Billabong Creek Regulators

Ecologically Sustainable Development Assessment

NSW Department of Climate Change, Energy, the Environment and Water

May 2024

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Executive Summary

NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) is proposing to replace two existing weirs along Billabong Creek with new regulators. The two existing weirs, Hartwood Weir and Wanganella Weir are situated on Billabong Creek within the Yanco Creek system and both will be demolished. These weirs were built in the early 20th century and have been used to regulate flows through Billabong Creek, create weir pools for irrigation and, in the case of Wanganella Weir, provide town water supply.

The new regulators would be fully automated and remotely operated to deliver water more efficiently. The proposal is needed to improve the operator's ability to deliver the right amount of water to the right place at the right time. The new regulators would also feature fishways to support fish movement past the new structures. WaterNSW would own and operate the new regulators once constructed.

As part of the environment impact statement (EIS) for the proposal, this Ecologically Sustainable Development (ESD) Assessment has been prepared to address the Secretary's Environmental Assessment Requirements. The primary objective is to ensure the proposal's adherence to ESD principles to meet or exceed industry-recognised building sustainability and environmental performance standards. GHD has identified the use of the Infrastructure Sustainability rating tool, developed by the Infrastructure Sustainability Council of Australia, as a suitable pathway for compliance with this objective.

As part of this ESD Assessment, a materiality assessment has been conducted to identify the most relevant sustainability aspects of the proposal, and proposed a sustainability pathway to address the material aspects and respond to the specific IS tool credits. The assessment and pathway have been defined based on information available at the time of preparation of this EIS. Several opportunities have been identified to enhance the proposal's sustainability and compliance with environmental regulations. These include:

- **Environmental Compliance and Monitoring:** Achieving a minimum Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) Essentials Design and As Built Rating (Version 2.1) of Silver.
- **Energy and Carbon Management:** Designing and building the proposal to minimise the embodied and operational greenhouse gases emissions and replacing the use of fossil fuels with renewable sources of energy.
- **Climate Risk and Resilience:** Designing the proposal to withstand any high to very high risks identified in detailed design associated with climate change to year 2100 in accordance with the climate information assets included in the NSW Common Planning Assumptions. Noting that no high to very high risks were identified in concept design.
- **Circular Resource Management:** Minimising primary/virgin resource and waste generation during all life cycle stages by embedding circular design strategies and maximising the opportunities for flexibility and adaptability in design, and reuse of components at the end of the lifetime of the asset.
- **Water Stewardship and Efficiency:** Developing and implementing an integrated water management plan for the proposal construction and operation.
- **Biodiversity:** Incorporating design strategies which seek to achieve no quantifiable net loss of biodiversity compared to its pre-development state.
- **Air Quality:** Implementing all reasonably practicable measures to minimise the emission of dust and other air pollutants during construction.

These strategies will ensure that the proposal not only meets but exceeds environmental standards, contributing to a sustainable future.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1 and the assumptions and qualifications contained throughout the Report.

Abbreviations

Term	Definition
DPHI	New South Wales Department of Planning, Housing and Infrastructure. Formerly NSW Department of Planning and Environment.
EIS	Environmental Impact Statement
ESD[1]	Ecologically/Environmentally Sustainable Design
IS	Infrastructure Sustainability tool
ISC	Infrastructure Sustainability Council
ISO	International Organisation for Standardisation
LCA	Life Cycle Assessment
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water. Formerly Water Infrastructure NSW.
SEARS	Secretary's Environmental Assessment Requirements

[1] In this report, the words ecological/ecologically and environmental/environmentally may be interchangeably used.

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1. Introduction

1.1 Overview

NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) is proposing to replace two existing weirs along Billabong Creek with new regulators (the proposal). The two existing weirs to be demolished are Hartwood Weir and Wanganella Weir. These structures are situated on Billabong Creek within the Yanco Creek system in south-west NSW (refer Figure 1.1).

These weirs were built in the early 20th century and have been used to regulate flows through Billabong Creek, create weirs pools for irrigation and, in the case of Wanganella Weir, provide town water supply. The weirs are currently in states of declining condition and functionality and are barriers to the movement of fish through the creek. Their condition limits their ability to regulate flows through the Yanco Creek system and leads to inefficiencies in how water is delivered to the environment and irrigators.

The new regulators would be fully automated and remotely operated meaning that operators could control the delivery of water more efficiently. The proposal is needed to improve the operator's ability to deliver the right amount of water to the right place at the right time. The new regulators would also feature fishways to support fish movement past the new structures. WaterNSW would own and operate the new regulators once constructed.

The proposal is subject to environmental and planning approvals in accordance with the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The proposal is State significant infrastructure (SSI), and the Minister for Planning is the approval authority. An environmental impact statement (EIS) is required to accompany the application for approval of the proposal.

1.2 Purpose and scope of this report

This report has been prepared by GHD Pty Ltd (GHD) as part of the EIS for the proposal. The EIS has been prepared to accompany the application for approval of the proposal and addresses the Secretary's Environmental Assessment Requirements (SEARs), issued on 17 October 2024.

The purpose of this report is to conduct the Ecologically Sustainable Development (ESD) assessment which outlines the development of an Infrastructure Sustainability Management Plan (ISMP) to guide the proposal team in identifying and managing sustainability risks associated with the proposal. This is a live document to be updated and expanded in detailed design by the proposal Sustainability Lead or equivalent appointed by Project Director or Project Manager, as the proposal progresses, design and sustainability initiatives are defined, and other design teams and contractors are included in the proposal.

The incorporation of ESD principles is emphasised as a part of this report, ensuring sustainability performance enhancement in detailed design, delivery, and ongoing operation. Components include review of the Infrastructure Sustainability ratings framework and identification of the opportunities and initiatives to achieve an IS Essentials rating. This report also provides a framework for sustainable project management and decision-making.

1.3 Structure of this report

The report is structured as follows:

– section 1 – introduces the proposal and the assessment
– section 2 – describes the methodology for the assessment
– section 3 – outlines the details of this assessment
– section 4 – outlines the plan implementation of this assessment
– section 5 – conclusion.

Figure 1.1 - Location of the proposal

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1.4 Summary of the proposal

1.4.1 Location

The proposal is located on Billabong Creek, which is part of the Yanco Creek system in south-west New South Wales (NSW). The Yanco Creek system forms a part of the Murray-Darling Basin. An overview of the location of the proposal is shown in Figure 1.1.

The proposal is located within the local government area (LGA) of Edward River.

1.4.2 Key features of the proposal

As discussed in section 1.1, the proposal involves replacing two existing weirs along Billabong Creek with new regulators including fishways.

The core structure of the two regulators is similar and would include:

- concrete piers with maintenance bulkhead slots
- automated layflat gates across the crest of the structure to assist with flow management and downstream fish passage
- a low turbulence 'keyhole' type vertical slot fishway with allowances for variable headwater to provide upstream fish passage
- automated sidewinder gates within the vertical slot fishway to allow for variable headwater conditions
- fixed concrete crests on the opposite side of the gates to the vertical slot fishway
- concrete apron downstream of the structure
- concrete wingwalls upstream and downstream of the structure
- access from a trafficable deck for maintenance (Hartwood Regulator only)
- pedestrian walkway access part way across Wanganella Regulator structure to facilitate housing of gate actuators and for maintenance
- walkway grating over gates to facilitate operations and maintenance
- crushed rock maintenance pads, access, and turnaround areas adjacent to the structure
- rip rap and rock beaching upstream and downstream of structure for erosion protection
- control house
- sheet pile cut-off walls beneath the structure
- fencing of the structures to prevent public access
- SCADA control system.

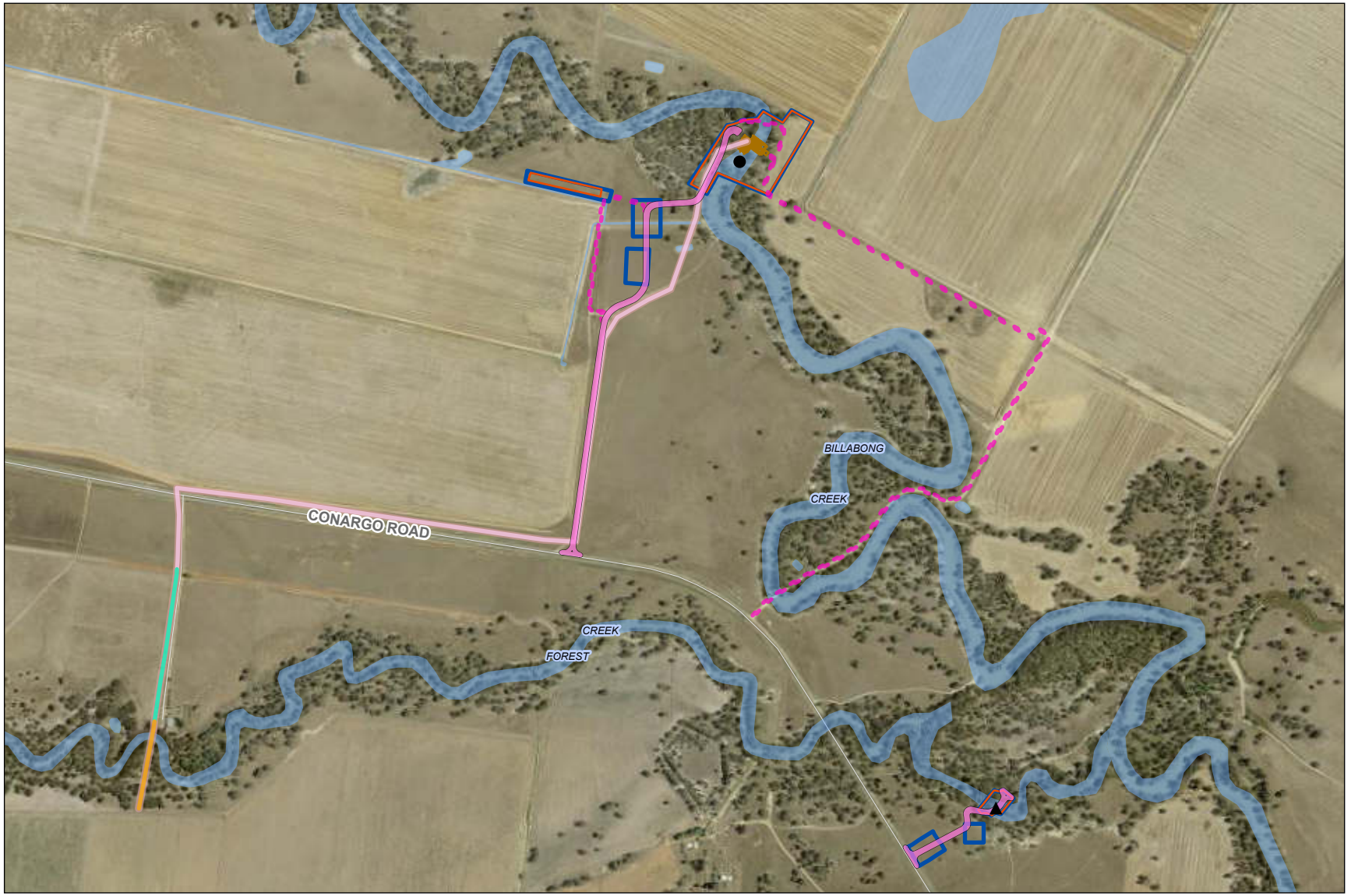
An indicative layout of a regulator is shown in Figure 1.2. This example has five gates and a trafficable deck for maintenance access.

Figure 1.2 Indicative layout of a regulator

The proposal would also involve the following elements:

– Power supply to the regulators would be provided by a mix of underground and overhead electricity cables connecting the structures to the grid.
– Access to the regulators would require permanent tracks for maintenance and some additional tracks to support construction only. Track upgrades include a new drainage culvert at Hartwood.
– The existing Forest Creek block bank, associated with the Hartwood Regulator, would be replaced with a similar earthen structure to the existing. This would include two concrete sills to define the upstream and downstream top of bank and armoured with rock beaching and crushed rock for erosion protection.
– A flood bypass channel would be constructed to reduce potential upstream flooding impacts from the Wanganella Regulator. The channel would enable flood waters to drain between the billabongs in the Wanganella Reserve during flood events. It would be 85 metres long, around 40 metres wide and 1.7 metres deep and located north of the Wanganella Tip. Once completed, the channel sides and base would be natural and vegetated with appropriate local native species.
– An existing borrow pit on private land at lot 56 / DP756322 on private land, near Hartwood Weir would be extended to provide material for the construction of Hartwood Regulator and Forest Creek block bank.

The location of the existing weirs, proposed infrastructure, and the indicative proposal footprints are shown on Figure 1.3 and Figure 1.4.



Proposal

- Proposed Hartwood Regulator
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Existing Block Bank
- Main Road
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:16,000

0 100 200 300 400

Metres

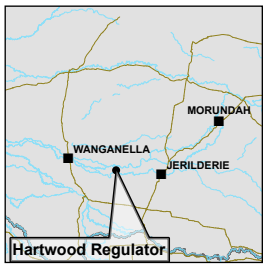


Figure 1.3 Location of Hartwood Regulator and Proposed Works

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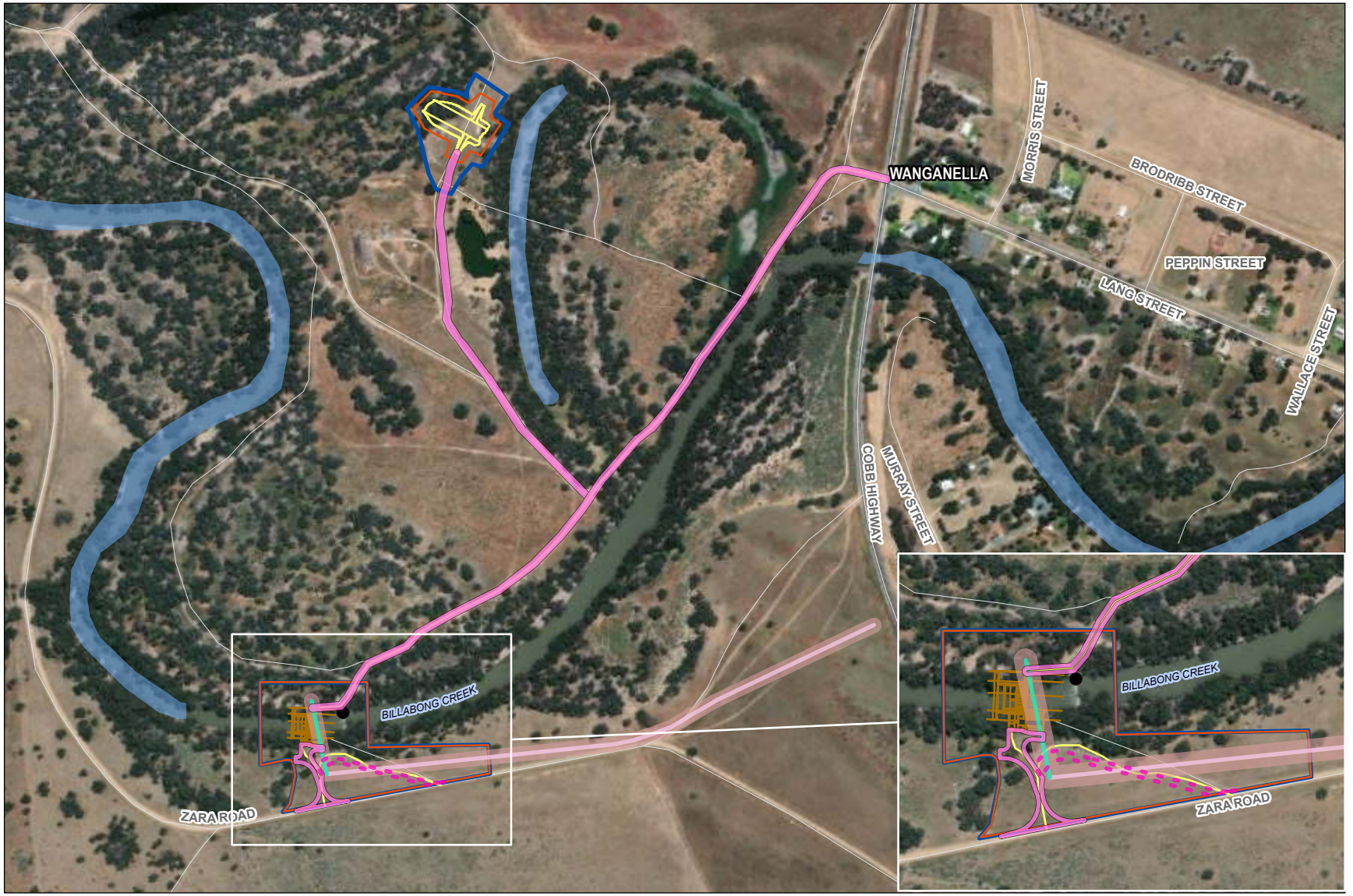

Proposal

- Proposed Wanganella Regulator
- Wanganella Bypass Channel
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Roads
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:8,000

0 75 150 225 300

Metres

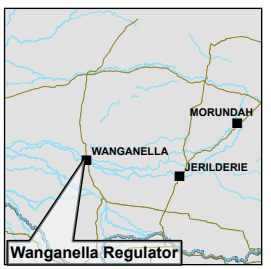

Figure 1.4 Location of Wanganella Regulator and Proposed Works

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1.4.3 Timing

Construction of the proposal is anticipated to start in 2025 and be completed by 2026. The construction period is anticipated to be around 18 months. Construction would pause during periods of high flow.

1.4.4 Operation

The proposal would be operated in accordance with the operating requirements established with the new asset owner and developed in consultation with key stakeholders. These operating requirements are known as the Yanco Creek System Operations Plan. The plan would consider the regulation requirements at each regulator, as well as constraints such as limits to rates of rise and fall to accommodate fish breeding requirements.

The proposed regulators would provide greater control of water levels which would be operated to meet environmental and water supply objectives. WaterNSW would own and operate the new regulators.

1.5 Secretary's Environmental Assessment Requirements

This ESD assessment has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs). Table 1.1 outlines the requirements relevant to this assessment.

Table 1.1 Relevant SEARs

Requirements	Where addressed in this report
Ecologically Sustainable Development (ESD)	
18 Detail how ESD principles (as defined in section 193, division 5, part 8 of the EP&A Regulation) will be incorporated in the proposal.	Entire report
Include an assessment against an accredited ESD rating system or an equivalent program of ESD performance. The assessment must include a minimum rating scheme target level.	Entire report

For the definition of Ecologically Sustainable Development (ESD), the SEARS refer to Environmental Planning Assessment Regulation (EPAR, 2000), section 193:

1. *"The principles of **ecologically sustainable development** are the following:*
   a. *the precautionary principle,*
   b. *inter-generational equity,*
   c. *conservation of biological diversity and ecological integrity,*
   d. *improved valuation, pricing, and incentive mechanisms.*
2. *The precautionary principle is 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.*
3. *In applying the precautionary principle, public and private decisions should be guided by—*
   a. *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*
   b. *an assessment of the risk-weighted consequences of various options.*
4. *The principle of inter-generational equity is that the present generation should ensure the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.*
5. *The principle of the conservation of biological diversity and ecological integrity is that the conservation of biological diversity and ecological integrity should be a fundamental consideration.*
6. *The principle of improved valuation, pricing and incentive mechanisms is that environmental factors should be included in the valuation of assets and services, such as—*
   a. *polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, and*

b. the users of goods and services should pay prices based on the full life cycle of the costs of providing the goods and services, including the use of natural resources and assets and the ultimate disposal of waste, and

c. established environmental goals 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.

1.6 Assumptions

This ESD assessment has been undertaken based on publicly available information and as a desktop assessment. Given the limited availability of information, several assumptions have been made and which will be confirmed during detailed design and construction stages.

2. Assessment approach

2.1 ESD assessment methodology

To demonstrate how the proposal “will meet or exceed the relevant industry recognised building sustainability and environmental performance standards”, the following tasks have been conducted:

– draft a Materiality assessment and scorecard (section 3.1) using Infrastructure Council Sustainability 2.1 Rating pathway
– documentation of outputs in an Infrastructure Sustainability Management Plan (ISMP – this document) including Sustainability Rating pathway.

2.1.1 Infrastructure Sustainability (IS) rating tool

The IS rating tool is the most widely used sustainability rating scheme for infrastructure projects in Australia. It provides a clear and comprehensive approach to sustainability in infrastructure projects, covering a wide range of sustainability issues, including environmental, social, economic, and governance aspects. It is designed to assess the sustainability of infrastructure projects across their entire life cycle, from planning and design to construction and operation (Figure 2.1). The IS rating tool is recognised by the Infrastructure Sustainability Council (ISC) as the most widely used sustainability rating scheme for infrastructure projects in Australia.

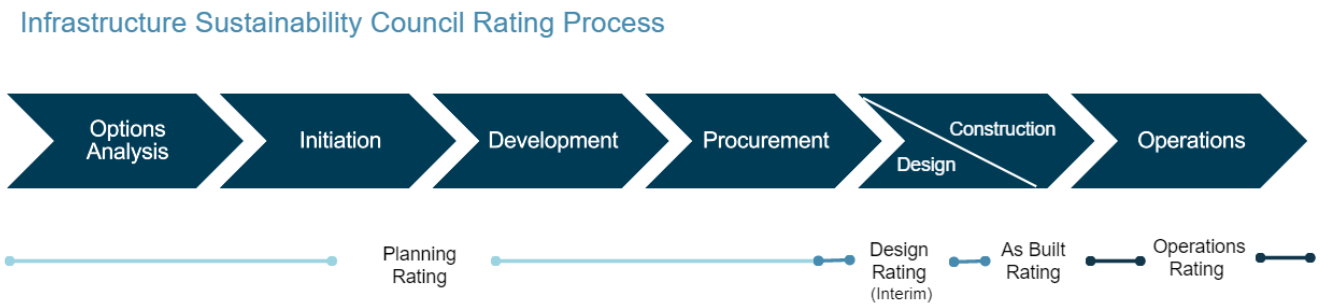

Figure 2.1 ISC ratings tools across the infrastructure life cycle

The tool sets distinct criteria for planning, design, construction and operations, with some credits applying across phases, highlighting the need for ongoing sustainability efforts from start to finish. The 37 credits are divided into four themes and 15 categories:

Governance theme

1. Place (Pla)
2. Leadership and Management (Lea)
3. Sustainable Procurement (Spr)
4. Resilience (Res)
5. Innovation (Inn)

Economic theme

6. Options Assessment (Ecn)
7. Energy and Carbon (Ene)

Environment theme

8. Environmental Impacts (Env)
9. Resource Efficiency and Management (Rso)
10. Water (Wat)
11. Ecology (Eco)

Social theme

12. Stakeholder Engagement (Sta)
13. Legacy (Legh)
14. Heritage (Her)
15. Workforce Sustainability (Wfs)

The IS Rating Scheme uses a points system (Table 2.1).to measure a project's sustainability performance, offering up to 100 points, plus an extra 10 for innovation. Based on the points scored, projects can achieve one of five levels, providing a clear scale for evaluating and benchmarking the sustainability efforts of infrastructure projects.

Table 2.1 IS Essentials Rating Award Levels

Score	Rating Level
95-100	Diamond
80-94.9	Platinum
60-79.9	Gold
40-59.9	Silver
20-39.9	Bronze
< 20	Not eligible for rating

2.1.2 IS tool as a driver for SEARs' ESD principles

The SEARS require an assessment against an accredited ESD rating system or an equivalent program of ESD performance. Whilst the SEARs do not mandate a specific ESD standard, protocol, or methodology for the ESD assessment, this assessment has adopted the Infrastructure Sustainability (IS) rating tool as an accredited ESD rating scheme, as detailed in Table 2.2. In addition the SEARs require a minimum rating scheme target level. To address this requirement the assessment has included documentation of what rating target the schemes are seeking to achieve and how the performance level of the schemes against those targets will be measured.

Table 2.2 IS rating tool approach to ESD principles

ESD principles	IS tool approach
Precautionary Principle	– The IS tool encourages project proponents to take a cautious approach by considering potential environmental impacts early in the planning and design stages. – It promotes thorough risk assessment and mitigation strategies to prevent harm to ecosystems, communities, and future generations.
Inter-generational Equity	– The IS tool emphasises long-term thinking. It encourages projects to balance immediate economic gains with the wellbeing of future generations. – By assessing the social, economic, and environmental impacts over time, projects can ensure equitable benefits for both present and future stakeholders.
Conservation of Biological Diversity and Ecological Integrity	– The IS tool integrates biodiversity considerations into project planning and execution. – It encourages the protection of natural habitats, endangered species, and ecosystem services. – Projects that prioritise ecological integrity contribute to the overall health of our planet.
Improved Valuation, Pricing, and Incentive Mechanisms	– The IS tool promotes a holistic approach to project evaluation. – It goes beyond financial metrics and considers broader value, including social and environmental aspects. – By valuing natural capital and ecosystem services, projects can make informed decisions that benefit society.

The IS rating tool for design and as built is currently in its version 2.1. Although it is applicable to all projects in its full version, a streamlined approach, the IS Essentials, has been developed for infrastructure projects with a capital value less than $100 million. The current estimation for the proposal's capital value is approximately $30 million, which is within the threshold for the application of the simplified IS Essentials rating. Thus, in this assessment the IS Essentials rating with 15 credits only has been adopted due to its capital cost being less than $50 million:

– <$20 million: 10-15 credits
– $20 million - <$50 million: 15-20 credits
– $50 million - $100 million: 20-25 credits.

3. ESD assessment

3.1 IS materiality assessment and scorecard

A preliminary materiality assessment (or weighting assessment) has been conducted on the concept design to understand the relative importance (materiality) of sustainability aspects and identify the most important issues for the proposal, using the IS Essential rating tool scorecard. This adjusts the value of certain items within the IS rating tool to best reflect the context of the proposal. During the assessment, each topic is categorised as one of the following:

– 0 = not material (scoped out)
– 1 = Low materiality (half as moderate as important as moderate)
– 2 = Moderate materiality
– 3 = High materiality (more than 50% more important than moderate)
– 4 = Very high materiality (twice as important as moderate).

The materiality assessment was undertaken as a desktop exercise by the EIS Sustainability team. A summary of the resulting materiality assessment and scorecard from the IS Essentials tool is shown in Table 3.1.

Table 3.1 ISC summary materiality and scorecard (those credits excluded from IS Essentials rating are shaded)

IS Credit	IS Essentials Credit name	Materiality	Score possible	No. of levels	Target level	Target Credit score
Lea-1	Integrating Sustainability	2	6.99	3	2	4.66
Lea-2	Risks & Opportunities	2	4.51	3	1	1.50
Spr-1	Sustainable Procurement Strategy	2	5.33	3	3	5.33
Spr-2	Supplier Assessment and Selection	2	4.51	3	3	4.51
Res-1	Climate and Natural Hazards Risks	3	6.77	3	3	6.77
Inn-1[2]	*Innovation*	2	10.00	10	0	0.00
Ecn-1	Options Assessment and Significant Decisions	2	8.63	3	1	2.88
Ene-1	Energy Efficiency and Carbon Reductions	3	9.87	3	1.00	3.29
Ene-2	Renewable Energy	3	6.77	3	0.00	0.00
Ene-3	Offsetting	3	3.67	3	0.00	0.00
Env-1	Receiving Water Quality	3	4.85	3	2	3.23
Env-5	Light Pollution	3	3.29	3	1	1.10
Rso-1	Resource Strategy Development	3	5.51	3	2	3.68
Rso-4	Resource Recovery and Management	3	5.51	3	3	5.51
Rso-6	Material Life Cycle Impact Measurement & Mgmt.	2	7.81	3	0.67	1.74
Wat-1	Avoiding Water Use	3	8.00	3	1.00	2.67
Wat-2	Appropriate Use of Water Sources	3	8.00	3	1	2.67
	Total		**110 pts**			**49.5 pts**

[2] Innovation credits have not been quantified for this scorecard, as they will have to be defined during the detailed design stage. However, they may provide up to 10 (ten) additional points.

The target credit score of 49.5 would be an IS Essentials rating level of ‘Silver’. However this is a preliminary materiality assessment for concept design and EIS, and a formal materiality assessment should be undertaken for the detailed design stage before the weightings assessment is issued to ISC for verification and a target score is confirmed.

For the preliminary materiality assessment, sustainability initiatives identified in concept design were included in the review process. Important to note that sustainability initiatives should be applied beyond the IS tool where tangible opportunities have been identified that would improve the performance of the proposal.

The categories assessed to be most material for the proposal from the default calculations are primarily:

– Energy and Carbon (Ene), 20.30 points
– Resource Efficiency and Management (Rso), with 18.83 points
– Water (Wat), with 16.00 points
– Leadership and Management (Lea), with 11.50 points
– Innovation (Inn), with 10 points.

3.2 Proposal sustainability opportunities

This section details the key sustainability opportunities to be conducted for the proposal during the detailed design and construction phases to meet the sustainability objectives of the proposal. These opportunities will address the ISC credits as detailed in the previous section, that are being pursued and any subsequent updates to achieve the recommended IS Essentials design and as built ratings. This summary of key sustainability initiatives draws on the materiality assessment and others documents previously developed for the proposal in concept design stage.

The below list of sustainability initiatives is not intended to be an exhaustive list but rather an indication of the enhancements that can be made in detailed design stage for the specific purposes of achieving the IS Essentials rating.

Table 3.2 IS Essentials pathway, comments and potential initiatives

Credit		Target level	No. of levels	IS Essentials rating requirements (to achieve target level) in detailed design stage	Opportunities/initiatives in detailed design stage
Lea-1	Integrating Sustainability	2	3	– Development or review and update of sustainability objectives, targets, responsibilities, and a reporting framework. – Development of a sustainability management plan specifically designed for the phases of design and construction. – Reviewing sustainability objectives and targets with significant external stakeholders, incorporating their input into the process. – Publicly stating sustainability targets and regularly reporting performance against these targets to promote transparency.	A sustainability initiatives workshop with discipline leads should be held to identify key opportunities and initiatives for the proposal. A preliminary infrastructure sustainability management plan (ISMP) has already been developed in concept design stage, which considers the opportunities. The ISMP can be further developed and updated in detailed design stage long with some sustainability target setting so this credit can be complied with.
Lea-2	Risks & Opportunities	1	3	– The project can build on the existing opportunities register and other documents assessing risks to comply with this credit through a more detailed risk assessment that identified and implements treatment options. – Sustainability risks assessment with treatment options identified and implemented for direct risks. – Sustainability opportunities identified and assessed. – Include multidisciplinary team in above tasks, review, and update documents quarterly, and provide register to operator.	As per Lea-1
Spr-1	Sustainable Procurement Strategy	3	3	– Material sustainability risks and opportunities in the project's supply chains are identified collaboratively with key internal stakeholders. – A formal commitment to sustainable procurement is integrated into the project's governance framework. – A strategy or management plan is established to effectively manage sustainable procurement practices throughout the design and construction phases of the project.	A value engineering workshop should be held in tender or detailed design stage to assess which materials could have the least carbon impact.

Credit		Target level	No. of levels	IS Essentials rating requirements (to achieve target level) in detailed design stage	Opportunities/initiatives in detailed design stage
Spr-2	Supplier Assessment and Selection	3	3	– Specific sustainability requirements for goods or services with material risks or opportunities are included in tender documentation for potential suppliers. – Supplier selection incorporates sustainability performance requirements, achieving Level 1 standards. – Suppliers' responses to sustainability requirements are assessed during the procurement process. – Unsuccessful suppliers receive feedback on their sustainability performance as part of the outcome communication.	As per Spr-1
Res-1	Climate and Natural Hazards Risks	3	3	– Climate and natural hazard risks to the asset are identified and assessed using current data and future climate projections. – Treatment options for direct risks are identified, implemented, and result in the reduction of extreme and high-priority risks to an acceptable level. – A multidisciplinary internal team participates in identifying and assessing direct risks and selecting treatment options. – Climate change projections used in risk assessment include a sensitivity analysis for added robustness. – The risk assessment considers both climate and natural hazard risks, including indirect risks to the asset. – Treatment options for indirect risks are identified, implemented, and extreme/high-priority risks are reduced to an acceptable level and a comprehensive set of affected stakeholders is involved in identifying direct and indirect risks and treatment options. – Treatment options for all extreme and high risks are assessed, considering optimal scale, timing, costs, and benefits of addressing climate and natural hazard risks	A desktop climate risk assessment was conducted as part of the EIS for concept design and can be expanded in detailed design stage to comply with the specific requirements of this credit.
Inn-1	Innovation*	0	10	– Innovations have been established within at least one of the following categories: a. 'First' innovative technology, process, or method b. Market transformation c. Improving on credit benchmarks d. Innovation Challenge. – * Innovation credits have not been quantified for this scorecard, as they will have to be defined during the design stage. However, they may provide up to 10 (ten) additional points.	

Credit		Target level	No. of levels	IS Essentials rating requirements (to achieve target level) in detailed design stage	Opportunities/initiatives in detailed design stage
Ecn-1	Options Assessment and Significant Decisions	1	3	– Develop and apply clear parameters for defining 'significant' project initiatives and evaluate options for significant project initiatives using a formal assessment technique considering environmental, social, and economic impacts. – Undertake whole-of-life costing for significant project initiatives and ensure that at least 50% of significant project initiatives apply the options assessment process.	A sustainability workshop should be held in detailed design stage to assess sustainability initiatives suitable for the proposal. The Sustainability Register should assess all initiatives with ‘scores’ developed through consultations with key stakeholders.
Ene-1	Energy Efficiency and Carbon Reductions	1.00	3	– Complete modelling of energy use and carbon emissions for both capital and operational phases. – Investigate and incorporate energy and carbon emissions reduction opportunities throughout the infrastructure life cycle, integrating them into design and construction planning. – Demonstrate a reduction in energy use and carbon emissions for both capital and operational phases compared to the Base Case. Achieve reductions on a sliding scale, ranging from >0% to 30%.	An energy use and carbon emissions assessment should be undertaken in detailed design stage to manage and reduce the scope 1 and scope 2 greenhouse gas emissions associated with the proposal. Additionally, the proposal should also identify detailed design stage considerations to achieve sustainability outcomes as well as the minimisation of scope 3 emissions.
Ene-2	Renewable Energy	0.00	3	– A gradual transition has been successfully implemented, ranging from substituting more than 0% to 100% of the anticipated capital and operational non-renewable energy consumption with renewable alternatives.	As per Ene-1
Ene-3	Offsetting	0.00	3	– Commitment to offset 0-100% of project's total carbon footprint, including materials' embodied carbon.	As per Ene-1
Env-1	Receiving Water Quality	2	3	– Assess and determine the location, extent, characteristics, and health of the existing receiving water environment. – Develop modelling for water quality impacts during construction and operation, identify water discharge and receiving water quality goals, and implement measures to achieve them. – Establish monitoring requirements for water discharges and receiving water quality, considering project goals. – Review water quality impacts, controls, and mitigation measures with stakeholders. – Ensure modelling demonstrates no adverse impact on receiving water environmental values. – Confirm that the infrastructure will not increase peak stormwater flows negatively impacting stream morphology.	To achieve the target level, this credit can be explored further in detailed design stage.

Credit		Target level	No. of levels	IS Essentials rating requirements (to achieve target level) in detailed design stage	Opportunities/initiatives in detailed design stage
Env-5	Light Pollution	1	3	– Determine the characteristics and sensitivity of light receptors. – Model lighting impacts, and if required, limit horizontal lux levels over the project boundary to 2 and upward light ratio to 2% (excluding decorative lighting). – Implementing design measures to prevent light spill.	The proposal could aim to restrict lighting impacts, specifying no more than 1 horizontal lux level over the project boundary and a 1% upward light ratio.
Rso-1	Resource Strategy Development	2	3	– Develop a Resource Efficiency Strategy (RES) to guide project design, construction, and operation expectations. – Identify and assess resource efficiency opportunities with the design team, evaluating their feasibility. – Develop a Resource Efficiency Action Plan (REAP) outlining the implementation of the RES. – Provide RES and REAP documentation to both the proponent and contractor. – Review performance targets, including circular economy outcomes, with external stakeholders. – Proactively communicate resource efficiency targets to the market to identify and realize circular economy opportunities.	Materials initiatives should be assessed for implementation. These initiatives have a positive contribution to the credit, but more opportunities should be considered to align with the requirements.
Rso-4	Resource Recovery and Management	3	3	– Assess risks and opportunities related to resource outputs and identify measures to minimize resource outputs during design, construction, and operation. – Develop project performance targets for resource outputs during the delivery phase. – Identify opportunities for beneficially reusing resource outputs. – Develop a management plan for resource outputs. – Implement design phase actions outlined in the management plan. – Formally assess and embed opportunities for beneficial reuse of resource outputs. – Ensuring significant beneficial reuse of resource outputs is embedded in the project.	As per Rso-1 and Lea-1
Rso-6	Material Life Cycle Impact Measurement & Management	0.67	3	– Undertake modelling of materials' life cycle impacts using the Infrastructure Sustainability Materials Calculator (ISMC) or a suitable Life Cycle Assessment (LCA) technique. – Demonstrate a reduction in materials' life cycle impacts compared to a verified Base Case footprint. – Achieve reductions on a sliding scale for every percentage point reduction in IS EnviroPoints, ranging from >0% to 45%.	To be compliant with this credit, there is opportunity to explore this item further. The environmental impacts of the construction materials and plant equipment can be assessed through an LCA.

Credit		Target level	No. of levels	IS Essentials rating requirements (to achieve target level) in detailed design stage	Opportunities/initiatives in detailed design stage
Wat-1	Avoiding Water Use	1.00	3	– Complete modelling of water demand for both operational and construction impacts. – Full investigation of water use avoidance and reduction opportunities throughout the infrastructure life cycle, integrating them into design and construction planning. – Demonstrate a reduction in water demand compared to the Base Case. – Achieve reductions on a sliding scale for every percentage point reduction in water demand, ranging from >0% to 30%.	
Wat-2	Appropriate Use of Water Sources	1	3	– Identification and formal assessment of available and suitable water sources for the asset. – Implementation of feasible alternative water source options with a financial payback period of two years or less. – Modelling the percentage substitution of residual water demand (Wat-1) by incorporating alternative water sources into the system.	As per Wat-1

4. Plan implementation

4.1 Sustainability performance targets

Infrastructure projects should aim to achieve maximum social, economic, and environmental outcomes and value at limited cost. By aligning with the ISC rating system in detailed design and delivery ('as built' IS rating stage), sustainability programs can drive better project outcomes and reduce the costs of project delivery.

The IS rating tool can be used to benchmark the project performance, thus demonstrating industry leadership, and helping identify continuous improvement opportunities. The IS rating can act as a guide to the integration of sustainable detailed design and construction.

Building on IS tool requirements as a reference, a strategy should be prepared to achieve, as a minimum, the ESD targets summarised in Table 4.1 in response to the sustainability focus themes and objectives.

Table 4.1 Sustainability targets for detailed design and construction of the proposal

Sustainability themes	Objectives	Sustainability Performance Targets[3] (detailed information on IS Essentials tool)
A. Environmental Compliance and Monitoring	Ensure strict adherence to environmental regulations, with continuous monitoring during construction to mitigate negative impacts and ensure compliance with sustainability objectives.	– Achieve an IS v2.1 Essentials design and as built rating level. – Implement a sustainability reporting and monitoring framework. – Prepare periodic reports (at least quarterly) identifying progress against sustainability targets and making them publicly available. – Develop and implement a sustainable procurement strategy that includes supplier assessment, selection, and management. – Develop an options assessment methodology to identify and formally evaluate 'significant' project initiatives. – Develop and implement a risk assessment methodology.
B. Energy and carbon management	Develop and implement an energy and carbon reduction strategy targeting greenhouse gas emissions associated with construction activities, including energy efficiency measures, renewable energy sources, and carbon offsetting.	– 10% reduction in total upfront and operational carbon emissions.
C. Climate risk and resilience	Assess risk associated with future climate in the region and design infrastructure to withstand climate impacts, ensuring long-term reliability and serviceability amidst extreme weather events.	– Identity and classify climate risks and provide treatment options for any high to very high (extreme) risks identified in detailed design. Note: no high or very high risks have been identified in concept design stage.
D. Circular Resource Management	Employ innovative construction techniques and materials that ensure future adaptability, focusing on sustainability, circularity, and waste reduction by prioritising the use of recyclable, recycled, and repurposed materials to support a circular economy.	– Components to be designed and installed for easy adaptability and end of life disassembly. – 10% reduction of total life cycle impacts (using IS Materials Calculator or other suitable LCA assessment tool).

[3] Detailed information about targets and methodologies can be found in the IS Rating Tool v2.1 Technical Manual, Design & As Built.

Sustainability themes	Objectives	Sustainability Performance Targets[3] (detailed information on IS Essentials tool)
E. Water Stewardship and Efficiency	Emphasise the use of water efficiently and conservation in both design and construction to ensure not only sustainable water management but also waste minimisation, leading to the conservation and improvement of quality in the receiving waters.	– 10% reduction in water demand for construction and operational uses. – Identify and implement, when feasible, alternative water source options with a financial payback of up to five years. – Develop and implement an integrated water management plan for the proposal construction and operation, encompassing impact modelling, goal setting, measure identification, and monitoring aligned with water quality goals.
F. Biodiversity	Implement measures to protect and enhance local biodiversity during construction, including habitat preservation, minimising land disturbance, and enhancement of ecological value.	– Develop and implement an ongoing ecological monitoring program.

A strategy to deliver the IS Essentials rating in detailed design and delivery should include:

– development and confirmation of the IS Essentials pathway with sufficient buffer points

– establishment or update of the tender design materials, energy, and carbon footprint to track detailed design development to meet sustainability targets and credit benchmarks

– target of high materiality credits, particularly those credits that support achievement of other credits, such as climate, materials, carbon, and energy

– target innovation points using the Innovation Challenge, including exceeding IS credit benchmarks.

4.2 Detailed Design - Roles and responsibilities

The Project Director or designated Project Manager for the proposal has overall accountability for sustainability in detailed design and will represent sustainability at the senior Management Level. On a day-to-day basis, this position will be supported by the Sustainability Lead, who will manage and coordinate sustainability performance during both design and construction.

The Sustainability Lead is responsible for the delivery of the sustainability assessment in detailed design, supported by the sustainability team and overall project team. While it is the role of the sustainability lead to ensure sustainability considerations are made during the project phase, sustainability is an integral part of the contract and must be a consideration by all project team members for all aspects. This structure will ensure sustainability requirements are embedded in all technical assessments and that all evidence to demonstrate implementation is collated using a streamlined value for money approach.

As the proposal progresses through detailed design to delivery, the specific deliverables to achieve stated sustainability objectives and targets will be refined and articulated. More details on the responsibility and accountability of deliverables and documentation required to evidence the proposed credit levels will be provided at the start of the Detailed Design phase. Table 4.2 below outlines the main roles and responsibilities for the formal IS design rating.

Table 4.2 Project Team Sustainability Responsibilities for IS Essentials Design Rating

Role	Responsibilities
Design Team Project Manager	– The Project Manager is responsible for the overall commercial management of the project through detailed design, and that monthly claims are managed in accordance with the General Conditions of Contract. – Sustainability specific responsibilities in detailed design: • endorse and promote the projects ISMP and sustainability objectives and targets • ensure project teams are implementing sustainable design and construction practices in line with the ISMP • ensure all managers and disciplines leads understand and are responsible for ensuring their scope of works meet the projects sustainability obligations • maintain governance structures, processes, and systems, ensuring integration of all sustainability considerations, initiatives, monitoring, and reporting • ensure sufficient resources are made available to implement the ISMP and its obligations.
Design Team Sustainability Lead	– Liaison with the Detailed Design Project Manager, Design Manager, Design Leads, and other representatives. – Oversight of the development/ implementation of the ISMP and achievement of the sustainability targets in Table 4.1, and an IS Essentials Design and As Built \ Rating. – Review and approval of sustainability deliverables in detailed design. – Attendance at detailed design team and delivery team meetings.
Design Team Environmental Lead	– Provide guidance and as required, review / input for the environmental aspects of sustainability to ensure the best for project environmental outcomes in detailed design.
Design Manager	– Endorse and promote the projects ISMP and sustainability objectives and targets and their inclusion within the detailed design. – Ensure project teams are implementing sustainable design requirements in detailed design in line with the ISMP. – Ensure all disciplines leads understand and are responsible for ensuring their scope of works in detailed design meet the projects sustainability obligations. – Maintain governance structures, processes, and systems, ensuring integration of all sustainability considerations, initiatives, monitoring, and reporting in detailed design.
Design Team Climate Advisor	– Preparation of detailed design stage climate risk assessment and adaptation plan. – Development of adaptation responses in conjunction with design and construction teams.
ISC Project Manager	– Facilitate the implementation of the IS Rating through the detailed design phase.

4.3 Decision-making

Effective decision-making during the detailed design and delivery of a project involves considering the long-term social, economic, and environmental impacts. To achieve this, it's essential to engage with strategic stakeholders who can appreciate the broader project outcomes in detailed design and delivery and understand the critical role of sustainability in achieving those outcomes. While this plan outlines some preliminary sustainability actions, they should continue to evolve during the detailed design and delivery process.

A Sustainability Initiatives Register should be developed as the decision-making tool to assist decision making for significant sustainability issues during the detailed design and delivery phases of the proposal. This tool will be utilised when considering significant decisions, to achieve sustainability outcomes.

Risks and opportunities should be thoroughly assessed, considering factors such as consequences and likelihood. Communication and management will occur through project team meetings, and a project risk register will be maintained. The specific frequency and dates of these workshops, including the IS opportunities workshop, will be defined in the detailed design stage of the proposal to ensure opportunities and sustainability initiatives are documented and implementation tracked in design and delivery stages via a Sustainability Initiatives Register.

4.4 Sustainability Performance Evaluation

4.4.1 Monitoring and reporting

The proposal may choose to establish a mandatory sustainability performance monitoring and reporting process for the contractor and supply chain through the tender documents and contract structures. Sustainability data would be collected quarterly during the detailed design phase and construction phase to track performance and contract compliance. This data would further help identify trends, opportunities, and initiatives for improved performance.

The sustainability monitoring and reporting for the proposal may include, but is not limited to:

– Climate adaptation strategy implementation
– Energy, water, and materials usage monitoring
– Water quality monitoring
– Waste monitoring
– Sustainability in Design implementation.

4.4.2 Audits

The proposal's Environmental Management System (resources, activities systems and processes) shall be audited at least once in both detailed design and delivery stages to provide information on whether:

– the proposal is meeting its compliance obligations
– the proposal is conforming to the requirements and processes specified in the ISMP
– determine if the ISMP is effectively implemented and maintained.

In addition to auditing the Environmental Management System itself, the audits will also cover the most material environmental and social issues as per the proposal's IS Essentials rating weightings assessment. To achieve this the proposal shall establish, implement, and maintain a sustainability audit program, including the methods, responsibilities, planning requirements and reporting of its audits. The internal and external audits should be conducted by a suitably qualified auditor who satisfies the competency requirements of ISO19011:2011 – Guidelines for auditing management systems, or equivalent. The external audits must be conducted by a suitably qualified auditors who is not part of the proposal team. Note that this person can be from a parent company, a client or a third party.

4.4.3 Management review

The proposal senior leadership team will review the implementation of the ISMP at project level in detailed design stage, annually to ensure its continuing suitability, adequacy, and effectiveness. The management review will include consideration of:

– the status of actions from previous management reviews
– changes in:
  - external and internal issues that are relevant to sustainability
  - the needs and expectations of interested parties, including compliance obligations
  - risks and opportunities
– review of reports, studies, and any relevant workshops
– the extent to which sustainability objectives have been achieved
– information on the proposal's sustainability performance, including trends in:
  - nonconformities and corrective actions
  - monitoring and measurement results
  - fulfilment of its compliance obligations
  - audit results

– adequacy of resources
– relevant communication(s) from interested parties, including the community
– opportunities for continuous improvement.

The outputs of the management review will include:

– conclusions on the continuing suitability, adequacy, and effectiveness of the ISMP
– decisions related to continual improvement opportunities
– decisions related to any need for changes to the ISMP, including resources
– actions, if needed, when sustainability objectives have not been achieved
– opportunities to improve integration of the ISMP with other proposal processes, if needed
– any implications for the strategic direction of the proposal.

This ISMP is considered a live document and will be progressively reviewed, monitored, amended, and updated in detailed design and delivery stages. During review, the ISMP will be reassessed for applicability, suitability, and effectiveness. This ISMP should be updated to reflect any changes in project scope or sustainability requirements when necessary. It shall be reviewed and updated at least annually through the duration of the detailed design.

5. Conclusions

This ESD Assessment has been conducted to address the SEARS and determine how the proposal can adhere to the ESD principles. Due to the nature of the proposal, it poses a relevant opportunity to provide positive sustainability impacts to the community and the environment.

The primary conclusion drawn is that the IS Essentials rating tool has been recognised as a suitable pathway for compliance with the ESD principles. The subsequent subsection presents a list of recommended key issue conditions to help achieve SEARS requirements and, where feasible, mitigate or manage residual sustainability risks and impacts. It is crucial that sufficient funding and resources are allocated for the detailed design stage of the proposal to facilitate the IS Essentials rating, annual audits annual update of the ISMP and the technical plans detailed below.

5.1 Key issue conditions

Environmental Compliance and Monitoring

The proposal must achieve a minimum Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) Essentials ‘Design’ and ‘As Built’ Rating (Version 2.1).

Energy and carbon management

The proposal must be designed in detailed design and built stage to minimise the embodied and operational greenhouse gases emissions to the maximum feasible extent possible, and to replace the use of fossil fuels with renewable sources of energy.

Climate risk and resilience

The proposal must be designed to withstand any high to very high risks identified in detailed design associated with climate change to year 2100 using an assessment comprising RCP8.5 (AR5) and SSP5-8.5 (AR6) scenarios with timeframes of 2050, 2070 and 2090 in accordance with climate information assets including but not limited to the NSW Common Planning Assumptions as well as the Climate Change Considerations chapter of Australian Rainfall and Runoff: A Guide to Flood Estimation. Noting that no high to very high risks were identified in concept design.

Circular Resource Management

The proposal should have a comprehensive waste management plan that promotes recycling and responsible disposal of construction materials. This plan should be developed in detailed design stage and updated in built stage.

Water Stewardship and Efficiency

The proposal must develop and implement an integrated water management plan for the proposal construction and operation, encompassing impact modelling, goal setting, measure identification, and monitoring aligned with water quality goals. This plan should be developed in detailed design stage and updated in built stage.

Biodiversity

The proposal must incorporate design strategies to minimise impacts, develop management plans for ecological outcomes, and model post-development ecological values to ensure no quantifiable loss compared to its pre-development state. This plan should be developed in detailed design stage and updated in built stage.

6. References

Infrastructure Sustainability Council of Australia (ISCA) (2021) *Infrastructure Sustainability Rating Scheme. Technical Manual Design & As-Built.* Version 2.1.

Infrastructure Sustainability Council of Australia (ISCA) (2023) *Infrastructure Sustainability Rating Scheme. Technical Manual* IS Essentials.

Edward River Council (2020), *Community Strategic Plan, 2022-2050.* Available at https://www.edwardriver.nsw.gov.au/files/assets/public/document-resources/community/have-your-say/csp-2022/erc_op_2022_proof-220518.pdf

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Edward River Council (2017), *Edward River at Deniliquin Floodplain Risk Management and Plan*. Available at https://flooddata.ses.nsw.gov.au/flood-projects/edward-river-at-deniliquin-frmsp

Edward River Council (2019), *Edward River Council Waste Strategy 2019-2049.* Available at https://www.edwardriver.nsw.gov.au/files/assets/public/document-resources/community/have-your-say/draft-waste-strategy/draft-edward-river-council-waste-strategy-2019-2049.pdf

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The Power of Commitment

Appendix S
Ecological Sustainable Assessment report and climate risk assessment report

Billabong Creek Regulators

Climate Risk Assessment

NSW Department of Climate Change, Energy, the Environment and Water

April 2024

The 3Rivers Joint Venture (3Rivers), a joint venture between Jacobs Group (Australia) Pty Limited and GHD Pty Ltd has been engaged to provide certain Engineering and Approvals Services for the NSW Sustainable Diversion Limit Adjustment Mechanism (SDLAM) program in accordance with the Agreement between 3Rivers and the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) (the client).

This report has been prepared by GHD for the client, and may only be used and relied on by the client for the purpose agreed between 3Rivers and the client as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than the client arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Project name		Billabong Creek Regulator EIS					
Document title		Billabong Creek Regulator | Climate Risk Assessment					
Project number		12537654					
File name		DE19-823-YCM2-DE-EN-RPT-0006_BillEIS_CRA_Final.docx					
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
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Executive Summary

This Climate Risk Assessment (CRA) has been completed for the Billabong Creek Regulators proposal (the proposal). The Climate Risk work explores the potential physical impacts of projected changes to climate on the assets and identifies potential adaptations to consider implementing to help mitigate the risk.

This CRA has been prepared to address the Secretary's environmental assessment requirements by describing, assessing, and quantifying climate change risks in accordance with current standards and data projections. The assessment was:

– Aligned with Australian Standard 5334:2013 Climate Change Adaptation for Settlements and infrastructure.
– Performed using the NSW and ACT Government Regional Climate Modelling (NARCLiM) version 1 and 1.5 and Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BOM) projections for climate change relevant to the location of the project, for three timeframes (baseline, 2050, 2050, and 2090). Representative Concentration Pathway (RCP) 8.5 was used, which represents a high-emission scenario that assumes high population growth and little curbing of emissions.
– Undertaken to identify and assess relevant risks related to climate change hazards and identify appropriate controls to manage the risk.

A total of twelve climate change risks were identified across climate hazards including extreme rainfall, extreme storms, bushfires, and extreme temperature. Of the 12 climate risks identified in the CRA, six were rated as 'Low' and six were rated as 'Medium' for 2090. There were no high or extreme risk identified in this assessment.

This report also details climate change science and uncertainty, discusses climate baseline and projected data, and outlines the risk assessment process. The CRA register is shown in Appendix B.

This report is subject to the assumptions and qualifications contained throughout the Report.

Acronyms and definitions

Terms	Definition
Adaptation to climate change	Process of adjustment to actual or expected climate and its effects (International Standard Adaptation to climate change – Principles, requirements and guidelines, ISO 14090:2019 (E) – definition adapted from IPCC,2014)
Adaptive capacity	Ability of a system to respond to climate change to medium potential damages, to take advantage of opportunities, or to cope with the consequences
AEP	Annual Exceedance Probability
ARR guidelines	Australian Rainfall and Runoff guidelines
AS 5334-2013	AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk-based approach
AS ISO 31000:2018	AS ISO 31000:2018 Risk management — Guidelines provide a common approach to managing any type of risk and is not industry or sector specific
Asset life	Period from asset creation to asset end-of-life (International Standard Asset management – ISO 55000:2014 (E))
BoM	Bureau of Meteorology
Climate Change	Change in climate that persists for an extended period, typically decades or longer (International Standard Adaptation to climate change – Principles, requirements and guidelines, ISO 14090:2019 (E) – definition adapted from IPCC,2014)
Climate hazards	A description of the climate variable change which is posing a risk to the proposal (e.g., lightning strike)
Climate impact	A threat or an opportunity that may arise as a result of either the weather or climate change both in the short and long term
Climate resilience	Is the ability to anticipate, prepare for, respond to, and adapt to incremental change and sudden disruptions associated with climate change
Climate variable	Commonly measured meteorological trends. For example, temperature, rainfall, wind, humidity
Cwth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
CO_2	Carbon dioxide
Consequence	Outcome of an event affecting objectives (International Standard Risk management – Guidelines AS ISO 31000:2018 (E))
Control	Measure that maintains and/or modifies risk (International Standard Risk management – Guidelines AS ISO 31000:2018)
CRA	Climate Risk Assessment
CSIRO	Commonwealth Science and Industrial Research Organisation
Direct risks	Climate risks that have a direct impact on proposal infrastructure (e.g. flooding damages bridges or light rail infrastructure)
EPA	NSW Environment Protection Authority
EIS	Environmental impact statement
ESD	Ecological Sustainable Development
Extreme weather event	Weather phenomena that are at the extremes of the historical distribution, including especially severe or unseasonal weather (AS 5334-2013)
FFDI	Forest Fire Days Index
GCM	Global Climate Model
GHG	Greenhouse gas
ICMG	Interim Construction Noise Guideline

Terms	Definition
Indirect risks	The chance of an impact (attributable to climate change) on another system or organisation, which disrupts the direct supply of goods or services that your infrastructure system or services that your infrastructure system or organisation critically relies upon, thereby adversely impacting on your system or organisation
IPCC	Intergovernmental Panel on Climate Change
IPCC AR5	The IPCCs 5th Assessment Report released in April 2014
IPCC AR6	The IPCCs 6th Assessment Report released in February 2022
IS	Infrastructure Sustainability
ISO 14901:2021	ISO 14901:2021 Adaptation to climate change — Guidelines on vulnerability, impacts, and risk assessment
ISO 31000:2018	ISO 31000:2018 Risk management — Guidelines provide a common approach to managing any type of risk and is not industry or sector specific
Level of risk	Magnitude of a risk or combination of risks, expressed in terms of the combination of
LGA	Local Government Area
Likelihood	Chance of something happening. Risk likelihood seeks to categorise the probability of the risk occurring (International Standard Risk management – Guidelines ISO 31000:2018 (E))
Mitigation	Treatment and actions to mitigate or eliminate risk to people and property from hazards and their impacts
Planned controls	Business As Usual (BAU) design measures that have been specified or planned that incidentally help to mitigate the climate risk
ppm	Parts per million
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water. Formerly Water Infrastructure NSW.
RCM	Regional Climate Models
RCP	Representative Concentration Pathway
Residual risk	Risk remaining after risk treatment or control (this can contain unidentified risk and may be known as ‘retained risk’)
Risk assessment	Overall process of risk identification, risk analysis and risk evaluation (AS 5334-2013)
Risk owner	Person or entity with the accountability and authority to manage the risk (AS 5334-2013)
SCADA	Supervisory control and data acquisition
SEARs	Secretary’s Environmental Assessment Requirements
Sensitivity	Degree to which a system is affected. Either adversely or beneficially, by climate-related stimuli
SSI	State Significant Infrastructure
SSP	Shared Socio-economic Pathways
Sustainability	State of the global system, including environmental, social, and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs (International Standard Adaptation to climate change – Principles, requirements and guidelines, ISO 14090:2019 (E) – definition adapted from IPCC,2014)
Vulnerability (to climate change)	Degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change including climate variability and extremes
WCRP CMIP 5	World Climate Research Project Coupled Model Intercomparison Project 5
WCRP CMIP 6	World Climate Research Project Coupled Model Intercomparison Project 6
WS	Weather Station

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1. Introduction

1.1 Overview

NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) is proposing to replace two existing weirs along Billabong Creek with new regulators (the proposal). The two existing weirs to be demolished are Hartwood Weir and Wanganella Weir. These structures are situated on Billabong Creek within the Yanco Creek system in south-west NSW (refer Figure 1.1).

These weirs were built in the early 20th century and have been used to regulate flows through Billabong Creek, create weirs pools for irrigation and, in the case of Wanganella Weir, provide town water supply. The weirs are currently in states of declining condition and functionality, and are barriers to the movement of fish through the creek. Their condition limits their ability to regulate flows through the Yanco Creek system and leads to inefficiencies in how water is delivered to the environment and irrigators.

The new regulators would be fully automated and remotely operated meaning that operators could control the delivery of water more efficiently. The proposal is needed to improve the operator's ability to deliver the right amount of water to the right place at the right time. The new regulators would also feature fishways to support fish movement past the new structures. WaterNSW would own and operate the new regulators once constructed.

The proposal is subject to environmental and planning approvals in accordance with the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The proposal is State significant infrastructure (SSI), and the Minister for Planning is the approval authority. An environmental impact statement (EIS) is required to accompany the application for approval of the proposal.

1.2 Purpose and scope of this report

This report has been prepared by GHD Pty Ltd (GHD) as part of the EIS for the proposal. The EIS has been prepared to accompany the application for approval of the proposal and addresses the Secretary's Environmental Assessment Requirements (the SEARs), issued on 17 October 2024.

The purpose of this report is to assess potential climate change risks to the construction and operation of the proposal, and where required, identify feasible and reasonable mitigation and management measures. This report documents the outcomes of the Climate Risk Assessment (CRA) completed for the proposal. This assessment is intended to identify potential vulnerabilities of the asset to climate hazards and identify ways to address and minimise this vulnerability and develop more climate resilient infrastructure. Specifically, this report:

- analyses historical climate data from the Bureau of Meteorology (BoM) to provide insights into present-day climate risks.
- identifies the potential effects of long-term climate change, and the impact of potential natural hazards on the asset based on scale, location, and design life.
- obtains climate projections from NARCliM 1.0 and NARCliM 1.5 that are relevant to the project, supplemented by Climate Change in Australia data, including temperature, rainfall, flooding, drought, and bushfire risk
- assesses climate change risk under three timeframes (2050, 2070 and 2090) to provide an indication of potential risks
- identifies adaptation measures to improve asset resilience and reduce risks.

Figure 1.1 - Location of the proposal

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1.3 Structure of this report

The report is structured as follows:

– section 1 – provides an introduction to the proposal and the assessment
– section 2 – describes the methodology for the assessment
– section 3 – outlines the details of the emissions scenarios and climate projections used in this assessment
– section 4 – outlines the results of the risk assessment
– section 5 – conclusion.

1.4 Summary of the proposal

1.4.1 Location

The proposal is located on Billabong Creek, which is part of the Yanco Creek system in south-west New South Wales (NSW). The Yanco Creek system forms a part of the Murray-Darling Basin. An overview of the location of the proposal is shown in Figure 1.1.

The proposal is located within the local government area (LGA) of Edward River.

1.4.2 Key features of the proposal

As discussed in section 1.1, the proposal involves replacing two existing weirs along Billabong Creek with new regulators including fishways.

The core structure of the two regulators is similar and would include:

– concrete piers with maintenance bulkhead slots
– automated layflat gates across the crest of the structure to assist with flow management and downstream fish passage
– a low turbulence 'keyhole' type vertical slot fishway with allowances for variable headwater to provide upstream fish passage
– automated sidewinder gates within the vertical slot fishway to allow for variable headwater conditions
– fixed concrete crests on the opposite side of the gates to the vertical slot fishway
– concrete apron downstream of the structure
– concrete wingwalls upstream and downstream of the structure
– access from a trafficable deck for maintenance (Hartwood Regulator only)
– pedestrian walkway access part way across Wanganella Regulator structure to facilitate housing of gate actuators and for maintenance
– walkway grating over gates to facilitate operations and maintenance
– crushed rock maintenance pads, access and turnaround areas adjacent to the structure
– rip rap and rock beaching upstream and downstream of structure for erosion protection
– control house
– sheet pile cut-off walls beneath the structure
– fencing of the structures to prevent public access
– SCADA control system.

An indicative layout of a regulator is shown in Figure 1.2. This example is of a five gate regulator with a fish passage and trafficable deck for maintenance vehicles.

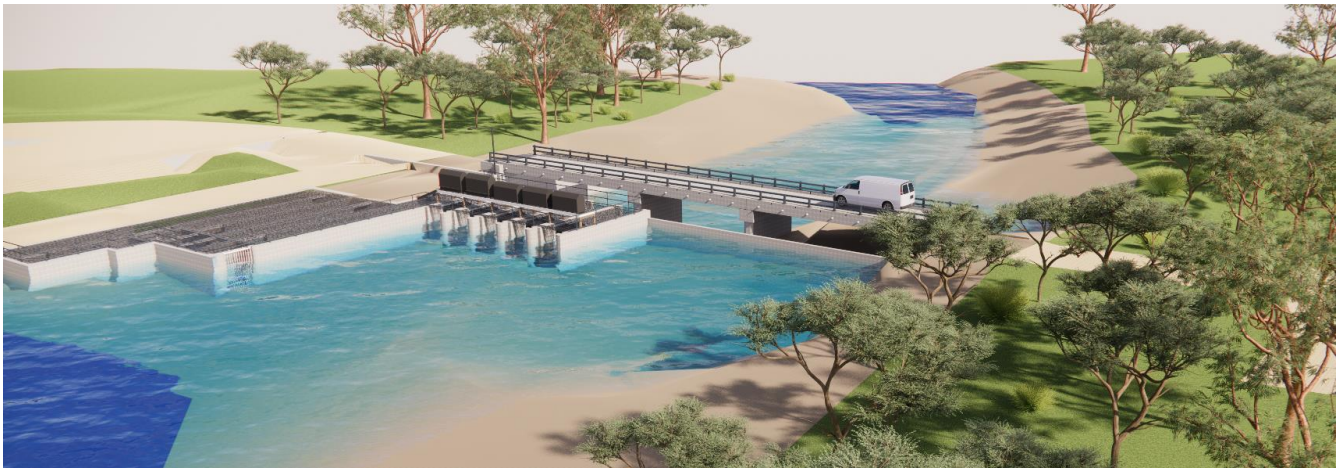
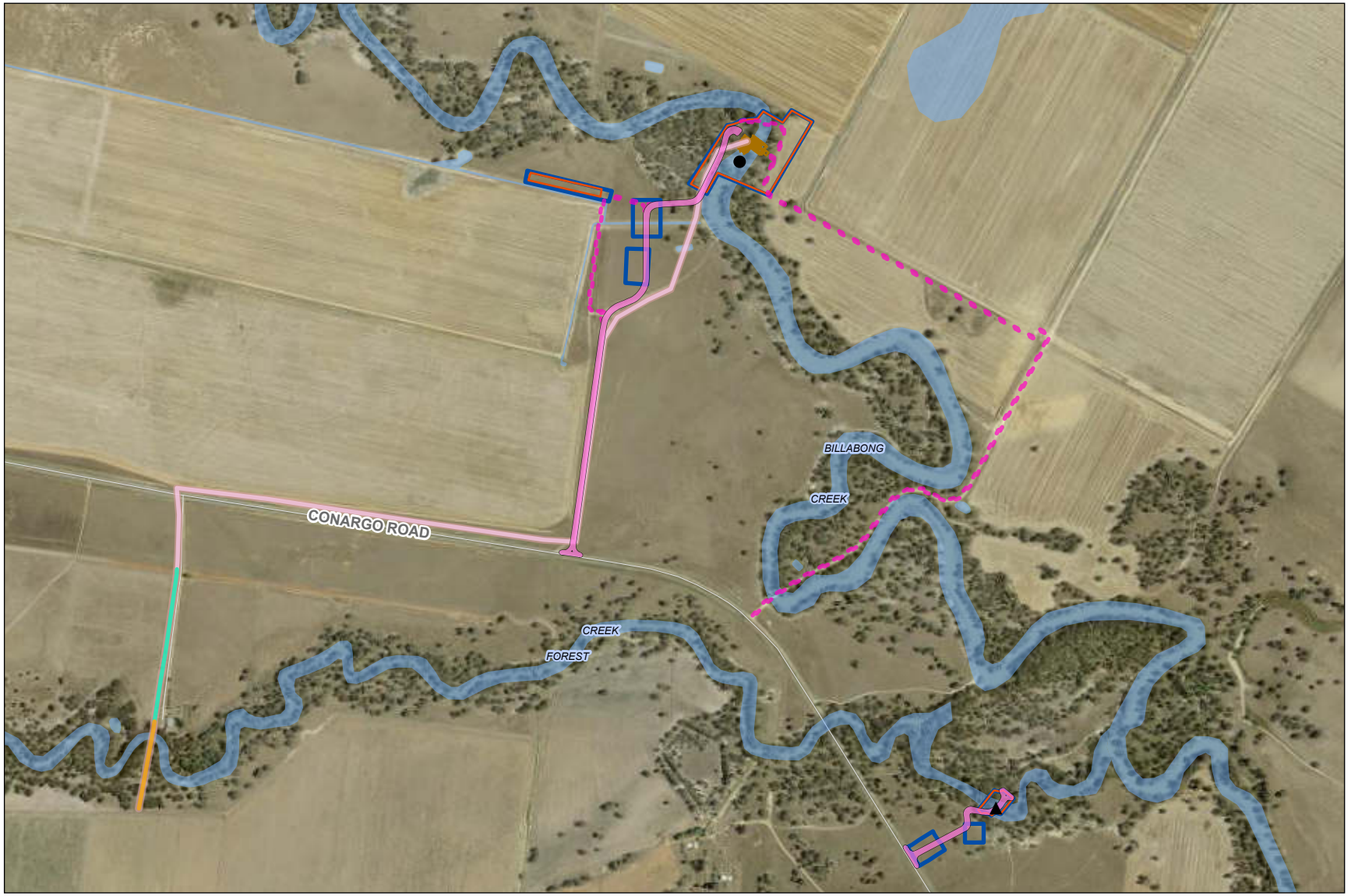


Figure 1.2 Indicative layout of a regulator

The proposal would also involve the following elements:

– Power supply to the regulators would be provided by a mix of underground and overhead electricity cables connecting the structures to the grid.
– Access to the regulators would require permanent tracks for maintenance and some additional tracks to support construction only. Track upgrades include a new drainage culvert at Hartwood.
– The existing Forest Creek block bank, associated with the Hartwood Regulator, would be replaced with a similar earthen structure to the existing. This would include two concrete sills to define the upstream and downstream top of bank and armoured with rock beaching and crushed rock for erosion protection.
– A flood bypass channel would be constructed to reduce potential upstream flooding impacts from the Wanganella Regulator. The channel would enable flood waters to drain between the billabongs in the Wanganella Reserve during flood events. It would be 85 metres long, around 40 metres wide and 1.7 metres deep and located north of the Wanganella Tip. Once completed, the channel sides and base would be natural and vegetated with appropriate local native species.
– An existing borrow pit on lot 56 / DP756322 on private land near Hartwood Weir, would be extended to provide material for the construction of Hartwood Regulator and Forest Creek block bank.

The location of the existing weirs, proposed infrastructure, and the indicative proposal footprints are shown on Figure 1.3 and Figure 1.4.



Proposal

- Proposed Hartwood Regulator
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Existing Block Bank
- Main Road
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:16,000

0 100 200 300 400

Metres

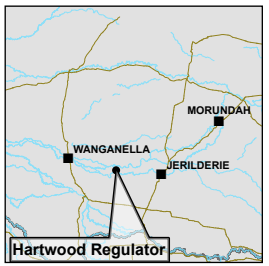


Figure 1.3 Location of Hartwood Regulator and Proposed Works

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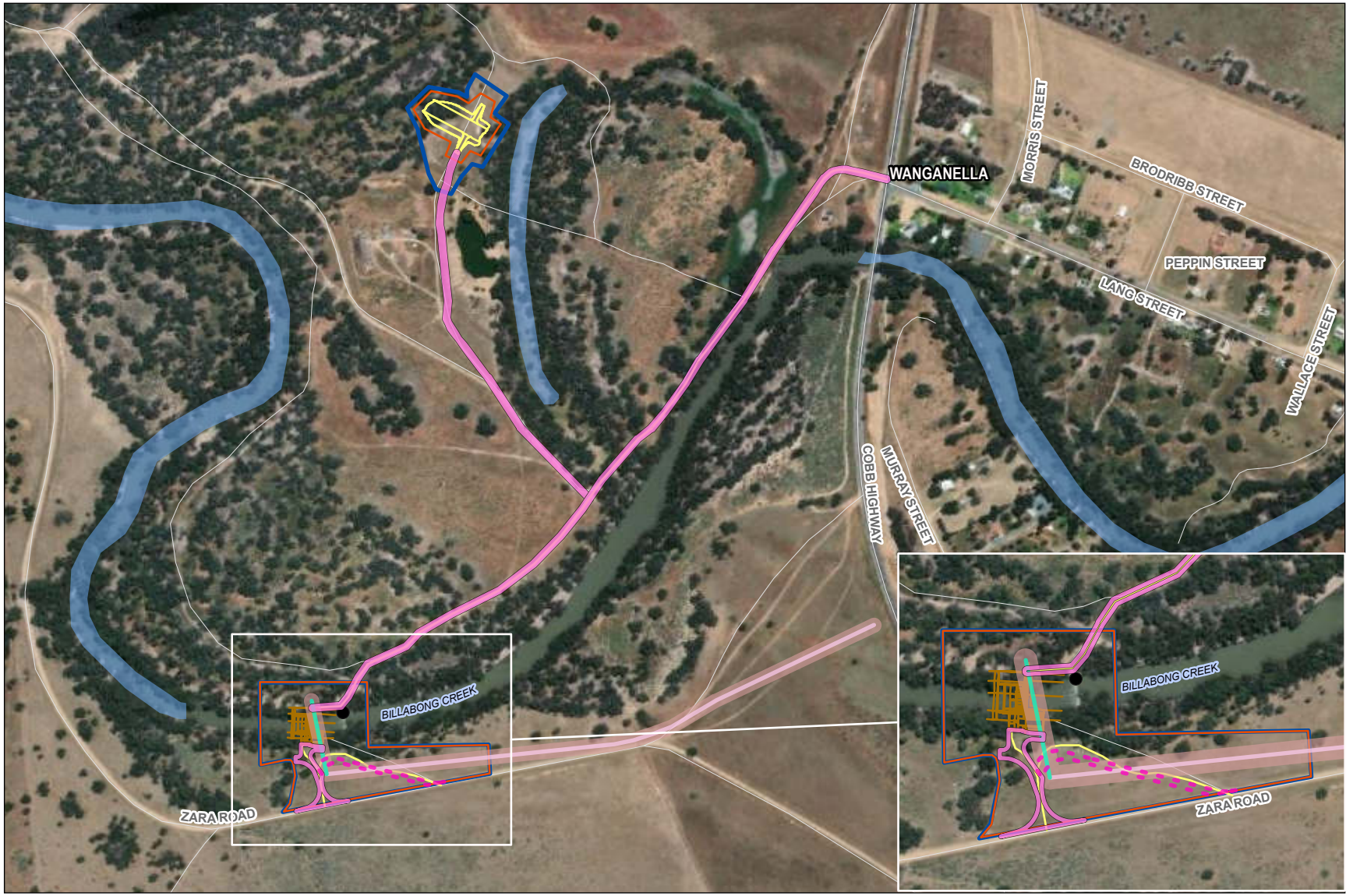

Proposal

- Proposed Wanganella Regulator
- Wanganella Bypass Channel
- Construction Activity Zone
- Clearing Area

Power Supply

- Power Supply
- Power Supply (Existing aboveground)
- Power Supply (to run underground)
- Power Supply Buffer

Access tracks

- Construction Only
- Construction plus O&M

Existing features

- Existing Weir
- Roads
- Water Bodies

N

GDA2020 MGA Zone 55

A4 Scale: 1:8,000

0 75 150 225 300

Metres

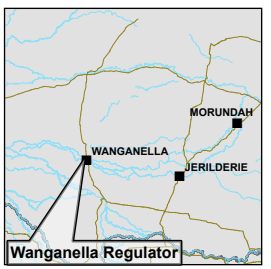

Figure 1.4 Location of Wanganella Regulator and Proposed Works

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1.4.3 Timing

Construction of the proposal is anticipated to start in 2025 and be completed by 2026. The construction period is anticipated to be around 18 months. Construction would pause during periods of high flow.

Standard construction hours would be adopted in accordance with the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) as shown in Table 1.1. Most construction activities would be undertaken during this time.

Table 1.1 Standard construction hours

Day	Start time	Finish time
Monday to Friday	7.00 am	6.00 pm
Saturday	8.00 am	1.00 pm
Sundays and public holidays	No regular work	

Notwithstanding this, the *Interim Construction Noise Guideline* (DECC, 2009) acknowledges that the following activities may need to be undertaken outside the recommended construction hours:

– emergency work
– delivery of oversized plant or structures
– works for which it can be demonstrated that there is a need to operate outside the recommended standard hours.

1.4.4 Operation

The proposal would be operated in accordance with the operating requirements established with the new asset owner and developed in consultation with key stakeholders. These operating requirements are known as the Yanco Creek System Operations Plan. The plan would consider the regulation requirements at each regulator, as well as constraints such as limits to rates of rise and fall to accommodate fish breeding requirements.

The proposed regulators would provide greater control of water levels which would be operated to meet environmental and water supply objectives. WaterNSW would own and operate the new regulators.

1.5 Secretary's environmental assessment requirements

This CRA has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs). Table 1.2 outlines the requirements relevant to this assessment.

Table 1.2 Relevant SEARs

	Requirements	Where addressed in this report
	Ecologically Sustainable Development (ESD)	
18	Climate modelling is to be in accordance with NSW and ACT Government Regional Climate Modelling (NARCLiM) version 1.5 or later, or the version should be determined in consultation with the relevant agency.	Entire report

Advice from DPHI outlines that "NARCliM 1.5 data should only be used in combination with NARCLiM 1.0 data, unless the purpose is for stress testing against a hotter drier future". Furthermore, it's noted that NARCLiM 2.0 is in development, but the data was not yet available at the time of this assessment. Therefore, this report incorporates NSW government NARCLiM 1.5 data in combination with NARCLiM 1.0 data as well as CSIRO and the Australian Bureau of Meteorology (BoM) led Climate Change in Australia data (outlined in more detail in Section 3.4). Additionally, once NARCLiM 2.0 becomes available, consideration should be given to incorporating that data into future assessments.

1.6 Assumptions

The following assumptions and limitations apply to this CRA:

– This CRA is based on the latest publicly available climate projection data and weather station historical data.
– This CRA is indicative of relevant risks based on asset design and other provided information available at the time.

2. Assessment approach and methodology

2.1 Legislation and policy context to the assessment

This CRA includes consideration of the following relevant standards, policy, and guidelines. The date of publication, applicability to the proposal and guidance of *AS 5334-2013 Climate change adaption for settlements and infrastructure – A risk-based approach* (AS 5334:2013) has been considered. In general terms, the documents detailed align with the risk management processes prescribed in AS 5334:2013 which provides the overarching approach adopted in this CRA.

Table 2.1 Guidelines used in the Climate Risk Assessment

Required document	Relevance to the CRA method
AS 5334-2013 Climate change adaption for settlements and infrastructure – A risk-based approach	The Standard provides guidance on managing climate change risks and includes implementation plans for suitable and effective adaptation (treatment). The Standard follows the International Risk Management Standard, ISO 31000:2018.
ISO 31000:2018 Risk Management – Principles and guidelines	ISO 31000:2018 provides a framework for an overarching risk management process which may be applied to climate change risk as to any other risk area. This CRA follows the principles of ISO 31000, and steps through the process described in Chapter 6 of the standard, whereby this report describes the context, risk assessment, but not the treatment, ongoing implementation, monitoring, and review. However, the iterative process recommended by ISO 31000 would be addressed in later stages of asset management planning.
ISO 14901:2021 Adaptation to climate change – Guidelines on vulnerability, impacts, and risk assessment	ISO 14901:2021 provides guidance on assessing the risks related to the potential impacts of climate change. It describes how to understand vulnerability and how to develop and implement a sound risk assessment in the context of climate change. Risk assessment according to this document provides a basis for climate change adaptation planning, implementation, and monitoring and evaluation for any organisation, regardless of size, type, and nature.

2.1.1 NSW government drivers

The NSW government has implemented a range of policies and initiatives aimed at addressing climate change and its associated risks. These policies serve as essential drivers for conducting climate change risk assessments, providing frameworks, resources, and support necessary for understanding and managing climate-related risks effectively.

Table 2.2 NSW policy drivers

Policy/Initiative	Role in Climate Risk Assessment
Climate Change (Net Zero Future) Act 2023 No 48	This act aims to establish guiding principles for action to address climate change; to set targets for the reduction in net greenhouse gas emissions in New South Wales; to set an objective for NSW to be more resilient to a changing climate; and to establish the Net Zero Commission to monitor, review and report on progress towards the targets and the objective and to exercise other related functions
Climate Change Fund Strategic Plan	Guides investment priorities and allocation of funds for climate resilience. This legislation signals commitment to a resilient, net zero future and sets out a clear path to deliver net zero by 2050.
The NSW Environment Protection Authority (EPA) Climate Change Action Plan 2023-26	This action plan describes how EPA will deliver on the objectives of the Climate Change Policy. It outlines the specific actions to be taken over the next three years.
EPA Climate Change Policy	This policy describes the causes and consequences of climate change in NSW and outlines EPAs commitment to deliver on statutory objectives and duty to address climate change and the commitments outlined in EPAs Strategic Plan 2021-24.

Policy/Initiative	Role in Climate Risk Assessment
NARCliM	NARCliM is led by the NSW Government in partnership with the ACT and South Australian governments, with input from the University of New South Wales's Climate Change Research Centre. NARCliM contributes to the NSW Government's long-term objective of NSW becoming more resilient to a changing climate. NARCliM serves to provide regional climate projections at fine temporal and spatial scale to support more robust climate change impact assessment and management, contributing as a valuable input for assessing the potential impacts of climate change.
Net Zero Plan Stage 1: 2020-2030	Outlines pathways and targets for achieving net-zero emissions in NSW.
NSW Climate Change Adaptation Strategy	This strategy provides a framework that will strengthen and expand action to adapt to climate change now and over the long term.
NSW Climate Change Fund	The Climate Change Fund was established to address the impacts of climate change and provides financial support for research, adaptation projects, and mitigation.
NSW Climate Change Policy Framework (November 2016)	This policy framework aims to build on preparing for the impacts of climate change. The policy sets overarching goals, strategies, and priorities for climate action in NSW.

2.1.2 Alignment with Infrastructure Sustainability (IS) tool

This CRA aligns closely with the principles and criteria outlined in the Infrastructure Sustainability (IS) Essentials v2.1 rating tool which emphasises the importance of integrating sustainability considerations into the planning, design, construction, operation, and decommissioning of infrastructure projects.

This assessment aligns with the resilience credit within Isv2.1. This credit (Res-1 Climate and Natural Hazard Risks) is intended to assess and treat risk to the asset associated with climate change and natural hazards.

The ESD assessment has addressed the application of Isv2.1 to the proposal as a recommended condition of approval.

2.2 Climate risk assessment methodology and approach

This CRA broadly follows a typical risk assessment process in line with *Australian Standard 5334:2013 Climate change adaptation for settlements and infrastructure – A risk-based approach* (AS 5334:2013), which in turn is aligned with ISO 31000:2018 – Risk Management –Guidelines (ISO 31000:2018).

The assessment methodology is specific to climate change and the risks to the proposal posed by climate variables and the associated changes to natural hazards. In principle, it follows the same process as for any type of risk, as shown in Figure 2.1, derived from ISO 31000:2018.

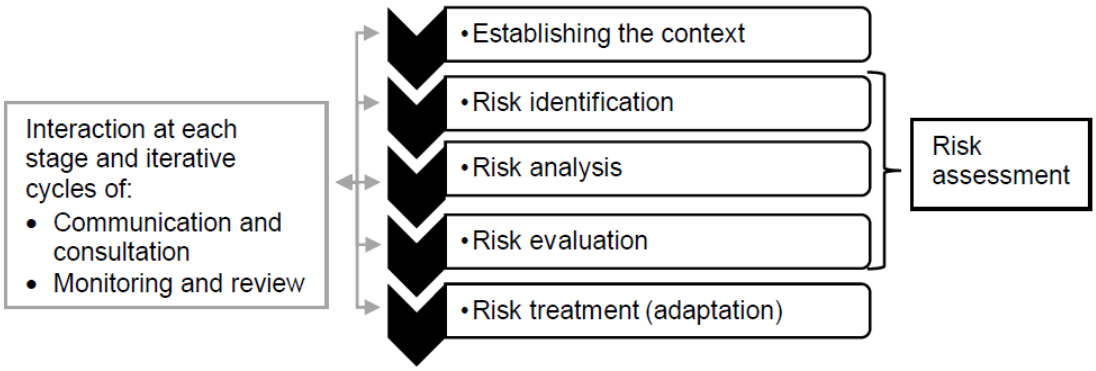


Figure 2.1 Risk management process (adapted from AS 5334-2013)

The detailed methodology for this proposal is outlined in Table 2.3.

Table 2.3 Assessment methodology

Steps	Details
Establishing context	– Reviewed SEARs requirements – Identified climate variables that could impact the project – Assessed baseline weather data and climate projection data to inform the assessment – Confirmed the asset design life and relevant risk matrix (NSW Government Climate Risk Assessment Tool Risk Criteria)
High level risk identification	– Reviewed the existing concept design report to inform CRA – Developed high-level climate risks to the project – Determined preliminary risk likelihood and consequence in alignment with the relevant risk matrix
Mitigation	– Identified controls implemented in design to mitigate climate risks – Identified additional mitigations to further reduce risks

2.2.1 Previous climate work

The Murray-Darling Basin Authority has completed some climate analysis for the Murray-Darling Basin. The BoM and CSIRO have crafted the following report to investigate and analyse the climate conditions and associated vulnerabilities within the basin.

– Trends and historical conditions in the Murray–Darling Basin (BOM, 2020)
– Hydroclimate Futures for the Murray–Darling Basin (Zhang et al, 2020)
– Vulnerabilities to climate change in the Murray–Darling Basin (Murray-Darling Basin Authority, 2020).

These reports represent significant contributions to our understanding of the climate dynamics and associated risks in the Murray-Darling Basin. They provide insights and scientific evidence to support this assessment.

3. Emission scenarios and climate change projections

3.1 About climate data

The Intergovernmental Panel on Climate Change (IPCC), established in 1988, is the leading body for assessing and sharing climate change science. It has released six assessment reports that explore climate change's scientific, technical, and socio-economic aspects, covering its impacts, future threats, and ways to slow down global warming. The latest credible climate change projection data for Australia at the time of this report was based on the IPCCs 5th Assessment Report (IPCC AR5) released in 2014 for most climate variables.

Assessing future climate changes resulting from anthropogenic activity is challenging due to its dependence on estimates for future greenhouse gas concentrations. These concentrations rely on global greenhouse gas emissions, influenced by economic factors, population shifts, technological advancements, and sustainability policies. Climate projections exhibit variability, which has been dealt with by the IPCC through consideration of 'scenarios,' that describe greenhouse gas concentrations and encompass potential economic, political, and social developments throughout the 21st century, drawing on results from various climate models for each scenario.

The IPCC has developed four scenarios for global climate projections in the IPCC AR5 that relate to how the world may respond to the challenge of a changing climate, the need to continue to produce and use energy and resources, and the global greenhouse gas emissions that may occur. These scenarios incorporate diverging tendencies based on alternative economic, globalisation and environmental pathways. These have been modified through subsequent reports and renamed as Representative Concentration Pathways (RCPs). These RCPs are described according to CO_2 concentration levels and may also be described by anomalies in global mean surface air temperatures for the period 2081-2100 relative to the average period 1986-2005, refer to Table 3.1 for a summary of the four RCP scenarios.

Since the IPCC 5th Assessment Report (IPCC AR5) in 2014, RCPs are being considered together with Shared Socio-economic Pathways (SSP), with new RCPs referenced such as RCP1.9, RCP3.4 and RCP7.0. CMIP6 uses the suite of SSPs to proposal how climate change will change in response to socio-economic indicators such as population, economy, land use, and energy change. Downscaling of IPCC AR6 data for southeastern Australia is being undertaken by NARCliM and NARCLiM 2.0 is expected to be released in 2024. Once this data is released, the outcomes of this risk assessment should be reviewed.

Table 3.1 Representative Concentration Pathways (RCPs) IPCC AR5

Scenario	Alternative name	Global climate response	Projected increase in global surface temperature by 2081-2100
RCP2.6	Mitigation scenario	Strong immediate response, emissions peak by 2020, with rapid decline in emissions thereafter from global participation and application of technologies	Mean projected increase 1.0 °C Anomaly range +0.3 to 1.7 °C
RCP4.5	Stabilisation scenario	Slower response, emissions peak around 2040, then decline	Mean projected increase 1.8 °C Anomaly range +1.1 to 2.6 °C
RCP6.0	Stabilisation scenario	Slow response, application of mitigation strategies and technologies	Mean projected increase 2.2 °C Anomaly range +1.4 to 3.1 °C
RCP8.5	Business as usual scenario	Little curbing of emissions, continuing rapid rise throughout the 21st century	Mean projected increase 3.7 °C Anomaly range +2.6 to 4.8 °C

3.2 Selected Representative Concentration Pathways and timescales

The infrastructure has a varied expected design life depending on the component or system, as shown in Table 3.2. As such, the selection of 2050, 2070 and 2090 projections allow the assessment to consider their anticipated design life. Minimum design lives are indicative for the purposes of the climate change assessment and may be subject to change.

Table 3.2 Minimum asset design life criteria

Item	Design life in years
Structural Concrete Elements	100 years
Precast concrete Box culverts Pipes	100 years
Structural Steelwork Sections (galvanised mild steel)	50 years
Sheetpiles – steel	100 years
Ancillary metalwork (walkways, handrail etc.) – galvanised steel	25 years
Stainless steel	50 years
Aluminium (Welded Alloy)	25 years
Mechanical items (gates)	50 years
Electrical	25-50 years (depending on item)
Instrumentation and control, telemetry (PLC / SCADA / Solar panels etc)	15 years
Tracks	20 years

The selected RCPs and timescales chosen for this assessment are shown in Table 3.3.

Table 3.3 Projections used in this climate risk assessment

Scenario	Timeframe
RCP8.5	2050±10 years
	2070±10 years
	2090±10 years

The use of three timeframes from the near future to the late century under a very high emissions scenario such as RCP8.5 allows for a comprehensive understanding of potential risks to the proposal. This selection encourages all potential risks to be identified, addressing the design life of proposal assets. Applying the RCP8.5 scenario allows the worst-case scenario risks to be addressed so that risk is not underestimated, acknowledging that scenarios may transpire earlier than projected. It should be noted that under RCP8.5 scenario, climate change will continue to be more extreme in the 22nd century – but also that the scenario assumes little curbing of emissions throughout the 21st century (refer to Table 3.1). Once IPCC AR6 data sets have been downscaled as part of NARCliM 2.0 and are available, SSPs should be used instead. This template will be updated accordingly.

3.3 Climate data uncertainty

Although climate projections represent the presently accepted forefront of climate change science, there is still a high level of uncertainty that exists regarding the climate changes that may eventuate. This uncertainty becomes more pronounced as the timescale of the projection is extended.

AS 5334-2013 addresses the inevitability and implications of uncertainty of climate science. Several areas of uncertainty exist which influence the accuracy of climate change projections, including:

– Scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols, resulting from uncertainties regarding the current and future activities of humans.
– Climate response uncertainty, resulting from limitations to scientific understanding of the climate system and its representation in climate models, and consequently how much the climate will change due to increased atmospheric concentration of greenhouse gases. This includes natural variability uncertainty, stemming from unperturbed variability in the climate system.
– Location specific uncertainties, regarding the assignment of probability distributions to regional climate change projections, and projecting climate change at small spatial scales, particularly for coastal and mountainous areas.

It is recognised that decisions and the adaptation planning processes should be flexible enough to cope with potential knowledge gaps. Also, given the uncertainty of climate change projections and potential for considerable damage to assets, a prudent and conservative approach is encouraged in undertaking climate risk assessment. In this regard, GHD utilises the high emissions scenarios and acknowledges the low confidence modelling ranges which represent the potential extreme scenario.

3.4 Climate data sources

The NSW and ACT Regional Climate Modelling (NARCliM) Project is a research partnership between the NSW and ACT governments and the Climate Change Research Centre at the University of NSW. The NARCliM project began in 2011 in response to the need by regional decision makers and impact assessment researchers for high resolution climate change projections. Previously climate change information had been at a scale that had low utility for localised decision-making. Accordingly, the NARCliM project produced an ensemble of robust regional climate projections for south-eastern Australia to allow the NSW and ACT community to plan for the range of likely future changes in climate.

The SEARs requirements state that 'climate modelling is to be on accordance with NSW and ACT Government Regional Climate Modelling (NARCLiM) version 1.5 or later, as determined in consultation with the relevant agency'. However as mentioned in section 1.5, NARCliM 1.5 data should only be used in combination with NARCliM 1.0 data. Hence this report incorporates data from NSW government NARCLiM 1.0, NARCLiM 1.5 and CSIRO and BoM led Climate Change in Australia data.

When selecting the most appropriate dataset to use for each climate variable, the dataset resulting in greater risks was selected. Temperature, wind speed, relative humidity, and soil moisture projections are derived from NARCliM 1.5, based on the 2014 CMIP5 AR5 dataset, with a baseline period from 1951 to 2005. This is because NARCliM 1.5 projects a hotter, drier future when compared to other datasets. Rainfall projections are based on CSIRO and BoM's climate modelling, to account for a potential wetter future. This dataset uses a baseline period from 1986 to 2005, aligning with IPCC standards.

Baseline data was collected from BoM between these baseline periods. Deniliquin (Visitor Information Centre) weather station (WS) (74128) was selected as the most appropriate source because it is the closest WS to both Wangenalla and Hartwood with a range of climate statistics available including rainfall and temperature across the baseline periods. The use of an averaged baseline period allows climate to be more realistically captured to avoid representing weather fluctuations as the average climate.

Table 3.4 Climate data

Variable	Baseline data	Climate change projections				
	(1951-2005)	Reported as	Mid Century, very high emissions scenario	Far future, very high emissions scenario	Far future, very high emissions scenario	Source
			2050, RCP 8.5	2070, RCP 8.5	2090, RCP 8.5	
Temperature						
Mean maximum daily temperature (°C) – Annual	22.8	Absolute value	25.6	26.4	28.1	1, 2
Mean maximum daily temperature (°C) – Summer (DJF)	30.9	Absolute value	35.3	34.7	36.5	1, 2
Mean minimum daily temperature (°C) – Annual	9.8	Absolute value	11.4	12.2	13.2	1, 2
Precipitation						
Mean Rainfall (mm) – Annual	381.9	Absolute value	-3.7% (-14.2 to 8)	-4.5% (-22.4 to 7.6)	-5% (-26.7 to 8.6)	1,3
			i.e. 367.8 mm (327.7 to 412.4)	i.e. 364.8 mm (296.4 to 410.8)	i.e. 362.9 mm (280 to 414.8)	
Mean Rainfall (mm) – Spring (SON)	111.2	Absolute value	-5.4% (-28.1 to 9.6)	-8.4% (-31.8 to 8.3)	-12% (-48 to 5.9)	1,3
			i.e. 105.2 mm (79.9 to 121.9)	i.e. 101.8 mm (75.8 to 120.4)	i.e. 97.8 mm (57.8 to 117.7)	
Mean Rainfall (mm) – Summer (DJF)	83.8	Absolute value	+1.3% (-17.2 to 13.6)	+4.3% (-16.5 to 24.2)	+5.9% (-13.4 to 26.6)	1,
			i.e. 84.9 mm (69.3 to 95.2)	i.e. 87.4 mm (70 to 104.1)	i.e. 88.7 mm (72.6 to 106.1)	
Mean Rainfall (mm) – Autumn (MAM)	79.9	Absolute value	-5.2% (-20 to 19.7)	-4.5% (-25.4 to 19.3)	-0.2% (-28.7 to 25.8)	1,
			i.e. 75.7 mm (63.9 to 95.6)	i.e. 76.3 mm (59.6 to 95.3)	i.e. 79.7 mm (56.9 to 100.5)	
Mean Rainfall (mm) – Winter (JJA)	107.1	Absolute value	-3.9% (-16 to 8.6)	-7.6% (-25.3 to 2.2)	-12.6% (-37.6 to 4.5)	1,3
			i.e. 103 mm (90 to 116.3)	i.e. 98.9 mm (80 to 109.4)	i.e. 93.7 mm (66.8 to 111.9)	
Rainfall depth for the 24 hour, 5% AEP (mm)	87.6	Percentage change	8% / degree of warming	-	"8% / degree of warming	4,5
			1.6’C (2050)		3.5’C (2090)"	
			99.1	-	114.7	

Variable	Baseline data	Climate change projections				
	(1951-2005)	Reported as	Mid Century, very high emissions scenario	Far future, very high emissions scenario	Far future, very high emissions scenario	Source
			2050, RCP 8.5	2070, RCP 8.5	2090, RCP 8.5	
Rainfall depth for the 24 hour, 1% AEP (mm)	87.6	Percentage change	"8% / degree of warming	-	"8% / degree of warming	4,5
			1.6'C (2050)"		1.6'C (2050)"	
			133.5	-	154.5	
Extreme events						
Severe fire danger days per year	1.6	Absolute change (applied)	1.8 to 2.3 days	2.4 to 4.4 days	2.4 to 4.4 days	1,3
Daily variables						
Avg. daily wind speed (km/h)	n/a	Absolute value	17.6	17.4	16.9	2
Avg. daily relative humidity (%)	n/a	Absolute value	64.7	63.8	64.0	2
Soil moisture (kg/m2)	n/a	Absolute value	474.6	436.0	413.4	2

Notes: 1. BOM weather station data
2. NARCliM1.5 spatial files **https://climatedata-beta.environment.nsw.gov.au/datasets**
3. CSIRO/BoM data
4. **bom.gov.au/water/designRainfalls/revised-ifd/?multipoint**
5. Draft guidance to the climate change considerations chapter in Australian Rainfall and Runoff: A Guide to Flood Estimation **https://interactive-atlas.ipcc.ch/**

3.5 Local climate and historical events

Using the Köppen climate classification, the proposal region is classed as grassland warm, featuring warm/humid summers and mild winters (BoM, 2023). This classification speaks to the prevailing conditions of consistent warmth and aridity. The distribution of rainfall throughout the year is skewed towards the winter months, signifying a winter-dominant precipitation regime. In the last 30 years, annual rainfall has been relatively stable, while spring frosts have been more common and have been occurring later (BoM, 2023).

Historically, the Edward River region has experienced various extreme weather events, including severe storms, floods, and bushfires. These events have had significant impacts on the community, infrastructure, and environment. Floods pose a recurrent risk as shown in Table 3.5 which outlines the disaster declarations issued to the Edward River LGA by the NSW Government.

Table 3.5 Disaster declarations issued to Edward River LGA by the NSW Government from 2019

Month/year	Disaster type	Australian Government reference number (AGRN)
28 November 2023	NSW Severe Weather and Flooding	1086
14 September 2022 onwards	NSW Flooding	1034
5 January 2022 onwards	Southern NSW storms and floods	1001

3.6 Projected climate trends

The projected climate trends for the Murray Basin are shown below:

– Average temperatures are predicted to rise consistently across all seasons, with very high confidence.
– Towards the end of the century (2090), a decrease in rainfall is expected during the cool season, with a high level of confidence. There is a medium level of confidence that rainfall will remain unchanged in the warm season. Natural variability is expected to dominate any projected changes in the near future.
– There is a very high level of confidence in projections indicating more hot days and warm spells, along with fewer frosts.
– Despite an anticipated decline in mean annual rainfall, heavy rainfall intensity is expected to increase, with high confidence.
– The future climate is likely to exhibit harsher fire conditions.
– There is a medium level of confidence in the projection that the duration of drought periods will increase throughout the century.

More detailed information on temperature, bushfire, rainfall, flooding, drought, and storm events is shown below.

3.6.1 Temperature and heat extremes

There is strong agreement on the direction and magnitude of temperature changes among Global Climate Models (GCMs) and Regional Climate Models (RCMs) used for downscaling. As a result, there is very high confidence in substantial warming for the annual and seasonal projections in temperatures, particularly for the higher emission scenarios. Consistent with the global trend, southern Australia is projected to experience high rates of warming in minimum-temperature, maximum-temperature and mean annual temperature indices.

Between 1951 and 2005, the proposal region experienced an average maximum temperature of 22.8 °C, and an average minimum temperature of 9.8 °C. The Project's regional mean maximum and minimum daily temperature is expected to increase to 28.1 °C and 13.2 °C by 2090 under RCP8.5 (using NARCliM1.5 dataset).

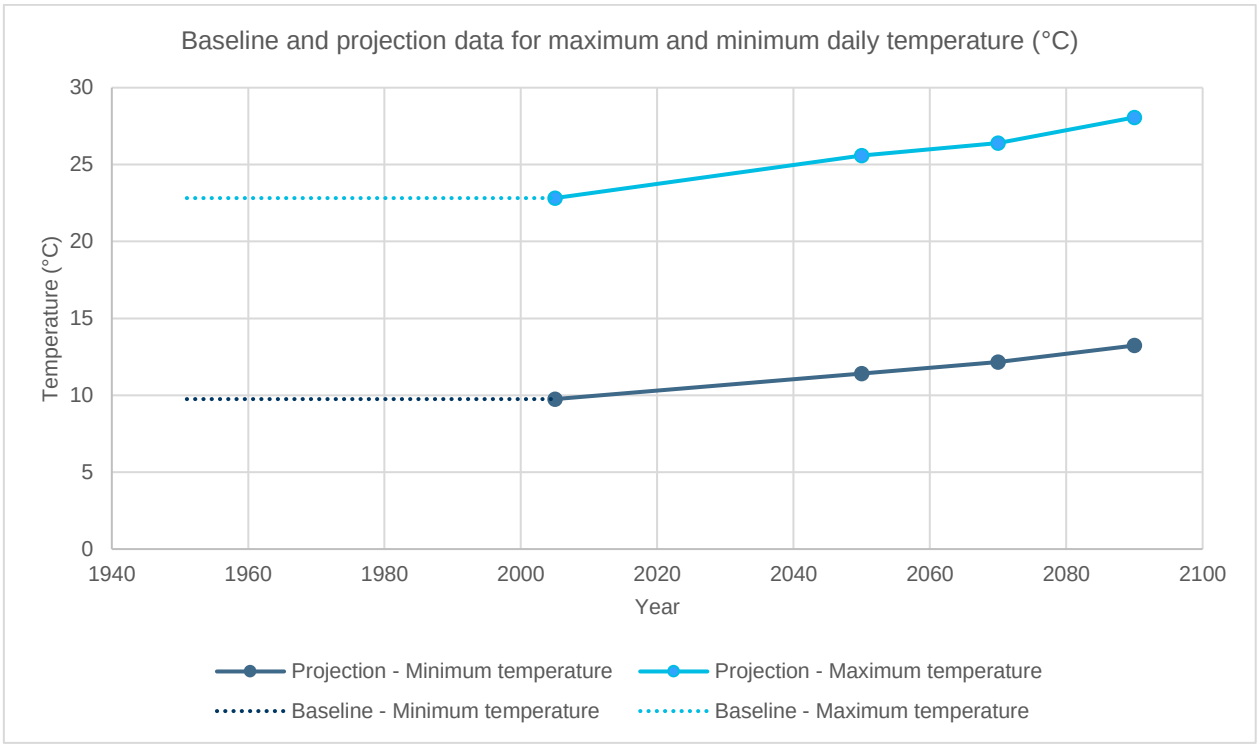
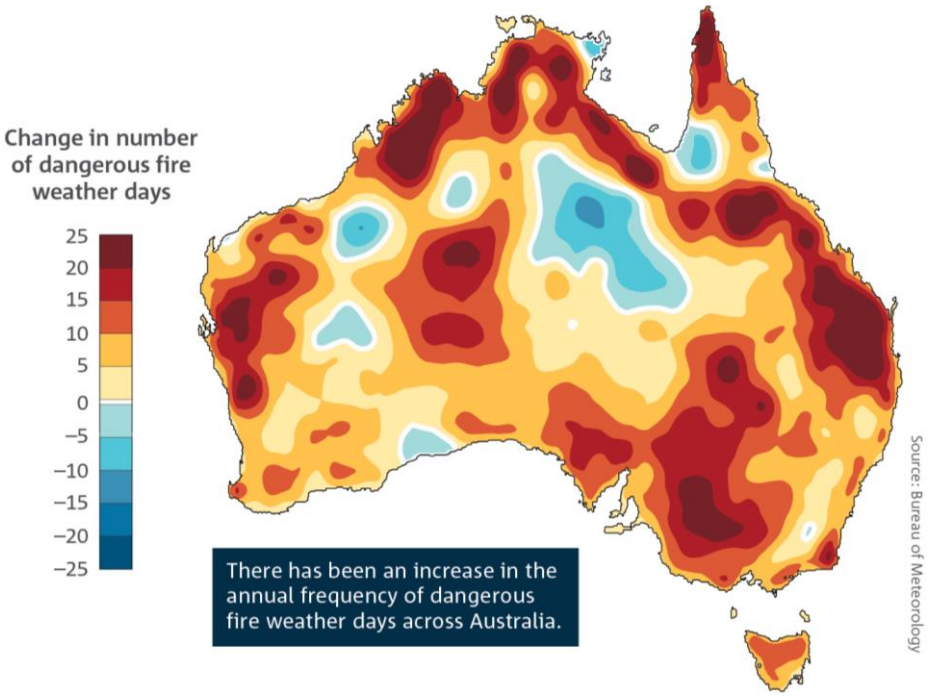


Figure 3.1 ***Baseline and projection data for maximum and minimum daily temperature (°C) derived from NARCliM 1.5***

3.6.2 Bushfire

Bushfires typically occur during dry spring and summer conditions (BoM, 2023). There has been an increase in both extreme fire weather and in the length of the fire season since the 1950s, as shown in Figure 3.2 (BoM, 2020). There have been more extreme conditions during summer, and an earlier start to the bushfire season with dangerous weather conditions occurring significantly earlier in spring than ever before.



Source BoM, 2023

Figure 3.2 ***Change in number of dangerous fire weather days in Australia between the two periods: July 1950 to June 1986 and July 1986 to June 2022.***

Fire risk is determined by fuel load, fuel dryness, weather conditions and ignition sources. It is projected that future fuel amounts will increase, and fuels will become drier as a result of the warmer and drier conditions projected.

The Murray Basin Cluster Report projects with high confidence that climate change will result in harsher fire-weather (CSIRO and BoM, 2015). Fire weather can be estimated using the McArthur Forest Fire Danger Index (FFDI). Using this index, when FFDI exceeds 50 it is considered severe fire weather. As shown in Table 3.4, severe fire days are expected to increase from a baseline of 1.6 days to 2.4 to 4.4 days in 2090 under RCP8.5 (CSIRO and BoM, 2015).

The Planning Portal Hazard – Bush Fire Prone Vegetation (BFPV) Mapping Tool is designed to identify areas of Bush Fire Prone Land based on vegetation types and their associated risks. The NSW Rural Fire Service (RFS)provides a methodology for categorizing bush fire prone land, which includes the following:

– Vegetation Category 1 – highest risk for bush fire. Represented as red on the bush fire prone land map and will be given a 100 m buffer. Includes areas of forest, woodlands, heaths, forested wetlands, and timber plantations.
– Vegetation Category 3 – medium bush fire risk. Represented as dark orange on a Bush Fire Prone Land map and will be given a 30-metre buffer. Includes grasslands, freshwater wetlands, semi-arid woodlands, alpine complex and arid shrublands.
– Vegetation Category 2 – lower bush fire risk (higher than the excluded areas). Represented as light orange on a bush fire prone land map and will be given a 30-metre buffer. Includes rainforests and lower risk vegetation parcels.

Bush Fire Prone Land maps for Wanganella and Hartwood are shown below in Figure 3.3. In both cases, the regulators are surrounded by grasslands (categorised as Category 2 vegetation) signifying lower bush fire risk. There are isolated sections with vegetation Category 1 which signify high risk.

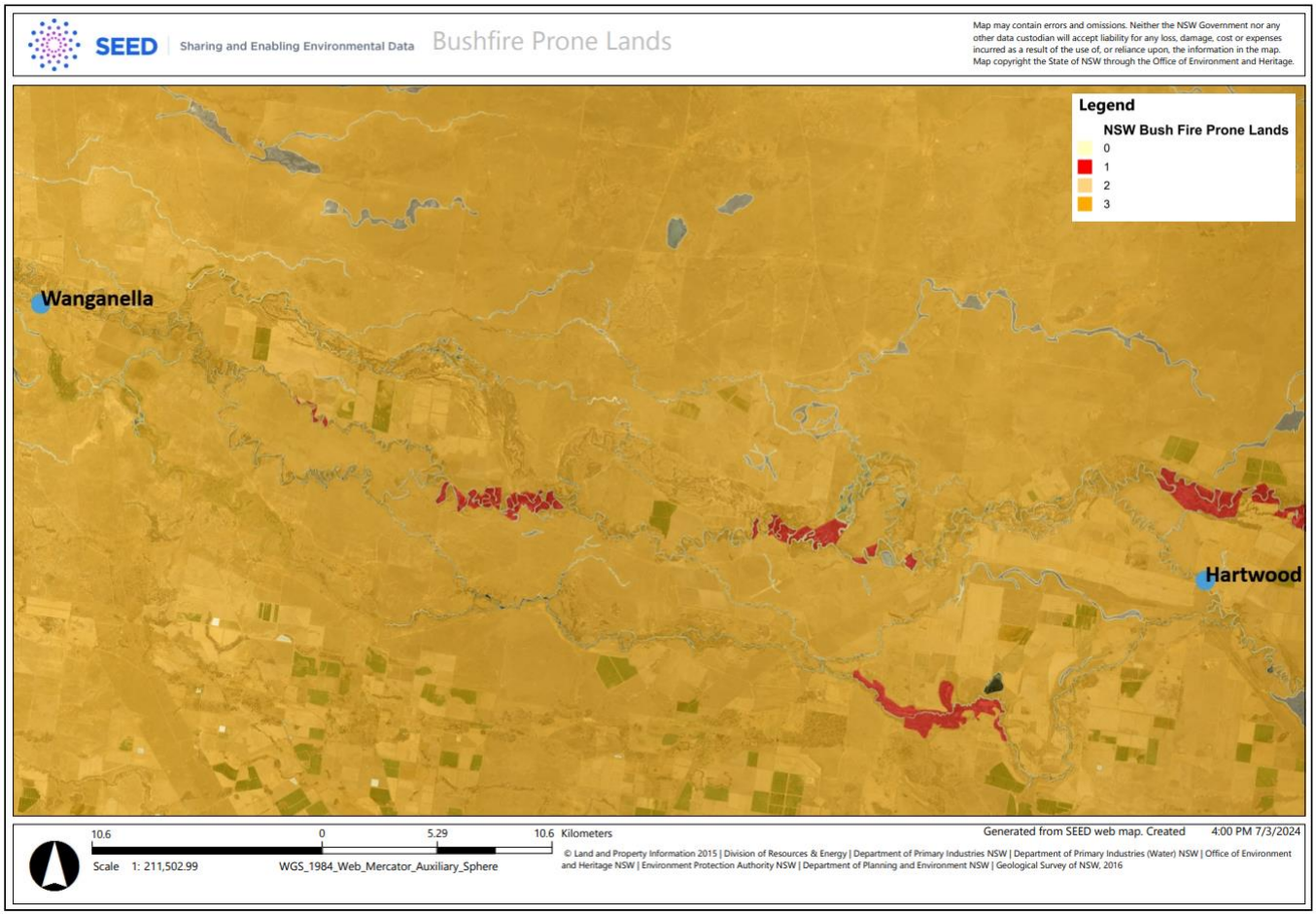


Figure 3.3 Bushfire Prone Land Map of Wanganella and Hartwood

3.6.3 Drought

Drought is defined by BoM as ‘a prolonged, abnormally dry period when the amount of available water is insufficient to meet our normal use’ (BoM, 2023). The proposal region has suffered through various droughts.

Drought conditions are projected at a high confidence to continue to be a feature of the NSW region (CSIRO and BoM, 2015). However, there is uncertainty in future drought characteristics, with low confidence in how the frequency and duration of extreme drought may change, and medium confidence that time spent in drought will increase over the 21st century under RCP8.5 (CSIRO and BoM, 2015). As mentioned, Australia is projected to experience continued warming, with more extremely hot days and fewer extremely cool days and a decrease in cool season rainfall across many regions of the south and east, leading to more time spent in drought (CSIRO, 2020).

3.6.4 Storm events (including wind, lightning, and hail)

Severe storms are localised events usually affecting smaller areas than tropical cyclones. A severe thunderstorm is defined by BoM as one which produces:

– hail with a diameter of two centimetres or more,
– wind gusts of 90 kilometres per hour or more,
– flash floods,
– tornadoes, or
– any combination of these.

BoM issue severe weather warnings when necessary, however the majority of storms that hit the region do not result in large scale disasters. In relation to fire ignition, there is some indication that climate change could influence the risk of ignitions from dry lightning i.e., lightning that occurs without significant rainfall, while noting large uncertainties in currently available model representations of this phenomenon. There is high confidence that the intensity of storms will increase in the future.

3.6.5 Rainfall and flooding

The Murray Basin experiences precipitation variability due to the diverse geographical features and climate influences. The proposal region receives most of its rainfall in spring, experiencing an average of 111 millimetres of precipitation over the baseline period (1986 to 2005). Additionally the region experiences the least amount of precipitation in summer with an average of 84 millimetres.

The projected changes in average precipitation under RCP8.5 show a wide range of seasonal variation The notable differences are shown in the winter months, which project a 13 per cent decrease in mean rainfall during June, July, and August by 2090 under RCP8.5. Additionally, rainfall in summer months is expected to increase by 6 per cent by 2090 under RCP8.5.

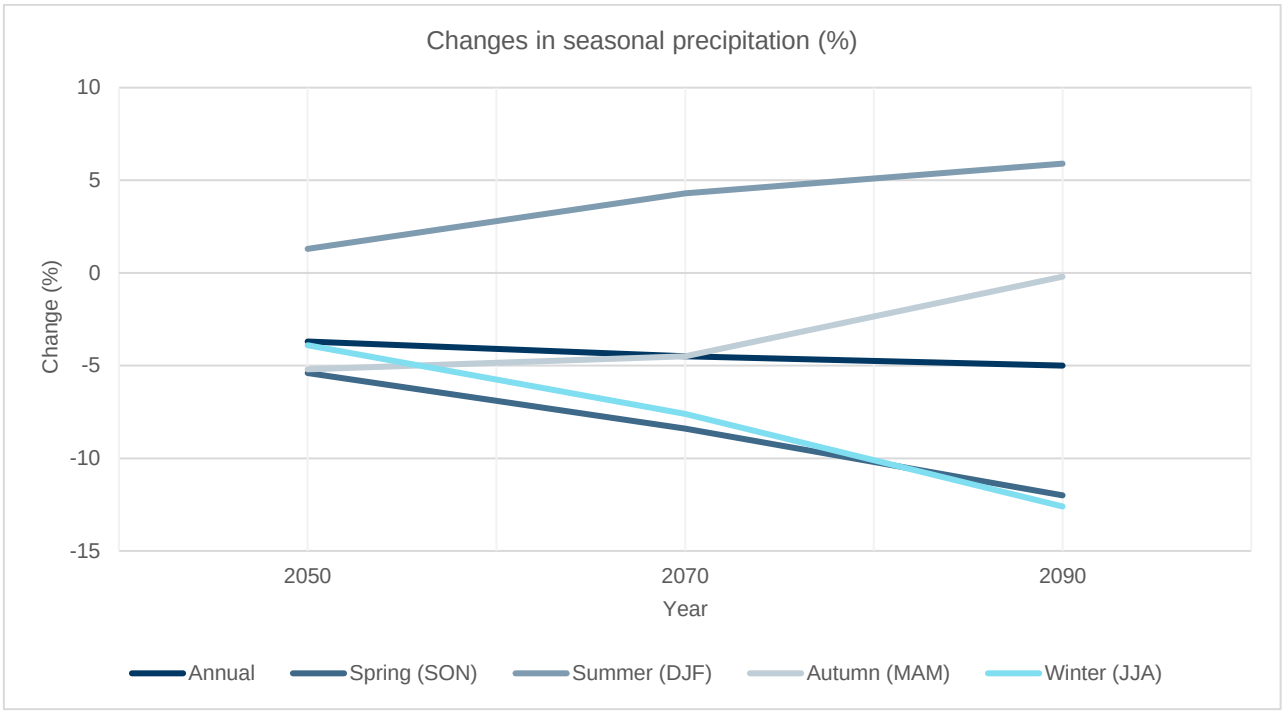


Figure 3.4 Projected change in annual and seasonal precipitation derived from CSIRO/BoM data.

Although there is a level of uncertainty around the average annual and seasonal rainfall projections, there is high confidence that the intensity of heavy rainfall events will increase in the future. The Australian Department of Climate Change, Energy, the Environment and Water (Cwth DCCEEW) have released a draft update to the Climate Change Considerations chapter in Australian Rainfall and Runoff guidelines (ARR Guidelines), which advises using temperature projections to improve accuracy of projected rainfall intensity (Ball et al., 2019). An 8 per cent increase in rainfall depth per degree of warming is projected over a 24-hour period, with scientific basis from Wasko et al. (2023). Table 3.6 applies this formula to project rainfall depth under SSP5-8.5 for 2050 and 2090, using temperature projections form IPCCs Interactive Atlas (based on IPCC AR6).

Table 3.6 Projected rainfall depth over a 24hr period (Ball et al., 2019) derived from the draft ARR Guidelines

Variable	Baseline data	Climate change projections	
		2050, SSP5-8.5	***2090, SSP5-8.5***
Rainfall depth for the 24 hour, 5% AEP (mm)	87.6	8% / degree of warming 1.6'C (2050)	8% / degree of warming 3.5'C (2090)
		99.1 mm	114.7 mm
Rainfall depth for the 24 hour, 1% AEP (mm)	118.0	8% / degree of warming 1.6'C (2050)	8% / degree of warming 3.5'C (2090)
		133.5 mm	154.5 mm

4. Climate risk assessment

A CRA was undertaken in line with the methodology described in section 2.2. Preliminary high-level hazards to the proposal were identified based on a review of proposal documentation, local hazard mapping and in consideration of future climate projections. The risk matrix used in this assessment is detailed in Appendix A and is derived from the NSW Government's Climate Risk Assessment Tool Risk Criteria. The summary of the twelve climate risks confirmed for the proposal in the CRA are presented in Table 4.1. There are no 'High' or 'Extreme' risks identified.

Table 4.1 Summary of climate risks confirmed for the proposal in the CRA

Risk classification	Baseline	2050	2070	2090
Extreme (E)	0	0	0	0
High (H)	0	0	0	0
Medium (M)	2	2	5	6
Low (L)	10	10	7	6
Total	12	12	12	12

5. Conclusion

This CRA has been conducted to address the SEARS and determine how the proposal can address climate risks. The CRA was prepared in alignment with *Australian Standard 5334:2013 for Climate Change Adaptation for Settlements and Infrastructure*. Utilising NARCLiM 1.0 and 1.5 and projections from the CSIRO and BOM, the assessment provided an understanding of potential climate change impacts on the proposal's assets.

A total of twelve climate change risks were identified, based on hazards including extreme rainfall, storms, bushfires, and temperature. Notably, none of these risks were rated as 'High' or 'Extreme' at this stage. Six were categorised as 'Low' and six as 'Medium' for the 2090 timeframe. The risks identified are presently manageable with appropriate mitigation measures in place.

It is recommended that ongoing monitoring occurs to address emerging risks in the future. Given the dynamic nature of climate change, regular reassessment and adaptation strategies are crucial to ensure the resilience of the proposal's assets

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Appendix A

Risk Matrix (NSW Government Climate Risk Assessment Tool)

Risk assessment criteria

The below tables are editable to allow you to customise this template with the risk assessment criteria outlined in your organisation's enterprise risk management framework/guidance.

Table 1: Likelihood criteria

Likelihood that a given scenario arises

Rating	Recurrent risks	Single events
Almost certain	Could occur several times per year	More likely than not – probability greater than 50%
Likely	May arise about once per year	As likely as not – 50/50 chance
Possible	May arise once in 10 years	Less likely than not but still appreciable – probability less than 50% but still quite high
Unlikely	May arise once in 10 to 25 years	Unlikely but not negligible – probability low but noticeably greater than zero
Rare	Unlikely during the next 25 years	Negligible – probability very small, close to zero

*prefilled based on Table 11 of Climate change impact and risk management - A guide for business and government (Australian Greenhouse Office 2006)

Table 2: Consequence criteria

Example consequence scales for a local authority

Consequence and success criteria	Public safety	Local growth and economy	Community and lifestyle	Environment and sustainability	Public administration	*Enter if required*	*Enter if required*
Catastrophic	Large numbers of serious injuries or loss of lives	Regional decline leading to widespread business failure, loss of employment and hardship	The region would be seen as very unattractive, moribund and unable to support its community	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage	Public administration would fall into decay and cease to be effective	*Enter if required*	*Enter if required*
Major	Isolated instances of serious injuries or loss of lives	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Severe and widespread decline in services and quality of life within the community	Severe loss of environmental amenity and a danger of continuing environmental damage	Public administration would struggle to remain effective and would be seen to be in danger of failing completely	*Enter if required*	*Enter if required*
Moderate	Small numbers of injuries	Significant general reduction in economic performance relative to current forecasts	General appreciable decline in services	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Public administration would be under severe pressure on several fronts	*Enter if required*	*Enter if required*
Minor	Serious near misses or minor injuries	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Isolated but noticeable examples of decline in services	Minor instances of environmental damage that could be reversed	Isolated instances of public administration being under severe pressure	*Enter if required*	*Enter if required*
Insignificant	Appearance of a threat but no actual harm	Minor shortfall relative to current forecasts	There would be minor areas in which the region was unable to maintain its current services	No environmental damage	There would be minor instances of public administration being under more than usual stress but it could be managed	*Enter if required*	*Enter if required*

*prefilled based on Table 8 of Climate change impact and risk management - A guide for business and government (Australian Greenhouse Office 2006)

Table 3: Risk matrix

		Consequence				
		Insignificant	*Minor*	*Moderate*	*Major*	*Catastrophic*
Likelihood	*Almost certain*	Medium	Medium	High	Extreme	Extreme
	Likely	Low	Medium	High	High	Extreme
	Possible	Low	Medium	Medium	High	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Low	Medium

*prefilled based on Table 7 of Climate Compass (CSIRO 2018)

Table 4 - Control effectiveness

	Description and further action
Substantially effective	Existing controls address risk, are in operation and are applied consistently. Management is confident that the controls are effective and reliable. Ongoing monitoring is required.
Partially effective	Controls are only partially effective, require ongoing monitoring and may need to be redesigned, improved or supplemented.
Largely ineffective	Management cannot be confident that any degree of risk modification is being achieved. Controls need to be redesigned.

*prefilled based on Table 4.6 of TPP12-03b (NSW Treasury 2012)

Appendix B

Risk register

DESCRIPTION OF IMPACTS AND CONTROLS												RISK ASSESSMENT																	
EXPOSURE AND VULNERABILITY			RISK TYPE	COMPONENTS POTENTIALLY IMPACTED							PLANNED CONTROLS	RATING FOR BASELINE CLIMATE CONDITIONS					RATING FOR 2050 RCP 8.5 PROJECTION					RATING FOR 2070 RCP 8.5 PROJECTION					RATING FOR 2090 RCP 8.5 PROJECTION				
Risk ID:	*Climate variable*	*Description of impact*	*Direct or Indirect*	*regulator/Regulator Structure*	*Gates*	*SCADA Control Systems*	*Control house*	*Fish Passage*	*Access roads*	*Construction*	*Description of controls either planned within current design or assumed to be planned for future packages of work*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*
001	Drought	Increased frequency and length of droughts leads to cracking and increased risk of structural damage of the regulator.	Direct	x	x			x			Structural capacity to take on ground movements is taken into account	RARE	1	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low
002	Extreme heat	Extreme heat impacts electrical and communication systems compromising gate operations and causing service disruption.	Direct	x	x	x					Gates can be operated manually From a safety perspective, gate operations can continue with communication systems down. Transmission lines design for an ambient temperature of typically 40 degrees.	LIKELY	4	INSIGNIFICANT	1	Low	LIKELY	4	INSIGNIFICANT	1	Low	ALMOST CERTAIN	5	MINOR	2	Medium	ALMOST CERTAIN	5	INSIGNIFICANT	1	Medium
003	Extreme heat	Extreme heat and greater temperature fluctuations over asset life can affect the gates' mechanical functionality including potential jamming of gates.	Direct	x	x			x			Regulator and gate design standards have allowances for a range of extreme temperatures.	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	POSSIBLE	3	MINOR	2	Medium	POSSIBLE	3	MINOR	2	Medium
004	Extreme heat	Extreme heat affects materials (e.g. regulator crest, concrete durability, beams) causing cracking and damage, resulting in reduced reliability and design life and increasing maintenance costs.	Direct	x	x			x			Concrete is inherently resilient to this risk. Expected thermal movement is a parameter used in design and materials selection.	RARE	1	MINOR	2	Low	RARE	1	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low
005	Extreme rainfall	Extreme rainfall events structural failure, causing flooding and damage to downstream receivers.	Direct	x	x			x			Regulator designed to cater for possible extended precipitation events in the catchment (Probable Maximum Precipitation - PMP). Allowance for flood surcharge to be incorporated into the operation of the dam.	RARE	1	INSIGNIFICANT	1	Low	RARE	1	INSIGNIFICANT	1	Low	UNLIKELY	2	INSIGNIFICANT	1	Low	UNLIKELY	2	INSIGNIFICANT	1	Low
006	Extreme rainfall	Extended periods of extreme rainfall exceeds spillway capacity leading to flood surcharge and potential embankment failure.	Direct	x							Regulator designed to cater for possible extended precipitation events in the catchment (Probable Maximum Precipitation - PMP). Allowance for flood surcharge to be incorporated into the operation of the regulator.	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low
007	Extreme weather	Lightning strike causes equipment failure e.g. electrical, comms components, equipment and systems, impacting the asset operations.	Direct			x	x				Lightning assessment provided based on AS 1768 thunder days. Earthing systems/protection to be provided per the AS.	UNLIKELY	2	MINOR	2	Low	POSSIBLE	3	INSIGNIFICANT	1	Low	POSSIBLE	3	MINOR	2	Medium	POSSIBLE	3	MINOR	2	Medium
008	Extreme weather	Extreme weather events result in increased large suspended material content in the water (including trees, branches, or debris), leading to a blockage of intake structure, increasing maintenance regime.	Direct	x							Intake structure is designed with protective measures such as impact loading and potential use of log protectors. Access and procedures in relation to maintenance are in place to clear storage area efficiently and effectively.	POSSIBLE	3	MINOR	2	Medium	POSSIBLE	3	MINOR	2	Medium	LIKELY	4	MINOR	2	Medium	LIKELY	4	MINOR	2	Medium
009	Bushfires	Increase in the number and severity of bushfires/grass fires causes damage to the network, affecting the power supply to essential equipment, leading to reduced operability of the regulator.	Direct			x	x				The gates can be operated manually until power is restored to the regulator	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	UNLIKELY	2	MINOR	2	Low	POSSIBLE	3	MINOR	2	Medium

DESCRIPTION OF IMPACTS AND CONTROLS												RISK ASSESSMENT																	
EXPOSURE AND VULNERABILITY			RISK TYPE	COMPONENTS POTENTIALLY IMPACTED							PLANNED CONTROLS	RATING FOR BASELINE CLIMATE CONDITIONS					RATING FOR 2050 RCP 8.5 PROJECTION					RATING FOR 2070 RCP 8.5 PROJECTION					RATING FOR 2090 RCP 8.5 PROJECTION				
Risk ID:	*Climate variable*	*Description of impact*	*Direct or Indirect*	*regulator/Regulator Structure*	*Gates*	*SCADA Control Systems*	*Control house*	*Fish Passage*	*Access roads*	*Construction*	*Description of controls either planned within current design or assumed to be planned for future packages of work*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*	*Likelihood*	*Likelihood No.*	*Consequence*	*Consequence No.*	*Risk*
010	Bushfires	Extreme heat generated by bushfires comes in direct contact with concrete structures causing damage.	Direct	x							Positioning of regulator and fishway structure distant enough to minimise risk of bushfire coming in direct contact with concrete structures.	POSSIBLE	3	INSIGNIFICANT	1	Low	UNLIKELY	2	INSIGNIFICANT	1	Low	UNLIKELY	2	INSIGNIFICANT	1	Low	UNLIKELY	2	INSIGNIFICANT	1	Low
011	Bushfires	Bushfires or smoke moves onto the site and blocks off access roads/evacuation routes resulting in staff being trapped onsite resulting in injury or loss of life.	Direct						x		Bushfire risk assessment undertaken in accordance with the Rural Fire Service (RFS) Planning for bushfire protection.	RARE	1	INSIGNIFICANT	1	Low	RARE	1	INSIGNIFICANT	1	Low	RARE	1	INSIGNIFICANT	1	Low	RARE	1	INSIGNIFICANT	1	Low
012	Extreme weather	Extreme weather impacts access roads and leads to lack of access for maintenance and construction resulting in delays of construction schedule.	Direct						x	x	During flood, gates are usually down and no access is required. Construction may experience delays in 1/20 flood event. Access roads are design to withstand minor flooding but require regular maintenance after such events	ALMOST CERTAIN	5	MINOR	2	Medium	ALMOST CERTAIN	5	INSIGNIFICANT	1	Medium	ALMOST CERTAIN	5	INSIGNIFICANT	1	Medium	ALMOST CERTAIN	5	MINOR	2	Medium

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