ESD Report

231262 GLENDENNING ROAD DATA CENTRE

(GRDC86-LCI-00-XX-RP-SSDA-EM-0000)

Revision:
F

Date:
10/11/2025

REPORT INFORMATION

Project	Glendenning Road Data Centre
Title	ESD Report
Client	
Revision	F
Revision Date	10/11/2025
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REVISION SCHEDULE

Revision	Date	Issue Name	Author	Authorised
A	13/09/2024	ESD Report - Draft	PS	MW
B	31/10/2024	ESD Report – 100% SSDA for review	PS	MW
C	16/12/2024	ESD Report – 100% SSDA for information	PS	MW
D	27/02/2025	Issued for Public Exhibition – SSDA 73761707	PS	MW
E	1/10/2025	Issued for RtS – SSDA 73761707	PS	TD
F	10/11/2025	Revised Issue for RTS – SSDA 73761707	PS	TD

Executive Summary

Lehr Consultants International has filed a Secretary's Environmental Assessment Requirements (SEARs) request with the NSW Department of Planning, Housing and Infrastructure (DPHI) for a data centre development in the Glendenning area of West Sydney.

The proposed development is classified as State Significant Development (SSD) (reference SSD-73761707) on the basis that it falls within the requirements of clause 25 of Schedule 1 of the of *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP), being:

25 Data centres

1) Development for the purpose of data centres that has a total power consumption of more than the relevant amount.

2) In this section—

relevant amount means—

(a) for development in relation to which the relevant environmental assessment requirements are notified under the Act on or before 31 May 2023—10 megawatts, or

(b) for any other development—15 megawatts.

The Data Centre seeks to deliver data centre services, including the accommodation, support and maintenance of large-scale centralised IT equipment.

This report was prepared to respond to the SEARS issued by the Department of Planning, Housing and Infrastructure (DPHI) on 25 July 2024. In preparing this report, the following SEARs General Requirements, Key Issues, and Agency's Advice letters have been addressed. The table below sets out the reference or location of these matters within this report.

General Requirement or Key Issue or Agency Advice	Reference / Location within this report
Identify how the Ecologically sustainable development (ESD) principles (as defined in section 193 of the EP&A Regulation) are incorporated in the design, construction and ongoing operation of the development	- Details of how the ESD principles are incorporated in the design, construction and ongoing operation of the development can be found in **Section 2.2.**
Demonstrate how the development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards.	- Details of how the sustainability and environmental performance standards are considered in the proposed development can be found in **Section 4.2 and Section 5.**
Demonstrate how the development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.	- Details of how the proposed development minimises greenhouse gas emissions and consumption of energy, water (including water sensitive urban design) and material resources can be found in **Section 5.2, 5.3 and 5.5.**
Chapter 3 of SEPP (Sustainable Buildings) 2022 applies:	

General Requirement or Key Issue or Agency Advice	Reference / Location within this report
• demonstrate how the development has been designed to address the provisions set out in Chapter 3.2(1) • provide a NABERS Embodied Emissions Material Form to disclose the amount of embodied emissions attributable to the development in accordance with section 35B of the EP&A Regulation.	• The development has been designed to address the provisions set out in Chapter 3.2(1) that the project will minimise waste, reduce peak electrical demand and dependence on artificial lighting and mechanical heating and cooling; include metering and monitoring of energy consumption and minimise the consumption of potable water (refer to **Section 3.1** for details). • The NABERS Embodied Emissions Material Form are submitted separately to this report in order to disclose the amount of embodied emissions attributable to the development. The proposed construction and operation of three (3) data centre buildings, known as DC01, DC02 and DC03 would be in three stages therefore 3 individual NABERS form have been completed for each stage.
SEARs Cover Letter Requirement – Include a comprehensive options analysis of all commercially available cooling and back-up power systems	• The cooling system options were analysed in detail for the development and findings are summarised in **Section 5.2.2**. • The backup power system options were analysed in detail for the development and the findings are summarised in **Section 5.2.5**.
SEARs Cover Letter Requirement – Provide a detailed overview of the proposed data hall cooling system including number and details of associated plant and equipment, and the energy and water demands of the proposed data hall cooling system	• A detailed assessment was conducted on the energy and water use for data halls and a summary of results are included in **Section 5.2.4**.
SEARs Cover Letter Requirement – Provide demonstration the development can achieve a NABERS 3 stars energy rating or higher including the Power Usage Effectiveness (PUE) calculations of plant and equipment required for the operation of a data centre.	• The use of energy efficient design initiatives will result in a targeted PUE of 1.17 or lower. This is equivalent to a NABERS Energy rating of better than 5.5 stars (Data Centre Infrastructure Rating) Related sustainability standards can be found in **Section 4.3.**
RTS Comments from NSW EPA – In summary, provide additional assessment detail consistent with the requirements of a GHG Assessment in accordance with the NSW Large Emitters Guide	• Additional assessment detail has been provided aligned to the requirements of a GHG Assessment per the NSW Large Emitters Guide. See additional reporting in Appendix A.

General Requirement or Key Issue or Agency Advice	Reference / Location within this report
RTS Comments from Blacktown Council – In summary, provide additional detail of how the development is considering and addressing urban heat island impacts with reference to the Greater Sydney Heat Smart City Plan 2025-2030.	• Additional details and assessment of the projects response to urban heat island impacts have been provided. See Appendix B.

This report also details the ecologically sustainable design features considered by the proposed development, and how the requirements for sustainable building standards will be addressed by the proposed development.

Also, refer to the ***GRDC86-LCI-00-XX-RP-SSDA-EM-0001 Energy and Water Report*** for further information.

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1 Introduction and Site

1.1 Introduction

This ESD SEARs report has been prepared by Lehr Consultants International (Australia) Pty Ltd (LCI) in support of a State Significant Development Application (SSDA, SSD-73761707 submitted to the Department of Planning, Housing and Infrastructure (DPHI) under Part 4 of the *Environmental Planning and Assessment Regulation 2021 (EP&A Regulation)*.

LCI has been engaged to guide the design of the project so that it may minimise environmental impacts, reduce resource use and provide healthy comfortable spaces for its users. This ESD report summarises those initiatives and features and addresses the NSW Planning SEARS item #8 and other frameworks and conditions outlined in the SEARS cover letter from Department of Planning, Housing and Infrastructure (DPHI) dated 25 July 2024 (**SSD-73761707**).

1.2 The Site

The SSDA relates to a proposed development located at 2 Glendenning Road, Glendenning and is legally described as Lot 2 DP 1137162. The subject site is zoned E4 General Industrial zone pursuant to the Blacktown Local Environmental Plan 2015. The site lies within the Blacktown local government area (LGA) approximately 8.5 km west of the Blacktown CBD, and approximately 21 km west of Parramatta.

The subject site comprises a total area of 10.44ha and exhibits a primary frontage to Glendenning Road at the western boundary for approximately 295m. A secondary frontage to Woodstock Avenue is located along the southern boundary, for a length of approximately 335m.

The subject site comprises three (3) existing warehouse buildings that undertake various operations, including storage and logistics and a transport vehicle centre. The buildings are positioned toward the Glendenning Road frontage and cover approximately one half of the subject site. The remainder of the subject site to the rear is vacant and contains a mix of grass, native vegetation and sporadic trees. A patch of mature native vegetation exists along the southern boundary, which is identified as outstanding biodiversity value. An established landscaping strip is located along the Glendenning Road frontage, providing some screening of the existing buildings.

Vehicle access is obtained via four (4) vehicles crossings off Glendenning Road, which provide separate access for the two (2) large tenants. Vehicle access is also provided off Woodstock Avenue for the southern tenant.

The subject site is traversed by overhead 132kV transmission lines and towers, managed by Endeavour Energy. A drainage reserve also exists directly north of the subject site, which is managed by Blacktown City Council.

The subject site is depicted in ***Figure 1*** below.

Figure 1: Aerial Map of Subject Site (Source: NearMap, 2024)

The subject site is surrounded by industrial land to the north, west and south (refer to the site context in ***Figure 2***). Directly adjoining the subject site to the east is the Nurragingy Reserve, which falls under the jurisdiction of the Western Parklands. The Eastern Creek is located within the reserve and runs along the eastern boundary of the subject site. The closest residential area is located approximately 400m to the west of the subject site on the opposite side of the Westlink M7 Motorway.

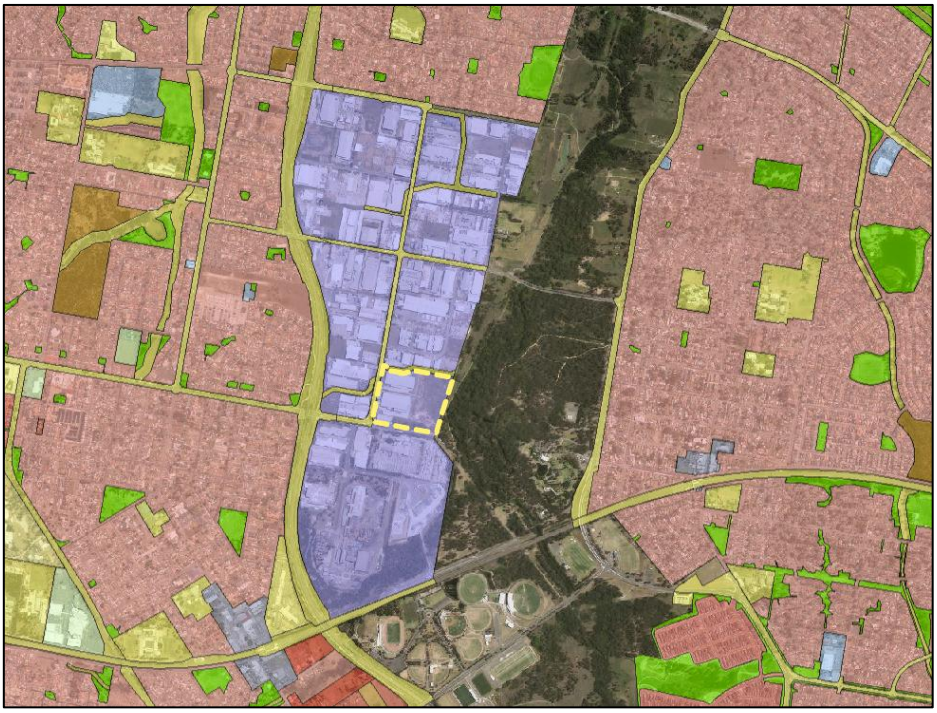

Figure 2: Site Context and Zoning (Source: Blacktown Local Environmental Plan, 2024)

The proposed development site is located in Climate Zone 6 - Mild Temperate, as per the BCA Climate zone map: Australian Building Codes Board (See ***Figure 3*** below).

Figure 3: Site Climate zone Map as per NCC *(Source: Climate zone map | ABCB)*

1.3 Overview of Proposed Development

The proposed development is known as the Glendenning Road Data Centre and includes the construction and operation of three (3) data centre buildings and associated infrastructure, with a total power consumption of approximately 235MW.

The proposed development seeks consent for the following aspects of development:

- Site preparation and establishment works including:
  - Bulk earthworks to create proposed site levels;
  - In-ground building services and utility work;
  - Clearance of trees and vegetation within the proposed development extent;

- Construction and operation of three (3) data centre buildings, known as DC01, DC02 and DC03, comprising:
  - A total Gross Floor Area (GFA) of 50,233m^2 (DC01 – 19,985m^2, DC02 – 10,263m^2 and DC03 – 19,985m^2);
  - A maximum building height of 45.3m, including five (5) storeys for each building;
  - Three (3) internal substations;
  - A total IT capacity of approximately 193.6MW (DC01 – 79.2MW, DC02 – 35.2MW and DC03 – 79.2MW);

- Total diesel fuel storage of 2,736,030L within underground bulk fuel storage tanks and generator day tanks;
- 97 back-up generators across the full development;
- External plant and equipment (including water tanks and pump rooms);
- Installation of evaporative cooling units;
- Three (3) vehicle crossovers to Glendenning Road and internal access roads;
- Security fencing surrounding the development, including a controlled entry and exit point;
- 165 on-site car parking spaces (including 6 accessible parking spaces and 12 Electric Vehicle (EV) parking spaces);
- Landscaping across the subject site;
- Hours of operation being on a 24 hours per day, seven (7) days per week basis.

The proposed works would be constructed in three (3) stages, as follows:

- **Stage 1:** The first stage would include the construction of DC01, located at the rear of the subject site. The three existing site buildings would be demolished.
- **Stage 2:** The second stage would involve the construction of DC02.
- **Stage 3:** The construction of DC03.

A rendered image of the Proposed development is provided below (**Figure 4**).

Figure 4: Render of the proposed development DC01 *(Source: GREENBOX ARCHITECTURE)*

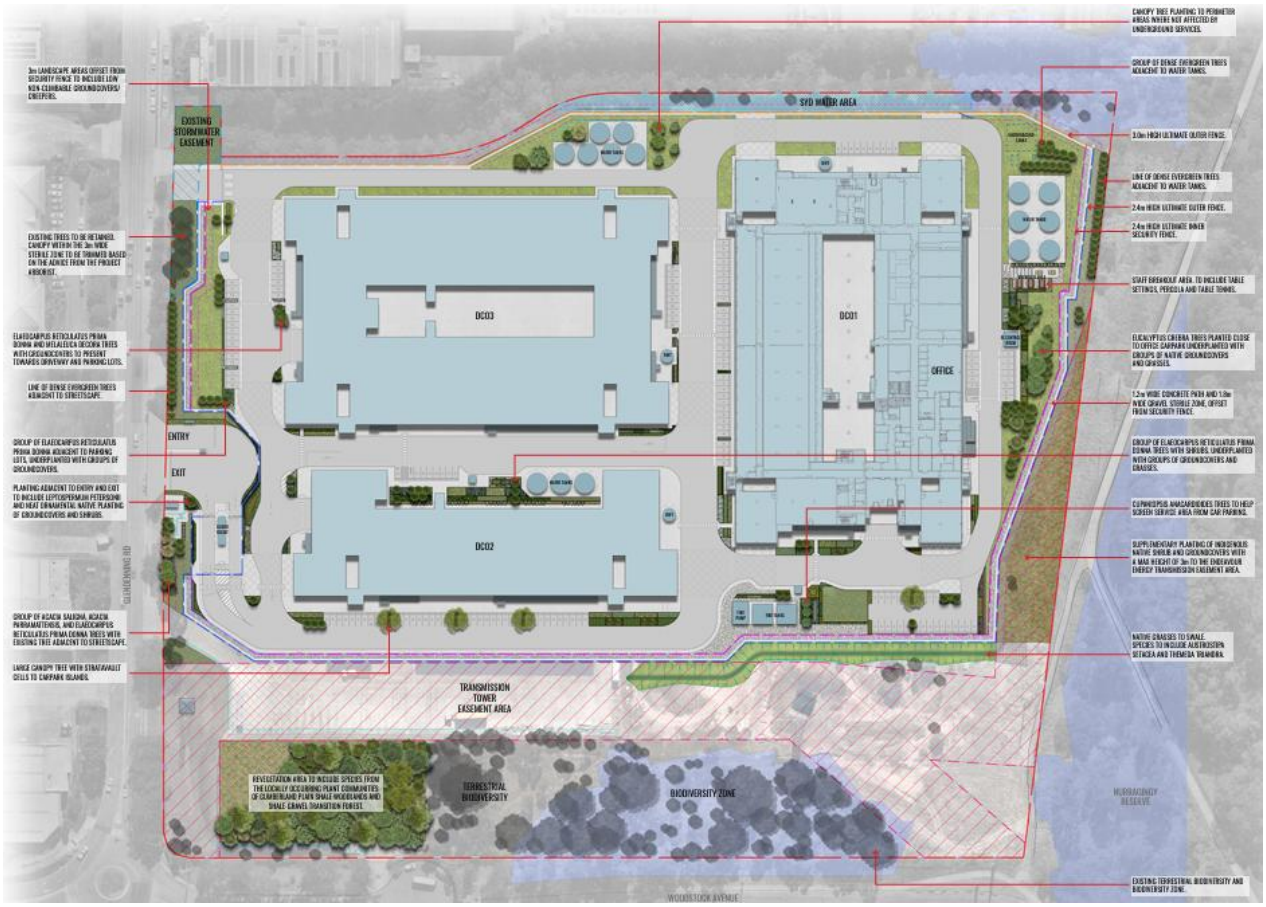

Figure 5: Landscape Masterplan of proposed development *(Source: GEOSCAPES)*

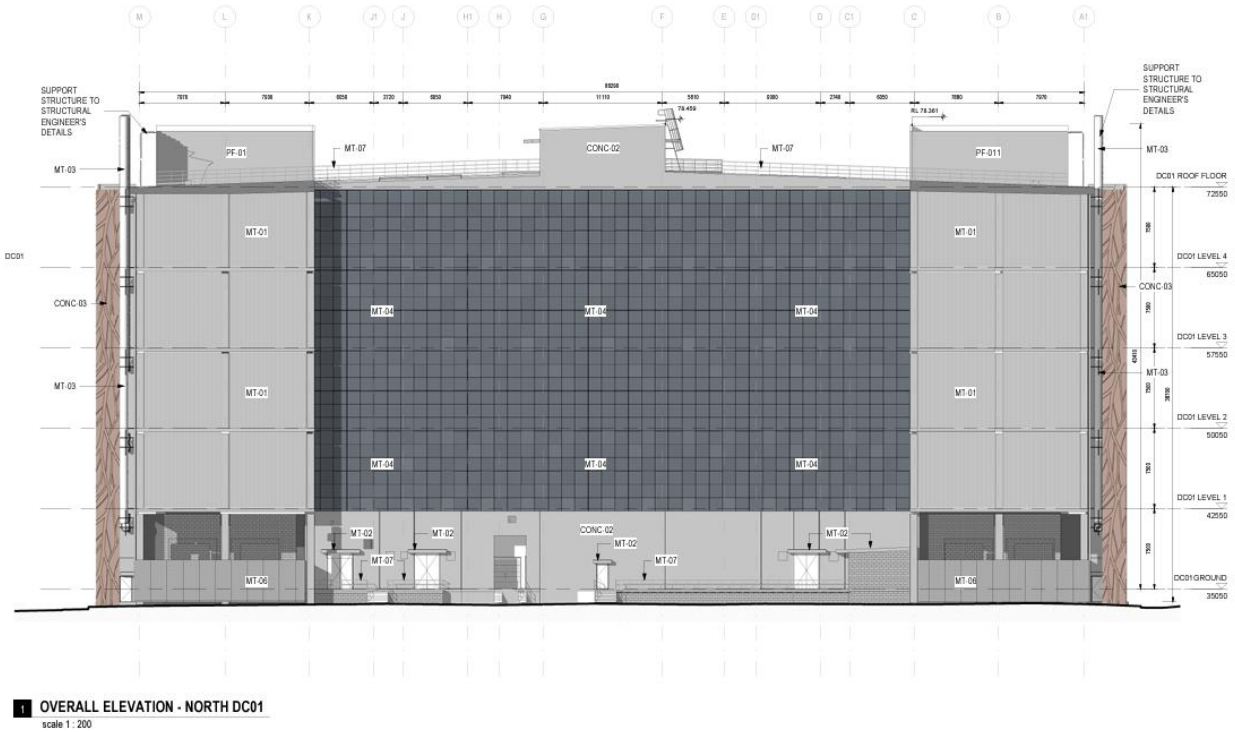

Figure 6: Overall Elevation - North DC01 of proposed development *(Source: GREENBOX ARCHITECTURE)*

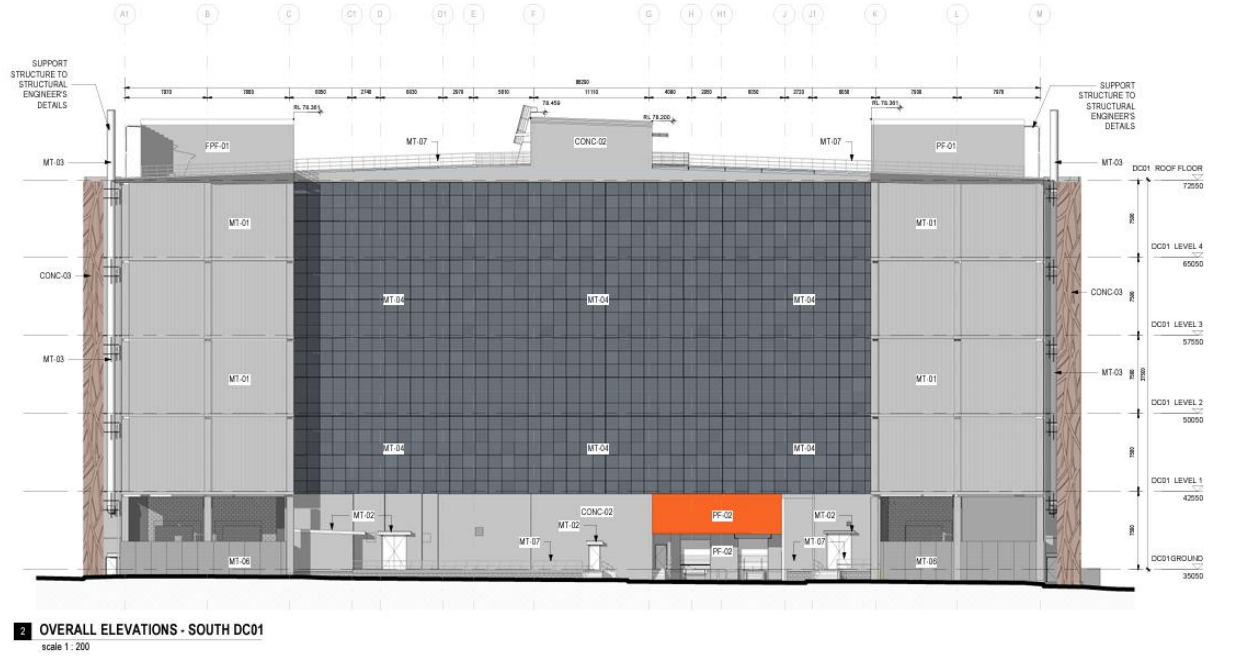

Figure 7: Overall Elevation - South DC01 of proposed development *(Source: GREENBOX ARCHITECTURE)*

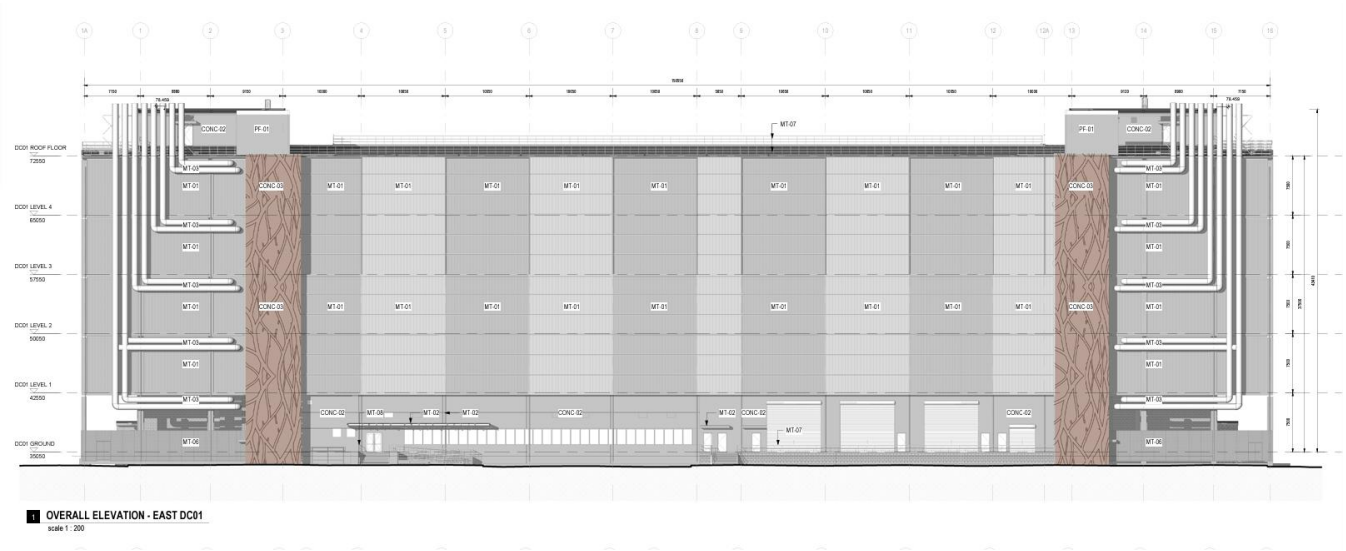

Figure 8: Overall Elevation - East DC01 of proposed development *(Source: GREENBOX ARCHITECTURE)*

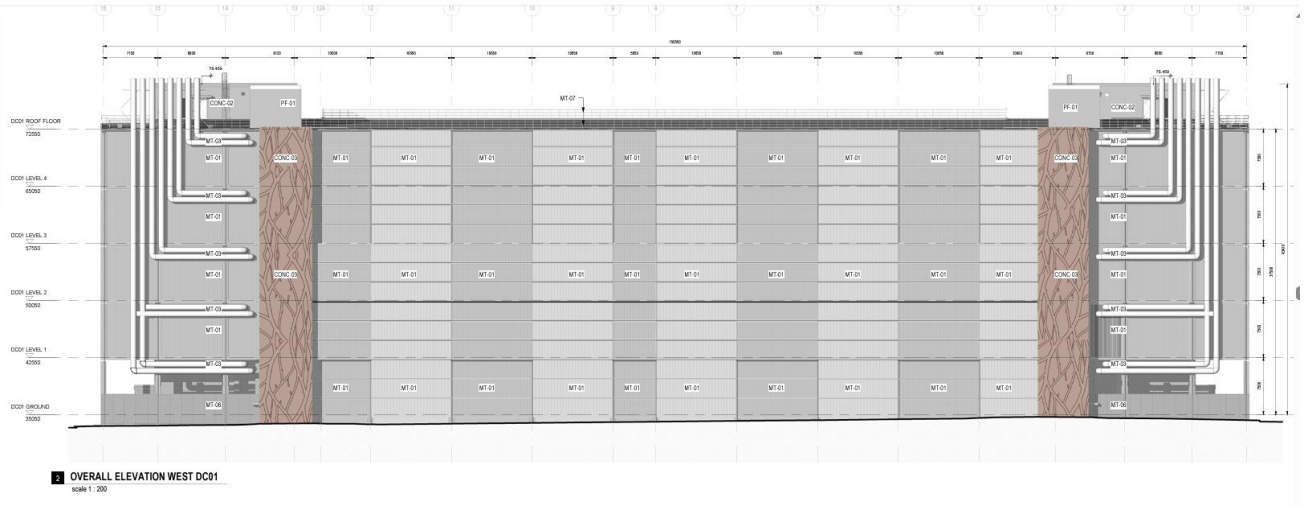

Figure 9: Overall Elevation - West DC01 of proposed development *(Source: GREENBOX ARCHITECTURE)*

1.4 Site Climate

The site is located in a humid subtropical climate, characterised by its long hot summers and cool short winters with cold nights, with maximum annual temperatures averaging 28.4°C and minimum annual temperatures averaging 4.5°C. Based on the BOM weather data for Seven Hills, which is the weather station closest to the site, the annual precipitation is just over 900mm, as shown in ***Figure 10*** *below* (BOM 2024) .

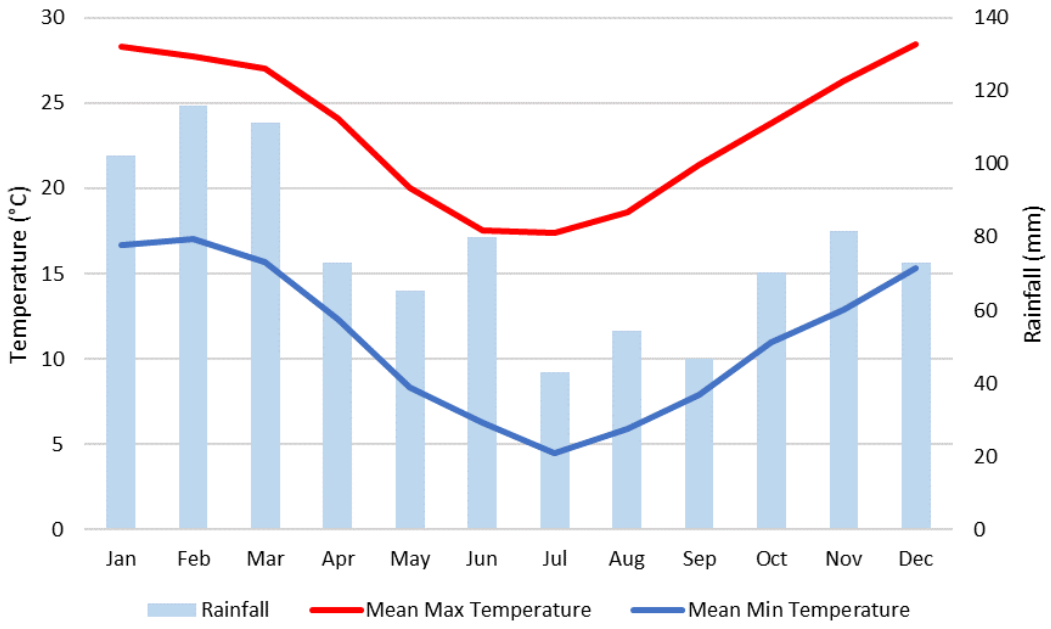

Figure 10: Seven Hills Climate *Data (Source: climate statistics for Australian locations (bom.gov.au))*

2 Regulatory Compliance

2.1 Secretary's Environmental Assessment Requirements (SEARS)

This table 1 below identifies and responds to the Secretary's Environmental Assessment Requirements (SEARs) issued by Department of Planning, Housing and Infrastructure (DPHI) on 25 July 2024 relevant to this assessment, and where they are addressed in the report. An outline of the specific items from the SEARs relevant to assessment, and how they have been responded to is also summarised in the table below.

Item 8 ESD – Description and Assessment Requirements	Response Reference in Report
Ecologically sustainable development – **including:** ***Identify how the Ecologically sustainable development (ESD) principles (as defined in section 193 of the EP&A Regulation) are incorporated in the design, construction and ongoing operation of the development***	• Details of how the ESD principles are incorporated in the design, construction and ongoing operation of the development can be found in **Section 2.2.**
Demonstrate how the development will meet or exceed the relevant industry recognised building sustainability and environment performance standards.	• Details of how the sustainability and environmental performance standards are considered in the proposed development can be found in **Section 4.2** and **Section 5**.
Demonstrate how the development minimises greenhouse gas emissions (reflecting the Government's goal of net zero emissions by 2050) and consumption of energy, water (including water sensitive urban design) and material resources.	• Details of how the proposed development minimises greenhouse gas emissions and consumption of energy, water (including water sensitive urban design) and material resources can be found in **Section 5.2, 5.3** and **5.5.**
If Chapter 3 of SEPP (Sustainable Buildings) 2022 applies: • demonstrate how the development has been designed to address the provisions set out in Chapter 3.2(1) • ***provide a NABERS Embodied Emissions Material Form to disclose the amount of embodied emissions attributable to the development in accordance with section 35B of the EP&A Regulation.***	• The development has been designed to address the provisions set out in Chapter 3.2(1) that the project will minimise waste, reduce peak electrical demand and dependence on artificial lighting & mechanical heating and cooling; include metering and monitoring of energy consumption and minimise the consumption of potable water (refer to **Section 3.1** for details). • The NABERS Embodied Emissions Material Form is submitted separately to this report in order to disclose the amount of embodied emissions attributable to the development. The proposed construction and operation of three (3) data centre buildings, known as DC01, DC02 and DC03 will be in three stages therefore three individual NABERS form have been completed for each stage.

SEARs Cover Letter Requirement – Include a comprehensive options analysis of all commercially available cooling and back-up power systems	• The cooling system options were analysed in detail for the development and findings are summarised in **Section 5.2.2**. • The backup power system options were analysed in detail for the development and the findings are summarised in **Section 5.2.5**.
SEARs Cover Letter Requirement – Provide a detailed overview of the proposed data hall cooling system including number and details of associated plant and equipment, and the energy and water demands of the proposed data hall cooling system	• A detailed assessment was conducted on the energy and water use for data halls and a summary of results are included in **Section 5.2.4**.
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RTS Comments from NSW EPA – In summary, provide additional assessment detail consistent with the requirements of a GHG Assessment in accordance with the NSW Large Emitters Guide	• Additional assessment detail has been provided aligned to the requirements of a GHG Assessment per the NSW Large Emitters Guide. See additional reporting in Appendix A.
RTS Comments from Blacktown Council – In summary, provide additional detail of how the development is considering and addressing urban heat island impacts with reference to the Greater Sydney Heat Smart City Plan 2025-2030.	• Additional details and assessment of the projects response to urban heat island impacts have been provided. See Appendix B.

2.2 EP&A Regulation 2021 Ecologically Sustainable Development (ESD) Principles

Ecologically sustainable development (ESD) principles (as defined in Clause 193 of the Environmental Planning and Assessment Regulation 2021) will be incorporated into the design, construction and ongoing operation of the proposed development. The ESD principles defined are to be aligned with Section 193 – Environmental Planning & Assessment Regulation and include the following:

- The precautionary principle
- Inter-generational equity
- Conservation of biological diversity and ecological integrity
- Improved valuation, pricing and incentive mechanisms

2.2.1 The Precautionary Principle

***the precautionary principle**, namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:*

i) Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and

ii) An assessment of the risk-weighted consequences of various options.

PROJECT RESPONSE

The site is zoned E4 General Industrial and already contains a number of buildings and hard standing which makes it a good site to be selected for further development. The proposed development includes landscaped areas with mature local trees and locally native vegetation will be used to improve aesthetics and amenity for users and adjacent businesses. There are a number of existing trees on site and adjacency to a riparian zone so it has been essential to engage with specialists that have advised about how to mitigate and minimise any negative impacts of the development.

The following environmental factors and initiatives are outlined in the Arboricultural Impact Assessment Report.

- The Site is identified as containing biodiversity values (NSW Environment and Heritage 2024). The following Endangered Ecological Communities are referenced within the mapped Biodiversity Values areas:
  - Critically endangered Cumberland Plain Woodland along the southern boundary of the site, &
  - Endangered Cumberland Red Gum River Flat Forest within the northeast corner of the site. (SEED 2024).
  - Trees located to the western side of the mapped EEC, are species indicative of the EEC, however species diversity is minimal and the majority of trees are younger specimens. Trees is in direct conflict with proposed entry driveway will require removal.
- Trees within the mapped Endangered Ecological Communities will be retained, protected and enhanced. The proposed development will include a landscape setback to Glendenning Road with a typical width of 15-20m. Landscaping plans propose a mixture of large and medium evergreen indigenous and native trees, shrubs and groundcovers throughout the site. Following maturity this, together with the retention of large trees within the biodiversity area and front setback, will provide softening and screening of the buildings when viewed from Glendenning Road and Woodstock Avenue. Although restricted by bushfire requirements, existing and proposed services and security fencing a total of 245 trees are proposed to be planted to

mitigate required tree removal. This will preserve the established environmental character of the site and enhance its connection to the broader area of Eastern Creek.
Replacement canopy tree planting will be of locally indigenous species which will serve to increase biodiversity, extend and consolidate vegetation corridors. (Arboricultural Impact Assessment Report and Visual Impact Assessment Report).

In addition, the operator has a sophisticated approach to managing the environmental impacts of their Data Centres though design, delivery and into operation.

- The operator will implement a site specific environmental management plan during construction that will minimise environmental impacts by implementing best practice processes and procedures. As an example, the promotion of Off-site construction elements like pre-cast concrete minimises noisy activities on site such as concrete pumping, stripping formwork, cutting of reinforcement, etc.
- Water Sensitive Urban Design principles are being adopted in the landscape / civil design to minimise stormwater runoff and control runoff pollution loads.
  Leaks to water and soil from diesel fuel systems have been considered in the proposed design, with provisions moving beyond code compliance. A fuel interceptor has been included within the sit stormwater drainage system and dry-type electrical transformers are included to avoid the risk of environmental contamination associated with oil-type transformers.

2.2.2 Inter-generational Equity

***Inter-generational equity**, namely, that the present generation should ensure that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations*

PROJECT RESPONSE
To uphold inter-generational equity, the proposed development has been designed such that it minimises the consumption of energy and water resources whilst reducing waste.

Some ways in which the design has been optimised include;

- The proposed building systems are optimised so that energy and water consumption is minimised through efficiency measures as described in ***Section 5.1***.
- The IT equipment, which is the most energy intensive component of the proposed development, will be specified to be best practice for energy efficiency.
- Reduction in water use will be achieved through water efficient construction practices and to reduce water consumption. Rainwater will also be collected and reused with potential uses for non-potable water. Vegetation with low irrigation requirements such as use of native species planting shall be selected which will require no irrigation once the plants are mature reducing the landscape water demand.
- Waste generated during the construction and operational phases will be diverted from landfill and to be recycled where possible. Target 85% diversion of construction and demolition waste from landfill.
- Retention and Protection - It is suggested that high retention value trees within the site be prioritized for retention and protection. These trees are considered important for retention and considered able to be retained and protected as part of the proposed works. 1 high retention value tree located within the site along the western frontage is proposed for removal. Majority of medium retention value trees and low retention value trees are proposed to be removed to accommodate the proposed development that are spread throughout the site. However, replacement planting opportunities exist within the site and additional replacement trees

possibly will be offset immediately adjacent to the site within the Council Road Reserve and Eastern Creek Reserve to the east.

The measures outlined above shall ensure that the development minimises its impact on the health, diversity and productivity of the environment, thus maintaining it for the benefit of future generations. Following the implementation of these mitigation measures, the design of the development will contribute to the Inter-generational Equity through mitigation of any negative impact it may have on the environment.

2.2.3 Conservation of Biological Diversity and Ecological Integrity

conservation of biological diversity and ecological integrity*, namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration*

PROJECT RESPONSE
The proposed development has considered biological diversity and ecological integrity as a key issue and has commissioned studies that would inform the design, construction and operation of the development to minimise its impact on biodiversity and ecological integrity. The development is located on a site classified as containing outstanding terrestrial biodiversity values along the southern boundary, as well as the north-eastern corner. Trees within the mapped Endangered Ecological Communities will be retained, protected and enhanced. This will preserve the established environmental character of the site and enhance its connection to the broader area of Eastern Creek.
Tree removal will be required as part of the proposed development and the total number of trees shall be confirmed as part of the Arboricultural Impact Assessment. Replacement canopy tree planting shall be of locally indigenous species which will serve to increase biodiversity, extend and consolidate vegetation corridors.
Initial Biodiversity values investigations confirm that a Biodiversity Development Assessment Report (BDAR) is likely to be required for vegetation clearance. This shall address all relevant matters of the BC Act and recommended mitigation measures that would manage the biodiversity on the site.

2.2.4 Improved Valuation, Pricing and Incentive Mechanisms

Improved valuation, pricing and incentive mechanisms*, namely, that environmental factors should be included in the valuation of assets and services, such as:*

(i) ***polluter pays****, that is, those who generate pollution and waste should bear the cost of containment, avoidance, or abatement,*

(ii) ***the users of goods and services should pay*** *prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*

(iii) ***environmental goals****, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

PROJECT RESPONSE

The valuation of the project's assets and services consider environmental factors through the implementation of various ESD initiatives.

- A Clean Construction Plan will be implemented throughout the construction to identify the measures and quantify (where possible) the carbon reduction and local air quality impacts from the construction phase, and to control pollution.
- A construction and demolition waste management plan will be implemented to establish recycling and landfill waste streams during construction. This will create a system where pollution is managed and controlled and creates an incentive to reduce pollution and waste.
- Further, the energy and water conservation measures in the proposed design shall reduce consumption of resources by the development.
- A lifecycle assessment may also be taken to determine the carbon footprint of the construction works of the development.
- The project will source more sustainable materials including concrete with >30% lower embodied carbon and responsible steel procurement, including steel procured from energy-reducing processes.
- The design shall aim to reduce the volume of materials required to achieve the same function, e.g. through 'lightweighting'. Environmental impacts during construction will be managed by implementing a best practice, site specific environmental management plan.
- Energy efficiency, on-site energy generation, water efficiency, and water harvesting initiatives demonstrate resilience to grid failures and interruptions to mains potable water supply.

3 State Environmental Planning Policy (Sustainable Buildings) 2022

The NSW State Environmental Planning Policy (Sustainable Buildings) 2022 came into effect in August 2022 and applies to relevant projects lodged for State Significant DA after 1 October 2023.
The Sustainable Buildings SEPP encourages the design and delivery of more sustainable buildings across NSW. It sets sustainability standards for residential and non-residential development and starts the process of measuring and reporting on the embodied emissions of construction materials.
The NSW Government's objectives for the SEPP are to:

- minimise the consumption of energy and potable water
- reduce greenhouse gas emissions from energy use
- monitor the embodied emissions of building materials
- deliver buildings that are comfortable in summer and winter
- provide household bill savings to families, especially for heating and cooling.

Consideration must be given to Clause 3.2(1) of the Sustainable Buildings SEPP which requires that the development must be designed to enable the following (***see project specific response in Section 3.1***):

(a) the minimisation of waste from associated demolition and construction, including by the choice and reuse of building materials,
(b) a reduction in peak demand for electricity, including through the use of energy efficient technology,
(c) a reduction in the reliance on artificial lighting and mechanical heating and cooling through passive design,
(d) the generation and storage of renewable energy,
(e) the metering and monitoring of energy consumption,
(f) the minimisation of the consumption of potable water.

In accordance with the SEARs, the embodied emissions for the proposed development must be quantified.

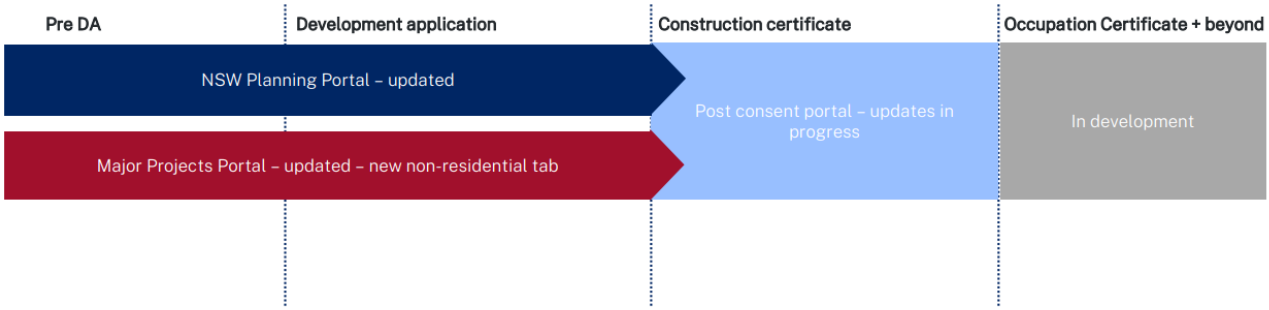

Figure 11: Digital integration into the NSW Planning Portal *(Source: Sustainable Buildings SEPP – Presentation slides (nsw.gov.au))*

The new Embodied Emissions Reporting requires disclosure at development application and construction certificate, the quantities of materials and associated emissions. The tool will describe how embodied emissions are minimised (by re-used or recycled content and low emissions construction technologies) and use NABERS embodied emissions materials form until NABERS framework is ready.

Summary of SEPP overview and Embodied emissions reporting at Sustainable Buildings SEPP (nsw.gov.au)

3.1 Project Relevance

The new SEPP requirements became mandatory with effect from 1st October 2023. The proposed development will demonstrate compliance and will meet or exceed the requirements as discussed below:

a) The project will minimise waste from associated demolition and construction, including choice and reuse of building materials (refer ***Section 5.4 & 5.5***).
b) The project will have a reduction in peak demand for electricity, including through the use of energy efficient technology (refer ***Section 5.2***).
c) The project will have a reduction in the dependence on artificial lighting and mechanical heating and cooling through passive design (refer ***Section 5.2.3*** and ***5.2.6***).
d) The projects generation and storage of renewable energy (refer ***Section 5.1***).
e) The project will provide metering and monitoring of energy consumption (refer ***Section 5.2.3***).
f) The project will minimise the consumption of potable water (refer ***Section 5.3***).

The new NABERS embodied emissions material form includes a calculation of embodied carbon emissions associated with construction materials. The form tabulates measurements for key materials in the substructure, superstructure and facade of the building and must be prepared by a quantity surveyor, designer, engineer or NABERS assessor. This interim form will be in used until the NABERS embodied emissions framework and related emissions factors comes into effect in 2024.

4 Sustainability Rating Tool - NABERS

4.1 Background

The SEARS Cover Letter makes reference to benchmarking the development against a NABERS Energy rating of 3 or higher.

NABERS (the National Australian Built Environment Rating System), is a rating system where the energy consumption of a building over a period of 12 months is rated across a benchmark. NABERS encourages buildings to measure and monitor its energy consumption, which allows building owners to manage their energy consumption while providing a starting point from which the owners can undertake analyses to identify any issues in the building and systems that are consuming more energy than expected, which then enables them to troubleshoot and optimise their building's energy consumption. Buildings are awarded a Star rating on a scale from 1 to 6 Star with 6 Stars being the highest based on the energy consumed in the rating period compared to a benchmark. The rating will be valid for a period of twelve months.

The key principle that NABERS facilitates is that "what gets measured gets managed". As the proposed development is a datacentre, the energy consumption is expected to be very high compared to other building types, and any issues that would cause any system to use more energy than expected would result in significant energy increases. Thus, the building shall be designed with a large number of submeters incorporated to facilitate energy analyses and diagnoses to optimise the energy consumption of the building. This allows the building operators to measure the building energy consumption and manage it, thus aligning with the key NABERS principle.

NABERS for data centres is based on a facility's actual operational data, not merely the design. A NABERS rating can be used to identify areas for operational improvements and cost savings, as well as to promote the environmental credentials. A NABERS Rating cannot be achieved until the data centre has been operating for at least 12 months.

4.2 NABERS Benchmarking

NABERS ratings for data centres provides an indication of the operational energy efficiency and environmental impact of data centres in Australia. It gives data centres a rating from one to six stars based on its Power Usage Effectiveness (PUE), a globally accepted metric. The proposed development is targeting a PUE of 1.17 which would be equivalent to a rating of better than 5.5 Stars.

Figure 12: ***How NABERS star ratings correspond to PUE values*** (Source: Data Centres | NABERS)

A PUE of 1.17 represents excellent performance and will be achieved through a number of approaches and initiatives including elevated air supply temperatures, hot aisle-cold aisle air delivery, evaporative cooling and a 'behind the meter' onsite solar PV array. These are further described in **Section 5.1**.

4.3 NABERS Position and PUE

A detailed assessment was undertaken to estimate the NABERS position for the development of DC01 primarily at Stage 1 and to estimate the PUE. Note that this performance estimate considers the project targeted design initiatives that reduce energy demand and maximise energy efficiency alone (see Section 5.2) without any benefit from the operator's further net zero commitments such as to procure renewable energy (see Section 5.1).

Summary of the assessment results are listed in the table below.

	NABERS Infrastructure Case
Postcode	2761
Total energy consumed by the IT equipment (kWh/year)	693,792,000
Metered heat rejection rate	100%
Total data centre infrastructure electricity use (kWh/year)	116,473,088
GreenPower use of total electricity use	0%
Total data centre diesel use (L/year)	24,876
Total DC01 Infrastructure GHG emissions (Tonnes CO_2-e/year)[1]	85,261.34
Estimated PUE	1.17
Predicted Infrastructure NABERS Energy Rating	5.5

Note: 1. The GHG emissions reported here correspond to the NABERS Energy scheme metrics and may not correspond to emissions calculated using factors from other sources such as the National Greenhouse Accounts Factors.

Refer to ***GRDC86-LCI-00-XX-RP-SSDA-EM-0001 Energy and Water Report*** for detailed information.

5 Sustainable Design Principles

5.1 Net Zero Carbon Performance

The Operator Organisation is an experienced developer and operator of Data Centres with a published track record of best practice performance. The Operator's aims are to invest in renewable energy, scaling solutions across operations, and collaborating with partners to broaden impact. They are committed to Net Zero Carbon operations and they enable consumers and businesses to procure cloud services from a company which is on a net zero carbon trajectory. Recently published research data shows that cloud based large scale data centres, like the one proposed, allow higher resource utilization and energy efficiency than the typical multitude of smaller on-premises data centres. The Operator provides its customers with transparent data on the carbon emissions associated with their cloud services usage, and provides educational material on how to use those services in a more carbon efficient way.

The organization is committed to procuring new sources of carbon-free energy that help decarbonize its operations, and is committed to investing in the electricity grids on which it operates. Across its Australian asset base, the Operator has on-site solar and contracted off-site wind and solar projects in various stages of development and construction that will total in excess of 200MW of generation capacity once operational. Scope 1, 2 and 3 GHG emissions are disclosed in a publicly available report which informs decision making by investors.

In line with similar commitments by the NSW Government for the NSW state to be Net Zero by 2050, the Organisation has committed to achieving 'net zero' for its global operations by 2040 – that is, it will remove an equal amount of carbon to its emissions via a portfolio of negative emission technologies potentially including afforestation and reforestation, soil carbon sequestration, bioenergy with carbon capture and storage (BECCs), and direct air capture (DAC). It should be noted that the Operator is committed to the European Green Deal and is a signatory of the Climate Neutral Data Centres Pact, working to ensure that data centres are an integral part of the sustainable future of Europe. Actions include annual PUE and water usage effectiveness (WUE) targets, 100% renewable energy for electricity by 2030 and implementation of circular economy practices for servers. It is expected that in response to innovations in Europe, these will become global best practice.

The proposed development aims to implement sustainable design and construction practices on the project based on these organisational goals. This project will support organizational commitment to design, construct, and operate ultra-low carbon (and/or net zero carbon) buildings.
The project is designed with a range of ecologically sustainable design initiatives that minimise its consumption of resources, especially energy and water. These are summarised in the following sections below.

The project is considered to be a 'large emitter' as it is likely to emit more than 25,000 tonnes CO2-e of scope 1 and 2 emissions in any financial year during its operational life. A GHG Assessment has been prepared following the general guidelines of the 'NSW Guide for Large Emitters'. The GHG Assessment provided emissions estimates considering the project design based mitigation measures and the operator's goals regarding Net Zero.

Refer to Appendix A of this report for further details of the project's GHG assessment and GHG emission reduction goals.

5.2 Energy Use

5.2.1 Passive Cooling and Heating Design

Continuous Roof and External Wall Insulation
Passive design elements in the building envelope reduce the cooling and heating required, particularly to administrative and back of house spaces, but it doesn't have as significant effect on the cooling and heating demand of the data halls where internal heat gains from equipment dominate and in these instances excessive insulation can even be counterproductive.
The development will maximise the use of continuous insulation wherever appropriate, which avoids the reduction of the thermal performance of the insulation through thermal bridging, whereby heat is lost or gained through structural members, which serves as a pathway through which heat can bypass the insulation. The development will also focus on selecting light external colours for building façade and roofing to reduce unwanted heat gain.

High-performance Glazing Systems
The building will consider the use of high-performance glazing systems to administrative areas which will reduce energy consumption in two ways. Low whole system U-values will reduce the amount of heat conduction through the window, including the glass and the frames, while low SHGC will reduce unwanted solar heat gain.

5.2.2 Cooling System Options

Multiple cooling system options are available for data centre hall cooling and the below list has been considered as options for the project.

- Direct evaporative coolers
- Indirect evaporative coolers
- Air-cooled chiller system
- Water-cooled chiller system

For the options analysis for the cooling system selection, the following criteria were looked into to select an appropriate cooling system for the development.

- Capital expenditure (Capex)
- Energy consumption
- Water consumption
- Refrigerant impact

Based on the options available and criteria for selection, an options analysis has been conducted with the impact significance matrix summarised below.

Cooling Option	Capex	Energy Use	Water Use	Refrigerant Impact
Direct evaporative coolers	Low	Low	Medium	Zero
Indirect evaporative coolers	Medium	Medium	High	Zero
Air-cooled chiller system	High	Very High	Zero	High

Cooling Option	Capex	Energy Use	Water Use	Refrigerant Impact
Water-cooled chiller system	Very High	High	Very High	High

Analysing the results of the options analysis, direct evaporative coolers were identified as the option with the lowest total impact and would be the preferred option for this development. Refer to **GRDC86-LCI-00-XX-RP-SSDA-EM-0001** Energy and Water Report for detailed information.

5.2.3 Mechanical Services

Elevated Supply Air Temperatures

The development is designed to operate at elevated operating temperatures with maximum supply air condition of 33.3°C, which reduces cooling energy as the system can use outdoor air with minimal cooling for the majority of the year. Additionally, 'Hot-aisle-Cold-aisle' configuration maximises the effectiveness with which cooling is provided to computer hardware by creating more efficient heat removal at the server level. Mechanical systems that are used to cool and heat the air in a building generally constitute the largest proportion of the building's Non-IT energy consumption so reducing flow rates and elevating temperatures has a big effect on PUE. The evaporative cooling system will only be switched on when ambient temperature is higher than 28.4°C. The cooling system will supply ambient air directly, without providing any form of cooling and hence not using water, when ambient temperature is less than 28.4°C.

Low GWP Refrigerants

During detailed design, all remaining refrigerant based systems will be reviewed and where feasible specify more environmentally friendly refrigerants with lower ODP and GWP, for example R-32 or R-454B. If suitable refrigerants are not currently available for these applications, the design will accommodate foreseeable refrigerant replacements at end of life of relevant equipment.

Building Management Control System

A Building Management Control System (BMCS) with automatic intelligent controls to control cooling equipment will be used. This allows plant efficiency to be optimised as cooling equipment are brought online only when required. A BMCS also allows equipment and their energy consumption to be monitored, facilitating troubleshooting and reducing excessive energy consumption when key components, such as sensors or equipment, fail.

Building-level Metering

Building-level energy meters will enable ongoing tracking of energy consumption and identification of targeted energy management strategies to reduce consumption. Submetering and monitoring of major water uses and sources, connected to the BMS to identify leaks.

5.2.4 Data Hall Cooling System

The data halls are served by Data Hall Air Handling Units (DAHUs), with 16 units on duty per data hall. There are 9 data halls in total within the DC01 building.

DAHUs are direct evaporative cooling units with bypass mode and air circulation mode available to operate when outside air conditions are favourable. Our assessment was with the consideration that the DAHUs are in evaporative cooling mode when the outside air temperature rises above 27°C.

The following table summarises energy use for the data hall cooling system:

System	Motor Power (kW)	Number of Halls	Annual Running Hours	Energy Consumption (kWh p.a.)
DAHUs	634	9	8,760	49,953,024
Data Hall Exhaust Fans	232	9	8,760	18,290,880
Total Energy Use (kWh p.a.)				68,243,904

The table below summarises the water use for the DAHUs that serve the data halls on a monthly basis considering the operation in evaporative mode only when required.

Month	Water Demand (kL/month)
January	7,074
February	3,516
March	1,672
April	429
May	43
June	0
July	0
August	0
September	943
October	1,715
November	4,245
December	3,001
Total (kL p.a.)	22,638

Refer to ***GRDC86-LCI-00-XX-RP-SSDA-EM-0001 Energy and Water Report*** for detailed information.

5.2.5 Backup Power

Multiple backup power system options are available for data centres and the below list was considered as options for the project.

- Diesel generator
- Diesel rotary uninterruptible power supply devices (DRUPS)
- Biofuel generator
- Hydrogen fuel generator
- Solar PV with battery storage

In the options analysis for backup power system selection, the following criteria were looked into to select an appropriate backup power system for the development.

- Capital expenditure (Capex)
- Operation issues
- Availability issues
- Green House Gas Emissions

Based on the options available and criteria for selection, an options analysis was conducted with the below summarised impact significance matrix.

Backup Power Option	Capex	Operational Issues	Availability Issues	Emissions
Diesel generator	Low	Low	Low	High
DRUPS	Medium	Medium	Low	High
Biofuel generator	Medium	High	Medium	Medium
Hydrogen fuel generator	Very High	Very High	High	Low

With the results of the options analysis, diesel generators were identified as the option with the lowest total impact and would be the preferred option for this development.
Refer to ***GRDC86-LCI-00-XX-RP-SSDA-EM-0001 Energy and Water Report*** for detailed information.

5.2.6 Electrical Services

<u>On-site Solar PV</u>
The project will incorporate a solar photovoltaic (PV) system with maximum capacity allowance of 455 kW with anticipated approximately 910 PV panels. Only 50% of the PV panels are planned to be installed as part of the first stage (227.5kW – 455 panels). During detailed design, once more accurate electrical sizing is finalised, the size of the PV system may be increased subject to spatial and structural limitations.

<u>Energy-efficient IT Equipment</u>
The proposed development will use best practice, highly efficient IT equipment. This allows less energy to be consumed for the provision of the same services. As energy consumption for IT equipment constitutes the most significant portion of energy consumption by the site, minimising this demand will have a large impact on the energy consumption of the proposed development.

Lighting
The proposed development will use robust, long-life LED lighting throughout the building and will constitute a majority of all luminaires. This efficient lighting and lighting controls (photocells, time-clock) throughout project site will reduce the power demand and energy consumption. The long life of LEDs also reduces the need for replacement, which further reduces waste and its associated impact on the environment. Sustainable design features including low energy LED lighting, automatic car lighting, ventilation control, signalization dimming and standby mode.

Distributed UPS Power Architecture
Distributed battery systems are proposed that will improve energy efficiency due to reduced losses compared to conventional double-conversion UPS.

5.3 Water Use

The Operator has made a commitment to become water positive by 2030 by returning more water to communities and the environment than used in direct operations. The following site specific initiatives will help to deliver on this commitment:

Reduce Water Consumption
The project will include identification of opportunities to reduce water consumption and potential uses for non-potable water. Evaporative coolers within air handling units and cooling towers for mechanical cooling are the major consumers of water on site. Systems selected allow excess water that is not evaporated to be reused until the concentration of solids within the coolers' sump water reaches three times the incoming water to achieve 3 cycles of concentration, thus reducing discharge to the sewers and reducing overall water consumption. The project will also adopt high-efficient water fixtures with WELS ratings and appliances for use. Fire protection systems have been designed as a closed loop system with water recirculation during testing which further reduces discharge. The Water efficient construction practices to include monitoring and recording all water use utilized by construction equipment (mobile and fixed), and any project offices located on the project site (e.g. trailers), for the duration of construction.

Rainwater Capture and Reuse
Rainwater harvesting and reuse shall be used and non-potable water reticulation from the rainwater harvesting plant to serve all toilets in the building. Rainwater from roof downpipes will be harvested and used as a primary source for evaporative cooling system, toilet flushing and irrigation. This is consistent with Blacktown City Council requirements for rainwater reuse for irrigation. The development is being provided with a 100kL rainwater harvesting tank effective storage capacity. It is intended that the rainwater harvesting system and re-use provided on site will reduce the annual potable water demand on the Sydney Water network by approximately 11%.

Low-Irrigation Demand Plant Selection
Plants with low irrigation demand will be considered to reduce water consumption for irrigation. The potential for plants that require low-irrigation will contribute strongly towards water usage reduction.

Strategic Water Metering
Building-level and sub-metering will be provided to monitor and record the water consumption of the overall development, as well as irrigation systems, water fixtures and water use for the mechanical systems. The meters will be connected to the BMCS system to enable monitoring and recording of water use data and to facilitate troubleshooting and improve water use efficiency.

5.4 Waste Minimisation

Construction and Demolition Waste Reduction
Construction and demolition waste will be reduced by diverting waste from going to landfill. The project will identify the potential waste streams and their expected quantities, collection and diversion methods for each waste stream, roles and responsibilities, and the waste haulers to be engaged. The project is expected to aim for a waste diversion target of 85%.

Operational Waste Management
Provisions in design include adequate space provided for separation of waste streams including – General waste (landfill); Paper / cardboard (recycled); E-waste (recycled) and Hazardous waste to be managed carefully to meet regulations and minimise environment impact recycle where possible. Electronic waste will be managed responsibly by implementing e- waste collection systems and utilising external recovery and recycling programs to minimize the environmental impact.

5.5 Embodied Carbon & other Scope 3 Greenhouse Gas Emissions

Embodied Carbon

Materials Procurement
The Operator measures their scope 3 emissions for materials used in new developments as part of their Net Zero targets; even simple specification of lower carbon concrete sends a market signal to suppliers / manufacturers regarding demand for more responsible products. This development is committed to the use of lower carbon construction materials and recycled materials where possible, including

- Durable materials, including reinforced and pre-stressed concrete, will be used for the primary structural frame and non-louvered facade in order to achieve a 50-year design life without replacement and with minimal maintenance.
- A commitment to using in-situ concrete with 30% lower embodied carbon, and investigating the feasibility of sourcing precast concrete with more than 25% lower embodied carbon.
- Use of Macro-fibre reinforcement of on-grade slabs (in lieu of reinforcing steel mesh)
- Responsible steel procurement, including steel procured from energy-reducing processes.
- The structural design reduces the volume of materials required to achieve the same function, e.g. through ‘lightweighting’.

End of Trip Facilities
The proposed development includes facilities to allow for active transport (e.g. cycling, walking) to and from the site, including showers and bicycle racks. Minimum end of trip facilities will include Bicycle parking and showers and lockers with changing room facilities. Number of bicycle parking spaces to be consistent with ratio of staff numbers. The provision of bicycle parking will be assisted by providing or promoting maps of local cycling paths and walking routes between local public transport and project site that will be available to all staff and encourage occupants to use them, which will enable the building to indirectly reduce the environmental impact through its occupants.

Electric Vehicle Chargers
Charging facilities for electric vehicles have been included in parking bays, encouraging the use of EV’s, and reducing local pollution. The provision of electric vehicle (EV) charging facilities, so that staff and

visitors can access electric charging on site. As a guide, two EV charging stations are to be made available for every 50 carparks. The EV installation shall encourage occupants to purchase and drive electric vehicles. The development will use hybrid or fully electric vehicles for its fleet vehicles to reduce direct emissions by drivers. As the energy grid becomes greener and renewable energy is further adopted, the greenhouse gas emissions of electric vehicles will be reduced further.

6 References

Reports and Documentation reviewed as part of the investigation for this report includes:

- SEPP Biodiversity and Conservation 2021
- Blacktown Local Environment Plan (LEP) 2015
- Blacktown Development Control Plan (DCP) 2015
- Project /Consultant Brief by WillowTree Planning dated 7 November 2024.
- Geotechnical Desktop Review by Martens dated 13 November 2024.
- Environmental Site Assessment Phase 1 by AECOM dated 03 February 2024.
- Environmental Site Assessment Phase 2 by AECOM dated 13 February 2024.
- Natural Resources Assessment by AECOM dated 13 February 2024.
- Draft Arboricultural Impact Assessment by Capability Green Consulting dated 8 November 2024.
- Draft Bush Fire Assessment Report by Bushfire Consulting Services dated 9 July 2024.
- Visual Impact Assessment Report by GEOSCAPES Landscape Architecture dated 9 Oct 24.
- Civil and Stormwater Design Report by Acor Consultants dated 8 November 2024.
- Flood Impact Assessment Report by Acor Consultants dated 8 November 2024.
- Architectural Plans (SSDA) by Greenbox Architecture dated 4 October 2024.
- Planning Secretary's Environmental Assessment Requirements (Data Storage Centres)
- Blacktown City Council. Available at: https://www.blacktown.nsw.gov.au/(Accessed: 2024)
- Google Earth. Available at: https://earth.google.com/web/(Accessed: 2024)
- (2024) NSW Environment and Heritage. Available at: https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap (Accessed: 2024)

Appendix A Greenhouse Gas Assessment

Executive Summary

This appendix presents a Greenhouse Gas (GHG) Emissions Assessment for the proposed data centre development located at 2 Glendenning Road, Glendenning. It has been prepared in accordance with the NSW Guide for Large Emitters as requested in response to the request from the NSW EPA provided in the SSDA Response to Submission (RTS) comments.

The assessment is of the proposed project considering the three main delivery stages corresponding to three data centre buildings DC-01, DC-02 and DC-03 and associated timing estimates for construction, IT functional capacity utilisation and operational design life.

GHG assessment has been carried out for the identified assessment boundary to estimate the emissions for the identified sources of the project across three comparative scenarios as follows:

- Scenario 1: Design Measures – Includes the targeted project design features that minimise demand and maximise efficiency in support of the target annual PUE of 1.17.
- Scenario 2: All Measures – Per scenario 1 plus an estimated 81% of electricity procured is matched with renewable energy sources from operational commencement and net-zero emissions (scope 1 & 2) is supported by 2040.
- Scenario 3: Benchmark – Equivalent to the national average data centre performance of an approximate PUE of 1.6 that exceeds the minimum 3 Star NABERS Energy for Data Centres Infrastructure requirement per the project SEARs.

In consideration of the scenarios emissions estimates were made across Scope 1 and 2 categories for both likely Operational Throughput and Maximum Throughput. Scope 3 emissions have also been estimated for information as required by the guide.

The following table provides a summary of the Scope 1 and 2 emissions estimates for the assessed scenarios. Note the assessment results are based on the annual balance of energy and emissions.

Table 1: Design Life Scope 1 & 2 Emissions (t-CO2-e) Summary – Operational Throughput

Emissions Scope	GHG Emissions (t-CO_2-e)		
	Benchmark	Design Measures	All Measures
Scope 1	11,834	8,654	1,438
Scope 2	13,163,995	9,535,627	502,475
Subtotal 1 + 2	**13,175,829**	**9,544,281**	**503,914**
Percentage Difference to Benchmark		*-27.6%*	*-96.2%*
Average Annual Scope 1+2 (t-CO_2-e / yr)	243,997	176,746	9,332

The estimated annual Scope 1 & 2 emissions due to the pursued Design Measures is around 27.6% less emissions than that of the Benchmark approximate national average performance. This demonstrates the operator through the design is committed to minimising energy demand and avoiding associated emissions.

Per the operator's commitments and emissions goals, considering All Measures being pursued leads to the Scope 1 & 2 emissions being almost entirely eliminated with an estimated 96.2% reduction compared to the Benchmark. Annual average emissions estimated at 9,332t-CO_2-e/yr annual average over the project life is well below the NSW Guide for Large Emitters threshold of 25,000 t-CO_2-e/yr.

A.1 Introduction

The following section presents a Greenhouse Gas (GHG) Assessment prepared in accordance with the NSW (EPA) Guide for Large Emitters, of the proposed data centre development located at 2 Glendenning Road, Glendenning. The GHG Assessment has been prepared in response to the NSW EPA request for preparation in the project SSDA Response To Submission (RTS) comments. This section is to be read in conjunction with and is supplementary to the project ESD Report.

A.1.1 Large Emitter Trigger

In accordance with Section 2.1 of the NSW Guide for Large Emitters, there are three criteria that if met a project is classified as a large emitter as follows and must prepare a GHG Assessment in accordance with the guide.

1. The project proposal requires development assessment and approval under the Environmental Planning and Assessment Act 1979;
2. The project involves scheduled activities under Schedule 1 of the POEO Act; and
3. The project is likely to emit more than 25,000 tonnes of scope 1 and 2 emissions carbon dioxide equivalent (CO_2-e) in any financial year during the operational life of the project (based on planned operational throughput and as designed).

The proposed development is understood to meet criteria 1 and 2 as approval is required under the EP&A Act and involves activities per POEO Act Schedule 1 such as for site diesel storage. The proposed development is also understood to exceed the Scope 1 & 2 emissions threshold of 25,000 t-CO_2-e per year for criteria 3. As all criteria are met the project is considered as a large emitter per the NSW Guide for Large Emitters.

A.1.2 IPCC sectors and subsectors of the project emissions

The project emissions are considered to have the following sector and subsector categorisation according to the Intergovernmental Panel on Climate Change (IPCC) aligned to the production categories used in the emissions assessment.

Table 2: Alignment to IPCC emissions sectors and subsectors

Production	Source	Sector	Subsector	Scope
Diesel Oil	Generators	Energy	Buildings	1 & 3
Non-IT Electricity	Grid	Energy	Buildings	2 & 3
IT Electricity	Grid	Energy	Buildings	2 & 3
Materials & Construction	Extraction, Transport, Manufacture & Construction	Energy	Manufacturing & Construction	3
Water Treatment & Distribution for Use	Grid	Energy	Other	3

A.1.3 Project Stages and Life

The proposed data centre development comprises three buildings each individually provided with associated supporting infrastructure that will be delivered in three stages. The following table describes the estimated timing for the project construction and fitout stages used as the basis of the assessment:

Table 3: Project Staging

Stage	Building	Construction Start	Construction End	Operational Start	IT Capacity Fitout
1	DC-01	Jun-2026	Sep-2028	Jan-2029	11.1% at operational start 33.3% 3 months post start

Stage	Building	Construction Start	Construction End	Operational Start	IT Capacity Fitout
					55.5% 6 months post start 100% 9 months post start
2	DC-02	Jun-2028	Jun-2030	Sep-2030	25% at operational start 50% 6 months post start 100% 9 months post start
3	DC-03	Jun-2030	Jun-2032	Sep-2032	11.1% at operational start 33.3% 3 months post start 55.5% 6 months post start 77.7% 9 months post start 100% 13 months post start

The data centre buildings are assumed for the assessment to have an overall design life minimum of 50 years.

A.2 GHG Emissions Assessment

A.2.1 Assessment Boundary

The GHG assessment boundary of the proposed development considers the following project life stages and elements:

- Construction of each new data centre building including:
  - Materials Production – Modules A1 to A3
  - Construction – Modules A4 to A5
- Operation over the design life including:
  - Energy Use – Module B6
  - Water Use – Module B7

Demolition, land clearing and excavation works prior to construction are not accounted for in this GHG assessment as these works fall under a separate development application.

Decommissioning, closure, post-closure and maintenance/repair/replacement activities are not considered in this GHG assessment boundary as it is anticipated the GHG emissions associated with materials maintenance and the end-of-life stage are minimal relative to the GHG emissions associated with construction and operations. Similarly, emissions from small AC unit refrigerants and sulphur hexafluoride (SF_6) in HV switch gear are not included as considered negligible relative to the operational emissions.

Scope 3 emissions associated with the organisational operation of the operator have not been considered for this assessment.

A.2.2 Assessment Scenarios

For the GHG assessment, the following scenarios have been considered for the emissions estimates:

Scenario 1: Design Measures

- Includes the targeted project design features that maximise energy efficiency avoiding associated emissions in support of the target annual average PUE of 1.17 and are described under ‘Avoid and Reduce’ in Section A.2.4.

Scenario 2: All Measures

- Includes all pursued emissions mitigation measures for the design and energy sourcing/offsets as described under both 'Avoid and Reduce' and 'Substitute and Offset' in Section A.2.4.

Scenario 3: Benchmark

- Reference Benchmark performance equivalent to the national average Data Centre performance that is approximately an annual average Power Usage Effectiveness (PUE) of 1.6. This Benchmark performance exceeds the NABERS Energy for Data Centres Infrastructure minimum 3 Star performance as demanded by the SEARs requirements.

For each scenario, the Maximum Throughput and Operational Throughput has been considered in accordance with the NSW Guide for Large Emitters requirements for the estimation of Scope 1 and 2 emissions. Maximum Throughput has been based on operating the project at 100% IT equipment load at all times however it is noted that this is implausible to occur due to the variation in IT equipment utilisation that will occur in operation. Operational Throughput has been based on the estimated likely average IT equipment loading of 80% considered to occur in operation.

A.2.3 Emissions Sources across Scopes

The GHG emissions estimates consider the project sources of emissions per the emissions scope as described in the following sections.

A.2.3.1 Scope 1 Sources

Scope 1 relates to the direct emissions from sources under the operator's control within the boundary of the project that includes:

- Diesel consumption from testing backup generators.

The following table describes the estimated annual operational runtime hours for testing the backup generators and associated diesel consumption utilised for the scope 1 (and scope 3) emissions assessment. The diesel use is determined considering the engine diesel consumption at generator test loads and test run hours across the number of generators in the design necessary to support the backup electrical load.

Table 4: Backup Generator Testing Annual Diesel Consumption Estimates

Test Type	Load	Diesel Consumption (L/hr)	Annual Testing Generator Runtime Hours			
			DC-01	DC-02	DC-03	Total Site
36 Month Testing	100%	765.5	13.0	6.3	13.0	32.3
Annual Testing	70%	545.2	19.5	9.5	19.5	48.5
Monthly Testing	No load	137.6	31.2	15.6	31.2	78.0
Annual Testing Diesel Consumption (L/yr)			**24,876**	**12,174**	**24,876**	**61,926**

Diesel consumption has been assumed to be equal in the assessment of both Maximum Throughput and Operational Throughput as the testing regime is not considered dependent on IT equipment utilisation.

A.2.3.2 Scope 2 Sources

Scope 2 relates to the indirect emissions resulting from the consumption of imported electricity from the local electricity grid covering the following applicable to the project:

- Electricity of the non-IT components of the project including:
  - Mechanical HVAC systems and ancillary ventilation systems supporting the data halls and office spaces;
  - Other building services including lighting, general power, lifts, domestic hot water, hydraulic & fire pumps and miscellaneous allowances; and
  - Additional electrical consumption to compensate for system losses, including electrical equipment losses and PDU losses.
- Electricity consumption of the IT equipment within the data centre.

The following table details the estimated annual grid imported electricity consumption considered for the scope 2 (and scope 3) emissions assessment across the assessment scenarios. Refer to the project *Energy and Water Report* (GRDC86-LCI-00-XX-RP-SSDA-EM-0001) for detailed calculations of the estimated imported electricity consumed by the project.

Table 5: Annual Imported Electricity Consumption Estimates for the Emissions Assessment Scenarios

Scenario		Throughput	Source	Imported Electricity (MWh/year)			
Ref	**Name**	**-**	**-**	**DC-01**	**DC-02**	**DC-03**	***Total***
1 & 2	Design & All Measures	Maximum	Non-IT	116,473	51,766	116,473	***284,712***
			IT Load	693,792	308,352	693,792	***1,695,936***
		Operational	Non-IT	93,178	41,413	93,178	***227,770***
			IT Load	555,034	246,682	555,034	***1,356,749***
3	Benchmark	Maximum	Non-IT	424,784	188,793	424,784	***1,038,361***
			IT Load	693,792	308,352	693,792	***1,695,936***
		Operational	Non-IT	297,349	132,155	297,349	***726,853***
			IT Load	555,034	246,682	555,034	***1,356,749***

A.2.3.3 Scope 3 Sources

Scope 3 relates to the indirect emissions (other than scope 2) that are generated in the wider economy including the following attributable to the project that have been considered for the assessment:

- Supply of diesel for the testing of backup generators;
- Losses through the electricity transmission and distribution network;
- Supply of potable water to the project; and
- Construction and materials embodied emissions.

The assessment of scope 3 emissions associated with the project diesel and electricity consumption utilised consumption estimate data as detailed in Table 4 and Table 5 respectively.

The following table details the estimated annual potable water consumption considered for the scope 3 emissions assessment. No difference in water consumption has been considered for the different scenarios. Refer to the project *Energy and Water Report* (GRDC86-LCI-00-XX-RP-SSDA-EM-0001) for detailed calculations of the estimated project potable water consumption.

Table 6: Annual Potable Water Consumption Estimates

Data Centre	Potable Water Consumption (kL/year)
DC-01	18,466
DC-02	31,053
DC-03	18,466
Total	**170,793**

The calculation of emissions associated with the construction of the new data centres DC-01, DC-02 and DC-03, have utilised materials quantities provided by the project quantity surveyor as detailed in the NABERS Embodied Materials Forms provided with the project SSDA submission. The material quantities have then been included in the NABERS Embodied Carbon Calculator to establish the associated emissions.

A.2.4 Mitigation Measures

In accordance with EPA expectations as detailed within the NSW Guide for Large Emitters, the emissions mitigation hierarchy as shown in the figure below has been followed in pursuit of mitigation measures for the project. This includes efforts to first avoid then reduce emissions through design followed by measures to replace (substitute) high-emission energy sources with those that are low-emission, before offsetting residual emissions to meet emissions goals.

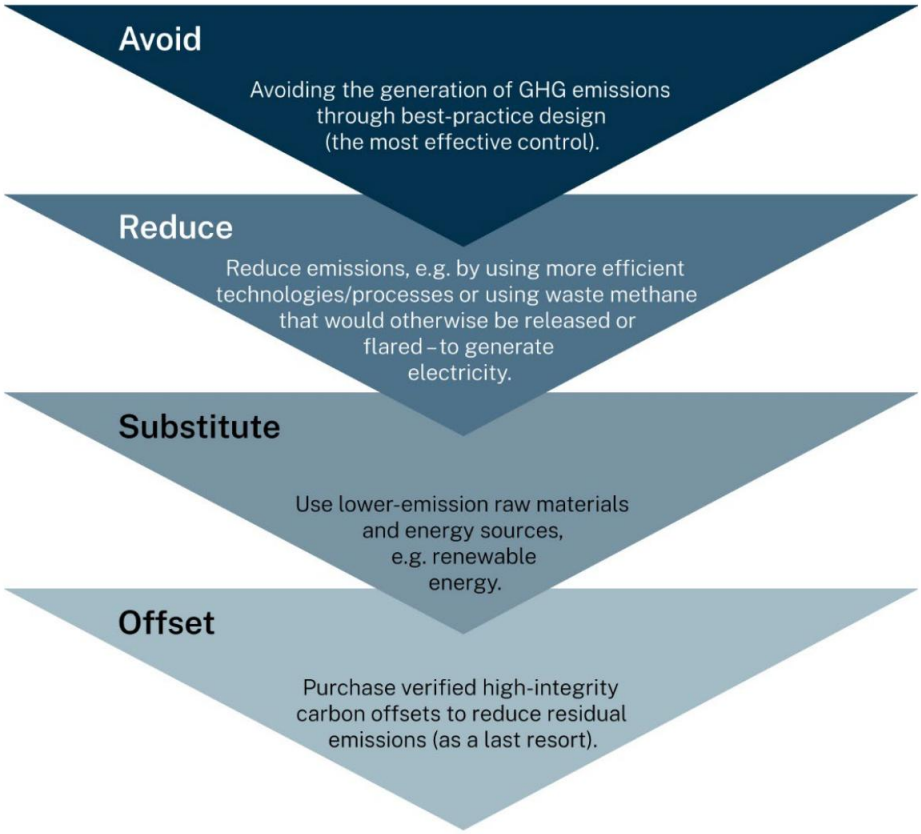

Figure 1: GHG Emissions Mitigation Hierarchy (source: NSW Guide for Large Emitters)

Detailed below are summaries of the measures being pursued by the operator for the project to mitigate GHG emissions prioritised and categorised according to the mitigation hierarchy above.

Avoid and Reduce

The following energy efficient design features considered best-practice are being pursued for the design to support the Power Usage Effectiveness (PUE) target of 1.17 annual average. These were selected for the design following the options analysis completed on major cooling and backup plant systems as described in the project *Energy and Water Report* (GRDC86-LCI-00-XX-RP-SSDA-EM-0001):

- Direct evaporative coolers for data halls as the cooling system, in lieu of chillers, which has low energy demand and zero refrigerant impacts.
- Elevated data hall cooling setpoint temperature to reduce cooling demands.
- On-site solar PV system for renewable energy generation with a targeted rated output capacity of 455kWe are following completion of all three project stages.
- Distributed battery systems are proposed with rack level conversion and storage that will improve energy efficiency due to reduced losses compared to conventional double-conversion UPS.
- High efficiency LED lighting selections throughout to minimise demand coupled with occupant responsive controls to minimise operational time and associated energy consumption.
- Low absorptivity / high Solar Reflective Index (SRI) building external finishes to reduce radiant heat gains and data hall cooling loads.

Measures described above are those included in assessment 'Scenario 1: Design Measures' per Section A.2.2.

Substitute and Offset

The operator is committed to achieve net-zero operational carbon emissions (scope 1&2) by the year 2040. In Australia, the operator has enabled utility-scale renewable energy projects resulting in 81% of electricity consumed currently being matched by renewable energy sources. This is anticipated to continue for the proposed project in accordance with the target of net-zero operational emissions by 2040. Further, the pursuit of net-zero operational emissions will be targeted through initiatives including:

- Continue to look for opportunities to enable more utility-scale renewable energy projects in Australia such that by 2040 net zero emissions from electricity can be supported. For assessment purposes, a linear reduction in emissions per unit of electricity from operational start to 2040 has been assumed;
- Utilisation of renewable Hydrotreated Vegetable Oil (HVO) diesel for backup generators subject to economical and highly-reliable availability of a viable source; and
- Neutralise remaining emissions with credible offsets.

Measures described under both 'Avoid and Reuse' and 'Substitute and Offset' categories above are included in assessment 'Scenario 2: All Measures' per Section A.2.2.

A.2.5 Assessment Assumptions

The following list summarised key assumptions used to development the emissions estimates:

- Diesel consumption from generator testing based on anticipated testing regime provided by project team and nominal equipment fuel consumption rates for test loads.
- National average data centre annual Power Usage Effectiveness (PUE), as used for Benchmark comparison Scenario 3, approximated at 1.6 based on several data sources.
- Annual operational electricity consumption based on that estimated in the project *Energy and Water Report* (GRDC86-LCI-00-XX-RP-SSDA-EM-0001)
- The maximum annual operational electricity estimates were modified according to an estimated operational throughput for an annual average 70% utilisation.

- Operational electricity was based on 50% capacity from Operational Commencement (see A.1.3) for the first 6 months, then 100% capacity onwards.
- Operational potable water consumption based on that estimated in the project *Energy and Water Report* (GRDC86-LCI-00-XX-RP-SSDA-EM-0001).
- Materials embodied and construction related emissions based on the materials quantities provided by the project Quantity Surveyor as described in the NABERS Embodied Emissions Materials Forms and emissions estimated using the NABERS Embodied Emissions calculator.

A.2.6 Emissions Estimation

The following Greenhouse Gas (GHG) emissions estimations are based on the assessment boundary as described in Section A.2.1 for the scenarios as described in Section A.2.2 considering the emissions sources and scopes as described in A.2.3. Results consider the annual balance of energy and emissions.

The GHG emissions have been estimated using emissions factors as detailed in the following table. Current factors have been sourced from the latest National Greenhouse Accounts Factors (2025) published by the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW), and the Sydney Water Annual Environmental Performance Report (2023-2024). Future electricity emissions factors have been estimated considering the Australian Government target of net zero emissions by 2050, to be supported in part through the future greening of the grid, based on a linear reduction from current factors to a small residual emissions level by 2050.

Table 7: Emissions Factors per Assessment Scenarios

Source	Year	Emissions Factors (kg.CO_2-e / unit)			Unit
		Scope 1	*Scope 2*	*Scope 3*	
Diesel Oil	All years	70.2[1]	-	17.3	GJ
Water Supply	All years	-	-	1.6[2]	kL
NSW Electricity	2025	-	0.64	0.04	kWh
	2050	-	0.03	0.01	

Notes: 1. Factor is the carbon dioxide equivalent (CO_2-e) total covering the combined gases emissions of CO_2, CH_4 and N_2O
2. Upper end of the range detailed in the Sydney Water Annual Environmental Performance Report.

A.2.6.1 Scope 1 and 2 Emissions Estimates

Operational Throughput

The following table details the Scope 1 and 2 emissions estimates for the project activity data based on the Operational Throughput over the predicted project design life for the Design Measures scenario.

*Table 8: Scope 1 & 2 Emissions (t-CO_2-e) Estimation – **Operational** Throughput – **Design Measures Scenario 1***

Scenario	Design Measures				Benchmark	
Production	Diesel	Non-IT Electricity	IT Electricity	**Total Scope 1+2 (t-CO_2-e)**	**Total Scope 1+2 (t-CO_2-e)**	**Percentage Difference to Benchmark**
Production Rate	61.93	227,770	1,356,749			
Units	kL/yr	MWh/yr	MWh/yr			
Source	Generators	Grid	Grid			
Sector	Energy	Energy	Energy			
Sub Sector	Buildings	Buildings	Buildings			
Year	**Scope 1 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**			
2026	0	0	0	0	0	-
2027	0	0	0	0	0	-

2028	0	0	0	0	0	-
2029	26	19,186	114,288	133,500	184,297	-27.6%
2030	70	50,054	298,156	348,280	480,802	-27.6%
2031	84	56,214	334,846	391,143	539,974	-27.6%
2032	104	65,579	390,633	456,316	629,946	-27.6%
2033	148	89,032	530,333	619,512	855,238	-27.6%
2034	168	95,754	570,377	666,299	919,828	-27.6%
2035	168	90,197	537,273	627,637	866,455	-27.6%
2036	168	84,639	504,168	588,975	813,081	-27.6%
2037	168	79,082	471,063	550,313	759,708	-27.6%
2038	168	73,524	437,959	511,650	706,334	-27.6%
2039	168	67,966	404,854	472,988	652,961	-27.6%
2040	168	62,409	371,749	434,326	599,587	-27.6%
2041	168	56,851	338,645	395,664	546,214	-27.6%
2042	168	51,294	305,540	357,001	492,840	-27.6%
2043	168	45,736	272,435	318,339	439,467	-27.6%
2044	168	40,179	239,330	279,677	386,094	-27.6%
2045	168	34,621	206,226	241,015	332,720	-27.6%
2046	168	29,063	173,121	202,352	279,347	-27.6%
2047	168	23,506	140,016	163,690	225,973	-27.6%
2048	168	17,948	106,912	125,028	172,600	-27.6%
2049	168	12,391	73,807	86,366	119,226	-27.6%
2050	168	6,833	40,702	47,703	65,853	-27.6%
2051	168	6,833	40,702	47,703	65,853	-27.6%
2052	168	6,833	40,702	47,703	65,853	-27.6%
2053	168	6,833	40,702	47,703	65,853	-27.6%
2054	168	6,833	40,702	47,703	65,853	-27.6%
2055	168	6,833	40,702	47,703	65,853	-27.6%
2056	168	6,833	40,702	47,703	65,853	-27.6%
2057	168	6,833	40,702	47,703	65,853	-27.6%
2058	168	6,833	40,702	47,703	65,853	-27.6%
2059	168	6,833	40,702	47,703	65,853	-27.6%
2060	168	6,833	40,702	47,703	65,853	-27.6%
2061	168	6,833	40,702	47,703	65,853	-27.6%
2062	168	6,833	40,702	47,703	65,853	-27.6%
2063	168	6,833	40,702	47,703	65,853	-27.6%
2064	168	6,833	40,702	47,703	65,853	-27.6%
2065	168	6,833	40,702	47,703	65,853	-27.6%
2066	168	6,833	40,702	47,703	65,853	-27.6%
2067	168	6,833	40,702	47,703	65,853	-27.6%
2068	168	6,833	40,702	47,703	65,853	-27.6%
2069	168	6,833	40,702	47,703	65,853	-27.6%
2070	168	6,833	40,702	47,703	65,853	-27.6%
2071	168	6,833	40,702	47,703	65,853	-27.6%
2072	168	6,833	40,702	47,703	65,853	-27.6%
2073	168	6,833	40,702	47,703	65,853	-27.6%
2074	168	6,833	40,702	47,703	65,853	-27.6%
2075	168	6,833	40,702	47,703	65,853	-27.6%
2076	168	6,833	40,702	47,703	65,853	-27.6%
2077	168	6,833	40,702	47,703	65,853	-27.6%

2078	168	6,833	40,702	47,703	65,853	-27.6%
2079	168	6,833	40,702	47,703	65,853	-27.6%
2080	168	6,833	40,702	47,703	65,853	-27.6%
2081	168	6,833	40,702	47,703	65,853	-27.6%
2082	168	6,833	40,702	47,703	65,853	-27.6%
Total	**8,654**	**1,370,717**	**8,164,910**	**9,544,281**	**13,175,829**	**-27.6%**

The following table details the Scope 1 and 2 emissions estimates for the project activity data based on the Operational Throughput over the predicted project design life for the All Measures scenario.

*Table 9: Scope 1 & 2 Emissions (t-CO_2-e) Estimation – **Operational** Throughput – **All Measures Scenario 2***

Scenario	**All Measures**				**Benchmark**	**Percentage Difference to Benchmark**
Production	Diesel	Non-IT Electricity	IT Electricity	**Total Scope 1+2 (t-CO_2-e)**	**Total Scope 1+2 (t-CO_2-e)**	
Production Rate	61.93	227,770	1,356,749			
Units	kL/yr	MWh/yr	MWh/yr			
Source	Generators	Grid	Grid			
Sector	Energy	Energy	Energy			
Sub Sector	Buildings	Buildings	Buildings			
Year	**Scope 1 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**			
2026	0	0	0	0	0	-
2027	0	0	0	0	0	-
2028	0	0	0	0	0	-
2029	26	3,645	21,715	25,386	184,297	-86.2%
2030	70	8,646	51,500	60,216	480,802	-87.5%
2031	84	8,739	52,053	60,876	539,974	-88.7%
2032	104	9,062	53,978	63,144	629,946	-90.0%
2033	148	10,765	64,122	75,035	855,238	-91.2%
2034	168	9,924	59,112	69,203	919,828	-92.5%
2035	168	7,790	46,401	54,358	866,455	-93.7%
2036	168	5,848	34,833	40,849	813,081	-95.0%
2037	168	4,098	24,410	28,675	759,708	-96.2%
2038	168	2,540	15,129	17,837	706,334	-97.5%
2039	168	1,174	6,993	8,335	652,961	-98.7%
2040	0	0	0	0	599,587	-100.0%
2041	0	0	0	0	546,214	-100.0%
2042	0	0	0	0	492,840	-100.0%
2043	0	0	0	0	439,467	-100.0%
2044	0	0	0	0	386,094	-100.0%
2045	0	0	0	0	332,720	-100.0%
2046	0	0	0	0	279,347	-100.0%
2047	0	0	0	0	225,973	-100.0%
2048	0	0	0	0	172,600	-100.0%
2049	0	0	0	0	119,226	-100.0%
2050	0	0	0	0	65,853	-100.0%
2051	0	0	0	0	65,853	-100.0%
2052	0	0	0	0	65,853	-100.0%
2053	0	0	0	0	65,853	-100.0%
2054	0	0	0	0	65,853	-100.0%
2055	0	0	0	0	65,853	-100.0%

2056	0	0	0	0	65,853	-100.0%
2057	0	0	0	0	65,853	-100.0%
2058	0	0	0	0	65,853	-100.0%
2059	0	0	0	0	65,853	-100.0%
2060	0	0	0	0	65,853	-100.0%
2061	0	0	0	0	65,853	-100.0%
2062	0	0	0	0	65,853	-100.0%
2063	0	0	0	0	65,853	-100.0%
2064	0	0	0	0	65,853	-100.0%
2065	0	0	0	0	65,853	-100.0%
2066	0	0	0	0	65,853	-100.0%
2067	0	0	0	0	65,853	-100.0%
2068	0	0	0	0	65,853	-100.0%
2069	0	0	0	0	65,853	-100.0%
2070	0	0	0	0	65,853	-100.0%
2071	0	0	0	0	65,853	-100.0%
2072	0	0	0	0	65,853	-100.0%
2073	0	0	0	0	65,853	-100.0%
2074	0	0	0	0	65,853	-100.0%
2075	0	0	0	0	65,853	-100.0%
2076	0	0	0	0	65,853	-100.0%
2077	0	0	0	0	65,853	-100.0%
2078	0	0	0	0	65,853	-100.0%
2079	0	0	0	0	65,853	-100.0%
2080	0	0	0	0	65,853	-100.0%
2081	0	0	0	0	65,853	-100.0%
2082	0	0	0	0	65,853	-100.0%
Total	**1,438**	**72,229**	**430,246**	**503,914**	**13,175,829**	**-96.2%**

Maximum Throughput

The following table details the Scope 1 and 2 emissions estimates for the project activity data based on the Maximum Throughput over the predicted project design life for the Design Measures scenario.

Note that the Maximum Throughput of 100% equipment loading at all times is considered implausible to occur due to the variation in IT equipment utilisation that will occur in operation.

*Table 10: Scope 1 & 2 Emissions (t-CO_2-e) Estimation – **Maximum** Throughput – **Design Measures Scenario 1***

Scenario	**Design Measures**				**Benchmark**	**Percentage Difference to Benchmark**
Production	Diesel	Non-IT Electricity	IT Electricity	**Total Scope 1+2 (t-CO_2-e)**	**Total Scope 1+2 (t-CO_2-e)**	
Production Rate	61.93	284,712	1,695,936			
Units	kL/yr	MWh/yr	MWh/yr			
Source	Generators	Grid	Grid			
Sector	Energy	Energy	Energy			
Sub Sector	Buildings	Buildings	Buildings			
Year	**Scope 1 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**			
2026	0	0	0	0	0	-
2027	0	0	0	0	0	-
2028	0	0	0	0	0	-

2029	26	23,983	142,859	166,868	230,362	-27.6%
2030	70	62,568	372,695	435,333	600,979	-27.6%
2031	84	70,267	418,557	488,908	674,939	-27.6%
2032	104	81,974	488,291	570,369	787,396	-27.6%
2033	148	111,290	662,916	774,353	1,068,998	-27.6%
2034	168	119,693	712,971	832,832	1,149,728	-27.6%
2035	168	112,746	671,591	784,504	1,083,011	-27.6%
2036	168	105,799	630,210	736,177	1,016,294	-27.6%
2037	168	98,852	588,829	687,849	949,578	-27.6%
2038	168	91,905	547,448	639,521	882,861	-27.6%
2039	168	84,958	506,067	591,193	816,144	-27.6%
2040	168	78,011	464,686	542,865	749,427	-27.6%
2041	168	71,064	423,306	494,538	682,710	-27.6%
2042	168	64,117	381,925	446,210	615,993	-27.6%
2043	168	57,170	340,544	397,882	549,276	-27.6%
2044	168	50,223	299,163	349,554	482,560	-27.6%
2045	168	43,276	257,782	301,226	415,843	-27.6%
2046	168	36,329	216,401	252,898	349,126	-27.6%
2047	168	29,382	175,021	204,571	282,409	-27.6%
2048	168	22,435	133,640	156,243	215,692	-27.6%
2049	168	15,488	92,259	107,915	148,975	-27.6%
2050	168	8,541	50,878	59,587	82,258	-27.6%
2051	168	8,541	50,878	59,587	82,258	-27.6%
2052	168	8,541	50,878	59,587	82,258	-27.6%
2053	168	8,541	50,878	59,587	82,258	-27.6%
2054	168	8,541	50,878	59,587	82,258	-27.6%
2055	168	8,541	50,878	59,587	82,258	-27.6%
2056	168	8,541	50,878	59,587	82,258	-27.6%
2057	168	8,541	50,878	59,587	82,258	-27.6%
2058	168	8,541	50,878	59,587	82,258	-27.6%
2059	168	8,541	50,878	59,587	82,258	-27.6%
2060	168	8,541	50,878	59,587	82,258	-27.6%
2061	168	8,541	50,878	59,587	82,258	-27.6%
2062	168	8,541	50,878	59,587	82,258	-27.6%
2063	168	8,541	50,878	59,587	82,258	-27.6%
2064	168	8,541	50,878	59,587	82,258	-27.6%
2065	168	8,541	50,878	59,587	82,258	-27.6%
2066	168	8,541	50,878	59,587	82,258	-27.6%
2067	168	8,541	50,878	59,587	82,258	-27.6%
2068	168	8,541	50,878	59,587	82,258	-27.6%
2069	168	8,541	50,878	59,587	82,258	-27.6%
2070	168	8,541	50,878	59,587	82,258	-27.6%
2071	168	8,541	50,878	59,587	82,258	-27.6%
2072	168	8,541	50,878	59,587	82,258	-27.6%
2073	168	8,541	50,878	59,587	82,258	-27.6%
2074	168	8,541	50,878	59,587	82,258	-27.6%
2075	168	8,541	50,878	59,587	82,258	-27.6%
2076	168	8,541	50,878	59,587	82,258	-27.6%
2077	168	8,541	50,878	59,587	82,258	-27.6%
2078	168	8,541	50,878	59,587	82,258	-27.6%

2079	168	8,541	50,878	59,587	82,258	-27.6%
2080	168	8,541	50,878	59,587	82,258	-27.6%
2081	168	8,541	50,878	59,587	82,258	-27.6%
2082	168	8,541	50,878	59,587	82,258	-27.6%
Total	**8,654**	**1,713,396**	**10,206,138**	**11,928,188**	**16,466,828**	**-27.6%**

The following table details the Scope 1 and 2 emissions estimates for the project activity data based on the Maximum Throughput over the predicted project design life for the All Measures scenario.

Note that the Maximum Throughput of 100% equipment loading at all times is considered implausible to occur due to the variation in IT equipment utilisation that will occur in operation.

*Table 11: Scope 1 & 2 Emissions (t-CO_2-e) Estimation – **Maximum** Throughput –**All Measures Scenario 2***

Scenario	**All Measures**				**Benchmark**	**Percentage Difference to Benchmark**
Production	Diesel	Non-IT Electricity	IT Electricity	**Total Scope 1+2 (t-CO_2-e)**	**Total Scope 1+2 (t-CO_2-e)**	
Production Rate	61.93	284,712	1,695,936			
Units	kL/yr	MWh/yr	MWh/yr			
Source	Generators	Grid	Grid			
Sector	Energy	Energy	Energy			
Sub Sector	Buildings	Buildings	Buildings			
Year	**Scope 1 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**	**Scope 2 (t-CO_2-e)**			
2026	0	0	0	0	0	-
2027	0	0	0	0	0	-
2028	0	0	0	0	0	-
2029	26	4,557	27,143	31,726	230,362	-86.2%
2030	70	10,807	64,375	75,252	600,979	-87.5%
2031	84	10,923	65,067	76,074	674,939	-88.7%
2032	104	11,327	67,473	78,904	787,396	-90.0%
2033	148	13,456	80,153	93,756	1,068,998	-91.2%
2034	168	12,405	73,890	86,462	1,149,728	-92.5%
2035	168	9,737	58,001	67,906	1,083,011	-93.7%
2036	168	7,310	43,542	51,019	1,016,294	-95.0%
2037	168	5,122	30,512	35,802	949,578	-96.2%
2038	168	3,175	18,912	22,255	882,861	-97.5%
2039	168	1,467	8,741	10,376	816,144	-98.7%
2040	0	0	0	0	749,427	-100.0%
2041	0	0	0	0	682,710	-100.0%
2042	0	0	0	0	615,993	-100.0%
2043	0	0	0	0	549,276	-100.0%
2044	0	0	0	0	482,560	-100.0%
2045	0	0	0	0	415,843	-100.0%
2046	0	0	0	0	349,126	-100.0%
2047	0	0	0	0	282,409	-100.0%
2048	0	0	0	0	215,692	-100.0%
2049	0	0	0	0	148,975	-100.0%
2050	0	0	0	0	82,258	-100.0%
2051	0	0	0	0	82,258	-100.0%
2052	0	0	0	0	82,258	-100.0%
2053	0	0	0	0	82,258	-100.0%

2054	0	0	0	0	82,258	-100.0%
2055	0	0	0	0	82,258	-100.0%
2056	0	0	0	0	82,258	-100.0%
2057	0	0	0	0	82,258	-100.0%
2058	0	0	0	0	82,258	-100.0%
2059	0	0	0	0	82,258	-100.0%
2060	0	0	0	0	82,258	-100.0%
2061	0	0	0	0	82,258	-100.0%
2062	0	0	0	0	82,258	-100.0%
2063	0	0	0	0	82,258	-100.0%
2064	0	0	0	0	82,258	-100.0%
2065	0	0	0	0	82,258	-100.0%
2066	0	0	0	0	82,258	-100.0%
2067	0	0	0	0	82,258	-100.0%
2068	0	0	0	0	82,258	-100.0%
2069	0	0	0	0	82,258	-100.0%
2070	0	0	0	0	82,258	-100.0%
2071	0	0	0	0	82,258	-100.0%
2072	0	0	0	0	82,258	-100.0%
2073	0	0	0	0	82,258	-100.0%
2074	0	0	0	0	82,258	-100.0%
2075	0	0	0	0	82,258	-100.0%
2076	0	0	0	0	82,258	-100.0%
2077	0	0	0	0	82,258	-100.0%
2078	0	0	0	0	82,258	-100.0%
2079	0	0	0	0	82,258	-100.0%
2080	0	0	0	0	82,258	-100.0%
2081	0	0	0	0	82,258	-100.0%
2082	0	0	0	0	82,258	-100.0%
Total	**1,438**	**90,287**	**537,807**	**629,532**	**16,466,828**	**-96.2%**

A.2.6.2 Scope 3 Emissions

Upfront Carbon Emissions for Materials and Construction

The project upfront scope 3 emissions have been outlined in the table below as the aggregation of the upfront carbon emissions of the product and construction stages (i.e. Building Life Cycle modules A1 to A5). The emissions have been established using the NABERS Embodied Carbon Calculator based on project materials quantity data per the NABERS Embodied Materials Forms provided with the SSDA submission.

Table 12: Upfront Materials and Construction Elements Scope 3 Emissions (t-CO_2-e) Estimation

Module	Scope 3 Emissions (t-CO_2-e)		
Materials, A1-A3	571,535	239,584	391,867
Transport, A4	19,755	8,238	13,348
Construction, A5	33,176	13,693	22,785
Subtotal per Building (A1-A5)	*624,466*	*261,515*	*428,001*
Total Project (A1-A5)	**1,313,983**		

The majority of the Upfront Materials and Construction scope 3 emissions are seen to be tied with the materials product stage (i.e. Module A1 to A3). These emissions can be reduced through measures such

as procurement of lower carbon construction materials and recycled materials where possible. Refer to Section 5.5 of the recommended material procurement initiatives for the development. No life cycle impacts assessment has been undertaken at this stage to determine the upfront carbon emission reductions achieved by the project with the recommended initiatives.

Overall Scope 3 Emissions Projection

The following table details the Scope 3 emissions estimates for the project activity data based on the Operational Throughput over the predicted project design life for the Design Measures scenario.

Table 13: Scope 3 Emissions (t-CO2-e) Estimation – Operational Throughput – Design Measures Scenario 1

Scenario	**Design Measures**						**Benchmark**	**Percentage Difference to Benchmark**
Production	Diesel	Non-IT Elec.	IT Elec.	Water	Materials & Construction	**Total Scope 3 (t-CO_2-e)**	**Total Scope 3 (t-CO_2-e)**	
Production Rate	61.93	227,770	1,356,749	45,139	N/A			
Units	kL/yr	MWh/yr	MWh/yr	kL/yr	N/A			
Source	Generators	Grid	Grid	Grid	Various			
Sector	Energy	Energy	Energy	Energy	Energy			
Sub Sector	Buildings	Buildings	Buildings	Other	Manufacture & Construction			
Year	**Scope 3 (t-CO_2-e)**	**Scope 3 (t-CO_2-e)**	**Scope 3 (t-CO_2-e)**	**Scope 3 (t-CO_2-e)**	**Scope 3 (t-CO_2-e)**			
2026	0	0	0	0	161,899	161,899	161,899	0.0%
2027	0	0	0	0	277,541	277,541	277,541	0.0%
2028	0	0	0	0	261,302	261,302	261,302	0.0%
2029	6	948	5,647	22	130,758	137,381	139,893	-1.8%
2030	17	2,512	14,965	32	179,316	196,843	203,499	-3.3%
2031	21	2,870	17,095	42	214,000	234,028	241,632	-3.1%
2032	26	3,410	20,314	48	89,167	112,965	122,001	-7.4%
2033	36	4,724	28,138	70	0	32,968	45,486	-27.5%
2034	41	5,193	30,934	72	0	36,241	50,002	-27.5%
2035	41	5,011	29,848	72	0	34,973	48,252	-27.5%
2036	41	4,829	28,763	72	0	33,705	46,502	-27.5%
2037	41	4,646	27,678	72	0	32,438	44,753	-27.5%
2038	41	4,464	26,592	72	0	31,170	43,003	-27.5%
2039	41	4,282	25,507	72	0	29,903	41,253	-27.5%
2040	41	4,100	24,421	72	0	28,635	39,503	-27.5%
2041	41	3,918	23,336	72	0	27,367	37,753	-27.5%
2042	41	3,735	22,251	72	0	26,100	36,003	-27.5%
2043	41	3,553	21,165	72	0	24,832	34,253	-27.5%
2044	41	3,371	20,080	72	0	23,564	32,503	-27.5%
2045	41	3,189	18,994	72	0	22,297	30,753	-27.5%
2046	41	3,007	17,909	72	0	21,029	29,003	-27.5%
2047	41	2,824	16,824	72	0	19,762	27,253	-27.5%
2048	41	2,642	15,738	72	0	18,494	25,503	-27.5%
2049	41	2,460	14,653	72	0	17,226	23,753	-27.5%
2050	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2051	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2052	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2053	41	2,278	13,567	72	0	15,959	22,003	-27.5%

2054	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2055	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2056	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2057	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2058	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2059	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2060	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2061	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2062	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2063	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2064	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2065	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2066	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2067	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2068	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2069	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2070	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2071	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2072	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2073	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2074	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2075	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2076	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2077	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2078	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2079	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2080	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2081	41	2,278	13,567	72	0	15,959	22,003	-27.5%
2082	41	2,278	13,567	72	0	15,959	22,003	-27.5%
Total	**2,133**	**150,853**	**898,581**	**3,752**	**1,313,983**	**2,369,301**	**2,769,401**	**-14.4%**

A.2.6.3 Total GHG Emissions Summaries

The following table summarises the scope 1 and 2 emissions associated with the project over the design life for the analysis scenarios. The annual average has also been provided based on the operational years for the overall project.

Table 14: Design Life Scope 1 & 2 Emissions (t-CO2-e) Summary – Operational Throughput

Emissions Scope	GHG Emissions (t-CO_2-e)		
	Benchmark	Design Measures	All Measures
Scope 1	11,834	8,654	1,438
Scope 2	13,163,995	9,535,627	502,475
Subtotal 1 + 2	**13,175,829**	**9,544,281**	**503,914**
Percentage Difference to Benchmark		*-27.6%*	*-96.2%*
Average Annual Scope 1+2 (t-CO_2-e / year)	243,997	176,746	9,332

Considering the project Design Measures being incorporated to avoid and reduce emissions per the mitigation hierarchy, a significant reduction in emissions is being supported estimated at 27.6%

compared to the Benchmark. Following the inclusion of substitute and offset pursued initiatives under the All Measures scenario, scope 1 and 2 emissions are close to eliminated over the project design life.

The following table provides the same summary data with the inclusion of scope 3 emissions. From these details it can be seen that compared to the Benchmark position a substantial reduction in overall emissions are supported for the project considering All Measures of mitigation.

Table 15: Design Life Scope 1, 2 & 3 Emissions (t-CO2-e) Summary – Operational Throughput

Emissions Scope	**GHG Emissions (t-CO_2-e)**		
	Benchmark	Design Measures	All Measures
Scope 1	11,834	8,654	1,438
Scope 2	13,163,995	9,535,627	502,475
Scope 3	2,769,401	2,369,301	2,369,301
Total	**15,945,230**	**11,913,582**	**2,873,215**
Percentage Difference to Benchmark		*-25.3%*	*-82.0%*
Average Annual Scope 1+2+3 (t-CO_2-e / year)	295,282	220,622	53,208

A.3 Emissions Goals

A.3.1 Reporting Obligations

A facility is required under the NGER Act to meet the reporting obligations of the act should the facility exceed the threshold of 25,000 t-CO_2-e per year of Scope 1 and 2 emissions. The obligations include reporting emissions data annually across both Scope 1 direct emissions and Scope 2 indirect emissions amongst other relevant data. The reported emissions data is disclosed publicly through the Clean Energy Regulator's NGER database.

The project is seen to exceed the threshold of 25,000 t-CO_2-e scope 1 and 2 emissions per year per the estimations provided in A.2.6.1. As such the operator will be responsible for providing annual reports per the NGER Act.

Note that response to Safeguard Mechanism and Electricity Firming Infrastructure as requested by the NSW Guide for Large Emitters is not required as these are not applicable to the project. The Safeguard Mechanism applies to projects that emit greater than 100,000 t-CO_2-e of Scope 1 emissions in any year which the project does not as can be seen in A.2.6.1. Electricity Firming Infrastructure applies to the grid energy storage / backup technology projects that provide electricity supply when renewable generation is not available that the project is not.

A.3.2 Goals and Trajectory

The operator has a commitment of reaching net-zero carbon (scope 1 and 2) emissions by the year 2040. In support of this goal, the operator is committed to:

- Minimise project energy needs through incorporation of design initiatives considered best practice that minimise energy demand and maximise energy efficiency limiting scope 1 and 2 emissions;
- Continue to look for opportunities to enable more utility-scale renewable energy projects in Australia such that by 2040 net zero emissions from electricity can be supported; and
- Sustain net-zero carbon emissions across scope 1 & 2 from year 2040 and throughout the project's life through considering the following measures:
    - Utilisation of renewable Hydrotreated Vegetable Oil (HVO) diesel for backup generators subject to economical and highly-reliable availability of a viable source.
    - Neutralise remaining emissions with credible offsets.

Refer also to additional details provided in Section 5.1 of the ESD Report of the operator's commitments to Net Zero Carbon performance.

The following figure provides the estimated emissions trajectory of the project taking into account the emissions goals as described above firstly for the 'Design Measures' alone and then 'All Measures' being pursued compared to an average 'Benchmark'.

From the figure it can be seen that the pursued initiatives under the 'Design Measures' scenario provides substantial reduction in emissions compared to the 'Benchmark' over the design life of the project. Considering 'All Measures' in support of the emissions goals, emissions are effectively eliminated from operational commencement and entirely eliminated from 2040 onwards. Over the project design life the total scope 1 and scope 2 emissions are reduced by 96.2% compared to the Benchmark following incorporation of All Measures in support of the emissions goals per the results shown in Table 14.

For further details of emissions estimations refer to A.2.6 and scenarios analysed refer to A.2.2.

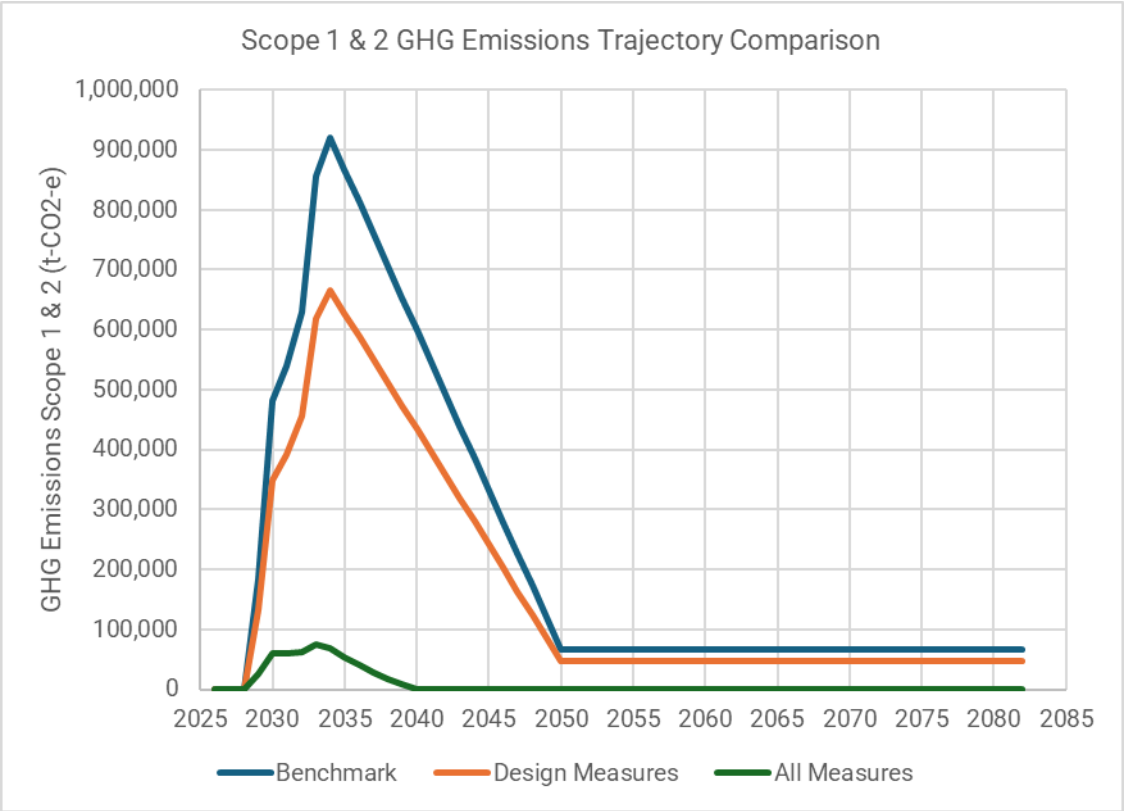

Figure 2: GHG Emissions Trajectory Estimation considering Implementation of Emissions Goals

A.4 Conclusion

The GHG Emissions Assessment results have shown that:

- The Design Measures being pursued for the proposed development, i.e. measures to reduce energy demand and maximise energy efficiency, provide significant reduction in Scope 1 & 2 emissions over the project design life in the order of 27.6% less than a Benchmark scenario approximately aligned to the national average performance.
- Following consideration of All Measure being pursued in support of the operator's emissions goals, including the estimated utilisation of 81% renewable electricity from operational commencement and commitment to achieve net-zero emissions (scope 1 & 2) by 2040, the Scope 1 & 2 emissions will be:
  - almost entirely eliminated with an estimated 96.2% reduction compared to the national average Benchmark scenario over the project design life;
  - well below the NSW Guide for Large Emitters threshold of 25,000 t-CO_2-e/yr at only an estimated 9,332 t-CO_2-e/yr annual average over the project design life, and 0 t-CO_2-e/yr from 2040 onwards.

A.4.1 Disclaimer

All quantified data presented in this report are estimates only for the preliminary design and provided for information only. No guarantee or warranty can be placed on the data presented.

A.5 References

Reports and documentation reviewed as part of the investigation for this report includes:

- NSW EPA Guide for Large Emitters
- DCCEEW Australian National Greenhouse Accounts Factors 2025
- DCCEEW Australia's Emissions Projections 2024
- Sydney Water Annual Environmental Report 2023-2024
- NABERS Embodied Carbon Rules
- NABERS Upfront Embodied Carbon Calculator
- NABERS Embodied Materials Forms
- Energy and Water Report – GRDC86-LCI-00-XX-RP-SSDA-EM-0001

Appendix B Urban Heat Impact Considerations

B.1 Introduction

This appendix has been prepared to respond to RTS matrix comments regarding Urban Heat Impacts raised by Blacktown City Council on the proposal for SSD-73761707 Glendenning Road Data Centre.

Urban Heat Impacts are characterised by elevated ambient temperatures in urban environments compared to adjacent rural areas. This phenomenon is primarily attributed to the extensive use of materials with high thermal mass—such as concrete, asphalt, and dark roofing—which absorb and retain solar radiation. These surfaces contribute to increased heat storage and delayed cooling, intensifying localised warming. Furthermore, heat emissions from sources such as motorised transport and air conditioning systems contribute extra waste heat to the urban microclimate, intensifying the urban heat island effect.

B.1.1 RTS Comments Summary

In summary, the following Response to Submission (RTS) comments in relation to Urban Heat Island impacts were raised by Blacktown City Council:

- The proposed project location is in one of the hottest parts of Western Sydney and vulnerable to urban heat despite nearby cooling benefits from Nurragingy Reserve's tree canopy.
- Climate change impacts will increase temperature and regularity of hot days and heatwaves increasing urban heat impacts to vulnerable communities of Blacktown.
- Urban heat effect may be exacerbated by the new data centre project that needs consideration.
- The design should address urban heat through improved design, technology, and site suitability.
- Development should align with the Greater Sydney Heat Smart City Plan (2025–2030), using innovative mitigation strategies to reduce environmental and social harm.

B.1.2 Climate Context: Urban Heat Exposure

Blacktown has been identified as experiencing above the mid-range exposure to urban heat island effects, with recorded air temperatures ranging between 27-30°C. This elevated thermal profile is primarily attributed to the limited presence of permeable land cover in the town centre, combined with extensive use of asphalt and concrete-paved surfaces. The city's designated growth areas are particularly susceptible to urban heat impacts due to the widespread vegetation clearing and ongoing urban development.

As per the 'Responding to climate change strategy' Section 3. Climate context, modelling conducted using the NSW and ACT regional climate modelling (NARCliM) project indicates that land use changes from forest and grasslands to new urbanised zones can potentially double the magnitude of temperature increases associated with climate change. The higher temperatures are typically observed in areas with dense urbanisation and a high concentration of impervious surfaces, such as rooftops and paved infrastructure.

Sydney Water's 2017 "Cooling Western Sydney" study highlights the important role of water in cooling, showing that "Although greenery does have a cooling effect, the most effective urban heat mitigation technologies are those incorporating a combination of water-based technologies with cool materials.

The 'Greater Sydney Heat Smart City Plan 2025-2030' aims to influence the design and planning of new developments to reduce any negative impacts to the environment and community. This Plan details strategies and interventions that seek to reduce the causes of urban heat. The following figure from the

Plan details identified strategies and measures to reduce urban heat. Measures of note from the Plan applicable to the development include energy efficiency, rooftop PV, cool roofs, cool paving, green cover shade and water features.

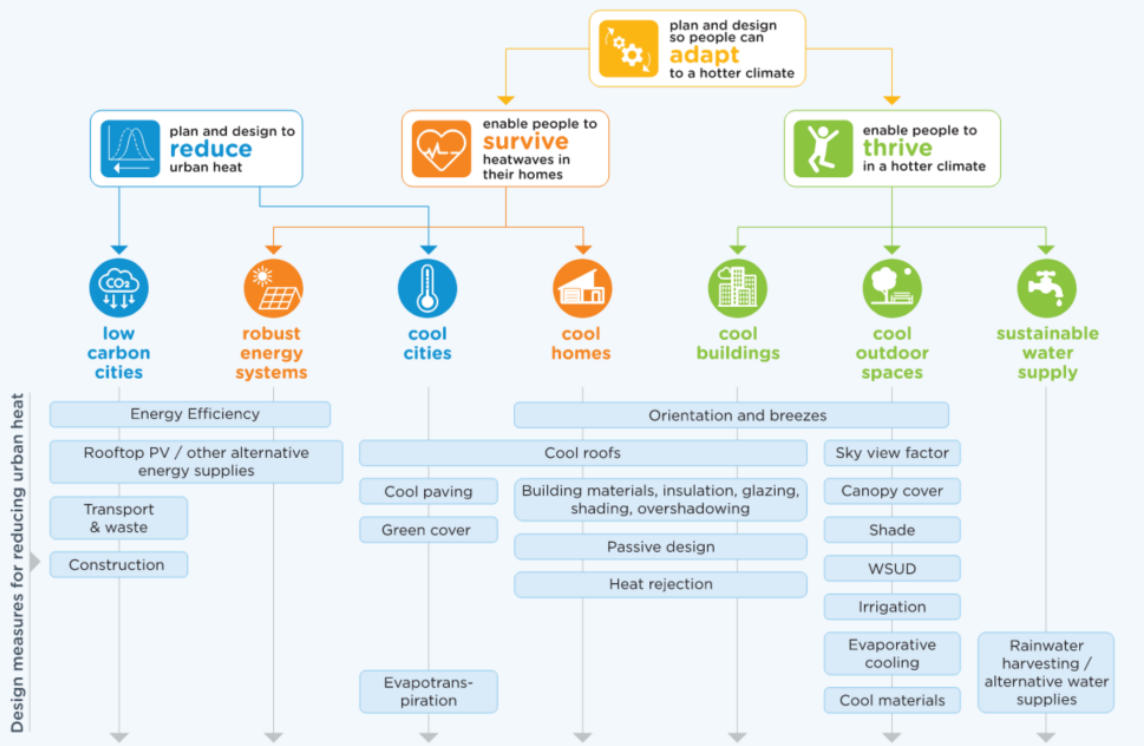

Figure 3: Heat Smart City Plan - Planning and design measures for urban heat resilience

In addition, the figure below shows Heat Vulnerability Index for the Greater Sydney region based on The Central Resource for Sharing and Enabling Environmental Data, as well as Urban Heat Island Effect with Heat Vulnerability Index and Disaster Resilience Index based on SEED map data. Analysing the site location, it is noted that the proposed development is located within the category of 'least vulnerable' to urban heat island impacts.

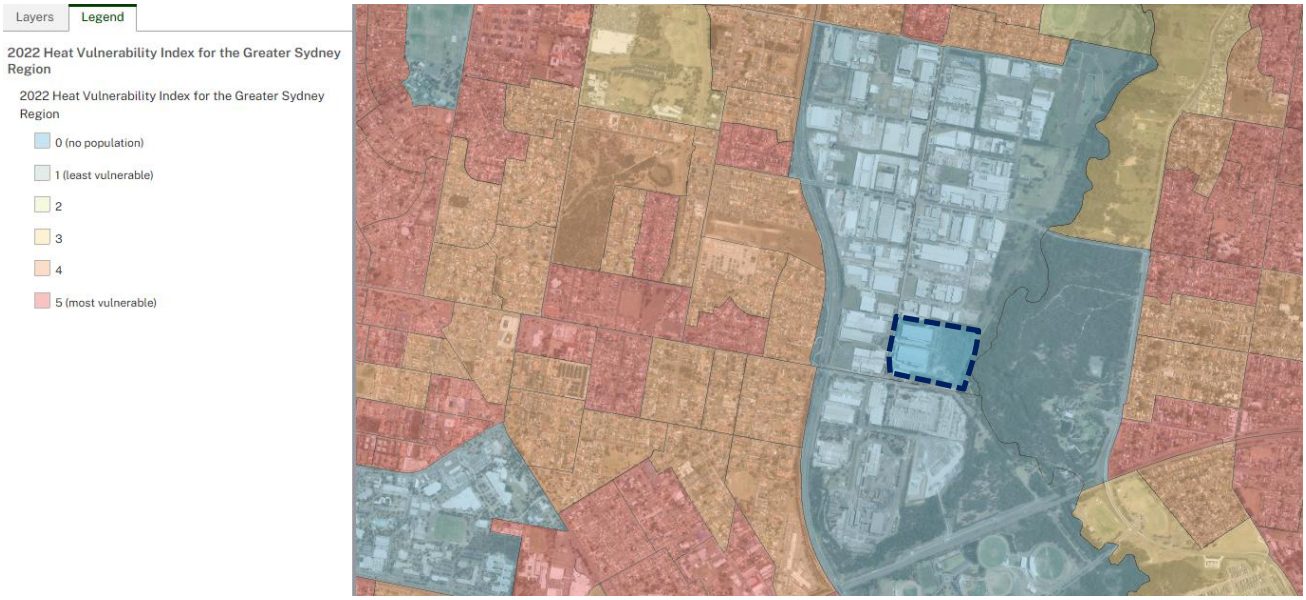

Figure 4: Proposed site in Glendenning and neighbouring area with Heat Vulnerability Index of 1 (least vulnerable)

B.2 Design Responses

The 'Greater Sydney Heat Smart City Plan 2025-2030 ' - Heat Smart Planning sections 10 and section 11 describes how simple design choices relating to orientation, shading, cool materials, use of greening, water and permeable surfaces can significantly impact local micro-climates reducing heat island impacts. Furthermore, Section 20 'Heat Safety Workplace Pilot' recommends a design approach for facilities to include designated and equipped cool centres, shaded areas, water stations and ensuring new buildings designed with heat mitigation features. The project design response to urban heat have consider these recommendations.

To mitigate the heat island effect in the proposed data centre, several design interventions have been pursued. These mainly include increasing the urban vegetation and tree canopy coverage, incorporating shading structures and integrating cool materials at development site. These strategies will help to reduce surface and ambient temperatures, improve thermal comfort, and enhance urban resilience.

The proposed project considers implementing strategies to help urban heat mitigation and reducing the impacts of urban heat as discussed in detail below.

B.2.1 Landscaping to Mitigate Urban Heat Effects

Trees play a crucial role in mitigating the urban heat island effect. Wherever feasible, existing trees have been retained to balance environmental benefits with the operational requirements of the development. Indigenous and native species from local plant communities have been integrated into the landscape design, enhancing the urban tree canopy and contributing to ambient cooling. Along the Glendenning Road and at the rear of the site, a diverse mix of native evergreen trees is proposed to enrich the urban landscape and strengthen the local ecosystem. These plantings offer seasonal variation, support wildlife habitats, and establish a biodiversity corridor that connects the site to Nurragingy Reserve.

The Landscape Design Report for the proposed development recommends maximising tree planting where possible. This recommendation has been carefully assessed against the specific security requirements and underground service constraints associated with the site.

The following list outlines the various landscaping strategies being pursued for the development that will minimise urban heat island impacts:

- Canopy trees have been strategically positioned within car park blisters to optimise shade for parking areas
- The landscape design aims to increase vegetation and green spaces by shading heat-absorbing built surfaces through the use of vegetation in combination with structural shading elements.
- To offset the removal of existing trees, the landscape design incorporates a diverse mix of locally indigenous and native trees, shrubs, and groundcovers.
- A significant revegetation zone is planned along the southern boundary, adjacent to existing biodiversity areas, with canopy cover limited to 15% within Asset Protection Zones (APZ).
- The proposed tree planting is expected to mature into a net increase in canopy cover that totals 10,460m². Although the existing canopy cover is 5,468 m², the proposed design introduces 4,992 m² of new canopy, contributing to long-term ecological and microclimatic benefits.

B.2.2 Cool Materials

- Proposed use of reflective and light-coloured building materials such as for roofs, roads, and pavements—can significantly reduce heat absorption and lower ambient temperatures.
- Permeable surfaces that mimic natural landscapes also help manage heat and water runoff.
- Additionally, incorporating sustainable design features such as shaded breakout areas with pergolas, seating, and recreational elements like table tennis provide cool, comfortable spaces for occupants to escape extreme heat

B.2.3 Energy Efficiency

Maximising energy efficiency and reducing greenhouse gas emissions minimises local heat output and the contribution to wider climate change impacts that contribute to Urban Heat. Such features have been heavily considered for the development through many initiatives as demonstrated in detail in the Appendix A.

B.3 Comparison to a Sustainability Rating Tool Metric

Analysis has been undertaken against the Urban Heat Island compliance criteria of the sustainability rating tools from the US based LEED Building Design & Construction (BD+C) v4.1 and local Green Star Buildings v1. The applicable credit criteria of Heat island reduction strategy has been discussed.

The LEED BD&C v4.1credit 'Heat Island Reduction' and the Green Star Buildings v1 'Heat Resilience' credit address urban heat island impacts of across the sites of new development. Both credits require external materials be selected such that the finishes exceed Solar Reflectance (SR) / Solar Reflective Index (SRI) thresholds to be considered compliant. Both credits have similar thresholds for compliance and both credits recognise landscaping as compliant area.

The LEED Heat Island Reduction credit requires that the total weighted area of compliant roof and non-roof finishes is greater than the total area of all paving and roofing across the site. Non-roof elements have a higher weighting than roof elements.

The Green Star Heat Resilience credit requires that no less than 75% of the site area have compliant materials finishes.

A site markup with elements and measurements provided under section B.6, has been completed to determine the various element areas within the project site boundary. The applicable analysis area has excluded the easement zone for the transmission equipment and the biodiversity area, noting that the biodiversity area would be considered compliant for both credits.

The following heat island mitigation strategies have been included in the project design as calculated:

- 17,940 m^2 of new and existing plants or vegetated area by tree canopy
- 27,745 m^2 of low-sloped roof with high 3-year aged Solar Reflective Index (SRI) of 64 or more
- 13,976 m^2 of hardscape with initial high Solar Reflectance (SR) of at least 0.33
- 1,900 m^2 of driveway hardscape with initial high Solar Reflectance (SR) of at least 0.33

The following figure details a calculation of compliance against both the LEED and Green Star credits.

Type (excludes tranmission easement and biodiversity zone)	Design Compliant Area (sq.m)	Design Non-Compliant Area (sq.m)	Compliance Reference Area (Paving+Roof) (sq.m)
Landscaping	17,940	-	-
High SRI Roof Area	27,745	-	-
Hardstand	13,976	-	13,976
Road Paving	-	17,824	17,824
Driveway	1,900	-	1,900
Totals	***61,561***	***17,824***	***33,700***
LEED Weighted Compliant Area	*104,625*		
Compliant with LEED v4.1 Criteria (Weighted > Reference)		**YES**	(104,625 > 33,700)
Green Star Percentage Compliant Total	***77.5%***		
Compliant with Green Star Buildings v1 Criteria (>75%)		**YES**	

Figure 5: Sustainability Rating Tools – Urban Heat Island Compliance Calculation

From the results above it can be seen that the development supports compliance for both the LEED and Green Star tool credits. This demonstrates that the proposed design solutions limit Urban Heat Impacts in excess of these sustainability rating tool standards.

B.4 Pre-development and Post-development Comparison

Comparing the existing site condition and measuring the pre development hardscape, pavement and landscape area within the proposed site shows a net improvement in measures that limit urban heat island impacts. This includes proposed vegetation cover providing increases of up to 10% compared to the pre-development condition.

Figure 6: Aerial Map of Subject Site showing pre-development condition (Source: NearMap, 2024)

B.5 Conclusion

In response to the Blacktown City Council comments regarding considerations for Urban Heat Impacts, the proposed development has been shown to:

- Provide extensive landscaping amounting to a net increase compared to the pre-development leading to associated improvements in local micro climate reducing urban heat
- Include tree canopy in appropriate area such that hardscape will be shaded minimising absorbed solar heat
- Incorporate cool materials with high solar reflectance / reflective index to reflect solar radiation and minimise absorbed heat and associated urban heat impacts
- Have initiatives to maximise energy efficiency minimising localised heat rejection and minimise greenhouse gas emissions that contribute to wider climate change impacts including warming that impacts urban heat buildup
- Include measures that support Heat Resilience and reduced Heat Island such that the compliance metrics of current sustainability tools of the US based LEED and local Green Star are supported

B.6 Site External Elements Markup

Type (excludes tranmission easement and biodiversity zone)	Design Compliant Area (sq.m)	Design Non-Compliant Area (sq.m)	Compliance Reference Area (Paving+Roof) (sq.m)
Landscaping	17,940	-	-
High SRI Roof Area	27,745	-	-
Hardstand	13,976	-	13,976
Road Paving	-	17,824	17,824
Driveway	1,900	-	1,900
Totals	***61,561***	***17,824***	***33,700***
LEED Weighted Compliant Area	*104,625*		
Compliant with LEED v4.1 Criteria (Weighted > Reference)		**YES**	(104,625 > 33,700)
Green Star Percentage Compliant Total	***77.5%***		
Compliant with Green Star Buildings v1 Criteria (>75%)		**YES**	

LEGEND

- LANDSCAPING
- DC01,DC02,DC03 ROOF AREA
- HARDSTAND
- ROAD PAVING
- DRIVEWAY

Heat Island Reduction Calculations -

Total Site Area = 104,400 m2

Vegetation (Landscape) = 17,940 m2

Total Unshaded Hardscape (Road) = 17,824 m2

Roof & shade structures = 11010+5725+11010= 27,745 m2

Total Hardstand & driveway (include Pavement Type 1,2,3,5 and 6) = 13,976 m2

EXISTING SEWER MAIN

EASEMENT

WATER TANKS

UNDERGROUND TANKS

DC03

DC01

DC02

OFFICE

BREAKOUT AREA

EE CONTROL ROOM

UNDERGROUND FUEL STORAGE TANKS

FIRE PUMP

FIRETANKS

RWT

Total within the LEED boundary
104,184 sq m

ENTRY

EXIT

GUARD HOUSE

GLENDENNING RD

TRANSMISSION TOWER EASEMENT AREA

REVEGETATION AREA TO INCLUDE SPECIES FROM THE LOCALLY OCCURRING PLANT COMMUNITIES OF CUMBERLAND PLAIN SHALE WOODLANDS AND SHALE-GRAVEL TRANSITION FOREST.

TERRESTRIAL BIODIVERSITY

BIODIVERSITY ZONE

NURRAGINGY RESERVE

WOODSTOCK AVENUE

NOTES

N

KEYNOTES

- NOT FOR CONSTRUCTION
- FINAL PLANTING NUMBERS AND POSITIONS TO BE FINALISED AT DD / CONSTRUCTION

LEGEND

- SITE BOUNDARY: 104,400 M2
- PROPOSED TREE CANOPY INSIDE APZ ZONE : 338 M2
- PROPOSED TREE CANOPY OUTSIDE APZ ZONE : 1,692.5 M2
- PROPOSED TREE CANOPY IN REVEGETATION ZONE : 2,961.3 M2
- TOTAL PROPOSED TREE CANOPY: 4,991.8 M2 (317 PROPOSED TREES)
- EXISTING TREE CANOPY COVER: 5,468.5 M2
- OVERALL CANOPY COVER
- SITE AREA: 104,400 M2
- TOTAL CANOPY COVER IN SITE AREA = 10,460.3 M2 (10%) (EXISTING TREE CANOPY + TOTAL PROPOSED TREE CANOPY: 5,468.5 M2 + 4,991.8 M2)
- BUSHFIRE CANOPY COVER (REFER TO BUSHFIRE REPORT)
- AREA OF ASSET PROTECTION ZONE = 21,144 M2 MAXIMUM PERMITTED CANOPY COVER IN AREAS OF APZ AS PER PBP2019 = 15% = 3,171.6 M2
- BUILDING FOOTPRINT, FIRE PUMP ROOM AND EE ROOM
- PROPOSED TREE CANOPY INSIDE APZ ZONE : 338 M2 (1.5%)
- EXISTING TREE TO BE REMOVED (REFER TO ARBORISTS REPORT)
- AREA REQUIRED FOR CRANE PADS
- EXISTING SEWER MAIN AREA
- TRANSMISSION TOWER EASEMENT
- EXISTING STORMWATER EASEMENT
- UNDERGROUND TANK

Hardscape
(SR 0.26 initial default for grey cement concrete as per LI ID# 10411)

REV	DATE	DESCRIPTION	DRN	ENG	CHK	APP
A	06.09.24	Master Plan for Information	AT	LCI	BG	
B	16.09.24	WIP Issue WIP Issue	AT	LCI	BG	
C	04.10.24	100% Draft Issue	AT	LCI	BG	
D	18.11.24	Final Issue for Review	AT	LCI	BG	
E	28.11.24	Issued for Adequacy Review	AT	LCI	BG	
F	28.02.25	Issued for Public Exhibition – SSDA 73761707	AT	LCI	BG	

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PROJECT: GLENDENNING ROAD DATE CENTRE

TITLE: COVER CANOPY PLAN

DRAWING: GRDC86-GEO-00-XX-DR-SSDA-L-0002

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