OAKDALE SOUTH ESTATE - LOT 2A/2B

Sustainability Management Plan

Prepared for:

Goodman Properties
Level 17, 60 Castlereagh Street
SYDNEY NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Goodman Properties (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30093-R01-v1.0	7 October 2020	Dr Neihad Al-Khalidy	Horatio Cai	Dr Neihad Al-Khalidy
610.30093-R01-v1.0	14 September 2020	Dr Neihad Al-Khalidy	Horatio Cai	Dr Neihad Al-Khalidy

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Goodman Property Services to prepare a Sustainability Management Plan (SMP) for the proposed warehouse and distribution facilities of Precinct 2, Lot 2A and 2B of Oakdale South industrial Estate (the Project).

The Project is classified as a State Significant Development on the basis that it falls within the requirements of Clause 13 of Schedule 1 of State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).

This report will form part of the Development Application to the Penrith City Council and this study has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant.

1.1 Objectives of the Study

The principal objective of this Sustainability Management Plan is to identify all potential energy savings that may be realised during the operational phase of the Project, including a description of likely energy consumption levels and options for alternative energy sources such as solar power in accordance with Council requirements.

The specific objectives of this plan are as follows:

- To encourage energy use minimisation through the implementation of energy efficiency measures;
- To promote improved environmental outcomes through energy management;
- To ensure the appropriate management of high energy consumption aspects of the Project;
- To identify energy savings procedures for overall cost reduction, greenhouse gas emission reduction and effective energy management;
- To assist in ensuring that any environmental impacts during the operational life of the development comply with Council's development consent conditions and other relevant regulatory authorities; and
- To ensure the long-term sustainability of resource use through more efficient and cost-effective energy use practices for the life of the development

2 SUSTAINABILITY MANAGEMENT GUIDELINES AND LEGISLATION

2.1 Building Code of Australia

The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government with the aim of achieving nationally consistent, minimum necessary standards of relevant health and safety, amenity and sustainability objectives efficiently. The BCA contains mandatory technical provisions for the design and construction of BCA class buildings.

Volume 1, Section J of the BCA outlines energy efficiency provisions required for BCA class buildings (including Class 7b Warehouses and Class 5 Offices). There are 8 Deemed-to-Satisfy subsections, J1 to J8, that focus on separate aspects of energy efficiency as follows:

- J1 - Building Fabric (i.e. the ability of the roof, walls and floor to resist heat transfer)
- J2 - External Glazing (i.e. the resistance to heat flow and solar radiation of the glazing)
- J3 - Building Sealing (i.e. how well parts of a building are sealed to ensure comfortable indoor environments are efficiently maintained)
- J4 - Air Movement (i.e. the provision of air movement for free cooling, in terms of opening and breeze paths)
- J5 - Air Conditioning and Ventilation Systems (i.e. the efficiency and energy saving features of heating, ventilation and air-conditioning systems)
- J6 - Artificial Lighting and Power (i.e. power allowances for lighting and electric power saving features)
- J7 - Hot Water Supply (i.e. the efficiency and energy saving features of hot water supply)
- J8 - Access for Maintenance (i.e. access to certain energy efficiency equipment for maintenance purposes)

2.2 SSD SEARs

The SEARs of the Oakdale Site include the following requirement:

- **Ecologically Sustainable Development and Energy Efficiency –** including:
  - an assessment of how the modification will incorporate ecologically sustainable development principles in all phases of the development;
  - consideration of the use of green walls, green roof and/or cool roof into the design;
  - climate change projections developed for the Sydney Metropolitan area and how they are used to inform the building design and asset life of the project; and
  - an assessment of the energy uses on-site, and demonstration of the measures proposed to ensure the modification is energy efficient.

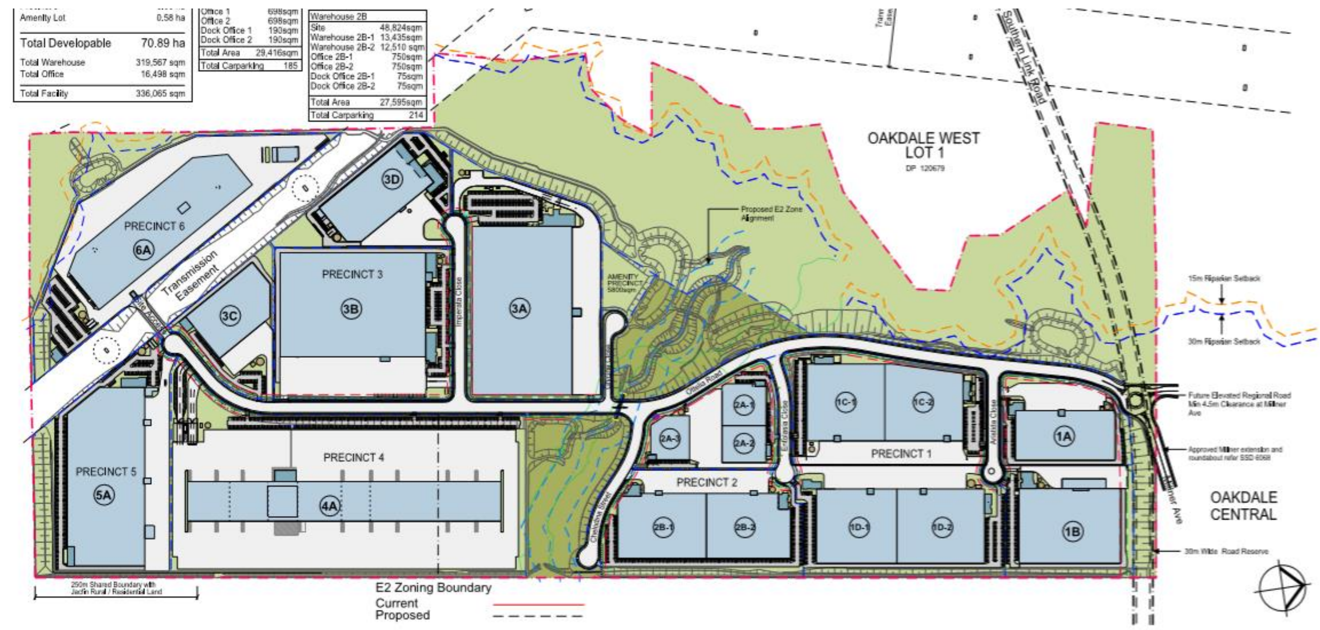
3 DESCRIPTION OF THE PROJECT

The Development Site, which is known as Oakdale South Estate, Horsley Park, is located within the Penrith Local Government Area (LGA) in the Western Sydney Employment Area (WSEA). It is situated within an approved Concept Plan area, which forms part of the broader Oakdale Industrial Precinct.

The project is a staged development which includes bulk earthworks, civil works and the construction of infrastructure and stormwater management. The overall Oakdale South Masterplan is shown in **Figure 1**.

The current study covers the sustainability management plan and greenhouse gas reduction for the proposed warehouse and distribution facilities of Precinct 2, Lot 2A and 2B (the Project).

Figure 1 Oakdale South Estate Master Plan



3.1 Overview of Proposed Development

The Precinct 2 development area comprises 75,566 m^2. Overall building areas are outlined in **Table 1**.

Table 1 Building Areas

Site Area	Lot 2A-1, 2A-2 and 2A-3	Lot 2B-1 and 2B-2
Warehouse	12,005 m^2	25,945 m^2
Office	900 m^2	1,500 m^2
Dock Office	-	150 m^2
Awning	1,860 m^2	2,881 m^2
Hardstand Area	6,300 m^2	7,345 m^2
Light Duty Area	2,660 m^2	6,346 m^2
Car Parking	69	211

Further details of the Lot 2 development are shown in **Figures 2 and 3**.

Figure 2 Oakdale South Estate: Warehouses 2A-1, 2A-2 and 2A3 and Associated Office & Amenities

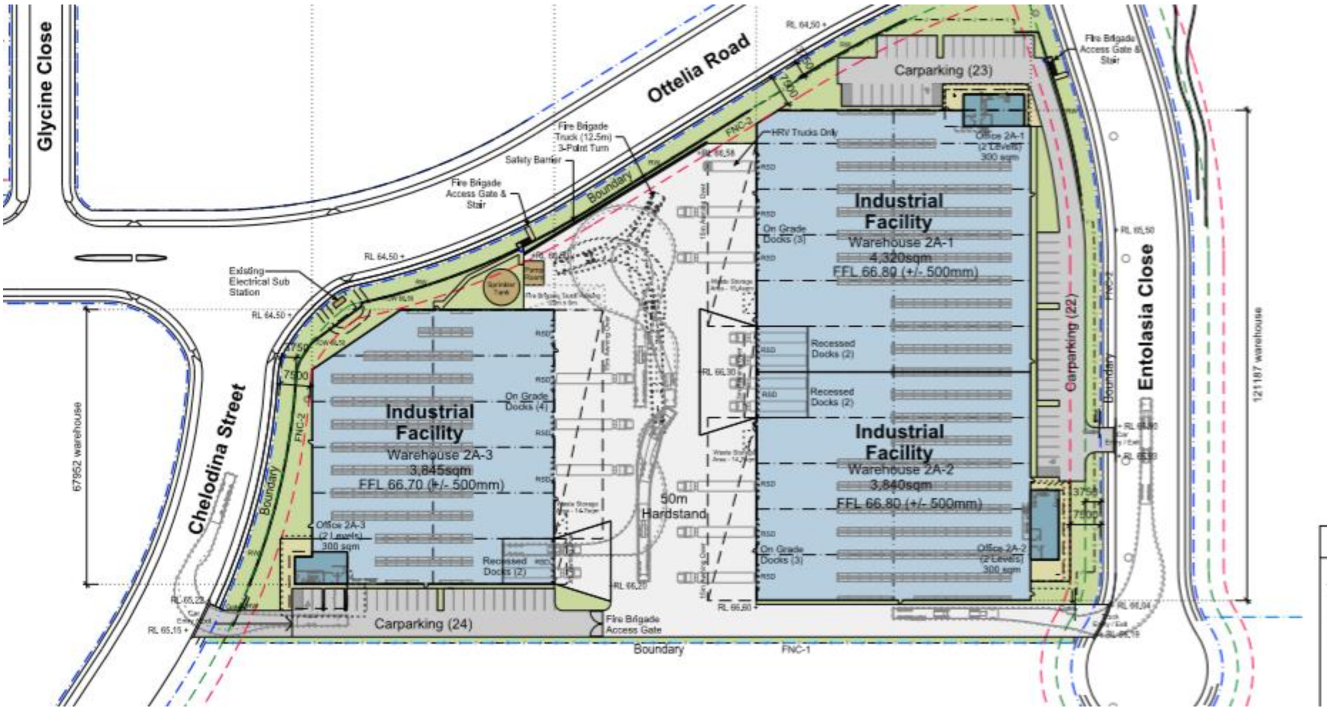
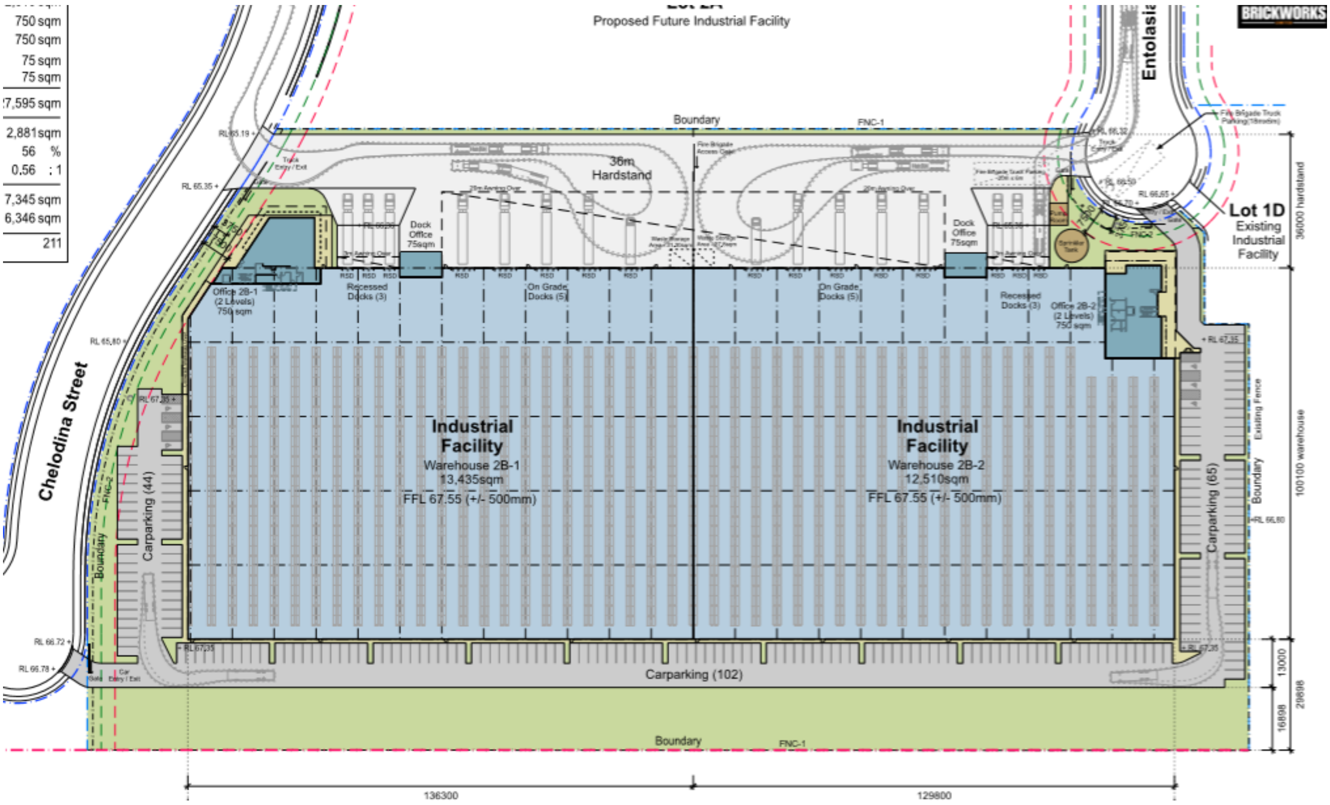


Figure 3 Oakdale South Estate: Warehouses 2B-1/2B-2 and Associated Office & Amenities



4 OPERATIONAL ENERGY MANAGEMENT

Ineffective energy management for industrial and commercial premises can lead to unnecessary growth in greenhouse gas emissions and consumption of natural resources. Effective energy management reduces costs using energy efficiency measures and improves environmental outcomes locally, regionally and globally.

Effective energy management is achieved through the implementation of a Sustainability Management Plan (SMP) for the operational life of the Project.

4.1 Identified Major Energy Use Components

The major energy use components of the Project Site have been identified below based on information available within the Project Design Brief.

- Lighting (include natural and artificial lighting and shading);
- Air Conditioning; AND
- Power.

4.2 Energy Sources

The main source of energy for the proposed site is electricity.

5 SUSTAINABILITY MEASURES COMMITMENTS

5.1 Documentation

The documentations used in this report is listed in **Table 2**.

Table 2 Project Documentation Sources

Document Type	Document Number	Issue Date
Architectural Drawing	19146_2A_Drawing_Set 19146_2B_Drawing_Set	25/09/2020 25/09/2020
Goodman - Industrial - Design Brief - Base Building Rev 06	Project no 190119	04/06/2019

Energy Efficiency measures have been recommended and approved for project implementation and have informed the sustainability assessment of this project – they are listed in **Table 3**.

Table 3 ESD Assessment Summary

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Design & Management	• Documentation of design intent and expected outcomes. • Appropriate commissioning.	• Communicate sustainability initiatives and operation to building users. • Commissioning and building tuning required by contractors and reviewed for 12 months after completion.	• Provision of Building Users Guide. • Investigate costs and viability of commissioning and building tuning requirements and appointing an independent commissioning agent. • Independent consultant to perform quarterly tuning of fire, mechanical, electrical, hydraulic services.	✓ ✓ ✓	• SLR recommends the preparation of Building User Guide that enables building users to optimise the building's environmental performance. • A sub-contractor will be engaged to maintain the facility in accordance with the operations and maintenance manuals during the 12-month defects liability period.
Façade Performance	• Optimised façade performance.	• Achieve minimum performance requirements under NCC Section J1 and J2. • Reduce heat gain through the warehouse façade.	• Meet or exceed NCC Section J1 and J2 façade performance for conditioned spaces. • Light coloured roofing with high reflectivity and appropriate insulation to reduce solar heat gain into the warehouse. • Daylight: evenly spaced translucent roof sheeting to warehouses areas. • Performance glazing in office spaces appropriate to the window size and orientation.	✓ ✓ ✓ ✓	• NCC Section J report needs to be prepared by a qualified ESD consultant. • This warehouse will comply with all the requirements specified within the report during construction stage. • Colourbond roof sheeting which has a higher solar reflectivity is proposed. • As per project NCC Section J report.

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Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Social Sustainability	• Consider design with due regard to occupant satisfaction in accessibility, usability, Indoor air quality and public space utility.	• High level of occupant satisfaction. • Provide external as well as internal comfort.	• Flexibility of space for potential future configurations. • Use of Low VOC paints, carpets and sealants. • Consider Landscaping and dense planting. • Consider occupant user control eg A/C systems, glare reducing strategies, lighting etc.	✓ ✓ ✓ ✓	• The design will incorporate open plan workspaces, offices, client rooms, meeting rooms, lunch room and outdoor seating area • Low VOC paints, carpet and sealant will be used • Refer proposed landscaping, Architectural Drawings • Selection of endemic and low maintenance landscaping species • Both AC and lighting control is provided to offices and warehouses.
Minimising Transport Impact	• Consider location with links to public transport and employee services. • Consider location to reduce operational transport. • Consider the impact of industrial trucks on local traffic.	• Reward drivers of fuel-efficient vehicles by providing spaces for small cars and or motorbikes. • Provide alternatives to single-occupancy vehicles. • Reduce operational fuel consumption through close proximity to major arterial roads. • Reduce the impact of operational traffic on local communities.	• Consider providing 10% of total parking spaces for small cars and 5% for motorbikes situated near the office entrance. • The site is located within close proximity (<5km) to both the M7 and M4 motorways. • The roads linking the site to the motorways are predominantly used for industrial traffic, as such the traffic is unlikely to impact on local areas.	✓ ✓	• SLR recommends providing spaces for small cars and or motorbikes. • Bicycle racks and end of trip facilities provided. Refer Architectural Drawings. • Car park numbers and provision for disabled parking are provided be in accordance with Consent Authority requirements.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Optimising IEQ	• Optimise natural light to work environment. • Optimise fresh air ventilation. • Consider Thermal Comfort of occupants. • Consideration of noise transference in space planning. • Minimise use of materials that emit volatile organic compounds. • Create a pleasant working environment.	• Daylight: Daylight Factor (DF) of at least 2% at finished floor level under a uniform sky for at least 60% of the GLA. • Thermal comfort: 95% of office areas have PMV levels between -1 and +1 for 98% of the year; Warehouse spaces include passive thermal comfort strategies. • Finishes: 95% of all paints, adhesives & sealants and all carpet and flooring to be low-VOC finishes; use low-formaldehyde wood products. • Electric lighting levels: 95% of GLA has a lighting system that is flicker free and has a maintained illuminance of no more than 25% above those recommended in AS1680.2.4, 2.1 and 0.1. • Reduce visual glare.	• Daylight: rationalised glazing to offices; high performance glass. • Daylight: evenly spaced translucent roof sheeting to warehouses areas. • Thermal comfort: Office envelope and HVAC system designed to meet thermal comfort requirements; • Provide sufficient roof and wall insulation to the air-conditioned spaces; • Finishes: Specify and track correct finishes and wood products. • Provide pleasant indoor and outdoor breakout spaces with sufficient daylight and plants. • Lighting: Good light fixtures and well-designed layout. • Ventilation: Consider increased fan and duct sizing. • Provide sufficient shading and blinds with rationalised glazing for visual and thermal comfort.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	• High performance glazing to all air-conditioned areas to satisfy Section J requirements • Shown on the Architectural Drawings • Refer Section 5.5 of this report for proposed set up temperatures • Insulation as per the NCC requirements • LED lighting and lighting controls to warehouse and offices. • Adequate ventilation will be supplied in accordance with AS1668. • Shown on the Architectural Drawings

Minimising Energy Use	• Consider passive design to minimise energy use such as orientation, ventilation, shading and floor plate design. • Appropriate sizing of plant and equipment in heating and cooling, lighting, control systems, • Building management systems and renewable energy sources. • Reduce reliance on connection to grid electricity and gas.	• Target a 20% reduction in Greenhouse gas emissions. • Energy sub-metering for all major uses greater than 100kVa; linked to monitoring system. • High efficiency warehouse lighting and controls. • Reduce energy for water heating. • Integrated building management. • Consider renewable energy generation for a portion of energy consumption and/or consider future-proofing the building for future installation. • Reduce urban heat island effect and heat load through the roof by providing a highly reflective roof. • Reduce office equipment load from 20W/m² to 15W/m². • Optimise insulation for energy and thermal comfort.	• Roof Insulation, External Wall Insulations, Reduced Glazing area and associated heat loss in winter. • Consider office air conditioning temperature set-points for an increased comfort band. • Provide energy efficient T5 lighting, with zoning and automatic controls where reasonable. • Consider LED lighting strategies and advanced controls. • Consider a solar hot water system or a heat pump. • Sub-metering: install appropriate metering; develop metering and tracking strategy to allow for self-assessment, problem solving and ongoing improvements during operations • Use roofing material that has a high Solar Reflective Index • Investigate current insulation design and determine proposed options.	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	• Shown on the Architectural Drawing • Design brief sets the temperature - Refer Section 5.5 of this report. • LED lighting to warehouse and offices. • Lighting controls to warehouse and offices. Solar hot water or heat pump system • Sub meters for major energy/water uses . • Colourbond roof sheeting which has a higher solar reflectivity is proposed. • As per project NCC Section J report.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Choosing Materials	• With consideration to energy inputs in manufacture. • Toxicity. • Consequential impacts – rain forest timbers. • Regional or local manufacturer employment support.	• Reduce steel and cement in internal slab (10% reduction in embodied energy). • Reduce embodied energy in concrete and plasterboard elements. • Consider 95% of timber to be AFS or FSC certified. • Reduce emissions associated with insulation and refrigerant. • Reduce environmental impact of materials for tiling, awning.	• Jointless fibre reinforced slab. • Use pre-cast concrete panels with recycled content.	✓ ✓	To minimise the environmental impacts of materials used by encouraging the use of materials with a favourable lifecycle assessment based on the following factors: • Fate of material • Recycling / re-use • Embodied energy • Biodiversity • Human health • Environmental toxicity • Environmental responsibility.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Minimising Waste	• By clever design. • Contracted to builder as a requirement on site for construction waste. • During the life of the building. • And in dealing with building end of life options.	• Reduce construction waste going to landfill by 90%. • Reduce operational waste going to landfill. • Consider a design that can be disassembled at the end of the building's life.	• Contractor is to develop and implement a Waste Management Plan and track all waste going offsite to show that 90% of all construction waste is re-used or recycled. • Waste storage and recycling facilities to be provided for different operational recycling streams such as paper, glass, plastics, metals, food waste etc. Consider operational waste plans and training for staff to provide incentive to reduce waste.	✓ ✓	• SLR recommends more than 70% of the predicted construction waste arising from development can be re-used (on-site or at another development) or recycled off-site. Refer project Waste Management Plan. • The following waste avoidance measures are recommended in the Waste Management Plan for the Project: - Provision of take back services to clients to reduce waste further along the supply chain.
Water Conservation and Reuse	• Monitoring of meters to track use. • Timely maintenance of fixtures and fittings. • Water sensitive landscape design. • Source potable water alternatives such as rain water harvesting, grey and black water treatment.	• Reduce potable water in internal fixtures. • Reduce potable water for irrigation. • Water efficient operation of appliances. • Utilise rainwater and/or recycled water.	• Water efficient sanitary taps and toilets. • Water efficient and drought tolerant landscaping. • Water and energy efficient dishwasher. • Rainwater collection for toilets, irrigation and truck wash down.	✓ ✓ ✓ ✓	• Low flow fixtures and fitting including taps and shower heads • Selection of endemic and low maintenance landscaping species • SLR recommends water efficient dishwashers • 123 kL Rainwater tanks have been proposed for rainwater harvesting and re-use for landscape irrigation and flushing of toilets.

Category	Objective	Proposed Target	Proposed Strategy	Commitment	Comment
Land Use and Ecology Impact	• Consider local biodiversity impacts of flora and fauna. • Look to specialist advice on land in development.	• Encourage biodiversity. • Reduce light pollution from the site. • Consider reducing impact of stormwater flows off the site into the natural watercourses including Ropes Creek adjacent to the site.	• Install indigenous plating appropriate to the area and the adjacent biodiversity lots. • Design external lighting to avoid emitting light into the night sky or beyond the site boundary. • Consider integrated stormwater management to minimise the impact on receiving waters of flow volumes and pollution content, eg bioswales, bio retention, OSD tanks and treatment. • Consider permeable concrete/paving for staff parking areas and footpaths, etc.	✓ ✓ ✓ ✓	Selection of endemic and low maintenance landscaping species LED lights have been proposed for all external lights to avoid emitting light The warehouse sustainability objectives include: • Reduce the impact of stormwater runoff and improve quality of stormwater runoff • Achieve best practice stormwater quality outcomes • Incorporate water sensitive urban design principles.

5.2 Baseline and Proposed Energy Consumption

An NCC Sections J Deem-to-Satisfy compliant building is used as the baseline building for energy consumption savings. NCC Section J provides the minimum requirement for energy efficiency and it is predicted that the proposed development will have more than 50.8% energy reduction - refer **Section 5.8** for the energy simulation results. The reduction has been enabled via:

- All luminaire shall be low energy LED type;
- Warehouse lighting is generally to be zonally controlled via motion sensor;
- Office lighting shall be controlled via dual technology infrared/ultrasonic sensor;
- Daylight harvesting function to office with external windows;
- Efficient air conditioning system; and
- Translucent sheets to warehouse 2A 1 to 3 and 2B 1 to 2 to receive daylight.

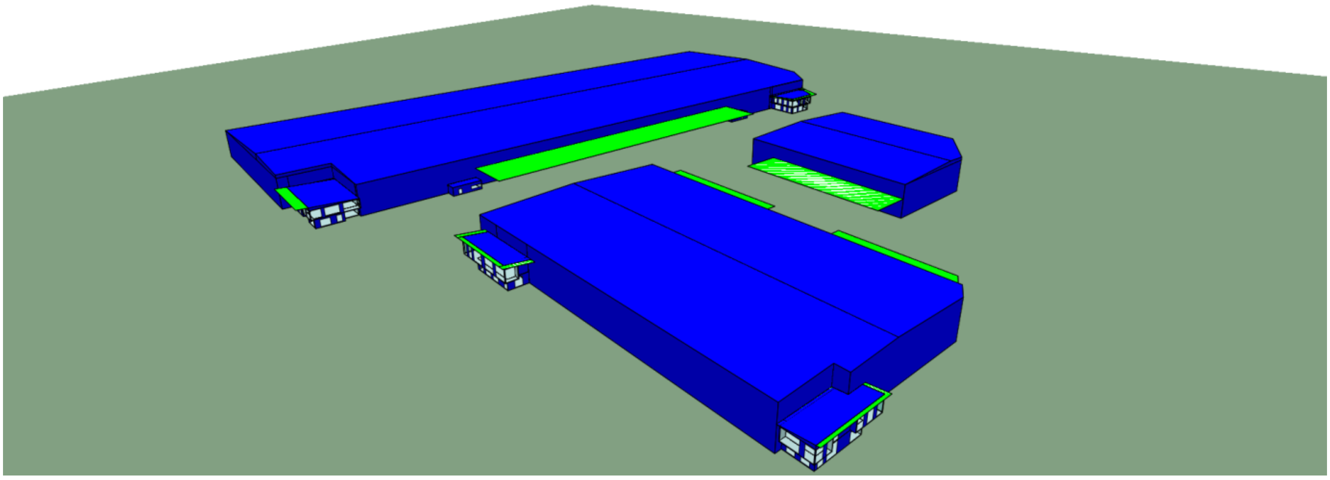
All building information and associated parameters are listed in the following sections of this report.

5.3 Energy Calculation of the Proposed and Reference Buildings

The Energy Simulation Program used in this study is the IES computer program Virtual Environment 2019 (VE). The program is based on the ASHRAE response factor and the modifications included utilising Australian weather data and including building materials more appropriate to those used in Australia and enabling the input of metric data.

- SLR supports a perpetual license of the Energy Simulation Software package IES <VE>;
- IES <VE> has passed the BESTEST (ASHRAE Standard 140) external validation process;
- The weather data from ACADS-BSG NSW Richmond Test Reference Year (TRY) is used for the modelling;
- IES<VE> assesses U-Value, SHGC, and shade coefficient when evaluating the effect of glazing;
- Detailed warehouse operating schedules are not available at this stage. Therefore, NCC standard building operating profiles such as occupancy, lighting, air conditioning and equipment were adopted for warehouse and office area; and
- At least 300 kW of PV system has been proposed for warehouse 2A and 690 kW for warehouse 2B.

Figure 4 Proposed Warehouses in IES Model



5.4 Artificial Lighting

In Section J6 of the NCC, the requirement for the total lighting power load within the proposed spaces of a building is to be no greater than a maximum illumination power load, measured in Watts (W). The maximum allowable building illumination power load is based on the total illumination power load calculated for each space.

For artificial lighting, the aggregate design illumination power load must not exceed the sum of the allowances. This may be obtained by multiplying the area of each space by the maximum illumination power density (as found in Table J6.2a of the NCC 2019 Volume One). The maximum illumination density for a storage warehouse is 4 W/m² as per Table J6.2a of the NCC 2019 Volume One.

The proposed warehouses will adopt the following energy efficiency measures to reduce the lighting energy consumptions:

Office lighting

- LED fitting for offices.
- Occupancy sensors to low occupancy areas e.g. office, toilets and lunch room.

Warehouse lighting

- LED fitting for warehouse.
- Occupancy sensors to low occupancy areas.

Outside lighting

- LED external lighting for all outside areas.
- External lighting will be controlled via daylight sensor (photocell).

Electrical lighting is the major energy reduction component for warehouse with a large footprint.

The lighting calculation for NCC reference building is based on the maximum illumination power density specified within NCC Table J6.2A as below:

- Warehouse = 4 W/m^2
- Offices = 4.5 W/m^2

The electrical lighting layout of the proposed building is not provided at the time of preparing this report. It is assumed the maximum design lighting power density will be achieved as below:

- Warehouse 3.5 W/m^2
- Offices 4 W/m^2

Therefore, the proposed building is likely to achieve a 12% lighting energy reduction when compared with reference building. Detailed calculation is shown in **Appendix A.**

5.5 Mechanical Air-Conditioning

The mechanical service design is not available at this stage. Performance reverse cycle package units to offices with individual controls. As per the mechanical specification of the Tenant Base Building Specification, air conditioning to be designed to the BCA/NCC section J and other statutory authorities and applicable Australian standards.

As per the mechanical specification of the Goodman's Tenant Base Building Specification, air conditioning to be designed to the BCA/NCC section J and other statutory authorities and applicable Australian standards.

Air-conditioning temperature control and set point – refer Table 4

Table 4 AC Unit Temperature Control Range

Space Type	Temperature Control Range (°C)
Offices	22.5±1.5°CBD

Air-conditioning energy efficiency requirements

2019 NCC Section J5.11 has specified the minimum energy efficiency ratios requirements for package air conditioning equipment.

Table 5 BCA Unitary Plant Requirement

Office Equipment	Minimum Energy Efficiency Ratio	
	NCC Requirement	Proposed System [1]
Cooling	2.9	4
Heating	2.9	4

Note 1: Detailed Mechanical design is not available at this stage. It is assumed that the proposed package system will achieve the performance requirements above.

When the air flow rate of a mechanical ventilation system is more than 1000L/s, the system must have a variable speed fan when its supply air quantity is capable of being varied.

Details or NCC Section J5 certification demonstrating compliance will need to be submitted with the application for a Construction Certificate

5.6 Building Fabric Requirements

Parts J1 to J3 of the BCA Section J contain the requirements of the Deemed-to-Satisfy compliance of the building fabric. The purpose of this subsection is to ensure that the building fabric will provide sufficient thermal insulation to minimise heating and cooling loads placed on the building and the commensurate energy consumption HVAC systems servicing internal building spaces.

All fabrics of the proposed building shall comply with NCC Section J. A Project Section J report will need to be submitted with the application for a Construction Certificate.

5.7 Domestic Hot Water (DHW)

The BCA specifies the thermal efficiency for hot water systems to be at least 80%. The solar hot water reticulation system shall be provided to all faucets' fittings, equipment and apparatus within the development. Hot water will be generated from the roof mounted solar water packaged plant.

With the installation of water efficient fixture, the hot water consumption will be decreased and thus the domestic hot water usage will also decrease. If the domestic hot water usage is less than the energy required to heat to the water also decreases. Moreover, the supplement natural gas consumption will be reduced by using the proposed solar hot water system.

The energy simulation in this analysis is assumed both reference and proposed building are using same gas fired boiler for DHW. The actual energy consumption will be reduced once solar hot water or electrical heat pump is adopted for the proposed building.

5.8 Simulation Results

The predicted Total Annual Energy Consumption of the NCC Reference Building and the Proposed Building is summarised in **Table 6**. For both buildings, temperatures lie within the range 16°CDB to 27°CDB for 100% of the plant operation time.

Table 6 Comparison of Annual Energy Consumption Between the Reference and Proposed Building

Electricity Usage	Reference Building (MWh)	Proposed Building (MWh)
Heating	12.68	9.19
Cooling	31.44	21.79
Auxiliary	9.69	9.01
Lighting	801,021	702.073
Equipment	assumed identical	assumed identical
DHW	assumed identical	assumed identical
PV System	-	-957
Total		

Note 1 these items are specific to a tenant's Fitout -hence assumed to be the same for the Reference and Proposed Buildings

By implementing all energy efficiency measures described in **Section 6**, the project is predicted to achieve a 50.8% GHG emission reduction when compared with NCC Reference Building.

6 POTABLE WATER CONSUMPTION

It is proposed that the Project will have a number of sustainable water-saving measures, including:

- Rainwater reuse and reticulation system – Rainwater will be harvested from the roof and reuse for irrigation and toilet flushing. The reticulation will be a separate system to the domestic cold water with domestic water top up in the event of insufficient rainfall;
- Use of water saving plumbing devices; and
- Water sensitive landscape design.

Further to above sustainable water measures, the following items will be considered during the detailed design stage:

- Water efficient sanitary taps and toilets – install higher WELS Rating sanitary fixtures such as 4 stars for water taps, urinals and toilet.
- Water and energy efficient dishwashers with minimum 4-star WELS water rating.

By installing 4 star rated toilets, urinals and taps and the proposed rainwater harvesting facility the proposed development will reduce its potable water demand by approximately 28%.

The quantities of each water fittings are assumed from the drawing and listed in **Appendix B**.

7 CLIMATE CHANGE

7.1 Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (2013)

IPCC 2013 unequivocally concluded that:

- Greenhouse gas (GHG) emissions have markedly increased in recent times as a result of human activities. This increase has influenced a warming of the atmosphere and the ocean (especially since the 1950s), changes in the global water cycle, reductions in overall snow and ice, a global rise in mean sea level, and changes in some climate extremes.
  - Each of the three most recent decades has been successively warmer at the Earth's surface than any preceding decade since 1850. In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years (**medium confidence**).
  - Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (**high confidence**)
  - The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (**high confidence**).
- Continued warming and changes in all components of the global climate system are projected.

7.2 Climate Change Impacts in Australia – Updated CSIRO-BOM Assessment

Australia has already experienced increasing temperatures, shifting rainfall patterns, surrounding ocean acidification and a rise in sea level associated with the impacts of a warming global climate.

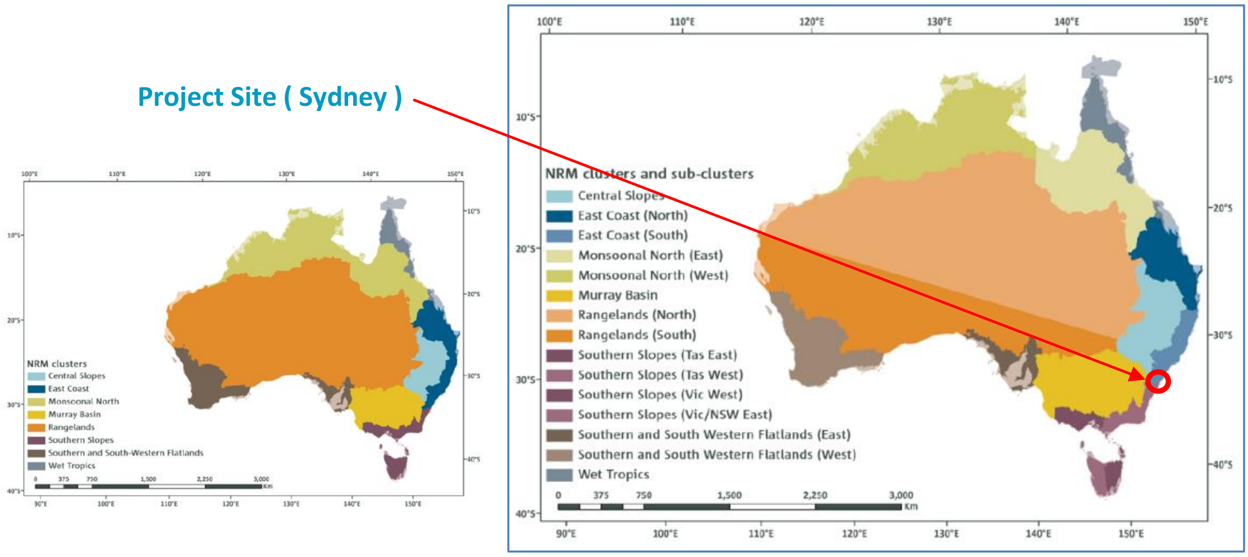
In recognition of the impact of climate change on the management of Australia's natural resources, the Australian Government developed the **Regional Natural Resource Management (NRM) Planning for Climate Change Fund**, to provide projections of the likely impact of climate change on Australia's natural resources. The Fund (which operates within the Commonwealth Department of Environment) has also been reviewing adaptation opportunities for protecting and managing our land, soil, water, plants and animals.

Australia has **54 NRM regions**, defined by catchments and bioregions. Many aspects of the activities of both human activity and ecosystems within these regions are vulnerable to impacts of climate change.

- For the purposes of climate change impacts, NRM regions have been grouped into so-called **"clusters"**, which essentially correspond to the broad-scale climate and biophysical regions of Australia – refer left-hand diagram in **Figure 5**. Each cluster is broadly consistent in terms of its own history, population, resource base, geography and climate, and therefore has a unique set of priorities for responding to climate change
- Recent studies suggested that further sub-division was needed in some cases to better capture the important patterns of projected change for specific climatic variables. In light of this, five of the eight clusters were sub-divided into so-called **"sub-clusters"**, more useful for impact assessment and adaptation planning - refer right-hand diagram in **Figure 5.**
- The location of the Project (Sydney) is shown in the sub-cluster diagram – it lies within the East Coast South sub-cluster.

Australia's CSIRO and Bureau of Meteorology (BOM) have prepared tailored climate change projections for each of Australia's eight NRM clusters (as well as their sub-clusters) to be considered in planning and adaptation option assessments.

Figure 5 Australia's Natural Resource Management (NRM) Clusters & Sub-Clusters



7.3 Most Recent CMIP5 Modelling Methodology Used for Climate Change Predictions

The future of anthropogenic greenhouse gas and aerosol emissions (and hence their resultant radiative forcing) is highly uncertain, encompassing substantial unknowns in population and economic growth, technological developments and transfer, and in particular, **political and social changes**. The recent Paris Agreement for example showed evident enthusiasm to tackle the impacts of climate change. Commitments were made in terms of both mitigation and adaptation strategies and targets. How these commitments will be delivered over coming years and decades however would appear to have considerable uncertainty.

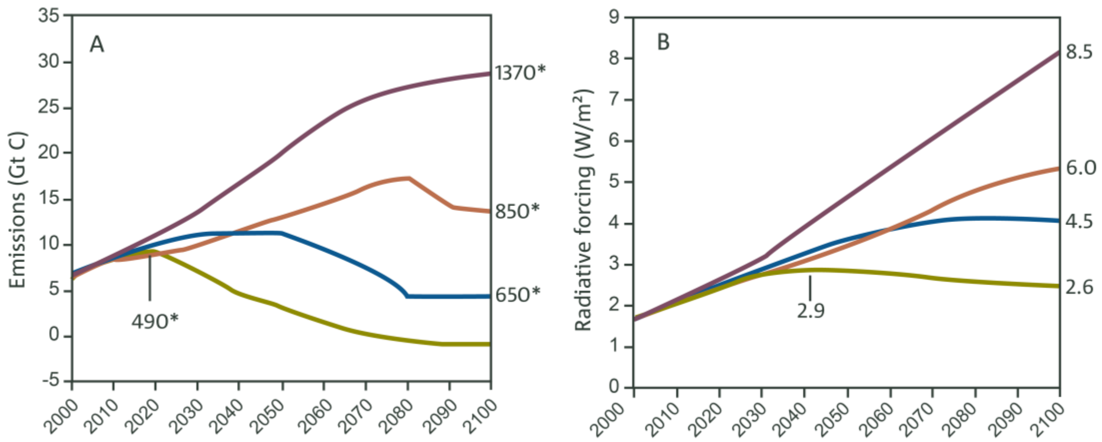
The climate modelling community has therefore developed **"Representative Concentration Pathways"** (RCPs) to explore credible future options, expressed in terms of future carbon emissions and associated radiative forcing.

- Each RCP prescribes internally self-consistent 'representative' concentrations of greenhouse gases and aerosols, as well as land use changes. RCPs were developed by a group of experts in areas spanning atmospheric modelling, chemistry and the carbon cycle and social scientists working in economics, policy and impacts [Moss et al. 2010].
- Four standard RCPs have since been commonly adopted in most global climate studies (**and used in the Australian context**). They represent the distillation of a much larger number of potential futures discussed in the literature [van Vuuren et al. 2011, Meinshausen et al. 2011].
- These RCPs were used in the **Fifth Climate Model Intercomparison Project (CMIP5)** and the latest **IPCC Assessment Report (2013)**. They span the range of plausible global warming scenarios and provide a range of options for the world's governments and other institutions for decision making.

The (projected) carbon emissions and the corresponding radiative forcing for the four standard RCPs are shown in . No particular scenario is deemed more likely than the others, although the lowest radiative forcing scenario, RCP2.6, would require major and rapid change in carbon emissions patterns on a global scale.

- **RCP8.5** represents a future with little curbing of emissions, with CO_2 concentrations continuing to rapidly rise, reaching 940 ppm by 2100 (we are currently just over 400 ppm).
- **RCP6.0** represents lower emissions, achieved by application of some mitigation strategies and technologies. CO_2 concentrations rise less rapidly than RCP8.5, but still reach 660 ppm by 2100 with total radiative forcing stabilising shortly after 2100.
- **RCP4.5** concentrations are slightly above those of RCP6.0 until after mid-century, but emissions peak earlier (around 2040). CO_2 concentrations reach 540 ppm by 2100.
- **RCP2.6** represents the most ambitious mitigation scenario, with emissions peaking very soon (around 2020), then rapidly declining. Such a pathway would have requires early and aggressive carbon emission controls from all emitters, including developing countries, combined with advanced technologies for actively removing carbon dioxide from the atmosphere. Given current national commitments, it is questionable whether RCP2.6 can still be considered a practical future scenario.

Figure 6 RCP Emission Scenarios – Carbon Emissions and Associated Radiative Forcing



7.4 East Coast (South) Cluster – Sydney Projections

CSIRO-BOM have produced a set of future climate projections derived from the East Coast Cluster dataset applying specifically to Sydney, with the following key outcomes:

- Average temperatures will continue to increase in all seasons (**very high confidence**). More hot days and warm spells are projected with **very high confidence**. Fewer frosts are projected with **high confidence**.
- Decreases in winter rainfall are projected with **medium confidence**. Changes in other seasons are possible but unclear. Increased intensity of extreme daily rainfall events is projected, with **high confidence**.
- Increased evapotranspiration is projected (**high confidence**).
- Mean sea level will continue to rise and height of extreme sea-level events will also increase (**very high confidence**).
- A harsher fire-weather climate is projected (**high confidence**).

Projections of key climatological parameters for Sydney are provided in **Table 7**. Data are shown for two of the CSIRO-BOM RCP scenarios - RCP4.5 and RCP8.5 – and two benchmark years – 2030 and 2090.

Table 7 Sydney Area Climate Projections

Variable	Season	Simulation Scenario: Year / RCP Pathway		
		2030 RCP4.5	2090 RCP4.5	2090 RCP8.5
Temperature (°C)	Annual	0.9 (0.6 to 1.1)	1.8 (1.3 to 2.5)	3.7 (2.9 to 4.6)
Number of Days over 35°C	Annual (currently 3.1)	4.3 (4.0 to 5.0)	6.0 (4.9 to 8.2)	11.0 (8.2 to 15.0)
Number of Days over 40°C	Annual (currently 0.3)	0.5 (0.5 to 0.8)	0.9 (0.8 to 1.3)	2.0 (1.3 to 2.3)
Solar Radiation (% change)	Annual	+0.5 (-0.5 to +1.9)	+1.5 (-0.3 to +3.7)	+1.3 (-1.2 to +3.4)
Rainfall (% change)	Annual	-3 (-10 to +6)	-2 (-16 to +9)	-3 (-20 to +16)
	Summer	+1 (-10 to +15)	0 (-15 to +19)	+11 (-12 to +27)
	Autumn	-3 (-22 to +15)	-1 (-22 to +18)	-2 (-28 to +20)
	Winter	-5 (-18 to +14)	-8 (-24 to +7)	-17 (-31 to +1)
	Spring	-1 (-19 to +12)	-6 (-23 to +9)	-8 (-30 to +14)
Relative Humidity (% change)	Annual	-0.5 (-1.6 to +0.8)	-1 (-3.1 to +0.3)	-1.5 (-3.8 to +1.3)
Evapotranspiration (% change)	Annual	+3.4 (2.3 to 4.4)	+7.8 (5.3 to 9.5)	+14.3 (10.1 to 18.1)
Wind Speed (% change)	Annual	-1.1 (-2.9 to +0.5)	-1.0 (-4.2 to +0.2)	-1.5 (-6.9 to +4.2)
Sea Level Rise (m)	Annual	0.13 (0.09 - 0.18)	0.13 (0.09 - 0.18)	0.14 (0.10 - 0.19)

Given the Project site location away from the coastline, and in relation to Sustainability aspects of the development, the projections shown in **Table 7** for the following climate variables are deemed of significance to this study:

- **Increasing** Temperature;
- **Increasing** Solar Radiation;
- **Decreasing** Relative Humidity;
- **Decreasing** Average Winter Rainfall & **Increasing** Peak Rainfall Intensity Events; and
- **Increasing** Number of Days for Extreme (Hot) Weather.

7.5 Impact of Climate Variables on ESD Outcomes

Changes in Solar Radiation

According to ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers), the following variables contribute to indoor thermal comfort: solar (or thermal) radiation (ie sunlight), temperature, indoor humidity, the time of day and external weather conditions.

Solar (thermal) radiation is a heat transfer mechanism. It has a significant impact on solid bodies (including people). The effectiveness with which solid bodies radiate or absorb thermal radiation depends on the type of material and its colour. A blackened surface for example is usually a super strong absorber and emitter.

The main sources of radiation in buildings are windows and walls/roofs. Glazing, wall and roof types as well as insulation all impact on internal building thermal comfort and hence HVAC system set-point temperatures.

Solar radiation is therefore controlled through various design responses, including:

- Shading of building surfaces and windows in summer;
- Selection of glazing;
- Introduction of blinds, curtains, etc, to limit solar radiation penetration through glazing; and
- Wall and Roof types and associated insulation.

Solar radiation is expected to rise under future climate conditions.

Changes in Temperature

As temperatures increase beyond a normal range, HVAC systems consume more energy than their typical design levels and can even experience underperformance. Typically, under these conditions, building occupants respond by lowering pre-set thermostat levels which will not automatically improve the effectiveness of their system. The system energy consumption will however increase significantly.

Apart from the increase in power bills, an increase in the expected number of extreme hot days has the potential to cause the following:

- clogging of air filters at a faster rate than normal and earlier accumulation of debris on fan blades;
- increases in area-wide energy usage that can cause instability to power grids.

Temperatures and the number of extreme hot days are expected to rise under future climate conditions.

Changes to Relative Humidity

Excessive humidity can have a significant impact on the effectiveness of air conditioning and heating systems in summer. Low humidity can also cause under-performance in HVAC systems in winter.

To help address high (summer) humidity and low (winter) humidity, HVAC systems are supplied with dehumidifiers that extract moisture from the airflow and humidifiers which add moisture to air respectively, before the airflow is distributed through the air-conditioned space.

7.6 Design Responses to Climate Change

MITIGATION

It is proposed that the development will incorporate a 990 kW PV solar system as follows:

- 100 kW for Warehouse 2A1
- 100 kW for Warehouse 2A2
- 100 kW for Warehouse 2A3
- 345 kW for Warehouse 2B1
- 345 kW for Warehouse 2B2

This measure provides a direct (albeit modest) reduction of overall (ie national) demand on fossil fuel generated electricity and hence greenhouse gas generation.

ADAPTATION

HVAC

The calculations in **Section 5.8** comparing the NCC Reference Building and Proposed Building were made using the same historical climatic variable inputs. If the potential changes to these key variables suggested in **Table 7**, eg increased temperatures, solar radiation, etc, are incorporated into these calculations, the resulting relative improvement in energy consumption will be comparable, ie a 50% reduction in energy consumption.

It is recommended that during the Detailed Design phase of the Project, the sizing of the project HVAC system be developed with an allowance for the projected changes to key climatic variables shown in **Table 7**. At that time, consideration as to which RCP pathway to adopt can be made.

Stormwater and Flood Management

Australian Rainfall and Runoff (ARR 2016) identifies two alternative methods to estimate the impact of climate change on rainfall depth.

- The **Simplified Method**, which incorporates the effects of climate change in design rainfall and flood estimation by modelling of the 0.5% (1 in 200) AEP or 0.2% (1 in 500) AEP events in lieu of the 1% AEP event. For a 24-hour rainfall event this would represent an increase in rainfall of 12% and 28% respectively. This provides a convenient approach suitable for small sites.
- The **Detailed Assessment Approach**, which involves a more detailed assessment of increased rainfall intensity based on predictive modelling of temperature increases sourced from CSIRO-BOM climate projection datasets and applying a 5% change in design rainfall per degree of global warming (Equation 1.6.1 of ARR 2016). In this approach it is necessary to select the RCP pathway results for the assumed increase in average temperature. A 2.5°C temperature increase would result in a 12.5% increase in peak rainfall intensity.

A consistent approach to selecting increased rainfall intensity for water retention, stormwater, flooding, etc, calculations taking into climate change would be to use the 0.5% AEP rainfall event in lieu of the normal 1% AEP rainfall event.

It is recommended that during the Detailed Design phase of the Project, Civil Design features of the Project related to the intensity of peak rainfall events take into account the projected changes to key climatic variables shown in **Table 7**, namely increased temperatures and increase in peak 24-hour rainfall event intensity.

Water Retention (Grey Water)

It is recommended that all landscaping incorporated into the Project take into account the projected decrease in average rainfall during the winter-spring months of the year (a projection that is common to the entire southeast Australia region).

Similarly, the accumulation rate of on-site water tanks which have as their source locally captured water, should take into account the potential for decreased average rainfall during relevant seasonal periods.

Fire Suppression / Firefighting Management / Bushfire Management

It is recommended that the Bushfire Management Plan developed for the Project (post-approval) consider the increased risk of bushfires projected for the Sydney area, and indeed the wider East Coast cluster region. This should cover both the construction and operational phases of the Project and cover practices such as:

- Hot works that may cause fire and use of petrol-powered tools in general
- Mulch piles and other increases to fire fuel loading from clearing and grubbing
- Management of smoking and careless disposal of cigarettes on site
- Site maintenance activities such as mowing, etc.

8 MONITORING AND REPORTING

All committed sustainability-related measures need to be commissioned and tuned once the project is completed, to ensure all services operate to their full potential and as designed.

As specified within the Tenant Base Building Specification, the building tuning will be provided by service contractors and overseen by an independent assessor, at least once a month within the Defects Liability Period (DLP) period to ensure that services are operating effectively and efficiently. Monthly reports to be provided to the tenant for DLP.

8.1 Energy Review and Audit

An energy usage review should be undertaken within the first few months of operation to ensure the Energy Management Plan is sufficient for the development’s needs. A breakdown of energy usage per month at the Project Site will help to measure the development’s baseline energy use and assess what appliances, equipment and processes are consuming energy.

An energy review is also necessary for the assessment of energy utilisation to further identify opportunities for improvement. Energy usage data obtained during the review process may be used to establish key performance indicators and annual energy targets for the Project.

Energy usage to be included in the review should include all purchased electricity and energy which is consumed by stationary equipment on site. Energy consumed by mobile equipment (e.g. forklifts) should also be examined as this will identify variations in warehouse operation efficiency. (Refer to ‘Guidelines for Energy Savings Action Plans’ (2005) (as developed by the former Department of Energy, Utilities and Sustainability) for reporting templates and further information.)

An energy audit and management review should also be undertaken on a half-yearly basis to ensure employees are following energy savings procedures correctly. Where audits show that energy savings procedures are not carried out effectively, additional employee training should be undertaken and signage and procedures re-examined.

The Energy Management Plan should be progressively improved and updated on an annual basis, or as required, to reflect changes to the Energy Management System and to promote continual improvement of energy management at the Project Site.

8.2 Energy Metering and Monitoring

To enable effective review of energy usage by the project, sub-metering should be implemented for all major energy consuming processes or items of equipment including sub-metering for all loads greater than 100 kVA.

Electrical equipment should be maintained to Australian Standards to ensure unnecessary energy wastage is minimised. Roof access system is proposed for third party access to roof for carry out necessary maintenance as required.

In accordance with the Goodman’s Industrial Building Specification, a Building Users’ Guide is to be prepared for the Project. The Building Users’ Guide provides details regarding the everyday operation of a building and should include energy minimisation initiatives such as natural ventilation strategies, user comfort control, maintenance of air conditioning units and other electrical devices to ensure maximum operating efficiency, and lighting zoning strategies.

An effective Building Users' Guide will ensure that:

- Facility managers understand in detail their responsibilities for the efficient operation of the facility and any additional building tuning necessary to continuously improve energy management.
- Maintenance contractors understand how to service the particular systems to maintain reliable operations and maximum energy efficiency.
- Employees understand energy minimisation procedures and working limitations required to maintain design performance for energy efficiency.
- Future fit-out / refurbishment designers understand the design basis for the building and the systems so that these are not compromised in any changes.

8.3 Roles and Responsibilities

It is the responsibility of the facility manager to routinely check energy savings procedures are undertaken correctly (i.e. lighting turned off while areas of the development are not in use). The facility manager should also ensure all monitoring and audit results are well documented and carried out as specified in the Energy Management Plan.

Senior management should also be involved in energy management planning as an indication of the organisation's commitment to the Energy Management Plan

9 CONCLUSIONS

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Goodman Property Limited (Goodman) to provide a Sustainability Management Plan (SMP) for the warehouse and distribution facilities of Precinct 2, Lot 2A and 2B of Oakdale South industrial Estate (the Project).

Th This report will form part of the Development Application to the Penrith City Council and this study has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the State Significant application:

- **Ecologically Sustainable Development and Energy Efficiency** – including:
  - an assessment of how the modification will incorporate ecologically sustainable development principles in all phases of the development;
  - consideration of the use of green walls, green roof and/or cool roof into the design;
  - climate change projections developed for the Sydney Metropolitan area and how they are used to inform the building design and asset life of the project; and
  - an assessment of the energy uses on-site, and demonstration of the measures proposed to ensure the modification is energy efficient.

The principal objective of this Sustainability Management Plan is to identify all potential energy savings that may be realised during the operational phase of the project, including a description of likely energy consumption levels and options for alternative energy sources such as PV solar power.

A BCA Sections J Deem-to-Satisfy compliant building is used as the baseline building for energy consumption savings. BCA Section J provides the minimum requirement for energy efficiency and it is expected that the proposed development will operate energy efficiently via:

- 990 kW PV Solar system;
  - 100 kW for Warehouse 2A1
  - 100 kW for Warehouse 2A2
  - 100 kW for Warehouse 2A3
  - 345 kW for Warehouse 2B1
  - 345 kW for Warehouse 2B2
- Daylight controlled LED lighting for the warehouse instead of metal halide, resulting in a considerable energy reduction and reduced maintenance;
- Motion sensors to all LED lights within the warehouse, and offices;
- Roof and external wall insulation as per the NCC requirements;
- High performance glazing to all air-conditioned areas or minimum NCC requirements;
- Passive solar design for external outdoor areas;
- Efficient air conditioning system;
- Power sub-metering to enable continued review of power consumption for the offices, and warehouse;
- Selection of endemic and low maintenance landscaping species;
- 123 kL Rainwater tanks (60kL for warehouse 2A and 63 kL for warehouse 2B) for rainwater harvesting and re-use for landscape irrigation and toilet flushing;

- Low flow fixtures and fittings including taps and shower heads;
- Low VOC paints, carpet and sealant; and
- Other measures as detailed in this report.

By implementing all energy efficiency measures described in Section 6 of this report, the project is predicted to achieve a 50.8% GHG emission reduction when compared with NCC Reference Building.

By installing 4-star rated toilets, urinals and taps and the proposed rainwater harvesting facility the proposed development will reduce its potable water demand by approximately 28%.

In conclusion, the relevant ESD initiatives and Energy Efficiency measures outlined in this report are incorporated into the proposed building and development details. The proposed ESD initiatives will help to achieve significant reductions in the energy required by the development both in building and operation.

Building tuning will be conducted by builder and SLR recommends that quarterly reviews of actual building energy and water consumption be carried out once the warehouses are operational to check the actual energy usage and energy savings and verify that all systems are performing at their optimum efficiency. This will provide an opportunity for the systems to be tuned to optimise time schedules to best match occupant needs and system performance while satisfying the sustainability target for the project.

APPENDIX A

Energy Saving Lighting Design Recommendations

BCA Lighting Requirements Oakdale South 2A+2B								
BCA Comply Building	**BCA Requirements**		**Area**	**Operating Hrs**	**Lighting Control**			**Total Annual Energy Consumption (kWh)**
	Warehouse W/m2	4	37950	Monday to saturday 24 hours	Motion Detector, Daylight Sensor	0.9	0.6	716107
	Offices W/m2	4.5	2400	Monday to saturday 24 hours	Motion Detector	0.9	1	84914
			40350				**Total**	**801021**
							kWh/m2	**19.85**

Proposed Lighting Requirements Oakdale South 2A+2B								
BCA Comply Building	**BCA Requirements**		**Area**	**Operating Hrs**	**Lighting Control**			**Total Annual Energy Consumption (kWh)**
	Warehouse W/m2	3.5	37950	Monday to saturday 24 hours	Motion Detector, Daylight Sensor	0.9	0.6	626594
	Offices W/m2	4	2400	Monday to saturday 24 hours	Motion Detector	0.9	1	75479
			40350				**Total**	**702073**
							kWh/m2	**17.40**

APPENDIX B

Water Saving Recommendations

WATER SAVINGS CALCULATION

Table C1 - Number of fixtures

Area	Toilets	Urinal	Basins	Showers
Amenities	45	15	95	10
Total	45	15	95	10

Assume 70% of toilet water usage is supplied by rainwater

Fraction not supplied	0.3

Table C2 - Results

No water saving measures		Max water usage rate [1]	
Toilet	Adopt 3* Average Flush Usage in Table C3	180	L/s
Tap	Adopt 3* Tap Usage in Table C3	855	L/s
Urinal	Adopt 3* Urinal Usage in Table C3	30	L/s
Water reuse measures (4*) with RWH		**Max water usage rate [1]**	
Toilet	Adopt 4* Average Flush Usage in Table C3	157.5	L/s
Tap	Adopt 4* Tap Usage in Table C3	712.5	L/s
Urinal	Adopt 4* Urinal Usage in Table C3	22.5	L/s
Water reuse measures (5*) with RWH		**Max water usage rate [1]**	
Toilet	Adopt 5* Average Flush Usage in Table C3	135	L/s
Tap	Adopt 5* Tap Usage in Table C3	570	L/s
Urinal	Adopt 5* Urinal Usage in Table C3	15	L/s

	3* with RWH	4* with RWH	5* with RWH
Improvement Percent	**14**	**28**	**42**

Calculation Notes

[1] *Water usage rate per use = Number of items in Table C1 x Usage rate in Table C3*

[2] *Assume total water usage is proportional to max water usage rate*

[3] *Improvement percentage = % difference between 3* rated fixtures max water usage rate with no rainwater harvesting and design fixture max water usage rate with 70% of toilet and urinal flushing*

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