to demonstrate an overall reduction in contaminant mass following remediation. This requirement has been reflected in the Remedial Action Plan, which includes a remediation objective for reducing contaminant mass.
3. The EPA also advised that odour control would be a key issue during remediation, both on-site and during off-site transport. This is particularly relevant to the alternative, ex-situ method. Therefore this EIS describes intended measures for odour control for the alternate ex-situ method which includes odour enclosures over excavation areas (with emission controls), and appropriate sealing of loads during off-site transport. Further details in relation to odour control will be addressed in consultation with the EPA during the preparation of the Air Quality Management sub plan for the development, and amendment of the existing Environment Protection License 13336.

4. City of Sydney Council noted that ongoing community liaison is key throughout the works, which Lend Lease agreed. City of Sydney Council asked how community feedback/complaints would be managed, and requested that they be kept update of issues and liaison (as they may often be a first point of contact for the community). Lend Lease confirmed the community engagement process and Community Enquiry line. Lend Lease committed to ongoing liaison with Council during remediation works, including providing fact sheets to Council to assist them with community liaison.

Consultation has also been undertaken by the Barangaroo Delivery Authority with Jemena Ltd who was identified as an appropriate person by the EPA under Section 13 of the CLM Act when the EPA Declaration was issued. Jemena Ltd was consulted during the preparation of the existing VMP and will be consulted in relation to any future VMPs.

5.0 Description of the Development

5.1 Introduction

This SSD DA seeks approval for the carrying out of remediation works within the road and road reserve of Hickson Road in accordance with the RAP prepared as part of the VMP approved by the EPA. The remediation objective for the RAP is to enable the EPA Declaration to be removed, insofar as it relates to Hickson Road.

While the RAP (**Appendix G**) relates to the whole EPA Declaration Area, this SSD DA seeks consent for remediation to address the EPA Declaration on part of Hickson Road only. The RAP envisaged the staged remediation of the EPA Declaration Area. Remediation of Hickson Road under this SSD DA does not remove obligations for remediating remaining parts of the EPA Declaration Area in separate stages, being 'Block 4' (SSD 5897) and Block 5 (SSD 6533).

Once remediation works associated with each of these three approvals has concluded, a Site Audit Statement will be prepared that should allow the EPA to remove the EPA Declaration.

5.2 Summary of Remedial Strategy

Two alternative technologies / methods of remediation are proposed to address the contamination within the Hickson Road Remediation Area to enable the EPA Declaration to be removed. These are:

- In-situ remediation; and
- Ex-situ remediation – excavation and disposal.

The preferred remediation option is to undertake in-situ remediation. A pilot trial of this method has been approved (MP10_0087) to determine if it would be suitable for remediation in relevant parts of the EPA Declaration Area. If the pilot trial finds in-situ remediation to be suitable, the preferred remediation method (in-situ remediation) will be used to remediate the Hickson Road portion of the EPA Declaration Area. If the pilot trial does not find in-situ remediation to be suitable, the proposed ex-situ remediation method will be used.

Both remediation options are explained further below and detailed in **Sections 5.3 and 5.4**. The environmental impacts of both remediation technology options have been examined as part of this EIS and the findings are included in **Section 7**.

5.2.1 Preferred Remedial Technology

The preferred remedial technology is in-situ chemical oxidation, comprising In-situ Chemical Oxidation (ISCO) and product recovery. The in-situ methodology proposed is described in detail in the Preliminary Work Plan for ISCO (**Appendix Z**). The general principles of the ISCO technology is summarised below, and the works associated with ISCO remediation are described in **Section 5.3**. Detailed design would be subject to procurement and selected contractor detailed methodology.

The ISCO process involves the chemical injection of oxidants into the subsurface to chemically break down contaminants in soil and groundwater into less harmful chemicals.

Oxidants typically used in ISCO are:

- Sodium/potassium permanganate.
- Activated persulfate.
- Hydrogen peroxide (as Fentons reagent).
- Ozone.

Chemicals are batched and mixed at the required dose and then injected into targeted injection wells over a period of time. Other systems required in the process include extraction wells and a soil vapour extraction (SVE) system to control build-up and migration of injected chemistry and vapours respectively.

Prior to implementation of ISCO it is desirable to remove significant contamination (such as SPGWT) to the extent practicable via physical extraction enhanced by chemical injection (product recovery). Product recovery would consist of injection of an oxidant and activator into the targeted areas using the injection system, followed by extraction of the free product and/or emulsified free-product solution using a liquid extraction pump. The final determination of whether product recovery will be undertaken prior to ISCO will be made during installation of the wells required for ISCO remediation in the vicinity of areas where SPGWT has been observed and/or TPH is present in significant concentrations (e.g. the tar tank, the gas holder and the gas holder annulus). Extracted fluids from product recovery will be classified and disposed off-site to an appropriately licensed waste facility.

Due to the proximity of the Site Remediation Area to underground services, a non-corrosive oxidant such as hydrogen peroxide will be used. To increase the effectiveness of the oxidant a catalyst such as Fentons reagent may also be required.

An ISCO Pilot Trial will be undertaken prior to commencement of full scale ISCO (under approved project MP 10_0087). The Pilot Trial is designed to target a portion of the overall Site Remediation Area. It has been designed to evaluate the field effectiveness of the chosen ISCO technology for remediation to remove the EPA Declaration and to refine the ISCO processes prior to scaling up to full scale remediation.

Some limited excavation and off-site disposal of material may also be undertaken as part of the preferred in-situ remediation approach.

5.2.2 Alternative Remedial Technology

The alternative remediation technology that is proposed is ex-situ remediation, which involves the excavation and disposal of contaminated material.

Contaminated materials will be removed from the site for treatment or disposal at a suitably licenced facility. Materials excavated from the Hickson Road Remediation Area will comprise heterogeneous fill materials, soil, and bedrock (where required). Materials will typically be excavated using hydraulic excavators and loaded to trucks by front end loaders and hydraulic excavators. Material will generally be classified to determine whether it requires treatment or is suitable for disposal off-site or beneficial reuse.

A detailed description of the proposed works associated with the ex-situ remediation technology is provided in **Section 5.4**.

5.3 Description of In-situ Remediation Works

This section describes the works that will be required to implement the in-situ remedial technology within the Hickson Road area. The main components of the works required for in-situ remediation works in Hickson Road include:

- Installation of groundwater control walls on the site's boundary with 36 Hickson Rd, in areas of existing gasworks infrastructure.
- Installation of a covered treatment compound incorporating reagent storage, injection pumps, safety shower and eyewash stations and extraction pumps;
- Installation of wells for injection, extraction and monitoring, including installation of a soil vapour extraction (SVE) system.
- Injection of chemicals into the groundwater to oxidise the contaminated materials, extraction of reacted chemicals and groundwater, and monitoring of groundwater.
- Supplementary localised excavation for off-site disposal may also be undertaken.

In-situ remediation will be undertaken generally in five stages, as described in **Section 5.8**. Detailed Staging Plans that explain the sequence of works associated with in-situ remediation are provided in **Appendix F**. During each stage of in-situ remediation access along Hickson Road will be maintained. In particular, in-situ remediation will be undertaken sequentially in two halves – being the eastern and western sides of Hickson Road.

5.3.1 Perimeter Retention Walls

Perimeter retention structures will be required at the location of known gasworks structures (in the vicinity of 36 Hickson Road) to facilitate the preferred in-situ remediation works.

The type of retention wall that is installed is anticipated to be secant piles or soldier piles with jet grout column. Final type installed will be subject to detailed design and contractor methodology.

The location and specifications of the perimeter retention walls associated with the in-situ remediation works are included in the Geotechnical Report, prepared by Coffey and provided as **Appendix HH**.

5.3.2 Injection, Extraction and Monitoring Wells

Injection, extraction and soil vapour monitoring/extraction wells will be installed throughout the Remediation Area using an auger drill rig, or direct push tube system.

Wells will be appropriately screened using sand based upon the local soil type and depth of groundwater at each location. Following installation of the wells, they will be backfilled and fitted with lockable well caps and covers (where required). If the depth of bedrock is greater than approximately 6m, intermediate or shallow wells may also be installed to cover the remaining depth between the bedrock and the ground surface.

The indicative location of monitoring and injection wells and trenches is provided at **Figure 4**, noting that this is indicative only to assess potential works impacts,

with final quantity and location subject to final contractor design, and agreement with the NSW EPA Site Auditor.

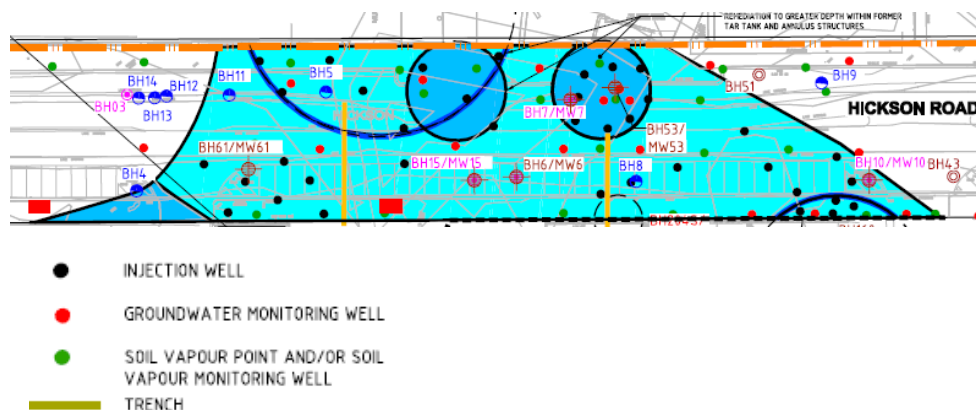


Figure 4 – Indicative location of wells
Source: ISCO Work Plan (*Appendix Z*)

Each well will consist of a stainless steel or PVC pipe with a slotted screen. The pipe will be surrounded by graded sand followed by bentonite and, finally, grout before being capped with concrete at or above ground level (allowing for access via a manhole cover).

Monitoring wells will be installed around the Remediation Area. The monitoring wells may also operate as extraction wells during product recovery or for contingency extractions.

Wells will be designed to clear pre-existing accumulated sediment and groundwater from the monitoring wells and the surrounding aquifer. The injection process is designed to create a surging action that promotes groundwater flow towards the monitoring well.

Where required, pipes will connect the wells to the compound via trenches. Where the trenches are located in trafficable areas (including both vehicle and pedestrian traffic) they will be backfilled to grade and finished with asphalt (or equivalent) to remove any potential tripping hazards or obstructions to users of the road or footpath. The footpath will remain open and accessible to the public (with the exception of short term closure necessary to construct the soil vapour monitoring points, monitoring wells, injection wells and associated trenches). All trenches and well heads will be routinely monitored for evidence of leaks. Appropriate erosion control and mitigation measures will be applied during construction of trenches.

5.3.3 ISCO and Product Recovery

Before the ISCO process commences, significant contamination (such as SPGWT) will be extracted, where practical, through the injection of an oxidant and an activator into targeted areas of the site (product recovery). An extraction pump would then be used to remove the free product and/or the emulsified free-product solution. Extracted fluids from product recovery will be classified and disposed off-site to an appropriately licensed waste facility.

Groundwater would be monitored at monitoring wells throughout this process to detect the presence of Non-Aqueous Phase Liquids (NAPL) outside the treatment area. If detected, NAPL would be extracted by connecting the extraction system to the monitoring wells in question.

Following the extraction of significant gross contamination (e.g. SPGWT), ISCO remediation would commence. ISCO would begin slowly before being intensified to full capacity so that the remediation contractor can demonstrate the effectiveness and safety of the process.

All liquids collected during the remediation process will be managed in accordance with the site's waste management plan. Liquids, such as NAPL, that are extracted during remediation would be stored on site so that denser NAPL can settle and separate from lighter liquids. Denser waste products would then be disposed of, while lighter liquids would be transferred to larger tanks for treatment or disposal at a licenced facility.

The intent of the ISCO process is to progressively increase the injection amounts, concentrations and rates in a controlled manner to allow sufficient time to allow the monitoring program to inform modifications to the systems and to implement refinements to enhance performance of the remediation and also to mitigate any potential adverse impacts.

Upon decommissioning all installed wells will be capped in-situ.

5.3.4 Soil Vapour Monitoring and Extraction

A soil vapour monitoring and extraction system will be implemented to prevent the emission of vapours generated by the injection of ISCO chemicals.

Soil vapour monitoring would be undertaken via a network of (indicatively) 15 – 20 wells, each approximately 50mm in diameter. Soil vapour monitoring would be achieved by installing probes into the wells to appropriate depths. The wells would be connected to a soil vapour extraction (SVE) system.

Soil vapour extraction points will be constructed similar to the soil vapour monitoring wells but with PVC slotted screen and casing (instead of Teflon tubing and probe) to allow for larger vapour extraction volume. The SVE system would continuously extract and treat vapours generated by the remediation process to minimise the potential for impacts to receptors around Hickson Road.

Soil vapour extraction points will be installed at a suitable distance from the monitoring points to enable a representative sample to be collected from the monitoring point to demonstrate the effectiveness of the soil vapour extraction system.

Soil vapour monitoring and extraction would be undertaken using pumps that would be operational 24 hours per day.

5.3.5 Localised Excavation and Disposal

The in-situ remediation may be supplemented by some localised excavation of material for off-site disposal. Some supplementary excavation and off-site disposal may be carried out as part of the in-situ remediation method, if required, where localised in-situ remediation proves to be less effective or would be less practical in a particular area, than localised excavation. It is expected that any localised excavation during the in-situ remediation works (if required) would be limited to small areas. Where any excavation is required, it will be undertaken using detailed odour control measures to ensure any potential odours are effectively controlled. Odour control measures would comprise mobile odour enclosures or applying suitable alternative odour controls (including limiting exposed excavations, and use of foams, covers and odour suppressants) as

appropriate based on the proposed excavation area. If excavation does become necessary as part of the in-situ method, Lend Lease will consult with NSW EPA to provide detailed design of odour control measures for the specific area, for review and agreement, prior to undertaking works.

5.3.6 Remediation Compound

Temporary remediation compounds will be required facilitate controlled injection of chemical mixtures into the ground, to treat required areas of gasworks contamination in-situ. Temporary remediation compounds will include containment areas to store the chemistry, equipment and wastes, and the site sheds. The temporary remediation compounds will include temporary covered enclosures, but will not be designed to control acoustic or odour emissions (which are expected to be minor – refer to **Section 7**).

All bulk chemicals will be stored in a secured shipping container located within the remediation compound. All Dangerous Goods will be stored in accordance with their Occupational Health and Safety requirements, and recommendations of the PHA, which is included as **Appendix BB** and summarised in **Section 7.15**. All remediation equipment will be chemically compatible with the injection chemistry.

Within the remediation compounds, the injection system will contain the following:

- 1,000L – 10,000L tanks for chemical batching;
- 200L drums for ISCO chemicals;
- Chemical storage containers (Intermediate Bulk Containers);
- 1,000L – 10,000L poly tanks for compatible chemicals and extracted fluids;
- Stormwater and wastewater storage;
- An injection system;
- Extraction system; and
- Soil Vapour Extraction (SVE) system.

The remediation compounds will be supplied with power and water to meet the requirement of the remediation contractor. Waste water associated with the extraction process will be stored within a separate bunded containment area within the remediation compounds.

5.3.7 Protection of Infrastructure

The Geotechnical Report prepared by Coffey (**Appendix HH**) concludes that there are a range of mitigation strategies to be implemented that will enable remediation to be carried out in a manner which does not adversely affect public or private infrastructure and buildings in the vicinity of the Hickson Road Remediation Area.

5.3.8 Removal of Trees

Existing trees along Hickson Road may require pruning. The in-situ treatment approach is not expected to require the removal of any of the street trees along Hickson Road.

5.4 Description of Ex-situ Remediation Works

The following sections describe the proposed works as part of this SSD DA, if the alternate ex-situ remediation method is undertaken. Detailed Staging Plans that explain the sequence of works associated with ex-situ remediation are provided in **Appendix F**.

5.4.1 Excavation Operations

Excavated materials will comprise heterogeneous fill materials, soil, and bedrock. Materials will typically be excavated using hydraulic excavators and loaded to trucks by front end loaders and hydraulic excavators. Material will be classified on site (in-situ or ex-situ classification) to determine whether it requires treatment prior to disposal or is suitable for immediate disposal off-site.

Where SPGWT and/or Confirmed Impacted Material (CIM) requiring remediation is identified, excavation operations will commence by the removal of overburden material.

Excavations will be regularly inspected by a suitably experienced environmental engineer or scientist to confirm that the visual and olfactory characteristics of the excavated materials are consistent with expectations. These regular inspections will also serve to identify additional hotspots of SPGWT or CIM that may not otherwise have been identified by the previous site investigations. The validated excavation will be effectively isolated from contaminated areas of the site by the use of physical means such as the placement of clean material bunds, temporary fences and by use of signage.

All excavated SPGWT and CIM will be kept separate from other materials. Depending on the level of contamination in excavated material, excavated SPGWT and CIM will be either:

- removed off-site to a licensed treatment facility (where required), followed by landfill disposal; or
- removed directly offsite to a licensed landfill facility.

De-watering will be undertaken during the excavation works, and water treated prior to discharge in accordance with the relevant criteria in the EPL or trade waste agreement (as applicable), or tankered off-site by licensed contractors to a licensed liquid waste facility.

Temporary retaining walls will be installed as required to facilitate excavation.

5.4.2 Excavation Enclosures

The management of odours is recognised as a critical aspect of the management of the proposed remediation works. Based on the results of historical investigations at the site, it is considered likely that odorous materials will be encountered across much of the site.

Given the potentially odorous nature of the materials to be excavated at the site, excavation of gasworks contamination will be undertaken within an excavation enclosure. The purpose of the excavation enclosures will be to mitigate uncontrolled emissions during excavation and truck loading processes and to ensure these emissions are vented to the atmosphere through an emissions control system.

The excavation enclosure will be a temporary structure that can be erected over the excavation area. The final design of the excavation enclosure for ex-situ works will be developed in consultation with the EPA. The structure would include a negative pressure working enclosure and an air extraction system for the control of odours and diesel exhaust.

Excavation Enclosure Emissions Stacks

The excavation enclosures will include a detailed emissions control system and vent stack to release treated air from the structures. Preliminary details are provided below, subject to final design prior to commencement.

The air exhausted from the enclosure will first pass through a particulate control device (bag-house or pleated paper filter system) to remove fugitive dust. The particulate control system will include a system to remove particulates from the filter media. Dust removed will be collected in enclosed drums or hoppers. After the exhaust gas exits the particulate filter, it will pass through an activated carbon adsorption system, which will be equipped with a number of monitoring ports, to remove odorous substances. Monitoring of the emissions stack will be undertaken as follows:

- All testing will be, in accordance with the *Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales* (DEC, 2005b).
- Monitoring will include testing for NO_x, particulates, volatile organic compounds (VOCs) and PAHs using the stack test method.

The final design and detailing of filtration systems will be subject to further design development. Before the Hickson Road works commence, Lend Lease would submit a detailed design plan of the emission control systems proposed to be used for the OCEs to the EPA for review and comment. This plan will include information such as:

- Manufacturers' performance specifications, which include the particle and VOC control efficiency of the proposed technologies;
- Detailed monitoring plan to confirm the performance of the proposed VOC control technology; and
- If appropriate, the proposed methodology to detect carbon bed breakthrough.

The detailed monitoring plan will address emissions of NO_x, particulates, VOCs and PAHs, and testing would be undertaken in accordance with the EPA's *Approved Methods for Sampling and Analysis of Air Pollutants in NSW* publication. Preliminary proposed stack concentration limits are provided below:

- Total particulates - 20 mg/Nm³
- VOCs as n-propane equivalent - 20 mg/Nm³

Monitoring will occur at the completion of commissioning followed by sampling every alternate month. The final nature of the sampling program and monitoring frequency will be agreed with the EPA and specified in the EPL, prior to commissioning.

A particulate monitoring protocol will be developed, which will form the basis for deciding when activated carbon beds need to be replaced. Air would be exhausted to the atmosphere via a stack and the emissions from the stack will be emitted in accordance with the EPL for the Barangaroo site.

As noted above, although the existing EPL for the Barangaroo site does not need to be varied, Lend Lease may elect to vary the existing EPL for Barangaroo South (EPL 13336) to include the proposed remediation following consultation with the EPA.

5.4.3 Groundwater Control and Excavation Retention Walls

Groundwater control walls will be required to facilitate excavation. The groundwater control walls will be installed to minimise inflows of groundwater into the excavation. Retention walls may also be required to support excavations. The technical specifications of the groundwater control walls and excavation retention walls associated with the ex-situ remediation works are included in the Geotechnical Report, prepared by Coffey and provided as **Appendix HH**.

5.4.4 Off-Site Transport and Treatment/Disposal

If excavated material (e.g. clean overburden) meets the site acceptance criteria established in the RAP then it may be re-used on-site as fill, if there is demand for it. It is expected that only a limited amount of excavated material may be re-used in this way. Otherwise, excavated material will be transported off-site for treatment or disposal at a suitably licenced facility.

CIM and SPGWT will be taken to an off-site facility by truck. Where required, the excavated materials will be treated at a suitably licenced treatment facility to ensure it meets appropriate NSW EPA waste disposal criteria. In this regard, all materials taken off-site for treatment and/or disposal will be classified in accordance with the EPA's *Waste Classification Guideline* and will be disposed of at a suitably licensed landfill facility.

A methodology statement for the off-site transportation and treatment of contaminated materials has been prepared by AECOM and is provided as **Appendix KK**. The statement includes environmental control measures for the transport of contaminated materials, which includes pre-treatment of the contaminated excavated material to ensure it is suitable for off-site transport. To mitigate potential dust or odour generation during off-site transport of soil, loads will be covered and sealed, including use of an odour suppressant foam or similar. It particularly nominates proposed types of foam and its specification to demonstrate that products are available that are specifically designed for the proposed purpose (i.e. suppressing odour from soil). Foam agents have previously been used on other remediation sites as a method of suppressing odour from contaminated soil, including from tarry waste (e.g. Hunter River Remediation project).

The methodology statement for the off-site transportation and treatment of contaminated materials also sets out the minimum requirements for the off-site treatment facility.

5.4.5 Backfilling and Reinstatement of Hickson Road

The area will be back-filled using suitable fill that is validated in accordance with the requirements of the RAP and the City of Sydney's Road Restoration Guidelines.

After backfilling, a temporary restoration of road/pavements will be installed (as required), to match existing and new street trees will be planted to replace those removed (unless new landscaping requirements are approved generally for Hickson Rd, under separate DA/approvals).

5.4.6 Protection of Infrastructure

Appendix HH provides a Geotechnical Report prepared by Coffey. The Geotechnical Report concludes that there are a range of mitigation strategies to be implemented that will enable remediation to be carried out in a manner which does not adversely affect public or private infrastructure or buildings.

5.4.7 Removal of Trees

Existing trees along Hickson Rd may require removal. Ex-situ remediation would require the removal of up to 15 street trees. Refer to **Appendix V** for details.

It is noted that this potential tree removal for the ex-situ remedial approach is the expected maximum, based on anticipated maximum extent of remediation excavation. If the final extent of remediation excavation required is reduced (following validation testing and/or agreement with the NSW EPA and Site Auditor), a qualified arborist will assess and confirm if the associated tree removal can also be reduced from the maximum proposed.

5.5 Selection of Remediation Technology

The preferred remediation technology is to undertake in-situ remediation (**Section 6** of this EIS describes the alternatives that were considered and the reasons that the preferred option was selected). This method has been selected as the environmental impacts are generally lower than those anticipated with the ex-situ technology. A pilot trial of this technology has been approved (MP10_0087) and will be undertaken prior to undertaking full scale in-situ remediation (subject to approval).

Following analysis of the results from this pilot trial a decision will be made about the most appropriate technology to adopt for the remediation of Hickson Road. If results from the trial (during or at completion) indicate that full-scale in-situ remediation would not be technically and/or commercially feasible, the alternate ex-situ method will be selected for full-scale remediation.

A document describing the pilot trial success parameters is included as **Appendix AA**. The success parameters for the pilot trial will be used to determine the success, or otherwise of the pilot trial. These include:

- Compliance with the requirements of MP10_0087;
- Compliance with the parameters described by the Trial Management Plan (to be prepared as part of the Pilot Trial under MP10_0087);
- Protection of human health and the environment as demonstrated by the monitoring program described in the Trial Management Plan and summarised in the pilot trial success parameters document; and
- Reduction in contaminant mass in the tar tank of approximately 25% based on naphthalene and TPH C10-C14 concentrations, as required by the RAP (or as otherwise agreed with the NSW EPA).

In addition, commercial and programme impacts will be assessed to confirm the most feasible method for full-scale remediation. Selection of the final remediation method will be undertaken in consultation with the NSW EPA and the Site Auditor.

5.6 Working Hours

Operation hours for some of the activities will be required to continue 24 hours per day, seven days a week, including operation of the soil vapour extraction pumps (required for the in-situ remediation method); air extraction and associated filtration plant and equipment (associated with the ex-situ method odour enclosures); and temporary electrical generators proposed to supply the SSD DA site.

In addition the following activities may be required to be carried out outside of normal working hours:

- Wastewater treatment plant (including both extraction / pumping and treatment components) may be required to run up to 24 hours per day and 7 days per week to facilitate the ongoing management of contaminated groundwater that is yielded from the ground during the proposed remediation activities.
- Diversion, cut over and commissioning of various authority infrastructure service diversions may be required outside the proposed hours. The exact requirements and timing of the various services diversions will be subject to the specific requirements of the various infrastructure service providers to tie-in with temporary utility shutdowns or off peak periods.
- Essential maintenance activities (such as dust suppression, attendance and maintenance of environmental protection structures, emergency works and the like) may need to be undertaken outside normal construction hours on occasions.
- Other relatively quiet activities may be required to occur outside standard construction hours, including delivery of plant and equipment to the site out of hours where approved or required by the police or the RMS, operation of environmental monitoring equipment, and the limited arrival and parking of trucks prior to 7am to prevent trucks queuing outside the site, or in other parts of Hickson Road.

The remaining works, including for excavation activities, are proposed to be undertaken between the hours of 7am and 6pm Monday to Friday, and 7am to 5pm Saturday. No construction work would occur on Sundays and Public Holidays.

The proposed hours for Saturdays are outside the EPA's standard hours for construction work. However, this extended period will enable the major noise and vibration generating activities to be carried out in a more efficient manner, thereby shortening the overall construction period to which sensitive receptors will be exposed. This is consistent with the approach approved for construction of other approved projects at Barangaroo South.

5.7 Site Access

The access route to the site will be via Hickson Road. As shown described in **Section 2** and shown in **Figure 2**, parts of Central Barangaroo will be used for the purposes of logistics and managing heavy vehicles associated with the remediation works, including for truck holding and turning areas. A gated entry from Hickson Road connects to Central Barangaroo. The entry point will control access to and around the site during the remediation works. The proposed site entry/exit arrangement is shown in the plans provided in **Appendix E**.

All site personnel entering and leaving the remediation works areas will be required to pass through the clean/dirty zone and a decontamination station.

No car parking at Barangaroo is provided for the site construction workforce.

5.8 Indicative Project Staging

The timing and overall duration of the remediation works are dependent on a number of factors, including:

- Receipt of planning approval and any other relevant approvals/licences.
- Detailed design and selected contractor programme.
- Final development and staging requirements.
- Agreement and approval by the BDA of the detailed design and extent of staging areas.
- Progress of the Pilot Trial.

Remediation of Hickson Road is forecast to commence at the end of 2016 (subject to planning approval) and with an estimated timeframe of up to 21 months.

- If in-situ remediation takes place, works would commence in November 2016 and would be expected to conclude in August 2018.
- If ex-situ works are undertaken, works would commence in November 2016 and would be expected to conclude in October 2018.

The stages of each remediation option, and the indicative duration of each are explained below in **Table 3**.

Table 3 – Indicative Project Programme and Staging

Months	In-situ remediation	Ex-situ remediation
1	▪ Stage 1 – 1 month – Installation of wells and infrastructure – west half of Hickson Road; – Temporary removal of street parking for works; – Temporary traffic diversions.	▪ Stage 1 – 3 months – Temporary removal of street parking on eastern half of Hickson Road for works; – Removal of street trees on eastern half of Hickson Road; – Divert traffic to west half; – Service diversion where required; – Install retention wall systems; – Install and commission odour structures; and – Install dewatering infrastructure.
2	▪ Stage 2 – 2 months – Installation of wells, infrastructure and groundwater control walls – east half of Hickson Road; – Set-up compound in road reserve; and – Temporary traffic diversions	
3		
4	▪ Stage 3 – 6 months – Undertake ISCO remediation – east half of Hickson Road.	▪ Stage 2 – 6 months – Excavate eastern half of Hickson Road and dispose of excavated materials off-site.
5		
6		
7		
8		
9		
10	▪ Stage 4 – 6 months	▪ Stage 3 – 2 months

Months	In-situ remediation	Ex-situ remediation
11	– Undertake ISCO remediation – west half of Hickson Road	– Validate excavations on eastern half of Hickson Road; – Backfill excavations; – Road/footpath restoration; and – Decommission odour structures.
12		▪ Stage 4 – 3 months – Divert traffic to east half; – Removal of street trees on western half of Hickson Road; – Service diversion where required; – Adjust existing retention systems; – Install and commission odour structures; and – Install Dewatering infrastructure.
13		
14		
15	▪ Stage 5 – 6 months: – Validate remediation; – Decommission wells / restore road (staged); and – Reinstate street parking.	▪ Stage 5 – 2 months – Excavate western half and dispose of excavated materials off-site
16		▪ Stage 6 – 2 months – Validate excavations on western half of Hickson Road; – Backfill excavations; – Road / footpath restoration; – Decommission odour structures; and – Reinstate street parking and trees
17		
18		
19		
20		
21		
22		

6.0 Consideration of Alternatives

Because of the EPA Declaration, the remediation of the land that that is the subject of the EPA Declaration within Hickson Road must be undertaken. As part of the preparation of the RAP, a number of remediation options were investigated and evaluated, as summarised out below. Note that the options considered in the RAP also included the 'Block 4' and Block 5 Remediation Areas.

Screening Assessment of Remedial Technology Options

The first step in the evaluation of remediation options was the identification and initial screening of remedial technology options. This included screening of 11 ex-situ remedial technology options. The initial screening of remedial technology options considered the following parameters for each of the remedial technology options:

- **Technical Constraints:** including applicability of the technology to the identified contamination, the ability of the technology to achieve the required soil and groundwater remediation targets; and acceptance of technology by local and international remediation practitioners and regulators.
- **Sustainability:** The sustainability component of the screening assessment was carried out in a manner consistent with the requirements of Section 9 of the CLM Act which requires consideration of Ecological Sustainable Development including the principles of the precautionary approach, intergenerational equity, biodiversity and improved valuation, pricing and incentive mechanisms. The sustainability component of the screening included consideration of resource use (specifically energy and water), waste generation, material reusability (i.e. potential for reuse or recycling), carbon dioxide (CO₂) generation, and ongoing management and risk.
- **Financial.**
- **Logistical.**
- **Timing.**
- **Community:** including the likelihood of community acceptance of proposed strategy, community impact during the remedial works (i.e. including potential disruption to traffic and additional traffic movements leaving the site), and continuing impact from any legacies that might remain upon conclusion of the remediation for a particular remedial technology.

As an outcome of the screening assessment, many of the remedial technologies were discounted from further detailed consideration. Technologies were typically eliminated from further consideration on the basis that they:

- Are not suitable for the identified contaminants of concern;
- Are impractical in the context of addressing the identified contamination; or
- Have a very high cost in comparison with other technologies.

Based on the initial screening process, seven remediation technologies were selected for further detailed consideration as follows.

- **Excavation and Ex-situ Thermal Desorption (on site):** Desorption and/or destruction of organic contaminants in excavated soil by heating, usually by a direct heating thermal unit.
- **Surfactant Enhanced In-situ Chemical Oxidation:** Injection of strong oxidants, such as hydrogen peroxide, permanganate or persulphate in the presence of a

surfactant, into the subsurface to degrade a wide range of organic contaminants (ISCO or similar).

- In-situ Stabilisation or Solidification: Encapsulation of contaminant by in-situ blending with chemical binders to immobilise contaminants of concern. This could be achieved by large drilling of large diameter borehole and mixing of fly ash, lime, cement with the contaminated soil.
- Excavation and ex-situ Thermal Desorption (off site): Desorption and/or destruction of organic contaminants in excavated soil by heating, usually by direct heating thermal unit. Requires transport of materials to an off-site thermal desorption facility.
- Excavation and ex-situ stabilisation (on site): Encapsulation of contaminant by ex-situ blending with chemical binders to immobilise contaminants of concern. Stabilised material could be disposed off-site or re used on site.
- Physical Containment: Containment or capping of contaminated soil to prevent or significantly reduce contaminant migration and to prevent human and environmental exposure.
- Excavation and Surfactant Enhanced Ex-situ Chemical Oxidation: Ex-situ treatment of excavated soils using strong oxidants, such as hydrogen peroxide, permanganate or persulphate, to degrade a wide range of organic contaminants.

Detailed Assessment of Remedial Technology Options

Those technologies which were considered to be potentially suitable based on the screening assessment were evaluated in more detail against each of the remediation objectives. A summary of the detailed evaluation is included below:

- Excavation and Ex-situ Thermal Desorption (on site): This remedial technology was assessed as being technically complex as well as requiring a significant amount of materials handling and further treatment of residual waste streams. Thermal desorption is also highly energy intensive and will result in significant CO₂ emissions. It was also considered unlikely that such technology would be readily accepted by regulatory agencies or the community at this location. This remedial technology was not a preferred technology.
- In-situ chemical oxidisation: In-situ remediation approaches, such as ISCO, are considered potentially advantageous for areas such as Hickson Road given the ongoing roadway land use and extensive network of underground services.
- In-situ Stabilisation or Solidification: Whilst stabilisation or solidification can treat a broad range of contaminants in a relatively short time-frame, capping and containment of the stabilised or solidified material may be required to facilitate future land use. Furthermore, ongoing dewatering of the treatment area may also be required, and long-term monitoring would be required because the contaminated material is not removed or destroyed. On-going environmental management in this fashion is the least preferred approach identified by the EPA and the National Environment Protection Council in the hierarchy of clean-up and management protocols. As such, this remedial technology was not a preferred technology.
- Excavation and ex-situ Thermal Desorption (off site): Thermal desorption is highly energy intensive and will result in significant CO₂ emissions. On this basis, this remedial technology was not a preferred technology.

- Excavation and ex-situ stabilisation: Generally similar to the In-situ Stabilisation or Solidification remedial technology option in terms of limitations and constraints, however ex-situ stabilisation has been used successfully on other gasworks sites, including the nearby Bond development in Hickson Road in 2002.
- Physical Containment: Although physical containment does not remove or destroy the contamination, containment technologies can effectively manage exposure risks, can be implemented in a timely manner, and are generally economical. Notwithstanding, it is considered unlikely that physical containment alone would be considered acceptable by regulators nor would containment satisfactorily address the EPA Declaration. As noted in the RAP, EPA guidelines (*Guidelines for the Assessment and Management of Groundwater Contamination*, NSW DEC 2007) require removal of non-aqueous phase liquid to the extent practicable. As such, this remedial technology is not a preferred technology.
- Excavation and ex-situ chemical oxidation: the ex-situ nature of the technology and the ability to physically amend the material prior to treatment reduces the reliance on surfactant enhancement and potentially provides a greater degree of confidence in comparison to *in-situ* approaches. However, this ex-situ method is not considered appropriate for Hickson Road as the alternate ex-situ stabilisation method is more available at off-site licenced facilities. As such this remedial technology is not considered further.

Based on the assessment provided above, in-situ remediation is the preferred remedial approach for Hickson Road as it is to be retained as a public road and if extensive excavation works can be avoided the impact of the remediation works can be minimised. The in-situ remedial approach would use in-situ chemical oxidation treatment technology (such as ISCO or an equivalent approach).

The alternative remedial approach, if the pilot trial for the in-situ remedial technology proves unsuccessful or unreliable, is to excavate the contaminated materials for off-site treatment and/or disposal.

7.0 Environmental Assessment

This section of the report assesses and responds to the environmental impacts of the proposed SSD DA. It addresses the matters for consideration set out in the SEARs. The SEARs are provided in **Table 4** along with a description of where each of the requirements has been addressed in this EIS and/or the cross reference to the relevant appendix. The Mitigation Measures at **Section 9** complement the findings of this section.

Table 4 – SEARs and cross-reference for where requirements are addressed

Secretary's requirements	Location in Report/Application
General Requirements	
The Environmental Impact Statement (EIS) must address the <i>Environmental Planning and Assessment Act 1979</i> and meet the minimum form and content requirements in clauses 6 and 7 of Schedule 2 the Environmental Planning and Assessment Regulation 2000.	Environmental Impact Statement
Notwithstanding the key issues specified below, the EIS must include an environmental risk assessment to identify the potential environmental impacts associated with the development.	Section 8
Where relevant, the assessment of the key issues below, and any other significant issues identified in the assessment, must include: ▪ Adequate baseline data. ▪ Consideration of potential cumulative impacts due to other development in the vicinity. ▪ Measures to avoid, minimise, and if necessary, offset the predicted impacts, including detailed contingency plans for managing any significant risks to the environment.	Section 7 Section 9
The EIS must be accompanied by a report from a qualified quantity surveyor providing: ▪ A detailed calculation of the capital investment value (as defined in clause 3 of the Environmental Planning and Assessment Regulation 2000) of the proposal, including details of all assumptions and components from which the CIV calculation is derived; ▪ An estimate of the jobs that will be created by the development during the construction and operational phases of the development; and ▪ Certification that the information provided is accurate at the date of preparation.	A report has been provided by a qualified quantity surveyor and has been provided to the Department of Planning and Environment with the EIS.
Key Issues	
The EIS must:	
1. Relevant EPI's, Policies and Guidelines Address the provisions of State environmental planning policies that would apply as if those provisions applied to the carrying out of the project, including the following: ▪ <i>State Environmental Planning Policy (State & Regional Development) 2011;</i> ▪ <i>State Environmental Planning Policy (Major Development) 2005;</i> ▪ <i>State Environmental Planning Policy No 55 - Remediation of Land; and</i> ▪ <i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005.</i>	Section 3.2
Address the relevant provisions, goals and strategic objectives in the following: ▪ <i>NSW 2012</i> ▪ <i>Draft Metropolitan Strategy 2031</i> ▪ <i>Draft Sydney Sub Regional Strategy NSW</i> ▪ <i>Barangaroo Integrated Transport Strategy</i> ▪ <i>Sydney City Centre Access Strategy</i>	Section 3.3

Secretary's requirements	Location in Report/Application
2. Demonstrate consistency with the terms of approval of Concept Plan MP06_0162 (as modified).	Section 1.1.2
3. Remediation and Contamination The EIS must include a Remedial Action Plan (RAP). The RAP must be prepared in accordance with the contaminated land planning guidelines under section 145C of the <i>Environmental Planning and Assessment Act</i> 1979 and relevant guidelines produced or approved under section 105 of the <i>Contaminated Land Management Act</i> 1997. The EIS must provide detailed justification for the preferred treatment methodology (on site or off-site) of gasworks site. If an ex-situ remediation strategy is proposed (i.e. gasworks waste underneath Hickson Road is excavated and transported to an off-site licenced facility for treatment and/or disposal), the EIS must provide a detailed justification for this process. Note: the current guidelines under Section 145C of the EP&A Act are the Dept.'s <i>Managing Land Contamination, Planning Guidelines, SEPP 55 – Remediation of Land</i> 1988.	Section 5.2 and Appendix G Section 5.5
4. Waste Management Provide details of the quantity and type of liquid and non-liquid waste generated, handled, processed or disposed of on-site. Waste must be classified according to the EPA's Waste Classification Guidelines 2008.	Section 7.3 and Appendix X
Provide details of the quantity, type and specifications for all output products proposed to be produced. The description should include the physical, chemical and biological characteristics (including contaminant concentrations) of those output products as well as relevant accredited standards against which the products would comply.	Section 7.3 and Appendix X
Provide details of intended (or potential) end uses for output products and the relevant product standards used against which those products would be assessed.	Section 7.3 and Appendix X
Provide details of the layout, the treatment process and the environmental controls of the proposal.	Section 7.3 and Appendix X
Provide details of liquid waste and non-liquid waste management, including: - the transportation, assessment and handling of waste arriving at or generated at the site; - any stockpiling of wastes or recovered materials at the site; - any waste processing related to the proposal, including reuse, recycling, reprocessing or treatment both on- and off-site; - the method for disposing of all wastes or recovered materials; - the emissions arising from the handling, storage, processing and reprocessing of waste; and - the proposed controls for managing the environmental impacts of these activities.	Section 7.3 and Appendix X
Provide details of spoil disposal (if applicable) with particular attention to: - the quantity of spoil material likely to be generated; - proposed strategies for the handling, stockpiling, reuse/recycling and disposal of spoil; - proposed strategies for confirming that waste treatment and /or disposal facilities can lawfully accept waste generated by the proposed development and have received the waste once transported off-site. - the need to maximise reuse of spoil material in the construction industry; - identification of the history of spoil material and whether there is any likelihood of contaminated material, and if so, measures for the management of any contaminated material; and - designation of transportation routes for transport of spoil.	Section 7.3 and Appendix X
Provide details of procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials used,	Section 7.3 and Appendix X

Secretary's requirements	Location in Report/Application
stored, processed or disposed of, in addition to the requirements for liquid and non-liquid wastes.	
Provide details of the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage.	Section 7.15 and Appendix BB
5. Soil and Water Assess impacts on water quality of Sydney Harbour and proposed management, mitigation and monitoring measures.	Section 7.6, Section 7.7 and Appendices G, O and P
Details of water supply, including consideration of alternative water supply arrangements and water conservation measures.	Section 7.7 and Appendices G, O and P
Erosion and sediment and stormwater management controls during construction and remediation.	Section 7.7 and Appendices G, O and P
Consideration of any impacts on Groundwater Dependant Ecosystems	Section 7.7 and Appendices G, O and P
6. Health Impacts Assess impacts on health (including extraction of sediments, off-site transport and treatment as well as disposal of sediments), during and following remediation, including details of human exposure scenarios and demonstration that the project will not have unacceptable acute or chronic health effects.	Section 7.5 and Appendix M
7. Earthworks Provide a detailed survey showing existing and proposed levels and proposed quantities of cut and fill necessary for the proposed works. Details of the fill, including types and materials and their source. Details of the location for the disposal of excess cut and the methodology of transportation to this location.	Appendix E
8. Air Quality and Odour The EIS must include an Air Quality Impact Assessment, prepared in accordance with the EPA's Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2005. The AQIA must also make appropriate reference to the EPA's <i>Assessment and Management of Odour from Stationary Sources in New South Wales: Technical Framework 2006</i> and <i>Management of Odour from Stationary Sources in New South Wales: Technical Notes 2006</i> . The AQIA shall include, where applicable: - the identification of the pollutants of concern, including individual toxic air pollutants, dust and odours; - the identification and assessment of all relevant fugitive and point source emissions, - appropriate coverage of all aspects of the remediation including excavation, storage, transport and treatment, of the contaminated material; - proposed air quality management and monitoring procedures during the remediation; and - consideration of the requirements of the PoEO (Clean Air) regulation.	Section 7.8 and Appendix Q
9. Noise The EIS must include a Noise and Vibration Impact Assessment as construction, operation, traffic and cumulative noise impacts prepared in accordance with the relevant EPA guidelines. The assessment must also consider and potential impacts on noise sensitive receivers and outline proposed mitigation and monitoring measures.	Section 7.9 and Appendix R
10. Traffic The EIS must include a Traffic Impact Assessment (TIA) that evaluates: - daily and peak traffic movements likely to be generated by the project; - Safety performance of the surrounding road network; - Indicative construction program and other construction projects likely to occur during the remediation works; - details of access arrangements for workers to/from the site, emergency vehicles and service vehicle movements; - details of arrangements for interim cycling and pedestrian access	Section 7.10 and Appendix S

Secretary's requirements	Location in Report/Application
- during construction; and ▪ details of any proposed transportation of materials to or from the site including haulage routes, types of vehicles accessing the site and proposed location of handling materials. ▪ Cumulative impacts associated with other construction activities within the Barangaroo and Wynyard Precincts; ▪ Impacts of any road closures (partial or full) on the operation of the road network, public transport, parking, pedestrians and cyclists; and ▪ Mitigation measures for the impacts identified in the TIA.	
11. Heritage Undertake an assessment of the likely impacts on the proposal on any heritage or archaeological items and proposed mitigation and conservation measures.	Section 7.11 and 7.12 and Appendices T and U.
12. Hazard and Risk Including a Preliminary Hazard Analysis of the development.	Section 7.15 and Appendix BB
13. Visual Identify and assess the visual impacts of the project.	Section 7.14
14. Staging Provide details on the staging of the project.	Section 5.8 and Appendix F
15. Infrastructure Servicing Detail measures to mitigate the impacts of the works on any infrastructure items, including proposed relocation. Detail of water supply, consideration of water sensitive urban design and water conservation measures.	Section 5.4.5 and Appendix HH
16. Ecological Sustainable Development Identify how the development will incorporate ESD principles in the design and construction phases of the development.	Section 7.17 and Appendix W
Consultation During the preparation of the EIS you must consult with the relevant local, State or Commonwealth authorities, service providers, community groups and affected landowners. In particular, you should consult with City of Sydney Council, TfNSW, RMS, the EPA, Sydney Water Corporation and Ausgrid.	Section 4
Relevant Plans and Policies	
Air Quality & Health ▪ Protection of the Environment Operations Act 1997 ▪ Protection of the Environment Operations (Clean Air) Regulation 2002 ▪ Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005) ▪ Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007) ▪ Environmental Health Risk Assessment Guidelines for Assessing Human Health Risks from Environmental Hazards Department of Health and Ageing and Health Council, 2012) ▪ Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework (DEC, 2006) ▪ Assessment and Management of Odour from Stationary Sources in NSW: Technical Notes (DEC, 2006)	Appendix Q
Water ▪ Managing Urban Stormwater: Treatment Techniques (OEH) ▪ Managing Urban Stormwater: Source Control (OEH) ▪ Managing Urban Stormwater: Erosion and Sediment Control and Managing Urban Stormwater: Harvesting and Reuse (OEH) ▪ Managing Urban Stormwater: Soils & Construction (Landcom) ▪ Australia Runoff Quality 2004 (Engineers Australia) Water Sensitive Urban Design Engineering Procedures: Stormwater 2005 (Melbourne Water) ▪ Water Sensitive Urban Design: Basic Procedures for 'Source Control'	Appendix O and Appendix P

Secretary's requirements	Location in Report/Application
- of Stormwater - A Handbook for Australian Practice 2007 (Engineers Australia) - Technical Guidelines: Bunding & Spill Management (OEH) - National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ) - Using the ANZECC Guideline and Water Quality Objectives in NSW (OEH) - Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (OEH)	
Noise - NSW Industrial Noise Policy 2000 (EPA) - NSW Industrial Noise Policy- application notes 2013 (EPA) - NSW Road Noise Policy 2001 (DECCW) - NSW Road Noise Policy- application notes 2013 (EPA) - Assessing Vibration: A Technical Guideline 2006 (DEC) - Interim Construction Noise Guideline 2009 (DECC)	Appendix R
Waste - Waste Avoidance and Resource Recovery Strategy (Resource NSW) - Waste Classification Guidelines 2008 (OEH)	Appendix X
Transport - Guide to Traffic Generating Development (RMS) - Guide to Road Design (AUSTROADS) - Guide to Traffic Management - Part 12: Traffic Impacts of Development (AUSTROADS)	Appendix S
Hazards and Risks - State Environmental Planning Policy No. 33 - Hazardous and Offensive Development - Applying SEPP 33 - Hazardous and Offensive Development Application Guidelines (DUAP) - Hazardous Industry Planning Advisory Paper No. 6 - Guidelines for Hazard Analysis	Appendix BB
Visual Control of Obtrusive Effects of Outdoor Lighting (Standards Australia, AS 4282)	Section 7.14
Contamination - State Environmental Planning Policy (Remediation of Land) No.55 - Managing Land Contamination, Planning Guidelines, SEPP 55- Remediation of Land 1998 (DP&I) - Guidelines for Consultants on Reporting on Contaminated Sites (1997) EPA - Contaminated Land Management Act 1997 - National Environment Protection (Assessment of Site Contamination) Measure 1999 - Environment Protection Licence No. 13336	Appendix G

7.1 Relevant EPIs and Policies

The relevant environmental planning instruments and strategic plans/policies are set out in the SEARs. **Section 3** provides a description of the legislative context for the project, including how each of the relevant environmental planning instruments and strategic planning policies are addressed. **Section 1.1.2** provides a description of the Barangaroo Concept Plan (as modified) and demonstrates that the proposed Hickson Road remediation works are consistent with it.

7.2 Assessment of Contamination

7.2.1 Description and Origin of Contamination

A description of the origin of the contamination on the site is provided in detail in the RAP at **Appendix G**, and is summarised in **Section 1.2** of this EIS.

The site is known to be contaminated with gasworks waste and particularly waste tar as a result of the previous use of the EPA Declaration Area as a gasworks plant. The chemical composition of gasworks waste includes the following contaminants: polycyclic aromatic hydrocarbons (PAHs); benzene, toluene, ethylene and xylene (BTEX); total petroleum hydrocarbon (TPHs); ammonia; phenol and cyanide.

Areas within the Hickson Road Remediation Area where SPGWT has been primarily identified are in the vicinity of:

- The southern tar tank and the northern tar tank;
- The eastern portion of the 1870 gas holder;
- The western portion of the main gas holder annulus; and
- Areas located west and down hydraulic gradient of the main gas holder annulus and northern/southern tar tanks.

The site has also been the subject of historic filling and there is potential contamination associated with buried fill.

Groundwater on the site has been found to be contaminated by TPHs, PAHs, BTEX, ammonia, phenol and cyanide at concentrations significantly exceeding the relevant trigger values for the protection of human health and aquatic ecosystems in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000).

Because of this known contamination, land associated with the former gasworks is subject of the EPA Declaration. Importantly, the EPA Declaration Area boundary is indicative only. If, during remediation activities, contamination associated with the former gasworks is identified in areas outside of the nominal EPA Declaration Area as shown on **Figure 2** then remediation of these areas will also need to be undertaken in order to address the EPA Declaration (insofar as it relates to Hickson Road).

7.2.2 Remediation Objectives

The objective of the proposed remediation is to allow the EPA Declaration to be removed insofar as it relates to Hickson Road.

AECOM has carried out a Human Health and Ecological Risk Assessment (HHERA) for the EPA Declaration Area (including Hickson Road) in order to establish the risk of harm to human health and the environment from the known contamination, including the derivation of exposure pathways, and with consideration of current land uses. It is noted that the current use of the Hickson Road Remediation Area as a public road will continue following the proposed remediation.

An exposure pathway describes the course that a chemical or physical agent takes from its source to an exposed individual. In order for a human receptor to be exposed to a chemical contaminant from the site a complete exposure

pathway must exist. If the exposure pathway is incomplete then there is considered to be no risk to a receptor.

The *VMP Human Health and Ecological Risk Assessment* (VMP HHERA) prepared by AECOM and provided in **Appendix L**, was prepared as part of the process to address the EPA Declaration for the entire EPA Declaration Area and to enable the EPA Declaration to be revoked. It was not prepared to address remediation required to facilitate any future development.

The objectives of the VMP HHERA are to:

- assess the risk to human health and the environment that the EPA Declaration Area currently represents; and
- develop human health related site-specific treatment criteria (SSTC) for soil and groundwater for use in defining the remediation end-point for the EPA Declaration Area when the EPA Declaration can be removed.

The focus of the VMP HHERA was on the chemicals specified within the EPA Declaration, specifically:

- PAHs;
- BTEX;
- TPH;
- Ammonia;
- Phenol; and
- Cyanide.

7.2.3 Risk Assessments

The VMP HHERA comprised the following key steps with respect to the derivation of SSTCs:

- Refinement of the list of Contaminants of Potential Concern (CoPC) for human health (from that in the EPA Declaration), based on comparison of EPA Declaration Area data to relevant 'Tier 1' screening criteria.
- Review of toxicological data for CoPC and identification of appropriate toxicity values to use in the HHERA.
- Review of chemical and physical properties of each CoPC for risk assessment purposes.
- Development of Conceptual Site Models (CSMs) for the current status of the EPA Declaration Area, including:
 - summarising the sources, nature and extent of contamination at the EPA Declaration Area;
 - description of the EPA Declaration Area physical conditions (including geology and hydrogeology, existing physical structures) to be used in assessment of contaminant fate and transport modelling; and
 - identification of current human receptors and who may be exposed to EPA Declaration Area contaminants and the pathways via which they may be exposed.
- Quantitative exposure assessment including the establishment of relevant exposure parameters for identified receptors and exposure pathways and the application of vapour and dust transport modelling.

- Comparison of risk estimates with risk acceptance criteria recommended and/or adopted by state and federal regulatory agencies. This approach is based on the potential exposure pathways identified for the Paved Recreation (i.e. the current land use) and Intrusive Maintenance Worker land use scenarios.
- Characterisation of the nature and potential incidence of adverse health effects to receptors based on comparison of estimated contaminant intake or exposures to relevant toxicity criteria.
- Where unacceptable risks were identified, chemicals were assessed in terms of their contribution to the total threshold and non-threshold risks reported. Where CoPC were defined to “significantly” contribute to reported risk totals, site SSTC were derived.
- SSTC for soil and groundwater were derived for those CoPC which were identified to “significantly” contribute to the total risk. Estimation of SSTC based on consideration of toxicity, exposure, contaminant migration modelling and acceptable risk levels.
- Comparison of SSTC for current scenarios to chemical concentrations reported within the EPA Declaration Area.
- Consideration of aesthetic risks or issues including odour.

The VMP HHERA comprised the following key steps with respect to the Ecological Risk Assessment:

- Identification of appropriate ecological receptors for both terrestrial and aquatic ecosystems (including groundwater dependant ecosystems);
- Identification of relevant marine water quality criteria (MWQC) from a nationally adopted hierarchy of acceptable guidance documents plus consideration of additional international sources, based on the protection of the nearest surface water receptor, Darling Harbour;
- Identification of potential risk associated with the CoPC based on the comparison of the concentration of CoPC (reported both within the EPA Declaration Area and at the down hydraulic gradient boundary) with the adopted MWQC; and
- Assessment of whether (or not) the concentrations of CoPC within the EPA Declaration Area and at the down hydraulic gradient boundary represent a risk to groundwater dependant ecosystems.

Site Specific Treatment Criteria Soil SSTC have been derived for the unsaturated soils only. Unsaturated soils (i.e. soils not fully saturated with water) are soils present above the level of groundwater reported across the EPA Declaration Area, estimated to be soils shallower than 2m bgl (approximately RL 0.18m). Whilst SSTC for saturated soils (i.e. those below 2m bgl) have not been derived, groundwater SSTC have been derived.

The SSTC for unsaturated soils and groundwater that have been adopted for the remediation of Hickson Road are shown in **Table 5**.

Table 5 – Soil and Groundwater SSTCs for Hickson Road

Chemical Name	SSTC
Unsaturated Soil SSTC	mg/kg
Benzene	380
TPH C10-C14 (aliphatic and aromatic)	54,000
TPH C15-C28 (aliphatic and aromatic)	72,000
TPH C29-C36 (aliphatic and aromatic)	21,000
CPAH (Sum of 8 carcinogenic PAH Compounds (Benz(a)anthracene Benzo(a) pyrene; Benzo(b)fluoranthene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Dibenz(a,h)anthracene; Indeno(1,2,3- c,d)pyrene))	67
Groundwater SSTC	mg/L
Acenaphthylene	47
Benzene	2.1
Naphthalene	1.3
Ammonia	150
TPH C10-C14 (aliphatic and aromatic)	17
TPH C15-C28 (aliphatic and aromatic)	220
TPH C29-C36 (aliphatic and aromatic)	250
CPAH (Sum of 8 carcinogenic PAH Compounds (Benz(a)anthracene Benzo(a) pyrene; Benzo(b)fluoranthene; Benzo(g,h,i)perylene; Benzo(k)fluoranthene; Chrysene; Dibenz(a,h)anthracene; Indeno(1,2,3- c,d)pyrene))	1

7.2.4 Marine Water Quality Criteria

In addition to the SSTC that have been defined for human health, the VMP HHERA refers to established MWQC relevant to protection of aquatic ecological receptors. The MWQC have been adopted at the site boundary at the direction of the EPA, as suitable screening criteria that are protective of the environment including: groundwater dependant ecosystems which may be present down hydraulic gradient of the EPA Declaration Area currently or in the future; and, Darling Harbour.

As set out the RAP, one of the goals of the VMP Remediation Works is to undertake remediation such that groundwater quality leaving the EPA Declaration Area approaches the MWQC. The MWQC are summarised in **Table 6** below.

Table 6 – Marine Water Quality Criteria

Chemical Name	MWQC (µg/L)	Source of MWQC
PAHs		
Acenaphthene	5.8	CCME (1999) Freshwater Guideline
Acenaphthylene	5.8	Adopted criteria for Acenaphthene as surrogate
Anthracene	0.1	ANZECC (2000) 99% Marine Water Trigger Value (0.01 µg/L) identified to be lower than laboratory Limit of Reporting (LOR). LOR adopted.
Fluorene	3	CCME (1999) Freshwater Guideline
Naphthalene	70	ANZECC (2000) 95% Marine Water Trigger Value, moderate reliability
Phenanthrene	0.6	ANZECC (2000) 99% Marine Water Trigger Value
Other Organics		
Phenol	400	ANZECC (2000) 95% Marine Water Trigger Value

Chemical Name	MWQC (µg/L)	Source of MWQC
Petroleum Hydrocarbons		
Benzene	700	ANZECC (2000) 95% Marine Water Trigger Value, moderate reliability
Ethylbenzene	80	ANZECC (2000) 95% Fresh Water Trigger Value, low reliability
Toluene	180	ANZECC (2000) 95% Marine Water Trigger Value, low reliability
Xylene (m & p)	75	ANZECC (2000) 95% Marine Water Trigger Value, low reliability for <i>m</i> xylene.
Xylene (o)	350	Adoption of the ANZECC (2000) 95% Marine Water Trigger Value, low reliability for xylene (o).
TPH C6 - C9	110	CCME (2008a) Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – Table B-9 values for TPH C6 to C8 and C>8 to C10. Criteria calculated from a weighted average assuming a Coal Tar composition of 25% aliphatic and 75% aromatic components
TPH C10 - C14	40	CCME (2008a) Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil – Table B-9 values for TPH C>10 to C12 and C>12 to C16. Criteria calculated from a weighted average assuming a Coal Tar composition of 25% aliphatic and 75% aromatic components
TPH C15-C28	100	No guidelines values available, therefore the LOR has been adopted.
TPH C29-C36	50	No guidelines values available, therefore the standard LOR has been adopted.
Ammonia		
Ammonia as N	4,830	ANZECC (2000) 95% Marine Water Trigger Value, moderate reliability

7.2.5 Remediation Goals and Extent

The remediation goals for the protection of human health and the environment defined in the EPA Declaration Area are as follows:

- As a primary goal, removal/remediation of SPGWT to the extent practicable, for the protection of human health and the environment; and
- As a secondary goal, removal/remediation, the extent practicable, of soil that is representative of CIM, which is defined as;
 - Unsaturated soil concentrations exceeding the soil SSTC; and/or
 - Unsaturated or saturated soil concentrations that are considered to be the source of groundwater concentrations exceeding the groundwater SSTC;
 such that groundwater quality leaving the site (measured at the down hydraulic boundary of the EPA Declaration Area, Block 5) approaches the Marine Water Quality Criteria (MWQC).

To achieve the remediation goals within those parts of the EPA Declaration Area identified as requiring remediation, that remediation should comprise the higher of:

- Removal of SPGWT to the extent practicable, for the protection of human health and the environment;
- Removal/remediation of soil and groundwater concentrations exceeding the relevant site specific treatment criteria to the extent practicable; and
- Removal/remediation of contaminated fill materials such that the contaminant mass is reduced, on average, by 90% to the extent practicable (calculated based on the estimated mass of naphthalene and TPH C10-C14).

Remediation to the extent practicable has been broadly defined in the RAP as remediation to the depth of the underlying natural bedrock to a maximum depth of 10m below ground level. While SPGWT and CIM have been reported in the natural marine sediments below 10m depth, it is expected to result in a negligible contaminant flux and is not considered to pose a significant risk to human health or the environment.

The indicative extent of remediation for the site to achieve the remediation goals is illustrated in **Figures 5 and 6**. **Figure 6** illustrates the indicative extent of contamination requiring remediation within the unsaturated soil zone. **Figure 6** illustrates the indicative extent of contamination requiring remediation within the saturated soil zone. It is noted that these figures relate to the whole EPA Declaration Area, while this SSDA relates only to remediation of the part of Hickson Road associated with the EPA Declaration.

It is further noted that the indicative extent of remediation shown on **Figures 5 and 7** for the Hickson Road Remediation Area shown is anticipated to be a maximum. As per the RAP (Section 8.5.3), the most significant contamination in the Hickson Road Remediation Area has been identified predominantly in historic subsurface gasworks structures (i.e. gasholder annuli and tar tanks), the location of which are shown in **Figure 7**.

To address these key contaminant source areas, remediation in Hickson Road is proposed to focus on contamination within these historic structures. Where required by the RAP and Site Auditor (or the EPA), remediation will also be undertaken to areas outside the structures (up to the extent shown in **Figures 5 and 6**). The final extent of remediation undertaken in the Hickson Road Remediation Area will be subject to future validation testing and agreement with the Site Auditor and EPA.

The remediation technology selected to achieve these remediation goals will be selected based upon the criteria outlined within the Pilot Trial Success Parameters Report, which has been prepared by AECOM and is provided in **Appendix AA**.

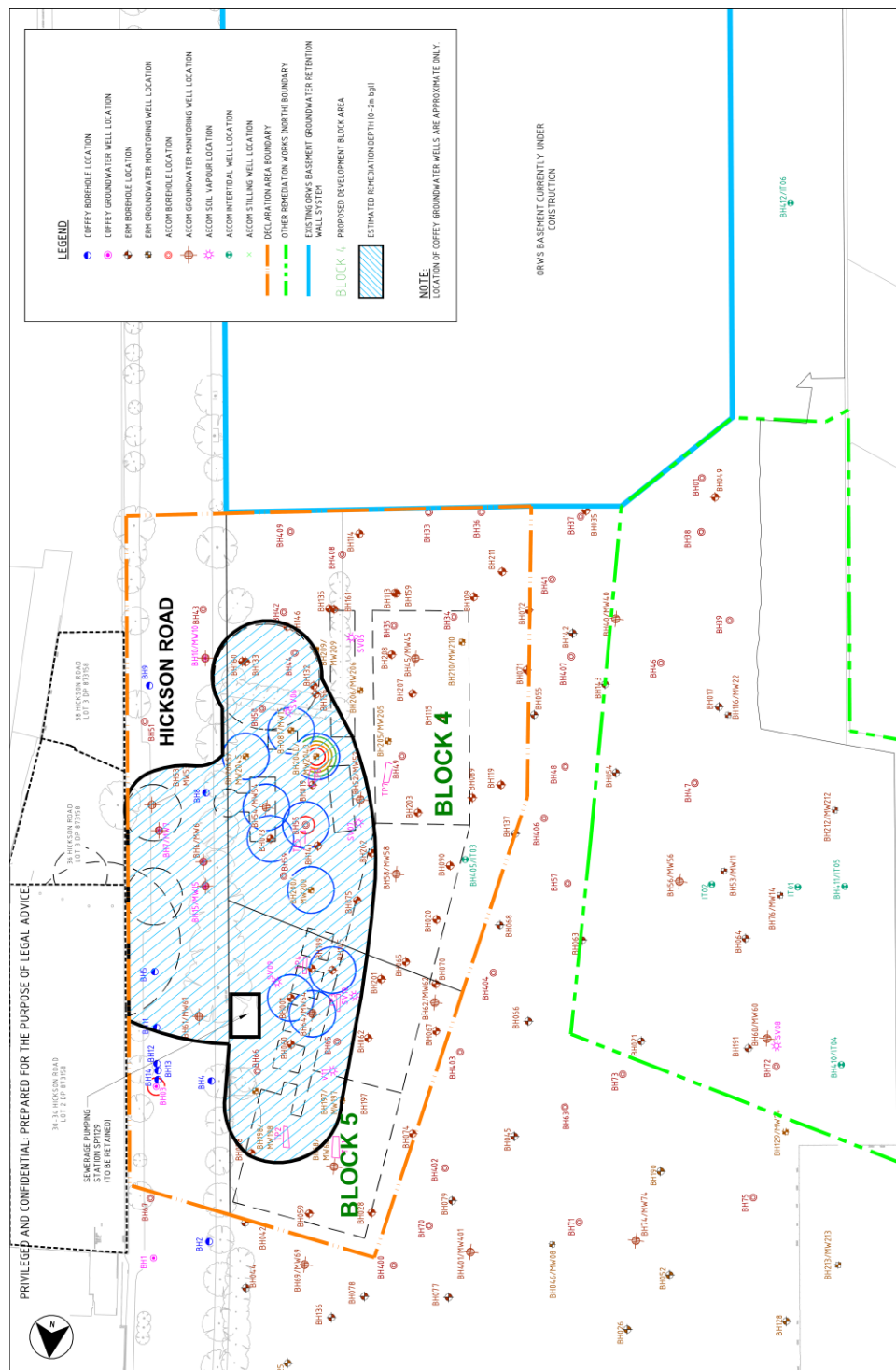


Figure 5 – The Extent of Contamination Requiring Remediation within the Unsaturated Soil Zone
Source: Figure F10 of the RAP (Appendix G)

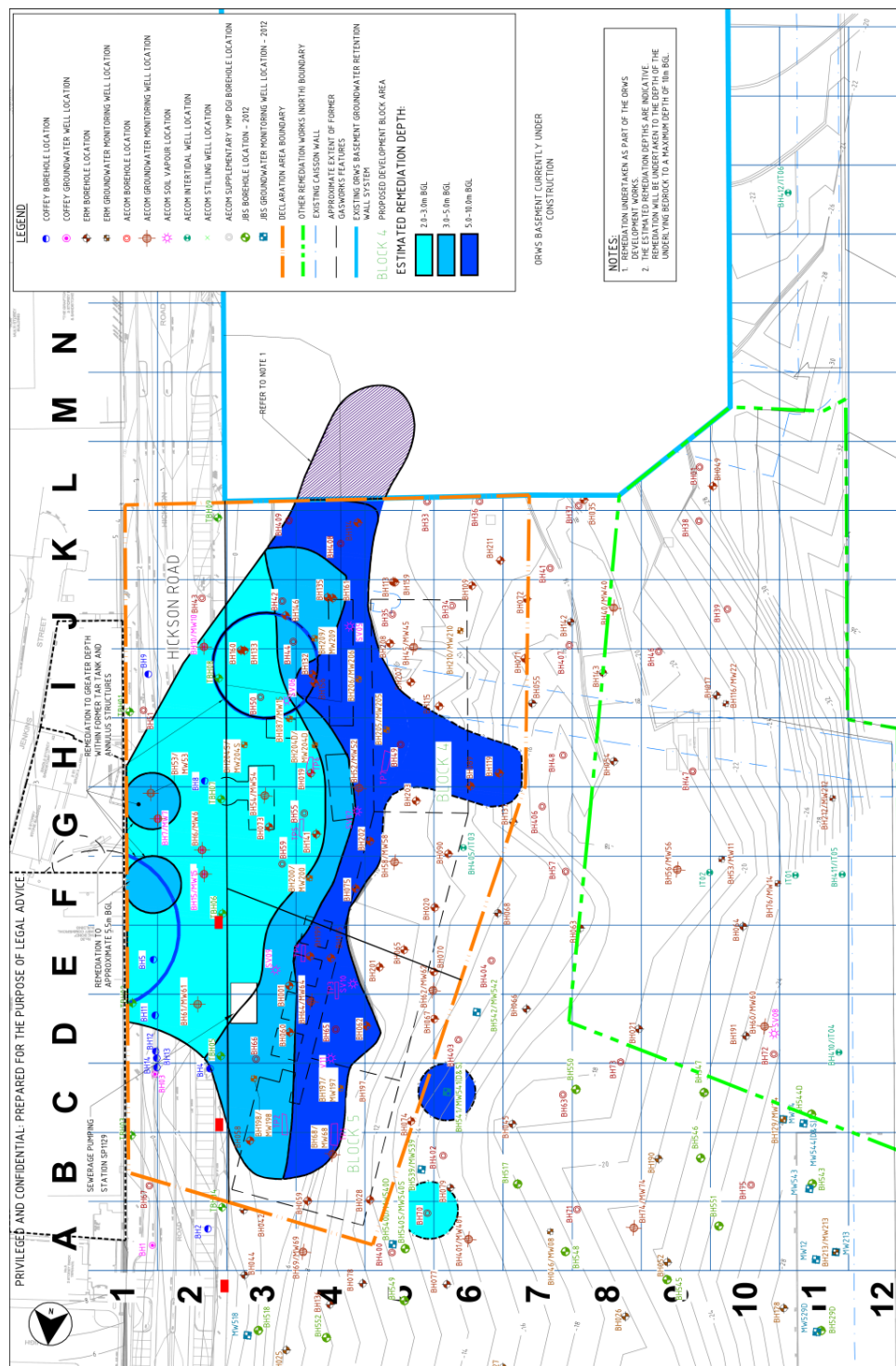


Figure 6 – Extent of Contamination requiring Remediation within the Saturated Soil Zone
Source: Figure F11 of the RAP (Appendix G)

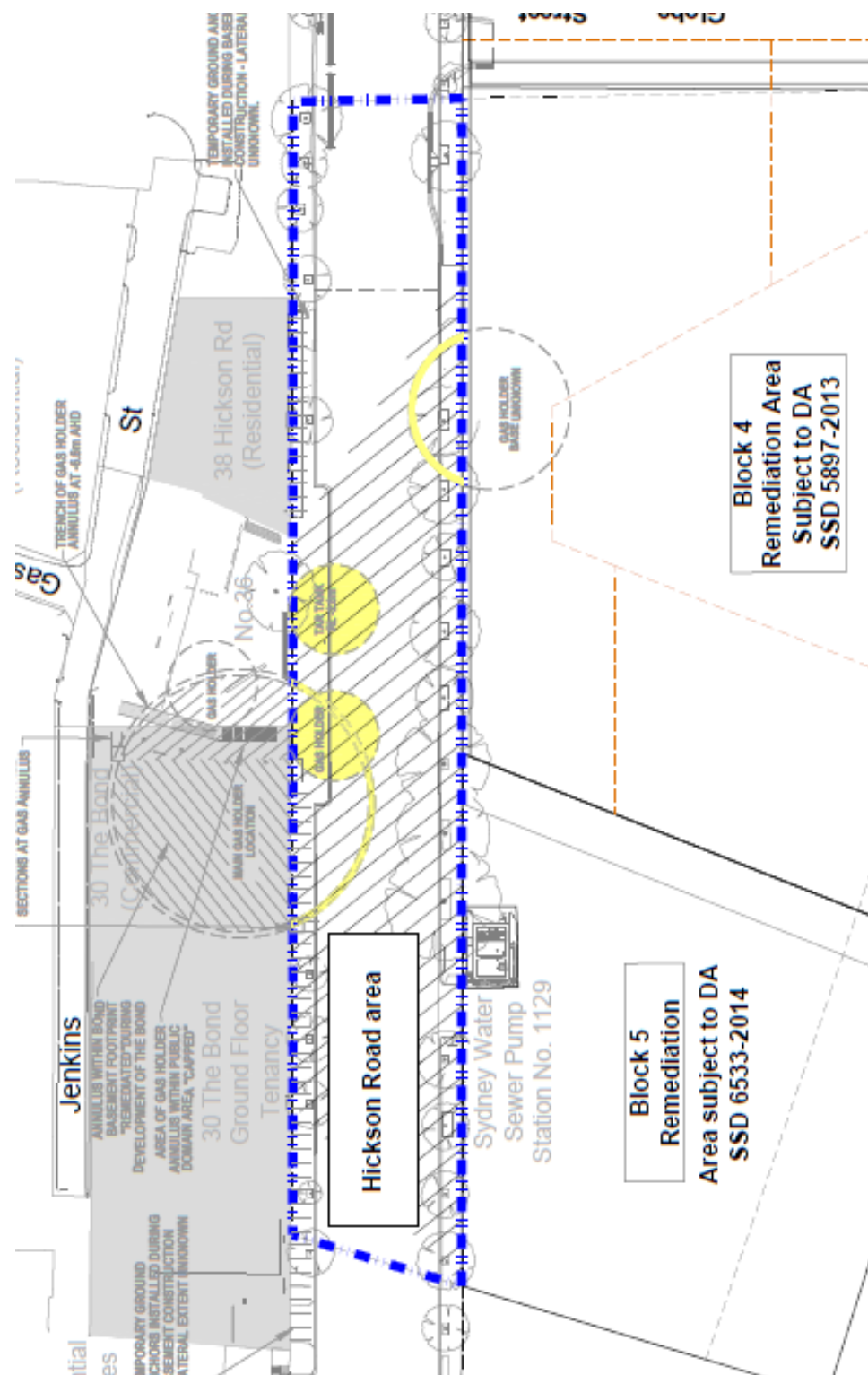


Figure 7 – Location of gasholder annuli and tar tanks
 Source: Staging Plans (Appendix F)

7.2.6 Validation

The RAP includes a detailed set of procedures to ensure that the remediation works achieve the remediation objectives described above. The main elements of the validation process are:

- Soil validation data is assessed in accordance with the National Environment Protection Measure (Assessment of Site Contamination). This will involve demonstrating that relevant SSTCs have been achieved through the:
 - use of systematic sampling patterns;
 - collection of an appropriate number of samples for estimation of the arithmetic average concentration of contaminant(s) within relevant environmental media and exposure areas; and
 - estimation of the 95% upper confidence limit of the arithmetic average concentration for soils.
- A validation Sampling Analysis and Quality Plan will be prepared to detail specific requirements for demonstrating that the remediation works have been undertaken in accordance with the requirements of this RAP.
- Validation of contamination removal through mass calculations before and after remediation.
- For in-situ remediation, collection and analysis of soil samples prior to and following completion of remediation works, to evaluate final CoPC concentrations relative to the RAP objectives.
- For excavated areas, excavated bases and walls will be visually inspected to ensure the excavated surface is free from SPGWT and asbestos containing materials (ACM) to ensure residual soils are suitably validated for the protection of construction workers. If SPGWT is identified at the base of the excavation (where bedrock is not encountered) the identified SPGWT will be removed by over excavation to the extent practicable, in accordance with the RAP. Removal of the material will be validated through visual observations and validation documented via field notes and photographs.
- Materials requiring stabilisation will be tested and validated in accordance with the EPA General Immobilisation Approval (approval number 2005/14) or a specific approval, where required).
- Clean overburden (i.e. excavated materials that meet the criteria as set out in the HHERA (See **Appendix L**) may be stockpiled on the site and may be reused for backfilling. Excavated material that does not meet the HHERA criteria or is not proposed for re-use will be removed from the site for treatment (if required) and/or disposal at a licenced landfill facility.
- Validation of overburden by visual observations. If the excavated material is significantly different from that anticipated by the available analytical data, the material will be stockpiled and additional discrete validation samples collected and analysed from each stockpile at a sampling frequency of 1 sample per 400m³.
- Validation of the areas used for stockpiling contaminated soils by visual inspection, and if necessary, validation of the soil beneath the hardstand (where stockpiles of contaminated soils are located) will be undertaken comprising the collection and analysis of validation samples on a 20m sampling grid collected from the soil surface (0.0 to 0.15m depth) underlying the hardstand.

- Groundwater monitoring will be conducted as per the RAP to assess groundwater quality across the in-situ treatment area (where applicable) and migrating from the EPA Declaration Area against relevant MWQC.
- Site Audit Statements will be obtained at the completion of remediation and validation works, to confirm successful remediation. Interim Audit Advice may be obtained from the auditor to progressively validate stages of remediation in Hickson Road against the applicable remediation goals (where appropriate).

7.2.7 Auditors Review of the RAP

A Site Audit Report has been issued by Accredited Site Auditor Graeme Nyland of ENVIRON Australia Pty Ltd (provided in **Appendix I**) in relation to the RAP. The Site Audit Report from the Site Auditor provides out that the Site Auditor considers that the nature and extent of contamination has been appropriately determined and that the RAP is appropriate for the purpose of enabling the EPA Declaration to be removed.

7.3 Waste Management

A Waste Management Plan (WMP) has been prepared by AECOM and is located at **Appendix X**. The WMP identifies waste sources during the project, estimates the quantities of each kind of waste, classifies that waste in accordance with the EPA's Waste Classification Guideline and specifies whether the waste will be recycled or disposed to landfill.

7.3.1 Waste Generated at the Site

The following wastes will be generated:

- Site office and work site general waste, including recyclables (such as plastic/glass containers, printer cartridges and office paper), domestic wastes, packaging wastes, miscellaneous work site waste and domestic sewage from port-a-loos). Where possible this waste will be recycled, otherwise it will be disposed of to landfill. Port-a-loo waste will be collected for disposal by a contractor.
- General chemicals waste, including waste oils, grease and lubricants, empty drums and containers, and material collected in sediment control devices. This material will generally be disposed to landfill.
- Odour filtration system filters will be disposed to landfill.
- Approximately 0.15 ML of extracted contaminated groundwater which will be treated and discharged in accordance with an Environment Protection Licence or a Trade Waste Permit, or disposed off-site.
- Existing road surface, up to approximately 34 m³ for in-situ remediation (the concrete is removed as part of the installation of wells and excavations for laying h reticulated pipe network) and 1,500m³ for ex-situ remediation works. This is considered to be uncontaminated concrete and will be recycled.
- Removal of trees and crown pruning may generate approximately 150m³ of green waste to be recycled for ex-situ remediation works. For in-situ remediation works, that does not require the removal of trees, the volume is expected to be around 5m³ of green waste.

7.3.2 In-situ Remediation

For in-situ remediation the volume of excavated materials is limited to approximately 42m³ of contaminated spoil requiring off-site treatment, and approximately 21m³ of uncontaminated spoil not requiring treatment.

7.3.3 Ex-situ Remediation

For ex-situ remediation works, up to 16,000m³ of excavated material is expected to be generated, of which up to 11,400m³ will need to be treated off-site. This is expected to be a maximum volume, with final actual volume based on extent of removal required based on validation and Site Auditor requirements. Excavated material that is not contaminated will be disposed off-site or (if suitable) reused on-site where possible. There may be some Potential Acid Sulfate Soils (PASS) in the excavated materials.

7.3.4 Waste Management

Solid Waste Management

Materials separation and segregation will be promoted to facilitate reuse and recycling as a priority of the waste management system. Materials that aren't reused at the site will include:

- Asbestos containing materials.
- Contaminated spoil, TCM and PASS will be disposed of at an appropriately licensed treatment or disposal facility.
- Contaminated material not requiring treatment will be disposed of at an appropriately licensed facility;
- Uncontaminated (and non-PASS/AASS) solid waste material may be transported off-site for reuse under a waste exemption, subject to the approval of the EPA.
- Solid waste material from Hickson Road will be removed and disposed of off-site.

Waste will be classified on-site as far as possible. Waste that is potentially hazardous will be treated off-site prior to disposal. Waste that is not hazardous will be transported off-site to an appropriately licenced facility.

Under in-situ remediation waste stockpiles would not be required. Under ex-situ remediation, space constraints within the excavation enclosure would limit the size of stockpiles.

Liquid Waste Management

Liquid wastes will, to the greatest extent possible, be treated within on-site storage containers to reduce the volume of such wastes requiring disposal. Where this is not possible, liquid wastes will be tankered off site for disposal. Treated liquid wastes will be:

- Discharged to the stormwater system or the sewer if it meets specific discharge criteria; or
- Disposed off-site at a suitably licensed facility after classification in accordance with the *Waste Classification Guidelines*.

Where required for the proposed works, an on-site wastewater treatment plant will be used to treat contaminated stormwater, wheel wash water (if applicable), decontamination water, and dewatering groundwater. The total volume of treated water may exceed 100ML per year, and if so an EPL will be required. Treated wastewater will be discharged to Sydney Harbour in accordance with the EPL as applicable, or to the sewer in accordance with Sydney Water requirements.

Waste Management System

A waste management system will be established utilising a high degree of waste avoidance through the segregation of suitable excavated materials and where possible the reuse of such materials on the Barangaroo site. All wastes generated as a result of the project will be classified in accordance with the Waste Classification Guidelines.

Wastes to be disposed (or recycled) off-site will be transported to a facility (for disposal or recycling) that can lawfully receive the waste. Storage and handling of such wastes will be subject to the following measures:

- Liquid wastes will be stored in appropriate containers in bunded areas until they can be appropriately disposed of. Bunded areas will have the capacity to hold 110% of the volume of the largest container.
- Hazardous wastes (comprising small quantities of printer cartridges and e-waste) will be managed in accordance with the requirements of the Environmentally Hazardous Chemicals Act 1985.
- All other recyclables and non-recyclables will be stored in appropriate receptacles in appropriate locations and covered where required.

The Waste Management Plan includes:

- Waste haulage routes to the specified appropriately licenced landfill facilities.
- Waste Management Forms which will be used for recording and tracking waste types, volumes, and destinations.

The project will be undertaken in conformance with **Appendix X** and accordingly the above recommendations are reflected in the draft Statement of Commitments.

7.4 Asbestos Containing Materials

7.4.1 Introduction

Asbestos containing materials (ACM) have been identified at two locations during investigations within the EPA Declaration Area, however none have been identified within the Hickson Road area. Bonded asbestos fragments have been encountered extensively during recent excavation of the adjacent Stage 1A basement area. The RAP notes that it is reasonable to anticipate that asbestos may be present fill material at the site.

7.4.2 In-situ Remediation

During in-situ remediation the likelihood of encountering ACM is much reduced when compared to the ex-situ method. The potential impacts associated with the in-situ method (including any localised excavation, if required) are therefore considered to be less than those associated with the ex-situ method, which is assessed below.

7.4.3 Ex-situ Remediation

Based on information obtained during the bulk excavation works for the Stage 1A basement the identification of ACM during ex-situ remediation excavation works is considered possible. However, it is noted that the area now known as Hickson Road was reclaimed and filled earlier than the Barangaroo site and therefore the extent of the ACM may differ.

ACM will be managed in accordance with an Asbestos Management Plan, which will be prepared prior to the commencement of site works. An asbestos management plan has already been prepared for works associated with the remediation of Stage 1A and the Hickson Road asbestos management plan will be based upon the measures already in place within this plan, where applicable.

Identified ACM which requires removal under the Asbestos Management Plan will be collected and disposed of by a licensed Asbestos Removal Contractor (ARC) in accordance with the requirements of the following:

- *PoEO Act 1997;*
- *PoEO (Waste) Regulation 2005;*
- *NSW Work Health and Safety Act 2011;*
- *NSW Work Health and Safety Regulation 2011;*
- *Code of Practice: How to Safely Remove Asbestos, Safe Work Australia 2011;* and
- *Code of Practice: How to manage and control asbestos in the workplace, Safe Work Australia 2011.*

The ACM removal works, if required, would be undertaken as follows:

- The remediation contractor would establish appropriate barriers and signage around the area where ACM has been identified;
- The ACM will be suitably removed from the site by an ARC, and transported and disposed of in accordance with Section 42 of the PoEO (Waste) Regulation 2005;
- Airborne asbestos fibre monitoring will be undertaken around the working area during the works to confirm that the ACM is being removed in an appropriately controlled manner;
- Validation soil samples will be collected at 10 m lineal intervals along the walls and base of any identified ACM impacted excavation areas and analysed for asbestos. Should the soils beneath the ACM be impacted with asbestos fibres, the impacted soils will be excavated for appropriate off-site disposal; and
- An ARC will conduct a visual inspection of the affected area to confirm that it is free of all visible ACM fragments. A clearance certificate will be prepared to document these works.

The requirements for the validation of materials to remain in-situ are described in the RAP. The additional works (including over-excavation if required) for management of ACM identified in residual soils for the protection of construction workers will be determined by the Asbestos Management Plan.

No excavated material contaminated with ACM will be reused at the Remediation Area at Barangaroo.

7.5 Health Impact Assessment

7.5.1 Introduction

A Health Impact Assessment (HIA) has been prepared by AECOM and is provided in **Appendix M**. The HIA is a qualitative assessment of potential health impacts associated with undertaking the proposed remediation works and includes the following:

- A conceptual site model for pollutants of concern, including identification of relevant receptors and identification and assessment of potential hazard sources and potential exposure pathways.
- Analysis of the potential for health impacts with respect to pollutants of potential concern location and availability.
- Identification of proposed risk mitigating controls that can be implemented to prevent these potential health impacts from occurring.

7.5.2 Conceptual Site Model

Pollutants of Potential Concern

The pollutants of potential concern were defined as those that have been detected at the site in concentrations greater than the relevant human health screening criteria. The pollutants of potential concern were identified as follows:

- **BTEX:** A group of VOCs which includes benzene (a toxic health hazard and a carcinogen), toluene, ethylbenzene, and xylenes which can be inhaled or ingested and absorbed through contact with the skin. At the site they are generally located in the soil and groundwater, but may vaporise into the air from exposed soil/water.
- **PAHs:** Another category of VOCs which can be inhaled or ingested and can also be absorbed through the skin. At the site they are generally located in the soil and groundwater, but may vaporise into the air from exposed soil/water.
- **TPH (C6-C9 and C10-C36 fractions):** petroleum hydrocarbons which generally contain PAHs and BTEX. At the site they are generally located in the soil and groundwater, but may vaporise into the air from exposed soil/water.
- **Particulate matter.** Suspended particles may carry small quantities of the other pollutants of potential concern through the air. Particulate matter is also linked to a variety of health effects, including respiratory problems, in their own right.
- **Heavy metals:** Heavy metals of concern are described below, and are associated with a range of acute and chronic health impacts. Lead was found to exceed the soil assessment criteria in the Hickson Road Remediation Area. Cadmium, chromium (III and VI), copper, nickel and zinc are reported above the groundwater assessment criteria at the site. These heavy metals are not volatile, so their presence in the air will be associated with suspended particles.
- **Asbestos.**

Sensitive Receptors

Potentially sensitive receptors have been classed into significant exposure groups, being groups of receptors likely to experience similar concentrations and duration of exposure, have similar tolerance to health impacts and have similar mitigation measures in place to prevent exposure. The significant exposure groups are:

- Site workers and visitors.
- Nearby residents.
- The childcare facility located at 37 High Street.
- Business patrons, staff and office workers to the east and south of the site.
- Pedestrians.
- Maintenance workers for utilities and adjacent properties.

The HIA provides a description of the likely extent and duration of exposure for each significant exposure group.

Relevant Exposure Pathways

The HIA identifies the following exposure pathways for pollutants of potential concern for remediation activities for both remediation options (unless otherwise specified these pathways exist for receptors on-site and off-site):

- Incidental ingestion or dermal absorption of chemical in soil.
- Inhalation of chemicals in soil-derived airborne particulates.
- Inhalation of soil-derived vapours.
- Incidental ingestion or dermal absorption of chemicals in groundwater (only for on-site receptors).
- Inhalation of groundwater derived vapours.

7.5.3 In-situ Remediation

Pollutant Sources

For in-situ remediation the limited nature of soil disturbance is expected to limit airborne concentrations of pollutants. Notwithstanding this, the following sources of pollutants have been identified:

- Soil vapours from volatilisation of contaminants in soils being treated in-situ, and from extracted soil and groundwater, may be released.
- Dust may be generated from drilling and trenching works.

Source Controls

The health risk assessment takes into account the proposed measures to be put in place to control the source of pollutants and minimise exposure pathways. Source controls for in-situ remediation activities will include:

- During drilling and other soil movement activities, real-time visual observations will monitor whether dust is being generated and leaving the immediate work area. Dust suppression will be applied where appropriate.
- Odours from volatilisation will be monitored and a soil vapour extraction system will be put in place.

Health Risk Assessment

The health risk assessment for in-situ works are summarised below:

- Inhalation of suspended particles containing pollutants of potential concern is a high risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the minimal disturbance of soil and limited dust generating works.
- Ingestion of suspended particles containing pollutants of potential concern is a moderate risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the implementation of dust control and suppression systems and small quantities of dust.
- Dermal absorption of pollutants of potential concern from dust is a high risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the implementation of dust control and suppression systems and small quantities of dust.
- Inhalation of vapours of pollutants of potential concern arising from groundwater is a low risk for all receptor groups due to the lack of an exposure pathway.
- Unintentional ingestion of contaminated water is considered to be moderate risk for workers on and immediately adjacent to the site, but is low for off-site receptor groups due to the unlikelihood of the exposure pathway.
- Dermal contact with contaminated water is considered to be a low risk for all receptor groups.

High and moderate risks are identified in the HIA for workers on and immediately adjacent to the site under both remediation options. These risks will be managed as follows:

- Engineering controls and safe work practices and effective hygiene procedures (such as hand washing);
- Use of appropriate personal protective equipment.

7.5.4 Ex-situ Remediation

Pollutant Sources

If the alternative remediation strategy is selected, all remediation excavation will take place within excavation enclosures. These structures will be fitted with filtration systems to remove contaminants from the air exhaust stream, with typical removal rates of 85% for gases and 98% for dust. Emissions from exhaust systems will be compliant with EPA emissions standards.

Source Controls

Source controls for ex-situ remediation activities will include measures to control emission of particulates and controls for emission of gases from exposed contaminated soils and water, including:

- Dust suppression, including sweeping and wetting of exposed surfaces including haul roads.
- Excavation and treatment of materials with temporary remediation and soil treatment enclosures, with filtration of exhaust streams.
- Odours from volatilisation will be monitored and a soil vapour extraction system will be put in place.

- Managing groundwater removal and drawdown, where practicable, such that material excavated is retained in a moist state.
- Minimising haul road lengths, implementing of site speed limits and covering haul loads.
- Solid perimeter hoarding adjacent to sensitive receptors.
- Surface stabilisation to minimise dust generation, and covering surfaces where appropriate.
- Prompt removal, covering and managing of heavily contaminated materials that have been exposed.

In addition, the following source controls will be implemented for contaminated water:

- Installation of ground water control and retention walls as practicable around the excavation area to minimise the infiltration of groundwater from the Remediation Area into the less contaminated areas.
- Treatment of contaminated surface water to enable safe discharge in accordance with site regulatory requirements.
- Use of surface bunds and drainage diversions to divert clean water away from contaminated areas.
- Silt fences to prevent cross-contamination between disturbed areas and undisturbed areas.

Health Risk Assessment

The health risk assessment for ex-situ works are summarised below:

- Inhalation of suspended particles containing pollutants of potential concern is a high risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the utilisation of the temporary odour and dust control structures (with emissions filtration system) during excavation activities, the distance to receptors, and the implementation of dust control and suppression systems.
- Ingestion of suspended particles containing pollutants of potential concern is a moderate risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the implementation of dust control and suppression systems and small quantities of dust.
- Dermal absorption of pollutants of potential concern from dust is a high risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the implementation of dust control and suppression systems and small quantities of dust.
- Inhalation of vapours of pollutants of potential concern arising from groundwater is a high risk for workers on and immediately adjacent to the site, but is a low risk for off-site receptor groups due to the utilisation of the temporary odour and dust control structures (with emissions filtration system).
- Unintentional ingestion of contaminated water is considered to be moderate risk for workers on and immediately adjacent to the site, but is low for off-site receptor groups due to the unlikelihood of the exposure pathway.
- Dermal contact with contaminated water is considered to be a low risk for all receptor groups.

7.5.5 Conclusion

The potential for adverse health impacts on the on-site workforce under both remediation options is considered to be high to moderate but manageable through appropriate work practices. In all cases the risks to off-site receptor groups was considered to be low.

To ensure that the potential human health impacts on nearby sensitive receptors are minimised, the source controls and pollutant management measures described above are considered by AECOM to be necessary and appropriate.

The HIA recommends that a vapour and dust monitoring program be implemented to assess the routine concentrations of pollutants of potential concern at locations representative of each significant exposure group. The results of the monitoring program should be used to manage the intensity, location and duration of works being undertaken. In particular, exceedances of the adopted assessment criteria should be linked to corrective work actions including the modification of work patterns and procedures and the implementation of additional control measures.

7.6 Acid Sulphate Soils

7.6.1 Introduction

The RAP (**Appendix G**) reports that results of chemical analysis of a soil sample indicate that Actual Acid Sulfate Soils (AASS) was not present in the sample analysed, however there is a low risk of Potential Acid Sulfate Soils (PASS) to be present.

Based on Acid Sulfate Soils Management Advisory Committee *Acid Sulfate Soils Assessment Guidelines* (1998), the reported sulfur trail (% sulfur oxidisable) and Acid trail (mol H⁺/tonne) exceeds the Action criteria (0.03% and 18 mol H⁺/tonne respectively) for works that involve more than 1,000 tonnes of soils are to be disturbed, triggering the need for an Acid Sulfate Soils Management Plan (ASSMP).

7.6.2 In-situ Remediation

During in-situ remediation the likelihood of excavating or handling Acid Sulfate Soils is much reduced when compared to the ex-situ method. The potential impacts associated with the in-situ method (including any localised excavation, if required) are therefore considered to be less than those associated with the ex-situ method, which is assessed below.

7.6.3 Ex-situ Remediation

An ASSMP has been prepared by AECOM and is provided in **Appendix N**. The purpose of the ASSMP is to consider the potential impacts relating to the ASS material on Sydney Harbour and to detail mitigation measures to minimise these potential impacts. The ASSMP is designed for use during ex-situ remediation. It will not be required for in-situ remediation, during which Potential Acid Sulfate Soil (PASS) materials will not be disturbed. The following control measures are set out in the ASSMP:

- Assessment procedure for PASS with a sampling protocol, set criteria to measure and agreed standards for those criteria to evaluate acid potential.

- Treatment of water accumulating within the EPA Declaration Area to an acceptable water quality for discharge. Ongoing monitoring program (if required).
- Treatment of PASS if encountered (or direct disposal off-site) and control structures to prevent leachate discharge off-site without meeting specified target water quality criteria.

7.6.4 Management Strategies

The ASSMP includes a range of management measures that will be followed to handle, treat and dispose of ASS if required, including:

- PASS materials will be kept separate from non-PASS materials at all times.
- Water collected from PASS treatment/storage areas will be directed to the wastewater treatment plant and treated to a prescribed discharge water quality.
- A truck wash down area will be constructed so that truck wash down water can be collected for treatment.
- Treated water will only be discharged in accordance with the relevant criteria in the EPL. A water quality monitoring program will be implemented.
- Excavated PASS would be either treated on-site, or disposed directly off-site to appropriately licensed landfills.
- If on-site treatment of excavated PASS is undertaken, neutralisation of the PASS will be undertaken by application of calcium carbonate (Aglime) in a designated bunded treatment area and thoroughly mixed with the soil. The treatment area is to be provided with a guard layer of neutralising agent (i.e. Aglime).
- During treatment soil pH will be measured regularly as a measure of the effectiveness of neutralisation.
- Treated materials will be monitored regularly at a rate of one sample per 500m³.
- Treated material will be disposed of in accordance with its classification under the Waste Classification Guidelines.

The ASSMP will be updated following confirmation of the responsible contractor.

7.7 Water Quality and Management

7.7.1 Introduction

The RAP (**Appendix G**) sets out the strategy for managing water throughout the remediation works. A Soil and Water Impact Assessment for the in-situ remediation method (**Appendix P**) has been prepared by AECOM, and a separate Soil and Water Impact Assessment for the ex-situ remediation method has been completed by Worley Parsons (**Appendix O**) to address the likely surface and groundwater environmental impacts. The following sections draw from both the RAP and the Soil and Water Impact Assessments (in-situ and ex-situ).

7.7.2 General Principles

Surface water flows and stormwater will be managed by segregating clean water from impacted water and preventing the inflow of surface water to excavation

areas (where applicable) using surface bunds, silt fences and drainage diversions. The general principles of management of water on the site would be as follows:

- Minimise the volume of contaminated water during the works wherever possible by directing surface water away from excavations, depressions, pits and stockpiles by the construction of drainage works such as bunds and diversion drains. These measures will minimise the flow of clean water into other areas of the site that contain contaminated materials;
- Recycling water where possible by using it on-site as dust suppression and for other site operations such as wheel and truck washing. To ensure that the use of recycled water does not impact on surrounding areas, the following information will be obtained prior to undertaking these activities:
 - Chemical data which demonstrates that the water to be recycled complies with the reuse criteria, including consideration of potential for odour generation;
 - Definition of the area where the water is to be discharged;
 - Details of environmental protection measures installed to ensure that the use of recycled water will have no adverse environmental impact;
 - Appropriate tracking of recycled water reused at the site; and
- Discharge of treated water to stormwater or sewer, with or without treatment, as per regulatory guidelines and in accordance with an EPL and Trade Waste Licence (if applicable) to be obtained for the project. Treated water is currently proposed to be discharged together with stormwater into the harbour or stormwater drains under an approved EPL, or pumped into storage tanks for off-site disposal at an appropriately licensed liquid waste disposal facility.

The following water is considered to be uncontaminated and will be discharged from the site without treatment:

- Rain water from roofs;
- Stormwater from uncontaminated surfaces such as roads (outside of the main soil movement corridor), footpaths, general hardstand, parks and reserve areas; and
- Stormwater generated up-stream of the site will continue to be discharged into the harbour without coming into contact with disturbed areas.

Run-off from areas under construction, but not contaminated, would be subject to standard erosion and sediment control procedures (e.g. silt fences, filter socks, sedimentation basins). This includes parts of the site outside the EPA Declaration Area.

7.7.3 Wastewater Treatment System

Both remediation methods will potentially include use of a temporary wastewater treatment plant (WTP). The final WTP for the remediation works will depend on the remediation method undertaken, however may consist of the following general process units:

- The WTP will be designed to treat PAHs, BTEX, ammonia, phenols, cyanide and heavy metals;
- Pumps and a buffer storage for transferring flows to the plant;

- Dissolved Air Flotation unit for the removal of oils, greases and hydrocarbons which might also include a coagulant and surfactant dosing to assist with solids removal;
- A chemical dosing step to adjust the pH and promote chelation and precipitation of heavy metal complexes;
- Reaction and mixing vessels to facilitate the metals removal process providing flow buffering and adequate reaction times;
- Activated carbon filtration, as required to polish specific residual or trace contaminants from the groundwater and ensure compliance with specific trade waste requirements;
- Sludge handling and/or sludge thickening equipment (or at least a tank, sludge separator) to minimise the residuals that require disposal off-site; and
- Effluent balancing storage (in holding tank) prior to pumping to the transfer sump.

Duty / standby pumps (variable speed drives) will control the pumped outflow to Darling Harbour, following approval of a variation to the existing EPL (refer to **Appendix G**), to the Sydney Water sewerage system, or to stormwater if appropriate.

Diverters and storage basins will be used during unexpected failures to prevent discharge of "untreated" or non-compliant waters into Darling Harbour

7.7.4 In-Situ Remediation

In-situ Remediation Surface Water Management Impact Assessment

The proposed in-situ remediation works will have minimal impact on surface water hydrology and quality. Off-site surface water will be directed away from the site into existing stormwater infrastructure through the use of stormwater control devices (e.g. geotextile gravel / sandbag bund, or similar). The manipulation of up-stream stormwater devices will minimise the amount of stormwater entering the site, and would include the installation of a bund around the active Remediation Areas. This perimeter bund also has the advantage of controlling potential on-site water or sediments exiting the site. Due to the in-situ remediation of Hickson Road being completed in stages, the perimeter bund will only encompass the portion of the road that is actively being remediated.

Where the remediation compound area is covered by a temporary enclosure, rainwater falling on this enclosure will be diverted directly into stormwater.

On-site surface water will be minimised wherever possible by directing 'clean' surface stormwater to stormwater drains through the use of bunds, diversion drains and stormwater controls. Areas where on-site stormwater could come into contact with spoil / waste material, contaminated material, excavated areas (trench locations, prior to backfilling), open boreholes and stockpiles, the stormwater will be contained through the use of bunds (or similar), to allow stormwater collection, categorisation, appropriate water quality treatment and reuse, or, off-site disposal.

Stormwater inlet / grate openings within the vicinity of in-situ works that have the potential to receive contaminated waters will be blocked through the use of barriers surrounding the inlet.

A containment bund will surround trench excavations and borehole drilling activities. Excavation of trenches and drilling of borehole wells will cease during heavy rainfall events, reducing the potential for mobilisation of sediments and/or contaminants. In addition to this, boreholes and trenches will be covered as soon as feasibly possible through backfilling and sealing of trenches and placement of well caps on boreholes, to reduce the potential exposure of stormwater to sediment and/or contaminants.

During set-up on the site, a bunded secondary containment area will be constructed around the System Compound area. This area will house the chemical storage tanks and drums, as well as the drums containing the extraction fluid and waste liquid. Within this System Compound bund, additional bund areas will enclose liquid waste and chemical storage areas. The bunded areas will be lined by a 0.5mm HDPE liner, and have a volume equal to 110% of the largest chemical volume to be contained therein. The lining and bunding will be inspected by a competent person daily for tears or other compromises to its seal. Inspections will be noted and tears repaired.

Potential stormwater collected in the secondary containment area will be stored and treated at the WTP, or tested prior to discharge to ensure it complies with the POEO Act and/or the terms of a Trade Waste Agreement with Sydney Water Corporation for disposal to sewer. Water that fails to meet the criteria of the applicable permits and/or licences will be pumped into storage tanks for off-site disposal at an appropriately licenced waste disposal facility

The likelihood of erosion or sedimentation occurring as a result of the proposed in-situ remediation works associated with the Hickson Road Remediation Areas is low due to the minimal excavation involved. Notwithstanding this, indicative erosion and sediment control measures have been prepared for in-situ remediation works in accordance with DECC's *Managing Urban Stormwater – Soil and Construction* and is provided as part of the Soil and Water Impact Assessment in **Appendix P**.

In addition, an Incident Management Plan will be prepared as part of the Construction Management plan to mitigate risks associated with spills, overfall or leaks during the in-situ remediation. Key strategies to prevent and controls spills include, amongst other things:

- The tanks in which the chemicals are batched and their corresponding transfer piping will be located within a secondary containment berm.
- The containment berm will be bunded and lined by a 0.5 mm HDPE liner. It will have a volume equal to 110% of the largest chemical volume to be contained therein.
- All transfer piping within the system will have flow valves that can be closed and locked. These flow valves will be closed and locked whenever the system is not in use.
- Where possible transfer piping will be enclosed to isolate spill and directed to a sump or injection well for extraction. Transfer piping substrate medium will be graded where possible to encourage spillage flow to collection points.
- Training to prevent and control spills and leaks.
- Administrative strategies including regular inspections, and appropriate documentation, reporting and monitoring.
- Spill response procedures, including containment and clean-up. In the event of a malfunction associated with the injection lines resulting in release of the

injected or extracted fluids the injection process will be shut down and product lines isolated.

In-Situ Remediation Groundwater Management Impact Assessment

As a result of the current hardstand covering at the in-situ Remediation Areas of the site there is likely to be minimal groundwater / surface water interaction. Previous studies have indicated that there is substantial interaction between groundwater and Harbour water at the Barangaroo site adjacent to Hickson Road, under two distinct, but related mechanisms, as follows:

- Rapid inundation and drainage of the porous fill material immediately adjacent to the Harbour, through a highly efficient hydraulic connection that exists between the Harbour and the fill, facilitated by an apparently permeable caisson structure.
- A typical aquifer – surface water response, evident within the marine sediments at depth, where the potential for discharge and infiltration develops in response to tide-induced hydraulic gradients.

The proposed in-situ remediation works associated with the Hickson Road Remediation Area is limited to the installation of boreholes/wells and near-surface trenching for the laying of injection pipes (at an approximate depth of 200mm to 1400mm).

The in-situ injection of remediation chemistry, may pose a potential risk to the groundwater quality. However, the chemicals used in the in-situ remediation process including potentially hydrogen peroxide, sodium persulfate, sodium hydroxide, surfactants and catalysts, can be managed such that they do not cause and adverse impact to the environment in the context of the in-situ remediation.

A detailed soil vapour monitoring program will be in place during the in-situ remediation that will manage any potential risk from gas that may be produced as a result of the oxidant being consumed.

Throughout chemical injections, the progression and extent of the injection front would be followed closely through groundwater monitoring, sampling and laboratory analysis of groundwater from monitoring wells located between the Harbour and the Remediation Area. The rate of reactions between the injected chemistry and subsurface contaminants will be closely followed to monitor that the injected reagents are being consumed. In the event that monitoring results indicate that the treatment front is migrating towards the Harbour and has reached the limit of the Remediation Area boundary, groundwater extraction will be initiated from the installed down-gradient extraction wells.

Where required, groundwater from the injection front zone will be extracted from the subsurface using groundwater extraction pumps, intercepting unreacted chemicals, and adverse risks to the Harbour will be mitigated. Extracted liquids will be handled in accordance with the Waste Management Plan (**Appendix X**).

In-Situ Remediation Aquatic Ecology Impact Assessment

The proposed in-situ remediation works for the Hickson Road Remediation Area are approximately 200m east of the existing foreshore caisson wall structure. As such, there is a low risk that material, treated or otherwise, will enter Darling Harbour and impact the water quality, flora, fauna or habitat in the Harbour as a result of the Hickson Road in-situ remediation works.

Potential impacts to aquatic ecology would be from migration of contamination or chemicals in groundwater or surface water discharging into the aquatic environment. However, as described above (in relation to surface water and groundwater respectively), the in-situ works are designed to prevent this from occurring and so are expected to have negligible negative effects on the surrounding environment.

Rather, remediation of the site contamination is designed to have a long-term beneficial effect on nearby marine vegetation and aquatic ecology by removing an historic contamination source.

In-situ Remediation Water Monitoring Plan

Monitoring will be undertaken during the Hickson Road Remediation Area in-situ remediation consistent with the existing EPL 13336 for the site, including any future licence variations required to reflect the proposed works.

Monitoring will be conducted in order to:

- Track the movement and performance of the injections;
- Optimise the system and treatment processes; and
- Mitigate potential negative impacts on the environment, the community and sensitive receivers in the vicinity of the treatment area.

Monitoring will be carried out during three time periods relative to injections in each treatment area:

- Pre-injection;
- Concurrent with injections/extractions; and
- Post-injection.

Monitoring will comprise the following components:

- Process monitoring: monitoring the chemistry at the system and in the injection wells to track the parameters of the system and subsequently to inform modifications to the operational parameters, including injection rate and pressure, and chemical concentration, in order to optimise treatment.
- Performance monitoring: monitoring of the injected chemicals in monitoring wells provides information as to where the injected chemicals are travelling and the nature of their reactions, which is used to understand the success with which the injected chemicals have contacted the contaminant mass and to document the chemical reactions taking place.
- Groundwater and soil sampling: enables a comparison of conditions before and after the in-situ remediation, and most importantly, will be used to assess the effectiveness of the treatment in attaining the SSTC.
- Soil vapour sampling: to monitor the presence and safety of soil vapours that may be generated.
- Sydney Harbour water monitoring: A Water Quality Monitoring Program will be developed to confirm that the in-situ remediation works are not having an adverse impact on water quality conditions in the Harbour. Monitoring would be undertaken prior to works to understand the baseline conditions, during works, and post works. Monitoring would involve visual inspections, water measurements using water quality meters, and laboratory testing of water samples.

7.7.5 Ex-situ Remediation

Ex-situ Remediation Surface Water Management Impact Assessment

The site is currently impervious and the positioning of excavation enclosure(s) over the remediation works where possible will mean that the site will generally remain impervious while the majority of ex-situ works are occurring. Therefore the volume of runoff from the site prior to the remediation works and while the works are being undertaken is expected to be comparable. As such, due to the impervious nature of the site prior to and during the undertaking of the remediation works, the proposed works would not have a significant impact on the surface water hydrology discharging to Darling Harbour.

The implementation of erosion and sedimentation control measures, in accordance with standard industry practice as per *Managing Urban Stormwater* (Landcom, 2004), would ensure that the stormwater runoff quality during the works is maintained at acceptable levels. Stormwater that is contaminated through contact with the Remediation Area will not be discharged without treatment.

Run-off from areas under construction that are not contaminated would be subject to standard erosion and sediment control procedures. **Appendix O** includes indicative erosion and sediment control plans associated with the ex-situ remediation methods proposed for Hickson Road. The erosion and sediment control measures for each stage include measures around excavated material handling, stockpile management, clean water diversion, minimising exposed surfaces, wash down and vehicle cleaning, use of sediment fences and impervious barriers, and use of sediment basins. Details will be further developed as the project progresses and more details become available.

The following types of water are considered likely to be contaminated:

- Groundwater recovered from any excavations. Control walls will be installed to minimise groundwater infiltration into excavations, where required (see below for assessment of groundwater impacts).
- Rain run-off as collected from any open excavations where it is collected with groundwater in the excavated pit (excavations will be covered by an excavation enclosure where possible minimising the collection of rainwater).
- Run-off from areas contaminated by vehicular traffic transporting contaminated material (if this contamination cannot be suitably controlled by other means such as vehicle wash-down and covering transported materials).
- Collected water in remnant underground structures or voids.
- Any other water from contaminated areas.

Potentially contaminated water will be treated (where required) in a WTP, and discharged in accordance with an EPL or a Sydney Water Trade Waste Licence (if applicable), or re-used on-site (where appropriate). Treated water is proposed to be discharged together with stormwater into the harbour or stormwater drains under an approved EPL, or pumped into storage tanks for off-site disposal at an appropriately licensed liquid waste disposal facility.

Ex-situ Remediation Groundwater Dewatering Impact Assessment

A dewatering system will be installed for the remediation excavations. An estimate of the anticipated volume of water arising from dewatering operations

at Hickson Road is 0.75 ML, in addition to this it is estimated that 0.4ML/day would be removed each day through seepage from off site.

The Geotechnical Report (**Appendix HH**) indicates that the expected volumes of seepage groundwater to be encountered during excavation could be removed using conventional groundwater pumping equipment (i.e. sump pumps at created localised low points in the excavations). All groundwater collected from site dewatering would be treated in the on-site WTP.

As the groundwater is considered to be contaminated, extracting and treating the shallow groundwater (particularly localised to the filling and saturated sediments) would result in a local improvement in groundwater quality.

The following activities are proposed to be implemented to ensure that groundwater extraction does not significantly impact on the surrounding groundwater regime:

- A suitable groundwater control and retention wall will be designed to intercept shallow groundwater flows where required.
- Localised grouting of groundwater control and retention walls may be a requirement where excess groundwater seepage occurs. The extent of grouting will be the subject of further design development.
- Water pumped to the WTP will be initially settled or screened at the interception point to reduce solids loads entering into the plant (to minimise the risk of blockages occurring in transfer lines or within the plant).
- Construction of the above measures will take into consideration the position of any retained services and the use of low impact installation methods to be investigated (if deemed as being required to protect such services).
- More detailed studies on the effects of shallow groundwater drawdown and settlements associated with localised dewatering of the staged excavations can be conducted if required. A site surface/infrastructure settlement effects survey can also be undertaken (pre, during and post construction).

Ex-situ Remediation Groundwater Quality Monitoring

Should ex-situ remediation be carried out, a Groundwater Monitoring Plan (GMP) will be prepared prior to commencement of the remediation works in consultation with the EPA Accredited Site Auditor and will:

- detail the required groundwater monitoring works during and after completion of the remediation works;
- provide for measurement of the effectiveness of the remedial works that have been undertaken (specifically source removal and subsequent groundwater quality improvement) with respect to groundwater quality migrating from the EPA Declaration Area boundary and the associated risk to aquatic ecosystems;
- make provision for any necessary management measures (contingency measures) that may be required to respond to the monitoring results; and
- Comply with legislative requirements and the appropriate requirements of the EPA.

Groundwater monitoring will be undertaken in accordance with the GMP on a quarterly basis during the remediation works to build a robust data set for groundwater quality and to demonstrate that the continuing remediation works are not having a detrimental impact on the environment.

All groundwater samples will be analysed for the relevant groundwater CoPCs and compared to the applicable groundwater SSTCs (on-site) and MWQCs (down gradient from the site) (as required).

Following completion of the remediation works, groundwater monitoring will be continued, if required, to assess whether CoPC concentrations in groundwater are consistent with the applicable groundwater SSTCs and MWQCs. A groundwater monitoring report will be prepared after completing each monitoring event and provided to the EPA Accredited Site Auditor and the EPA.

Specific details of the remediation groundwater monitoring program (including the groundwater monitoring network) will be detailed in the GMP.

Ex-situ Remediation Aquatic Ecology Impact Assessment

The remediation works will be undertaken on land behind (and that is set back from) the existing caisson walls and the rock embankment beneath the existing wharf which form the current shoreline. The Hickson Rd Remediation Area is approximately 200m from Darling Harbour. Remediation works will also be undertaken within groundwater control and retention walls. As such, the risk of groundwater or sediment movement through or under the shoreline structures during the remediation process is insignificant.

The process of remediation will remove a potential existing source of contamination to the local environment, which will constitute an indirect long-term improvement to nearby riparian and aquatic habitats.

Ex-situ Remediation Surface Water Monitoring

An indicative surface water monitoring program is provided in **Appendix O**. The final Water Quality Monitoring Plan requirements will be subject to consultation with the EPA, but will include monitoring of water quality in:

- The WTP (before and after treatment). Both online or real time monitoring and grab sampling are proposed to occur for the treatment plant. An automated water quality monitoring station at the treatment plant will be installed for real time monitoring. If the monitoring results indicate a failure to meet the discharge criteria, then management measures are to be implemented.
- The Harbour. Water quality within the harbour will be monitored for the duration of the remediation phase of the project. Harbour water quality adjacent to operations ("near field") and background sites will be monitored for turbidity, conductivity, temperature and pH continuously (every 15 minutes). Automated water quality monitoring stations (two near field and one reference site fixed stations (on buoys / in pipes)) will be used. Other elements include reactive water sampling and incidental measurements with hand-held meters.
- The sediment basin. Water in sediment basins (if applicable) would be tested for turbidity as required prior to discharge.

Additionally, a daily inspection regime will be carried out for any onsite sediment basins, soil and water management infrastructure, as well as the turbidity / visual plumes within and surrounding the silt curtain (see below).

7.7.6 Conclusion

In-situ Remediation Water Assessment Conclusions

Through detailed consideration of the proposed in-situ remediation works, the potential for adverse impacts on the local surface and groundwater systems is considered to be low. Where impacts are possible, they will be managed through a series of mitigation and monitoring measures to be implemented during the in-situ remediation.

No contaminated or treated water will be discharged into Sydney Harbour or any sewers without being compliant with the POEO Act, EPL 13336 and any future Sydney Water Corporation's Trade Waste Agreement for disposal of water to stormwater (as may be applicable, in each case).

Ex-situ Remediation Water Assessment Conclusions

The Ex-situ Soil and Water Impact Assessment (**Appendix O**) assess the potential impacts to groundwater, stormwater, harbour water and marine ecology resulting from ex-situ remediation works within the Hickson Road Remediation Area. It also identifies measures that can be implemented during application of the ex-situ remediation works to mitigate any potential for impacts to surface water runoff, groundwater, marine ecology, and harbour water quality. The techniques for management of erosion and sedimentation, stormwater, groundwater and contaminated water are documented along with the requirements for water quality monitoring.

Where impacts have been identified, suitable industry standard mitigation measures have been proposed to limit impacts to within acceptable levels. The findings from the assessment indicate that there are no significant negative impacts. In the case of groundwater, the anticipated typical groundwater drawdown would be less than 5 m, with it extending to 9 m in the vicinity of the gasworks structures, while a long term beneficial effect on groundwater quality is expected.

7.8 Air Quality

7.8.1 Introduction

An Air Quality Impact Assessment (AQIA) was carried out by AECOM and is provided in **Appendix Q**.

7.8.2 Pollutants of interest

The proposed works will generate particulate emissions associated with both excavation and materials handling. Heavy metals detected within the soil may be released to the air attached to the dust. The works will primarily use electrical and diesel-powered plant and equipment. The combustion of diesel fuel generates a range of pollutant emissions, primarily NO_x and particulate matter (PM₁₀). When exposed to air, the contaminated material is also expected to generate gaseous emissions of the contaminants and associated odours.

For the purposes of the AQIA, pollutants of potential interest were defined as chemicals that have been detected on the site in concentrations greater than relevant human health screening criteria. The pollutants considered were:

- Nitrogen dioxide (NO₂);
- Particulate matter;

- Heavy metals (being cadmium, chromium VI, copper, lead, mercury, nickel zinc);
- VOCs, including BTEX (including benzene, toluene, ethylbenzene, xylenes);
- Benzo(a)pyrene; and
- Odour.

Other emissions, such as carbon monoxide, sulfur dioxide and VOCs, are also emitted from combustion engines, but were not assessed as they were considered to be lower risk than particulate and NO_x emissions due to their generally higher trigger values.

7.8.3 Existing environment

The EPA operates a network of air quality monitoring stations around the state. The closest station to the site is located at Rozelle, (approximately 3.5 km to the west). Ambient pollutant concentrations recorded at this station in 2013 were adopted for this assessment for consistency with previous assessments undertaken for the Barangaroo site.

Ambient TSP concentrations have not been monitored at Rozelle since 2004. The ratio of PM₁₀ to TSP from Rozelle for 2004 (the last recorded year of TSP monitoring at Rozelle) was used with the ambient annual PM₁₀ concentration from Rozelle in 2013 to estimate the annual TSP concentration. The ratio of PM₁₀ to TSP for 2004 was calculated to be 49% at Rozelle (i.e. 49% of TSP in the region monitored by Rozelle was PM₁₀), which, when applied to the 2013 ambient annual PM₁₀ concentration of 18.3 µg/m³, equates to an annual TSP concentration of 37.4 µg/m³.

The background concentrations used in the AQIA are summarised in **Table 7**.

Table 7 – Ambient Pollutant Concentrations, Rozelle Monitoring Station

Pollutant	Averaging Period	Background Concentration µg/m ³	Assessment Criteria µg/m ³
NO ₂	1 hour maximum	131.6	246
	Annual	20.2	62
PM ₁₀	24 hour maximum	58.5	50
	Annual	18.3	30
TSP	Annual	37.4	90
Ozone	1 hour maximum	143.1	214
	1 hour maximum	114.7	171
	Annual	31.7	-

7.8.4 Relevant assessment criteria

The EPA has specified ground level concentration criteria that are intended to minimise the adverse effects of airborne pollutants on sensitive receptors. The ambient air quality criteria for the pollutants considered in this assessment are shown in **Table 7**.

The EPA's odour assessment criteria for complex mixtures of odorous air pollutants take into account individual sensitivity to odour in the community, and use a statistical approach for determining the appropriate criterion for a particular site based on the size of the surrounding population. As population size

increases, the likelihood of sensitive individuals being within that population also increases; as such, areas with larger populations require more stringent criteria. An odour assessment criterion of 2 odour units (OU) was adopted for this assessment due to the urban nature of the area surrounding the project site. The following pollutants were combined and assessed as a complex mix of odour:

- BTEX (including 1,2,4-trimethylbenzene; 1,3,5-trimethylbenzene and isopropylbenzene);
- Cyanide;
- Naphthalene;
- Phenols (2-methylphenol; 4-chloro-3-methylphenol and phenol);
- Dibenzofuran; and
- Styrene.

7.8.5 In-situ Remediation Emissions

The in-situ remediation works would emit pollutants primarily through the soil vapour recovery stack which is part of the treatment compound.

Limited excavation works will be required for the in-situ method, including trenching and soil boring/well installation. As described in Section 5.3.5 some limited localised excavation/disposal of gasworks contaminated material may also be undertaken if required to complete remediation. Suitable odour controls such as limiting exposed excavations, use of foams, covers and odour suppressants would be applied for these localised excavation works.

Other equipment expected to be used during the excavation works, such as the water pumps and fans, would be expected to be electrically-powered and, as such, would not generate combustion products during their operation.

As the amount of potential excavation works associated with the in-situ remediation is small compared to those assessed under the ex-situ remediation, and as the soil vapour extraction emissions from the in-situ process are also relatively small (compared to emissions from the excavation enclosures), the ex-situ scenario is considered to represent the worst-case expected emissions associated with remediation and is described below. **Section 7.8.7** provides the results of the air quality impact assessment for in-situ remediation works.

7.8.6 Ex-situ Remediation Emissions

Ex-situ remediation works involve the excavation and handling of potentially odorous materials, which would generally occur inside excavation enclosures. Emissions from these activities would be emitted from the stacks associated with the excavation enclosures following filtration.

Works that cannot be carried out within excavation enclosures relate to the construction of retention walls, due to the use of piling equipment. A Hickson Road Perimeter Retention Wall – Preliminary Air Quality and Odour Control Plan has been prepared (provided at Attachment 1 of **Appendix KK**) that sets out odour control methodology during these retention wall works, and these are summarised in **Section 7.8.9** below.

Trucks would be used to transport materials from the excavation enclosures to off-site treatment destinations. **Appendix KK** includes a detailed description of odour emission controls that will be implemented during the off-site transport of

contaminated excavated materials, and these are summarised in **Section 7.18** below.

Any off-site treatment works would be undertaken at a licenced treatment facility, and, as such, the emissions associated with treatment would be subject to that facility's EPA licence conditions. **Appendix KK** sets out the minimum requirements for the off-site treatment facility, and these are summarised in **Section 7.18** below.

Other equipment expected to be used during excavation works, such as the water pumps and fans, would be expected to be powered by mains electricity and, as such, would not generate combustion products during their operation.

7.8.7 Impact assessment

Dispersion modelling was undertaken to predict the potential effects of the remediation works associated with both options. The following sections outline details of the dispersion model used and its inputs (specifically meteorology, terrain, building parameters, modelling scenarios, source characteristics and emissions inventory), sensitive receptor locations, and the methodology used in the estimation of pollutant concentrations.

The modelling was conducted in accordance with and/or in consideration of the following statutory documents:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (DEC, 2005);*
- *Assessment and Management of Odour from Stationary Sources in NSW: Technical Framework 2006;*
- *Assessment and Management of Odour from Stationary Sources in NSW: Technical Notes 2006; and*
- *Protection of the Environment Operations (Clean Air) Regulation 2010.*

The 'CALPUFF' air dispersion model was used in the AQIA. The AQIA sets out the assumptions for the dispersion modelling as well as the details of the source emission characteristics for each scenario, including emission rates from excavation areas and truck movements.

A series of scenarios were assessed, representing the expected highest activity levels during the in-situ and ex-situ remediation works respectively, as well as scenarios that combine the in-situ and ex-situ remediation works with other construction activities at Barangaroo South. Cumulative assessment also includes the combined project contribution (for both in-situ and ex-situ remediation works) plus background pollutant concentrations.

The results show the total cumulative pollutant concentrations of the Hickson Road remediation activities, Block 4 remediation activities, Block 5 remediation works, construction of the C1 building, Stage 1C remediation and earthworks, and the operation of the water treatment plant, as well as the contribution to this cumulative pollutant concentration from the in-situ and the ex-situ remediation works respectively.

The dispersion modelling for the cumulative scenarios assessed the Hickson Road remediation works taking place alongside the following projects:

- Block 5 Remediation Activities (comprising emissions from excavation equipment and excavation enclosure stacks);

- 'Block 4' Remediation Activities (comprising emissions from excavation equipment and excavation enclosure stacks);
- Building C1 construction;
- Stage 1C Remediation and Bulk Earthworks; and
- Operation of on-site water treatment plant.

At the time of writing this report, the Air Quality Impact Assessment for the Stage 1B Basement was yet to be finalised. Accordingly, the Stage 1B Basement works are not modelled as a concurrent activity in the cumulative impact assessment in this Hickson Road Remediation AQIA.

Other Barangaroo projects were not modelled as it is unlikely that that will occur concurrently with the Hickson Road remediation activities. Particularly, Other activities on the Barangaroo site, including works associated with Barangaroo South and the operation of the concrete batching plant, which were addressed in previous assessments for Block 4 and/or Block 5 remediation proposals, are expected to be completed when the Hickson Road remediation works commence. Other works associated with Hickson Road remediation, such as construction of the retention wall, were also not expected to occur concurrently with the remediation works, and were not, therefore, included in the modelling scenario.

7.8.8 Results

No exceedances of the EPA criteria were predicted to occur at any sensitive receptor location assessed for TSP, air toxics (i.e. heavy metals, benzo(a)pyrene and cyanide) or odour.

Exceedances of the relevant criteria for annual and one hour NO₂ and 24 hour PM₁₀ were predicted for both in-situ and ex-situ remediation, when taking into account both the background and Stage 1C contributions. There were no exceedances of the annual criteria for NO₂ and PM₁₀.

Table 8 shows the modelling results of the AQIA for both in-situ and ex-situ remediation.

Table 8 – AQIA Modelling Results.

Pollutant	Averaging Period	Units	In-situ		Ex-situ		Criteria
			Maximum Predicted Contribution	Total Cumulative Contribution	Maximum Predicted Contribution	Total Cumulative Contribution	
NO ₂	Max 1 hour Average	µg/m ³	0	390.8 *	181.9	390.8*	246
	Annual Average	µg/m ³	0	53.9	12.7	57.7	62
PM ₁₀	Max 24 Hour Average	µg/m ³	0	91*	2	92*	50
	Annual Average	µg/m ³	0	25	1	25	30
TSP	Annual Average	µg/m ³	0	54	7	58	90
Benzene	99.9 th 1 hour	µg/m ³	0.00002	N/A	0.24	N/A	29
Ethylbenzene	99.9 th 1 hour	µg/m ³	0.00003	N/A	0.19	N/A	8,000
Toluene	99.9 th 1 hour	µg/m ³	0.00018	N/A	0.33	N/A	360
Xylenes	99.9 th 1 hour	µg/m ³	0.00008	N/A	0.71	N/A	190

Pollutant	Averaging Period	Units	In-situ		Ex-situ		Criteria
			Maximum Predicted Contribution	Total Cumulative Contribution	Maximum Predicted Contribution	Total Cumulative Contribution	
Naphthalene	99.9 th 1 hour	µg/m ³	0.00120	N/A	16.45	N/A	440
Phenol	99.9 th 1 hour	µg/m ³	0	N/A	0.94	N/A	20
Odour	99 th % NRT	OU	0	N/A	0.06	N/A	2

* Maximum cumulative concentration calculated contemporaneously
Exceedences are in **Bold** NRT – Nose Response Time 100th Percentile

The maximum predicted cumulative one hour NO₂ concentration is inclusive of all onsite construction activities, background concentrations, and Stage 1C works of 390.8 µg/m³ for both in-situ and ex-situ remediation.

The modelling predicted two exceedences of the criterion to occur at one singular receptor location (Receptor 81, located adjacent to the development site) for both remediation methodologies. This corresponds to 0.09% of the year; which is considered to be infrequent.

THE AQIA included further analysis of the predicted exceedences in NO₂ concentrations, which suggested that the exceedences of one hour NO₂ are likely to be caused by a combination of conservative emission factors, conservative equipment utilisation rates and the placement of forklift sources on the site boundary. The real operations will be expected to result in less conservative operations and given the predictions are very close to compliance, exceedance of the criteria is not expected to occur in reality.

The following assumptions are considered to have built a substantial layer of conservatism into the modelling, which is likely to result in over prediction of NO₂ concentrations. On this basis, monitoring of the NO₂ is not considered necessary.

- Placing major contributing sources of NO_x on the site boundary, including forklifts associated with the C2 building.
- Assuming forklifts will be diesel powered, when they will likely be dual powered and are expected to primarily operate on LPG.
- Assuming all mobile construction equipment will operate continuously within the construction hours of 7am to 6 pm, seven days per week all year.

For the 24 hour PM₁₀ criterion, there were three exceedences of the 24 hour PM₁₀ criterion in the background data. The AQIA shows that the contribution to 24-hour PM₁₀ is small (0-2 µg/m³) and the modelling predicted there would be no additional exceedences of the criterion at nearby sensitive receptors for all scenarios.

7.8.9 Recommendations

Air Quality Recommendations for All Remediation Works

The AQIA describes mitigation and work practices that should be implemented at the site to minimise pollutant emissions under both remediation scenarios. These include odour control measures, standard control measures to minimise the generation of dust and other air pollutants such as turning vehicles off when not in use, ensuring all equipment and vehicles are well tuned and in good working order, covering loads, minimising haulage, reduce exposed work areas, and watering exposed surfaces and roads. All mitigation and work practices that should be implemented at the site to minimise pollutant emissions are described in the AQIA. These measures are intended to reduce risks to human health and

nuisance impacts. The proposed monitoring works should be undertaken for the duration of the remediation works.

When monitoring systems continuously measure pollutant concentrations, an early warning system based on trigger levels can be used to minimise adverse impacts on the environment. The trigger levels are generally set below a relevant assessment criterion. A reactive management plan has been developed for the site, based on a three-stage approach:

- **Investigate:** Identification of the likely reasons for the elevated pollutant concentration and formulation of a contingency response for the action stage;
- **Action:** Implementation of the measures formulated in the investigative stage and review of their effectiveness; and
- **Stop Work:** All works should stop at this stage until the measured pollutant levels are below the action level to avoid an exceedance of the pollutant criterion.

The reactive management procedures for PM₁₀ are provided in the AQIA, as well as the ambient air quality agenda for TSP, heavy metals, PAH, VOCs and odour.

Air Quality Recommendations for Ex-Situ Remediation Works

For ex-situ remediation works, the following measures relate to ensuring that the proposed works are carried out in a manner consistent with the air quality modelling assumptions for ex-situ remediation works, as follows:

- All excavation, materials handling and on site ex-situ treatment (excluding retention wall works) will be undertaken within the sealed excavation enclosures, which will be maintained under negative pressure.
- A minimum of two granular activated carbon (GAC) filters will be installed in series for each emission stack in the excavation enclosures as per the modelling assumptions. The GACs chosen will be suitable for the contaminants being treated.
- Prior to commencement of the relevant stage of works where excavation enclosures will be used, a detailed design plan of the structures, the air discharge point and emission control system, will be submitted to the EPA for review and comment. The detailed design plan will include the following information:
 - Performance specifications, including particle and VOC control efficiency for the proposed technology;
 - Proposed monitoring to confirm the performance of the proposed VOC control technology; and
 - The proposed methodology to detect carbon bed breakthrough.
- Stacks will be located on the western sides of the excavation enclosures as assumed in the modelling.
- The excavation enclosures will be maintained to their design specifications. Regular checking and maintenance of excavation enclosure filtration systems will be undertaken.
- Generator emissions will be vented through the excavation enclosure stacks.

As described in the AQIA, ambient air quality monitoring will be carried out for the duration of the remediation works to confirm that the excavation enclosure and

Other Air Quality Recommendations

In addition, **Appendix KK** sets out the odour control measures that would apply to:

- The retention wall works; and
- The off-site transportation of contaminated materials.

Retention wall works would be subject to the mitigation measures set out in the Hickson Road Perimeter Retention Wall – Preliminary Air Quality and Odour Control Plan (provided at Attachment 1 of **Appendix KK**), which includes the following measures where tar is anticipated:

- As a primary control minimising the quantity of tar exposed at any one time by only drilling one hole at a time and filling it with concrete slurry once it is drilled.
- As secondary controls:
 - Managing odour from spoil arising and stockpiles through installation of barriers, use of odour suppressants or misting sprays around the works area, use of foaming agents on spoil, and covering stockpiles (preferably with solid cover such as tarpaulins).
 - Managing trucks to minimise fugitive odours, including the use of sealed trucks, and covering loads prior to leaving loading zones with odour suppressant foam and automatic tarpaulins.
 - Implementing monitoring and reactive management via odour and weather monitoring and modifying works or controls as required.

Off-site transport of contaminated materials would be subject to the mitigation measures set out in **Appendix KK**, which are detailed in **Section 7.18**.

7.8.10 Conclusion

Exceedances of the 1 hour NO₂, annual NO₂ and 24 hour PM₁₀ criteria were predicted to occur for both in-situ and ex-situ remediation when considered cumulatively with background pollutant concentrations and other construction projects at Barangaroo. These exceedances were considered to be a result of conservative assumptions and emission factors used in the dispersion modelling, and the proximity of receptors to the proposed works.

The predicted pollutant concentrations at sensitive receptors were lower than those predicted for other, approved, aspects of the Barangaroo development. Lend Lease currently operates a reactive dust mitigation system at the Barangaroo South site, which includes ambient pollution monitoring, is directly linked to real-time warnings and incorporates work procedures to ensure that action is taken to reduce dust levels when they are elevated and at risk of exceeding acceptable air pollution levels. The system has been operational on the Barangaroo South site for several years, and will continue to operate throughout the duration of the Hickson Road remediation works. Lend Lease uses its existing air quality monitoring network and its operational procedures to ensure the site emissions are mitigated to an appropriate level and that adverse impacts (i.e. exceedances of ambient air quality criteria) are minimised at sensitive receptor locations as a result of site operations.

Lend Lease has demonstrated that it can undertake significant materials handling activities with substantial plant and equipment numbers on site while minimising emissions through this reactive management and monitoring system.

Furthermore, rigorous safeguards would be in place during the ex-situ transport of excavated materials. As such, unacceptable adverse effects on local air quality are not expected to occur as a result of the proposed Hickson Road remediation activities.

An Air Quality and Odour Management Sub-Plan would be prepared to include mitigation measures from the AQIA, and would include an Air Quality Monitoring Plan. The Sub-Plan would contain measures to reflect variations in cumulative emissions from construction activities across Barangaroo.

7.9 Noise and Vibration

A Noise and Vibration Impact Assessment has been prepared by Wilkinson Murray, and is provided in **Appendix R**. The outcomes of the Noise and Vibration Impact Assessment report are summarised below.

7.9.1 Representative Ambient Noise and Background Noise

The Noise and Vibration Assessment identifies five (5) commercial receivers and seven (7) residential receivers as well as three (3) heritage receivers. The receivers include those at Millers Point, Barangaroo, Darling Island, Pyrmont, King Street Wharf, and Balmain East.

In order to quantify the existing noise environment, long-term ambient noise levels were monitored at eight (8) locations surrounding the site, selected to cover the range of environments in the potentially affected areas. These monitoring locations include Hickson Road, Barangaroo, King Street Wharf, Millers Point, Darling Island and Balmain East. For each noise monitoring location the background noise level (Rated Background Level(RBL)) and average noise over each 15 minute period ($LA_{eq, 15-min}$) were determined.

7.9.2 Noise Guidelines and Criteria

The EPA's *Interim Construction Noise Guideline* provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $LA_{eq, 15min}$ noise level should not exceed the background noise by more than 10dBA. This is for standard hours: Monday to Friday 7.00am to 6.00pm, and Saturday 8.00am to 1.00pm.

Outside the standard hours, each criterion would be background plus 5dBA. The criteria are based on the monitoring background noise monitoring data described above, which determines the background noise.

The guideline also identifies that noise above $LA_{eq, 15 min}$ 75dBA is likely to result in strong community reaction to noise, and the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works are to proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

In addition, the following construction noise management levels $LA_{eq, 15 min}$ are recommended for other receivers and areas.

- Active recreation areas (such as parks): external $L_{Aeq, 15 min}$ 65dBA.

- Industrial premises: external $L_{Aeq,15\text{ min}}$ 75dBA.
- Offices, retail outlets: external $L_{Aeq,15\text{ min}}$ 70dBA.
- Classrooms at schools and other educational institutions: internal $L_{Aeq,15\text{ min}}$ 45dBA.

Table 9 sets out the background noise levels monitored for each receiver and the resulting construction noise management level for each receiver.

The EPA guidelines stipulate that where the predicted $L_{Aeq(15\text{min})}$ is greater than the construction noise management level, the proponent should apply all feasible and reasonable work practices to minimise noise, and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 9 – Background Noise and Construction Noise Management Levels

Location	Background Noise Level (RBL)				Construction Noise Management Level ($L_{Aeq,15\text{-min}}$)			
	Day	Evening	Night	Sat	Day	Evening	Night	Sat
Hickson Rd Residents	53	53	49	51	63	58	54	55
High St Residents	47	44	41	45 *	57	49	46	50
Merriman St Residents	46	44	40	46 *	56	49	45	51
Balmain East Residents	49	45	40	46 *	59	50	45	51
Darling Island / Sydney Wharf Residents	47	44	39	50 *	57	49	44	55
Commercial Properties	52-60	50-60	45-49	48-57	70			
Schools	47-53	44-53	41-49	46-57	55**			
Parks/outdoor areas	NA				65			

* Determined from the afternoon on Saturday 4 September as the morning was affected by rain.

** The external NML of 55dBA is based on a 10dB reduction through an open window to meet an internal level of 45dBA.

7.9.3 Noise Generation Activities

The full list of construction plant and equipment expected to be used for the remediation works is provided in the Noise and Vibration Assessment. The proposed remediation hours are between 7.00am and 6.00pm Monday –Friday and between 7.00am and 5.00pm on Saturdays which are outside of standard City of Sydney hours.

No noise generating remediation work is proposed to be undertaken outside the proposed remediation hours, including on Sundays or Public Holidays.

Loud activities, such as excavator mounted hammers, would not be undertaken outside the hours of 7.00am and 6.00pm Monday – Friday and between 7.00am and 5.00pm on Saturdays.

A 2.4 metre solid hoarding / noise barrier equivalent to a plywood barrier is proposed to be erected around the perimeter of the site. This noise mitigation measure has been included for the purpose of this assessment.

7.9.4 In-situ Remediation Assessment

The proposed in-situ remediation has been divided into five stages as follows:

- Stage 1 –Installation of western (northbound) Remediation Area.

- Stage 2 – Install of eastern (southbound) Remediation Area and groundwater controls.
- Stage 3 – Undertake remediation on the eastern (southbound) lane.
- Stage 4 - Undertake remediation on the western (northbound) lane.
- Stage 5 – Validate remediation, decommission wells and restore road.

The cumulative acoustic scenario is based on the Hickson Road in-situ remediation works for Stage 2 coinciding with the following other projects at the Barangaroo site:

- Remediation of 'Block 4' and 'Block 5';
- Construction of Commercial Building C2/C6;
- Construction of Commercial Building C8/H2;
- Remediation of Stage 1C; and
- Construction of the Stage 1B Basement; and
- Construction of the Crown Hotel.

The anticipated noise impacts on these identified residential receivers are summarised in **Table 10**.

Table 10 – Noise Impacts on Residential Receivers

Scenario	Hickson Rd	High St	Merriman St	Balmain East	Darling Island	Sydney Wharf	Residential Building R8
Criteria(dBA)							
Day	63	57	56	59	57	57	63
Evening	58	49	49	50	49	49	58
Night	54	46	45	45	44	44	54
Saturday	55	50	51	51	55	55	56
Predicted Noise: In-situ Remediation (dBA)							
Stage 1							
Day	74	46	38	39	40	39	49
Night	<30	<30	<30	<30	<30	<30	<30
Stage 2							
Day	77	46	38	39	40	39	49
Night	<30	<30	<30	<30	<30	<30	<30
Stage 3							
Day	68	35	32	31	34	32	40
Night	51	<30	<30	<30	<30	<30	<30
Stage 4							
Day	67	38	32	32	34	32	42
Night	49	<30	<30	<30	<30	<30	<30
Stage 5							
Day	75	45	39	37	39	38	48
Night	<30	<30	<30	<30	<30	<30	<30
Cumulative							
Day	79	67	56	57	59	65	72
Night	51	37	<30	<30	<30	<30	48

Notes: Where a predicted noise exceeds either of the relevant criteria it is highlighted in red in the table.

Predicted Noise (Day) is assessed against the Daytime and Saturday criteria, whereas the Predicted Noise (Night) is assessed against the evening and night time criteria.

Residential Receivers

The greatest exceedances are generally restricted to residences in Millers Point (Hickson Road) to the east of the site, although minor exceedances are predicted at all receivers during the cumulative assessment. Exceedances of up to 22 dBA on Saturdays are predicted for the residences on Hickson Road due to the proximity of these residences, which overlook the site.

The noise predictions at Hickson Road residences exceed the 'Highly noise affected' level of 75dBA for some in-situ remediation work stages.

At night time noise levels from the in-situ method are predicted to meet relevant criteria. This assumes that the injection / extraction pumps would be housed in an acoustically treated trailer / housing which would effectively minimise noise breakout, and the soil vapour extraction pumps would be provided with acoustic screens that would break the line of sight to the closest residences on Hickson Road. Therefore, the Noise and Vibration Management Sub Plan is proposed to include these requirements.

The potential impacts associated with the in-situ method (including any localised excavation, if required) are less than those associated with the ex-situ method, which is assessed below.

Commercial Receivers

For commercial receivers, general compliance with the 70dBA noise objective is anticipated when the in-situ remediation of Hickson Road is considered in isolation. When in-situ remediation is considered cumulatively, an exceedance of 1-2 dBA is predicted at 30 Hickson Road, which is considered to be a marginal exceedance.

Preschool Receivers

Noise levels associated with in-situ remediation are predicted to generally comply with the 65dBA noise objective for play areas of identified Preschools.

In the case of internal areas, an exceedance of internal noise objectives by up to 5 dBA is predicted when assessed cumulatively. This is proposed to be mitigated by implementation of the mitigation measures contained within the Noise and Vibration Assessment (**Appendix R**) and summarised in **Section 7.9.8** below. Furthermore, it is noted that windows can be closed during intensive periods of construction if required noting that the affected preschool has operable windows on all several sides of the building and alternate ventilation is available in the form of air-conditioning.

Cumulative Impact

The cumulative impact of the project was assessed alongside a number of other projects that are likely to be undertaken concurrently with the remediation of Hickson Road. Based on the cumulative assessment it can be concluded that noise from remediation of Hickson Road will be a significant contributor to cumulative noise levels at residences on Hickson Road, however other works, will be the main contributor to noise levels at other receivers.

7.9.5 Ex-situ Remediation Assessment

The proposed ex-situ remediation has been divided into six stages as follows:

- Stage 1 – Installation of eastern area (southbound lane).
- Stage 2 – Remediation of eastern area (southbound lane).
- Stage 3 – Validation and backfill of eastern area (southbound lane).
- Stage 4 – Installation of western area (northbound lane).
- Stage 5 – Remediation of western area (northbound lane).
- Stage 6 – Validation and backfill of western area (northbound lane).

The anticipated noise impacts on these identified residential receivers through stages 2 – 4 are summarised in **Table 11**.

Table 11 – Noise Impacts on Residential Receivers

Scenario	Hickson Rd	High St	Merriman St	Balmain East	Darling Island	Sydney Wharf	Residential Building R8
Criteria (dBA)							
Day	63	57	56	59	57	57	63
Evening	58	49	49	50	49	49	58
Night	54	46	45	45	44	44	54
Saturday	55	50	51	51	55	55	56
Predicted Noise: Ex-situ Remediation (dBA)							
Stage 1							
Day	81	48	43	44	46	44	56
Night	<30	<30	<30	<30	<30	<30	<30
Stage 2							
Day	80	48	43	44	46	44	54
Night	66	32	<30	<30	30	<30	39
Stage 3							
Day	81	48	43	44	46	44	54
Night	66	32	<30	<30	30	<30	39
Stage 4							
Day	78	49	41	42	44	42	53
Night	<30	<30	<30	<30	<30	<30	<30
Stage 5							
Day	78	49	41	42	44	42	55
Night	64	35	<30	<30	<30	<30	40
Stage 6							
Day	79	50	42	43	45	43	55
Night	64	35	<30	<30	<30	<30	40
Cumulative							
Day	81	60	55	56	58	65	72
Night	66	33	30	30	30	30	39

Notes: Where a predicted noise exceeds either of the relevant criteria it is highlighted in red in the table. Predicted Noise (Day) is assessed against the Daytime and Saturday criteria, whereas the Predicted Noise (Night) is assessed against the evening and night time criteria.

The cumulative acoustic scenario is based on the Hickson Road ex-situ remediation works for Stage 2 coinciding with the same projects at the Barangaroo site as listed in **Section 7.9.4**.

Residential Receivers

The greatest exceedances are generally restricted to residences in Millers Point (Hickson Road) to the east of the site, although minor exceedances are predicted at all receivers during the cumulative assessment. Exceedances of up to 26 dBA on Saturdays are predicted for the residences on Hickson Road and High Street. This is due to the close proximity of these residences, which overlook the site.

The noise predictions at Hickson Road residences exceed the 'Highly noise affected' level of 75dBA for all ex-situ scenarios. Unmitigated, the night time ex-situ works may be expected to exceed criteria at the Hickson Road residences during Stages 2 and 3, by up to 12 dBA. In order to reduce the ex-situ exceedances to compliant levels it would be necessary to locate the diesel generators and air extraction fans to the far west of the site (as far as practicable) and provide local acoustic screening around the diesel generators such that the acoustic screens break the line of sight to the closest residences on Hickson Road. It is also recommended to direct the air extraction fans away from the closest residences as much as practicable. The Noise and Vibration Management Sub Plan should include these requirements.

Commercial Receivers

For ex-situ remediation, exceedances of 1-2 dBA are predicted at 30 Hickson Road, and up to 3 dBA when considered cumulatively with other Barangaroo projects. Compliance with assessment criteria is anticipated at all other receivers.

Preschool Receivers

Noise levels associated with ex-situ remediation are predicted to generally comply with the 65dBA noise objective for play areas of identified Preschools.

In the case of internal areas, an exceedance of internal noise objectives by up to 3 dBA is predicted when assessed cumulatively.

This is proposed to be mitigated by implementation of the mitigation measures contained within the Noise and Vibration Assessment (**Appendix R**) and summarised in **Section 7.9.8** below. Furthermore, it is noted that windows can be closed during intensive periods of construction if required noting that the affected preschool has operable windows on all several sides of the building and alternate ventilation is available in the form of air-conditioning.

Cumulative Impact

The cumulative impact of the project was assessed alongside a number of other projects that are likely to be undertaken concurrently with the remediation of Hickson Road. Based on the cumulative assessment it can be concluded that noise from remediation of Hickson Road will be a significant contributor to cumulative noise levels at residences on Hickson Road, however other works will be the main contributors to noise levels at other receivers.

7.9.6 Vibration

Vibration impacts were assessed against the EPA document *Assessing Vibration: A Technical Guideline* (2006), which is used to set criteria in relation to human comfort within buildings as well as potential damage to structures.

Operation of vibratory rollers and rock breakers and the like generate ground vibration that has the potential to transmit to nearby buildings.

It is noted that these nearest receivers to the site are:

- The Bond (Commercial) at 30 metres from the eastern site boundary;
- High Street Residences at 45 metres from the eastern site boundary; and
- Heritage Buildings South of the Bond at 50 metres from the eastern site boundary.

It is expected that the in-situ works may largely be undertaken with minimal risk of any vibration impacts. During ex-situ works, however, there would be some risk of impacts due to the minimal separation between the works area and the adjoining buildings. This would be particularly so for the works undertaken in the eastern part of the site.

The level of impact would depend upon several factors including the remediation methodology, plant sizing and selection and geological conditions. A structural engineer review the groundworks / excavation plan to verify that risk of structural damage to the adjoining buildings can be prevented.

Human comfort objectives are likely to be exceeded if larger vibratory rollers are used. Such impacts are most likely to occur at 38 Hickson Road. Options to minimise the impact of these activities include:

- Notification of occupant's adjacent to the site of when these activities occur; and
- Utilise the smallest practicable size of vibratory roller.

Trial testing of vibration levels will be conducted where equipment is identified as having the potential to exceed the human comfort criteria.

7.9.7 Construction Traffic Noise

Criteria for assessment of road traffic noise are set out in the NSW Government's *NSW Road Noise Policy* (RNP).

The site is serviced by Hickson Road, which would be classified as a sub arterial road. The noise level goals at the residential receivers, for this project, based on the RNP are:

- $L_{Aeq,15hr}$ day 55dBA; and
- $L_{Aeq,9hr}$ night 50dBA

Existing traffic noise along Hickson Road is up to approximately 67.1dBA, which exceeds the daytime objective of 55 dBA. Peak hour traffic along Hickson Road was predicted to cause noise levels of 67.2 dBA when considering traffic from the Hickson Road remediation works alongside the existing base traffic levels. Hickson Road remediation traffic will therefore increase traffic noise levels at Hickson Road residences by approximately 0.1 dBA. The cumulative traffic noise impact rises to 68.6 (or an additional 1.5dBA) when total traffic (including from occupation of Barangaroo South) is included.

The RNP notes that:

For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dBA above that of the corresponding 'no build option'.

When considered cumulatively an increase of approximately 1 dBA is predicted. The remediation works would therefore comply with the requirements of the RNP.

7.9.8 Management and Mitigation Measures

The Noise and Vibration Impact Assessment (**Appendix R**) includes at Appendix D an analysis of reasonable and feasible noise reduction measures. The following project specific mitigation measures are recommended in the Noise and Vibration Assessment to manage noise and vibration impacts:

- Localised treatment of fixed plant;
- A 2.4 metre noise barrier to be installed on the eastern boundaries of the site;
- Where practicable, installing attenuators on the exhaust fans, filtration and air handling plant associated with the odour control structures;
- Localised treatment such as barriers, shrouds and the like around fixed plant such as pumps, generators and groundwater extraction plant and by “stepping down” the plant settings out of construction hours where able. The detailed design of acoustic treatments will be undertaken during the detailed design phase; and
- Provision of respite from noise producing activities during extended hours operations where practicable;
- Selection and maintenance of low vibration equipment where practicable;
- Selection and maintenance of “quiet” type equipment where practicable; and
- Effective community consultation and complaints management.

A Construction Noise and Vibration Management Plan has been prepared by Lend Lease for Barangaroo South (a sub-plan to the CFEMP provided in **Appendix Y**), and it is intended that this plan be applied to the Hickson Road remediation work. The following measures are already included in the Noise and Vibration Management Plan.

- Plant Noise Audit – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.
- Operator Instruction – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- Equipment Selection – All fixed plant at the site should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures in order to ensure that the total noise emission from the site complies with EPA guidelines.
- Site Noise Planning – Where practicable, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.
- Use rocksaws and rippers where feasible.
- Install a noise barrier between the site and street frontages. This should be a minimum 17mm thick structural plywood or equivalent panel.

Specific measures required as a result of the noise and vibration assessment of the Hickson Road remediation works will be incorporated into a revised version

of the Construction Noise and Vibration Management Plan prior to the commencement of works. The application of the measures identified above and the procedures identified in the Construction Noise and Vibration Management Plan are aimed towards achieving the noise management levels established at surrounding receivers.

In addition Lend Lease has a Community and Stakeholder Engagement Strategy that has been specifically developed for the Barangaroo Project, which includes a community relations programme. The community relations programme keeps the community that has been identified as being potentially affected apprised of progress of the works, and forewarns the potentially affected groups of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and explains complaint procedures and response mechanisms.

7.9.9 Conclusion

Without mitigation, noise levels from both in-situ and ex-situ remediation has been predicted to exceed the noise management levels nominated in the guidelines at some surrounding receivers. Therefore, the planning and management of construction activities must take into account the sensitivities of surrounding residents so as to minimise the impact of construction noise at these receivers. A comprehensive suite of construction noise mitigation measures has been proposed in order to minimise noise impacts. In all cases the Highly Affected Noise Level (75dBA) is not predicted to be exceeded.

Vibration associated with excavation activities is predicted to exceed established human comfort criteria at properties along Hickson Road. Therefore, trial testing of vibration levels will be conducted where equipment identified as having the potential to exceed the human comfort criteria is proposed. The trial testing of vibration levels will allow equipment, procedures, and monitoring to be specified accordingly. A structural engineer will also inform the excavation works adjacent to buildings along Hickson Road.

7.10 Traffic and Transport

7.10.1 Introduction

Arup has prepared a Traffic Impact Assessment (TIA) which is provided in **Appendix S**. This section summarises the key aspects of the Arup TIA. The Project Application is not for any on-going operational aspect of Barangaroo, and so therefore operational traffic has not been considered further.

Site Access and Traffic Routes

The remediation site is located on Hickson Road and will be accessed via Hickson Road approximately 200m to the north of Napoleon Street.

From the north and north-west, trucks will typically travel via;

- Harbour Bridge – York Street – Margaret Street – Napoleon Street – Hickson Road (inbound); and
- Hickson Road – Napoleon Street – Kent Street – Western Distributor – Harbour Bridge (outbound) to and from the site.

This southbound truck activity would occur through the middle of the day when this route is used but would reduce or be finished before the PM Peak when bus activity is heaviest.

It is noted that the planned construction works associated with the construction of the light rail on George Street may have an impact on Hickson Road. At the time of writing insufficient information is available to assess this impact.

As there is no access for general traffic from the Harbour Bridge to York Street between 6.30am – 9.30am (Monday – Friday), trucks will not use this access until after 9.30am on weekdays. A likely alternate route for trucks approaching from the north would be via the Western Distributor onto Harbour Street in accordance with MP10_0023 condition of consent no. D4(e), which restricts trucks using York Street between 2pm and 8pm.

Use of Wheat Road / Shelley Street will be minimised as trucks will turn right onto Erskine Street from Harbour Street and then left onto Sussex Street to access the site.

It is anticipated that this route would be used sparingly in accordance with MP10_0023 condition of consent number D4(e) as most suppliers would be located to the west and south west.

From the west, trucks will typically travel via:

- Anzac Bridge – Western Distributor – Sussex Street – Hickson Road (inbound); and
- Hickson Road – Sussex Street – Western Distributor – Anzac Bridge (outbound) to and from the site.

From the south and the east, trucks may utilise the Eastern Distributor and the Cross City Tunnel to access and depart the site. Harbour Street could be used as a route for inbound traffic once trucks have exited the Cross City Tunnel.

7.10.2 In-situ Remediation Traffic Generation

It is envisaged that the transport task associated with the in-situ works would generate the following average and maximum daily and peak hour truck movements each day. **Table 12** sets out the forecast truck movements associated with the in-situ remediation works.

Table 12 – Forecast Truck Movements associated with the proposed in-situ works

Stage of Works	Indicative Duration	Summary of Works	Predicted Daily Construction Vehicle Movements
Stage 1	November '16 – December '16	Installation – west half; Temporary removal of street parking for works; Install wells and infrastructure; and Temporary traffic diversions.	10
Stage 2	January '17 – February '17	Installation – east half; Install wells and infrastructure; Install groundwater control walls; Set-up compound in road reserve; and Temporary traffic diversions.	20
Stage 3	March '17 – June '17	Remediation – east half; and Undertake ISCO remediation.	4
Stage 4	July '17 – January '18	Remediation – west half; and Undertake ISCO remediation.	4

Stage of Works	Indicative Duration	Summary of Works	Predicted Daily Construction Vehicle Movements
Stage 5	February '18 – August '18	Validate remediation; Decommission wells / Restore road (staged); and Reinstate street parking.	8

7.10.3 Ex-situ Remediation Traffic Generation

It is envisaged that the transport task associated with the ex-situ works would generate the following average and maximum daily and peak hour truck movements each day. **Table 13** sets out the forecast truck movements associated with the In-situ remediation works.

Table 13 – Forecast Truck Movements associated with the proposed In-situ works

Stage of Works	Indicative Duration	Summary of Works	Predicted Daily Construction Vehicle Movements
Stage 1	November '16 – February '17	Temporary removal of street parking for works; Removal of street trees; Divert traffic to west half; Service diversion where required; Install retention systems; Install & commission odour structures; and Install Dewatering infrastructure.	20
Stage 2	March '17 – September '17	Excavate eastern half and dispose fill off-site; and Dewatering.	50
Stage 3	October '17 – December '17	Validate eastern half excavations; Backfill excavations; Road/footpath restoration; and Decommission odour structures.	25
Stage 4	January '18 – April '18	Divert traffic to east half; Removal of street trees; Service diversion where required; Adjust existing retention systems; Install & commission odour structures; and Install Dewatering infrastructure.	20
Stage 5	May '18 – July '18	Excavate western half and dispose fill off-site; Dewatering.	50
Stage 6	August '18 – October '18	Validate western excavations; Backfill excavations; Road / footpath restoration; Decommission odour structures; and Reinstate street parking and trees.	25

As shown in **Table 12** and **Table 13**, ex-situ remediation represents a larger impact on traffic numbers, this scenario has therefore been assessed within the TIA as a worst-case scenario. Should the preferred option (in-situ remediation) be adopted the impact of the project, in relation to traffic and transport impacts, would be reduced.

7.10.4 Cumulative Traffic Scenario

The TIA considers the cumulative construction traffic from the following projects which will occur concurrently with the Hickson Road remediation works:

- 'Block 4' remediation works;
- Block 5 remediation works;
- Construction of Commercial Building C1
- Stage 1C Remediation and Earthworks;
- Stage 1B Basement; and
- Construction of Crown Hotel.

During the Hickson Road remediation works, the highest combined level of total morning peak hour vehicle movements generated by all the worksites the peak traffic activity is anticipated to occur in June 2017, with 335 traffic movements forecast during the AM peak.

Consistent with other works associated with the Barangaroo South precinct, 70% of construction vehicles are forecast to approach the worksite from the southern and western parts of Sydney. The remainder would approach from the northern direction (i.e. via the Harbour Bridge, Western Distributor and Harbour Street). For trucks returning to the north, they would utilise Napoleon Street and then turn left onto Kent Street to approach the Harbour Bridge. Margaret Street would not be used as a construction route during peak hours.

Although, as noted previously, insufficient information is currently available to fully assess the impact of construction works associated with the light rail on George Street, likely implications have been considered in the staging of the construction.

7.10.5 Potential Traffic Impact

In June 2017 during the peak period of traffic activity, construction activity associated with the Hickson Road remediation works is forecast to contribute to only 10 peak hour traffic movements (out of a total of 335). This represents a negligible 3% of total traffic movements in the Barangaroo precinct.

During the AM peak hour, when construction vehicles attributable to Hickson Road remediation will access the site, the road network generally operates satisfactorily. Traffic modelling provided in the TIA demonstrates that the addition of construction traffic movements associated with Hickson Road remediation works does not impact the overall operation of the local road network, and requires no further works to accommodate the levels of construction traffic anticipated.

Furthermore, the majority of construction truck movements will occur prior to the afternoon peak commuter period (5pm – 6pm), thereby minimising the impact on the local road network. Therefore the traffic impacts arising from the proposed works is considered to be minimal, particularly in the context of existing and future traffic volumes in the northern CBD area.

7.10.6 Traffic Management

Construction Traffic Management

During the remediation of Hickson Road, construction vehicles will set down in the area of Hickson Road to be sectioned off to vehicular traffic. As the remediation proceeds north along Hickson Road, trucks will set down further north within the work-zone area adjacent to the excavation.

As depicted in **Figure 8**, during the remediation of the western half of Hickson Road, trucks will enter the work-zone from the south via a left turn into the site. To exit, trucks will enter the Barangaroo South construction site via the gatehouse access and turn around within the site. They will then turn right onto Hickson Road and depart the precinct to the south via Sussex Street.

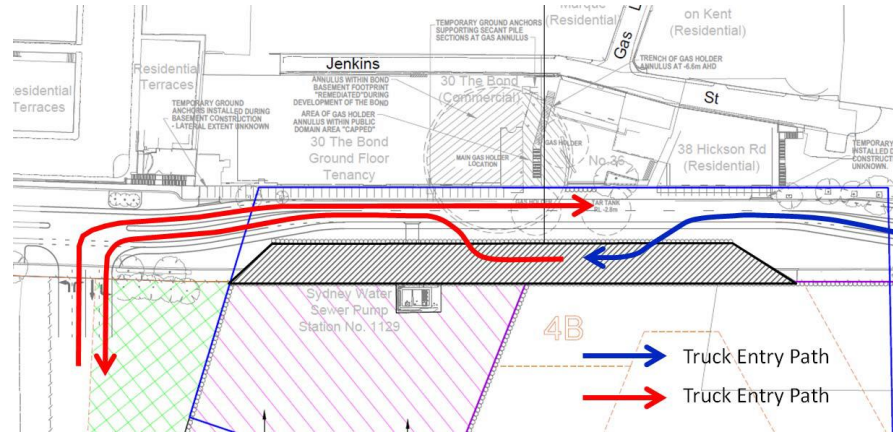


Figure 8 – Access arrangements to western side of Hickson Road Remediation Area

As depicted in **Figure 9**, to access the eastern half of the Hickson Road work-zone, construction vehicles will typically first enter the Barangaroo construction site and turn around within the site. On occasions when the Barangaroo construction site is not available for vehicles to turn around, entry to the Hickson Road worksite will be via a right turn from Hickson Road - to be managed by an on-site traffic controller. Given the relatively low traffic volumes at this location, the small number of truck movements expected and the presence of a traffic controller, this right turn movement is considered acceptable.

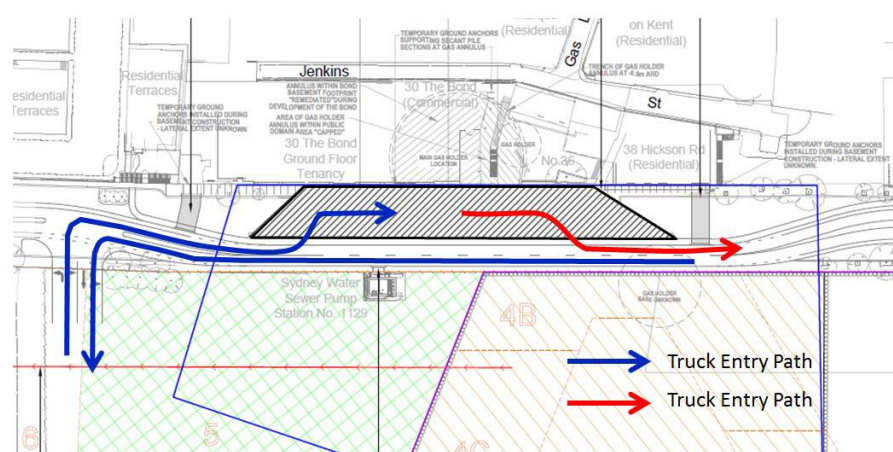


Figure 9 – Access arrangements to eastern side of Hickson Road Remediation Area

Traffic Management and Parking Impacts

During either remediation option, a section of Hickson Road will temporarily be restricted to traffic movement. During this time, Hickson Road will be restricted to a single lane in each direction for traffic. On-site traffic controllers will be present to manage the movement of heavy vehicles in this area and ensure through traffic is not significantly impacted.

A number of on-street parking bays along Hickson Road will be temporarily unavailable for use during the construction period. The specific number of spaces impacted will be determined closer to the time of construction when the construction methodology is confirmed. Existing users of these car parking bays will be notified prior to works commencing.

Hickson Road has been identified as a bus corridor in the Sydney City Centre Access Strategy. Locations for new bus stops to serve the future routes along Hickson Road are currently being investigated by Transport for NSW. These bus stops may need to be temporarily relocated during the construction period to accommodate the remediation works. The (potential) requirement for this would be confirmed closer to the time of construction, in consultation with Transport for NSW and the road authority.

It is noted that the planned construction works associated with the construction of the light rail on George Street may have an impact on Hickson Road. At the time of writing insufficient information is available to assess this impact.

7.10.7 Pedestrian and Cycle Management

During the Hickson Road remediation works, hoardings will be established to maintain pedestrian movement on both sides of the road. Planning for the remediation works has allowed for 2m wide footpaths to be provided on both sides of Hickson Road. Pedestrian access to key buildings and paths in the area such as 30 and 38 The Bond and Gas Lane staircase will be maintained throughout the works.

The remediation works on Hickson Road will require the temporary closure of the existing bicycle shoulder lane on both sides of the road. A 3.5m vehicle lane has been provided which will operate as a mixed-traffic environment. Following consultation with the Road Authority, it is proposed that on-road bicycle symbol be provided in the impacted areas on Hickson Road to emphasise the mixed use environment. Cycling would not be encouraged on the Hickson Road footpath, consistent with all other CBD streets.

7.10.8 Management and Mitigation Measures

Consistent with existing restrictions applying to construction works at Barangaroo South, trucks would not be able to use York Street between 2pm and 8pm, or York Street or Clarence Street in the AM peak between 6am and 10am.

The site traffic control recommendations for each worksite gate entry or exit point (including all appropriate signage) will be determined by means of a Traffic Control Plan to be prepared by an RMS accredited contractor closer to construction commencement.

Truck movements are to be staged and coordinated to prevent trucks circulating CBD streets whilst awaiting access to the site.

Construction vehicles will approach the site from areas outside the CBD using major arterial routes such as the M4, M5 etc.

The size of trucks proposed to access the site will be in accordance with Clause 300-3 of the Road Rules in terms of lengthy vehicle restrictions.

The vehicular traffic movements at each of the site entry or exit gates for traffic to and from Hickson Road will potentially need to be controlled by a flagman to

ensure no potential traffic safety conflicts occur between the site truck traffic and pedestrians on the adjacent footpath.

Personnel will not be permitted to use stop/slow signage in Hickson Road or Sussex Street on weekdays between 7am and 9am and 4pm to 7pm. However, personnel using stop/slow signage will be permitted on Hickson Road, north of the intersection of Hickson Road and Napoleon Street, when it is required to ensure safe truck access at designated site access points, provided that vehicles queue lengths generated as a result of the traffic control do not exceed more than six vehicles in either direction.

Lend Lease implements a green travel plan to maximise and encourage public transport use. This will be applied to the proposed development. It involves:

- Providing no parking for construction workers on site. The constrained parking environment surrounding the site, coupled with the relatively high cost of long term parking, will ensure the majority of construction workers arrive to the site via public transport; and
- Providing information about public transport availability and fare costs compared with on and off street parking costs. For example, Lend Lease through their site inductions will provide travel information and advice to construction workers about public transport, walking and cycling routes to the Barangaroo south site.

7.11 European Heritage

7.11.1 Introduction

Casey & Lowe Pty Ltd have prepared a Heritage Impact Statement report which is provided in **Appendix T**. This section summarises the key aspects of the Casey & Lowe assessment report.

Archaeology of the Site

The 1788-1839 occupation within this area typically related to early maritime trade and infrastructure and other similar activities. The area was generally built up with stages of reclamation, construction of seawalls and infilling. The occupation from 1839 by the AGL gasworks involved phases of expansion, reclamation and upgrading of technology. The 1920s construction of two double-decker wharves, berths 5 and 6, required the excavation of part of the reclaimed land including wharves, coal stores and retort houses. Therefore an important section of the gasworks was removed at this time. The mid twentieth-century construction works will have had some impacts on areas but these will generally be isolated and relate to concrete caissons and deeper services.

A concrete wharf was identified in the testing stage in 'Block 4' and confirms that this area was heavily impacted during the 20th century. Remnant timber piling and cultural deposits formed within marine sediments under the shadow of Jetty 6. Some timber piling and cultural deposits within the marine silt could be present eastwards of the early 20th-century seawall, under 19th-century reclamation.

The following levels based on the Darling Walk excavation program can be used as guides for the levels at which some of the archaeological resources will be found:

- Water table was encountered at between -0.3m and 0.2m and higher after rain.

- Foreshore span with archaeological features ranged from -0.8m to 0.8m where sands met rocky outcrops (information based on Darling Walk, Area 7 and Area 6 combined).
- Mid-19th-century level after reclamation across all areas varied between RL 1.5m to 1.7m (in Darling Walk, Barkers Mill yard).

It is likely that most of the area on the western side of Barangaroo has been considerably impacted by 1950s and 1960s excavation and dredging but there is still some likelihood for piles and some cultural deposits within the shadow of Jetty 6. There is limited opportunity for archaeological evidence in this area. The eastern area (including the Hickson Road Remediation Area) is likely to contain substantial remains of Australia's first gasworks but this is part of an extensively contaminated EPA Declaration Area. The undertaking of archaeological works in this area is likely to be highly compromised by the risk the site poses to human health and the environment.

The archaeological phasing studies indicate that there was considerable rebuilding over the original part of the site. The EPA Declaration Area includes the original gasworks area, which included the original and replacement retort buildings (to the west of the dashed line) which were probably removed in the 1920s. The southern section of Hickson Road area contained gasworks structures built prior to 1880 as well as some other additional buildings after this date.

The EPA Declaration Area has potential for impacts from wharfage rebuilding but these are most likely to be quite minor. The 1920s wharfage extended into the northern part of Portion 11 but the areas to the east should have had relatively minor impacts other than from gasworks contamination extending into this area. The making of Hickson Road through the gasworks site will have involved removal of structures, excavation of softer areas and their backfilling with compacted material as well as reduction of rock levels throughout the area.

The most recent geo-technical report on the EPA Declaration Area indicates that there are extensive fills across the site and that bedrock along Hickson Road is quite high and there are a number of services running along the road as well. Typically the fills deepen out westwards from Hickson Road then step down again once out past the gasworks early and later reclamations.

The site has the potential to contain remains of the following:

- Some remains of pre-gasworks use of the area, this relates to later phases of timber ship building dating to the 1840s and 1870s;
- Stages of reclamation dating prior to and during the occupation of the site by the gasworks;
- Remains of the eastern part of the gasworks of all phases where it was not removed by the 1920s remodelling of the foreshore for wharves; and
- Demolition of the gasworks is likely to have had considerable impact on the gasworks structures and technology.

7.11.2 Assessment of Heritage Significance

The EPA Declaration Area at Barangaroo has the potential to contain a range of archaeological remains dating from the 1830s to the 1920s. The remains include early and later maritime infrastructure and substantial reclamation of the foreshore, mid to later nineteenth-century shipbuilding as well as the remains of Australia's first gasworks site.

The EPA Declaration Area contains a significant archaeological resource associated with Australia's first gasworks and nineteenth-century shipbuilding, reclamation and wharfage. The nature of the contamination makes it difficult to realise the significance of this resource in its current state. There is reduced ability to record the remains of the gasworks due to contamination, the extensive rebuilding which will have removed early phases of technology and the excavation of the western part of the EPA Declaration Area. This means that the area is not considered to reach the State significance threshold. The level of significance of the site as outlined below in its current state is therefore of Local significance.

7.11.3 In-situ Remediation Impact Assessment

Should the preferred remediation option (in-situ remediation) be carried out, the impact on European heritage will be minimal.

7.11.4 Ex-situ Remediation Impact Assessment

Should ex-situ remediation be carried out, an archaeological methodology will be developed as part of detailed design prior to works, to allow for some limited recording of the remains to be removed.

The detailed framework for archaeological methodology and recording will be established following some initial sampling trenches to determine the extent to which the potential archaeological remains within the site may survive and be accessible for archaeological investigation and recording. The preliminary framework for archaeological recording, defined as a result of detailed sampling trenches is as follows:

- Where contamination is at depth and the upper layers are uncontaminated, the upper layers could potentially be archaeologically excavated, with restrictions as required for OHS management of works.
- Where the archaeology is completely covered with contamination and therefore inaccessible for normal archaeological recording methodologies, other alternative techniques may be tested to determine if recording is possible. Then it may be possible to record some major gasworks features but only if they offer a research outcome.
- It is likely that opportunities may be extremely limited in what can be recorded. In the end there may be no ability to record remains prior to the remediation.

7.12 Indigenous Heritage

7.12.1 Introduction

To ensure that the Aboriginal cultural heritage significance of the Hickson Road Remediation Area is not adversely impacted upon by the proposed remediation works, Comber Consultants carried out an Aboriginal cultural heritage assessment of the proposed remediation works, which is provided in **Appendix U**. This section summarises the key aspects of the Comber assessment report.

Archaeological Background

A search of the Office of Environment and Heritage's (OEH's) Aboriginal Heritage Information Management System (AHIMS) indicates that no known Aboriginal sites have previously been recorded within or in the vicinity of the Barangaroo site.

An assessment by Comber & Stening (2010) in respect of the Barangaroo redevelopment, indicated that the site does not contain any known sites and does not contain any Aboriginal cultural heritage significance. However, that report indicated that it is possible that sites might remain on the south-eastern portion in Blocks 2 and 3 of the Barangaroo redevelopment area, near the location of the original shoreline. This is outside of the site.

It is possible that evidence of occupation exists within the south-eastern portion of Barangaroo South, near the original shoreline in Blocks 2 and 3. However, as the site is predominantly within reclaimed land it is highly unlikely that sites will exist. In addition the construction of the AGL Gasworks and operation of the Gasworks would have destroyed any evidence of Aboriginal occupation, if it did exist.

7.12.2 Impact Assessment

There will be no adverse impact on Aboriginal archaeological or cultural heritage values by the remediation works.

There is no need for any further archaeological assessment or testing of the site. Subsurface testing and/or monitoring is not considered to be required prior or during the remediation project.

7.12.3 Recommendations

If, during the course of the remediation project, any unexpected Aboriginal 'objects', artefacts or sites are uncovered, work must cease in the vicinity of that object, artefact or site and further advice sought from the consultant and the Metropolitan Local Aboriginal Land Council.

7.13 Tree Removal and Arboriculture

7.13.1 Introduction

A Tree Health and Assessment Report has been prepared by Tree Wise Men and is located at **Appendix V**. The report assesses the health and significance of all the trees located on and around the site.

Existing Situation

There are 46 trees located within and adjacent to the remediation site. These have been assessed as being 42 Hills Figs (*Ficus microcarpa* var. *Hilli*), 1 Moreton Bay Fig (*Ficus Macrophyllia*) and 3 Fan Palms (*Washingtonia filifera*). These trees are located along Hickson Road.

7.13.2 In-situ Remediation Impact Assessment

Under the preferred remediation option (in-situ remediation), no trees will need to be removed as part of the project.

7.13.3 Ex-situ remediation Impact Assessment

Should the alternate remediation option be carried out, up to 15 of the identified Hills Fig trees would need to be removed to facilitate the remediation of the site. These trees are 5-16 m high.

It is noted that this potential tree removal for the ex-situ remedial approach is expected to be a maximum, based on anticipated maximum extent of excavation required. If the final extent of remediation excavation required is reduced

(following validation testing and/or agreement with the NSW EPA and Site Auditor), a qualified arborist will assess and confirm if the associated tree removal can also be reduced from the maximum proposed.

7.13.4 Management and Mitigation Measures

Appendix V includes a Tree Management Plan, which identifies the trees to be removed and those to be retained, and includes a detailed set of restrictions in order to protect the trees which are identified as being retained. These recommendations include:

- Appointment of an arborist to oversee the works, observe/monitor all works within the Tree Protection Zones (TPZ) of trees to be retained, oversee the removal of trees to be removed, and to monitor the condition and protection of trees to be retained.
- Where possible, ensure that the TPZ is fenced for protection (and clearly signed as Tree Protection Fencing). Install trunk, branch and ground protection where fencing cannot be installed.
- Prevent stockpiling, storage or preparation of materials, parking of machinery and machinery trenching in the TPZ for a tree to be retained. Any trenching in the TPZ should be by hand excavation, or directional boring (trenchless) and under the specific instructions of the on-site project arborist
- Selection of piling equipment that is as short as possible so as to minimise the need for overhead crown pruning.
- Any trenching within the Structural Root Zone should be undertaken by hand and under the specific instructions of the on-site project arborist.
- Retain the existing road and footpath pavements intact where possible within the TPZ to minimise impacts to the underlying roots from works.
- All traffic diversions to include adequate root zone protections.
- All crown pruning works to be approved and monitored by the on-site project arborist and are to be undertaken by a suitably qualified arborist (AQF Level 3 Certificate) in compliance with AS 4373-007 Pruning of Amenity Trees.
- New street trees will be planted to replace those removed, unless new landscaping for Hickson Road is provided for under separate projects.

7.14 Visual Impact Assessment

7.14.1 Existing Visual Context

The Hickson Road Remediation Area forms the eastern edge of Barangaroo, which is currently the subject of extensive excavation and construction works associated with the construction of Basement 1A and commercial and residential buildings and the northern Headland Park. As such, the visual context of the site is changing on an on-going basis.

Figure 10 and **Figure 11** are photographs taken in 2014 which show the nature of recent construction activities at the interface of Barangaroo South and Central. Construction works at Barangaroo South will continue for the duration of remediation works.



Figure 10 – Recent Visual Context of the site (from the east)
(The red line shows the approximate extent of the Hickson Road Remediation Area)

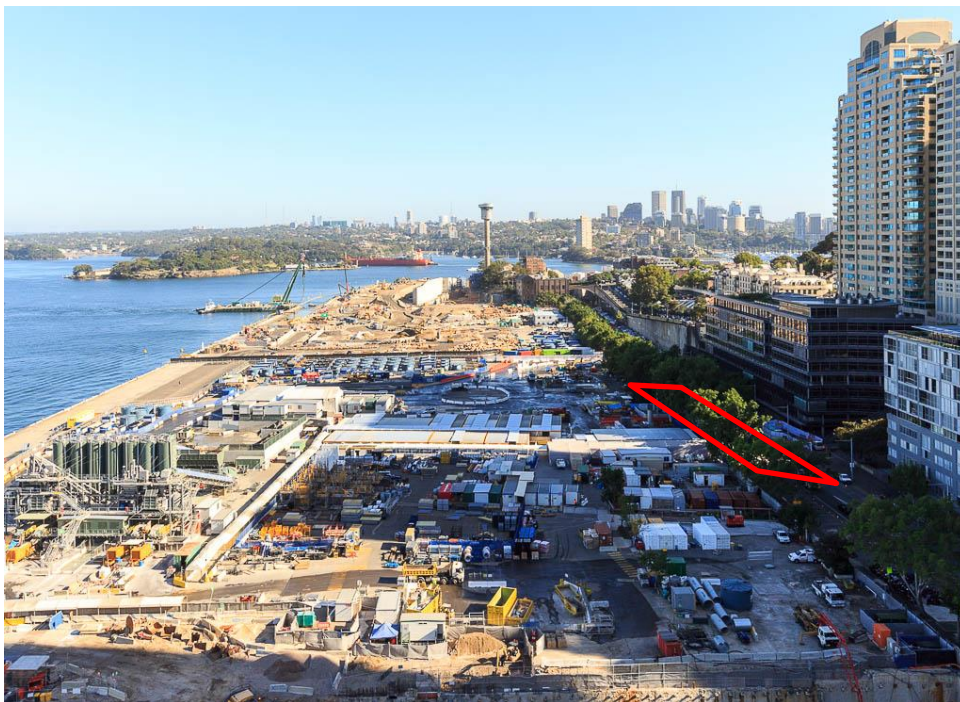


Figure 11 – Recent visual context of the site (from the south)
(The red line shows the approximate extent of the Hickson Road Remediation Area)

Observer Groups

Key observer groups along Hickson Road include:

- Users of 30 The Bond, Hickson Road, including parents and carers dropping off and picking up children from child care facility located at street level.

- Users of 36 Hickson Road, including patrons of the Verandah Café located on the 5th floor.
- The ground floor offices at 38 Hickson Road.
- Pedestrians walking along Hickson Road.
- Residents accessing and overlooking the area, including residents in 38 Hickson Road and residents/pedestrians on High Street.

Further afield, the Barangaroo site is able to be seen from a number of prominent locations around Sydney Harbour, most importantly from Pyrmont and East Balmain

7.14.2 Impact Assessment

Under both remediation scenarios (i.e. in-situ and ex-situ) the remediation works would involve the temporary closure of part of Hickson Road and the installation of temporary hoarding around the remediation site.

Remediation works are estimated to take place at Barangaroo for up to approximately 21 months. As such, they will be temporary in nature, and will occur concurrently with, and as part of the ongoing construction associated with the broader development of Barangaroo.

The visual nature of remediation works will be no different from the current and ongoing construction works that will continue during and subsequent to the completion of remediation works.

Works (for both in-situ and ex-situ remediation) will generally take place behind a 2.4m high hoarding and so will generally not be visible from ground level. In addition, works (for in-situ or ex-situ remediation) may include a temporary tent structure over the works area, which will limit the visual impact of the works activities.

From raised elevations, such as from High Street, the site will be clearly visible. Due to the temporary nature of the works at the site, and the existing construction related visual context which will continue during the remediation works, and subsequent to the completion of the remediation works, it is not considered that the project will have a significant impact on views towards the site by the immediate observer groups or from areas beyond the immediately adjacent observer groups.

Whilst remediation activities will be limited to day time hours, certain activities will be required to occur on a continuous basis. Night time lighting will be consistent with Australian Standard AS1680, Lighting and the Visual Environment.

The site will ultimately be left in a state which is broadly the same as the current state, i.e. a public road.

7.14.3 Management and Mitigation Measures

Night time lighting will be consistent with Australian Standard AS1680, *Lighting and the Visual Environment*. No other visual impact mitigation is considered necessary, over and above the hoardings already proposed.

7.15 Hazardous Substances

The preferred remedial technology (in-situ remediation) would involve the on-site use and storage of potentially hazardous substances. A Preliminary Hazard Analysis (PHA) has been prepared by AECOM for the in-situ remediation works, and is provided in **Appendix BB**. The PHA has been prepared in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*, including the *Applying SEPP 33 Guidelines and Hazardous Industry Planning Advisory Paper (HIPAP) No.6, Hazard Analysis Guidelines*.

The ex-situ remediation technology would not involve the use or storage of dangerous goods or potentially hazardous substances, therefore the potential impacts associated with the ex-situ method are considered to be less than those associated with the in-situ method, which is assessed below.

7.15.1 Preliminary Risk Screening

The PHA includes an initial screening of the Dangerous Goods (DGs) that would potentially be stored at the site during in-situ remediation against the screening thresholds set out in Applying SEPP 33.

The PHA also includes an assessment of the DGs that would be used or stored within the existing approved water treatments plant on the site

DGs that would be required on site are shown in **Table 14** along with their respective screening quantities.

Table 14 – Potentially Hazardous Chemicals

Works	Chemical / Product	Class / PG	Screening Threshold	Quantity (l)
In-situ Remediation	Oxidant	5.1/II	5 tonne / 5,000 l	10,000
	Surfactant	3/III	-	1,664
	Catalyst	-	-	208
Existing Approved Water Treatment Plant	Sodium Hydroxide	8/II	25 tonne / 25,000 l	10,000
	Hydrochloric Acid	8/II	25 tonne / 25,000 l	2,000
	Diesel	C1	-	820
	Peroxide	5.1/11	5 tonne / 5,000 l	1,000

Storage of Oxidant (10,000kg) would exceed the SEPP 33 screening threshold of 5,000L and 5,000kg respectively. Other dangerous goods are well below the SEPP 33 screening threshold.

7.15.2 Multi-Level Risk Assessment

Because the Applying SEPP33 screening thresholds have been exceeded by one dangerous goods class, a Preliminary Hazards Analysis has been prepared.

Based on the type of materials stored and handled, and the operations conducted at the proposed site, the study was conducted using the Level 2 analysis detailed in the Multi-Level Risk Assessment approach, recommended by the Department. As the selected approach for this analysis was a level 2 assessment, where incidents were identified to impact offsite and where a consequence and frequency analysis was conducted, the consequence and frequency analysis for each incident were combined and compared to the risk criteria published in HIPAP No.4. Where the criteria were exceeded, a review of the major risk

contributors was performed and the risks reassessed incorporating the recommended risk reduction measures.

The DGs are likely to be stored within a DG storage area which will be in a secure compound enclosed by a Class A Hoarding. Each depot storing liquid will be located within a bunded containment area lined with an impermeable material.

The Multi-Level Risk Analysis details the storage type (including container type and size) and the hazardous properties of each dangerous good to be stored at the site. Key properties are summarised below. **Appendix BB** also describes in detail how each dangerous good is proposed to be stored and handled on-site:

- **Surfactant** - Surfactants contain hydrophilic and hydrophobic groups which allows insoluble liquids (i.e. oil in water) to dissolve into the water. The specific surfactant has not been chosen for this component of the project, hence, the “worst case” material has been assumed - a surfactant classified as a flammable liquid. Flammable liquids are characterised by low flash points (<60.5°C) which results in the generation of flammable vapours from spills which can ignite resulting in fire.
- **Oxidant** - Oxidants (including Peroxide) are classified as a Class 5.1/PGII oxidising agents. They may be used as bleaching agents and disinfectants. When heated, oxidants have the potential to undergo thermal decomposition releasing oxygen. Excessive heating may result in rapid thermal decomposition. In addition, contamination (e.g. ferric elements) may also result in rapid decomposition resulting in expulsion of the material from the container. There is no detonation of percussive wave as a result of rapid decomposition incidents.
- **Sodium Hydroxide (Water Treatment Plant)** - Sodium hydroxide (caustic) is a Class 8/PGII corrosive substance (alkali). Caustic can dissolve organic material, fats, oils and some metals. Caustic is generally used as a pH buffer in a range of industries including pulp and paper, textiles, water treatment, soaps and detergents. It is corrosive to skin, metals and other materials and can cause chemical burns in higher concentrations. The concentration of caustic in this project would not result in immediate chemical burns and can be washed off before permanent chemical impact can occur.
- **Hydrochloric Acid (Water Treatment Plant)** - Hydrochloric acid is a Class 8/PGII corrosive substances (acidic). Similarly to sodium hydroxide it will dissolve organic matter, fats, oils and some metals. It naturally occurs in the human stomach and is used in a range of industries such as steel, pharmaceuticals, water treatment, etc. It is corrosive to skin, metals and other materials and can cause chemical burns in higher concentrations.
- **Diesel (Water Treatment Plant)** - Diesel is not classified as a DG by the ADG as it has a flash point >60.5 centigrade. Due to the high flash point, it is difficult to ignite; however, once ignited, it is difficult to extinguish. Diesel is insoluble in water and will form a slick of diesel on the surface of water if mixed.

The Multi-Level Risk Analysis identifies potentially hazardous incidents, which are subjected to qualitative analysis, and establishes those incidents which were assessed quantitatively as part of a consequence analysis. The following incidents were assessed for consequence analysis:

- Surfactant drum damage and full contents release, ignition and pool fire;
- Surfactant drum damage, leak, ignition and pool fire (stabilisation);
- Surfactant drum damage, leak, ignition and bund fire; and

- Diesel tank leak, ignition and bund fire.

The consequences of each of these are described below.

Surfactant drum damage and full contents release, ignition and pool fire

There is potential for a drum of surfactant to be dropped which may result in damage and subsequent release of flammable liquid which will form a pool. If the pool ignites, a fire will form with the dimensions of the spill. This incident would have the potential to cause an impact over the boundary of the remediation site.

Surfactant drum damage, leak, ignition and pool fire (stabilisation)

Similarly to the scenario described above, a drum may be damaged resulting in a release of flammable liquid. This incident would have the potential to cause an impact over the boundary of the remediation site

Surfactant drum damage, leak, ignition and bund fire

There is potential that a damaged drum could be delivered to the site which could be stored in the bunded area. If the drum leaks, a pool of flammable liquid will form within the bund. If the leak remains unnoticed then the leak may be sufficient to cover the surface area of the bund and if ignited, a pool fire will occur with the dimensions of the bund. This incident would have the potential to cause an impact over the boundary of the remediation site.

Diesel tank leak, ignition and bund fire.

There is potential that a diesel tank could leak within the bund resulting in a diesel spill. If the leak remains unnoticed, there is the potential it could continue until the surface area of the bund is covered with diesel. If the spill was ignited a fire would occur with within the bund. This incident would have the potential to cause an impact over the boundary of the remediation site.

Summary of consequence analysis

The potential off site impacts for the in-situ remediation of the eastern half of Hickson Road are shown in **Figure 12**, the potential off site impacts for the in-situ remediation of the western half of Hickson Road are shown in **Figure 13**.

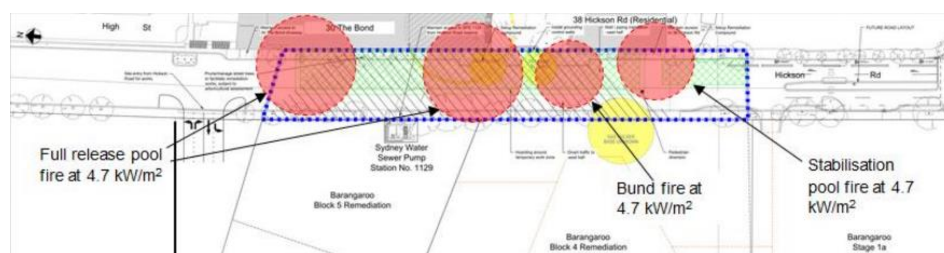


Figure 12 – The potential off site impacts for the In-situ remediation of the eastern half of Hickson Road

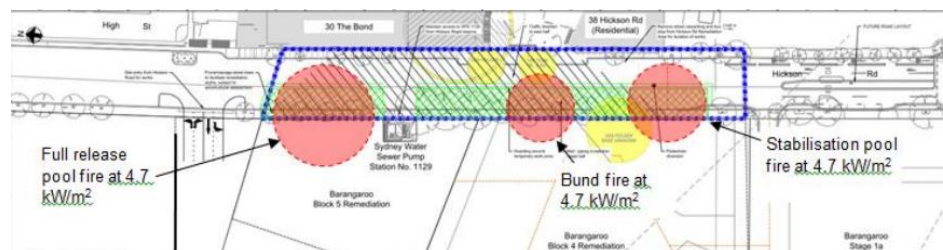


Figure 13 – The potential off site impacts for the in-situ remediation of the western half of Hickson Road

Frequency analysis and risk assessment

The PHA then carries out a frequency analysis of the three surfactant drum damage fire scenarios to determine the frequency of a fire resulting from a damaged drum. The frequency analysis is combined with the consequence analysis as part of a risk assessment. The risk assessment calculates the fatality risk as a result of exposure to radiant heat, concluding that the acceptable risk criteria would be exceeded in surrounding areas. As a result of this unacceptable level of risk, a risk reduction process was carried out.

7.15.3 Risk Reduction

To minimise the potential impact of fire, and subsequent heat radiation on surrounding areas, it is possible to store flammable liquids within Dangerous Goods cabinets that will contain the fire for a period of time to allow the evacuation of adjacent areas to the fire and the mobilisation of fire response services before the cabinet containment is breached.

AECOM recommends that the drums should be plastic wrapped offsite prior to delivery to the Hickson Road remediation works site, where they should be loaded directly into a DG flammable liquids storage cabinet for the plastic wrapping can be removed. Based on the proposed Dangerous Goods cabinet risk reduction approach, further assessment has been performed to ensure the risks are within the acceptable criteria.

The use of a DG storage container would eliminate the potential for a stabilisation fire scenario to occur as the bund of the container would fill before the maximum or stabilised pool diameter is reached, hence, both fire scenarios would occur within the container.

The drums will typically be stored on pallets which will result in a reduction of individual drum movements. It is estimated that approximately 400 drums may be required during the remediation activities which will require 100 pallets (4 drums per pallet). Drums will be delivered to the Hickson Road Remediation site where they will be transferred by forklift directly into DG storage cabinets.

The drums will be plastic wrapped on pallets; hence, the potential for a drum to dislodge from the pallet and be damaged is very low. In addition, the drums will be transferred directly into a DG storage cabinet; hence, the only release from a drum that could occur is from a spontaneous failure of the drum. The failure rate for a spontaneous drum failure is provided by the HSE as 2×10^{-6} per drum stored. Eight (8) drums (4 per cabinet) will be stored inside the DG cabinets; hence, the chance of a release occurring is $2 \times 10^{-6} \times 8$ drums, which is equal to 1.6×10^{-6} failure per year.

The probability of ignition is 2.7%, therefore, the frequency of a spill and ignition is $1.6 \times 10^{-6} \times 0.027$, which equals 4.32×10^{-7} fired per year.

Assuming a conservative fatality rating of 1 from a fire within the DG cabinet, the chance of a fatality is 4.32×10^{-7} which is below the acceptable criteria for all sensitive land uses.

Therefore, the in-situ remediation activities would be classified as a potentially hazardous and not actually hazardous and therefore would be permitted within the proposed location.

7.15.4 Management and Mitigation Measures

The following recommendations have been made to ensure the risks are managed and controlled at the site during in-situ remediation:

- An Emergency Response Plan (ERP) should be incident based and developed to include a range of incidents at the DG storage area:
 - A spill in the WTP should be included into the ERP;
 - Incidents involving the surfactant should be included in the site ERP;
 - Incidents involving diesel should be included into the site ERP; and
 - A fire in the DG container should be included in the ERP;
- Tanks containing oxidant should be manufactured from a white or opaque plastic to minimise the potential for heating from direct sunlight;
- Spills kits should be installed adjacent to the existing approved WTP that can be deployed in the event of a spill, preventing spread of the release;
- Spill kits should be located adjacent to the diesel storage;
- First response firefighting equipment should be stored adjacent to the DG container;
- A final hazard analysis (FHA) should be conducted prior to commencement of in-situ remediation; and
- Suitable temporary barriers/roof should be put in place to prevent potential cigarette butts from off-site entering the hazardous zone where DGs are being stored; or
- The building manager that administers the lunch area above the rock wall on Hickson Road should be contacted and informed of the remediation works that will occur below the lunch area and that request that the existing no smoking areas should be strictly enforced during the remediation activities;
- The Remediation Contractor should include in their operation procedure a daily pre-start check to ensure the 'no smoking' signs have been placed on the terrace directly above the Remediation Area;
- Surfactant should be stored in dangerous goods containers with dimensions of approximately 1.5 m x 1.5 m; and
- Surfactant drums should be delivered to site on plastic wrapped pallets and loaded directly into the DG storage cabinets.

7.16 Infrastructure and Utilities

7.16.1 Introduction

This section of the report addresses the impacts of the project on infrastructure and utilities.

7.16.2 In-situ Remediation Assessment

In-situ remediation can be implemented around existing underground services without the need for resource intensive and costly service disruption, diversion and relocation. As such, if the preferred option is progressed then there will be minimal impacts for existing services in Hickson Road.

7.16.3 Ex-situ Remediation Assessment

Water Supply, Electricity, Communications and Gas

If ex-situ remediation is progressed, excavation in Hickson Road will require the temporary protection and/or diversion of existing below ground services in the proposed area of excavation.

Services that require temporary protection or diversion/relocation will be done so in accordance with the requirements of the relevant service provider.

Sewerage

Sewage pumping station SP1129 will be retained for the future land use.

Remediation works to be undertaken adjacent to the pumping station will consider appropriate protection measures for the structure and its associated sewer lines. Any temporary protection or diversion/relocation will be done so in accordance with the requirements of Sydney Water Corporation.

Protection of Infrastructure and Utilities

Appendix HH provides a Geotechnical Report prepared by Coffey which:

- Assesses the geotechnical impacts (including vibration) of both the proposed in-situ and ex-situ remediation works on the existing services and structures within and directly adjacent to the Remediation Area.
- Assesses impacts on existing Sydney Water Corporation sewer assets including SP1129, tunnelled sewers, sewer rising mains, proposed bored sewers and other existing infrastructure.
- Provides a review of the below ground structures to The Bond and 38 Hickson Road in respect to supplied as built information

The Geotechnical Report includes a range of measures to be implemented to ensure that retained infrastructure and adjacent building supports are not detrimentally impacted by the remediation, land forming and general excavation works, including:

- Careful consideration of the type of groundwater control and retention wall should be undertaken to assess the most suitable retention with respect to performance, effect on adjacent buried structures, and effect on adjacent building users and spoil generation.
- Suitable monitoring plan to be developed prior to commencement of excavation. A monitoring plan is to address the requirements of survey monitoring of adjacent buildings to assess potential movements during excavation.
- Cut off wall construction and bedrock excavation methods should be chosen to avoid damage to vibration sensitive structures. Where possible the use of impact hammers and rock breakers should be avoided.

- A more detailed assessment of likely settlement/movement will be undertaken to assess impact on utilities.
- Construction of groundwater control and retention wall will take into consideration the position of retained services, and the use of low impact installation methods will be investigated.
- Excavation techniques close to retained services will be chosen to minimise impact based on a review of the anticipated vibration levels and service provider requirements.
- Care in design and installation of anchors to avoid contact with or damage to retained services, in particular concrete sewer pipes tunnelled beneath Hickson Road.

The Geotechnical Report concludes that the remediation works being considered under both remediation Options, if undertaken in a carefully planned and managed manner, can be carried out without unacceptable environmental impacts on adjacent landowners and stakeholders.

7.17 Climate Change and Ecologically Sustainable Development

A Climate Change and Ecologically Sustainable Development (ESD) Assessment Report has been prepared by Worley Parsons and is located at **Appendix W**. The report:

- Identifies how the development will incorporate ESD principles in the design and construction phases of the development; and
- Provides an assessment of the risks associated with sea level rise on the proposal as set out in the draft NSW Coastal Planning Guidelines: Adapting to Sea Level Rise.

Detailed consideration of the principle of ESD, as set out in the EP&A Regulation, is provided in **Section 10.3**.

The report identifies the following ESD benefits associated with the Hickson Road remediation project:

- Remediated land and groundwater will provide benefits to human health and ecosystem impact for current and future generations (ESD Principle: Intergenerational Equity).
- Given the relatively short timeframe of remediation works, it is not expected that impacts due to sea level rise will affect any of the proposed remediation activities.

In order to maximise the sustainability and ESD benefits of the project the following key initiatives have been recommended:

- Where possible, minimise the disposal of excavated material, and maximise the re-use of materials (that meet the re-use acceptance criteria). While it is noted the majority of excavated material will likely require off-site disposal, any potential re-use will minimise the need for off-site disposal of waste and minimise the need for imported materials, as well as minimising energy use for transportation.
- Provide centralised recycling areas in all construction (remediation) site buildings and waste bins for remediation worker use which provide for waste separation where appropriate.
- Provide site workers with public transport options during their induction (Green Travel Plan).
- Reuse of treated extracted groundwater for dust suppression and wash down to reduce potable supply use where appropriate.
- Fit pollution control measures on remediation equipment (including diesels oxidation catalysts and diesel particulate matter filters) where practicable.
- Minimise the impacts to the local community by maximising internal haul routes within the Barangaroo site where possible.

The report concludes that through the implementation of suitable techniques, ESD principles can be applied in the undertaking of the remediation works and further that impacts associated with forecast sea level rise will not affect proposed remediation activities.

The project will be undertaken in line with the recommendations in **Appendix W** and accordingly the above recommendations are reflected in the draft Statement of Commitments.

7.18 Off Site Transportation

A methodology statement for the off-site transportation and treatment of hazardous wastes has been prepared by AECOM and is provided as **Appendix KK**. This statement confirms that the off-site transportation and treatment or disposal of material required under either the in-situ or ex-situ method can be carried out in accordance with:

- The RAP.
- The Waste Classification Guidelines (NSW EPA 2014); and
- *Protection of the Environment Operations (Waste) Regulation* (2014).

In order to minimise the impact of the off-site transportation a number of measures are proposed to isolate the contaminated material from the receiving environment as it is transported between the site and its intended treatment or disposal site.

The EPA accredited Site Auditor has reviewed the methodology statement for the off-site transportation and treatment of hazardous wastes prepared by AECOM. The Site Auditor's review letter is provided in **Appendix LL** and concludes that:

- The proposed off-site treatment of material prior to disposal to a licensed landfill is consistent with the remediation approach described in the RAP; and
- Off-site treatment is consistent with EPA guidelines if managed appropriately.

7.18.1 Transportation Requirements

Environmental control measures that will be implemented in relation to the off-site transportation of contaminated materials, are set out in detail in **Appendix KK**, and will include:

- Preparation of materials to ensure they are spadeable and suitable for transport, including:
 - Mixing of saturated excavated material with fly ash, lime or cement;
 - Drainage and drying of saturated excavated materials; and
 - Screening or manual separation of material to separate oversize and/or materials suitable for recycling (e.g. steel, concrete, brick and rock fill, timber piles, construction and demolition waste).
- Visual assessment of materials to confirm the material is spadeable and does not contain excess free liquids and is suitable for transport.
- Once the truck trailer has been loaded, the exposed surface of the untreated contaminated soil will be sprayed with a suitable foam agent, such as Rusmar AC-645 (or equivalent) to minimise the release of fugitive emissions during transportation. The intent of the foam agent is to form a barrier that provides adequate odour control for the duration of transport.
- A suitable work area (for example a raised platform) will be constructed within the excavation enclosure to allow a thorough application of the foam agent (or equivalent) across the surface of each truck load containing untreated odorous soil;

- Trucks carrying excavated materials will be covered and decontaminated in the wheel wash facility before exiting the excavation enclosure (as applicable) and exiting the Site;
- Trucks carrying contaminated materials will be covered prior to exiting the Site and will remain covered until authorised to unload at the destination;
- Trucks will be fitted with seals to ensure that the movement of potentially saturated materials is undertaken appropriately;
- Trucks will not wait in the streets surrounding the Site or within the CBD;
- Trucks will exit the Site through predetermined exit points on Hickson Road and will follow a predetermined transport route to the destination (landfill or other) via Sussex Street, Anzac Bridge and the City West Link or across the Harbour Bridge;
- Truck trailers will also be covered with a waterproof tarpaulin to mitigate the potential ingress of rainwater during transportation and to assist in protecting the integrity of the foaming agent;
- The truck will be inspected prior to leaving Site to ensure that the mitigation measures described above have been appropriately implemented;
- Where possible, the selected transport route(s) will avoid travel through residential areas;
- Contingency measures will be developed and implemented to manage potential risks associated with breakdowns, accidents or other emergency circumstances. This will include monitoring of trucks using Global Positioning System (GPS) and development of actions to respond to breakdowns and accidents and to monitor compliance with the above mitigation measures; and
- Photographs will be taken regularly to confirm that the above works have been conducted appropriately.

7.18.2 Off-site Treatment Facility

The off-site treatment facility has not been identified at this stage. The facility will be required to meet the following minimum requirements:

- The facility and its operations must be approved by the NSW EPA and comply with the *Protection of the Environment Operations (Waste) Regulation (2014)*;
- The facility must have (or obtain) an EPL which permits the treatment of Hazardous Waste and must comply with the requirements of the EPL for the duration of the Barangaroo treatment works;
- The facility must obtain an Immobilisation Approval from the NSW EPA as required by the NSW EPA *General Approval of the Immobilisation of Contaminants in Waste (Approval Number 2005/14)* for the materials to be received and treated from Barangaroo;
- Following treatment of Hazardous Waste materials (as required by the Immobilisation Approval) all treated materials must be disposed to NSW EPA licensed landfill facility appropriately licensed to receive the relevant waste type; and
- All materials must be tracked through the treatment and landfill disposal process in accordance with Part 4 of the *Protection of the Environment Operations (Waste) Regulation (2014)*.

7.19 Environmental Management

Lend Lease has prepared a Construction Framework Environmental Management Plan (CFEMP) for Stage 1 of the Barangaroo works. This CFEMP has been updated to include the remediation of Hickson Road, and is provided in **Appendix Y**. The CFEMP includes the following sub-plans:

- Water & Stormwater Management Sub-Plan.
- Noise & Vibration Management Sub-Plan.
- Air Quality & Odour Management Sub-Plan.
- Acid Sulfate Soil Management Sub-Plan.
- Spoil and Waste Management Sub Plan.

These sub-plans will be supplemented or updated as appropriate to incorporate the mitigation and management measures described above, and in **Section 9**.

7.20 Cumulative Assessment

The environmental impact assessment has provided for cumulative environmental impacts with regards to ongoing construction activities at Barangaroo South as follows.

Cumulative impacts from the remediation works were assessed alongside the following projects:

- Construction of Commercial Building C3;
- Remediation of 'Block 4';
- Remediation of Block 5;
- Construction of Commercial Building C2/C6;
- Construction of Commercial Building C8/H2; and
- Construction of the Crown Hotel.

7.20.1 Noise and Vibration:

The noise impact assessment established a cumulative noise impact scenario to determine the cumulative noise impacts of the remediation works and other site construction works that are projected to occur at the same time.

Both in-situ and ex-situ remediation methods were modelled alongside other developments. Based on the cumulative assessment it can be concluded that noise from remediation of Hickson Road (using either in-situ or ex-situ remediation technologies) will be a significant contributor to cumulative noise levels at residences on Hickson Road. However, other works at Barangaroo will be the primary contributors to noise levels at other receivers.

The most affected area is residences on Hickson Road, although exceedances are anticipated at all receivers, as shown in **Table 10** and **Table 11** in **Section 7.9**. Under the preferred remediation option (in-situ remediation) an increase of up to 24 dBA is anticipated at the residences on Hickson Road (16dBA above the relevant criteria for day time). Under the secondary remediation technology (ex-situ remediation) an increase of up to 26 dBA is anticipated at residences on Hickson Road (18dBA above the relevant criteria for day time)..

Without mitigation, noise levels from remediation activities have been predicted to exceed the noise management levels on Hickson Road. Therefore, the planning and management of construction activities must take into account the sensitivities of surrounding residents so as to minimise the impact of construction noise at these receivers. **Section 7.9** includes a comprehensive suite of noise mitigation measures that will be implemented to appropriately minimise and proactively manage noise impacts.

7.20.2 Air Quality

The assessment provided in **Section 7.8**, relates to the cumulative impacts of the Hickson Road remediation works with other Barangaroo related works that will occur at the same time, as described in **Section 7.8.7**.

The maximum predicted cumulative one hour NO₂ concentration is inclusive of all onsite construction activities, background concentration and Stage 1C of 390.8 µg/m³ for both in-situ and ex-situ remediation. The modelling predicted two exceedances of this criterion to occur at one singular receptor location (Receptor 81, located adjacent to the development site) for both remediation methodologies. This corresponds to 0.09% of the year, which is considered to be infrequent.

The cumulative assessment for PM₁₀ provided in the AQIA indicates that the Hickson Road remediation activities would make a relatively small contribution when compared to other projects being undertaken at Barangaroo, and would not result in any additional exceedances of the 24-hour PM₁₀ criterion.

The AQIA describes mitigation and work practices that should be implemented at the site to minimise pollutant emissions under both remediation scenarios. All mitigation and work practices that should be implemented at the site to minimise pollutant emissions are described in the AQIA. These measures are intended to reduce risks to human health and nuisance impacts.

No exceedances of the EPA criteria were predicted to occur at any sensitive receptor location assessed for TSP, air toxics or odour. Exceedances of the 1 hour and 24 hour criteria for NO₂ and PM₁₀ respectively were predicted when taking into account both the background and Stage 1C contributions. There were no exceedances of the annual criteria for NO₂ and PM₁₀.

Further, Lend Lease currently operates a reactive dust mitigation system at the Barangaroo South site, which will be continued. The reactive management procedures for PM₁₀ are provided in the AQIA.

7.20.3 Traffic

As described in **Section 7.10**, an assessment has been made of the cumulative impacts of the Hickson Road remediation works combined with other traffic generated from construction and occupation of completed buildings at Barangaroo.

It determined that, during the Hickson Road remediation works, the total morning peak hour vehicle movements generated by all of Barangaroo is 335 traffic movements forecast during the AM peak.. Construction activity associated with the Hickson Road remediation works is forecast to contribute only 10 peak hour traffic movements. This represents 3% of the total traffic movements in the Barangaroo precinct, which is considered to be a negligible contribution.

Intersection modelling of the cumulative traffic scenario demonstrates that the road network generally operates satisfactorily during the AM peak hour, and that

the addition of construction traffic movements associated with Hickson Road remediation works is not anticipated to impact the overall operation of the local road network.

8.0 Environmental Risk Assessment

The Environmental Risk Assessment (ERA) establishes a residual risk by reviewing the significance of environmental impacts and the ability to manage those impacts. The ERA for the remediation of Hickson Road has been adapted from Australian Standard AS4369.1999 Risk Management and Environmental Risk Tools.

In accordance with the SEARs, the ERA addresses the following significant risk issues:

- the adequacy of baseline data;
- the potential cumulative impacts arising from other developments in the vicinity of the site; and
- measures to avoid, minimise, offset the predicted impacts where necessary involving the preparation of detailed contingency plans for managing any significant risk to the environment.

Figure 14 indicates the significance of environmental impacts and assigns a value between 1 and 10 based on:

- the receiving environment;
- the level of understanding of the type and extent of impacts; and
- the likely community response to the environmental consequence of the project;

The manageability of environmental impact is assigned a value between 1 and 5 based on:

- the complexity of mitigation measures;
- the known level of performance of the safeguards proposed; and
- the opportunity for adaptive management.

The sum of the values assigned provides an indicative ranking of potential residual impacts after the mitigation measures are implemented.

Significance of impact	Manageability of impact				
	5 Complex	4 Substantial	3 Elementary	2 Standard	1 Simple
1 – Low	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)	2 (Low)
2 – Minor	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)
3 – Moderate	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)
4 – High	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)
5 – Extreme	10 (High)	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)

Figure 14 – Risk Assessment Matrix

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures and / or Comment	Risk Assessment		
				Significance of Impact	Manageability of Impact	Risk Rating
Contamination and remediation	C	▪ Risk of exposure to onsite workers. ▪ Risk of exposure to off-site receptors during remediation.	▪ Implementation of a RAP, including review and sign-off by an EPA Accredited Site Auditor.	High (4)	Complex (5)	High (9)
Air Quality and Odour	C	▪ Risk of exposure to off-site receptors during remediation.	▪ A suite of mitigation measures will be applied to minimise the emission of particulates. A reactive monitoring and management program is being implemented to address the potential for cumulative dust (particulate) emissions arising from the construction works at Barangaroo.	High (4)	Complex (5)	High (9)
Noise	C	▪ The noise contribution from the remediation works will result in significant cumulative noise impact at surrounding residential or commercial receivers.	▪ A Noise and Vibration Management Plan will be implemented which includes a suite of noise and vibration mitigation and management measures aimed at working towards achieving the noise management levels established at surrounding receivers.	High (4)	Substantial (4)	High (8)
Waste Management	C	▪ Additional waste streams ▪ Incorrect disposal offsite or reuse of material onsite.	▪ Where possible clean material that does not require treatment will be re-used on-site. ▪ Implement Spoil and Waste Management Plan	Moderate (3)	Substantial (4)	High (7)
Soil and Water Management	C	▪ Discharge of contaminated waste water or stormwater.	▪ All contaminated waste water will be collected and treated, with all discharges subject to an EPL. ▪ Trade Waste Agreement, or tankered directly off-site to a licensed liquid waste facility.	Moderate (3)	Substantial (4)	High (7)
Traffic	C	▪ The remediation works will contribute to construction traffic impacts in surrounding streets. ▪ The remediation works will impact on vehicle access along Hickson Road during works.	▪ A Construction Traffic Management Plan will be prepared.	Minor (2)	Standard (2)	Low/Medium (4)
Visual Impacts	C	▪ Contribution to deterioration in views to/from the Harbour.	▪ The remediation works are proportionate to the nature and scale of structures and equipment that will be located at Barangaroo South during the construction period (such as cranes).	Minor (2)	Standard (2)	Low/Medium (4)
Heritage	C	▪ Impacts to previously unidentified heritage items.	▪ Should previously unknown artefacts be discovered then work on the site shall cease until the item has been identified and reported to a suitably qualified professional and the Local LALC.	Moderate (3)	Standard (2)	Low/Medium (5)
Ecology and Arboriculture	C	▪ Impacts to transient species (e.g. birds) who may visit the site. ▪ Biodiversity impacts arising from a site discharge to air or water.	▪ Tree Management Plan will be implemented to ensure that only trees specified for removal are directly impacted by the remediation works, and that trees to be retained are appropriate protected during the works ▪ The remediation works will result in an improvement to water quality and aquatic ecosystems in the vicinity of the site.	Minor (2)	Substantial (4)	Medium (6)

Item	Phase	Potential Environmental Impact	Proposed Mitigation Measures and / or Comment	Risk Assessment		
				Significance of Impact	Manageability of Impact	Risk Rating
Hazard and Risk	C	Impacts from fire or explosion of flammable materials held on the site.	- Works will be undertaken in line with the recommendations of the PHA - A final hazard analysis (FHA) should be conducted prior to commencement of in-situ remediation - The in-situ remediation compound area will be covered with appropriate barriers or the building manager that administers the lunch area above the rock wall on Hickson Road should be contacted and informed of the remediation works that will occur below the lunch area and that request that the existing no smoking areas should be strictly enforced during the remediation activities; - The Remediation Contractor should include in their operation procedure a daily pre-start check to ensure the 'no smoking' signs have been placed on the terrace directly above the Remediation Area; - Surfactant should be stored in dangerous goods containers with dimensions of approximately 1.5 m x 1.5 m; and - Surfactant drums should be delivered to site on plastic wrapped pallets and loaded directly into the DG storage cabinets.	High (4)	Standard (2)	Medium (6)
Infrastructure and Utilities	C	Inadvertent impacts to existing utilities to be retained.	Stormwater diversion will be implemented to address existing stormwater constraints upstream of the remediation works site.	Moderate (3)	Standard (2)	Low/Medium (5)

9.0 Mitigation Measures

The collective measures required to mitigate the impacts associated with the proposed works are detailed in **Table 15** below. These measures have been derived from the previous assessment in **Section 7.0** and those detailed in appended consultants' reports.

Table 15 – Mitigation Measures

Issue	Commitments
Contamination	▪ The Remediation Works will be carried out in accordance with the Remedial Action Plan provided in Appendix G. ▪ At the completion of the Project, an Interim Audit Advice will be obtained from a NSW EPA Accredited Site Auditor, to confirm successful completion of the Hickson Road works as per the RAP. ▪ At the completion of all Remediation Works to address EPA Remediation Site 21122 (i.e. Block 4, Block 5 and Hickson Rd), a Section A Site Audit Statement will be obtained from a NSW EPA Accredited Site Auditor, to confirm successful completion of works.
Health Risk Management	Source controls for the project will include measures to control emission of particulates and controls for emission of gases from exposed contaminated soils and water, including: ▪ Enclosure (where practicable) of excavation and filtration of exhaust streams to manage pollutants of potential concern that may be produced/released during the soil excavation and remediation processes. ▪ Prompt removal, covering and managing of heavily contaminated materials that have been exposed and are identified to have caused the emissions. ▪ Dust suppression, including sweeping and wetting of exposed surfaces including haul roads. ▪ Excavation of materials within temporary remediation and soil treatment enclosures, with filtration of exhaust streams. ▪ Odours from volatilisation will be monitored and a soil vapour extraction system will be put in place. ▪ Managing groundwater removal and drawdown, where practicable, such that material excavated is retained in a moist state. ▪ Minimising haul road lengths, implementing of site speed limits and covering haul loads. ▪ Solid perimeter hoarding adjacent to sensitive receptors. ▪ Surface stabilisation to minimise dust generation, and covering surfaces where appropriate. ▪ Prompt removal, covering and managing of heavily contaminated materials that have been exposed. The following source controls will be implemented for contaminated water: ▪ Installation of ground water control and retention walls as practicable around the excavation area to minimise the infiltration of groundwater from the Remediation Area into the less contaminated excavation area. ▪ Treatment of contaminated surface water to enable safe discharge in accordance with site regulatory requirements. ▪ Use of surface bunds and drainage diversions to divert clean water away from contaminated areas. ▪ Silt fences to prevent cross-contamination between disturbed areas and undisturbed areas. In addition to source controls, risks to on-site workers will be minimised by: ▪ Engineering controls and safe work practices and effective hygiene procedures (such as hand washing). ▪ Use of appropriate personal protective equipment.
Acid Sulfate Soils	The ASSMP includes a range of management measures that will be followed to handle, treat and dispose of ASS if required, including: ▪ PASS materials will be kept separate from non-PASS materials at all times.

Issue	Commitments
	■ Water collected from PASS treatment/storage areas will be directed to the wastewater treatment plant and treated to a prescribed discharge water quality. ■ A truck wash down area will be constructed so that truck wash down water can be collected for treatment. ■ Treated water will only be discharged in accordance with the relevant criteria in the EPL. A water quality monitoring program will be implemented. ■ Neutralisation of the ASS will be undertaken by application of calcium carbonate (Aglime) in a designated bunded treatment area and thoroughly mixed with the soil. The treatment area is to be provided with a guard layer of neutralising agent (i.e. Aglime). ■ During treatment soil pH will be measured regularly as a measure of the effectiveness of neutralisation. ■ Treated materials will be monitored regularly at a rate of one sample per 500 m³. ■ Treated material will be reused or disposed of in accordance with its classification under the Waste Classification Guidelines. The ASSMP will be updated following confirmation of the responsible contractor.
Water	■ Clean stormwater will be diverted away from the site. ■ All contaminated water (including stormwater collected in disturbed contaminated areas and works areas, and groundwater from disturbed contaminated areas) will be collected for treatment on-site prior to discharge. No contaminated or treated water will be discharged into Sydney Harbour or any sewers without being compliant with EPL 13336 or any future Sydney Water Corporation Trade Waste Agreement. ■ A Water Quality Monitoring Program will be put in place to ensure the remediation works are not having an adverse impact on water quality conditions in the Harbour. ■ A Groundwater Monitoring Plan will be prepared and implemented to measure the effectiveness of the remedial works that have been undertaken (specifically source removal and subsequent groundwater quality improvement) with respect to groundwater quality migrating from the EPA Declaration Area boundary and the associated risk to aquatic ecosystems.
Air Quality	An Air Quality Management Plan will be prepared. The AQMP will include mitigation measures and work practices to be implemented at the site to minimise pollutant emissions including: ■ Continue the dust, VOC and meteorological monitoring program. ■ Use mains power where available and suitable. ■ Turn vehicle engines off while parked on site. ■ Confine vehicular access to designated access roads. ■ Appropriately tune, modify or maintain equipment, plant and machinery to minimise visible smoke and emissions. ■ Undertake all excavation and materials handling within excavation enclosures, to the extent practical. ■ Maintain the excavation enclosures to their design specifications. ■ Undertake regular checking and maintenance of air emission filtration systems. ■ Implement site speed limits. ■ Vent generator emissions inside excavation enclosures through the emission stacks. ■ Minimise haul road lengths. ■ Reduce exposed areas as much as practical. ■ All loads would be appropriately sealed to prevent odour and dust emissions during transport (for example through the use of odour suppressant foam, such as Rusmar AC-645 or equivalent). ■ Undertake good housekeeping practices to minimise dust on hardstand areas. ■ Immediately clean up spills. ■ Maintain the complaints management system. ■ Adjust work practices (as required) based on wind observations and real

Issue	Commitments
	time monitoring results. ■ Use water sprays and/or surfactants wherever and whenever necessary. ■ Erect windbreak barriers at the site boundary. ■ Water exposed surfaces and roads.
Air Quality	Implement the reactive management plan, based on a three-stage approach for PM₁₀: ■ Investigate: Identification of the likely reasons for the elevated pollutant concentration and formulation of a contingency response for the action stage; ■ Action: Implementation of the measures formulated in the investigative stage and review of their effectiveness; and ■ Stop Work: All works should stop at this stage until the measured pollutant levels are below the action level to avoid an exceedance of the pollutant criterion. Trigger levels have been established for PM₁₀ and are provided in Appendix Q. ■ The following measures relate to ensuring that the proposed works are carried out in a manner consistent with the air quality modelling assumptions as follows: ■ A minimum of two granular activated carbon (GAC) filters will be installed in series for each emission stack in the excavation enclosures as per the modelling assumptions. The GACs chosen will be suitable for the contaminants being treated. ■ Prior to commencement of the relevant stage of works where excavation enclosures will be used, a detailed design plan of the structures, the air discharge point and emission control system, will be submitted to the EPA for review and comment. The detailed design plan will include the following information: – Performance specifications, including particle and VOC control efficiency for the proposed technology; – Proposed monitoring to confirm the performance of the proposed VOC control technology; and – The proposed methodology to detect carbon bed breakthrough. ■ Stacks will be located on the western sides of the excavation enclosures as assumed in the modelling. ■ All trucks transporting the spoil will be sealed, including use of odour suppressant foam or similar, and receivers of the spoil will be appropriately licensed to receive the material. ■ Alternate odour control measures will be used during retention wall works, such as covering exposed soil or using odour suppressants and foam.

Issue	Commitments
	During the construction of retention walls at locations where tar is anticipated the Hickson Road Perimeter Retention Wall – Preliminary Air Quality and Odour Control Plan would be implemented (to the extent practical). The following air quality/odour control measures are set out in the plan to minimise the quantity of free tar exposed during works, and to minimise odour generation / air emissions. ■ For pile method, conduct works under a bentonite slurry to minimise exposed excavation faces and free tar, and subsequent odour generation / air quality impacts. ■ Where piling method is used, limit the extent of open excavation at any one time to a discrete hole (generally up to 1200mm diameter). Drill each hole using a rotary auger and then fill with a concrete slurry. This method would limit the amount of tar exposed at any one time, thereby minimising odour generation / air quality impacts. During the construction of retention walls the following air quality/odour control measures are proposed (to the extent practical), at locations where tar is anticipated to control the impact of odours that are generated from the works: ■ Use a dedicated labour resource to manage odours in work area. ■ Install vertical barriers around the work area and adequately sealed, to help minimise risk of odour off-site. ■ Use odour suppressants (e.g. BioSolve) or misting sprays in or around the work area. ■ Spray odorous spoil / drill arisings with foaming agents (e.g. Rusmar) once brought to the surface. ■ Cover stockpiles with tarps, non-odorous material or foaming agents, or place into sealed drums. ■ Dispose of stockpiles off-site as soon as practicable. ■ Use water spray on excavated or stockpiled material to mitigate particulate emissions. ■ Cover open excavations overnight. ■ Collect and treat run-off water, or promptly store in sealed containers. ■ Load material promptly and with care to reduce loading times and spillage. ■ Use sealed trucks to control potential for spilling material through the site or off-site. ■ Cover loads prior to leaving loading zones, with odour suppressant foam and automatic tarps. ■ Immediately clean truck and loading areas upon loading. ■ Use truck and wheel wash facilities prior to leaving the site. ■ Undertake detailed odour monitoring on and off-site to allow works/controls to be modified as required. ■ Undertake weather monitoring and modify works based on weather conditions, if required.
Noise and Vibration	A Construction Noise and Vibration Management Plan has been prepared by Lend Lease for the Barangaroo South Site in its entirety. This plan would be updated to take into account the project specific noise and vibration management measures as follows: ■ Localised treatment of fixed plant; ■ A 2.4 metre noise barrier to be installed on the eastern boundaries of the site; ■ Where practicable, installing attenuators on the exhaust fans, filtration and air handling plant associated with the odour control structures; ■ Localised treatment such as barriers, shrouds and the like around fixed plant such as pumps, generators and groundwater extraction plant and by “stepping down” the plant settings out of construction hours where able. The detailed design of acoustic treatments will be undertaken during the detailed design phase; and ■ Provision of respite from noise producing activities during extended hours operations where practicable;

Issue	Commitments
	- Selection and maintenance of low vibration equipment where practicable; - Selection and maintenance of “quiet” type equipment where practicable; and - Effective community consultation and complaints management. Trial testing of vibration levels will be conducted where equipment identified as having the potential to exceed the human comfort criteria is proposed.
Traffic	The following traffic management measures will be implemented in accordance with the Construction Traffic Management Plan in Appendix S: - The site traffic control recommendations for each worksite gate entry or exit point (including all appropriate signage) will be determined by means of a Traffic Control Plan to be prepared by an RMS accredited contractor closer to construction commencement. - Truck movements are to be staged and coordinated to prevent trucks circulating CBD streets whilst awaiting access to the site. - Construction vehicles will approach the site from areas outside the CBD using major arterial routes such as the M4, M5 etc. - The size of trucks proposed to access the site will be in accordance with Clause 300-3 of the Road Rules in terms of lengthy vehicle restrictions. - The vehicular traffic movements at each of the site entry or exit gates for traffic to and from Hickson Road will potentially need to be controlled by a flagman to ensure no potential traffic safety conflicts occur between the site truck traffic and pedestrians on the adjacent footpath. - Personnel will not be permitted to use stop/slow signage in Hickson Road or Sussex Street on weekdays between 7am and 9am and 4pm to 7pm. However, personnel using stop/slow signage will be permitted on Hickson Road, north of the intersection of Hickson Road and Napoleon Street, when it is required to ensure safe truck access at designated site access points, provided that vehicles queue lengths generated as a result of the traffic control do not exceed more than six vehicles in either direction. - Lend Lease implements a green travel plan to maximise and encourage public transport use. This will be applied to the proposed development. It involves: - Providing no parking for construction workers on site. The constrained parking environment surrounding the site, coupled with the relatively high cost of long term parking, will ensure the majority of construction workers arrive to the site via public transport; and - Providing information about public transport availability and fare costs compared with on and off street parking costs. For example, Lend Lease through their site inductions will provide travel information and advice to construction workers about public transport, walking and cycling routes to the Barangaroo south site.
European Heritage	- Where contamination is at depth and the upper layers are uncontaminated, the upper layers could potentially be archaeologically excavated, with restriction as required for OHS management of works. - Where the archaeology is completely covered with contamination and therefore inaccessible for normal archaeological recording methodologies, other alternative techniques may be tested to determine if recording is possible. Then it may be possible to record some major gasworks features but only if they offer a research outcome. - It is likely that opportunities may be extremely limited in what can be recorded. In the end there may be no ability to record remains prior to the remediation.
Indigenous Heritage	If, during the course of the remediation project, any unexpected Aboriginal “objects”, artefacts or sites are uncovered, work must cease in the vicinity of that object, artefact or site and further advice sought from the consultant and the Metropolitan Local Aboriginal Land Council.

Issue	Commitments
Arboriculture	Carry out the remediation in accordance with the relevant Tree Management Plan for the remediation option selected. Tree protection measures include: ▪ Appointment of an arborist to oversee the works, observe/monitor all works within the Tree Protection Zones of trees to be retained, oversee the removal of trees to be removed, and to monitor the condition and protection of trees to be retained. ▪ Where possible, ensure that the TPZ is fenced for protection (and clearly signed as Tree Protection Fencing). Install trunk, branch and ground protection where fencing cannot be installed. ▪ Prevent stockpiling, storage or preparation of materials, parking of machinery and machinery trenching in the TPZ for a tree to be retained. Any trenching in the TPZ should be by hand excavation, or directional boring (trenchless) and under the specific instructions of the on-site project arborist. ▪ Selection of piling equipment that is as short as possible so as to minimise the need for overhead crown pruning. ▪ Any trenching within the Structural Root Zone should be undertaken by hand and under the specific instructions of the on-site project arborist. ▪ Retain the existing road and footpath pavements intact where possible within the TPZ to minimise impacts to the underlying roots from works. ▪ All traffic diversions to include adequate root zone protections. ▪ All crown pruning works to be approved and monitored by the on-site project arborist and are to be undertaken by a suitably qualified arborist (AQF Level 3 Certificate) in compliance with AS 4373-007 Pruning of Amenity Trees. ▪ The number of trees noted to be removed within this EIS is expected to be a maximum based on anticipated maximum extent of excavation required. If the final extent of remediation excavation required is reduced (following validation testing and/or agreement with the NSW EPA and Site Auditor), a qualified arborist will assess and confirm if the associated tree removal can also be reduced from the maximum proposed. ▪ New street trees will be planted to replace those removed
Infrastructure	▪ Further assessment of the potential for damage to utilities will be carried out during the detailed design phase, and dilapidations surveys will be carried out prior to commencing excavation.
Visual Amenity	▪ Night time lighting will be consistent with Australian Standard AS1680, Lighting and the Visual Environment. No other visual impact mitigation is considered necessary, over and above the hoardings already proposed.
Hazard and Risk	The following recommendations have been made to ensure the risks are managed and controlled at the site: ▪ An Emergency Response Plan (ERP) should be incident based and developed to include a range of incidents at the DG storage area: ▪ A spill in the WTP should be included into the ERP; ▪ Incidents involving the surfactant should be included in the site ERP; ▪ Incidents involving diesel should be included into the site ERP; and ▪ A fire in the DG container should be included in the ERP; ▪ Tanks containing oxidant should be manufactured from a white or opaque plastic to minimise the potential for heating from direct sunlight; ▪ Spills kits should be installed adjacent to the existing approved WTP that can be deployed in the event of a spill, preventing spread of the release; ▪ Spill kits should be located adjacent to the diesel storage; ▪ First response firefighting equipment should be stored adjacent to the DG container; ▪ A final hazard analysis (FHA) should be conducted prior to commencement of in-situ remediation; and ▪ Suitable temporary barriers/roof should be put in place to prevent potential cigarette butts from off-site entering the hazardous zone where DGs are being stored; or ▪ The building manager that administers the lunch area above the rock wall on Hickson Road should be contacted and informed of the remediation works that will occur below the lunch area and that request

Issue	Commitments
	that the existing no smoking areas should be strictly enforced during the remediation activities; ▪ The Remediation Contractor should include in their operation procedure a daily pre-start check to ensure the 'no smoking' signs have been placed on the terrace directly above the Remediation Area; ▪ Surfactant should be stored in dangerous goods containers with dimensions of approximately 1.5 m x 1.5 m; and ▪ Surfactant drums should be delivered to site on plastic wrapped pallets and loaded directly into the DG storage cabinets.
ESD	In order to maximise the sustainability and ESD benefits of the project the following key initiatives will be implemented: ▪ Provide centralised recycling areas in all construction (remediation) site buildings and waste bins for remediation worker use which provide for waste separation where appropriate. ▪ Provide site workers with public transport options during their induction. ▪ Reuse groundwater or collected stormwater (where possible) for dust suppression and wash down to reduce potable supply use where appropriate. ▪ Remediation worker accommodation to incorporate ESD initiatives. ▪ Fit pollution control measures on remediation equipment (including diesels oxidation catalysts and diesel particulate matter filters) where practicable. ▪ Minimise the impacts to the local community by maximising internal haul routes within the Barangaroo site where possible.
Waste Management	The management of wastes will be in accordance with the Waste Management Plan provided in Appendix X. The WMP includes that: ▪ The on-site waste management system to be established at the site will aim to maximise waste avoidance through reuse on-site or at off-site locations under a waste exemption approved by the EPA and/or the Barangaroo Site, where possible ▪ Materials separation and segregation will be promoted on the site, to facilitate reuse and recycling as a priority of the waste management system. ▪ All wastes generated as a result of the project will be classified in accordance with the EPA Waste Classification Guidelines. ▪ Details of waste types, volumes and destinations will be recorded on Waste Management Forms, including a Monthly Recycling and Waste Management Statistics form. This information will be collated for record keeping and appropriate communication to any relevant authorities, where required. Wastes to be disposed (or recycled) off-site will be transported to a facility (for disposal or recycling) that can lawfully receive the waste. Storage and handling of such wastes will be subject to the following measures: ▪ Liquid wastes will be stored in appropriate containers in bunded areas until they can be appropriately disposed of. Bunded areas will have the capacity to hold 110% of the volume of the largest container. ▪ Hazardous wastes (comprising small quantities of printer cartridges and e-waste) will be managed in accordance with the requirements of the Environmentally Hazardous Chemicals Act 1985. ▪ All other recyclables and non-recyclables will be stored in appropriate receptacles in appropriate locations and covered where required.
Environmental Control Measures Off-Site Transportation	Materials would be subject to the environmental control measures set in Appendix KK and as described below: ▪ Preparation of materials to ensure they are spadeable and suitable for transport, including: - Mixing of saturated excavated material with fly ash, lime or cement; - Drainage and drying of saturated excavated materials; and - Screening or manual separation of material to separate oversize and/or materials suitable for recycling (e.g. steel, concrete, brick and rock fill, timber piles, construction and demolition waste). ▪ Visual assessment of materials to confirm the material is spadeable and

Issue	Commitments
	does not contain excess free liquids and is suitable for transport. ■ Once the truck trailer has been loaded, the exposed surface of the untreated contaminated soil will be sprayed with a suitable foam agent, such as Rusmar AC-645 (or equivalent) to minimise the release of fugitive emissions during transportation. The intent of the foam agent is to form a barrier that provides adequate odour control for the duration of transport. The foam agent will be required to meet the following criteria: - Must be non-hazardous and bi-degradable. - Must be able to be quickly applied to truck loads shortly after the truck is loaded to rapidly mitigate the generation of fugitive emissions and odours. - Must form a seal across the surface of the soil and effectively bind surface dust particles. - Upon drying, must form a cover which is flexible and capable of resisting degradation during transportation of the materials to the licensed off-site facility. ■ A suitable work area (for example a raised platform) will be constructed within the excavation enclosure to allow a thorough application of the foam agent (or equivalent) across the surface of each truck load containing untreated odorous soil; ■ Trucks carrying excavated materials will be covered and decontaminated in the wheel wash facility before exiting the excavation enclosure (as applicable) and exiting the Site; ■ Trucks carrying contaminated materials will be covered prior to exiting the Site and will remain covered until authorised to unload at the destination; ■ Trucks will be fitted with seals to ensure that the movement of potentially saturated materials is undertaken appropriately; ■ Trucks will not wait in the streets surrounding the Site or within the CBD; ■ Trucks will exit the Site through predetermined exit points on Hickson Road and will follow a predetermined transport route to the destination (landfill or other) via Sussex Street, Anzac Bridge and the City West Link or across the Harbour Bridge; ■ Truck trailers will also be covered with a waterproof tarpaulin to mitigate the potential ingress of rainwater during transportation and to assist in protecting the integrity of the foaming agent; ■ The truck will be inspected prior to leaving Site to ensure that the mitigation measures described above have been appropriately implemented; ■ Where possible, the selected transport route(s) will avoid travel through residential areas; ■ Contingency measures will be developed and implemented to manage potential risks associated with breakdowns, accidents or other emergency circumstances. This will include monitoring of trucks using Global Positioning System (GPS) and development of actions to respond to breakdowns and accidents and to monitor compliance with the above mitigation measures; and ■ Photographs will be taken regularly to confirm that the above works have been conducted appropriately.

10.0 Justification of the Proposal

In general, investment in major projects can only be justified if the benefits of doing so exceed the costs. Such an assessment must consider all costs and benefits, and not simply those that can be easily quantified. As a result, the EP&A Act specifies that such a justification must be made having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.

This means that the decision on whether a project can proceed or not needs to be made in the full knowledge of its effects, both positive and negative, whether those impacts can be quantified or not.

Various components of the biophysical, social and economic environments have been examined in this EIS and are summarised below.

10.1 Social and Economic

The remediation of the EPA Declaration Area is a necessary requirement to address the significant risk of harm to human health and the environment identified by the EPA Declaration.

10.2 Biophysical

One of the key objectives of the proposed remediation works is removal/remediation of contaminated soil, to the extent practicable, such that groundwater quality leaving the site approaches the adopted Marine Water Quality Criteria.

As such, the environmental impact assessment of the proposed development has demonstrated that remediation will contribute to a long term improvement of ground water quality which is leaving the site and migrating towards Sydney Harbour.

10.3 Ecologically Sustainable Development

The EP&A Regulation lists 4 principles of ecologically sustainable development to be considered in assessing a project. They are:

- The precautionary principle;
- Intergenerational equity;
- Conservation of biological diversity and ecological integrity; and
- Improved valuation and pricing of environmental resources.

An analysis of these principles follows.

Precautionary Principle

The precautionary principle means if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The existing contamination that is present at Hickson Road, and is the subject of the EPA Declaration (No.21122), presents a significant risk to health and to the environment.

The EPA considered that the EPA Declaration Area is *'contaminated in such a way as to present a significant risk of harm to human health and the*

environment’. In the EPA Declaration, the EPA state that *“The EPA believes that the site is contaminated with gasworks waste and particularly waste tar as a results of the previous use of the site as a gasworks plant.”*

The proposed Hickson Road remediation works intend to significantly reduce the risk of future environmental harm in the vicinity of the site by removing contaminant mass within Hickson Road such that the site is safe for its current and ongoing use, and the discharge of groundwater off the site towards Sydney Harbour is improved to point where it approaches the MWQC.

The environmental impacts associated with the proposed development are detailed in **Section 7** and have been identified and quantified to an adequate degree of certainty. To ensure that the development is carried out in ways that factors in precautionary approaches mitigating measures have been proposed where considered necessary to prevent detrimental impacts from occurring.

Following the development, the net long-term impact of having carried out the remediation will offset any shorter term negative impacts associated with the works. Provided that the development is carried out in accordance with the management and mitigation measures suggested within **Section 9** the proposed remediation, be it in-situ or ex-situ remediation, can be carried out in a manner such that the risk of carrying out the works is far less than the risk of not carrying out the works. .

Intergenerational Equity

Intergenerational Equity requires that the *“present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for benefit of future generations.”* The requirement for equity between generations binds or integrates the other principles of ecologically sustainable development.

Intergenerational equity implies that the present generation should ensure that its local environment is maintained or enhanced for the benefit of future generations.

Currently, existing contamination within Hickson Road presents a significant risk to human health and the environment for future generations. The project will ensure that the historical legacy of contamination at the site will be removed, making the site suitable for its current and ongoing uses, and providing for an improvement to the environmental conditions in the vicinity of the site. By remediation of the existing contamination the likelihood of impacts to human health or the environment from the contaminants is significantly reduced for future generations.

Remediation of the existing contamination by today’s generation will ensure that the costs of removing the contamination do not fall on future generations, as well as ensuring that future generations are not liable for dealing with human health or environmental impacts that might arise in the future as a result of the contamination.

Conservation of biological diversity and ecological integrity

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems and the linkages between them. Biological resources provide food, many medicines, fibres and industrial products.

Maintenance of biological diversity will ensure life support functions and can be considered a ‘minimal’ requirement for intergenerational equity.

The proposed remediation does not impact on biological diversity or ecological integrity. At the completion of remediation the removal of principal sources of contamination will improve the quality of groundwater migrating off the site towards Sydney Harbour.

Improved valuation, pricing and incentive mechanisms

This principle is a component of “intergenerational equity” and establishes the need to determine economic values for services provided by the natural environment, such as the atmosphere’s ability to receive emissions, cultural values and visual amenity.

The value of the environmental resources affected by the proposal has been acknowledged and provided for through the examination of environmental consequences of the proposal and identification of mitigation measures to address potential impacts, including any short term construction impacts.

11.0 Conclusion

This SSD DA (SSD 6617-2014) seeks approval for the remediation of contaminated land in Hickson Road that forms part of the EPA Declaration Area, located adjacent to Barangaroo South and Central Barangaroo.

The objective of the remediation work for Hickson Road as described in this SSD DA is to enable the EPA Declaration to be revoked in respect of Hickson Road. In order to achieve this objective a detailed remedial strategy has been developed for the site, as set out in the RAP (**Appendix G**), which has been reviewed and approved by an independent EPA-accredited Site Auditor, Mr Graeme Nyland (**Appendix I**).

The proposed remediation will remove the principal sources of contamination within Hickson Road which are currently contributing to the possible migration of contaminated groundwater off the site. As set out in the EPA Declaration, these contaminants include human carcinogens and substances toxic to aquatic ecosystems and could ultimately be affecting aquatic ecosystems. As such, the proposed remediation works will result in an improvement to water quality and aquatic ecosystems in the vicinity of the site. The benefits that will result from the proposed development will outweigh the anticipated impacts of the development as well as the anticipated cumulative impacts of the development alongside other planned works, as outlined in Section 7.20.

Two potential remediation technologies are proposed and assessed within this EIS. Following the completion of a separately approved pilot trial, one of these technologies will be selected. The assessment of the Hickson Road remediation works has demonstrated that, whichever remediation methodology is selected, remediation works can be carried out in a manner that can ensure significant adverse environmental effects do not occur and environmental impacts will remain within acceptable limits with the application of robust and comprehensive management measures.

Lend Lease has demonstrated an ability to undertake significant remediation and materials handling activities with substantial plant and equipment numbers within acceptable environmental limits at Barangaroo South. In particular, Lend Lease already has in place a comprehensive CFEMP for Stage 1 of the Barangaroo works and is carrying out those works subject to strict environmental controls, including a suite of comprehensive monitoring programs. The CFEMP has been updated to include the Hickson Road remediation works (**Appendix Y**).

Lend Lease will supplement the CFEMP with a set of works specific mitigation and management measures as set out in **Section 9**.

During and following the proposed remediation Hickson Road will be retained as a public road. The proposed remediation of Hickson Road will not adversely impact on the future development of Barangaroo in accordance with the approved Concept Plan (as modified).

Given the environmental planning merits described above, and significant public benefits proposed, it is requested that the Minister approve the SSD DA under Section 89E of the EP&A Act.