

BARANGAROO SOUTH UTILITIES



	Change Type	Author	Date
4.0	Including Crown Integrated Resort	P. FLYNN	July. 2019
5.0	Issued for Crown Subdivision	P FLYNN	April 2020

Acknowledgement

The Barangaroo Delivery Authority and Lend Lease would like to acknowledge that the Gadigal people are the Traditional Custodians of this land and form part of the wider Aboriginal nation known as the Eora. We also acknowledge the present Aboriginal and Torres Strait Islander people, who now reside within this area.

This report has been prepared by The Barangaroo Delivery Authority, Lend Lease and expert consultancies, it may not be reproduced in whole or in part without prior written consent.

The work product informing this document has been derived from best practice research, existing desk-top data, preliminary on site investigations and agency consultation. Details of the existing utilities infrastructure have been obtained from the following sources:

- Dial Before You Dig service
- Radar Penetrometers Survey
- Utility Authorities information

Sketches for each utility service are provided at the end of each section of this report.

It should be acknowledged that this document is conceptual and iterative, it will be further refined over time as design development progresses.

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1. THE PURPOSE OF THIS DOCUMENT

This report outlines the proposed approach and methodology that will be used for the design development of utility services infrastructure across Barangaroo and updates previous revisions to allow for the utilities requirements of the Crown Integrated Resort. Previous revisions included provision for original Hotel in the Harbour included in Mod 4 to the Barangaroo Masterplan. This revision updates layouts and loads to those appropriate to the Mod 8 Barangaroo MasterPlan. Best available provisions for Barangaroo Central have been made pending finalisation of its design.

The plan responds to the SEARS requirements of SSD9758 General Requirement 5.

The Infrastructure Plan has been prepared to provide a description of each existing utility infrastructure service on the site and the proposed utility services required to serve the proposed and completed Barangaroo Development. Where alterations or augmentations have already been made as part of previous stages of the Barangaroo South development they are noted as current and only further alterations required to serve the Crown Resort are noted.

The report also addresses the principals for ownership, operation and maintenance of the proposed utility services.

The document also seeks to fulfil requirements arising from Stratum Subdivision DA reference SSD 10429 for evidence of utility engagement and agreement to supply arrangements prior to subdivision.

Barangaroo South is a major new business, tourism, residential and retail precinct opening onto a public waterfront promenade. Lend Lease was awarded the right to develop Barangaroo South in December 2009, following a public bid process. Planning for the precinct is mature and most utilities connections and provision have been completed to support earlier stages of the development. This document either notes previous provisions or notes altered provisions required for the updated design to reflect Mod 8 and the Crown Integrated Resort.



Concept designs for provision of each utility service have been developed in conjunction with the relevant Authority, and other relevant parties, to ensure that the most efficient and most economical service is designed and constructed. In most cases Servicing Agreements and Strategies have been agreed and implemented with Utilities providers which include provision for connections to Crown.

In the case of several Utilities connection of the Crown Hotel/Resort is via an existing connection to Stage 1A and involves and extension to privately operated infrastructure rather than new utility owned infrastructure.

2. VISION AND OBJECTIVES FOR BARANGAROO

vision

Barangaroo is intended to be a place to inspire innovation for generations to come. It will be climate positive having a net positive impact environmentally, economically and socially, precinct wide and to its external areas of influence. It will be reflective of the extraordinary context of Sydney – its harbour, its diverse communities and its globally competitive business leadership. It will be a place designed for play and work alongside living and learning.

objectives

The objectives for Barangaroo are to:

- Be a precinct that will be studied for generations to come as a world benchmark for its bold and inspiring design, architecture and public domain, awarded for its authenticity, integration and diversity.
- Re-establish a dynamic place for all of Sydney's people which is integrated, connected, secure – defined by its waterfront and CBD location.
- Operate as an exemplar of the next generation in sustainable development by being climate positive.
- Design Barangaroo to uphold community wellbeing including health and fitness, and to value what matters to people and the planet internationally and City of Sydney 2030 targets.
- Be financially viable over the long term, maximising public returns and value to the people and businesses of Sydney.
- Add a new dimension to Australia's financial capital by integrating mixed use commercial, residential, retail, educational, civic, cultural and entertainment activities with our extended financial hub.

3. Introduction

Barangaroo aims to set new world benchmarks in sustainability. It will be climate positive having a net positive impact environmentally, economically and socially.

The objectives for the sustainable design and delivery of Barangaroo are to:

- Provide next generation infrastructure of a scale that allows for an innovative precinct-wide network to support the twin challenges of reduced potable water demand and reduction in greenhouse gas emissions.
- Provide a place to live and work, by seeking to be a liveable neighbourhood and lively work environment. Overtime Barangaroo's range of cultural, educational and recreational amenities and programs will ensure its position as a great destination for Sydney-siders and visitors to the city.
- Provide a comprehensive remediation outcome for Barangaroo and in doing so become a benchmark for the reuse of degraded post-industrial landscapes.
- Work with government agencies, private sector and community to provide timely and co-ordinated delivery of social and community infrastructure and programs.
- Co-ordinate transport and access outcomes to ensure, reduced dependency on car travel to the city supported by new and safe pedestrian and cycle links to a range of transport modes and ease of connectivity with the CBD.

PRINCIPLES of DESIGN,

The planning and design development of the Integrated Services Infrastructure for Barangaroo will incorporate the principles of:

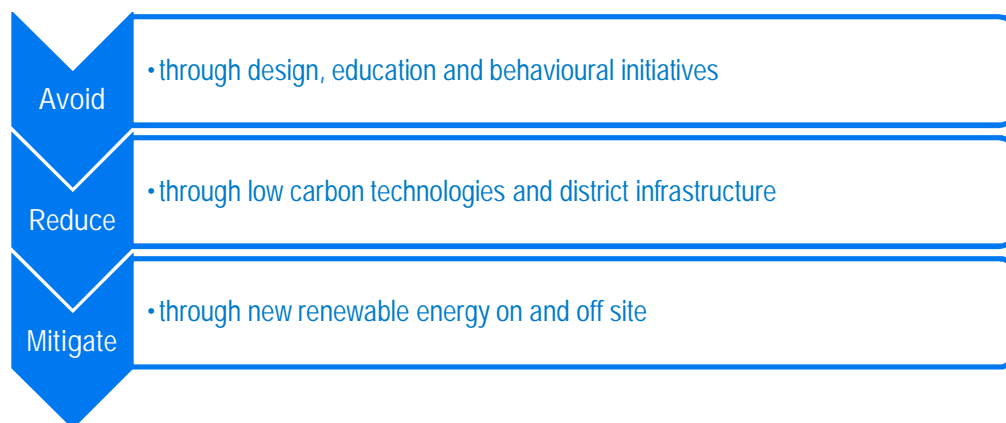
- Carbon Neutral
- Zero Waste
- Water Positive

CARBON NEUTRAL

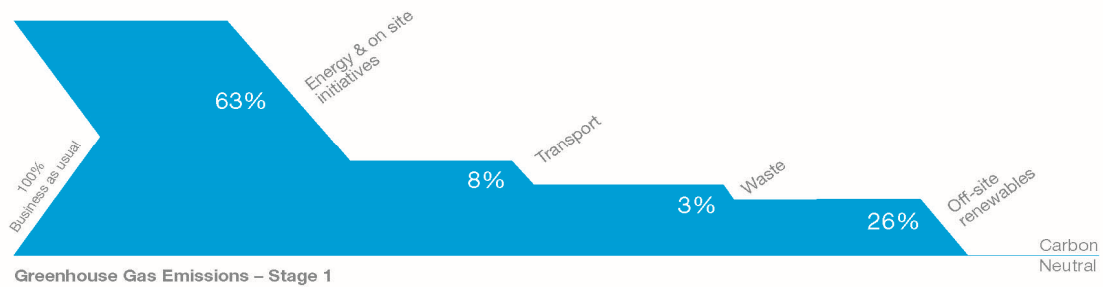
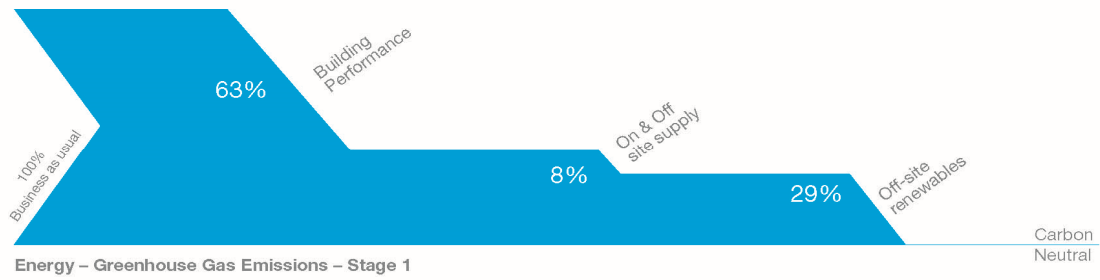
- Barangaroo aims to be a carbon neutral community through leading edge energy efficiency, low carbon energy production and by generating enough renewable energy to cover total net green house gas emissions from energy use at Barangaroo. Transportation emissions for workers commuting to and from the site will also be offset to achieve a net zero carbon outcome.

100% of public domain will be powered by on site renewable energy, such as solar PV arrays

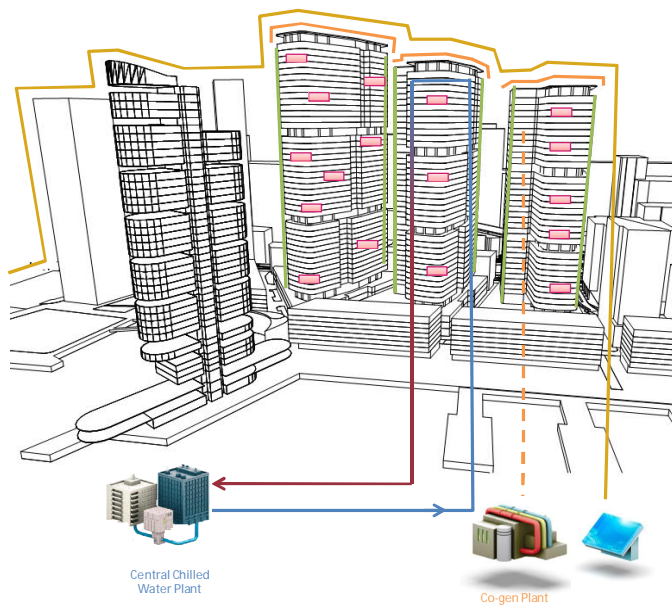
Greenhouse Gas Reduction Hierarchy



Energy/carbon balance



AUSTRALIA'S FIRST LARGE SCALE CARBON NEUTRAL COMMUNITY

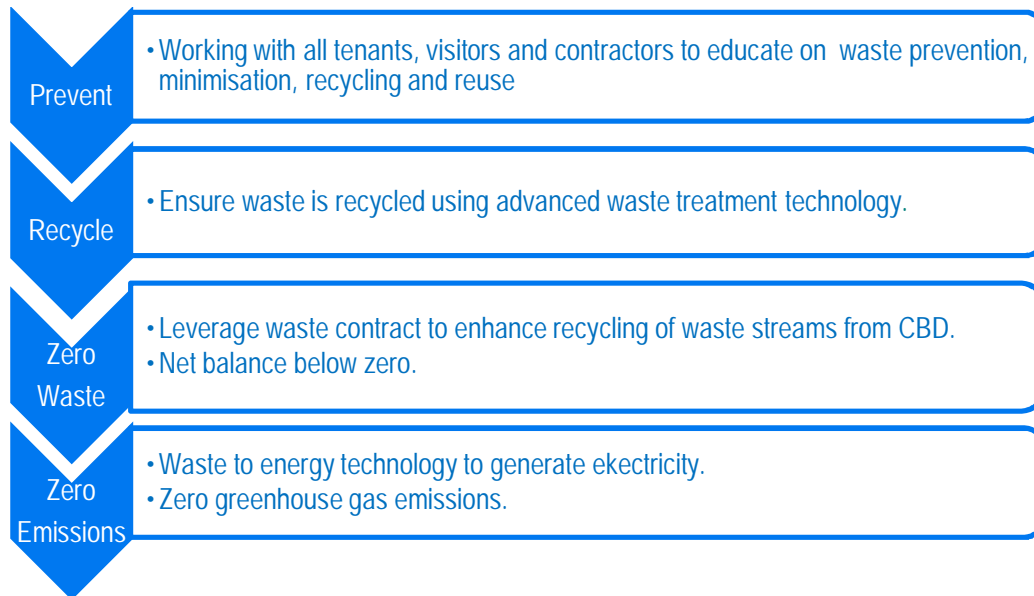


- Ultra low energy buildings
- Smart Metering & Monitoring
- Centralised cooling
- Onsite energy generation
- Offsite renewable energy
- Commuter emissions offset

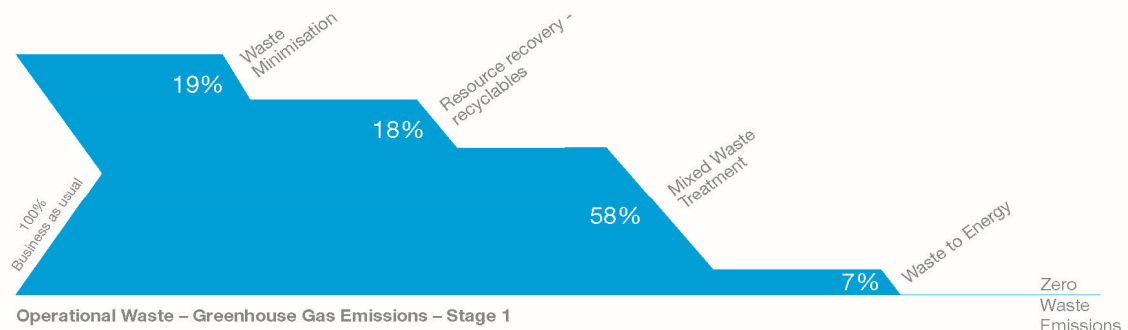
REDUCTION OF WASTE TO LANDFILL

- Barangaroo targets reduction of to landfill of 80% by 2020 through prevention, minimisation, recycling and reuse.
- Public domain will provide source segregation of waste and education initiatives.
- Public drinking water supplies to replace bottled water.

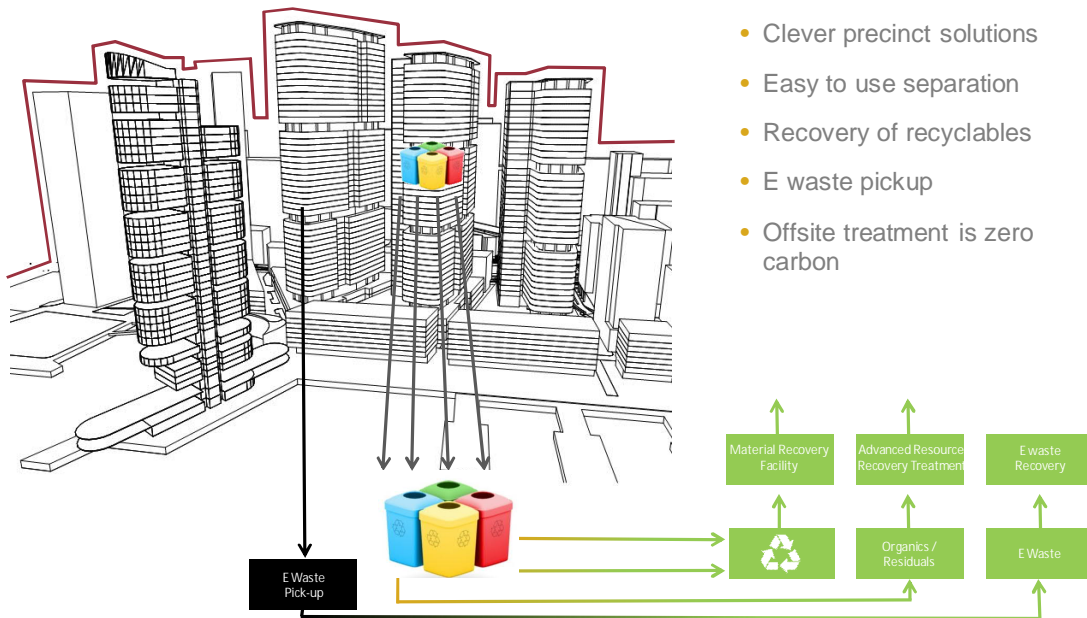
Waste Hierarchy



Waste balance

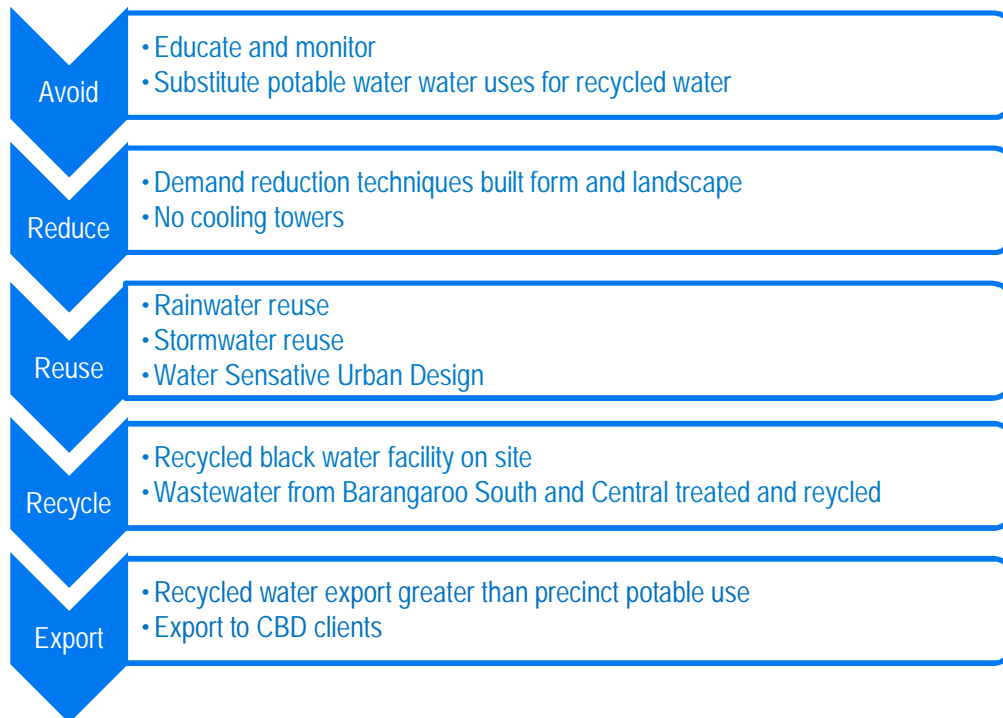
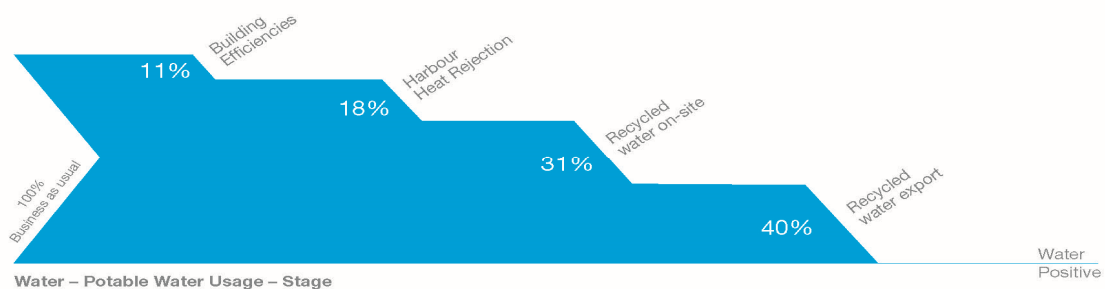


TREATING WASTE AS A RESOURCE

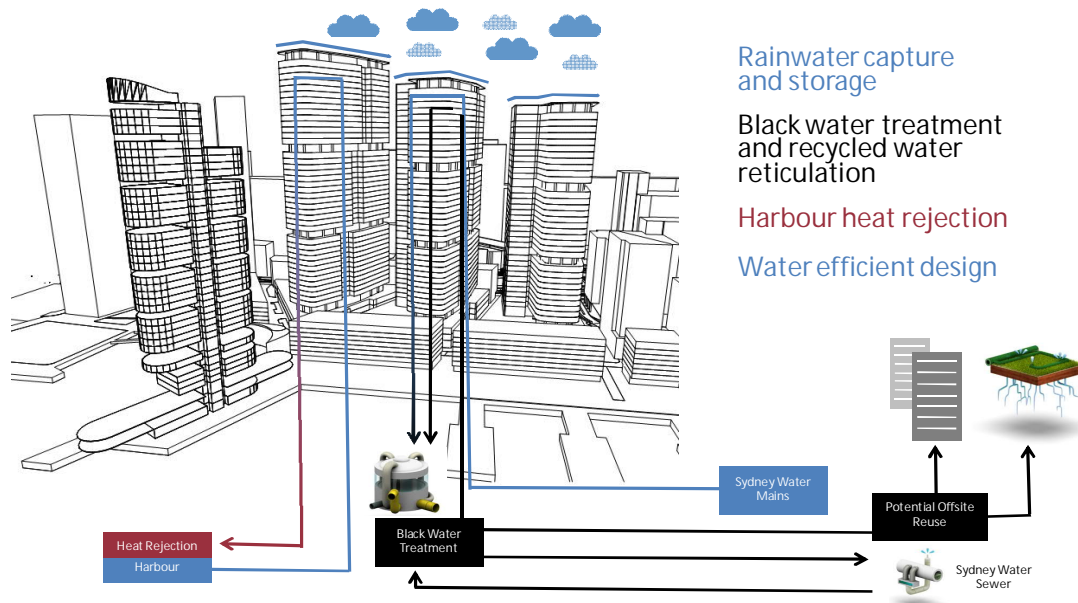


WATER POSITIVE

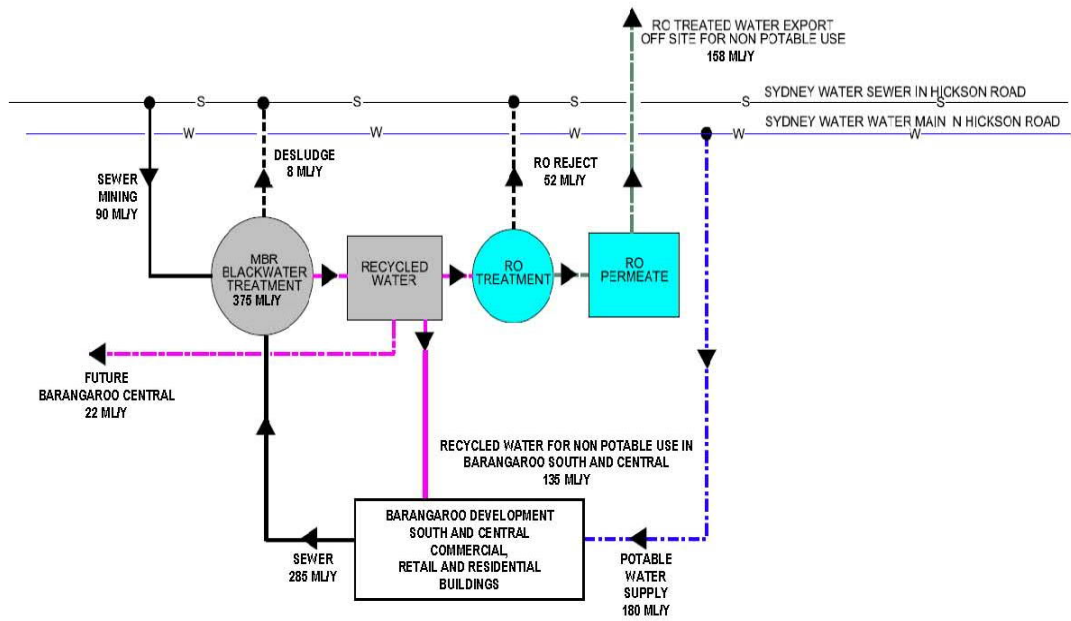
- Targeting a water positive outcome by reducing, recycling and exporting more water than Barangaroo uses.
- Export of recycled water to CBD clients
- 100% of public domain irrigation will use recycled water.
- Low water and drought tolerant plant species will be used in public domain.
- Blackwater treatment system provides a district recycled water supply powered by on site renewable energy, solar PV arrays.

Water Hierarchy*Water balance*

PRESERVING PRECIOUS Water RESOURCES



OVERALL WATER BALANCE



4. Stormwater Services

4.1. Stormwater Strategy

The Stormwater Strategy for Barangaroo South is mature. It has been revised to include the public Domain and run off from the updated Mob 8 precinct layout including from the Crown resort podium and tower areas. The Strategy is detailed in the Stormwater Management and Civil Infrastructure Report Barangaroo South Stage 1B Public Domain prepared by Cardno and Associates in March 2017 attached at Appendix A. The report has been produced pursuant to the Public Domain Planning Application, but its subject matter is relevant to the provision of infrastructure to and around the Crown Resort.

This document includes all areas around the Crown Resort and makes allowances for flows from the podium and Tower building areas and plans stormwater flows in the context of the surrounding catchments.

Implementation for the Stormwater strategies' assets around Stage 1A is complete. Construction of the assets associated with Stage 1B and 1C and those serving Hickson road are currently underway.

4.2. Proposed Stormwater Services

4.2.1. Barangaroo South

The layout of the existing pipe system and overland flow path prior to the commencement of the Development are non compatible with the proposed Barangaroo South basement footprint, ground plane and proposed buildings. The existing stormwater needs to be diverted around the site to suit the development master plan. Permanent diversion to the south along the existing Shelley and Lime streets has been provided.

The stormwater management system that conveys the stormwater from the external catchment located between Bradfield Hwy and Kent Street will be diverted in stages around the sites to the north along the future constructed roads and Hickson Road.



In respect to overland flows, due to the site constraints and climate change principles, the piped stormwater management system needs to cater for 1 in 100 year event. The design of the external stormwater managements system will be in accordance with design and catchment management best practice.

Internal, on site stormwater from the building roofs and hard surfaces will be collected, treated and either discharged into the harbour or reused for irrigation.

The treatment of the most efficient event of the onsite stormwater drainage will be designed to national best practice.

4.2.2. Barangaroo Central & Headland Park

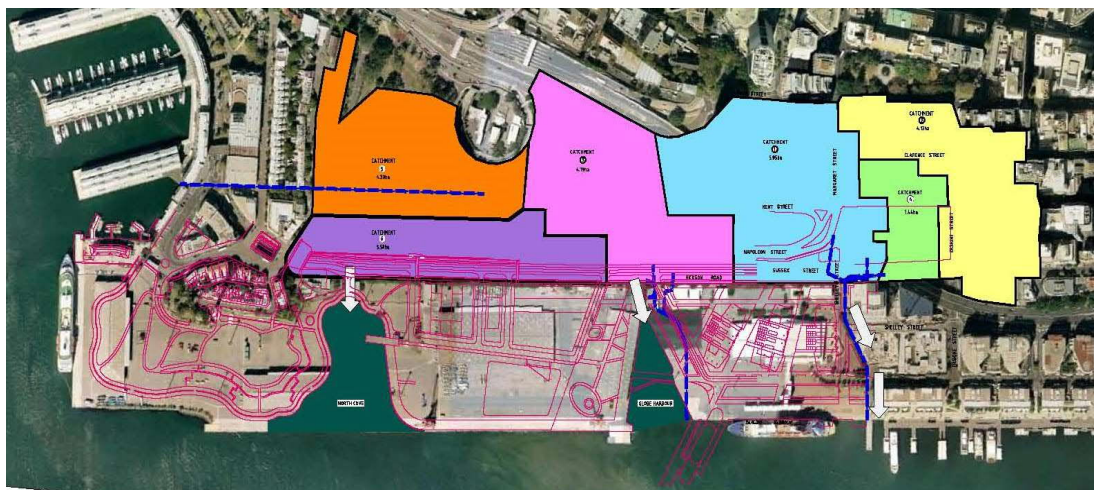
The locations of the existing network within the Barangaroo Central & Headland Park are not compatible with the proposed development and their removal or relocation is proposed to ensure that any stormwater on these sites will be adequately discharged.

Pipes draining the stormwater run-off from the external catchments will be relocated to suit the proposed development layout and easements or reserves should be created where necessary. It is proposed to extend this existing stormwater network to allow external stormwater to flow to the Northern and Southern Coves. Potential for storage in the cultural parkland (part of Barangaroo Central) for use in irrigation of the future parkland will be explored. The intention is to use recycled water for irrigation.



It is proposed that rainwater falling on roofs is collected through either a central rainwater tank or individual rainwater tanks within buildings. This rainwater typically will be harvested for reuse, reducing the runoff entering the stormwater system.

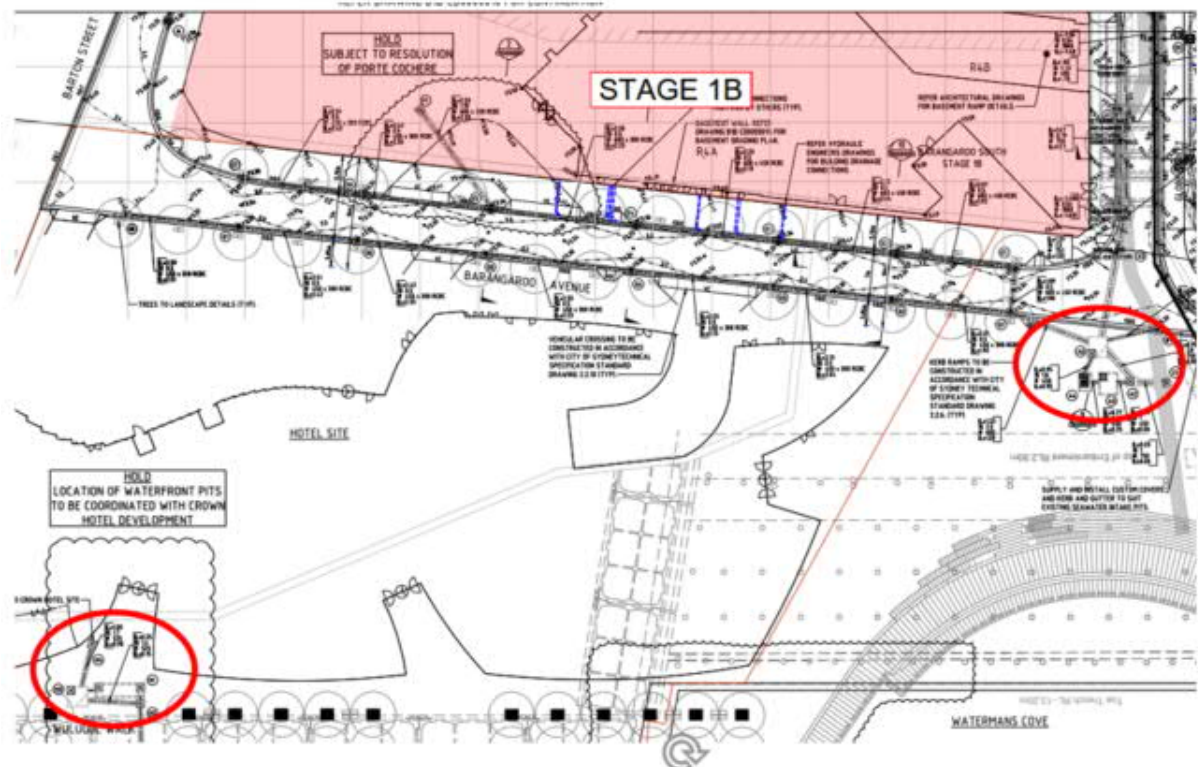
It is also proposed that the new Water Sensitive Urban Design (WSUD) bio-swale collection system connects into these four stormwater drainage lines. The intention is to use recycled water for irrigation.



4.2.3. Crown Resort Provisions

Flows originating in and on the Resort building are discharge to the Harbour via pits and treatment systems located in the foreshore to the West of the Resort.

[illegible]



4.3. Principals for Operations Management

4.3.1. Barangaroo South

The external stormwater trunk pipelines will continue to be owned and maintained by Sydney Water including any assets which ultimately pass through the site. The onsite stormwater management system will be part of the site infrastructure and will be owned and maintained by the public authority operating the Public Domain (currently the BDA)

4.3.2. Barangaroo Central & Headland Park

The external stormwater trunk pipelines will continue to be owned and maintained by Sydney Water including any assets which ultimately pass through the site. The onsite stormwater management system will be part of the site infrastructure and will be owned and maintained by the public authority proposed to operate the Public Domain

Potable Water Supply & Sewer Strategy

4.4. Strategy Document

The Barangaroo Sewer, Water and Recycled Water Masterplan Report has previously been prepared by the Barangaroo Development Authority and Lend Lease. This document serves as an addendum to the Local Areas Servicing Strategy previously agreed with Sydney Water. Rev C of this document, Attached as Appendix B, includes updates to the assessment of sources, loads and drainage from Barangaroo the Development as modified in Mod 8 and Mod 9. Sydney Water has reviewed and commented on the Document under its Case 145051 and provided a Feasibility letter setting out their requirements associated with the required infrastructure (attached at Appendix C).

4.5. Existing Water Services

4.5.1. Barangaroo South

The site is currently served by a 300mm diameter water main in the western side of Hickson Road. There are numerous connections serving the previous buildings on the site. The existing connections have been and will continue to be capped in stages at the main in accordance with Sydney Water requirements. Some existing incoming supplies may be used as temporary incoming water supplies during construction.

4.5.2. Barangaroo Central & Headland Park

Barangaroo Central & Headland Park have a number of water supplies supplying existing buildings from water mains adjacent to the site. The water mains that supply the site are:

- 300mm water main in Hickson Rd.
- 150mm water main in Merrimam St.
- 300mm water main in Dalgetty Rd.
- 100mm water main in Town Place and extends to the sewage pump station SP0014.

SP0014 is to be decommissioned.

4.6. Proposed Water Services Upgrade

4.6.1. Barangaroo South

The potable water supply to the Barangaroo South development is connected to the existing 300mm Sydney Water Water main in Hickson Road. Sydney Water has confirmed that the capacities in this main are sufficient to meet the demands of the development including those to the Crown Resort and Central Barangaroo. The flow from this main will also be used for the main fire fighting water supply, having been reviewed for flow and pressure available being satisfactory to the requirements of New South Wales Fire Brigade.

The proposed strategy to secure potable water supply to the Crown Resort site is to construct a ring main from the existing 300mm Hickson Road main down Waterman's Quay and Barangaroo Avenue past the front of the Resort, returning to Hickson Road via the Park. The installation of this main may be staged as Construction permits. Tees of appropriate size to the Resort will connect separately for Potable Water (200mm) supply and Fire Water supply (150mm) (in addition to the primary Fire Water supply from Stage 1A).



The Development water strategy and proposed implementation of a recycled water system will reduce the demand for potable water compared to a Business as Usual case. The potable water demand will be from the following potable water uses:

- All potable water uses other than toilet flushing, irrigation and wash downs.
- Potable water top up when the recycled water system is off line.

The Development will utilise standard Sydney Water process for the design and construction of a potable water main. The asset will be created the Developer and transferred to Sydney Water for operation and maintenance.

4.6.2. Barangaroo Central & Headland Park

The Headland Park water service has been provided by connections to the existing water main located in Hickson Rd and Dalgetty Rd. Sydney Water approval will be required for all connections to the water mains.

Barangaroo Central will be fed by multiple water main connections that will provide potable water to the buildings and public domain. The location of the supply pipeline will vary from in ground installation to suspended pipeline from basement structure depending on the configuration of the buildings and road construction.

A Sydney Water Section 73 is required to gain approval for the water supplies to the site and will provide information on the metering strategy.

4.7. Principals for Operations Management

It is proposed that Sydney Water will own, operate and maintain potable water mains located within the Development. All potable water pipelines from the Sydney Water trunk mains will be operated and maintained by the building owners.

The billing water meters are owned by Sydney Water and are read and billed directly to the building owner.

5. Sewer Services

5.1. Existing sewer Services

5.1.1. Barangaroo South

The site is served by a sewer trunk main in Hickson Road near the western kerb line draining into the existing Sewage Pumping Station SP1129.

All existing connections servicing the existing buildings have been or are to be demolished and capped off in accordance with Sydney Water requirements.

5.1.2. Barangaroo Central & Headland Park

Barangaroo Central & Headland Park are served by Sydney Water Sewer Mains. As the site is a low point in the surrounding sewage network two Sydney Water pump stations SP1129 and SP0014 serve Headland Park and Barangaroo Central.

There is a number of sewer main that enter onto the sites which will be realigned to allow the proposed building and earth works to be completed. All redundant pipelines within the site will be removed.

5.2. Proposed Sewer Services

5.2.1. Barangaroo South

The sewage collection system on the site will discharge to a central Blackwater Treatment Plant (BWTP) located in the Barangaroo South basement. A bypass overflow from the BWTP connection shall be provided, connecting the Development to the existing Sydney Water Sewer located in Hickson Road.

When the BWTP is offline or there is surplus recycled water available for the needs of the buildings, then the wastewater shall be diverted to discharge directly to the Sydney Water sewer in Hickson Road, and ultimately to the Sewage Pumping Station SP1129. There will also be a discharge of the waste by-products from the BWTP system to the Sydney Water sewer, including the desludging from the Membrane Bioreactor (MBR), and the reverse osmosis-reject water managed by a Trade Waste Agreement entered into between the operator of the BWTP and Sydney Water..

The buildings on the eastern section of the site, including the office towers C3, C4 and C5 drain by gravity connection to the inlet works of the BWTP. In by-pass mode, a diversion valve will operate, directing the flow by gravity into the Sydney Water sewer. The buildings on the western side of the development, including sections of the retail outlets below the commercial towers, will discharge to private sewer pumping stations located in the Basement of Barangaroo South. The discharge from the sewer pumping stations shall connect into the high level gravity collection system upstream of the by-pass diversion valve and drain to the inlet works of the BWTP.

All sewer pumping stations shall be provided with minimum 8 hours average flow storage.

Due to the Development water strategy and proposed implementation of a recycled water system and off-site export, the flow to sewer will be reduced when compared to a Business as Usual case.

The Development has entered into Trade Waste Agreement with Sydney Water for discharging of waste water, excess recycled water and BWTP process by-products into the Sydney Water sewer system.

In addition, the Development will require sewer mining to increase the quantity of recycled water as required for off-site export. The sewer mining connection is into the Sydney Water sewer main in Hickson Road, intended to be upstream of the sewer connection serving the Barangaroo Site.

The Development has entered into a Sewer Mining Agreement with Sydney Water for the proposed sewer mining at Barangaroo South.

5.3. Sewer Service

The sewer service to Barangaroo South has been agreed with Sydney Water of the "Barangaroo South Water and Sewer Servicing Strategy" document, dated March 2012 as added by Appendix B. Barangaroo Central & Headland Park

The proposed Barangaroo Central buildings will be served by a network of gravity drainage and pumped waste water systems throughout the development discharging to the Barangaroo South BWTP. Further discussions are required to determine the final arrangement and concepts.

The proposed sewer works on Headland Park will include the decommissioning of sewer pump station SP 14 and the realignment and diversion of the existing Sydney Water mains via a new sewer mains along Towns Place and Hickson Road to connect with SP 1129 pump station located on Barangaroo Central. All requirements of Sydney Water's section 73 Notice of Requirements apply. The superstructure of SP 14 is to be relocated for adaptive reuse as a toilet block within the Headland Park.

5.4. Principals for Operations Management

5.4.1. Barangaroo South

The sewage collection system within the Basements is proposed to be privately owned. The sewerage collection system operator is intended to be the private network service provider that is also to be responsible for the BWTP operation.

The sewer outfall and sewage mining connection shall also be owned and operated by the private network service provider.

The operation of the recycled water system will be in accordance with the WICA licensing requirements and IPART regulations.

5.4.1.1. Benefits

The benefits of a centralised BWTP include:

- Reduced consumption of potable water,
- Reduction of flow of waste water to sewer,
- Precinct wide solution that can potentially be expanded.

5.4.2. Barangaroo Central & Headland Park

The Sydney Water sewer drainage that will be diverted will remain under ownership of Sydney Water. All sewer drainage and trade waste will be the responsibility of the developer.

The operation and maintenance of the Sydney Water sewer drainage will be Sydney Water all other drainage system will be owned, operated and maintained by the future private network service provider.

6. Recycled Water Services

6.1. Proposed Recycled Water Service

The proposed Recycled Water Scheme consists of:

- wastewater collection system,
- wastewater treatment,
- recycled water reticulation system.

The proposed Blackwater Treatment Plant (BWTP) at Barangaroo South will treat waste water to a suitable quality and produce recycled water for non potable water use on the Barangaroo South site, and for export to neighbouring buildings. The input capacity of the proposed BWTP will be 1ML/day based on the current water



model. The plant will produce enough recycled water to fill approximately 120 Olympic size swimming pools per year.

The export for neighbouring buildings, that will reduce their potable water demand, is primarily expected to be recycled water for cooling water and may therefore be treated to reverse osmosis (RO) quality suitable for use in cooling towers.

The recycled water use on the Barangaroo South site shall be for all non-potable water uses such as toilet flushing, irrigation, fire systems test water and wash-down as approved by IPART. The use of the recycled water in residential clothes washing machines shall be considered during the design process. If the quality of recycled water produced is

suitable for washing machine use an optional recycled water supply tap may be installed adjacent to the potable water supply taps.

The BWTP process includes 24 hour storage tanks for the recycled water supply. A recycled water pressure system pumps the water from the storage tanks. The recycled water distribution system is a network of pipes located at high level within the basement. Each building / strata title lot shall have an individual supply point and recycled water meter.



The recycled water storage tanks have a back up water supply fed from the Sydney Water potable water main in Hickson Road.

If the water level in the storage tanks drops to a low level then the storage are automatically supplemented from the potable water supply to maintain this low level. The water level in the recycled water storage tanks may drop to low level if the BWTP is off line for maintenance.

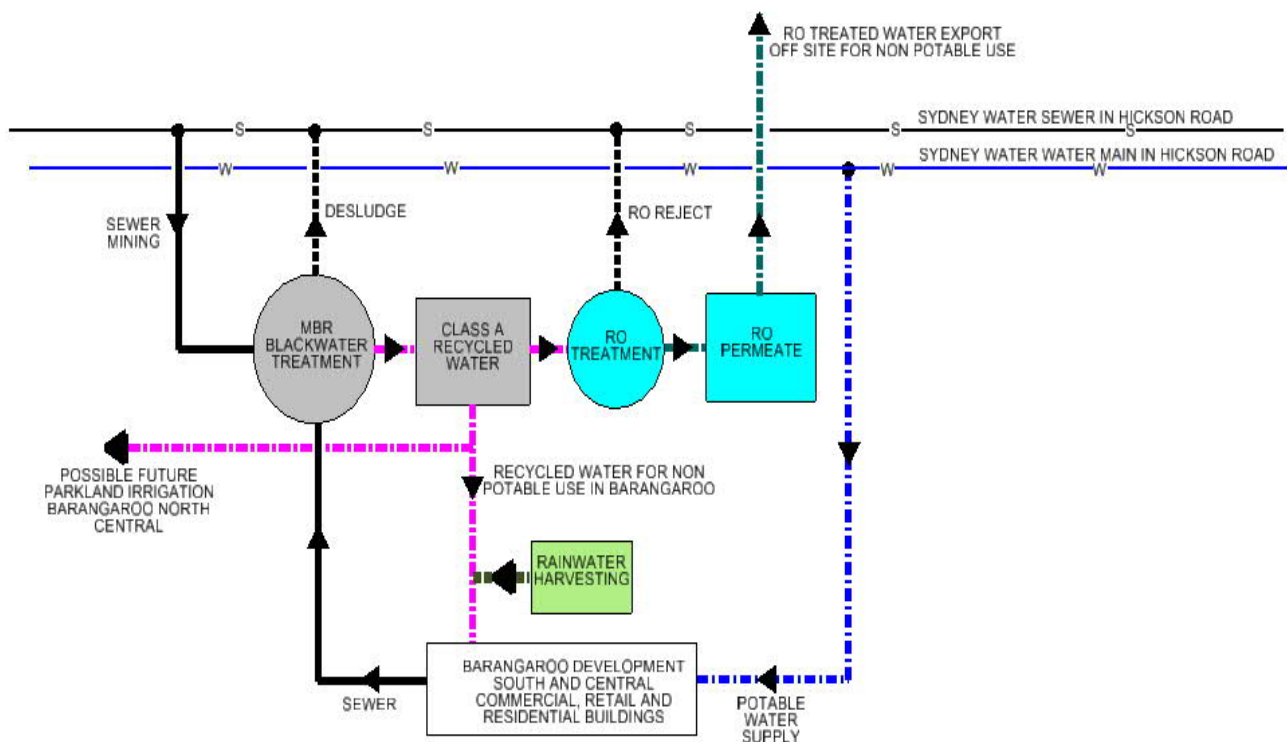
The backup potable water supply supplies or will supply the buildings on Barangaroo South, Central and possibly Headland Park. The backup recycled

water supply for the export buildings is proposed to be from the existing potable water supply in the export buildings.

Recycled water to all buildings in Barangaroo South including the Crown Resort and 60,000M² of GFA in Barangaroo Central will be supplied from the proposed BWTP.

It is proposed that recycled water from Barangaroo South BWTP will also be available for use as irrigation supply to the Barangaroo Central and Headland Park.

The recycled water scheme will be designed in accordance with NSW health regulations and Standards. Appropriate Local Government Act (LGA) and Independent Pricing and Regulatory Tribunal (IPART) Network Operators Licence will be obtained to build and operate a recycled water scheme. An IPART Retail Supplier license will also be obtained.



CONCEPT WATER FUNCTIONAL DIAGRAM

6.2. Principals for Operations Management

It is proposed that the Recycled Water Scheme including the recycled water meter will be owned and operated by the proposed private network service provider, Lend Lease Recycled Water Services..

Each individual building will be responsible for operation and maintenance of the recycled water system downstream of the recycled water supply main and is responsible for storage and pressure boosting the recycled water if needed.

The commercial operation of the recycled water system is in accordance with the WICA licensing requirements and IPART regulations. The applicable fee structure and supply charges results from detailed negotiation with Sydney Water and IPART

7. Chilled Water Services

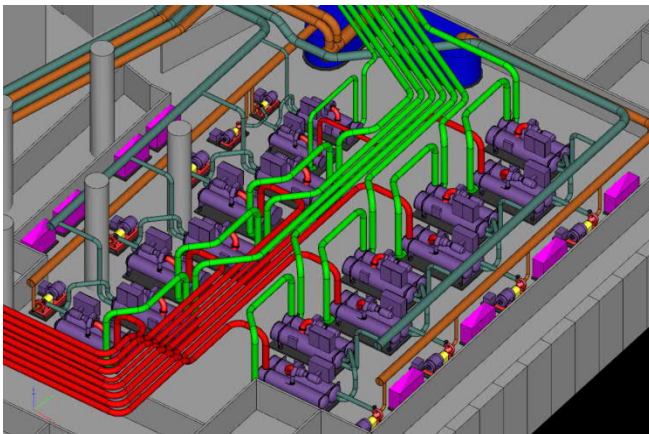
7.1. Proposed Chilled Water Service

7.1.1. Barangaroo South

A precinct based district centralised chilled water plant (DCP) and Harbour Heat Rejection (HHR) Plant has been constructed in the Stage 1A Basement. The District Central Chilled Water Plant (DCP) is able to deliver energy reductions since the centralised plant is able to capture the diversity across the site so that the plant is operated at optimum load levels.

Chilled water will be reticulated from a number of energy efficient chiller sets to the individual buildings including the Crown Resort. The chilled water pumping system is variable volume so as to reduce energy consumption at part load conditions. Metering of chilled water energy consumption will be provided in each building. Construction of the chilled water plant will be staged to reflect the overall development of the site.

Heat is rejected from the chilled water plant via a sea water heat rejection system.



- Chilled Water return temperature – 14.70C
- Design entering seawater temperature – 26.00C max.

The HHR approach requires less energy and water consumption to operate than conventional cooling tower installations. Construction of the HHR water plant will be staged to reflect the overall development of the site.

It is anticipated that the cooling capacity of the centralised chilled water plant for the developed site will be approximately 62,000 kW_r. The general design parameters for the centralised chilled water plant include;

- Chilled Water supply temperature – 4.70C



7.1.2. Barangaroo Central

A chilled water plant with harbour heat rejection will be installed similar to that to be installed at Barangaroo South.

The opportunity to extend the chilled water pipework reticulation from Barangaroo South to the individual buildings in Barangaroo Central will be investigated during design development.

7.1.3. Headland Park

Headland Park facility will utilise a separate, dedicated harbour heat rejection strategy to complement a low impact air conditioning system design.

The Headland Park infrastructure includes a dedicated deep water harbour intake to maximize future annual energy savings of the facility through low and stable chiller condensing temperatures.

The harbour heat rejection strategy will negate the requirement for cooling towers associated with the future facility. While reducing the aesthetic impact of plant on site, this approach will also minimise water consumption and eliminate the public health risks associated with cooling towers.

7.2. Principals for Operations Management

7.2.1. Benefits

The benefits of a centralised chilled water infrastructure with harbour heat rejection include:

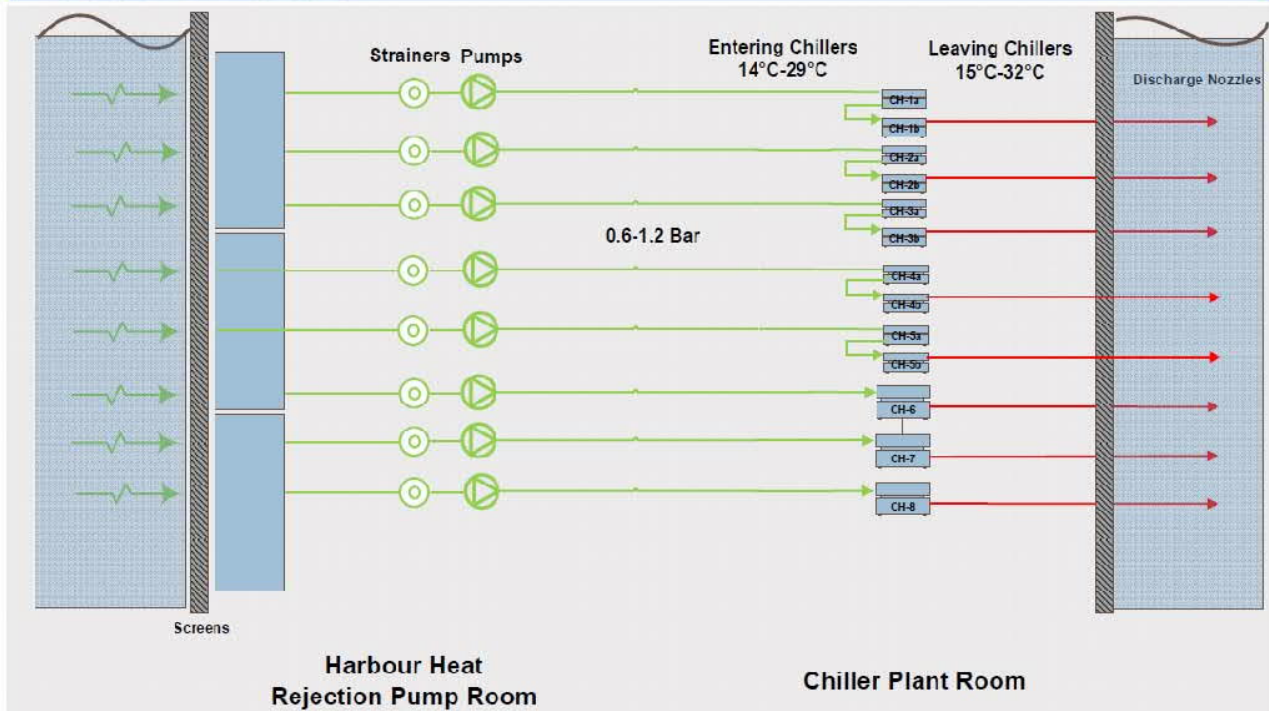
- Significant water savings – no cooling towers,
- Energy savings when compared to individual buildings with dedicated plant and the benefits of buildings diversity,
- Quieter operation due to the absence of cooling tower,
- Hidden from public view,
- Negligible impact on harbour water,
- No Legionnaires' disease risk,
- It removes roof top clutter and potentially increases green roof space,
- It is a precinct wide solution which potentially can be expanded.

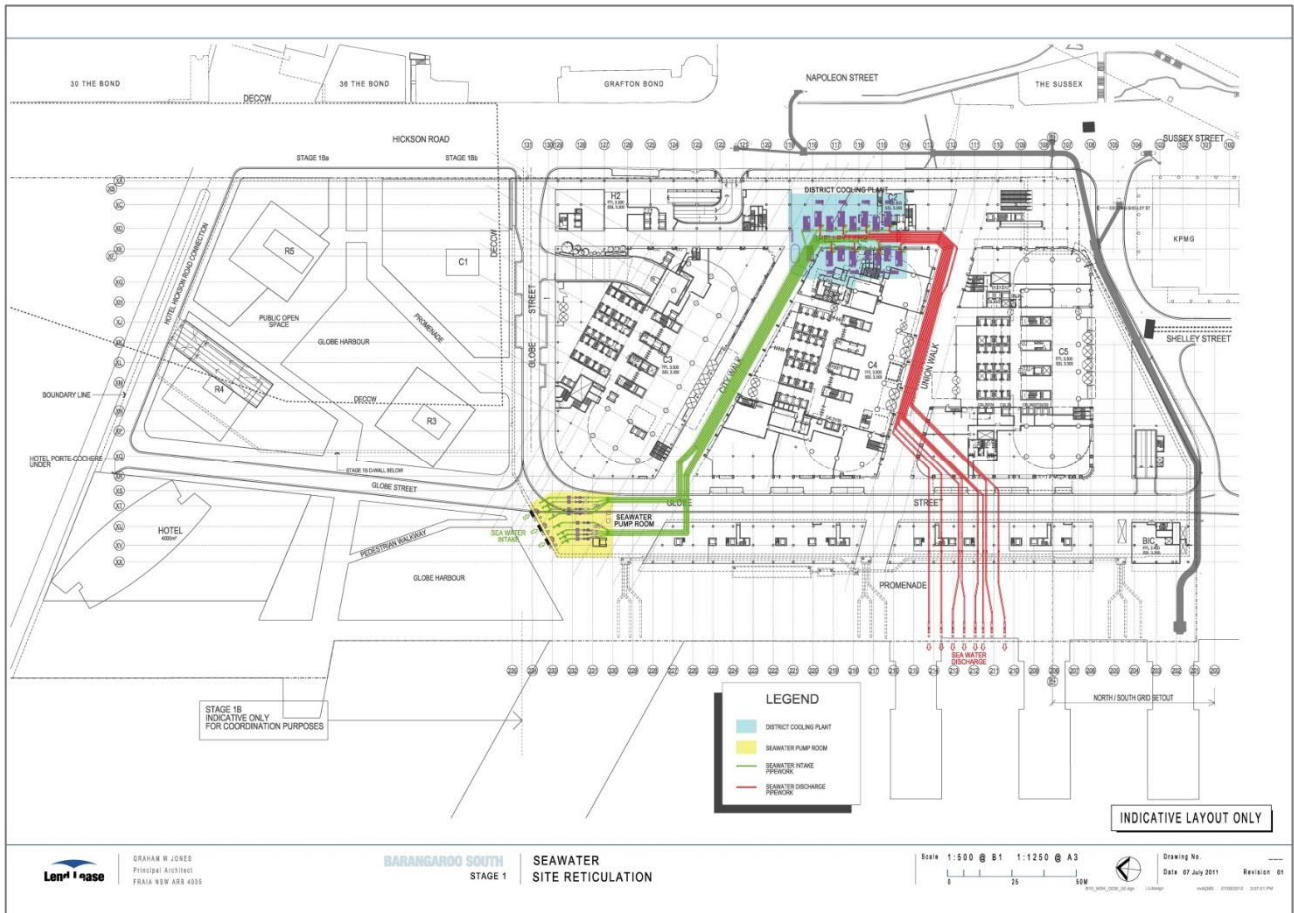
7.2.2. Operations

Principles for operation:

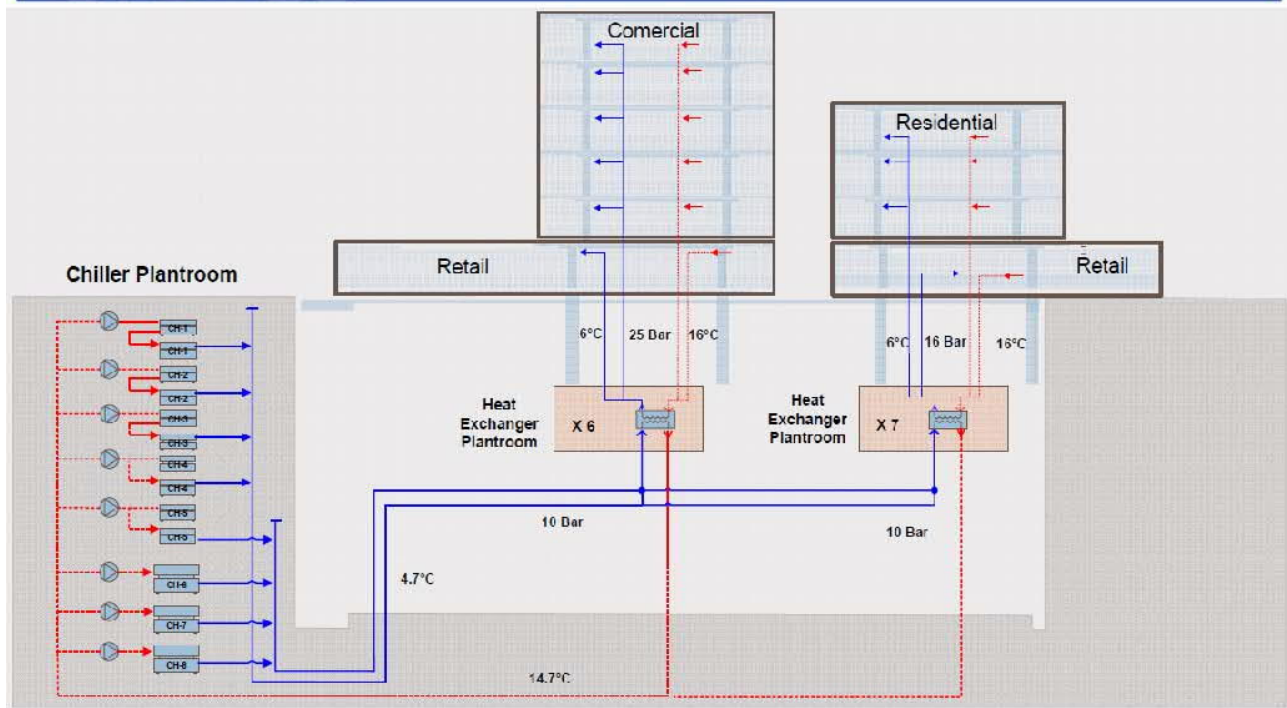
- To be agreed within the Barangaroo Management Plan,
- Operated by a private network service provider,
- User pays service,
- Operations to comply with all relevant regulation and codes.

Barangaroo - Condenser Water Configuration





Barangaroo – Chilled Water Configuration



8. Electrical Services

8.1. Proposed Electrical Services

8.1.1. Barangaroo South Distribution Network

The electricity supply to Barangaroo South established via a commercial agreement between the Developer and Ausgrid is through 33KV feeders from Pyrmont Zone Substations. The Agreement to Connect is documented in a ES-9 agreement to Ausgrid Standards.

The feeders from Pyrmont Zone Substation supply to Barangaroo South site have been established via pit and duct system in the existing roads network. Three feeders are provided to the precinct to supply an N-1 level of redundancy. The infrastructure planning capacity provided in these feeders is assessed at approximately 24.1MVA. A load review of the Mod 8 Loads including the Crown Integrated Resort has confirmed that sufficient capacity is present in the current connection to serve Barangaroo South including Crown. The Developer and Ausgrid are in consultation regarding options to increase capacity of supply from Pyrmont the Barangaroo should it prove necessary at a later stage.

Barangaroo is the first development in the CBD connected to 33KV Distribution System. The 33KV Distribution Network is different to the traditional 11KV Distribution Network.

The reticulation of the feeders from the linkage point receiving pit, along Shelley Street in an underground pit and duct system. The feeders will terminate in the Control Point 1-located in the basement which is the interface between the Ausgrid and Barangaroo Embedded Network. The reticulation of the new 33KV network from there throughout Barangaroo South is a Private Embedded Network connected in a Triplex Star configuration. The Embedded Network has been designed and procured to Ausgrid standards to facilitate possible transfer of ownership in the future if required. The substations, established in the basement and upper levels of the commercial towers, to service the site demand, will be connected to the Control Point 1. Each substation will be configured with three (3) 33kV/400V transformers each rated at 1500kVA and configured in an N-1 level of redundancy.

The HV supply to the District Central Chilled Water Plant is by a private HV networks including private substations connected in a ring main configuration to the 33kV HV supply at the Control Point 1.

8.1.2. Benefits

The benefits of the 33KV Distribution Network Supply when compared to traditional 11KV includes:

- Increased capacity and increased power circulation by the factor of 3,
- Simplified configuration, reduced risks for failure,
- Flexible system for implementation of onsite power generation and offsite export,
- Number and capacity of substations and reliability of supply.

8.1.3. Crown Hotel

The feeders to the Crown Hotel site will continue through the Barangaroo South development via a trench and duct system in Basement B2 slab on ground from the Control Point 1 via Substation 6 to a Private Basement Substation owned by Crown and a second elevated private Substation at high level in the tower. Additional spare conduits shall be provided to facilitate the future installation of high voltage and low voltage cables.

9. Renewable Energy Services Barangaroo

9.1. Proposed Renewable Energy Services Options (on and off-site)

9.1.1. On site Barangaroo South

The commitment for Barangaroo South is to produce enough renewable energy on site to service the public domain and the recycled water treatment plant. This commitment is to ensure that the public domain and recycled water energy is effectively carbon zero, although there is no requirement to directly connect the renewable energy sources to these end uses.

It is expected that solar photovoltaic (PV) will contribute to the bulk of the generation. Primarily these PVs will be



located on building roof tops to capitalise on the increased solar access to these areas. Consideration is also being given to Building Integrated PVs (BIPVs) on facades, solar street lighting and locating the PVs in public areas such as on the proposed ferry wharf roof structures.

The PVs will be fed directly into the building (or local infrastructure) which they serve as this is the most beneficial solution which reduces the need for additional cabling and minimises transmission losses. To ensure that the offset requirements and the energy generation are accurately accounted for, metering will be provided to the public realm and recycled water treatment plant and to

the onsite renewable energy sources.

The PVs and associated infrastructure will ultimately be part of the building into which they feed and will therefore be owned as part of the building asset.

The capacity of the PVs installed on Barangaroo South buildings will be approximately equivalent to the capacity of PVs installed on 300 homes.

10. Telecommunications Services

10.1. Existing Telecommunications Services

Lend Lease has co-ordinated the location of new 'Carrier Neutral' access pits on Hickson Road. Entry conduits at two major entries have been established for the use of telco's seeking to serve occupants and pathways within the development to two central Precinct Node Rooms and then extend access to the site and various individual buildings in the precinct. Lend Lease will provide by way of 'Pits & Pipes' or cable pathways into the site on pre-defined and coordinated routes. The co-ordination of the infrastructure design has from day one will extend long term flexibility and provide the ability to cater for all potential tenants, residents and visitors in the delivery into Barangaroo any Telecommunication Services from any Carrier or Service Provider.

Most major telcos have already established feeds to Barangaroo to serve existing tenants as customers.

10.2. Proposed Telecommunications and Building Communications Services

10.2.1. Barangaroo South Stage 1A

The vision for communications systems at Barangaroo South is to provide a co-ordinated precinct infrastructure that provides:

- An open access telecommunications network infrastructure to facilitate provision of telecommunications services (voice and data) for essential building services and future tenancy requirements.
- An integrated Communications Network (ICN) consisting of a common IP based communications backbone for Building Control Systems within buildings and across the precinct.

This communications infrastructure is envisaged to be an enabler for connectivity and accessibility, community communication, and utilities monitoring. The design is based upon a fibre based network for speed and performance with a wireless overlay to support mobility and convenience where required.

Pathways from existing city exchanges may need to be upgraded to support the onsite demands. It is currently envisaged that the Kent Street Exchange and Daley Street Exchange be the two key diverse locations to service the precinct.

The ICN will provide a common platform for the interconnection and management of a number of information and base/tenant building services, to provide a fully integrated communications facility throughout the precinct. The ICN will utilise optical fibre technology so as to support "day-one" systems as well as future proofing the site.

Typical services delivered across each of these infrastructure types include:

- Telecommunications Network – allowance for high speed fibre based telecommunications services for delivery of broadband, telephony, tenant specific data services..
- Integrated Communications Network – allowance for a high speed communications network for delivery of centralised services such as FTA TV, Foxtel and Satellite Services and for the management and control of systems such as BMS, CCTV, Intercom, Access control, energy monitoring, PA, Car park management, etc.

10.2.2. Crown Hotel

Communications infrastructure to the Crown Hotel will be provided with two alternate access pathways to existing infrastructure in Hickson road. The first path is via a crossing of Waterman's Quay and Stage 1B basement to connection into Hickson road from Stage 1A basement (and to installed telecommunication systems in Barangaroo South Precinct Nodes rooms). The second pathway is via conduits direct from the Crown Hotel through Hickson Park to Hickson Road.

Adequate provisions shall be provided within these conduit paths for future expansion of the network and for multiple telecommunications service providers.

10.3. Principals for Operations Management

10.3.1. Barangaroo South

All offsite infrastructures (i.e. feeding the 'Carrier Neutral' access pits) will be owned and operated by each respective telecommunications service provider. All onsite infrastructure will be operated by the private network service provider and operate as an open access network. All civil infrastructures will be constructed so as to comply with NBN's design guidelines.

11. Gas Services

11.1. Existing Natural gas Services

11.1.1. Barangaroo South

A natural gas supply to Barangaroo South has been provided by extending the existing 1050 kPa main across Hickson Road to a boundary regulator in the footpath area. A 7kPa looped main from the regulator in Hickson Road to Margaret Street West and Watermans Quay to provide connection for each customer/building.

11.1.2. Crown Hotel

Crown's identified loads (77,000Mj/hr) have been assessed by Jemena as in excess of those that can be serviced by the low pressure supply to Barangaroo South. Jemena have indicated that a dedicated high pressure steel main will be required to run down Waterman's Quay to service the gas demand of the Hotel. A design of this 100mm steel has been produced and co-ordinated with other services along Waterman's Quay and Barangaroo Avenue.

A commercial agreement has been reached with Jemena for the provision of this supply.



11.2. Principals for Operations Management

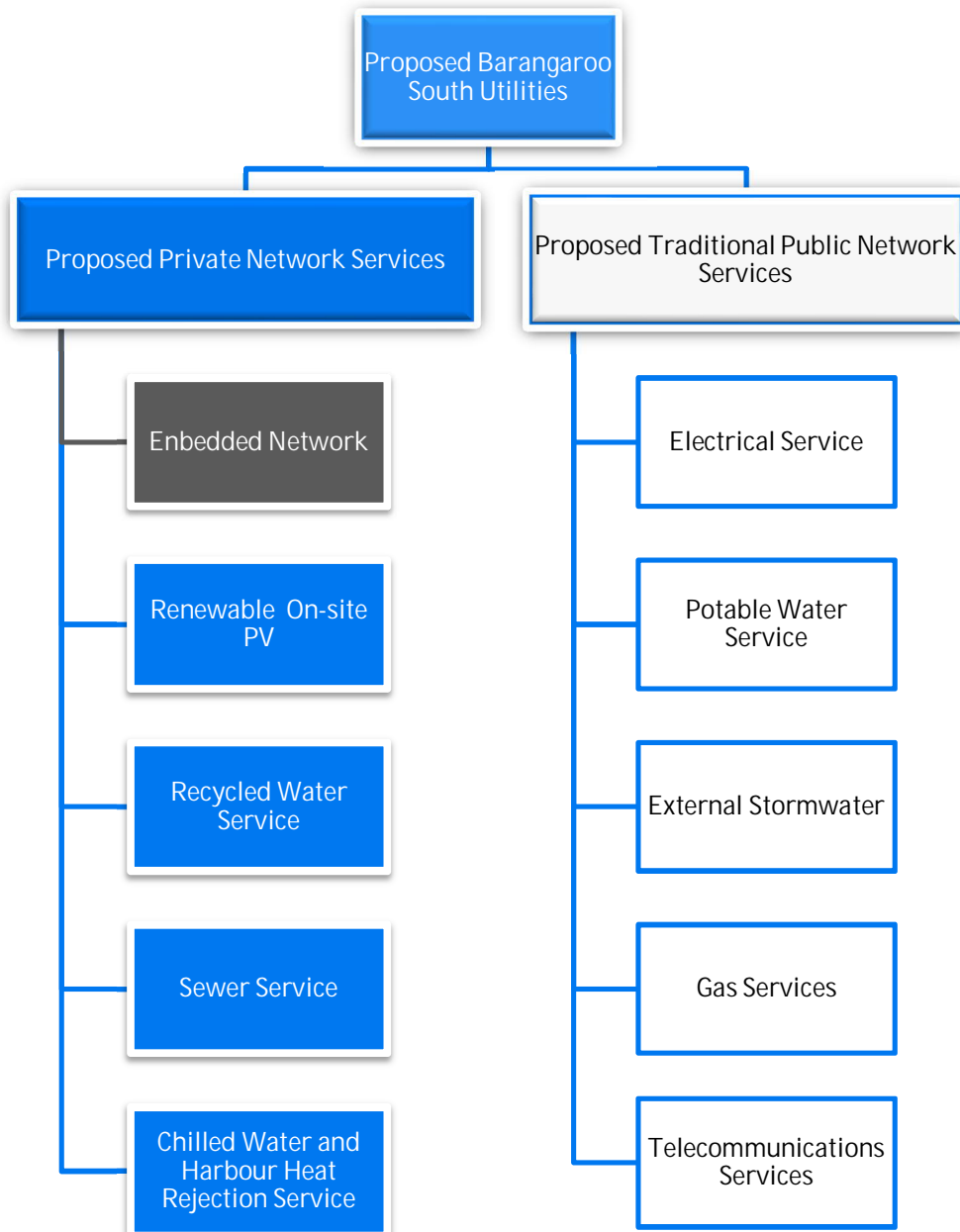
11.2.1. Barangaroo South

The gas pipelines outside the site and metering equipment will be owned and maintained by Jemena while the gas pipelines within the site will be owned, operated and maintained by the building served.

12. SERVICES OPERATIONAL MANAGEMENT

The future operation of utilities at Barangaroo will be through a combination of a traditional public utility service and a private network service. The Barangaroo Management Plan, Building Management Statements, Leases, Easements and Licences will be the core governance arrangements adopted by key stakeholders for the ongoing management and operation of Barangaroo South.

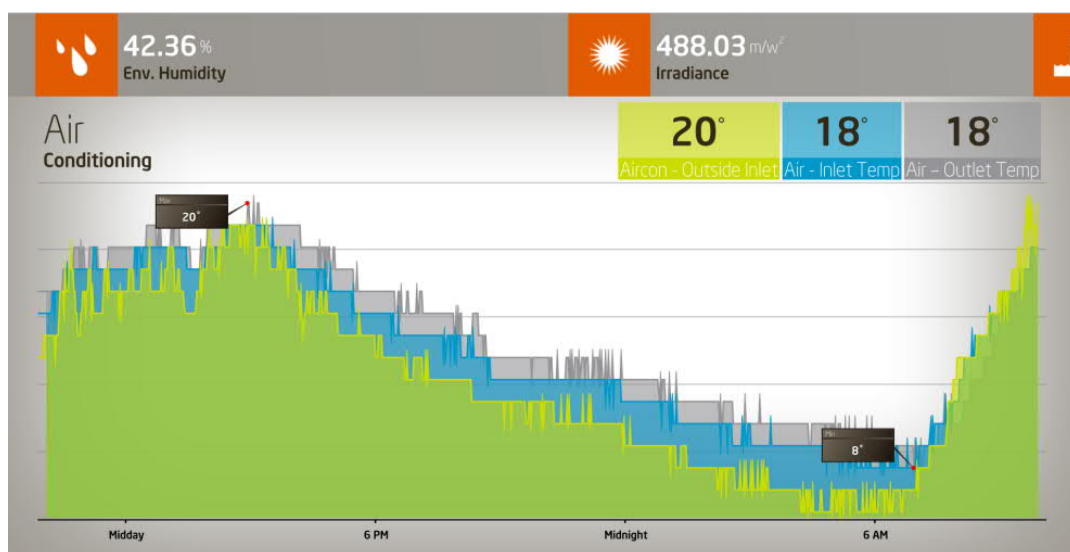
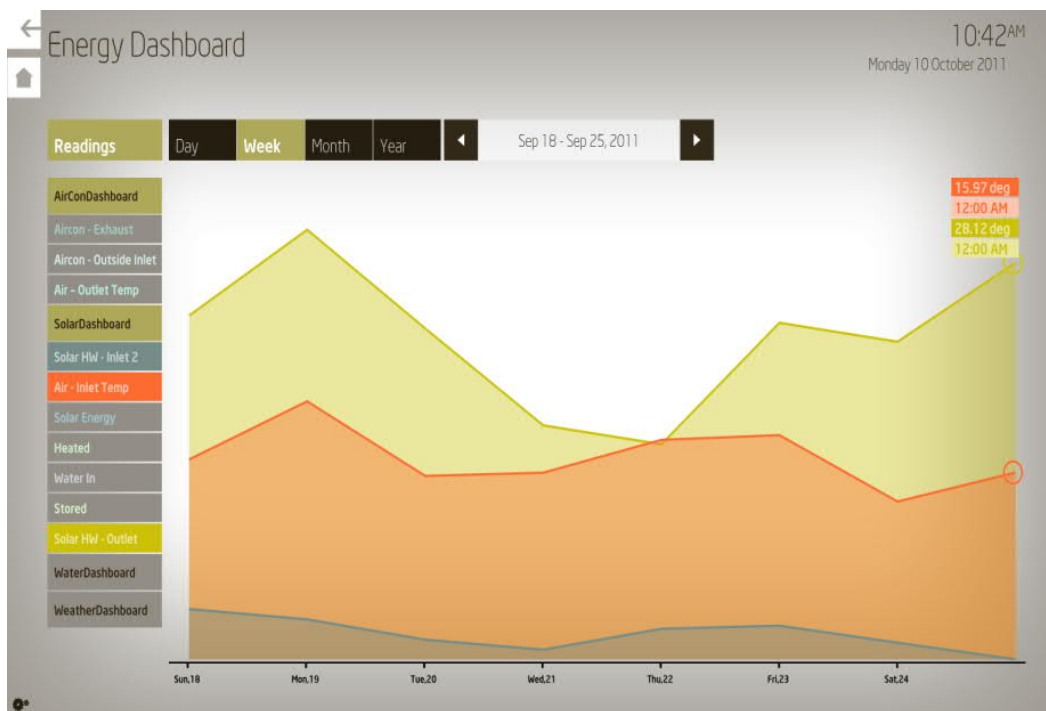
Below is a high-level diagram showing the utilities likely to be private versus traditional public at Barangaroo South:



The principles for ownership and management are subject of on-going discussion and agreement with relevant parties.

13. RESOURCE CONSUMPTION REPORTING

- Barangaroo aims to provide a range of energy monitoring solutions implemented for a range of environments such as commercial, retail and residential.
- These solutions will provide real time reporting and trend analysis of energy, water and other renewable energy sources.
- Information from energy monitoring systems are capable of being displayed on various forms of digital signage, lift cars, in home displays and web browsers using mobile devices.
- Examples of how information obtained via proposed monitoring could be displayed are shown below



14. Appendices.

14.1. [Appendix A](#) Stormwater Management and Civil Infrastructure Report Barangaroo South Stage 1B

14.2. [Appendix B](#) Barangaroo Sewer, Water and Recycled Water Masterplan Report