ARUP

SSD

Project Echidna

Ecologically Sustainable Development (ESD) and Greenhouse Gas (GHG) Report

Reference: Appendix O

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Job number 288255-00

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1. Introduction

1.1 Purpose of this report

The purpose of this report is to address the Secretary's Environmental Assessment Requirements (SEARs) by providing a description of how the Proposal will incorporate the principles of ecologically sustainable development (ESD) into the design, construction, and ongoing operation of the development. This report also provides an analysis of Scope 1, 2 and limited Scope 3 emissions associated with key aspects of the operation of the development. Consideration has been given to the design initiatives included in the Proposal, or recommendations for further evaluation, which relate to ESD principles.

1.2 Proposal overview

1.2.1 Site context

Arup on behalf of the Proponent is seeking development consent to construct a data centre (the Proposal) at 10 Eastern Creek Drive, Eastern Creek NSW, legally described as Lot 4001 DP 1243178 (the Site). The Site is situated within the Blacktown Local Government Area (LGA) on the corner of Eastern Creek Drive and Old Wallgrove Road. The parcel of land is currently vacant, and the site gross floor area (GFA) is of approximately 9,225 square metres. The entire site area is approximately 56,800 m^2 and is to accommodate Building 1, Building 1A, a substation and Building 2 (the Proposal). The Site is approximately 40 kms west of the Sydney CBD, 20 kms west of Paramatta and 24 kms southeast of Penrith. Road access to the site is currently via Eastern Creek Drive near Old Wallgrove Road.

The site is subject to the provisions and development controls specified within SEPP 59 – Eastern Creek Precinct Plan (Stage 3) 2005, Blacktown Local Environment Plan (LEP) 2015 and Blacktown Development Control Plan (DCP). It is zoned for general industrial and warehouse land use (IN1) under the SEPP (Industry and Employment) 2021 – formerly the SEPP (Western Sydney Employment Area) 2009 – and is located on the southern boundary of the Blacktown City Council and Fairfield City Council local government areas (LGAs). To the north of the site is bushland and to the west is a riparian buffer, both zoned for environmental conservation (C2). Beyond that, east of the M7 Westlink (SP2 road infrastructure) is the Western Sydney Parkland, including Prospect Nature Reserve, which is also zoned as environmental conservation (C2). Broadly, the site exhibits industrial character with a clustering of manufacturing, IT, freight, and logistics. It is surrounded by similar light industrial neighbouring suburbs in the south, southwest and northeast. By exception is the Southridge Plaza to the immediate southeast of the site, which includes Little Graces Childcare Centre and Plus Fitness. The Plaza is owned by York Developments and leased to private operators.

There is low density residential (R2) to the site's north and a mix of primary production small lots (RU4) and rural landscape (RU2) south of the site. Reedy Creek runs south of the site, while Ropes Creek is located to the west. Eastern Creek connects to Reedy Creek about 2.3 km northeast of the site.

There are two key public transport links along Old Wallgrove Road, including bus routes 738 and 835, with a bus stop after Eastern Creek Road in both directions. An additional bus route, 723, stops on Wonderland Drive in both directions and is 1.6 km from the site. There is a shared pedestrian and cycle path alongside the eastern lane of Old Wallgrove Road.

1.2.2 Overview

The proposed data centre is permissible with consent within a light industrial zone pursuant to the provisions outlines in Section 2.31 of *State Environmental Planning Policy* (Transport and Infrastructure) 2021.

Given the proposal has a capacity that is greater than 10 MW, the proposal classifies as State Significant Development (SSD) pursuant to the provisions outlined in Schedule 1 of the *State Environmental Planning Policy* (Planning Systems) 2021.

1.2.3 Description of the proposed development

The proposed development, construction and operational use of the Data Centre will serve Sydney and the wider region in providing for increasing cloud-based storage and compute requirements. The Data Centre will positively impact the social and economic conditions of Blacktown LGA, creating jobs during both construction and operation.

The design of the Data Centre is based on the end-client's reference design as well as applicable Australian Standards and will deliver capacity for approximately 35.2 MW of IT equipment. Utility power will be delivered via a dedicated on-site electricity substation (subject to a separate development application), with emergency backup power provided by a combination of lithium-ion battery systems and standby generators. Cooling will be delivered by highly efficient fresh air free-cooling systems, supported by direct-evaporative cooling on hot days, to ensure energy consumption is minimised as far as practical.

The two (2) level facility will reach a building height of approximately 25 m including all significant plant and rooftop equipment. The facility will include two (2) levels of data hall space and supporting plantrooms, and supporting administrative spaces incorporating secure entry facilities, loading dock, storage, staff offices and the like. The standby generators will occupy an external equipment yard to the west of the main building, and some mechanical equipment will be located at rood level. The site will be served from a private on-site substation, located to the west of the proposed data centre building and subject to a separate development application.

Landscaped areas are also proposed, where mature local trees and locally native vegetation will be used to improve aesthetics and amenity for local businesses. On-site car parking spaces will be provided for staff and visitors, including disabled and electric vehicle parking.

Figure 1 shows the land zoning applicable to the Site and Figure 2 illustrates the Site and surrounding context.

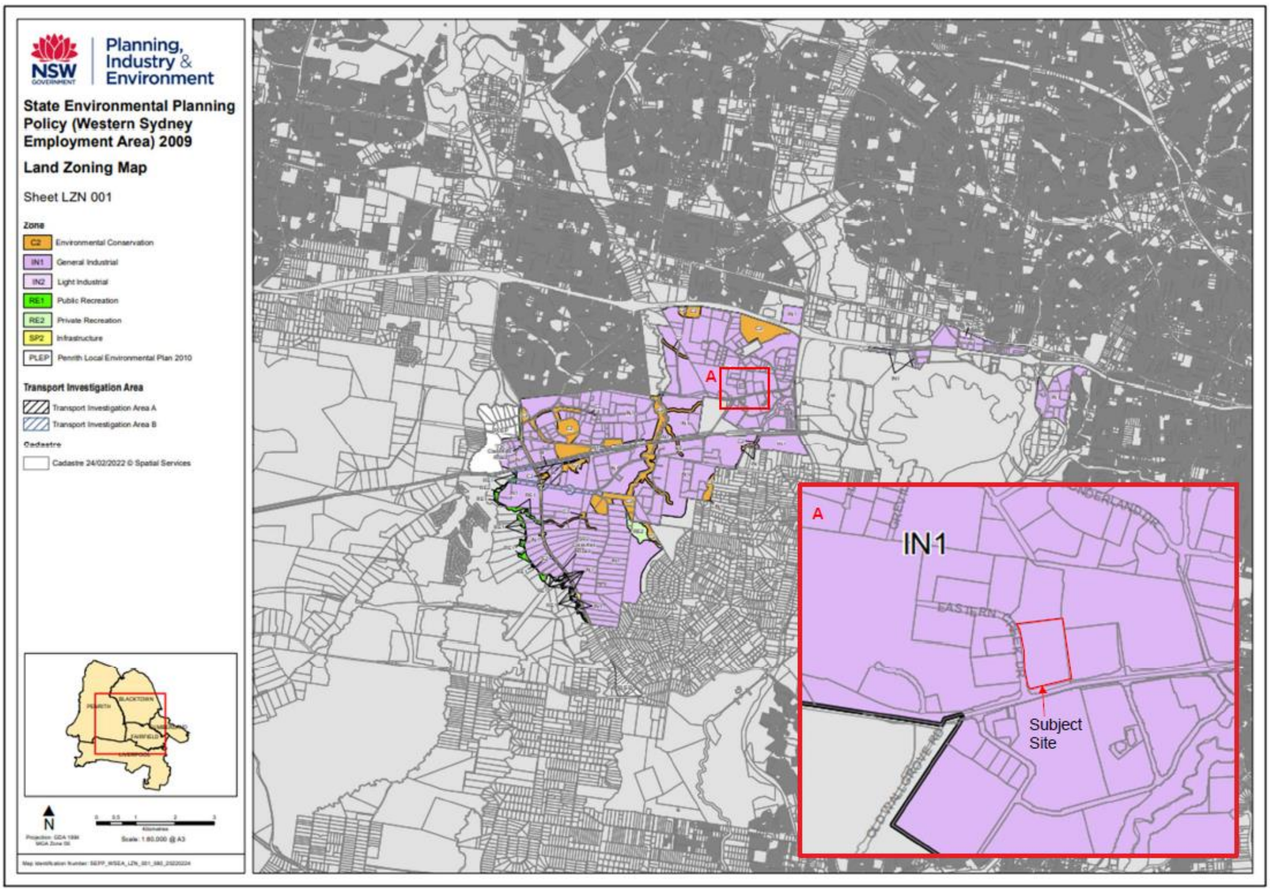

Figure 1: Land zoning applicable to the Subject Site under SEPP (Western Sydney Employment Area) 2009

Figure 2: Site context and surrounding area

1.3 SEARs and DCP requirements relevant to this report

Table 1 identifies the SEARs and Development Control Plan (DCP) requirements which are relevant to this technical assessment and where they are addressed in this report.

SEARs requirements	Where addressed in this technical report
Identify how ecologically sustainable development principles are incorporated in the design and ongoing operation of the development	Section 3 Section 4
Demonstrate how the development will meet or exceed the relevant industry recognised building sustainability and environmental performance standards	Section 4
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	Section 4 Section 6
DCP requirements	**Where addressed in this technical report**
Car parking areas: at a minimum standard one tree should be planted every 10 metres and be at a minimum height of 1 metre at the time of planting	Section 4.1
Trees should be planted to achieve 50% shading of the carpark at ten-year maturity	Section 4.1
Minimisation of water consumption should also be a consideration in the design of irrigation systems	Section 4.1
Encouraged to incorporate safe storage/parking areas for bicycles, with adequate shower and change facilities provided for staff	Section 4.1
Facilitate on-site source waste separation	Section 4.1

Table 1: SEARs and DCP requirements for ESD principles

2. Policy and Planning Context

This section identifies the key strategic and regulatory drivers that will drive sustainability outcomes for the Proposal. These drivers will help frame sustainability actions and ESD considerations to be embedded into the design and the delivery of the development.

Legislation / Policy		Where addressed in this technical report
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	This Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, and heritage places. It also promotes ESD through the conservation and ecologically sustainable use of natural resources	Section 3
Environmental Planning and Assessment Regulation 2000 (NSW)	The EP&A Act legislates for ESD while the Regulation describes the ESD principles. ESD principles as defined in clause 7(4) of Schedule 2 of the EP&A 2000 Regulation are as follows. 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 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 Conservation of biological diversity and ecological integrity – namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration 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	Section 3 Section 4
Government Resources Efficiency Policy 2019 (NSW)	This policy acts to drive resource efficiency by NSW Government agencies in four main areas – energy, water, waste and air emissions. The policy aims to ensure NSW Government agencies meet the challenge of rising costs of energy, water, clean air and waste management; use power purchasing to drive down the cost of resource-efficient technologies and services; and show leadership by incorporating resource efficiency in decision making	Section 4
Organisational policy	The organisation has made a series of commitments to reduce their impact, covering carbon and renewable energy. Key commitments include: • Net-zero carbon by 2040	Section 4.2 Section 6

Legislation / Policy		Where addressed in this technical report
	• 100% renewable energy for operations by 2025 • Water stewardship initiative • Climate neutral datacentres initiative signatory	

Table 2: Relevant Policy and Planning Documents

3. EP&A Regulation 2000 ESD Principles

The SEARs require details of how ESD principles (as defined in clause 7(4) of Schedule 2 of the Regulation, see Table 1) will be incorporated in the design and ongoing operation phases of the development. The ESD principles defined in clause 7(4) of Schedule 2 are detailed in this section. These include high level principles, concepts, and ideologies to be incorporated into the design, construction, and operation of the Proposal. For specific design initiatives related to the ESD principles, both at the Proposal and organisational level, see Section 4.

3.1 The precautionary principle

The process of deciding on the scope of assessment to be included in the EIS adopted a precautionary risk-based approach by treating those issues for which the risk was unknown or uncertain at that time as key issues requiring further detailed assessment. The environmental impact statement process undertaken within this assessment aims to identify potential environmental risks and minimise any potential threats of serious or irreversible damage to the environment resulting from the Proposal along with specific mitigation and management measures. The potential impacts of climate change will also be reviewed as part of this assessment to inform and guide the mitigation strategies. Initial identification of environmental risk factors helped inform the scope for further investigations, including a statement of environmental effects to assess potential environmental impacts of the project and identify mitigations. Based on historic site use, the site was identified to be of limited ecological value – see Section 3.3 for further details.

There is limited identifiable risk to the receiving environment through operation of a data centre, however inherently, data centres consume vast amounts of electricity and other resources during operations, resulting in potentially large greenhouse gas emissions footprints. Energy efficiency, electricity and embodied carbon have been considered in the design at length, with a number of mitigations reflecting the intention to minimise the greenhouse gas footprint. These include: a direct outside air economiser cooling system with supplementary evaporative cooling, which is considered 'best in class,' and reduces the embodied carbon for installation by negating the need for mechanical systems typical in data centres; onsite rooftop solar photovoltaics for power supply to non-critical systems; and selection of concrete mixes with lower embodied carbon content, informed by an assessment of several structural-design options. Additionally, the Proposal exceeds both Australian and global best practice for Power Usage Efficiency (PUE). The Project has a peak PUE of 1.2, which is a 15% energy saving against the global ASHRAE 90.4 standard of 1.41 PUE for Sydney's climate zone (3A) and a 25% energy saving in comparison to the NABERS Energy benchmark of 1.6. Implementation of energy efficiency measures (and others detailed in Section 4.1) subsequently reduce the carbon and environmental footprint of the facility, minimising the potential long-term impact on future generations and indicate a commitment to exceeding sustainability standards.

3.2 Inter-generational equity

A number of proposed initiatives seek to optimise facility design and in turn, minimise operational energy use. Implementation of energy efficient measures including adoption of 'best in class' design (see Section 3.1), energy efficient lighting fixtures and distributed battery systems for critical IT loads, subsequently reduce the greenhouse gas and environmental footprint of the facility, minimising long-term negative impacts on future generations.

Considerations has also been given to material selection and resource consumption, taking into account increased global resource scarcity and the pursuit of material conservation and productivity. Embodied carbon assessments of concrete mixes and the selection of mercury-free lighting both acknowledge and mitigate the impact of resource consumption on the environment. This is also reflected in the Proponent's water stewardship, which is reflected locally in the use of water efficient appliances and landscaping, as well as globally through community water programs designed to return water to the communities they operate within for use by future generations. Furthermore, by developing on previously developed land, minimal land clearing is needed, and the Proposal provides the opportunity for tree planting that reflects the ecological character of the surrounding ecosystems. The selection of indigenous species, in line with the requirements of SEPP 59 – Eastern Creek Precinct Plan and the Blacktown DCP is discussed further in Section 3.3, and reflects a future-focused approach towards rejuvenating the environment at the proposal site and providing opportunities to support fauna in the area.

Data centres are considered to be critical infrastructure and a service which supports the safe and long-term storage of cloud and electronic data for both business and consumer transactions. The facility will not only provide employment generating opportunities for the present but will also provide medium- and longer-term employment opportunities. It will also support the operation of external businesses and services over the longer term through a continually evolving technology future to service future generations.

3.3 Conservation of biological diversity and ecological integrity

The site is located in Eastern Creek, a suburb in Western Sydney that is largely cleared as a result of previous industrial development. The immediate surrounding areas are industrial zones, low density development and small rural production lots. The Proposal is on land which was previously used as farmland. The Statement of Environmental Effects did not identify any impacts to species and vegetation, and an additional site ecology study will be conducted to confirm that there is no danger to the habitat of any threatened endangered species within the development footprint. The nearest sensitive land uses are comprised of environmental conservation (C2) to the north and east of the Site, however due to their distance from the Site they are deemed to be unaffected by the Proposal. Landscaping guidelines provided in the SEPP 59 - Eastern Creek Precinct Plan and Blacktown DCP are designed to encourage a high standard of environmental quality of individual developments and selection of indigenous tree species in line with the existing character across the LGA. Native species are favoured for their appearance, amenity, energy, and water efficiency, as most species are drought and pollution resistant, provide dense canopy cover and shade, and are adaptable to most soils. In line with these DCP requirements, the landscaping and tree planting at the site will regenerate the landscape to reflect local ecology and support existing fauna in the area surrounding the site.

3.4 Improved valuation, pricing, and incentive mechanisms

To ensure the successful integration of the principles of ESD and to secure long-term sustainable development, it is of critical importance that these measures and incentives are appropriately valued and therefore costed into the Proposal. At this stage of design, the environment and sustainability goals for the Proposal have not been confirmed, however a number of initiatives have been proposed in line with the SEARs, SEPP 59 and DCP social, economic, and environmental sustainability requirements. As the design progresses, these initiatives will be evaluated in relation to operational and embodied impacts of the design, ensuring that the ESD principles are appropriately considered, valued, and priced at each stage of the Proposal lifecycle.

Additionally, the Proponent's global commitment to carbon neutrality has resulted in a recognised internal price on carbon emissions, incentivising the adoption of lower-carbon design options, material selections and construction practices. Energy and emissions data is reported to NGER annually, and the procurement of offsite renewable electricity via power purchasing agreements (PPAs) is included in global totals. This is an important approach to the Proposal as it allows for the development of a more sustainable and resilient asset that can be identified and accounted for effectively and that is recognised for its long-term asset value for the community.

4. ESD Mitigations

4.1 Design mitigations

The following section outlines the ESD mitigations in design that are in line with the requirements of the SEARs, Blacktown DCP and Eastern Creek Precinct Plan. These mitigations are a combination of basis of design, reference design and SSDA compliance measures. Table 3 provides a summary of the mitigations which are adopted in the proposed design.

Impact	Mitigation	Mitigation Details
Heat Island Effect	Green infrastructure	Non roof measures have been incorporated into design to reduce the impact of heat island effect including the planting of one evergreen tree every 10 metres that will reach 50% shading of the carpark at 10-year maturity.
Water Use	Planting water efficient native plants	To reduce the volume of water for on-site irrigation, water efficient native plants – selected from the species list provided in the Blacktown DCP – will be used for landscaped areas. Areas of turf grass will also be minimised to reduce the volume of water required for irrigation.
	Rainwater recycling	Measures to minimise water consumption have been incorporated into design. For on-site irrigation and toilet flushing, rainwater harvesting will be used to capture the majority of the roof's water and thereby reduce the use of potable water for the proposal. The proposed design includes a 50,000 L rainwater harvesting system, preferential for evaporative cooling.
	Water efficient appliances	All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labelling will be WELS labelled.
	Building-level metering	Water metering enables ongoing tracking of water consumption and identification of leaks to prevent unnecessary losses. Metering will occur at the facility potable water inlet and water discharge meter, as well as components of the CRAHU system.
Energy Use	Power Utilisation Effectiveness (PUE) reduction	The design is based on a direct outside air economiser cooling system with supplementary evaporative cooling, which is considered 'best in class.' This is estimated to result in a peak PUE less than 1.2 and annual average PUE of approximately 1.15. In comparison, a facility of equal capacity in the same location which achieves a NABERS 3 Star ("Market Standard") rating, would be expected to achieve an annual average PUE of approximately 1.80. Thus, the estimated annual average PUE of 1.15 for Echidna represents a saving of approximately 36% for overall facility and approximately 81% for non-IT energy, against a NABERS 3 Star benchmark. Similarly, a facility of equal capacity in the same location which achieves a NABERS 5 Star ("Superior Performance") rating, would be expected to achieve an annual average PUE of approximately 1.31. Thus, the estimated annual average PUE of 1.15 for Echidna represents a saving of approximately 12% for overall facility and approximately 52% for non-IT energy, against a NABERS 5 Star benchmark.
	Building-level metering	The installation of building-level energy meters will enable ongoing tracking of energy consumption and identification of targeted energy management strategies to reduce consumption. Energy and emissions data is reported to NGER annually, and internally for the Proponent's carbon accounting.
	Distributed battery systems	Consideration has been given to the critical IT load (which requires continuous power) and will be supported by the use of distributed battery systems which improve energy efficiency due to reduced losses compared to conventional double-conversion UPS systems.
	Roof-mounted solar photovoltaics	A nominal 32 kW roof-mounted solar photovoltaics (PV) is included in the proposed design and will be connected to part of the electrical infrastructure where power can be utilised without compromising critical systems.

Impact	Mitigation	Mitigation Details
Refrigerants	Refrigerant use reduction	Refrigerant based systems are used only for a small portion of the total site load, with the system primarily based on free cooling and supplementary evaporative cooling. As such, the total mass of refrigerant included in the design is significantly less than a conventional mechanical cooling design.
Waste	Storage and collection of recyclables	The design includes a dedicated area for the collection and storage of recyclable materials for the Proposal site including mixed paper, corrugated cardboard, glass, plastics, and metals.
	Construction and demolition waste management planning	A construction and demolition waste management plan will be developed and implemented for the Proposal. The plan will include details of all major waste streams, including disposal and diversion rates. Off-site construction will be utilised for the primary structure (pre-cast).
MEP	No mercury lighting	Selection of light fittings that contain no mercury content, as part of a wider global transition away from mercury use to minimise its impact on the environment.
	Energy efficient LED lighting	Consideration of lighting design with respect to energy efficiency has resulted in the selection of energy efficient LED lighting with automatic control based on motion detection and/or time clocks where appropriate.
Materials	Low embodied materials	Selection of materials with low embodied carbon content and/or recycled materials, which reduce the overall embodied carbon of the Proposal, including: Concrete mixes with 20% lower global warming potential (GWP) Macro-fibre reinforcement of on-grade slabs (in lieu of reinforcing steel mesh)
	Low embodied structural design	An efficient primary structural frame will be utilised to minimise the materials required for the structure. This is done with a regular grid system with reasonable spans, and the absence of heroic structures, e.g., long spans or transfer elements.
	Durable materials	Durable materials, including reinforced and pre-stressed concrete, will be used for the primary structural frame and non-louvered façade in order to achieve a 50-year design life without replacement and with minimal maintenance.
Local Pollution	Bicycle facilities	Safe storage and parking areas for bicycles will be included in the detailed design, as well as adequate shower and change facilities for staff. Given the site's location along a shared bicycle path, these measures will further encourage staff to cycle to work creating positive impacts on traffic and local pollution.
	Electric vehicle charging	Charging facilities for electric vehicles have been included in parking bays, encouraging the use of EV's, and reducing local pollution.
	Fuel systems	Leaks to water and soil from diesel fuel systems has 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.
	Noise pollution during construction	Off-site construction minimises noisy activities on site such as concrete pumping, stripping formwork, cutting of reinforcement, etc.

Table 3: ESD Project Design Initiatives

The above mitigation measures that are components of the building or site infrastructure, including solar panels, EV charging bays, bicycle parking, water tanks, waste collection and battery systems, are indicated in Figure 3 below.

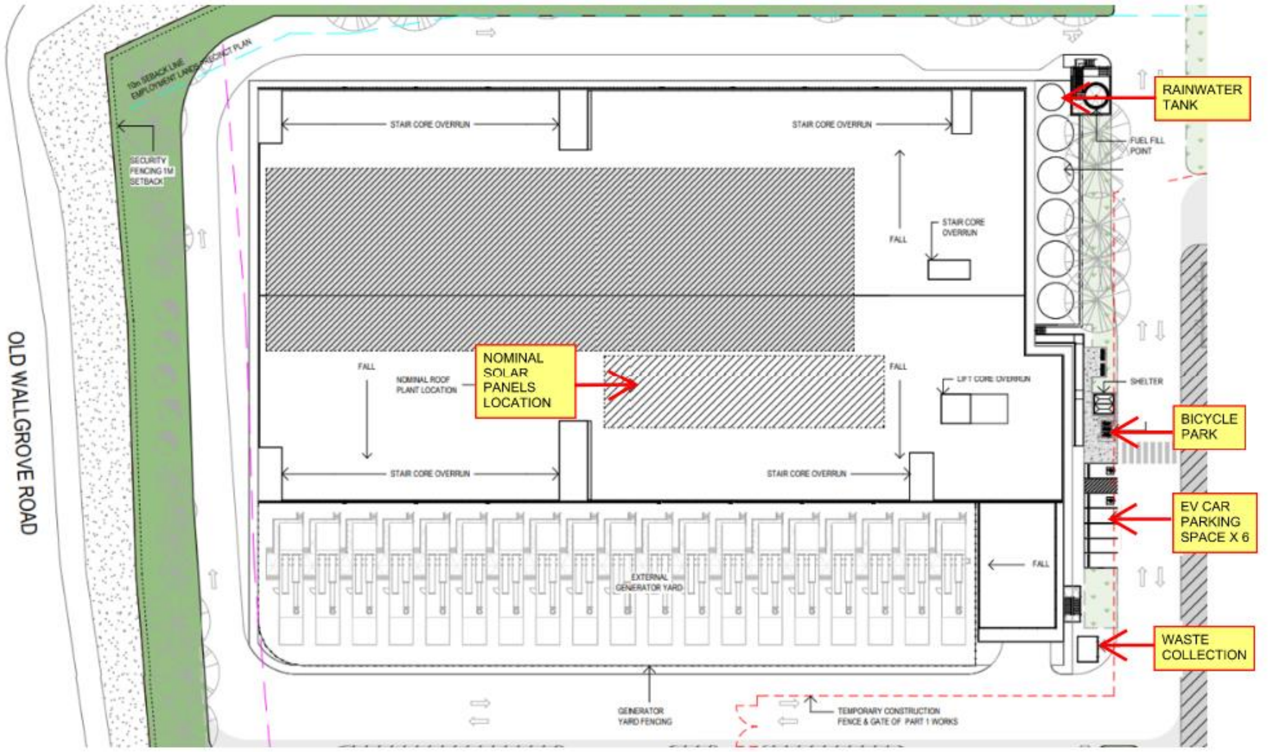

Figure 3: Sustainability measures included on architectural drawings

The mitigation measures in Table 3 act to reduce the impacts of the proposal and are designed to result in significant reductions in resource use. At this stage, however, it is not possible to quantify the positive impact of these mitigations or the total scale of resource reduction, which will occur at a later design stage.

The mitigation measures also act to impact or influence the ESD principles. The ESD principles that are particularly influenced by the above measures include:

- **Inter-generational equity –** by reducing environmental impacts and the consumption of resources due to the proposal, the measures help to ensure that the health and productivity of the environment is maintained for the benefit of future generations.
- **The precautionary principle –** by reducing environmental impacts and resource consumption, the measures serve to avoid, wherever practicable, serious, or irreversible damage to the environment.

4.2 Organisational mitigations

Table 4 provides a summary of the Proponent’s policy which will, in time, impact the operational sustainability of the Proposal.

Mitigation Theme	Mitigation	Mitigation Details	ESD Principle(s) addressed
Energy	Green power	The organisation has made a commitment to 100% renewable energy for all operations by 2025, meaning that all electricity will be purchased through Power Purchase Agreements for renewable energy.	• The precautionary principle • Inter-generational equity • Conservation of biological diversity and ecological integrity • Improved valuation, pricing, and incentive mechanisms
Carbon	Carbon neutrality	By 2040, the organisation commits to achieving ‘net zero’ for its global operations – 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).	

Mitigation Theme	Mitigation	Mitigation Details	ESD Principle(s) addressed
Water	Water stewardship	Water conservation, reuse and recycling are the core components of the organisation's water stewardship in data centres. The Proponent is engaged in a number of community water programs designed to return water to the communities they operate within. Additionally, through partnerships with global non-profits, the Proponent has delivered watershed restoration, clean water provision, wetland creation and water quality projects.	
Energy Water Circular Economy	Climate neutrality	The Proponent is a signatory of the European Green Deal and the Climate Neutral Data Centres Initiative, which aims to make data centres climate neutral by 2030. 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.	

Table 4: ESD Organisation Policy Initiatives

5. Initiatives for Investigation

The following section provides proposed initiatives to push the project beyond industry best-practice and exceed the requirements of the SEARs, Blacktown DCP and Eastern Creek Precinct Plan to enhance the sustainability outcomes of the Proposal. These initiatives will be investigated throughout detailed design for their feasibility and applicability on this project, with the intention of integrating many – if not all – of these initiatives into detailed design.

Impact	Recommendation
Heat Island Effect	Consideration has been given to the use of roof and non-roof materials with high solar reflectivity which is used to reduce heat-related effects. Throughout detailed design, light coloured roof sheeting and- where concrete is being used- concrete paving materials will be selected to reduce the impacts of urban heat.
Energy Use	Design and specification of the electrical room cooling system will be investigated throughout detailed design and if feasible, a refrigerant system with free cooling will be included.
	Design and specification of the solar photovoltaic (PV) system will be investigated throughout detailed design, and if feasible, the size of the PV system will be increased.
Refrigerants	Where refrigerant use is unavoidable, the use of refrigerant type R410A or similar is used for the proposal. 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.
Water Use	Through detailed design, a detailed supply/demand analysis of rainwater available and expected site usage of water will be undertaken. If feasible and beneficial, the size of the rainwater harvesting system will be increased.
Waste	Industry best practice for landfill diversion will be reviewed, with an ambitious landfill diversion benchmark committed to throughout detailed design.
	Feasibility and cost of an off-site segregation and recycling contract will be investigated to address construction and demolition waste management. The feasibility of a NABERS Waste Platform or Rating will also be investigated.

Impact	Recommendation
Materials	Industry best practice examples will be reviewed, and if feasible and achievable, the use of 30%+ lower GWP concrete mixes will be implemented.

Table 5: ESD Initiatives for Investigation

6. Greenhouse Gas Emissions Estimate

6.1 Emissions Scope and Coverage

Under this assessment, the following emissions scope has been assessed:

- Scope 1 – Related to direct emissions from sources within the boundary of the Project.
- Scope 2 – Related to the emissions resulting from the consumption of imported electricity from the local electricity grid.
- Scope 3 – Related to the indirect emissions attributable to losses through the electricity transmissions and distribution network.

Sources of emissions estimated in this assessment include the following:

- Imported electricity consumed in the operation of the facility; and
- On-site diesel fuel consumption consumed in the monthly testing of backup diesel generators.

Emissions have been estimated on an annual basis under the assumption of full and ultimate operational capacity over a 50-year period from 2024 (i.e. conservatively ignoring phased fit out and load growth which are difficult to predict accurately).

The assessment below provides two scenarios:

- Scenario 1: where the Proponent's emissions reduction targets are not in place,
- Scenario 2: where the Proponent's emissions reduction targets are in place and are met.

6.2 Input Data

6.2.1 Emissions factors

Emissions factors used for the estimation of GHG emissions has been taken from the National Greenhouse Accounts Factors 2022 (published February 2023), published by the Australian Government Department of Climate Change, Energy, the Environment and Water. At the time of writing, this was the latest revision of these accounts factors and it is assumed that they are applicable to the estimates at commencement of operation.

Emissions factors associated with relevant sources for the Project are outlined in Table 6 below.

Source	Emissions Factors
Diesel Fuel	Scope 1: CO_2: 69.9 kgCO_2-e/GJ (2698.1 kgCO_2-e/kL) CH_4: 0.1 kgCO_2-e/GJ (3.9 kgCO_2-e/kL) N_2O: 0.2 kgCO_2-e/GJ (7.7 kgCO_2-e/kL) Total: 70.2 kgCO_2-e/GJ (2,709.7 kgCO_2-e/kL)

Source	Emissions Factors
NSW Grid Electricity	Scope 2: 0.73 $kgCO_2$-e/kWh Scope 3: 0.06 $kgCO_2$-e/kWh

Table 6: Emissions taken from National Greenhouse Accounts Factors 2022 (published Feb 2023)

With respect to estimating emissions of an assumed facility life of 50 years, the decarbonisation of the electricity grid has been estimated based on linear interpolation and extrapolation of publicly announced government commitments related to renewable energy targets (Scenario 1), as well as the Proponent's organisational emissions reduction policy targets (Scenario 2). Emissions for the generation of electricity are projected to decline with increased renewable energy supply, while emissions for distribution losses are held constant (as a conservative assumption, although likely also to decline) until generation is fully decarbonised. Diesel emissions are also held constant. Figure 4 and Figure 5 illustrate the assumed changes to these factors for Scenarios 1 and 2 notionally for an assumed 50-year facility life between 2024 and 2074.

Note, with the generators operating at full load, the diesel fuel emissions of 2,709.6 $kgCO_2$-e/kL in Table 6 above equates to approximately 0.73 $kgCO_2$-e/kWh, based on the full-load fuel consumption rate of the 2800kW generators. The $kgCO_2$-e/kWh factor has been used in Figure 4 and Figure 5 below, for the purpose of illustrating like-for-like comparison against grid electricity emissions. Nevertheless, the emissions calculations in Section 6.3.1 are based on the $kgCO_2$-e/kL emissions factors and the actual estimated fuel consumption rates for the different generator types under the load testing scenarios.

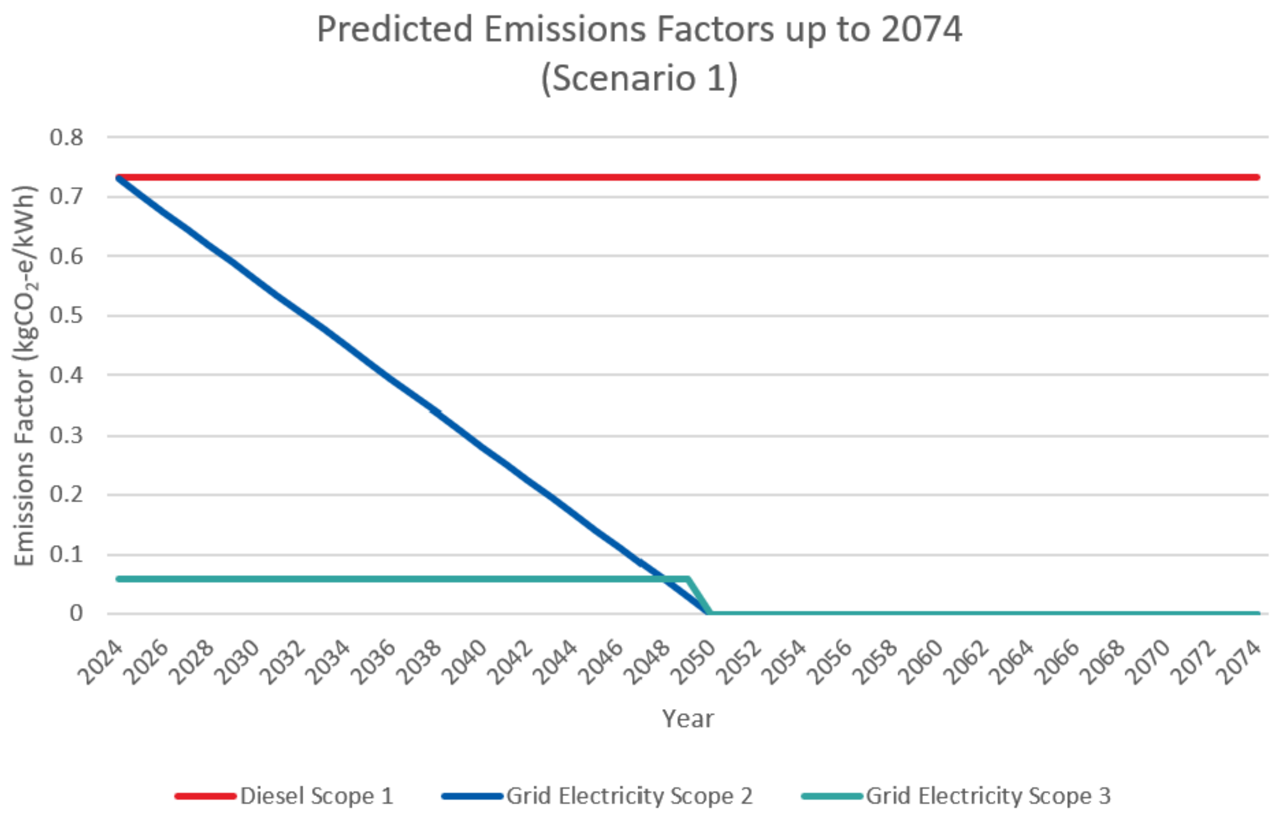

Figure 4: Projected emissions factor for diesel and grid electricity for the life of the asset (Scenario 1)

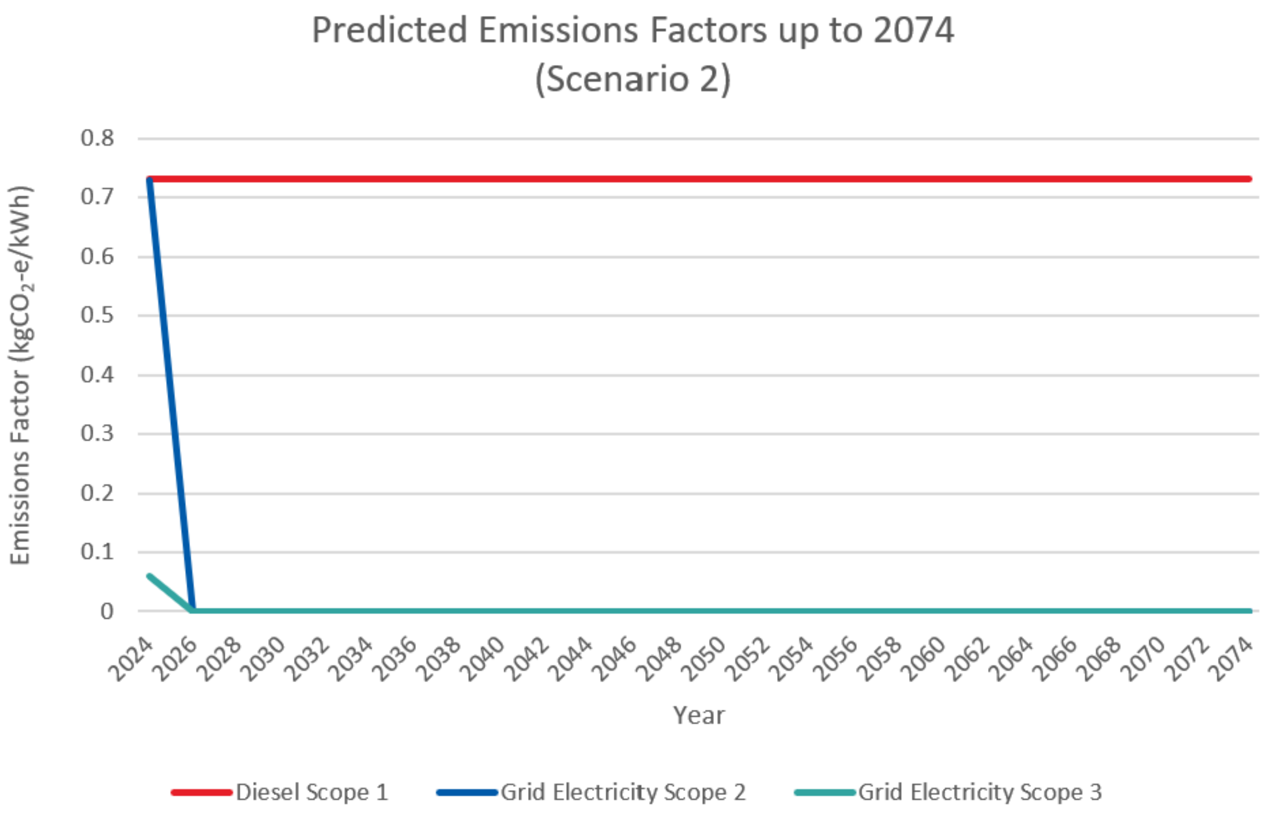

Figure 5: Projected emissions factor for diesel and grid electricity for the life of the asset (Scenario 2)

6.3 Emission Sources

6.3.1 Emissions arising from diesel fuel consumption

Source of Scope 1 emissions within the facility are the diesel generators which provide a backup source of electricity for the facility. In total, 1 x 600kW/750kVA and 18 x 2800kW/3500kVA generators will produce Scope 1 emissions as a result of monthly generator testing. Generators are tested for operational readiness based on the following regime:

- Fortnightly test: 5 mins each generator, no load
- Quarterly test: 20 mins each generator, 100% load
- Annual test: 110 mins each generator, 100% load

The fuel consumption rates of each generator are shown in Table 7 below:

Generator	100% Load Fuel Consumption (L/hr)	No Load Fuel Consumption (L/hr)
600kW/750kVA	237	14
2800kW/3500kVA	756	50

Table 7: Generator fuel consumption rates

This results in 40.9kL diesel fuel consumption annually, or 110.8 t CO_2-e.

6.3.2 Emissions arising from consumption of imported grid electricity

Scope 2 and 3 emissions are produced through the consumption of imported electricity from the grid.

Electrical energy consumption for the site has been assessed based on the estimated annualised Power Usage Effectiveness (PUE) of the site. The annualised PUE is a measure of total energy consumption as a ratio of the energy used only by the IT load, and thus provides an indication of the energy efficiency of the facility (a lower number is more efficient, with 1.0 being the theoretical optimum limit). The annualised PUE has been estimated with due consideration of local hourly historic weather data, cooling system efficiency performance, and other energy used to support the facility operation such as lighting).

The annual energy consumption has therefore been estimated as follows:

- Maximum site IT load / power consumption: 35.2 MW
- Average annualised site PUE: 1.15
- Average annualised site total power consumption: 40.48 MW
- Annualised site total energy consumption: 40.48 x 24 x 365 = 354.60 GWh

In the first year of operation based on the predicted 2023 emissions factors, electricity consumption will result in 280,137 t CO_2-e.

6.4 GHG Emissions Over Life of Asset

Figure 6 below shows the annual emissions for the predicted 50-year life of the asset using predicted emissions factors shown in Table 6. It compares the annual emissions in 4 different cases:

- Benchmark 1: average annualised site PUE of 1.80 (based on NABERS 3 Star Energy Efficiency);
- Benchmark 2: average annualised site PUE of 1.31 (based on NABERS 5 Star Energy Efficiency);
- Echidna Scenario 1: estimated average annualised site PUE for Echidna of 1.15 (without considering the emissions-reducing initiatives that are part of the Proponent's organizational policies);
- Echidna Scenario 2: estimated average annualised site PUE for Echidna of 1.15 (including emissions reductions in line with the Proponent's organizational policy targets).

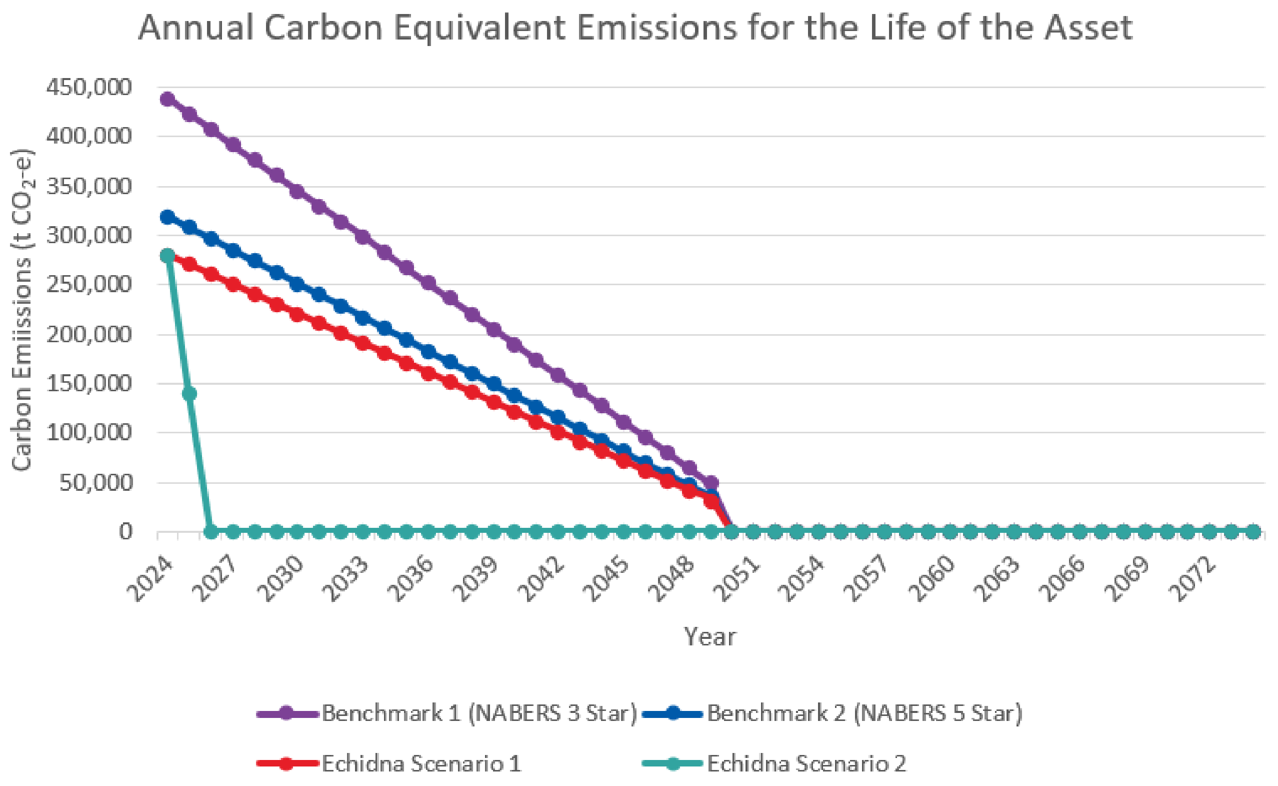

Figure 6: Annual CO_2 equivalent over 50 years for all four cases

Note that in Figure 6, Scope 1 emissions from diesel fuel continues to contribute 110.8 t CO_2-e each year. However this number is too small to be visible on the graph in comparison to the Scope 2 and Scope 3 emissions, and thus visually appears as effectively zero beyond year 2051.

Table 8 below summarises the GHG emissions analysed for the project, comparing NABERS 3 and 5 Star Energy Efficiency PUE benchmarks against the PUE estimated for Echidna. It also compares the scenario when the Proponent's emissions reduction targets are not in place (Scenario 1) and when the Proponent's emissions reduction targets are in place and are met (Scenario 2).

	Benchmark 1 (NABERS 3 Star)	Benchmark 2 (NABERS 5 Star)	Echidna Scenario 1	Echidna Scenario 2
	(t CO_2-e)			
Total GHG Emissions for Life of Asset	6,341,361	4,616,640	4,053,466	425,859
Total GHG Emissions for 1st Year of Operation	438,587	319,224	280,249	280,249
Total GHG Emissions for Last Year of Operation (2074)	110.8	110.8	110.8	110.8
Average Annual GHG Emissions for Life of Asset	124,340	90,522	79,479	8,350
Average Annual Improvement over Benchmarks	-	-	36% (Benchmark 1) 12% (Benchmark 2)	93% (Benchmark 1) 91% (Benchmark 2)

Table 8: Summary of GHG emissions under all four cases

6.5 State Greenhouse Gas Inventory

The State and territory greenhouse gas inventories emissions show that New South Wales' total GHG emissions for 2020 were 132.4 Mt CO_2-e. Emissions have declined 18.1% on 2005 levels, mainly due to reductions in emissions from stationary energy (mostly electricity) and the land sector.

The proposed development is predicted to contribute at most 280,249 t CO_2-e to the 2024 State and territory greenhouse gas inventories (in practice the contribution will be less due to staged construction and IT load growth). As shown above, the predicted GHG emissions will fall year-on-year in line with the decarbonisation of grid electricity and the Proponent's organisational policy targets for emissions reduction. Through the combination of a decarbonised grid, the proposed development is predicted to have minimal GHG contributions by circa 2050. This date can be brought forward to approximately 2030, with consideration for the Proponent's organisational policy targets being met.

Digital infrastructure assets have a central role to play in the transition to a low-carbon economy and sustainable cities, and can improve the state's GHG emissions per GDP especially in comparison to less-efficient alternatives such as on-premises infrastructure.

7. Water Consumption

7.1 Potable and Industrial Water Supply

The site will be supplied with both potable and industrial water supplies. Potable water will be supplied to the industrial water tanks, administration, and bathroom areas as well as hose taps surrounding the site. Industrial water will supply the evaporative cooling system serving the data halls. In addition, the potable water supply backs up the industrial water tank fed supplies.

7.1.1 Potable water

Potable water from Sydney Water's water mains will supply the industrial water supply storage tanks and will also be used as a secondary water supply source to the industrial water system when the rainwater storage tanks are offline. In addition, potable water will also supply all sanitary fixtures and fittings within the administration building.

7.1.2 Industrial water

The industrial water system will supply the evaporative cooling system serving the data halls. The cooling system recirculates water at 3 cycles prior to discharge. The industrial water system will be supplied primarily from industrial water tanks located in a tank yard to the west of the site.

The industrial water system will be supplied from the following sources;

- Potable water from the authority's water mains.
- Rainwater harvested from building roof

The industrial water system will draw its water source in sequence as follows;

- Rainwater tanks
- Potable water

The industrial water supply will be filtered with automatic back wash filters and automatically chemically dosed to prevent legionella growth prior to being supplied to the evaporative cooling units.

7.1.3 Demand estimate and water reuse

Water consumption for Echidna is mainly driven by the evaporative cooling process system serving the data halls. The evaporative coolers within air handling units allows 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.

To further reduce water consumption, 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.

In the final configuration, when all data halls are operational, the estimated water demand for Project Echidna is tabled below:

	Industrial Water Use	Domestic Water Use	Total
Peak Day Water Usage (kL/day)	1,145.7	2.5	1,148.2
Annual Water Usage (kL/year)	19,734.2	912.5	20,646.7

Table 9: Peak day and annual water usage when all data halls are operational.

This demand will be reduced by utilising the rainwater stored in the site's 163,000L rainwater tank. It is intended to harvest the roof water of 60% of the Project Echidna building for use in the evaporative cooling process and for landscape irrigation.

The rainwater tank has been sized based on the rainfall data from the Bureau of Meteorology (BoM) from the closest weather station from the past 10 years and a roof catchment area of 4,500m^2. The average annual rainfall over the past 10 years has been calculated to be 2.83ML/year.

Based on the estimated annual average potable water consumption by the cooling systems of 19.73ML/year, the rainwater harvesting system could reduce the potable water consumption by 15% in the ultimate configuration and by higher percentages in early stages of the ramping profile.

The design mitigations above are considered to minimise the development's water consumption as far as reasonably practicable.