

# ONE SYDNEY HARBOUR

## Stormwater Management and Infrastructure Servicing Strategy

Barangaroo South – Stage 1B Basement  
State Significant Development Application (SSD 6960)

NA50613044

Prepared for  
Lend Lease Building Pty Ltd

August 2015



## Document Information

Prepared for Lend Lease Building Pty Ltd  
Project Name Barangaroo South – Stage 1B Basement  
File Reference NA50613044 15-0128 Rev8-20150901.docx  
Job Reference NA50613044  
Date August 2015

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## Document Control

Version	Date	Description of Revision	Prepared by:	Reviewed by:
01	09/12/2014	Draft for Client Review	T Michel	M Hodges
02	13/02/2015	Final Draft	T Michel	M Hodges
03	24/02/2015	Incorporating minor amendments	T Michel	M Hodges
04	27/02/2015	Incorporating minor amendments	T Michel	M Hodges
05	15/04/2015	Issue for Final Client Review	T Michel	
06	17/04/2015	Issue for Final Client Review	T Michel	M Hodges
07	01/05/2015	Issue for SSSA	T Michel	M Hodges
08	31/08/2015	Issue for SSSA	T Michel	M Hodges

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# 1 Project Appreciation

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## 1.1 Introduction

This Stormwater Management and Infrastructure Servicing Strategy supports a State Significant Development Application (SSD 6960) submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Development Application (DA) seeks approval for construction of the Stage 1B Basement, provision of infrastructure to service to the proposed Crown Hotel development and associated works at Barangaroo South.

This Strategy addresses stormwater management and infrastructure servicing requirements during and post-construction including:

- Internal and external stormwater drainage;
- Stormwater quality and quantity management requirements;
- Flooding, including management of overland flow within and adjacent to the site;
- Climate change adaptation requirements;
- Erosion and sediment control measures;
- Construction of internal roads within the Stage 1B development site; and
- Provision of utility services to cater for ultimate development of the Stage 1B basement.

## 1.2 Scope of this Report

This report has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) in respect of *SSD 6960 Stage 1B Basement*, specifically as outlined below.

### 7. *Soil and Water*

- Undertake an assessment of the potential impacts on water quality of Sydney Harbour and associated marine ecology impacts.
- Assess impacts on water quality of Sydney Harbour and surface and groundwater hydrology and quality including proposed management, mitigation and monitoring measures.
- Include an integrated water management system including consideration of stormwater and wastewater.
- Detail erosion, sediment and stormwater management and controls during construction and management and mitigation measures for the prevention of potential water quality impacts during construction.
- Identification of any water licensing requirements or other approvals required under the Water Act 1912 or Water Management Act 2000.

### 21. *Infrastructure Provision*

- Detail any infrastructure proposed to service the development and demonstrate that the site can be suitably serviced.
- Detail the existing infrastructure on-site, and identify any possible impacts on infrastructure arising from the construction of the proposed works.
- Where the proposed works affect existing infrastructure, the application should detail any mitigation works proposed, including service relocations.

### 1.3 Overview of Proposed Development

The Stage 1B Basement DA seeks approval for the construction of a four level basement to accommodate parking and associated loading dock and service areas for the Stage 1B Residential Buildings (subject to separate SSD applications). The works include the construction of common plant and services, loading docks, waste rooms and storage areas, as well as structural cores and associated building services for the Stage 1B Residential Buildings. The proposed development will also include trunk drainage associated with the ground plane, trunk drainage deviation works as well as roads and landscape works.

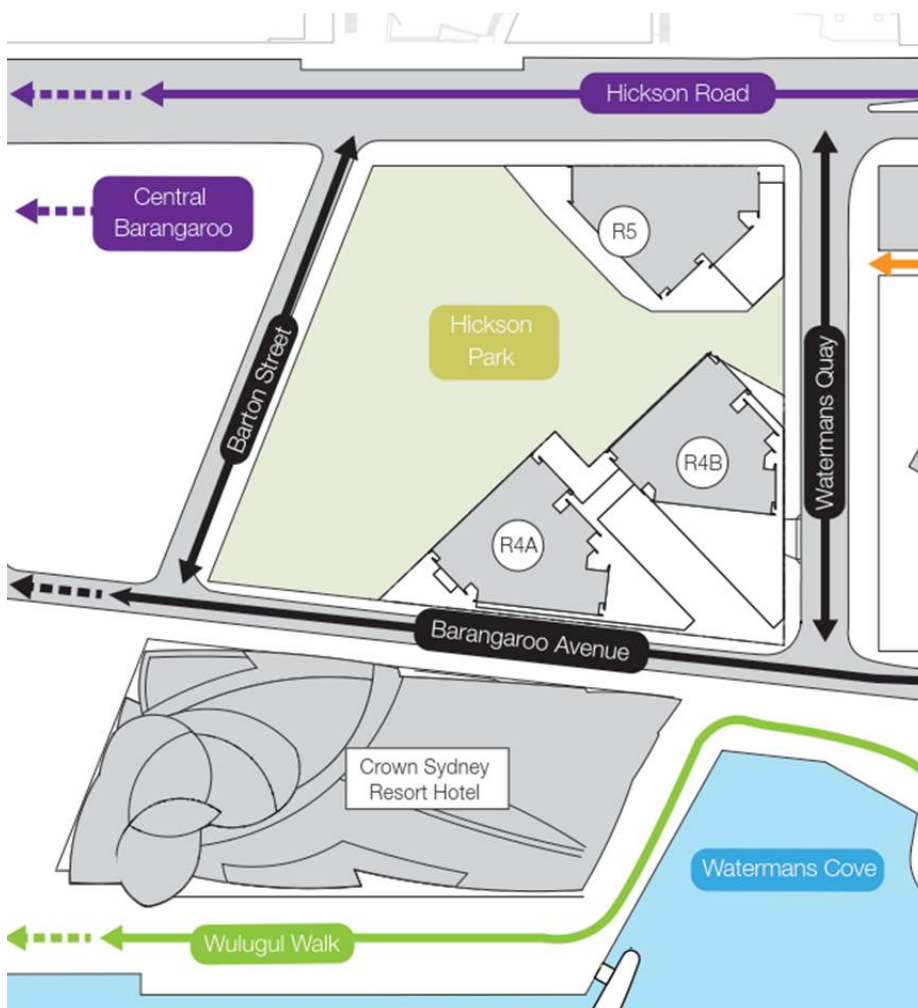
It is noted that site preparation works, including demolition, remediation and some excavation works are covered under a separate state significant development application for remediation and land forming works (SSD 5897).

### 1.4 Site Description

Barangaroo is located on the north western edge of the Sydney Central Business District (CBD), bound 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 bounded to the south by a range of new development dominated by large CBD commercial tenants.

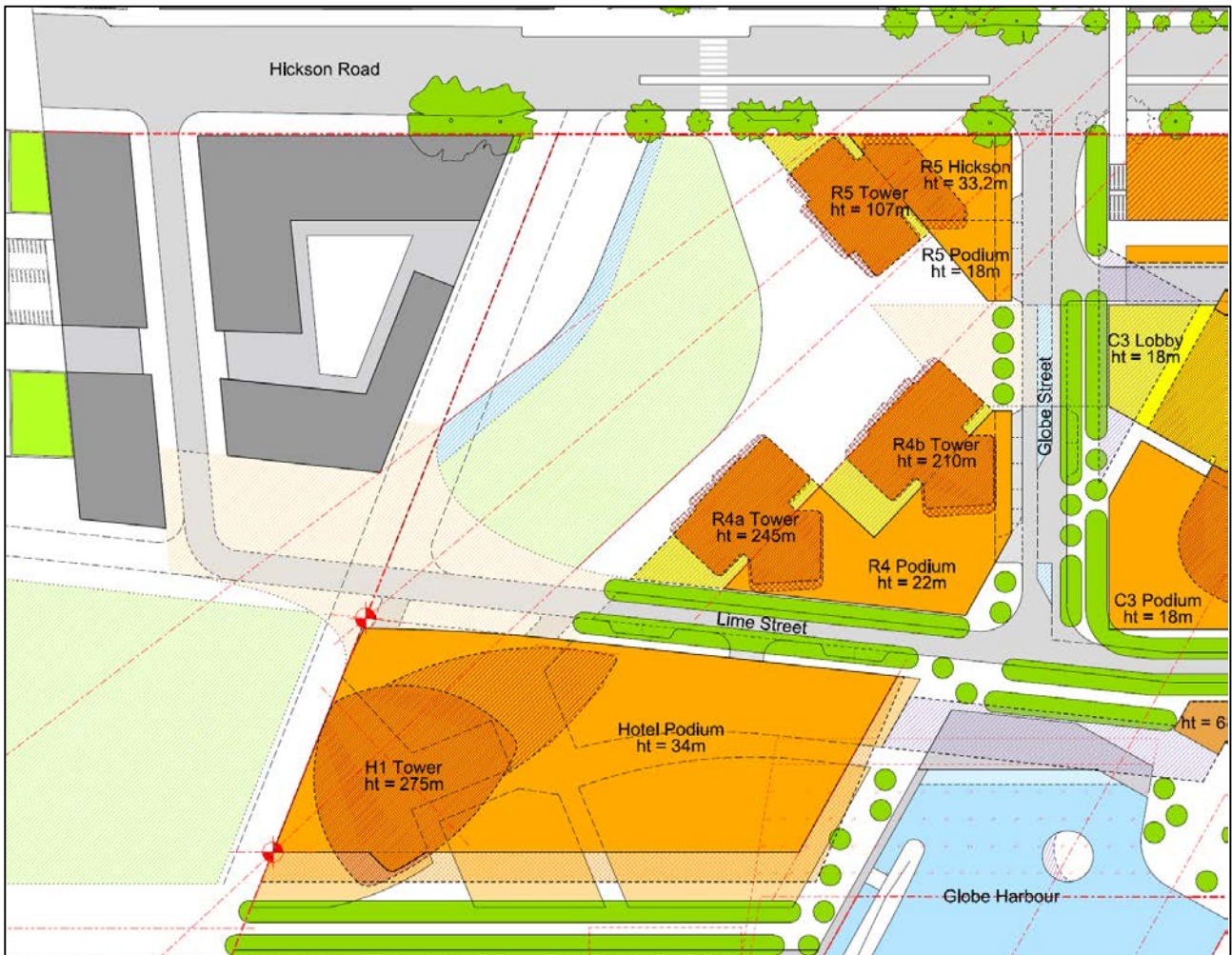
The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Central Barangaroo and Barangaroo South.

The Stage 1B Basement DA Site area is located within Barangaroo South as shown in **Figure 1-1**. The DA Site is located on land generally known and identified in the approved Concept Plan MP06\_0162 (as modified) as Blocks 4A and 4B and part of the public domain area between those blocks and Block 5.



**Figure 1-1 Stage 1B Basement Development Application (SSD 6960) Site Location Plan**

An extract of the Barangaroo South Concept Plan (including Modification 8, which is subject to approval) is presented in **Figure 1-2**.



**Figure 1-2 Extract of Barangaroo South Concept Plan (MOD8)**

## 1.5 Related Documents

The following reports shall be read in conjunction with this document:

1. Barangaroo South Flood Study CS7300 (15-0132), Revision 1, dated March 2015, prepared by Cardno;
2. Site Servicing Strategy (11-0321), Revision K, dated March 2013, prepared by Cardno.

## 2 Project Description

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### 2.1 Preceding Works

Prior to the commencement of the scope of work that is the subject of this DA, works that will be undertaken within the Stage 1B site include those listed below. These works were the subject of a separate development consent and were recently assessed as a State Significant Development (Application No. SSD 5897). Development consent for SSD 5897 was granted by the Minister for Planning on 10<sup>th</sup> November 2014.

- Construction of a perimeter retention wall system;
- Remediation of contaminated land within the Stage 1B site (also referred to as Block 4), which forms part of the EPA Declaration Area N21122, in accordance with a Remedial Action Plan (RAP);
- Carrying out remediation works within the extent of the perimeter retention wall to ultimately allow the EPA to revoke the Declaration Area and ensure the Stage 1B development area is suitable for the intended future uses of the land;
- Diversion of trunk stormwater drainage infrastructure within the development boundary and provision of a temporary stormwater diversion; and
- Bulk excavation of the portion of the Stage 1B development area within the perimeter retention wall.

### 2.2 Proposed Works

The works to be assessed under this DA, which is the subject of this report, include:

- Excavation of any material outside the scope of work completed under SSD 5897 and within the extent of the proposed basement structure to a level of approximately -13.5 mAHD to top of B4 slab, - 16.9 mAHD to top of lift pit slab and below this due to hydrostatic slab, blinding, drainage layer and piling works;
- Works associated with the diversion and protection of utility services to allow for construction of the proposed basement structure and future servicing of proposed residential buildings above the basement;
- Construction of a four level basement structure and associated vehicular ramps within the perimeter retention wall completed under SSD 5897;
- Trunk drainage above the ground slab, including construction of permanent works to divert stormwater from external catchments through the site;
- Temporary landscaping;
- Construction of an interim layout for roads and footpaths within Stage 1B, including:
  - Construction of an access driveway to the Stage 1B basement off the recently constructed Watermans Quay;
  - Construction of proposed roads Barton Street and Barangaroo Avenue, including a temporary turning head on Barangaroo Avenue;
- Installation of infrastructure to service the Stage 1B Basement, proposed Crown Hotel site and the ultimate road layout for Stage 1B, including:
  - Water supply (potable, recycled, chilled)
  - Sewerage
  - Stormwater drainage
  - Gas
  - Electrical (including street lighting)
  - Communications and security cameras

The scope of work is presented in the drawings listed in the following table (refer to **Appendix A** for civil drawings SKC200 to SKC234 inclusive).

Drawing No.	Revision	Drawing Title
BB2_PA2_A000	A	Title Sheet
BB2_PA2_A001	A	Aerial Location Plan
BB2_PA2_A002	A	Survey Plan
BB2_PA2_A003	A	Demolition, Excavation and Services Zone Plan
BB2_PA2_A100	A	Basement Plan Level B0
BB2_PA2_A101	A	Basement Plan Level B1
BB2_PA2_A102	A	Basement Plan Level B2
BB2_PA2_A103	A	Basement Plan Level B3
BB2_PA2_A104	A	Basement Plan Level B4
BB2_PA2_A105	A	Basement Plan Level B5
BB2_PA2_A300	A	Section 01
BB2_PA2_A301	A	Section 02
BB2_PA2_A302	A	Section 03
BB2_PA2_A303	A	Section 04
BB2_PA2_A400	A	Building Elements – Ground Floor
BB2_PA2_A401	A	Building Elements – Podium 1
BB2_PA2_A402	A	Building Elements – Podium 2
BB2_PA2_A501	A	Building Elements – Elevations

### 2.3 Planning Context

Similar to the work approved under SSD 5897, approval for the proposed scope of work that is the subject of this DA is being sought from the Minister for Planning under Part 4 of the *Environmental Planning and Assessment Act 1979*.

## 3 Data Compilation

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### 3.1 Topographic Survey

Airborne Laser Scanning (ALS) was undertaken by AAM-Hatch. Generally the accuracy of ALS data is  $\pm 0.15\text{m}$  to one standard deviation on hard surfaces.

### 3.2 Ground Survey

A detailed field survey of the proposed development site, Hickson Road, Sussex Street and Shelley Street was undertaken by Rygate & Company. The ground survey and ALS data have been used to analyse existing overland flow paths within and adjacent to the site.

### 3.3 Site Inspection

Site inspections have been undertaken by to confirm site and catchment features. The site inspections provided the opportunity to identify street drainage features, identify the catchment boundaries and visually identify potential flooding areas within the catchments.

### 3.4 GIS Data

The following Geographic Information System (GIS) data was provided by Cardno's GIS team and Sydney Water's asset database system for this study:

- Cadastre for the catchment area;
- Topographic map with contours at 2 metre intervals;
- Aerial images; and
- Hydra plans featuring Sydney Water's stormwater infrastructure.

## 4 Integrated Water Management Plan

### 4.1 Relevant SEARs

This section addresses the following SEAR for SSD 6960:

- Include an integrated water management system including consideration of stormwater and wastewater.

### 4.2 Overview of Barangaroo South Integrated Water Management

Barangaroo South will include an integrated water management system that will take into account all facets of the water cycle to provide services that maximise social, economic and environmental benefits associated with water management within the development.

The overall objective of the integrated water management system for Barangaroo South is to achieve a positive water balance based on exporting recycled water from the site in greater quantity than potable water is imported. This objective will be achieved through a site wide approach that focuses on:

- Potable water demand reduction, including a commitment to achieve a reduction in potable water consumption compared to a standard practice development.
- Incorporation of sewer mining into the site water balance, which following treatment at the Barangaroo Recycled Water Treatment Plant (RWTP) will provide an additional source of recycled water for both supply within the development and potential to export to adjacent customers.
- Water balance modelling including:
  - Review and selection of the most appropriate sources of water for both potable and non-potable uses;
  - Assessment and selection of appropriate treatment measures; and
  - Further development of existing conceptual water balance model; refer to **Figure 4-1**.

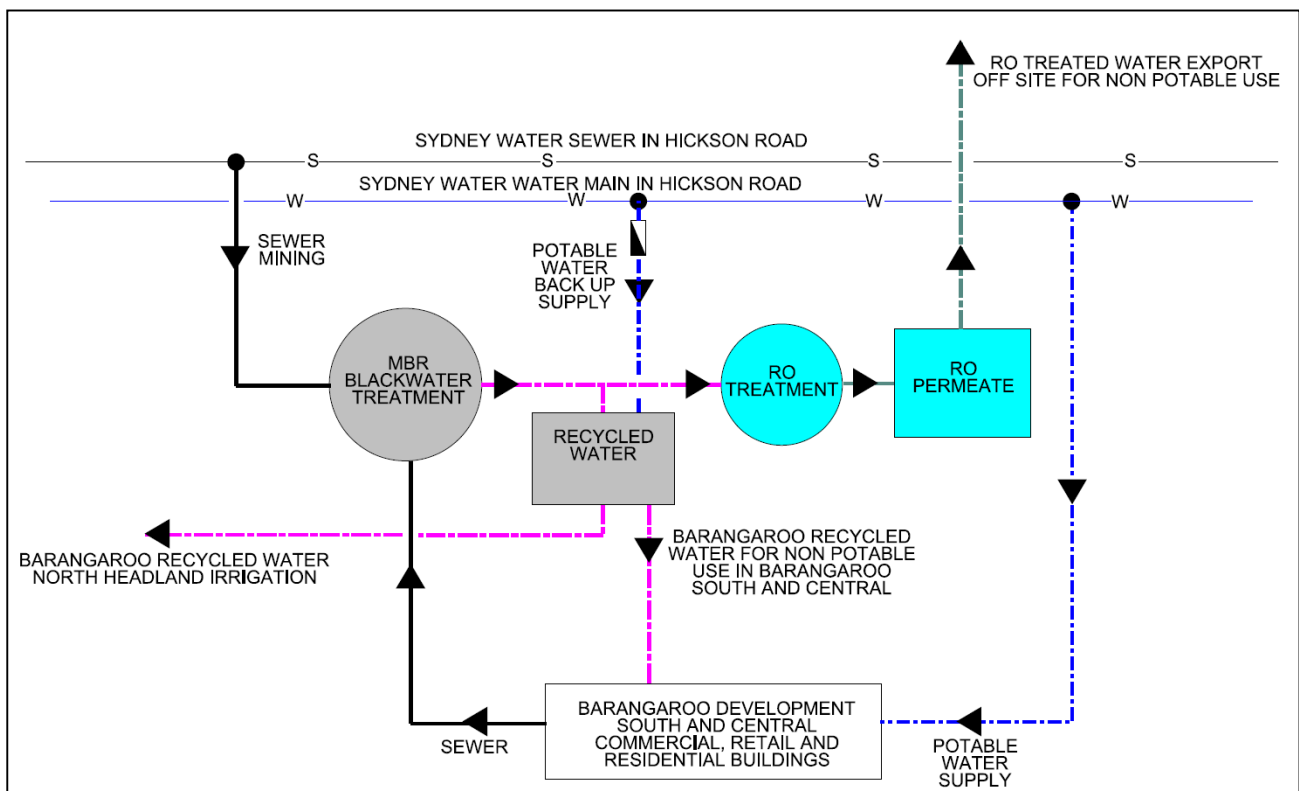


Figure 4-1 Barangaroo South – Integrated Water Management flow diagram

Details of the proposed integrated water management system for Barangaroo South are presented in the report titled *Site Servicing Strategy* (11-0321, Revision K, March 2013), prepared by Cardno.

Further development of the integrated water management system for Stage 1B will occur through detailed design of the Stage 1B development, including the residential buildings and public domain, and further refinement of site water balance modelling.

Stormwater management is one aspect of the site-wide Barangaroo South integrated water strategy. It is envisaged that, where possible, stormwater harvesting could be incorporated within the development to provide an alternative source of non-potable water (e.g. for irrigation of Hickson Park and podium level gardens within the future residential buildings).

Proposed methods of stormwater drainage and treatment to be adopted within Stage 1B are discussed further in **Section 5**.

## 5 Water Licensing and Approvals

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### 5.1 Relevant SEARs

This section addresses the following SEAR for SSD 6960:

- *Identification of any water licensing requirements or other approvals required under the Water Act 1912 or Water Management Act 2000.*

### 5.2 Water Act 1912

Under the *Water Act 1912*, a water licence must be obtained for extraction of groundwater via any type of bore, well, spearpoint or groundwater interception scheme for all purposes except to take water from an aquifer under a basic landholder right.

As the excavation works for the basement construction will incorporate a temporary groundwater interception scheme, a license under the *Water Act 1912* will be required.

The license would be obtained by the Contractor responsible for the excavation and dewatering works.

### 5.3 Water Management Act 2000

The *Water Management Act 2000* applies to areas of New South Wales that have a water sharing plan. As the proposed works do not include any activities that are governed by a water sharing plan, a licence under the *Water Management Act 2000* will not be required for the proposed works.

## 6 Water Quality

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### 6.1 Relevant SEARs

This section addresses the following SEARs for SSD 6960:

- *Undertake an assessment of the potential impacts on water quality of Sydney Harbour and associated marine ecology impacts.*
- *Assess impacts on water quality of Sydney Harbour and surface and groundwater hydrology and quality including proposed management, mitigation and monitoring measures.*

### 6.2 Background

An assessment of potential water quality impacts was prepared to accompany SSD 5897 for the Block 4 Remediation and Land Forming Works (WorleyParsons 2013), which will precede the proposed works to be assessed under SSD 6960.

Potential impacts of the proposed works and proposed management, mitigation and monitoring measures are generally consistent with those covered under SSD 5897. A summary of these is presented in the following sections.

### 6.3 Surface Water

This section addresses the potential water quality and hydrology impacts of surface water generated by both upstream external catchments and the Stage 1B Basement site itself.

#### 6.3.1 Hydrology

The existing condition of the Stage 1B site is such that it is impervious and consists of an asphalt surface. The site will remain impervious as a result of the remediation and land forming works that will precede construction of the Stage 1B basement due to construction of an odour control structure over the extent of the remediation works.

The Stage 1B Basement works will consist of temporary landscaping measures such as turf on top of the proposed basement structure. These temporary landscaping measures will ultimately be replaced by a permanent park and areas of tree planting. As a result of both the temporary and permanent landscaping measures, the impervious fraction of the site will reduce compared to the existing scenario. This reduction in impervious fraction will result in a reduction in the volume of surface water runoff from the site towards Darling Harbour, which will have a positive impact on surface water hydrology discharging to Darling Harbour.

#### 6.3.2 Surface Water Quality

As discussed further in **Section 10**, implementation of erosion and sediment control measures will ensure that surface water runoff quality from both external and internal catchments is maintained at acceptable levels during construction. The requirements for surface water quality management are outlined in the *Environment Construction and Site Management Framework Plan* for the Stage 1B Basement works.

Surface water quality post-construction of the proposed works will be managed through implementation of a number of measures that will capture and treat surface water runoff prior to discharge to Darling Harbour. These proposed measures are discussed further in **Section 7.4.3**.

### 6.4 Groundwater

#### 6.4.1 Existing Geological Conditions

The following subsurface conditions have been identified across the wider Barangaroo site, including the extent of the Stage 1B basement:

- Hardstand consisting of concrete, asphalt and bitumen from ground level to a maximum depth of approximately 0.5 metres below ground level (bgl).

- Road base fill to a maximum depth of approximately 0.5 metres bgl.
- Fill material consisting of sandstone, building rubble, bricks, concrete and silty gravelly sand with black staining and odours up to 18 metres bgl.
- Marine Clay / Sand between 3 metres bgl and 33 metres bgl.
- Bedrock of varying quality between 1.3 metres bgl and 33 metres bgl.

#### **6.4.2 Hydrogeology**

A geotechnical assessment was undertaken by Coffey to accompany the Block 4 Remediation and Land Forming Works (SSD 5897). A summary of the findings included in this report pertaining to groundwater is presented below:

- The highest observed astronomical tide is RL 1.175 mAHD and the existing mean high spring water level is RL 0.67 mAHD. Groundwater tidal level fluctuations were recorded adjacent to the existing caisson wall and were found to be very similar to tidal movements within Darling Harbour.
- At Hickson Road, groundwater monitoring suggested that the magnitude of groundwater fluctuation is approximately one quarter of the observed normal tidal amplitude at Darling Harbour, suggesting at least a moderate tidal influence on groundwater levels across the extent of the site.

#### **6.4.3 Groundwater Interception Works**

A dewatering system will be installed as part of the Block 4 Remediation and Land Forming Works. Any groundwater seepage encountered during the additional excavation works included in the scope of work for the basement construction will be removed using conventional dewatering equipment (e.g. sump pumps or dewatering spears). All groundwater collected on site will be treated in the on-site groundwater treatment plant that will be installed as part of the Block 4 Remediation and Land Forming Works.

The basement structure will be designed to prevent groundwater intrusion. Therefore, groundwater interception works will be limited to the construction phase of the proposed works.

#### **6.4.4 Groundwater Quality**

The proposed works under SSD 6960 are considered unlikely to have an impact on groundwater quality either during or after construction. The preceding remediation works are considered likely to have a positive impact on groundwater quality due to the removal of contaminated material that is currently impacting upon the quality of groundwater within the site.

#### **6.4.5 Groundwater Management during Construction**

A number of activities to manage, monitor and mitigate potential groundwater impacts are proposed. These activities will be implemented for the duration of the works to be completed under SSD 5897 and during the excavation works under SSD 6960:

- A groundwater control and retention wall will intercept shallow groundwater flows where required.
- Local grouting of groundwater control and retention walls may be required where excess groundwater seepage occurs.
- All groundwater intercepted will be transferred to a groundwater treatment plant, where it will be screened and treated prior to discharge to Darling Harbour.
- Monitoring of groundwater will be undertaken during site dewatering and excavation works to the extent practicable.
- If deemed necessary, a site settlement survey may be undertaken before, during and after construction to determine any potential effect of groundwater extraction on surrounding infrastructure (e.g. Hickson Road, residential and commercial buildings on eastern side of Hickson Road, Stage 1A works).

## **6.5 Marine Ecology**

### **6.5.1 Existing Conditions**

A Marine Ecology Impact Study was undertaken by WorleyParsons in 2010 and included investigation of the bed of Darling Harbour adjacent to Barangaroo South by both divers and with underwater video transects. The divers and video surveys observed a generally undisturbed substrate with a high clay percentage. No marine ecology or vegetation such as seagrass, mangroves, saltmarsh or microalgae were observed at the time of the inspection.

### **6.5.2 Potential Impacts**

As noted in the Soil and Water Impact Assessment Report that accompanied SSD 5897 (WorleyParsons, 2013), there is little potential for harm to aquatic vegetation due to construction activities as no aquatic vegetation exists here. The nearest aquatic vegetation in existence to the site is located at Balmain. Due to the distance of this location to Barangaroo (approximately 500 metres), it is unlikely that the proposed works will impact upon aquatic vegetation in this area.

## 7 Stormwater Drainage

### 7.1 Catchments

#### 7.1.1 External Catchments

Delineation of catchments that drain towards Stage 1B has been undertaken based on NSW Land & Property Information contour data, detailed ground survey, site inspections and ALS data. The external catchment area draining to the Stage 1B development site is approximately 5.3 ha. Drawing SKC200 presents the extent of external sub-catchment areas adjacent to Stage 1B. Details of the catchments are as follows:

- a. **Catchment A:** This catchment has a total area of approximately 2.83 ha that discharges into Gas Lane and Jenkins Street through a 600mm diameter pipe and a 750mm diameter pipe and then into an existing 1200mm diameter pipe that traverses the Stage 1B Residential development site prior to ultimately discharging directly into Darling Harbour.
- b. **Catchment B:** This catchment has a total area of approximately 2.29 ha that discharges into the existing Hickson Road stormwater drainage network prior to ultimately discharging into Darling Harbour through a series of varying diameter pipes traversing the Stage 1B Residential development site.
- c. **Catchment C:** This catchment has a total area of approximately 0.15 ha that discharges into the stormwater diversion works that were constructed within Hickson Road and Watermans Quay as part of the Stage 1A works.

Flow in excess of the capacity of existing stormwater drainage infrastructure within External Catchments A and B discharge towards both the Barangaroo South Stage 1B and Central Barangaroo sites as overland flow.

#### 7.1.2 Internal Catchments (Post-Development)

Based on the current Site Concept Plan (Modification No. 8) the development site will be divided into a number of sub-catchments as a result of the location and proposed surface grading of buildings, internal roads and open space. The combined sub-catchments total approximately 2.83 ha and will ultimately discharge into Darling Harbour.

Drawing SKC201 provides details of sub-catchment areas and approximate directions of flow within the Stage 1B site. The internal catchment area fronting Hickson Road that will discharge into the proposed external drainage system is approximately 0.6 ha; ultimately discharging to Darling Harbour via the proposed stormwater drainage network along Watermans Quay.

### 7.2 Overland Flow and Flooding

#### 7.2.1 Historic Flood Data

Detailed ground survey and site inspections have been used to define existing overland flow paths adjacent to Barangaroo South.

City of Sydney has confirmed that there is no available historical flood data for the Barangaroo site or the external catchments to the site; however localised flooding is known to have occurred within the bounds of Hickson Road adjacent to Barangaroo South.

Anecdotal evidence is available that suggests that in March 2006, flooding of the commercial building at 30 Hickson Road (The Bond) and residential building at 38 Hickson Road occurred to a depth of approximately 20mm after over 100mm of rainfall fell in the Sydney CBD over a 24 hour period. This storm event was estimated to have had an average recurrence interval (ARI) of between 2 and 5 years.

#### 7.2.2 Pre-Development Overland Flow Paths

Prominent overland flow paths adjacent to Stage 1B are described as follows:

- i. **Catchment A:**
  1. Overland flow splits at the intersection of Gas Lane and Jenkins Street with the majority of the flow diverting to the north between 30 Hickson Road (The Bond) and 34 Hickson Road; entering the existing Hickson Road subsurface stormwater drainage network.
- ii. **Catchment B:**
  1. North and South on Hickson Road towards an existing low point generally located in front of The Bond"; and
  2. Through the Stage 1B development site.

### 7.2.3 Impact of Proposed Development

The key changes to overland flow paths and effects on existing stormwater infrastructure as a result of the development of Stage 1B will be as follows:

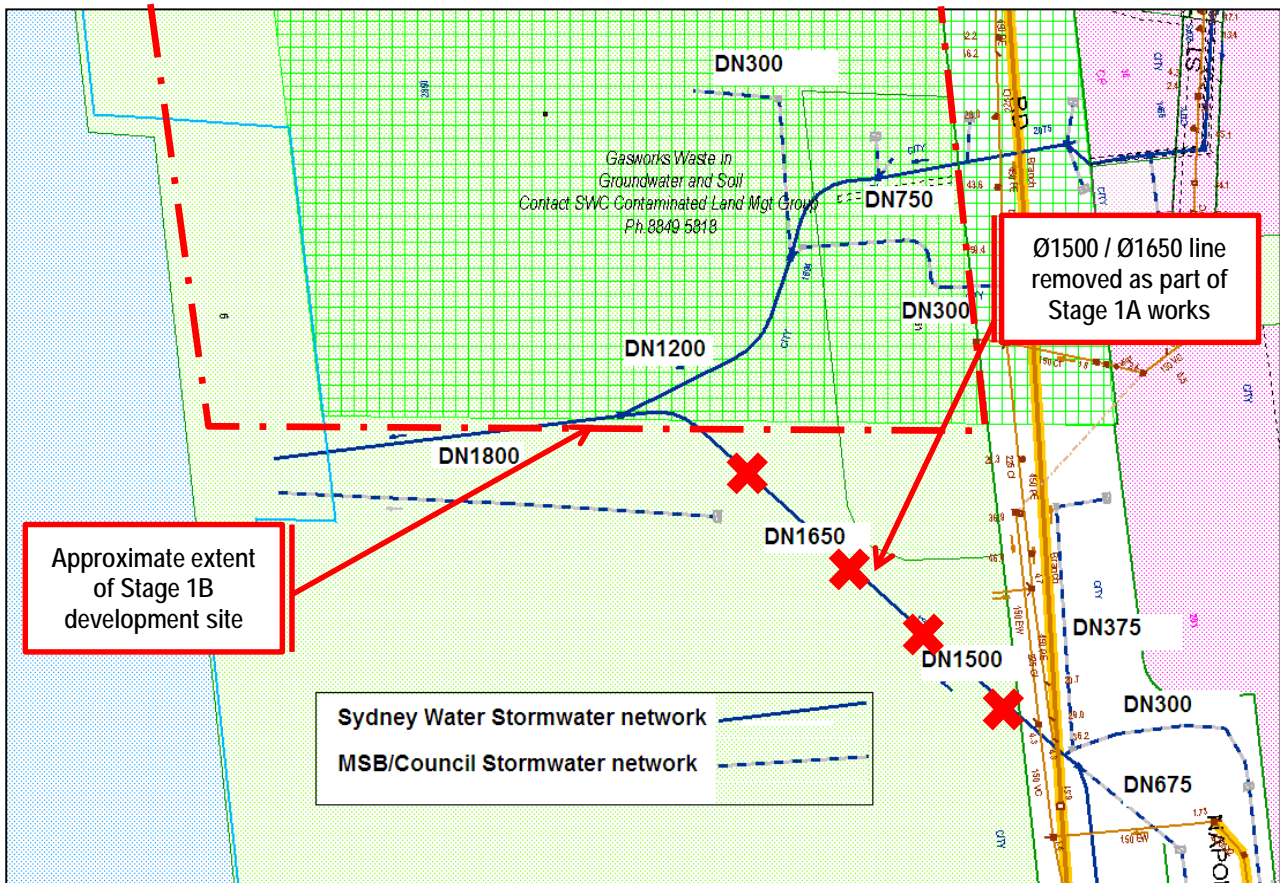
- a. The existing stormwater pipes for the external catchment that traverse the site are to be relocated due to the conflict with the Stage 1B basement footprint;
- b. The *Sydney Harbour Foreshores and Waterways Area DCP 2005* requires that where seawalls are permitted, the top of the seawall should be 2.6 metres above the Zero Fort Denison Tide Gauge (ZFDTG), which is equivalent to 1.675 mAHD;
- c. City of Sydney's *Interim Floodplain Management Policy* (May 2014) requires consideration of the potential impacts of climate change in the assessment of proposed development. Specifically, Council's Policy requires that allowances in the *NSW Coastal Planning Guideline: Adapting to Sea Level Rise* (August 2010, recently withdrawn from publication) be met, and that an allowance of 0.9 metre sea level rise (SLR) above 2009 mean sea level be considered. This allowance for SLR would require a minimum top of seawall level at 2.575 mAHD;
- d. Stage 1A has been set with a promenade height of RL 2.90. This allows for a grade to be achieved across the site from a building FFL of 3.3-3.5. It is envisaged that Stage 1B will adopt a similar strategy in order to integrate with Stage 1A; and
- e. Considering existing levels on Hickson Road and the proposed building FFL within the Stage 1B site, it has been proposed to divert overland flow that would have traversed the eastern site boundary from Hickson Road into an upgraded pit and pipe network within Hickson Road and through the site. No changes to the proposed passage of overland flow to the north of the Stage 1B site are proposed.

## 7.3 External Stormwater Drainage

Detailed ground survey and site inspections have allowed for a detailed assessment of existing stormwater drainage network as documented below.

### 7.3.1 Existing External Stormwater Network

The existing stormwater network is characterised by a series of in-ground piped stormwater systems (typically between 300mm and 1800mm in diameter) draining Hickson Road and other external catchments through the Barangaroo site and ultimately into Darling Harbour. An overview of the external stormwater drainage network prior to construction works at Barangaroo South is presented in **Figure 7-1**. Additional details are presented in SKC202.



**Figure 7-1 Stormwater Infrastructure prior to construction work at Barangaroo South**

As part of the Stage 1A works, a concrete pipe and box culvert diversion has been constructed. This diversion has the capacity to capture and convey storm events up to the 100 year ARI event and has been adopted to alleviate flooding within Hickson Road in the vicinity of the Sussex Hotel.

### 7.3.2 Proposed External Stormwater Drainage Strategy

Works to divert external stormwater drainage around the extent of the Stage 1B works will be required. The design of these works is currently being undertaken and coordinated with Sydney Water and City of Sydney. A concept design for the proposed Stage 1B diversion has been submitted to the Barangaroo Delivery Authority (BDA) and Sydney Water for their review and acceptance. Sydney Water has issued a Letter of Approval (dated 28<sup>th</sup> April 2014) to commence the design process for the proposed stormwater deviation works.

The proposed finished ground levels within the Stage 1B development are such that the existing overland flow paths through the site will be obstructed. Therefore, the current conceptual design is to provide a stormwater drainage network outside the Stage 1B site including a pit and pipe network along with maintaining overland flow north along Hickson Road and through Central Barangaroo (refer to Drawing SKC202). This network will include grated surface inlet pits in Hickson Road to capture and divert overland flow around Stage 1B and ultimately into Darling Harbour. The intent of the proposed diversion works is to manage the impact of the development on the external stormwater drainage network and to ensure no net increase in flood levels along Hickson Road.

Detailed design will be subject to review and acceptance by Sydney Water and City of Sydney.

## 7.4 Internal Stormwater Drainage

### 7.4.1 Design Criteria

The proposed stormwater drainage network within the extent of Stage 1B and provision of stormwater infrastructure for connection of the proposed Crown Hotel development is proposed to be designed to provide:

- a. Low flows directed through water quality management measures (nominally up to a 3 month ARI event); and
- b. Internal site drainage with a capacity to capture and convey all storm events up to the 100 year ARI event.

### 7.4.2 Design Standards

The internal stormwater drainage network will be designed generally in accordance with the following standards and guidelines:

- a. *Australian Rainfall and Runoff Volume 1 and 2, 1997*;
- b. *NSW Floodplain Development Manual 2005*;
- c. City of Sydney's *Interim Floodplain Management Policy* (May 2014);
- d. The City of Sydney Stormwater Drainage Design Code Version 1.1 (August 2009) in particular Appendix G;
- e. Any other applicable City of Sydney design standards, guidelines and policies;
- f. *Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005*;
- g. *AS3500 – Stormwater and Drainage Design codes*;
- h. *AS3725 – Loads on Buried Concrete Pipes*;
- i. *Water Sensitive Urban Design; Book 1 – Policy* (Landcom, 2009), which is considered current best-practice for stormwater management in NSW and suggests the following targets for reduction of pollutant mean annual load:
  - 85% for Total Suspended Solids (TSS)
  - 65% for Total Phosphorus (TP)
  - 45% for Total Nitrogen (TN).

### 7.4.3 Internal Stormwater Drainage Strategy

The drainage strategy for the Stage 1B development provides for capture and conveyance of all flows during storm events up to and including the 100 year ARI storm within the pit and pipe network for Stage 1B. The current internal drainage strategy is presented in SKC203 and summarised below.

The internal stormwater drainage network will be constructed to accommodate the proposed interim road layout within the site (refer to **Section 12**), with the provision to undertake minor modifications to the network to accommodate the ultimate road layout.

The Stage 1B internal stormwater drainage network will ultimately connect to the existing 1800mm diameter pipe located under the proposed Watermans Quay, between Stages 1A and 1B. This network will collect flow from the proposed residential buildings (R4A, R4B and R5), public domain area, Barangaroo Avenue and Watermans Quay. Treatable flows (nominally up to a 3 month ARI event, subject to further design) will be diverted to the proposed stormwater treatment train. The existing 1800mm pipeline and discharge outlet into Darling Harbour will remain. As requested by Sydney Water, a CCTV inspection has been undertaken to confirm the condition of the pipe. The inspection found the existing pipe to be in a good condition.

The stormwater treatment train for the ultimate development of Stage 1B will incorporate water sensitive urban design (WSUD) principles to remove gross pollutants, suspended solids and nutrients. The treatment train may consist of a range of measures, including (but not limited to):

- Tree pits;
- Roof gardens (incorporating a bio-retention system);
- Gross Pollutant Traps (GPTs); and
- Proprietary tertiary treatment measures such as cartridge filtration.

## 8 Potential Impacts of Climate Change

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The risk and likely magnitude of climate change induced sea level rise is addressed in detail in the Climate Change and Sea Level Rise Report prepared by Arup - "*Public Domain (Stage 1A) Planning Application Climate Change and Sea Level Rise Report*" dated 18 December 2013. The findings of this report include projections of climate change induced sea level rise, including a projected increase in global mean sea level of between 0.26m and 2m by 2100.

Local drainage systems within and adjacent to Barangaroo South will reduce in capacity and effectiveness as the depth of submergence at their outlets increases due to the effects of climate change induced sea level rise.

Requirements for the consideration of impacts associated with climate change on developments are included in the City of Sydney's *Interim Floodplain Management Policy* (May 2014). Specific objectives that apply to the proposed development of Stage 1B are outlined as follows:

- *For those developments which have a lifespan of more than fifty years the impact due to sea level rise and impacts due to increased rainfall intensities shall be considered.*
- *Meet the allowances for sea level rise as recommended in the NSW Government Coastal Planning Guideline: Adopting Sea Level Rise 2010 (recently withdrawn from publication). Specifically, this shall include and allowance of 40cm by 2050 and a 90cm by 2100 from the 2009 Mean Sea Level.*
- *Where in the opinion of the City the proposed development is of reasonable impact to regional or catchment trunk drainage, the drainage system design shall allow for a minimum of 10% increased rainfall.*

It is also noted that the recommended minimum seawall level for the proposed Barangaroo South development is RL 2.575 mAHD. This level is equivalent to the requirement in the *Sydney Harbour Foreshores and Waterways Area Development Control Plan 2005* and incorporates a sea level rise allowance of 0.9 metres.

The design of the proposed internal and external drainage systems for Stage 1B will account for potential climate change impacts including increased rainfall intensity of up to 10% and an increase in mean sea level of up to 0.9 metres.

Risks associated with the impacts of climate change will be addressed by:

- a. Locating stormwater discharge points as high as possible to minimise the effect of tailwater conditions on the capacity of the proposed drainage network;
- b. Design of stormwater drainage systems to accommodate partial inundation from tide flows, including allowance for sea level rise;
- c. Specification of materials to marine grade to prevent accelerated degradation; and
- d. Use of tidal flaps (Tideflex or similar) on stormwater discharge points into Darling Harbour.

## 9 Finished Surface Levels

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The current design strategy for minimum floor and ground levels within Stage 1B are driven by three factors:

- Tie-in to existing and proposed levels surrounding the development site;
- Future water levels within Darling Harbour; and
- Capacity to convey overland flow from upstream catchments.

Main building floor levels are primarily governed by future harbour water levels. As noted in **Section 7.2.3**, the future HAT level is predicted to rise to RL1.975 by the year 2100. It is recommended that the proposed seawall be constructed at RL2.575 to allow 600mm freeboard for storm surge and wave action.

It is recommended that floor levels for future main buildings within Stage 1B should be set at a minimum of RL3.35, though an appropriate relationship with existing buildings and ground levels in Stage 1A must also be achieved.

The finished floor level of buildings or part of buildings that front Hickson Road will be set at a minimum level of RL2.70. Finished floor levels will be designed to ensure compliance with the flood planning level requirements stipulated in City of Sydney's *Interim Floodplain Management Policy* (May 2014).

## 10 Erosion and Sediment Control

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This section addresses the following SEAR for SSD 6960:

- *Detail erosion, sediment and stormwater management and controls during construction and management and mitigation measures for the prevention of potential water quality impacts during construction.*

As part of the works, erosion and sedimentation controls shall be designed, installed and maintained throughout the duration of construction works in accordance with *Managing Urban Stormwater - Soils & Construction Volume 1* (Landcom, 2004).

It is noted that the majority of erosion and sediment control measures required for the construction of the Stage 1B basement will be established as part of the works to be completed under SSD 5897 and will be maintained through the duration of the Stage 1B basement construction. The requirements for erosion and sediment control measures are outlined in the *Construction Framework Environmental Management Plan* for the Stage 1B Basement works.

Prior to any earthworks commencing on site, all erosion and sediment control measures will need to be implemented in accordance with the above specifications. These measures shall generally include, as necessary:

- Installation of A-Class hoarding around the perimeter of the site;
- Installation of truck wash down facilities at each point of exit from the site;
- Installation of sediment fencing around disturbed areas, including any stockpiled topsoil;
- Placement of geotextile bags filled with sand and/or gravel around and along existing and proposed catch drains and stormwater drainage pits;
- Installation of water monitoring facilities within Darling Harbour.

In order to minimise the volume of polluted stormwater runoff generated by site works, stormwater within and adjacent to the site will generally be managed by diverting clean rainfall and runoff from any disturbed areas. Measures that will be implemented to prevent the ingress of surface water runoff into excavation areas include bunds, silt fences and drainage diversions. Proposed drainage diversion works are discussed in **Section 7.3.2** and detailed on Drawing SKC202.

In accordance with the Remediation Action Plan (RAP) that will be implemented for the remediation of the Stage 1B basement extents, the preferred hierarchy for management of water onsite is as follows:

- Minimising 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. Sediment basin(s) may be employed as deemed necessary for the collection of surface water for maintenance of water quality and/or re-use;
- Recycling water, where possible, by reusing on site as dust suppression or for other site operations including wheel washing and truck washing subject to suitable treatment measures; and
- Discharging to the adjacent stormwater drainage network via overland flow or formal reticulation or to sewer, with or without treatment, will be as per regulatory guidelines and in accordance with the licensed discharge for the works.

Where required, surface water that falls directly on areas of bulk excavation works shall be directed to a temporary water treatment plant. Prior to commencement of the bulk earthworks, diversion works associated with external stormwater drainage systems traversing the site shall be undertaken to ensure basement excavations are not affected by external stormwater surface and piped flows.

The placement of sediment fencing around the perimeter of the site will supplement the implementation of diversion banks and sediment fences around stockpiled materials. Sediment filters and geotextile bags filled

with sand and/or gravel shall also be placed around existing and proposed drainage pits to ensure surface water runoff is treated prior to discharging into Darling Harbour.

A truck wash down facility shall be constructed at all points of exit from the work site. All construction vehicles exiting the site to Hickson Road will require cleaning prior to accessing the public road network. Where possible, water from the wash down area shall be reticulated to a treatment and storage system for reuse.

Groundwater encountered during excavation will require management in concert with surface water management. Control walls will be installed to minimise groundwater infiltration into excavations as part of the development, where required.

Dewatering and control of groundwater seepages will also be required. Groundwater collected from the excavations will be transferred to the on-site water treatment plant prior to discharge to the local stormwater drainage network. Trade waste applications will be negotiated with Sydney Water as appropriate. If required, limited contaminated water may be disposed off-site with use of truck tankers. Handling and disposal of contaminated liquids will be addressed in the WMP.

Surface and ground water management structures will be frequently monitored in accordance with the *Construction Framework Environmental Management Plan* for the Stage 1B Basement works.

Overall water quality shall be assessed with harbour monitoring. Final locations of harbour monitors will be to future detail.

## 11 Water & Stormwater Management Plan

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Lend Lease commits to the preparation of a detailed Water and Stormwater Management Plan that addresses water quality and water monitoring requirements for the duration of construction works associated with the development of Stage 1B. The Water and Stormwater Management Plan will include construction phase control measures to be implemented for Stage 1B and will be incorporated into an overarching site specific Environmental Construction and Site Management Plan.

The Water and Stormwater Management Plan will address the following:

### **Water Volumes**

- a. Water volume management;
- b. Anticipated volumes of water generated on-site including potential volumes of groundwater and stormwater discharges;
- c. Volume of wastewater to be treated on site;
- d. Volume of recycling/reuse;
- e. Volume to be discharged to sewer; and
- f. Volume to be sewer mined from the existing sewerage system in Hickson Road.

### **Water Monitoring**

- a. Criteria for nominating areas and different sources of site water as clean or contaminated;
- b. Water monitoring protocols and decision criteria for whether site water will be directed to stormwater, a waste water treatment plant, to sewer or to a liquid waste facility;
- c. Water discharge criteria and monitoring frequency for parameters listed in the 'Water Quality Monitoring Requirements' document prepared as part of the Environmental Assessment;
- d. An initial more intensive monitoring program for sediment basins, stormwater discharges, reused water and ambient waters to help determine potential water quality impacts and ongoing monitoring protocols;
- e. Specific discharge and monitoring points for on-site generated water including collected groundwater seepage into excavations, sediment basins for clean or contaminated areas, discharge points to stormwater drains, and confirmation of ambient monitoring locations in Darling Harbour and Johnstons Bay;
- f. Suitability of chosen reference site(s) based on turbidity data from a proposed monitoring program;
- g. Consideration of tidal currents, circulation patterns in Darling Harbour and the position of stormwater discharge points with regard to the positioning of monitoring location(s) outside the turbidity (silt) curtain. The location will not be a fixed point so that it can account for potential plume movement under different conditions. Alternatively, more than one location may be needed; and
- h. The development of criteria for wastewater discharges that would trigger a review of water management systems. These criteria will trigger operational responses that help in ensuring licence conditions are not exceeded. It is noted that this element may fall under approval of the site recycled water/treatment devices and may be separated from the Concept Approval.

### **Stormwater and Sediment Controls**

- a. A detailed description of measures for stormwater and sediment control for specific locations on the site; and
- b. Silt curtain arrangements for the protection of Darling Harbour as a secondary protection control.

### **Construction Operational Procedures**

- a. An operational plan detailing how contaminated water and sediment control systems will be implemented, operated and maintained;

- b. A description of the operation and maintenance of environmental protection structures such as (not limited to) silt curtains, bunding and filtration systems, dewatering plant and methodology etc.; and
- c. Details of the prevention of contaminated water being discharged to Darling Harbour.

**Wastewater and Effluent Reuse on site**

- a. Criteria for wastewater or effluent reuse for either contaminated or clean sources of water;
- b. Management practices for reuse of treated wastewater from contaminated areas; and
- c. As above, it is noted that this element may fall under separate approval of the site recycled water/treatment devices and may be separated from the Concept Approval.

## 12 Roads

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### 12.1 General

The road layout is based upon the proposed MOD8 Concept Plan (refer to **Figure 1-2**) and is consistent with the established design standards and planning framework. Roads and associated footway areas have been designed so not to preclude future dedication to City of Sydney.

### 12.2 Road Layout

The proposed internal road layout within Stage 1B for which approval is being sought under SSD 6960 is presented in SKC215.

Interim works are proposed at the intersection of Barangaroo Avenue and Watermans Quay, pending finalisation and approval of a Remediation Action Plan (RAP) for the area referred to as 'Other Remediation Works North' (ORWN) as shown on SKC215.

### 12.3 Design Standards

The road and walkway network has been designed generally in accordance with the following standards and guidelines:

- City of Sydney standards, policies and guidelines; and
- Australian Standards including:
  - AS2890.1 – Parking facilities: Off-street parking
  - AS2890.2 – Parking facilities: Off-street commercial vehicle facilities
  - AS2890.5 – Parking facilities: On-street parking
  - AS1742 – Manual of uniform traffic control devices
  - AS1428 – Design for access and mobility

### 12.4 Design Vehicle

Design turning paths were modelled using Austroads 2013 vehicle templates in the AutoTURN software package to determine where local increases in pavement width were required to ensure the design vehicle could negotiate turns and bends safely with adequate clearances.

Where necessary, 'No Stopping' signs will be provided to ensure that required turning areas are free of parked vehicles. Turning paths for the proposed road layout are shown on drawings SKC227 and SKC231 to SKC234 inclusive.

The internal road layout has been designed to comply with the following vehicle circulation requirements:

- 14.5 m coach access from Hickson Road to Stage 1B via a clockwise loop of the internal roads;
- 12.5 m Heavy Rigid Vehicle from Hickson Road to Stage 1B via an anti-clockwise loop of the internal roads;
- 9.9 m City of Sydney Garbage Vehicle access to the Stage 1B basement via Watermans Quay; and
- 8.8 m service vehicle for the temporary turning head on Barangaroo Avenue (part of the interim works, subject to finalisation and approval of ORWN RAP).

### 12.5 Road Geometry and Width

Road geometry design has been undertaken in accordance with the approved Concept Plan. A summary of the road type characteristics are described in **Table 12-1**.

**Table 12-1 Summary of Roads Characteristics**

Road Name	Pavement Width	Comments
Watermans Quay	11.5m	<ul style="list-style-type: none"> <li>Footpath widths are as generally indicated on the drawings (minimum width 3.45m).</li> <li>Drop off/pickup &amp; taxi bays on the southern side of Watermans Quay as indicated on the drawings.</li> </ul>
Barangaroo Avenue	7.0m	<ul style="list-style-type: none"> <li>Footpath width are as generally indicated on the drawings (minimum width 3.45m).</li> </ul>
Barton Street	7.0m	<ul style="list-style-type: none"> <li>Face of northern kerb aligns with the Stage 1B northern site boundary.</li> <li>Footpath on northern side of road will be constructed as part of the Central Barangaroo development.</li> </ul>

## 12.6 Road and Walkway Grading

Due to the relatively flat nature of the site, roads have generally been designed using a ‘sawtooth’ grading with a series of localised sags and crests. Typically, road crossfall will be maintained at 3%.

## 12.7 Road and Walkway Pavements

In general, pavements for roads and walks will be constructed over the Stage 1B basement structure, with the exception of Watermans Quay and sections of Barangaroo Avenue and Barton Street that will be constructed over the proposed Crown Hotel basement. The southern side of Watermans Quay will be constructed over the Stage 1A basement structure and the northern side of Watermans Quay will be constructed over either insitu material or imported fill material (if required to be placed as a result of the proposed remediation work), between the Stage 1A and Stage 1B basements. The ultimate alignment of Watermans Quay will be subject to a separate development application.

Under the ultimate scenario (subject to a future application), there will also be a section of Barangaroo Avenue approximately 50 metres long that will be constructed above insitu material (subject to a separate submission).

A preliminary road pavement design has been prepared for the three internal roads and is presented in **Table 12-2**.

**Table 12-2 Concept road pavement design for Watermans Quay, Barangaroo Ave and Barton St**

Layer Type	Thickness
Wearing Course - Asphaltic Concrete (AC10)	30mm
Base Course - Asphaltic Concrete (AC14)	55mm
Base Course - Asphaltic Concrete (AC14)	55mm
Base Course (DGB20)	200mm
Sub Base (DGS40)	300mm

## 12.8 Intersections

There will be four intersections within and adjacent to the Stage 1B site:

1. Hickson Road / Watermans Quay (signalised as part of the proposed works) – subject to a separate development application.
2. Hickson Road / Barton Street (unsignalised).
3. Watermans Quay / Barangaroo Avenue (unsignalised) – subject to a separate development application.

4. Barangaroo Avenue / Barton Street (unsignalised).

The primary access to the Stage 1B basement will be via the intersection at Hickson Road and Watermans Quay.

Under the interim road layout as shown on SKC215, access to the proposed Crown Hotel development will be via the internal roads connected to the intersection of Hickson Road and Barton Street. Under the ultimate Stage 1B road layout as shown on SHC230 (subject to a future approval), access to the Crown Hotel development will also be available via Watermans Quay.

Access between the Stage 1A and 1B sites will ultimately be via a continuation of Barangaroo Avenue through the Stage 1B site. Barangaroo Avenue will be approximately aligned in a north-south direction and will continue to the northern site boundary where it will intersect with Barton Street.

## **12.9 Footpaths**

Footpaths will be provided in accordance with Council's standard drawings with no provision for shared paths. Footpaths will generally be designed with 1 to 2.5% crossfall.

## 13 Utility Service Provision

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### 13.1 Relevant SEARs

This section addresses the following SEARs for SSD 6960:

- *Detail any infrastructure proposed to service the development and demonstrate that the site can be suitably serviced.*
- *Detail the existing infrastructure on-site, and identify any possible impacts on infrastructure arising from the construction of the proposed works.*
- *Where the proposed works affect existing infrastructure, the application should detail any mitigation works proposed, including service relocations.*

### 13.2 General

Infrastructure that will be constructed as part of the proposed interim works will include potable water, recycled water, sewerage, chilled water (for heating, ventilation and air conditioning), natural gas, electrical and telecommunications. All infrastructure service designs are currently at concept phase and are subject to detailed design.

Infrastructure will be constructed to service the proposed basement and future residential and commercial development within Stage 1B. Services will reflect the proposed ultimate road alignment and levels.

The following general comments apply:

- a. A desktop services investigation (Dial Before You Dig), survey and Ground Penetrating Radar (GPR) have been used as source data for the information contained in this document;
- b. Physical investigation has been undertaken by Christie Civil Pty Ltd to locate and record existing services at strategic locations along the proposed external trunk stormwater drainage alignment. This information is contained in the potholing and services investigation report prepared by Christie Civil received 18 March 2014; and
- c. The concept service coordination plans have been developed based on masterplan service strategies for the Barangaroo South development.

### 13.3 Potable Water Supply

#### 13.3.1 Existing Services

A Sydney Water owned and operated 300mm diameter watermain is located on the western side of Hickson Road and extends for the full frontage of the Barangaroo South development. Sydney Water has confirmed, through approval of the "Site Servicing Strategy – Barangaroo South", prepared by Cardno and dated March 2013, that this main has adequate capacity to provide potable water to the development.

All existing supplies to the development site, serving buildings and other structures have been disconnected and either disused or removed.

For the Stage 1A site a 250mm diameter ring main from Hickson Road runs along Shelley St and will be continued north along Barangaroo Avenue and east along Watermans Quay.

#### 13.3.2 Proposed Services

To service the Stage 1B site and the proposed Crown Hotel development, connection will be made to the existing 300mm diameter watermain in Hickson Road. From this connection, a potable water main will be constructed along the internal road network. The new main will be laid above the podium level structural slab. An indicative alignment of the proposed potable water main is presented in SKC220.

Sydney Water has confirmed that the existing 300mm water main in Hickson Rd has sufficient capacity for the Stage 1B development and exceeds the minimum main size required for the Barangaroo development (refer to *Site Servicing Strategy*, Revision K dated March 2013).

It is intended that Sydney Water will own and maintain the new potable water assets. Minor water reticulation lines will be required to service public domain areas. These will be installed both above and below the structural slab to future detail and subject to a future DA.

Reticulation of potable water within buildings and after the meter location will be privately owned. The metering strategy as agreed with Sydney Water from the Stage 1A works will be implemented for the Stage 1B works.

Final details, routing and location of assets are to be agreed with Sydney Water during detailed design development.

## **13.4 Recycled Water Services**

### **13.4.1 Existing Services**

There were no recycled water services adjacent to the site prior to construction of the Stage 1A works. Recycled water infrastructure has been constructed as part of the development of Stage 1A.

### **13.4.2 Proposed Services**

The recycled water supply to Stage 1B and the proposed Crown Hotel developments will be drawn from the central Recycled Water Treatment Plant (RWTP) in Stage 1A, which will treat wastewater from the Barangaroo South development as well as a sewer mining connection from an existing Sydney Water sewerage line in Hickson Road.

Recycled water will be treated in accordance with Australian Recycled Water guidelines and reticulated throughout the Stage 1A and 1B developments for non-potable uses including landscape irrigation and toilet flushing. General by-products from the RWTP are proposed to be discharged to Sydney Water's sewerage system as trade waste. A Trade Waste Application is currently being prepared by Lend Lease for submission to Sydney Water.

Recycled water mains are generally to be located within the Stage 1B basement, reticulating to customer recycled water meters that will be located within the basement. The recycled water mains for Stage 1B will be extended from the existing termination point within the Stage 1A basement.

The recycled water supply system is to be provided with a backup water supply connected to the Sydney Water potable water supply system serving Barangaroo South.

Indicative pipework associated with the proposed recycled water network within Stage 1B is presented in SKC225.

## **13.5 Chilled Water Services**

### **13.5.1 Existing Services**

No chilled water supply currently exists in close proximity to the Stage 1B development area.

### **13.5.2 Proposed Services**

A centralised chilled water plant and harbour heat rejection system have been constructed as part of Stage 1A works to provide reticulated chilled water to the Barangaroo South buildings, including the Stage 1B and proposed Crown Hotel developments. Chilled water will be reticulated throughout the Barangaroo South development within a privately owned pipe network.

A Harbour Heat Rejection Plant, and associated reticulation of chilled water, was approved in August 2013 as part of the MP10\_0023 Modification 5 Planning Application.

The location of pipework associated with the proposed chilled water system and Harbour Heat Rejection Plant within the extent of Stage 1B is presented in the service coordination plans in SKC220.

## **13.6 Sewerage Services**

### **13.6.1 Existing Services**

The pre-developed sewerage network is owned by Sydney Water and consists of 225mm and 450mm diameter gravity pipes in Hickson Road. This network drains to existing Sydney Water owned Sewage Pump Station SP1129, which is located north of the Barangaroo South Stage 1B development boundary.

The existing pump station serves catchments extending to Sussex Street, Kent Street and includes the catchment served by Sewage Pump Station SP0014 located at Headland Park. SP0014 has recently been decommissioned as part of the Headland Park works with flows diverted to SP1129.

All existing sewerage services to the Stage 1B site have been disconnected and disused or removed.

The RWTP installed as part of Stage 1A works will capture and treat sewage from Barangaroo South. The RWTP will be owned and operated under the *Water Industry Competition Act 2006*.

### **13.6.2 Proposed Services**

Provision of wastewater services connections to the Stage 1B and the proposed Crown Hotel developments has been addressed through the Site Servicing Strategy as agreed with Sydney Water.

Sewerage from Stage 1B and the proposed Crown Hotel development will discharge to the central Recycled Water Treatment Plant installed as part of Stage 1A works. Alternatively, the sewerage may be connected directly to the existing main in Hickson Road subject to future design assessment.

Internal sewerage reticulation within Stage 1B and the proposed Crown Hotel development will be privately owned.

Additional storage within the local sewerage network is required to offset the peak load from the development for occasions when the RWTP is offline. This will be achieved through re-use of the redundant Stage 1A temporary stormwater diversion pipework or construction of storage at the SP1129 location. A connection between the redundant Stage 1A stormwater diversion line and SP1129 is currently being constructed in order to provide the requisite emergency storage volume.

An overflow from the RWTP will be required and has been approved, in principal, by Sydney Water through the "Site Servicing Strategy".

The proposed concept sewerage locations are presented on SKC221.

## **13.7 Natural Gas Services**

### **13.7.1 Existing Services**

There is an existing 110mm diameter low pressure (7kPa) nylon gas main along Hickson Road and a high pressure gas main located at the corner of Sussex and Napoleon Streets. There are no existing high pressure main connections serving the Barangaroo site but there are small low pressure connections. The existing gas network from the low pressure main has been decommissioned and capped off at the site boundary and removed.

The Stage 1A site includes a low pressure 7kPa gas main located within the roadways. A high pressure regulator installation is proposed to be connected to the existing high pressure Jemena gas main located in Hickson Road adjacent to the Stage 1B site. Gas mains shall be reticulated within the local roadways and strategically located to provide service points to each of the proposed buildings requiring gas. The new gas reticulation mains shall be owned and maintained by Jemena.

### **13.7.2 Proposed Services**

The proposed gas servicing strategy for Stage 1B is currently being developed with Jemena, the gas asset owner and manager for the area. Jemena has confirmed that there is adequate capacity to service the Stage 1B development from the existing 110mm low pressure gas main in Hickson Road.

There is currently a combined servicing strategy being considered by Jemena for the supply of gas to Stage 1B and the proposed Crown Hotel development:

- Construction of a new low pressure gas ring main within the roadways of Stage 1B to service stage 1B development,
- Construction of a high pressure connection from Hickson Road to the eastern site boundary, with a private network of low pressure mains to be constructed within the proposed Crown Hotel basement to service the proposed Crown Hotel development

The preferred option for the supply of gas to Stage 1B is currently being assessed by Jemena.

A separate high pressure gas service would service the proposed Crown hotel site and would be provided under a separate application.

An indicative alignment of the proposed natural gas supply to service Stage 1B is presented on SKC222.

## **13.8 Electricity Services**

### **13.8.1 Existing Services**

Existing electrical services in Hickson Road include:

- A disused Railcorp 33KV feeder. Lend Lease have received advice confirming these assets “...are old gas cables and no longer required for Railcorp’s rail network purposes and are to be decommissioned”. Railcorp have advised that these assets are to be treated as live. This service is located in close proximity to the eastern kerb alignment of Hickson Road;
- Existing HV supply and concrete encased bank of conduits feeding “The Bond” at 30 Hickson Road. The bank of conduits is believed to consist of 150mm conduits laid in 4 rows of 4 conduits generally between 0.8m and 1.2m below ground level;
- Existing HV supplies to substations serving the pre-developed Stage 1B site which are to be disused and removed;
- Existing temporary HV supplies to temporary substations providing construction supply; and
- Various LV services for street lighting, parking ticket machines and other purposes.

### **13.8.2 Proposed Services**

The electrical services that will be required for Stage 1B can be broadly separated into three categories:

- Common infrastructure, including high voltage infrastructure that will be privately owned and operated.
- Basement
- Podium, including Public Domain

The scope of electrical services that will service Stage 1B include low voltage reticulation, main switchboards and distribution boards, standby power, energy metering, earthing and lighting protection, lighting and controls, exit and emergency escape lighting and small power reticulation.

In 2008, Ausgrid (then Energy Australia) advised that the Barangaroo South development would be serviced from their City North Zone substation at 11kV and fed from their CBD Triplex grid.

Subsequent to this, Ausgrid determined that the site would instead be serviced at 33kV from their Pyrmont Switching Station. Lend Lease has since decided to own and operate the 33kV network and substations on the Barangaroo South site as a private embedded network. This will be configured in a triplex configuration and will provide a similar level of redundancy to the 11kV CBD system.

The feeders from Pyrmont Switching Station will be a combination of new and existing feeders. New Ausgrid feeders will be run from Slip Street to the Barangaroo South development where they will terminate on switchgear which demarcates the Ausgrid network from the private embedded network. At Slip Street the new feeders will be joined to existing feeders that run to Pyrmont. These feeders were recently in service but were decommissioned when the new City North Zone substation was commissioned. These arrangements are subject to ongoing negotiations with Ausgrid and the ultimate method of supply to the site will be determined as a result of these ongoing negotiations.

Within the Stage 1B site, private embedded network cabling and substations will be established to service the building and other site loads. Refer to SKC224 for preliminary proposed electrical infrastructure plan.

In the event the negotiations with Ausgrid result in reticulation of 11kV triplex electricity service, it is possible that electricity service will not be privately owned network and will remain the property of Ausgrid.

The provision of electricity service to the proposed Crown Hotel development may differ from the provision of electricity service to the Stage 1B development.

## **13.9 Telecommunications Services**

### **13.9.1 Existing Services**

The Kent Street telephone exchange is located relatively close to the site. A number of telecommunications carriers have existing cables in the vicinity of the site.

All telecommunications infrastructure previously existing within the Stage 1B basement footprint have now been capped at the boundary and removed.

### **13.9.2 Proposed Services**

The scope of communications services that will ultimately be provided for Stage 1B and the proposed Crown Hotel development includes lead-in telecommunications service provider infrastructure, distribution, an Integrated Communications Network (ICN), Master Antenna Television System (MATV) and in-building (i.e. basement) mobile coverage / distributed antenna system.

A single lead-in connection will be provided to the Stage 1B site indicatively from Hickson Road. Allowance will be made for a primary telecommunications provider with spare capacity for up to two additional future service providers. Private fibre services may be interfaced directly to Barangaroo South Stage 1A.

Reticulation within the site will generally be in dedicated carrier cable trays at a high level in the basement to individual building node rooms. Cable tray and conduit zones are subject to detailed design.

Refer to SKC223 for preliminary proposed telecommunications infrastructure plan. Final routing and locations are to be agreed with the telecommunications provider(s) and developed during detailed design.

## 14 Conclusion

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This Stormwater Management and Infrastructure Servicing Strategy report has been prepared for the proposed construction of a basement structure within Stage 1B of the Barangaroo South development site.

This report supports a State Significant Development Application (SSD 6960) submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Development Application (DA) seeks approval for construction of the Stage 1B Basement and associated works at Barangaroo South.

The completed design of proposed stormwater management measures will result in no adverse impact on surrounding neighbours or public spaces due to adjusted overland flow paths around the Barangaroo South development. Details are to be developed and integrated into the ground plane design and detailed in the design development phase.

The climate change induced sea level rise predicted for 2100 poses a risk to the effectiveness of the existing local stormwater drainage system in the Barangaroo area. However, the proposed internal and external stormwater drainage works seeks to improve the capacity and allow for future climate change driven increases in harbour water levels.

In terms of infrastructure servicing, the Barangaroo South Stage 1A development has been designed to accommodate the servicing of Stage 1B at a level of technology and innovation required by the governing authorities.

Lend Lease will enter into the necessary arrangements and obtain necessary approvals for stormwater, water supply, sewerage and natural gas from the relevant authorities, as required.