Rookwood Weir Offset Strategy

(Version 10)




earthtrade

Date:	25 October 2022
Prepared for:	Sunwater Limited
Our Reference:	20192213 Version 10
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ACKNOWLEDGEMENTS & DISCLAIMER

This report should be cited as: *Rookwood Weir Offset Strategy (version 9)*

ACKNOWLEDGEMENTS:

This document has been prepared by Environmental Offset Solutions Pty Ltd t/a Earthtrade with support from Sunwater Limited.

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List of abbreviations

Abbreviation	Description
AEIS	Additional Information to the EIS
AHD	Australian height datum
AMTD	Adopted middle thread distance
BVG	Broad vegetation group
CGER	Coordinator-General's evaluation report
CoG	Coordinator-General (Qld)
CQSS:2030	Central Queensland Sustainability Strategy 2030
DAF	Department of Agriculture and Fisheries (Qld)
DATSIP	Department of Aboriginal and Torres Strait Islanders Partnerships (Qld)
DAWE	Department of Agriculture, Water and Environment (now called DCCEEW)
DBC	Detailed business case
DCCEEW	Department of Climate Change, Energy, Environment and Water
DES	Department of Environment and Science (Qld)
DNRME	Department of Natural Resources, Mines and Energy (Qld) (now DRDMW)
DoEE	Department of the Environment and Energy (Commonwealth) (now called DCCEEW)
DoR	Department of Resources (Qld)
DRDMW	Department of Regional Development, Manufacturing and Water (Qld)
EIS	Environmental impact statement
EO Act	*Environmental Offsets Act 2014* (Qld)
EOP	Environmental Offsets Policy (EPBC Act) (October 2012)
EPBC Act	*Environment Protection & Biodiversity Conservation Act 1999 (Cth)*
FBA	Fitzroy Basin Association
FSL	Full supply level
GAWB	Gladstone Area Water Board
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRWHA	Great Barrier Reef World Heritage Area
GIS	Geographic information systems
ha	Hectares
km	Kilometres
LFRIP	Lower Fitzroy River Infrastructure Project
ML	Megalitres
MNES	Matters of national environmental significance
MSES	Matters of state environmental significance
NC Act	*Nature Conservation Act 1992* (Qld)
OS	Offset strategy
PMAV	Property map of assessable vegetation
QEOP	Environmental Offsets Policy (Qld)
RE	Regional ecosystem

Abbreviation	Description
Reef 2050 WQIP	Reef 2050 Water Quality Improvement Plan
RRC	Rockhampton Regional Council
RW1	Rookwood Weir Project Stage 1
RW2	Rookwood Weir Project Stage 2
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now called DCCEEW)
SMP	Species Management Plan
TEC	Threatened ecological community
TMS	Turtle movement study
USL	Unallocated state land
VM Act	*Vegetation Management Act 1999* (Qld)
WASC	Woorabinda Aboriginal Shire Council
WPC	Woorabinda Pastoral Company
WQIP	Water Quality Improvement Plan
WQMP	Water Quality Management Plan

Glossary

Term	Definition
Category A vegetation	Under Queensland vegetation management legislation, Category A vegetation is an area which is: · a declared area · an offset area, an exchange area, an area that has been subject to unlawful clearing or an enforcement notice, an area subject to clearing as a result of a clearing offence OR · an area that the chief executive determines to be Category A Category A areas are colour-coded red on the regulated vegetation management map. See *Vegetation Management Act 1999*, s20AL.
Category X vegetation	Under Queensland vegetation management legislation, all areas other than Category A, B, C and R areas are Category X areas. Some Category X areas are also identified on a property map of assessable vegetation (PMAV) as 'locked in'. Category X areas are also known as 'exempt areas' because activity in Category X areas is not regulated by the *Vegetation Management Act 1999*. Category X areas are colour-coded white on the regulated vegetation management map. see *Vegetation Management Act 1999* (Qld), s 20A.
Offset Investigation Area	The area that was investigated via GIS modelling that encompasses the Fitzroy, Mackenzie, Issacs, Connors and Dawson Rivers from the Fitzroy River Barrage to the Peak Downs Highway in the North, Bingegang Weir on the Mackenzie River to the west and the Dawson Weir at Theodore in the south.
Regrowth vegetation	Vegetation that is not remnant vegetation.
Regulated vegetation	Vegetation that: · is an endangered regional ecosystem, an of concern regional ecosystem, or a least concern regional ecosystem, and · forms the predominant canopy of the vegetation covering more than 50% of the undisturbed predominant capacity; averaging more than 70% of the vegetation's undisturbed height; and composed of species characteristic of the vegetation's undisturbed predominant canopy.
The Project	Rookwood Weir and associated Infrastructure

1. Introduction

Earthtrade was commissioned by Sunwater Ltd (Sunwater) to develop an Offset Strategy (**OS**) for impacts to Commonwealth matters of national environmental significance (**MNES**) from the construction and operation of Stage 1 of the Rookwood Weir component (the Project) of the Lower Fitzroy River Infrastructure Project (**LFRIP**). The LFRIP was approved by the Queensland Government's Coordinator General (**CoG**) in December 2016 and the Federal Minister for Environment in February 2017 (EPBC 2009/5173), subject to conditions.

This OS addresses offset requirement conditions for the residual impacts to both MNES required in the Federal approval (EPBC 2009/5173), as well as Matters of State Environmental Significance (**MSES**) conditioned by the CoG (being threatened species and fish habitat, regulated vegetation, and connectivity offsets). The OS was approved by the Minister on 27 July 2021 with a condition requiring the OS to be revised and updated following competition of pre-clearance surveys for the inundation area. In addition, the previously approved OS outlined residual impacts for a weir height of 45.5m Australian Height Datum (**AHD**). The weir height was subsequently raised to 46.2 m AHD. This document, as Version 6, is the revised and updated OS to address DCCEEW's comments dated 23 September 2022.

1.1 Background

The LFRIP included the construction and operation of a new weir at Rookwood and the existing Eden Bann Weir on the Fitzroy River in Central Queensland. A staged development process was proposed for both weirs comprising two stages:

- Rookwood Stage 1: mass concrete weir to a full supply level (**FSL**) of 45.5m
- Rookwood Stage 2: addition of 3.5m high flap gates to FSL 49.0m
- Eden Bann Stage 2: raising of the existing structure to FSL 18.2m
- Edan Bann Stage 3: addition of 2m high flap gates to FSL 20.2m.

Following approval of the environmental impact statement (**EIS**), in late 2017, Sunwater and the Gladstone Area Water Board (**GAWB**), in partnership with Building Queensland, completed the detailed business case (**DBC**)[1] for construction of Rookwood Weir Stage 2 (**RW2**). Both State and Federal governments agreed in principle to jointly fund RW2 on a 50:50 basis. In mid-2018, the State Government advised that Sunwater would continue as the sole preferred proponent for the Project and to continue with preparatory activities that had previously commenced under the joint venture agreement between Sunwater and GAWB). In parallel with the preparatory works, a budget review was undertaken using the detailed design. This review indicated that project costs had increased beyond those outlined in the DBC and exceeded the funding commitments by the State and Federal Governments. Sunwater was directed by the Queensland Department of Natural Resources, Mines and Energy (**DNRME**; now the Department of Regional Development, Manufacturing and Water (**DRDMW**)) to work within the approved budget. This necessitated investigating an un-gated solution analogous to Stage 1 as

[1] Building Qld, 2017, Detailed Business Case Lower Fitzroy River Infrastructure Project, published by Qld Government in October 2017, At: https://buildingqueensland.qld.gov.au/wp-content/uploads/2018/01/LFRIP-detailed-business-case.pdf

outlined in the EIS. The outcomes of this investigation identified that RW2 would exceed the budget outlined in the DBC and Sunwater was directed to proceed with Rookwood Stage 1 to be delivered under an alliance arrangement, and jointly funded by the Australian and Queensland Governments. During this time, an optimisation assessment was undertaken in consultation with both the Queensland and Australian Governments to assess the most economically viable weir height. The assessment identified a raising of the weir by 700mm to 46.2m AHD. All impacts outlined in this revised OS are those resulting from a weir height of 46.2m AHD. This is less than the maximum assessed in the EIS that was approved by the Queensland and Australian Governments.

The alliance arrangement, consisting of the State of Queensland (owner participant), GHD Pty Ltd (design participant), Acciona and McCosker Contracting (construction participants) commenced in July 2020 with in-river works commencing in July 2021.

Sunwater, as the sole proponent, is progressing the detailed design, implementing EIS approval conditions, and obtaining development permits as they relate to the construction and operation of Rookwood Weir.

1.2 Project location

The Rookwood Weir is located on the lower Fitzroy River, within the Fitzroy sub-catchment, central Queensland (refer to *Figure 1*). The Fitzroy River forms at the confluence of the Mackenzie River (flowing from the north) and Dawson River (flowing from the south) and flows out into the Coral Sea. This is where the Great Barrier Reef World Heritage Area (**GBRWHA**) and the Great Barrier Reef Marine Park (**GBRMP**) are located.

The Fitzroy River passes through the city of Rockhampton, which lies approximately 59 km from the mouth of the Fitzroy River. The Rookwood Weir Project is located within the Brigalow Belt bioregion, Mount Morgan Ranges subregion.

1.3 Rookwood Weir

The Rookwood Weir is a 'greenfield' development near Rookwood Crossing on the Fitzroy River.

Key project components include:

1. Constructing a new weir at Rookwood to capture and store water resources to an approximate height of 46.2 m (AHD)
2. Constructing turtle and fish passage infrastructure to facilitate movement of turtles and fish around Rookwood Weir
3. Replacing the low-level crossing at Riverslea with a new bridge and associated road approaches up-stream of the Weir
4. Upgrading the low level and existing culvert crossing at Hanrahan's downstream of the Weir
5. Upgrading public roads (State and local) to facilitate construction traffic along Thirsty Creek Road (a local road) from the Capricorn Highway (including the intersection with the State-controlled road) at Gogango.

The development of weir infrastructure (and associated works) and the resultant storage of water (inundation of the riverbed and banks) comprise the scope of this OS. The Rookwood Weir Project does not include water delivery infrastructure (e.g. pipelines) to supply water to users.

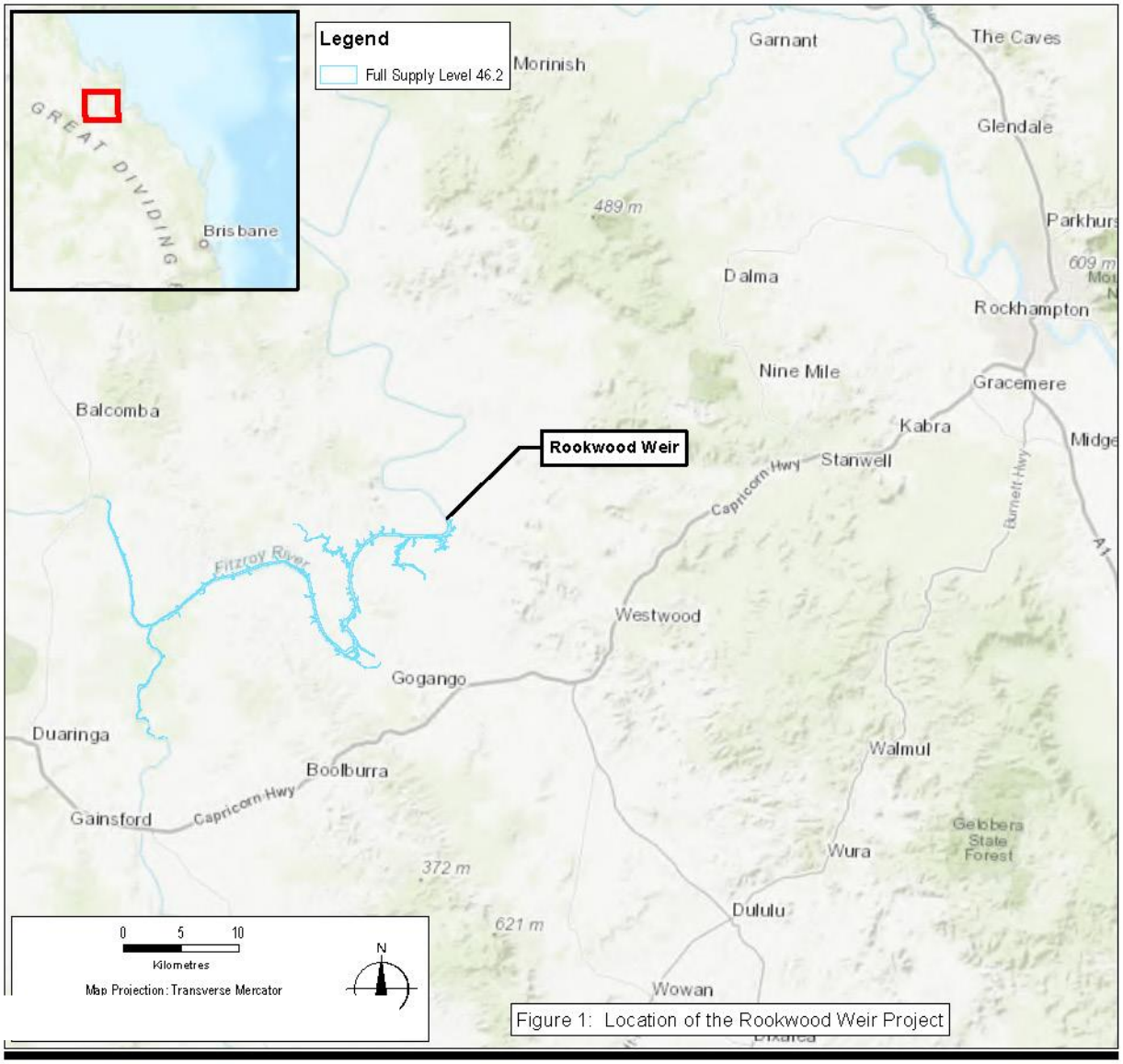
The construction of Rookwood Weir and subsequent inundation is proposed to occur in two main construction phases and the commissioning phase:

- Early works construction including access tracks and laydown areas, clearing and grubbing; preparatory excavations; Riverslea Bridge and road upgrade works
- Construction of the weir itself including form and pour of the monoliths, fish passage and turtle passage and abutments
- Commissioning of the weir and inundation of land.

1.4 Proponent

Sunwater Limited (Sunwater) (ACN 131 034 985; ABN: 17 020 276 523) is a statutory government-owned corporation under the Queensland *Government Owned Corporations Act 1993*. Sunwater owns and operates the Queensland Government's bulk water supply and distribution infrastructure located throughout regional Queensland. Sunwater is the sole proponent of the Rookwood Weir Project.

Figure 1: Location of the Rookwood Weir Project area



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Data source: GHD: Inundation Area 46.2 (2010); Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community Created by: AJ

2. Purpose and Scope

The purpose of this OS is to revise and amend the field verified impacts following completion of the inundation areas pre-clearance surveys for impacts associated with a weir height of 46.2m AHD. As per the approved OS, this revised OS provides an overarching document that summarises the quantum of field verified residual impacts to areas and features proposed to be offset, in accordance with the requirements of the Coordinator-General's evaluation report (**CGER**) on the EIS and the Australian Government approval under the EPBC Act. The OS has been developed to specifically address and satisfy Condition 4 of the EPBC Act approval (EPBC 2009/5173) and to outline how Sunwater intends to deliver the offset obligations outlined in Condition 4 to offset residual impacts to MNES, (being threatened species and ecological communities and water quality). The Strategy also addresses the offset obligations outlined in Appendix 2, Schedule 2, Condition 1 and Appendix 4, Conditions 1 and 2 of the CGER to offset significant residual impacts to MSES (being threatened species and fish habitat, regulated vegetation, and connectivity offsets).

This OS explains the offset delivery approach proposed to be undertaken to offset the unavoidable impacts of the Project to MNES and MSES as per the respective conditions of approval.

2.1 Objectives

This Offset Strategy is for projected impacts arising from the construction and operation of the Rookwood Weir component of the LFRIP only. As per the EPBC Condition 3, matters to be impacted are required to be confirmed via field verification pre-clearance surveys. This is to confirm the extent of MNES (and MSES) to be impacted. Pre-clearance surveys have been undertaken for the weir and Riverslea Bridge construction footprints and the field verification results have been outlined in a Construction Area Pre-clearance Survey Report. The Report was submitted to the Department of Agriculture, Water and Environment (**DAWE**) in February 2020. The inundation areas pre-clearance surveys could not be undertaken at that time. Field verification of the inundation areas was completed in September 2021 and the inundation area Pre-clearance Survey Report was submitted to DAWE on 20 October 2021. These terrestrial pre-clearance surveys were undertaken over the inundation area for the RL46.2m AHD weir height. These field verified impacts extents will be used to determine the extent of offset areas required and will be included in the ensuing Offset Management Plan (**OMP**). The OMP is required to be approved by the Minister prior to inundation, as per EPBC Condition 5. The Offset Management Plan will be submitted for approval to the Minister following approval of this OS.

The objectives of this OS are to outline Sunwater's approach to delivering the required offsets by:

- Identifying the likely offset obligations for the Rookwood Weir for the construction and inundation phases as well as the associated ancillary infrastructure as required.
- Defining the approach to deliver offsets for the Rookwood Weir including impacts from construction, inundation, and associated infrastructure to fulfil:
    - The Australian Government's offset requirements
    - The Queensland Coordinator-General's offset requirements

- Presenting the proposed offset delivery method and pathway to securing the required offsets.

2.2 Structure of this Strategy

This OS has been prepared taking into consideration:

- Relevant Commonwealth and Queensland legislative offsets frameworks
- LFRIP EIS and Additional Information to the EIS (**AEIS**)
- Commonwealth EIS approval conditions
- Queensland EIS approval conditions
- Detailed consultation with Queensland Government agencies and industry experts; and
- Conservation and ecological outcomes.

This OS combines MNES and MSES. Where information is relevant for both Commonwealth (MNES) and State (MSES), information has been combined in each section for ease of reading. Of note is that at the time of the EIS assessment, only the Fitzroy River turtle was listed under the Commonwealth legislation and as such, was included on the Commonwealth approval conditions. However, the white-throated snapping turtle was included in the State approval conditions. Turtle-related offsets encompass actions that are relevant to both the Fitzroy River turtle and the white-throated snapping turtle and both species are included in this OS.

This OS has been structured to address:

- The relevant Commonwealth and State EIS approvals conditions relating to offsets and where these items have been addressed in this OS;
- MNES and MSES requiring offsets;
- The intended offset delivery approach for:
    - Terrestrial vegetation and fauna
    - Aquatic habitat offsets for the Fitzroy River turtle and the white-throated snapping turtle
    - Nest protection offsets for the Fitzroy River turtle and the white-throated snapping turtle
    - Water quality offsets
- Indicative management actions for each required MNES offset matter; and
- Indicative time frames for securing the intended offsets and likely method of legally securing the offsets differ between the various MNES, thus information within the relevant sections have been split.

Table 1 below outlines the structure of this Offset Strategy:

Table 1: Structure of this offset strategy

Section	Section title	Matters covered within the section	
		MNES	MSES
Section 1	Background	Yes (joint)	Yes (joint)
Section 2	Purpose	Yes (joint)	Yes (joint)
Section 3	Legislative framework and requirements	Yes (separated)	Yes (separated)
Section 4	Matters requiring offsetting	Yes (separated)	Yes (separated)
Section 5	Offset strategy approach	Yes (separated)	Yes (separated)
Section 6	Offset delivery method	Yes (joint)	Yes (joint)
Section 7	Offset Management Plan and next steps	Yes (joint)	Yes (joint)
Section 8	Legally securing the offsets	Yes (joint)	Yes (joint)

3. Legislative framework and approval requirements

As outlined in *Section 1.1*, State and Federal approval of the EIS was granted in December 2016 and February 2017, respectively. Condition 4 of the EPBC approval requires an OS to be submitted and approved by the Federal Minister prior to weir construction works commencing as defined in the varied conditions. This OS addresses the requirements of Condition 4, and the State approval conditions in *Section 3.1*.

It should be noted that the offset requirements listed in Table 1 of Condition 4b of the EPBC Act approval are for the potential maximum impacts for the entire LFRIP (Eden Bann and the two Rookwood stages). As outlined in *Section 1.1* and *Section 1.3*, only Rookwood Weir is progressing. As such, this OS only addresses offsets associated with the Rookwood Weir and to a height of 46.2 m AHD. This OS addresses the process for identifying and delivering the required offsets. A summary of the MNES and MSES requiring offsetting are outlined below.

3.1 EPBC Act and approval conditions

The EPBC Act is the Commonwealth Government's principal piece of environmental legislation and is administered by the DAWE. The EPBC Act is designed to protect MNES, which include threatened species of flora and fauna, threatened ecological communities (**TEC**s), migratory species as well as other protected matters. The Act includes EPBC categories of threat for threatened flora and fauna, identifies key threatening processes to their survival and provides for the preparation of recovery plans for threatened flora and fauna.

Approval is required under the EPBC Act for any action (development) that has the potential to significantly impact MNES. As outlined above, the LFRIP was approved by the Federal Minister on 28 February 2017. Condition 4 of the approval relates to the requirements to develop and have approved, an OS for the MNES listed in Table 1 of Condition 4 of the approval. This Condition and where it has been addressed in this OS are outlined in *Table 2*.

*Table 2: EPBC offsets strategy approval conditions**

<table>
<tr><th>Condition No.</th><th>Condition requirement</th><th>Section in the offset strategy</th></tr>
<tr><td colspan="3">The relevant policy is the EPBC Act Environmental Offsets Policy (2012)</td></tr>
<tr><td colspan="3">The policy sets out eight key overarching principles that must be applied in determining the suitability of offsets, summarised as follows:</td></tr>
<tr><td>4a</td><td>The approval holder must submit for the Minister's written approval, a separate Offset Strategy for each weir to be constructed or raised, which identifies the residual impacts arising from the respective weir on the following MNES:
i. Brigalow (Acacia harpophylla dominant and co-dominant) ecological community;
ii. Black Ironbox (Eucalyptus raveretiana);
iii. Red Goshawk (Erythrotriorchis radiates);
iv. Fitzroy River Turtle (Rheodytes leukops);
v. Great Barrier Reef World Heritage Area and National Heritage place.</td><td>This document.</td></tr>
<tr><td>4b</td><td>The offset strategy for each weir must propose in general terms the offsets that the approval holder will provide for the residual impacts arising from the construction or raising of the relevant weir, as set out in Table 1, and how the approval holder intends to deliver the offset obligations.
Table 1
<table>
<tr><th>Impact</th><th colspan="2">Indicative Impact Area / Quantity</th></tr>
<tr><td></td><td>Rookwood Weir</td><td>Eden Bann Weir</td></tr>
<tr><td colspan="3">Listed threatened species and ecological communities</td></tr>
<tr><td>i. inundation of Fitzroy River Turtle nest sites within the weir impoundment areas</td><td>-</td><td>-</td></tr>
<tr><td>ii. modifying aquatic habitat for the Fitzroy River Turtle</td><td>660 ha</td><td>282 ha</td></tr>
<tr><td>iii. loss of Red Goshawk nesting habitat</td><td>588 ha</td><td>384 ha</td></tr>
<tr><td>iv. loss of the area of Black Ironbox habitat</td><td colspan="2">impact area to be determined by pre-clearance surveys required under Condition 3</td></tr>
<tr><td>v. loss of the area of Brigalow (Acacia harpophylla dominant and co-dominant) ecological community</td><td colspan="2">impact area to be determined by pre-clearance surveys required under Condition 3</td></tr>
<tr><td>vi. any increase in nutrients, sediments, farm chemicals and/or</td><td colspan="2">as determined by the Program approved in accordance with Condition 1</td></tr>
</table></td><td>Impacts for Rookwood Weir are in Section 4 Table 7</td></tr>
</table>

<table>
<tr><th>Condition No.</th><th>Condition requirement</th><th>Section in the offset strategy</th></tr>
<tr><td></td><td>
<table>
<tr><td>other water quality parameters above baseline levels</td><td colspan="2"></td></tr>
<tr><td>vii. any increase in nitrogen due to decaying vegetation in the inundation area</td><td>at least 645 tonnes [1, 2]</td><td>at least 458 tonnes[2]</td></tr>
<tr><td></td><td colspan="2">unless the monitoring required at Condition 1b) i. conclusively determines that the impact is less than predicted[1]</td></tr>
</table>
Notes:
(1) The indicative areas/quantities will need to be determined based on the particular weir to (first) be constructed or raised.
(2) Unless a different impact area is determined by the pre-clearance survey required under Condition 3.</td><td></td></tr>
<tr><td>4c</td><td>The Offset Strategy for each weir must include, but is not limited to:
i. offset outcomes to be achieved, for listed threatened species and ecological communities listed in Table 1;
ii. details of how offsets will be provided for modifying Fitzroy River Turtle aquatic habitat (Table 1, item ii.);
iii. information about how the offset area/s will provide connectivity with other relevant habitats and biodiversity corridors;
iv. the timeline and legal mechanism/s for securing the offset area/s and offset outcomes;
v. how water quality offsets will be provided consistent with Table 1;
vi. inputs and justification for inputs demonstrating that the offsets are likely to be in accordance with the EPBC Act Environmental Offsets Policy and relevant Reef 2050 Plan requirements including the net benefit principle.</td><td>Section 5.4
Section 5.5
Section 5.4
Section 8
Section 5.7
Section 5.7</td></tr>
<tr><td>4d</td><td>The approval holder must not commence construction or raising of the relevant weir unless the offset strategy for that weir has been approved by the Minister in writing. The approved offset strategy relevant to each weir must be implemented.</td><td>Noted</td></tr>
</table>

* Note: The above conditions are reproduced from the EPBC approval conditions with impacts reflecting the maximum impacts associated with Rookwood Stage 2. Impact area provided elsewhere in this document reflect those associated with a weir height of 46.2 m AHD.

3.2 Queensland approval conditions

The Coordinator-General's imposed and stated conditions, as they relate to the content and matters addressed in this OS, are shown in *Table 3* and *Table 4*, respectively.

Table 3: Coordinator-General's imposed conditions as they relate to RW1[2]

Condition No.	Condition requirement	Section in the offset strategy
Schedule 1, Part C	Turtle Nest impacts The outcome sought by these conditions is to improve the breeding success for the white-throated snapping turtle.	
Condition 5.	**Nest protection programs**	
(b)	Implement nest protection measures for the white-throated snapping-turtle generally in accordance with Appendix G of the AEIS (Offset Proposal for the Fitzroy River Turtle and White-throated Snapping Turtle).	*Section 5.6*
Schedule 2	Powerful owl This schedule applies specifically to the management of project impacts on the powerful owl (*Ninox strenua*).	
Condition 1	**Regulated vegetation offsets**	
	The offset required for the project's significant residual impact on regulated vegetation (Appendix 4, Part B, Condition 1) must provide habitat features that support powerful owl nesting[1].	*Section 5.4*

Definition: (1) Habitat features for powerful owl nesting: Features that support powerful owl nesting habitat as defined in section 6.2.2 and 6.2.4 of the addendum to the AEIS. Nesting habitats include forests aged 60+ years on fertile soils in large (>100 cm diameter) old eucalypts with suitable hollows (45-75cm diameter, 50-180 cm deep, and 6-45 m above ground).

[2] *Lower Fitzroy River Infrastructure project Coordinator-General's evaluation report on the environmental impact statement* December 2016, Appendix 2

Table 4: Coordinator-General's stated conditions[3]

Condition No.	Condition requirement	Section in the offset strategy
Schedule 1	*Sustainable Planning Act 2009*	
Part B Condition 2	*Vegetation Management Act 1999* Regulated vegetation and connectivity offsets The outcome sought by this condition is to ensure that suitable offsets are provided for any residual impacts of the weir on regulated vegetation and connectivity. The relevant other Act for this condition under section 18(1) of the EO Act is the *Vegetation Management Act 1999*.	
(a)	Subject to (b) the significant residual impacts on prescribed environmental matters are only authorised to the maximum extent of impact identified for the prescribed environmental matters in Table A5.	
Estimated[1] and authorised maximum extent of impact on prescribed environmental matters (ha)		
Endangered RE 11.3.1[2]	Total of 19.4: 1.4 (weir construction area) 17.8 (impoundment)	*Section 4.2.3 and Section 5.4*
Of concern RE 11.3.2	4.3 (impoundment)	*Section 4.2.4 and Section 5.4*
Of concern RE 11.3.3	Total of 188.10: 186.3 (impoundment), 1.2 (weir construction area), 0.2 (Hanrahan Crossing)	*Section 4.2.3 and Section 5.4*
Regional ecosystems located within a defined distance of the defining banks of a watercourse	Total 439 435 (impoundment) and 3 (weir construction area)	*Section 4.2.4 and Section 5.4*
Connectivity area[3]	1,285.7	*Section 4.2.5 and Section 5.4*

Note: (1) Estimated impacts are reproduced from the evaluation report and include maximum impacts from Rookwood Stage 2. Impacts have been field verified during the pre-clearance surveys as required to address Condition 3 of the EPBC approval; (2) Overlaps with Commonwealth offset for the brigalow ecological community; (3) Comprised of the sum of impacts to all Regulated Vegetation (endangered and of concern regional ecosystems) and least concern regional ecosystems.

3.3 Environmental Offsets Policy - Commonwealth

Under the EPBC Act Environmental Offsets Policy 2012 (**EOP**), environmental offsets are actions taken to counterbalance significant residual impacts on MNES. Offsets are used as a last resort

[3] *Lower Fitzroy River Infrastructure project Coordinator-General's evaluation report on the environmental impact statement* December 2016, Appendix 4

and only considered after all management actions have been considered and where significant residual impacts remains. The policy allows for offsets for MNES to be located in the same area if the habitat/TEC accommodates the protected matters. For example, the habitat for ornamental snake and the brigalow TEC coincide and so the 2 matters can be located in the same offset area.

As per Condition 4) c) vi) of the approval conditions, this OS must demonstrate that the offsets are likely to be in accordance with the EOP. The EOP consideration of offsets is required for MNES where a residual significant impact is likely to remain after avoidance, mitigation and management measures have been undertaken.

The EOP provides guidance on the role of offsets in environmental impact assessments and how DAWE considers the suitability of a proposed offset package (SEWPaC, 2012). The EOP has five key aims that involve:

- Ensuring the use of offsets are efficient, effective, timely, transparent, and scientifically robust
- Providing all stakeholders with greater certainty on how offsets are determined and provided
- Delivering improved environmental outcomes
- Outlining the appropriate nature and scale of offsets
- Providing guidance on acceptable offsets and their delivery.

The EOP also sets out eight key overarching principles that must be applied in determining the suitability of offsets. These principles, how they are addressed and the section of the strategy where they are addressed are summarised below in *Table 5*.

Table 5: Offset policy principles addressed in the strategy

Offset policy No.	Policy requirement	Section in the offset strategy
The relevant policy is the EPBC Act *Environmental Offsets Policy (2012)*		
The policy sets out eight key overarching principles that must be applied in determining the suitability of offsets, summarised as follows:		
1.	Deliver an overall conservation outcome that improves or maintains viability;	*Section 5* and *Section 6*
2.	Be built around direct offsets but may include other compensatory measures;	Offsets are direct offsets for each matter and are detailed for each matter in *Section 6*
3.	Be in proportion to the level of statutory protection that applies;	*Section 6* and *Section 8*
4.	Be of a size and scale proportionate to the residual impacts on the protected matter	*Section 6* and *Section 8*
5.	Manage the risks of the offset not succeeding	*Section 5*
6.	Be additional to what is already required;	*Section 7.1*
7.	Be efficient, effective, timely, transparent, scientifically robust, and reasonable; and	*Section 6* and *Section 8*

Offset policy No.	Policy requirement	Section in the offset strategy
8.	Have transparent governance arrangements.	*Section 5* and *Section 8*

3.4 Reef 2050 Plan – Commonwealth and State

As per Condition 4) c) vii) this Offset Strategy must demonstrate that the offsets are likely to be in accordance with the relevant *Reef 2050 Plan*. The key Reef Plan document is the Reef 2050 Long-term Sustainability Plan (**Sustainability Plan**). The Reef Plan was developed by the Australian and Queensland Governments in response to a mid-term review of the previous Reef 2050 Plan following mass coral bleaching events of 2016-2017. The Reef Plan is currently being updated as part of the five yearly comprehensive review and a draft of the Sustainability Plan was released for a six-week public consultation period in August and September 2020. The outcomes of this consultation will inform the finalisation of the updated Reef 2050 Plan which is expected to be released in early 2021.

The Reef Plan provides an overarching framework for managing the Reef and it focuses on actions to address key threats in relation to seven overarching themes: ecosystem health, biodiversity, heritage, water quality, community benefits, economic benefits, and governance. Of primary relevance to this OS and to the broader EPBC approval conditions is the water quality theme. The Reef 2050 Water Quality Improvement Plan (**Water Quality Plan**). The Water Quality Plan is a nested plan under the Water Quality theme of the Reef Plan and identifies how the water quality outcomes under the Sustainability Plan will be delivered. The aim of the Water Quality Plan is to:

- Accelerate improvements in the water quality flowing from the catchments adjacent to the Reef by applying minimum practice standards across all industries and land uses, including urban and agricultural
- Set ecologically relevant targets for the reduction of pollutants at the end of catchments discharging into the Marine Park.

The Reef Plan and Water Quality Plan are primarily associated with water quality offsets for anticipated increases in nitrogen from decaying vegetation. The proposed strategy for addressing these offset obligations and the requirements of the Reef Plan is outlined in *Section 5.7*.

3.5 Net benefit principle – Commonwealth

The purpose of net benefits is to enhance the condition of MNES, including the Great Barrier Reef's (**GBR**) outstanding universal value. While offsets are focused on addressing residual impacts associated with development actions, net benefits are focused on delivering actions (above and beyond offset actions) which will restore or improve the GBR to a good condition.

The Net Benefit Policy provides guidance on designing or implementing programs, plans and actions to improve the condition and trend of values and achieve an overall net benefit to the GBR, where a net benefit is an overall improvement in the condition and/or trend of a GBR

value, or those actions which result in the net improvement. A key environmental pressure identified in the net benefit policy is water quality from land-based runoff.

The proposed strategy for addressing water quality offset obligations and the net benefit policy is outlined in *Section 5.7*.

3.6 Environmental Offsets Policy - Queensland

The relevant legislative and policy requirements of the Queensland Government are the *Environmental Offsets Act 2014* (Qld) and the Environmental Offset Policy (**QEOP**) V1.6 (2018), referred to as the Environmental Offset Framework. It is noted that as the project is a coordinated Project under section 35 of the *State Development and Public Works Organisation Act 1971* (Qld), the Coordinator-General has some discretion in the application of the policies and acceptance of the offsets proposed. The Environmental Offset Framework is based around the environmental offset policy principles outlined in *Table 6*.

Table 6: Offset policy principles to be addressed in the strategy

Policy requirement Offset principle		Section of OS where addressed
1	Offsets will not replace or undermine existing environmental standards or regulatory requirements or be used to allow development in areas otherwise prohibited through legislation or policy.	*Sections 5 and 8*
2	Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact.	*Section 3.7*
3	Offsets must achieve a conservation outcome that achieves an equivalent environmental outcome.	*Section 5*
4	Offsets must provide environmental values as similar as possible to those being lost.	*Section 5*
5	Offset provision must minimise the time-lag between the impact and delivery of the offset.	*Section 3.8*
6	Offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values.	*Section 7.1*
7	Where legal security is required, offsets must be legally secured for the duration of the impact on the prescribed environmental matter.	*Section 8*

3.7 Avoidance, mitigation, and offset

All attempts have been made during the design phase to minimise impacts to protected matters, however geographical, economic, and geological factors restrict the location of the structure and the resultant impoundment. Areas that can be rehabilitated (mitigation) post construction, will be rehabilitated as per an approved Species Management Plan within 12 months of the cessation of use of those areas.

3.8 Minimise the time-lag between impacting and offsetting

Offsets for all matters have been identified prior to impact and will be secured prior to the weir being commissioned. Significant impacts due to inundation are scheduled for the 2023 wet season, depending on seasonal rainfall. Once this OS has been agreed by DAWE and Sunwater, then the OMP will be developed and will therefore be ready to be legally secured and implemented once the weir is commissioned.

4. Matters requiring offsetting

Environmental offsets compensate for the significant residual impacts of an action on the environment. Offsets provide conservation gains to counterbalance the impacts that remain after avoidance and mitigation measures have been implemented. The remaining unavoidable impacts are referred to as residual impacts. Offsets can help achieve long-term environmental outcomes for matters protected under the EPBC Act, while providing flexibility for proponents. seeking to undertake an action that will have residual impacts on those protected matters.

Impacts associated with the construction and operation of the Rookwood Weir were assessed as part of the LFRIP EIS (GHD, 2015) and AEIS (GHD, 2016). These impacts were deemed acceptable, subject to the conditions outlined in the EPBC and Queensland Coordinator General's approvals (*Tables 2, 3 and 4*), as outlined in *Section 3.2* above. This section provides an overview of the impact on MNES and MSES species from the Project.

The LFRIP EIS and AEIS undertook detailed environmental assessments and modelling to assess the potential impacts to MNES and MSES. Ecological assessment entailed both desktop and field-based surveys to assess impacts to terrestrial vegetation such as:

- EPBC Act listed TECs
- Queensland regional ecosystems (REs)
- EPBC Act listed flora species
- EPBC Act terrestrial and aquatic species
- State listed fauna species.

Based on the extent and type of REs to be impacted, GIS modelling was undertaken to assess the potential impact of decaying vegetation on the Great Barrier Reef through changes to water quality. This modelling was updated after the Pre-clearance surveys were undertaken in July and September of 2021. GIS modelling was also undertaken to assess the potential quantum of turtle habitat to be impacted.

The EPBC Act and State matters requiring offsets as included in the approval conditions and outlined in *Section 3* are summarised below in *Table 7*. The impact areas outlined in *Table 7* comprise the field verified data as outlined in the construction area pre-clearance survey report and the recently completed inundation area pre-clearance report. As per Condition 5b, offsets for these field verified impacts to MNES will be included in the OMP and will be consistent with the inclusions in any updated offsets strategy.

Table 7: Summary of MNES and MSES requiring offsets

MNES or MSES	Matter requiring offsets	Impact
MNES	Vegetation: Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC	0.5 ha
	Vegetation: Black Ironbox (*Eucalyptus raveretiana*)	233 individuals
	Fauna: red goshawk (*Erythrotriorchis radiates*) nesting habitat	187.9 ha
	Fauna: red goshawk (*Erythrotriorchis radiates*) foraging habitat	53.87
	Fauna: Fitzroy River turtle (*Rheodytes leukops*) for impacts to habitat and nests	545.6 ha
	Water quality: Great Barrier Reef World Heritage Area and National Heritage place	Potential 358 tonnes of Nitrogen due to the inundation of vegetation in the impounded area*
	Any increase in sediment, nutrients, or farm chemicals and/or other "water quality" parameters, due to the use of the water supplied by the Project to irrigators [4]	No impact. The Water Quality Monitoring Program will inform if this requirement is triggered
MSES	Regulated vegetation including Queensland Regional Ecosystems#	
	Regional ecosystems located within a defined distance of the defining banks of a watercourse	195.36 ha
	Connectivity areas	316.97
	Protected species	
	Powerful owl (*Ninox strenua*) nesting habitat	15.6ha
	White-throated snapping turtle (*Elseya albagula*) for impacts to nests	545.6ha

 # Note that values shown for MSES impacts to a height of 46.2m AHD as amended by Changed decision notice 2205-29032 SPD dated 1 July 2022.

** See Attachment 2 for the detailed description of the nitrogen modelling based on the reduced height of the weir and the revised field-verified vegetation impacts.*

As per Condition 3 of the EPBC approval, pre-clearance surveys are required to be undertaken to confirm the extent of impacts that were predicted in the EIS and AEIS. Pre-clearance surveys were undertaken for the Riverslea Bridge and Weir construction areas and included in a pre-clearance report that was submitted to DAWE in February 2020. Pre-clearance surveys for the inundation areas were completed in September 2021 with a pre-clearance report submitted to

[4] "Water quality" as defined in the EPBC Conditions of Approval.

DAWE in October 2021. The field-verified vegetation extents determined the actual area of impact and through habitat quality assessments, will inform inputs into the EPBC Offsets Assessment Guide ("offsets calculator"). These revised and field verified vegetation impacts were put into the Rookwood Weir 46.2 nutrient offset calculations spreadsheet (updated June 2022). Calculations for Rookwood RL 46.2 have been updated using the outputs of the FullCAM program used in the Lower Fitzroy River Infrastructure EIS. The total dry mass (tdm/ha) was applied as per the 2013 Rookwood calculations (91.55 tdm/ha) to keep the data consistent. The only change that has been made is the area of regional ecosystem.

As part of the Queensland Coordinator General's approval, a turtle movement study (**TMS**) was required to be implemented. This was in order to assess the movements of the Fitzroy River turtle and the white-throated snapping turtle within the vicinity of the proposed weir. This program commenced and is now in its fourth year and will continue into construction and operations. As part of the TMS, detailed data on nest site locations within the proposed impoundment area as well as upstream and downstream and at the potential offset location at Foleyvale has been collected (refer to *Section 5.6*). These data sets will be supplemented by a targeted turtle nest monitoring program that will continue throughout 2022. The purpose of the targeted monitoring program, which will be undertaken in consultation with turtle experts from Queensland's Department of Environment and Science (**DES**), will be to determine locations of turtles and within, upstream and downstream of the proposed impoundment. Further, the purpose of the targeted monitoring program will be to detect a subset of nests that will be targeted for ongoing protection. The TMS has also collected data on potentially suitable habitat that could be remediated to enhance habitat that can be used to address offset obligations for impacts to turtle habitat. The targeted nest monitoring program will collect further data on potential nesting areas and areas that could be remediated to provide habitat.

A water quality monitoring program is currently being finalised for submission to DAWE and has been prepared by Fitzroy Basin Association (**FBA**), Central Queensland University (**CQU**) and Sunwater to address the requirements of Condition 1 of the EPBC approval. This monitoring program involves a targeted monitoring program that will enable the quantification of direct water quality impacts resulting from the decayed vegetation as well as facilitated agriculture. Pre-commissioning baseline monitoring commenced in July 2020 and will continue on a monthly basis through construction and into operations. This is to ensure that direct before- and after-impact comparisons can be made to determine the actual water quality impacts from the Project. The monitoring program will integrate with the monitoring undertaken as part of the Paddock to Reef Integrated Monitoring, Modelling and Reporting Program (Paddock to Reef program).[5] The Paddock to Reef program integrates monitoring and modelling across a range of attributes and at a range of scales including paddock, sub-catchment, catchment, regional and GBR-wide. In line with the Reef 2050 Water Quality Improvement Plan (**Reef 2050 WQIP**), the program evaluates management practice adoption, management practice effectiveness (in terms of water quality benefits and economic outcomes), catchment condition (riparian, wetlands, and ground cover), pollutant run-off and marine condition. The Paddock to Reef data is reported through the Reef Water Quality Report Card. Additionally the Fitzroy Partnership for River Health reports data collected within the Fitzroy sub-catchments to track

[5] https://www.reefplan.qld.gov.au/tracking-progress/paddock-to-reef

local changes in a range of indicators.[6] The methods to be used by Sunwater are standard monitoring methods employed across all programmes and will be reviewed in the context of the report cards for regional indicators.

4.1 MNES offset requirements

4.1.1 Brigalow threatened ecological community

This TEC is characterised by the presence of brigalow (*Acacia harpophylla*) as one of the three most abundant tree species (Butler 2007). Brigalow is usually either dominant in the tree layer or co-dominant with other species such as *Casuarina cristata* (belah), other species of acacia, or species of eucalyptus. Occasionally belah, or species or acacia or eucalyptus may be more common than brigalow within the broad matrix of brigalow vegetation. The structure of the vegetation ranges from open forest to open woodland. The height of the tree layer varies from about 9 m in low rainfall areas (averaging around 500 mm per annum) to around 25 m in higher rainfall areas (averaging around 750 mm per annum) (Butler, 2007). A prominent shrub layer is usually present.

Broadscale GIS modelling was initially undertaken within the catchment to locate a suitable offset site for the potential Project impacts to 0.97 ha of this TEC which was located within the road reserve area only at the site of the potential new bridge at Foleyvale Crossing. The modelling utilised the data available from the Queensland Herbarium of remnant, regrowth, and pre-clear layers of the 16 REs listed as the brigalow TEC by the Threatened Species Scientific Committee in the Listing Advice (2001). This modelling was then filtered to locate brigalow TEC areas within 1km of watercourses of stream order 5 and above, within which potential offset areas within the Foleyvale and Stoney Creek properties were determined to occur. Ecological investigations within these properties identified the presence and availability of brigalow habitat that is suitable for offsets.

Brigalow in the inundation area

The preclearance surveys undertaken in July and September of 2021 found no brigalow within the inundation area, and as such no impacts or offsets are required for the brigalow TEC, as described by GHD in the pre-clearance report:[7]

> *Field-verification of RE communities identified substantial changes in the mapping from that presented in the Environmental Impact Statement (EIS), or in current Department of Resources (DoR) version 12 RE mapping. Much of the riverine environment had been mapped at a relatively coarse scale. This erroneously included many areas of water and Melaleuca dominated woodland (i.e. 11.3.25b) in a broader RE community 11.3.25 (riverine fringing wetland). There are many sub-types within that broad RE community, many of which hold no value for MNES. All polygons previously mapped as 11.3.1 (Acacia harpophylla and/or Casuarina cristata open forest on alluvial plains) (i.e. Brigalow) that could have been consistent with Brigalow TEC were assessed*

[6] https://riverhealth.org.au/report_card/ehi/
[7] GHD (2021). Rookwood Weir Project: EPBC Pre-clearance report, p.13

and found to not support that RE community. No brigalow dominated RE communities were observed within the inundation area.

Brigalow in the weir construction area

A patch of low value Brigalow TEC (based on the small patch sizes (barely 0.5 ha) and high abundance of exotic species within the ground layer) were confirmed present within the survey area at Rookwood Weir.[8] This 0.5ha will be offset at the terrestrial offset area using RE 11.3.1.

Brigalow at Riversleigh Crossing

The field survey undertaken confirmed that there was no brigalow present at the Riversleigh Crossing site.[9]

Brigalow at Foleyvale Crossing

No brigalow will be cleared at the site of the Foleyvale Crossing, as confirmed in the field survey report:[10]

> *A key objective of the survey was, (2020) to map the extent of Brigalow TEC and determine whether it was possible to identify an alignment that entirely avoids impact on the Brigalow TEC. While the survey has confirmed that Brigalow TEC is present immediately east and west of the existing road reserve, the surveys confirmed a gap of approximately 10 m exists between the two Brigalow TEC polygons. An optimal alignment that runs between the mapped Brigalow TEC polygons has the potential to entirely avoid impact on the TEC, provided this gap is wide enough to incorporate the alignment.*

4.1.2 Black ironbox

Eucalyptus raveretiana, commonly known as Black Ironbox, is a medium-sized tree that grows to 25m in height and occurs between Rockhampton and Ayr in Queensland. The extent of occurrence is about 90,000 km^2 (Queensland Herbarium, 2008). There are 23 recorded sites or subpopulations in two main areas of occurrence: Nebo to Ayr, and Apis Creek to Rockhampton. Black ironbox occurs on the banks of rivers, creeks, and other watercourses, on clayey or loamy soil (Halford, 1997; Queensland Herbarium, 2008). No individuals were predicted to be impacted from the construction of Rookwood Weir at a weir height of 45.5RL. However, field verification identified 233 individuals of varying size and maturity classes within the 46.2m AHD inundation area.

Offsets for the Black Ironbox were previously identified within the offset areas to be located on the McKenzie River and anabranches includes suitable Black Ironbox habitat and co-dominant species such as *Eucalyptus tereticornis* and *E. camaldulensis* woodland (RE 11.3.25). Further, Black Ironbox individuals were intermittently identified within the riparian zone and occurring on landzone 3 within the riparian fringing vegetation on the offset properties 'Foleyvale' and 'Stoney Creek'. The intent is to identify and select areas within the fringing riparian vegetation

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[8] GHD (2020). *Sunwater Rookwood Weir Project EPBC Act Pre-clearance Report 41-29978-02-AP-RPT-0005.* Refer to section 3.2.2, Figure 5, and Plate 3-1.
[9] GHD (2020). *Sunwater Rookwood Weir Project EPBC Act Pre-clearance Report 41-29978-02-AP-RPT-0005*. See Section 3.2.2 and Figure 2.
[10] GHD (2020). *Foleyvale Crossing Ecology Assessment*. See Figure 1 and Section 6.

where Black Ironbox are currently located and implement management actions to improve the habitat quality for this species. The number of Black Ironbox individuals required as an offset outcome will depend on the starting number and quality of Black Ironbox at the proposed offset location, At the time of establishing the offset area and quantifying the number of individuals present, seeds will be collected and an additional 300 seedlings established in a nursery to be used if required. The seed collected for establishing an additional 300 Black Ironbox seedlings will come from the individuals in the area proposed to be inundated by the weir, and that any seedlings established that are not required for use in offset plantings will be given to the Qld Botanic Gardens.

The final number of Black Ironbox required in the offset area will be determined using the Commonwealth Offsets Assessment Guide to ensure a 'like for like' offset is attained.

Should recruitment in the offset area be insufficient after 3 years, and additional individuals need are required to be established, the supplemental planting of Black Ironbox individuals can then be instigated. An assessment will also be made if any further changes in the management regime of the offset area is required. The outcome sought is the establishment of a minimum of 245 Black Ironbox with a diameter at 1.3m height (DBH) of >10cm by year 10 of the offset area being legally secured.

4.1.3 Red goshawk

The red goshawk is a large, swift, and powerful rufous-brown hawk, growing to a length of 45–60 cm, with a wingspan of 100–135 cm and occurs in a patchy, widespread distribution across coastal and sub-coastal regions of northern and eastern Australia. Preferred habitat consists of coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and the edges of rainforests, usually on fertile soils (Marchant & Higgins, 1993). The red goshawk rarely breeds in areas with fragmented native vegetation (Aumann & Baker- Gabb, 1991; Czechura, 2001). The stick nests, in which 1–2 eggs are laid, are restricted to trees that are taller than 20m and within 1km of a watercourse or wetland (Aumann & Baker-Gabb, 1991). The species hunts within a home range of up to 200 km^2 in open forests and gallery forests, taking mostly medium to large birds (Czechura & Hobson, 2000).

An initial offset investigation area was modelled to assess the potential red goshawk habitat available from a range of properties within the Fitzroy Catchment. The analysis was further constrained to two primary properties adjacent to the Mackenzie River and at the upper reach of the Rookwood impoundment. Detailed ecological surveys were undertaken on these two properties to assess the available habitat to address the required offset obligations to terrestrial MSES and MNES (refer to Appendix A for the offset suitability assessment report for Foleyvale and Stoney Creek).

Presence of the Red Goshawk was confirmed at the offset site via an active nest and a pair of Red Goshawk individuals were observed during the offset areas survey on four separate occasions as outlined in the offset suitability assessment report (reference to active nest omitted from this report to protect the location but has been provided to DAWE separately).

The field verified impacts to red goshawk nesting habitat is 187.9ha and 53.87ha of foraging habitat. The proposed offset site includes a range of habitat types that are either current nesting habitat (remnant vegetation) or regrowth vegetation that is potential nesting habitat over the

life of the approval. At the Foleyvale and Stoney Creek sites, the surveyed amount of red goshawk nesting habitat is 673.7ha , and foraging habitat is 1327.3ha (see *Table 10*). Although the offset area will be determined from the DAWE Offsets Assessment Guide, the area approximates the anticipated offset area required based on the field verified impacts. The output of the Offsets Assessment Guide for red goshawk is provided at *Attachment 3* The final required offset area will be determined during the development of the Offset Management Plan. The red goshawk nesting/breeding habitat attributes will consist of the REs as per the EIS and AEIS unless otherwise agreed and will consider the conservation advice for this species. If required, additional REs will be considered at the Offset Management Plan stage.

4.1.4 Fitzroy River turtle

Rheodytes leukops, family *Cheluidae*, also known as the Fitzroy tortoise and Fitzroy River turtle, is a light to dark brown turtle growing up to 26cm with scattered darker spots and blotches, a pale yellow or cream belly, and dull olive-grey exposed fleshy parts. It has a distinct narrow white inner ring around the eye, and the shell and neck are covered with large, pointed conical tubercles.[11] The Fitzroy River turtle has a distinctive white ring around its eye. The feet are fully webbed, and five claws are present on each forelimb. The shell of hatchlings is serrated along the back edge and the ring around the eye is metallic silver blue (Cogger, 2000; Wilson and Swan, 2003; Latta and Latta, 2005; Limpus et al., 2007; Limpus et al., 2011a).

The known distribution of the Fitzroy River turtle extends from the Fitzroy Barrage to at least Theodore Weir (at 228.7 km adopted middle thread distance (**AMTD**)) on the Dawson River, and within the lower reaches of the Nogoa River and upper reaches of the Connors River (in the vicinity of the proposed Connors River Dam at 95.7 km AMTD).[12]

Specific surveys for potential habitat and to identify known nest sites are being undertaken within, upstream and downstream of the Rookwood Weir inundation area and also within the 16 sandbanks identified within the Mackenzie River adjacent to the two potential offset sites currently under negotiation. Turtle nests are known to occur within the Offset Investigation Area included in the offset availability modelling for the Project. The offset for this species will be based on Recommendation 13 in the CGER and focus on the risks identified in the *Back on Track* document for the Fitzroy NRM Region.[13]

4.1.5 Water quality (nitrogen)

Native vegetation clearing in Australia can result in increased runoff and subsequent pollutant loads including nitrogen, that often cause adverse impacts downstream (Elledge & Thornton, 2017)[14]. As part of the Project, vegetation is not proposed to be cleared during inundation and the potential impacts will be due to the decay of the inundated vegetation overtime once the weir is commissioned and the impoundment is filled. As the decaying process occurs, nutrients

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[11] *Approved Conservation Advice for Rheodytes leukops (Fitzroy Tortoise)*, (s266B of the EPBC Act 1999).
[12] *Appendix E, Lower Fitzroy River Infrastructure Project, Additional information to the draft environmental impact statement Fitzroy River turtle and white-throated snapping turtle species management program*, May 2016.
[13] *Back on Track, Actions for Biodiversity, Taking action to achieve species conservation in the Fitzroy Natural Resource Management region*, Fitzroy Natural Resource Management Region, July 2010
[14] Elledge, A., & Thornton, C. (2017). Effect of changing land use from virgin brigalow (*Acacia harpophylla*) woodland to a crop or pasture system on sediment, nitrogen, and phosphorus in runoff over 25 years in subtropical Australia. *Agriculture, ecosystems & environment*, *239*, 119-131.

will be released into the system, and the water quality monitoring program will assess these changes.

The modelling undertaken for the EIS, estimated that 645 tonnes of nitrogen would be released during the first year of inundation for Rookwood Stage 2. The value, based on the revised and updated field survey work, and based on a weir height of 46.2m AHD, which has a lower inundation area relative to Stage 2 due to the removal of the weir gates, has been estimated at 358 tonnes (refer to *Table 7* and *Attachment 2).* The calculations and summarised methodology of the nitrogen modelling provided at *Attachment 2* is consistent with the approach accepted in the EIS that informed the EPBC Act and CG Conditions of Approval.[15]

Offsets are required for this aspect and for potential impacts relating to "unless the monitoring required by Condition 1b) i. conclusively determines that the impact is less than predicted".

The proposed approach to offset nitrogen impacts is to intercept/reduce sediment and hence bound nitrogen, from entering the waterway from the Foleyvale and Stoney Creek properties. This process would involve streambank/riparian stabilisation as well as working with the Woorabinda Traditional Owners to investigate farming practice option that could reduce nitrogen use and that are in addition to legislative requirements. In addition, a number of additional options are outlined in the strategy to address water quality offsets in *Section 5.7*.

Each of these MNES matters to be addressed and the offset methods for each are shown in *Table 8* below.

4.1.6 Water quality (other)

An assessment of the impact of the Project against the water quality targets of the Reef 2050 Plan was undertaken in the Addendum to the AEIS (Section 3 – Facilitated agricultural development). An excerpt from this assessment is below: [16]

> *The Fitzroy Basin is a priority area for suspended sediment management as defined in the RWQPP.*
>
> *Sediments delivered to the Fitzroy River estuary are derived almost exclusively from erosion in the upper Fitzroy Basin (Douglas et al. 2005). Episodic, generally short-lived flow/flood events during the summer months carry the majority of the suspended sediment from the Fitzroy River to the Fitzroy estuary (Webster et al. 2006). The operation of the Project alone is not expected to alter the sediment load within the system. There is the potential for the weirs to hold back sediment in the short-term. However, sediment within the system would be transported over the weirs during large flows in (excess of 5 m/s) and floods.*
>
> *The Fitzroy Basin catchment is not a priority area for nitrogen management as defined in the RWQPP. An assessment has been undertaken in relation to consequential impacts arising from agricultural development potentially facilitated by the Project. Section 11 indicates that a negligible contribution (0.05 – 1.70 per cent increase) to end*

[15] *Lower Fitzroy River Infrastructure project Coordinator-General's evaluation report on the environmental impact statement* December 2016, Section 5.3.
[16] Assessment against Water Quality Targets AEIS, Part 2, Chapter 5, Table 8-1 and Table 8-2.

of system nitrogen loads may result from facilitated agricultural development. Having regard to the scale of potential agricultural development, the environmental permitting requirements for intensive agricultural activities, the land management practices being adopted throughout the region and collaboration between stakeholders with regard to data sharing and reporting it is considered that facilitated development is unlikely to contribute to an increase to end-of-catchment sediment loads. Irrigated agriculture and intensive horticulture that may be facilitated by the Project will be subject to the expected increased pressure for adoption of management practices under the actions of the Reef 2050 Plan.

The Fitzroy Basin is a priority area for pesticide management as defined in the RWQPP. The Project alone would not change land use practices or anthropogenic inputs of fertilisers, pesticides and herbicides from catchment sources.

Any increase in nutrients, sediments, farm chemicals and/or other water quality parameters observed above baseline levels will be determined by the Water Quality Monitoring Program as per Condition 1. The Land Management Code of Practice as required under Condition 2 and that is currently being developed, outlines the management actions water users must adhere to, in order to mitigate any residual impacts from nutrients, sediments, and farm chemicals and/or other water quality parameters. Should the program indicate any increase in nutrients, sediments, farm chemicals and/or other water quality parameters resulting from the use of water, potential offsets could be delivered using the approach outlined in *Section 5.7* and from consultation with DAWE and the relevant water user(s) that contributed to any increase.

Any increase in nutrients, sediments, farm chemicals and/or other water quality parameters observed above baseline levels due to the use of the water supplied by the Project to irrigators will be confirmed by the Water Quality Monitoring Program. A commitment is made that the data collected by the WQMP will be used in water quality modelling for the catchment. The additional data supplied to these models will be used to inform a risk assessment, and in turn, any potential future offset requirements.

Any increase in nutrients, sediments, farm chemicals and/or other water quality parameters observed above baseline levels due to the use of the water supplied by the Project to irrigators is to be investigated and addressed as per the Sunwater – Rookwood Weir: Land Management Compliance and Incident Response Procedure which is contained within that document. The flowchart for that Procedure is at *Attachment 1*.

If impacts are found during the Incident Response Procedure, Sunwater will develop corrective actions to ensure that the water user regains compliance with the Land Management Code of Practice.

Residual impacts that have resulted from the non-compliance will be offset. The offsets will be developed by Sunwater in conjunction and consultation with scientists from DES and DCCEEW. The Department will determine the quantum of any offset required, which will be contingent on the nature of impact that occurs. Any decisions made will be in line with EPBC Act offset policy.

If the impact is sediment-related, on-ground offsets to intercept sediment will be developed.

If the impact is nutrient-based, then options to increase the nutrient interception that is developed in Stage 2 of the Nitrogen offset will be investigated or an alternative methodology developed.

Impacts that are due to farm chemical and/or other water quality parameters will be referred to the DES and DCCEEW within 2 business days of Sunwater becoming aware of the non-compliance.

Table 8 provides a detailed analysis of the potential attributes affecting water quality, their triggers and the process involved to mitigate these impacts, and if necessary, the potential offset solutions.

Table 8: Potential water quality impacts, their mitigation and potential offset solutions

Potential attribute impacting water quality	Trigger	Process	Mitigation	Potential offset solutions (not limited to this list)
Nitrogen, Phosphorus, Potassium	Trigger: Any increase above the Reference (Upstream) Site of N, P, or K •	Would trigger an investigative approach, including implementing the incident response procedure from the Land management code of practice at *Attachment 1*.	Non-compliant landholder/s to address the cause of the non-compliance	• Sediment interception project (gully or streambank erosion) • Contour bank installation • Reduced tillage adopted • Increase in the capacity of the Nitrogen offsets developed for the inundation area offsets (if required)
Farm chemicals and/or other "water quality"[17] parameters	Trigger: Any increase above the Reference (Upstream) Site for any of the sampled Pesticides or Herbicides	Implement the incident response procedure from the Land management code of practice at *Attachment 1*. Inform Qld Dept of Forestry and Fisheries as this maybe a compliance matter under the *Fisheries Act 1994, DES under the Environmental Protection Act 1994, Agricultural Chemical*	Non-compliant landholder/s to address the cause of the non-compliance If DAF/DES are involved, then they will impose a fine and/or rectification requirements on the landholder	In addition to the requirements that DES and/or DAFF may impose on the responsible landholder. If there are direct impacts to MNES (e.g. GBR) Sunwater will increase the offset for that matter to offset the impacts utilising the Offset Policies in effect at the time of the incident. (Sunwater to pass any costs onto the responsible party). If the GBR is impacted, the appropriate offset will depend on the nature and scale of the impact that occurs: Some options are: • Purchase of reef credits where a reef credit represents a quantifiable volume of nutrient, pesticide or sediment

[17] "Water quality" as defined in the EPBC Conditions of Approval

Potential attribute impacting water quality	Trigger	Process	Mitigation	Potential offset solutions (not limited to this list)
		Distribution Control Act 1966, Agricultural and Veterinary Chemicals 1994		prevented from entering the GBR catchment • A financial contribution to the Reef Trust Partnership with the Great Barrier Reef Foundation • Contributing to a water quality program within the Fitzroy Basin
Sediment	Trigger: Any increase above the Reference (Upstream) Site of Suspended solids	Implement the incident response procedure from the Land management code of practice at *Attachment 1*.	Non-compliant landholder/s to address the cause of the non-compliance	• Sediment interception project (gully or streambank erosion) • Contour bank installation • Reduced tillage adopted

4.2 MSES offset requirements

As described previously, Sunwater intends to co-locate all offsets for the prescribed environmental matters (*Table 7*) along with MNES wherever practicable. Sunwater may be able to co-locate offsets for multiple prescribed environmental matters arising from the different authorities on the one offset area regardless of whether the authorities are issued by Commonwealth, State, or local government. This is provided that the proposed management activities create benefits for all of the prescribed environmental matters, and that a conservation outcome can be achieved for all of the prescribed environmental matters.

The section below outlines the approach undertaken by Sunwater for identifying potential offset areas for each matter identified in *Table 7*.

Each identified matter has had potential offset sites identified initially via GIS desktop modelling (*Section 5*) with the required attributes for each matter being identified by ecologists and then factored into the model.

4.2.1 White-throated snapping turtle

Elseya albagula is one of the largest short-necked freshwater turtles in Australia; females with shell up to 38 cm long. Hatchlings and small juveniles have strongly serrated shell margins. Adults are large and heavily built, with large head and, in females, white face and neck. Males

are significantly smaller than females. This species is only found in Queensland in the Fitzroy, Mary and Burnett Rivers and associated smaller drainages in south-eastern Queensland.

The principal threat to the white-throated snapping turtles is the excessive (near total) loss of eggs and hatchlings at the aggregated nesting areas in the Fitzroy, Burnett, and Mary catchments. Principal predators are feral: fox, dog, pig, cat; native varanid, water rat. Trampling of nests by cattle is also a threat. This egg loss is continuing and has been occurring for at least a generation. The majority of the population is aging adults with very low recruitment to the adult breeding population.

Specific surveys for potential habitat and to identify known nest sites are being undertaken within, upstream and downstream of the Rookwood Weir inundation area, including within the 16 sandbanks identified within the Mackenzie River adjacent to the two potential offset sites currently under negotiation. Turtle nests are known to occur within the Offset Investigation Area included in the offset availability modelling for the Project. The offset for this matter is based on Schedule 1 in Appendix 2 of the CGER.[18]

4.2.2 Powerful owl

The largest of Australia's owls, the powerful owl usually inhabits the moist forests of eastern Australia. Its main item of prey is possums of various species, though large bats such as flying foxes are also often caught. They roost by day, perched in the dense shade of a tree, often with the previous night's prey held in its talons; this is when powerful owls are seen most often. With expanding populations of possums occurring in built-up areas, powerful owls are increasingly being recorded in the suburbs.

The area of impact to the powerful owl as verified from the construction and inundation area pre-clearance surveys field-verified vegetation communities is 15.6 ha (refer to *Table 7*).

Nesting habitats include forests aged 60+ years on fertile soils in large (>100 cm diameter) old eucalypts with suitable hollows (45-75 cm diameter, 50-180 cm deep, and 6-45 m above ground).

The proposed offset area adjoins the McKenzie River for 22km and there are also a number of anabranches that dissect the area. These areas are capable of supporting suitable habitat for the species.

4.2.3 Regulated vegetation – of concern RE 11.3.3

This RE is described as *Eucalyptus coolabah* woodland to open woodland with a grassy understorey, on alluvial plains.

The 251.11 ha impact to this RE will be offset by identifying regrowth areas that are identified as being an of concern class within broad vegetation group (**BVG**) 16c on the pre-clearing 1:1M layer. The areas will be refined to target category X areas on property maps of assessable vegetation (**PMAV**s) that have a foliage projection cover of more than 11%. That is, the regrowth will be circa 2-3m in height and targeted for re-clearing. Additionally, the areas preferred will be

18 *Lower Fitzroy River Infrastructure project Coordinator-General's evaluation report on the environmental impact statement December 2016*, Appendix 2, p.155.

within the defined distance of the banks of a major watercourse being a stream order 8 or above.

4.2.4 Regulated vegetation - REs within a defined distance of the defining banks of a watercourse

This 274.31 ha impact will be offset by identifying regrowth areas that are within the defined distance of the banks of a major watercourse being a stream order 8 or above, targeting category X areas on PMAVs that have a foliage projection cover of more than 11%; i.e., the regrowth will be circa 2-3m in height and targeted for re-clearing.

4.2.5 Regulated vegetation - connectivity

The proposed offset contains a minimum of 256.2ha of regrowth. The approach is to supply this MSES offset by identifying regrowth areas that are preferentially within the defined distance of the banks of a major watercourse being a stream order 8 or above, targeting category X areas on PMAVs that have a foliage projection cover of more than 11%; i.e., the regrowth will be circa 2-3m in height and targeted for re-clearing.

5. Offset strategy approach

The Rookwood Weir Project has a range of unique aspects requiring offsets (refer to *Section 3* and *Section 4*) that call for the consideration of unorthodox and unprecedented approaches to delivering the offset obligations if the best ecological, social and cost-effective outcomes are to be achieved. To this end, Sunwater is proposing a range of complementary direct land-based offset solutions that when combined, are expected to result in a greater ecological, ecosystem and social outcome relative to that possible if each matter were offset in isolation. This approach was arrived at following detailed consultation with subject matter experts from private industry and within Government agencies and departments, both original proponents, (GAWB and Sunwater) stakeholders including local councils, community groups and landholders of the potential offset locations (refer to *Section 5.3*) and taking into consideration relevant recovery plans and conservation advice.

This section describes the offset strategy approach process Sunwater intends to pursue to address and deliver the offset obligations for impacts to MNES and MSES from RW1. The section discusses:

- The type of offset being pursued for each MNES and MSES including stakeholder consultation
- The general scale of the offsets
- Co-location of offsets
- Identification of offset sites for each MNES and MSES.

The offset delivery approach is categorised for each matter (e.g. turtles, vegetation) followed by jurisdiction (e.g. MNES and MSES) as the offset delivery approach is more determined by the matter rather than jurisdiction.

5.1 Type and scale of offsets

Commonwealth and State offset policies allow offsets to be delivered through a range of mechanisms. This OS considered predominantly land-based offsets as well as alternative mechanisms available recognising that both the Commonwealth and State offset policies require the offset to be of a size and scale proportional to the residual impact on the matter. The Commonwealth offset policy requires offsets to generally be achieved through direct offsets (i.e. land-based offsets) via a minimum of 90% of the total offset requirement. However, the EPBC approval afforded the option of addressing offset requirements for impacts to turtle habitat via a 100% financial offset due to the difficulty in delivering the required offsets via land-based offsets. Nevertheless, consultation with subject matter experts including those within the Queensland DES Threatened Species Unit and aquatic ecologists at GHD, determined that a direct land-based offset for impacts to turtle habitat could potentially provide greater conservation outcome relative to a financial offset (*Section 5.5*). This depends on how a financial offset is to be administered.

The QEOP defines a maximum multiplier of four (i.e. a maximum of four times the area of the residual impact), with the exception of connectivity impacts - which is set at a multiplier of one. For land-based offsets, the size and scale of the offset is based on a habitat quality assessment

of both the impact site and offset site. The QEOP also allows a multiplier of one for aquatic offsets. As impacts to turtles were determined via the same methodology as impact to fish (MSES only), the same offset multiplier has been used in this OS (i.e. 1:1).

The Commonwealth offset policy does not define a multiplier to calculate the size of an offset for a given impact. The Commonwealth offset policy is accompanied by a calculator (the Offsets Assessment Guide) that considers factors such as quality of impact and offset sites, the duration of residual impacts, the risk of loss for a proposed offset site, and time until an offset yields a conservation gain. Habitat quality scores and hence, the residual impacts to MNES have only recently been determined and these metrics are currently being used in the Offsets Assessment Guide to determine the offset areas required. This information will be submitted in the Offsets Management Plan as required by Condition 5 of the EPBC approval.

5.2 Co-location

Sunwater will locate offsets for multiple prescribed environmental matters either on immediately adjoining land parcels or on land parcels in close proximity to one another. This will allow significant efficiencies and a greater ecological outcome enabling scale and reducing edge effects relative to locating offsets in discrete areas. Therefore, and in order to achieve the best possible environmental and social outcome, Sunwater intends to co-locate and/or overlap as many of the required offsets as practicable. This is outlined in *Table 7* and the below sections. It is also Sunwater's preference to deliver direct land-based offsets where practicable rather than delivery of financial based offsets and this OS outlines this approach as relevant to each MNES. *Table 9* below summarises the proposed co-location of offsets.

Table 9: Proposed co-location of offsets[19]

Jurisdiction	Value impacted	Estimated significant residual impact (ha)	Authority
Australian Government	Red goshawk	187.9 nesting habitat 53.87 foraging habitat	EPBC Act Seek to co-locate with regulated vegetation (including watercourse vegetation) and connectivity offsets
	Brigalow TEC	0.5 ha	
	Any increase in nitrogen due to decaying vegetation in the inundation area	358 tonnes of N This potential impact is to be confirmed by the Water Quality Monitoring Program	Stage 1 to be co-located with fauna habitat and regulated vegetation offsets (including watercourse vegetation) and connectivity offsets. Stage 2 to be supplied via a biodigester or other project to be developed as per *Table 12*
	Any increase in sediment, nutrients, or farm chemicals	This potential impact is to be confirmed by the	To be addressed as per the Incident Response Procedure which is contained within the

[19] Table 8 considers water quality offset options.

Jurisdiction	Value impacted	Estimated significant residual impact (ha)	Authority
	and/or other water quality parameters due to the use of the water supplied by the Project to irrigators	Water Quality Monitoring Program	*Land management code of practice irrigation water from Rookwood Weir*. The flowchart for that Procedure is at *Attachment 1*.
	Black ironbox	233 comprising • 96 adults • 122 saplings • 16 seedlings	
	Fitzroy River Turtle habitat	545.6	Co-locate where possible with the terrestrial offset area and adjacent riparian and riverine habitat.
	Fitzroy River Turtle nests	Number and/or extent to be confirmed	Identify and protect from predation via a Turtle Nest Protection Plan. These would ideally be located adjacent to the terrestrial and turtle habitat offset area for efficiencies in management and access
Queensland Government	Regulated vegetation * includes impacts to category A area * includes riparian habitat suitable for red goshawk & powerful owl Connectivity areas *includes regulated vegetation	0.28 ha of category A area regional ecosystems 11.3.25/11.3.3, ratio 85/15% Of concern regional ecosystem: 36.17ha RE 11.3.3 Regional ecosystems located within a defined distance of the defining banks of a watercourse: 316.97ha • 188.73ha of Least Concern RE 11.3.25 • 6.63ha of Of Concern RE 11.3.3	An activity assessed under module 8 (vegetation clearing) of the State Development Assessment Provisions Intent is to co-locate these MSES offsets with the MNES offsets within the proposed offset area on Foleyvale and Stoney Creek. An additional area for riparian community RE 11.3.25 is to be located at Fairbairn Dam which is owned by Sunwater.
	Protected wildlife habitat–powerful owl	15.6	MSES: Seek to co-locate with regulated vegetation (including watercourse vegetation) and connectivity offsets
	Fish Habitat	545.6	The construction of fish passage on Tartrus Weir. This Offset Delivery Plan and notice of election has been approved by the Queensland Government, Department of Agriculture and Fisheries

Note:[1] Values shown are impacts associated with a weir height of 46.2 m AHD . MSES impacts amended by Changed decision notice 2205-29032 SPD dated 1 July 2022

5.3 Consultation

In determining the most appropriate offset delivery mechanism that achieves the greatest social, conservation, ecosystem and cost-effective outcomes, a range of stakeholders have been engaged. Initial and early consultation was undertaken with DAWE and Queensland's DES in relation to the delivery of water quality offsets in late 2018 and 2019, and the most effective mechanism to delivery offsets for impacts to turtle habitat in 2019 and 2020. A summary of consultation undertaken to date, including the items discussed and the outcomes, is provided in *Table 10* and also discussed where relevant in sections below.

As context for the information provided in *Table 10*, the key aspects for consultation for each MNES were:

- Vegetation and fauna habitat: Consultation primarily involved discussions on the delivery process which will be via the standard terrestrial offsets land-based process.
- Turtle habitat offsets: The EPBC approval condition states that offsets to address impacts to turtle habitat 'may' be delivered via a financial offset. The use of the term 'may' allows for flexibility in delivering the required offsets for impacts to turtle habitat. Consultation was undertaken with DES regarding alternate land-based offset measures which is installation of a turtle passage at a location that currently impedes turtle movement or remediating habitat to improve or provide additional habitat for the Fitzroy River turtle and the white-throated snapping turtle. Consultation also involved discussions on the current impediments to turtle breeding and the foremost management actions required.
- Turtle nest offsets: In contrast to turtle habitat offsets, the EPBC approval conditions for offsetting impacts to turtle nests 'must' be undertaken in accordance with the offset delivery mechanism outlined in the EIS and AEIS. Therefore, discussion involved the current best management practice for turtle nest protection and foremost management actions.
- Water quality and nitrogen offsets: For water quality related offsets, while a financial offset via the reef trust or similar entity could potentially be made, consultation primarily involved undertaking a land-based offset program whereby the anticipated nutrients loads could be offset by implementing a nutrient interception program that reduces the equivalent level of nutrient and sediment loads from entering the Fitzroy catchment.

Table 10: Consultation undertaken

Stakeholder (Agency/ Department/ Landholder)	Matter/Topic	Matters raised/discussed and date	Outcomes	Actions
Dr Natalie Clarke	Turtle movement study (TMS) and nest surveys	Turtle nest survey methodology and scope of surveys Turtle habitat survey methodology and scope	Include preliminary nest surveys during all upcoming TMS events	
DES- Duncan Limpus GHD – Dr Natalie Clarke	Turtle habitat offsets and nest protection	Impacts to the Fitzroy River turtle and white-throated snapping turtle Main threats to turtle nesting and habitat use Mitigation measures and best practice turtle nest protection 17/10/2019	Main threats to both turtle species are predation on eggs from feral pests	DES to send through updated and relevant information on a range of matters
DES- Dr Col Limpus DES- Duncan Limpus GHD – Dr Natalie Clarke	Turtle habitat offsets, nest protection and the Species Management Plan (SMP)	Preliminary design of turtle passage ramp Structure and management actions in the SMP Turtle nest protection 24/02/2020	Preliminary design of turtle passage ramp to be updated SMP management actions sufficient Turtle offset approach acceptable	Preliminary design of turtle passage ramp to be updated and sent back for comment SMP to be finalised Turtle offsets approach, particularly for habitat remediation to be further investigated
DES- Manda Page DES- Dr Col Limpus DES- Duncan Limpus	Turtle habitat offsets	Proponent driven offset options and evaluation criteria on Teams meeting on 21/04/2020	Turtle passage not a preferred option	Sunwater to identify other suitable options and possible location for offsets in the form of Habitat enhancement programs
DES- Dr Col Limpus	Turtle nest survey	Proponent driven offsets for turtle habitat and financial offset delivery options Turtle offsets strategy oversight Nest protection program Teams on 22/05/2020	Agree to progress proponent driven turtle offsets and further discuss options for financial offset delivery	Sunwater to provide turtle nest protection survey methodology for DES comment

Stakeholder (Agency/ Department/ Landholder)	Matter/Topic	Matters raised/discussed and date	Outcomes	Actions
		27.07.2021 – Meeting to discuss the turtle passage and success criteria and conservation outcomes for financial offset.		
DES – Duncan Limpus	Turtle nest surveys and habitat	Turtle nest survey methodology and scope of surveys Main threats to turtles including habitat for nesting and survival of eggs Offset approach and importance of predator control June 2020 and mid 2021 Threatening processes to turtles including aquatic weeds	Duncan to send though detailed information Commitment to working together to confirm turtle nesting aggregations and to investigate the threats imposed by aquatic weeds to turtles	
DES- Manda Page DES- Dr Col Limpus DES – Lindsay Delzoppo	Turtle offsets	SMP Construction -approval Further approvals Habitat offsets Turtle nest offsets – nest survey Teams meeting: 14/09/2020	Approvals method is acceptable to DES Consultative process is acceptable	Sunwater to provide nest survey methodology for review and approval Sunwater to provide opportunity for DES to participate in the surveys
Fitzroy Basin Association (FBA) – Craig Davenport	Water quality, riparian remediation, and turtle habitat enhancement	Water quality offsets including streambank stabilisation and weed removal Riparian habitat remediation Turtle habitat remediation Predator control Integration with FBA programs 25+ face-to face and Teams meetings and phone calls	Many opportunities to work with FBA to achieve catchment wide solutions to ecological problems Sunwater's water quality and turtle habitat and nest offset approach aligns with FBA vision and current works Commitment to continue exploring options to integrate Sunwater's requirements with FBA programs Further consultation on water quality including streambank stabilisation and weed removal	
Rockhampton Regional Council (RRC) – Wade Clark Christine Bell	Fish movement and aquatic habitat improvements Water quality, riparian	RRC programs current and proposed works programs associated with: -Water quality including streambank stabilisation and weed removal -Predator control -Aquatic habitat enhancement	RRC to send through information on potential works programs to assess integration with Rookwood requirements Further consultation on water quality including streambank stabilisation and weed removal	

Stakeholder (Agency/ Department/ Landholder)	Matter/Topic	Matters raised/discussed and date	Outcomes	Actions
	remediation, and turtle habitat enhancement			
FBA Sunwater Roger Shaw	Water quality workshop	Discussion on the options for addressing water quality offsets including intercepting sediment and riparian enhancement July 2019	Improved water quality can be achieved by sediment interception and riparian enhancement Sunwater proposed approach to addressing water quality offsets is acceptable and currently being used across a range of industries	
Woorabinda Aboriginal Shire Council (WASC) and Woorabinda Pastoral Company (WPC) Board of Directors Manny Hegarty Regional Director DATSIP	Locating terrestrial vegetation and fauna habitat offsets on WASC and WPC properties. Vegetation and fauna habitat, indigenous burning practices, offset management.	Properties identified in September 2017 and initial discussion started with DATSIP and WASC 07.03.2019. Subsequently 25 meetings have been held between Sunwater, Earthtrade, DATSIP and WASC/WPC. 16.06.2021 and 25.10.2021 – Meetings with David Galvin – WPC chair – to discuss the offset areas on Foleyvale and Stoney Creek 3.11.2021 – Site visit to the offset area with David Galvin and the WPC manager.	WASC agreed to the circa 2,700ha offset Investigation Area. WPC engaged in early 2020 as a new Board of Directors were appointed after the WASC elections.	Ecological Surveys of the Offset Investigation Area were undertaken in November 2019. Subsequent 2 meetings with WPC Board of Directors prior to COVID 19. Independent land valuation obtained. Financial modelling of the cost of the management actions was developed and refined in 2020. Contractual negotiations to progress in November/December 2020. DATSIP investigating supporting opportunities for a Ranger Program so that the management actions will be undertaken by Aboriginal people on their lands.
DNRME	Vegetation offsets	Land-based offset delivery for vegetation and fauna habitat February 2020 and various meetings and phone calls through to October 2020	DNRME agreed that MSES offsets could be covered by MNES offsets where applicable and allowed by the offsets policies Offset conditions would be imposed on the State vegetation clearing approval	Sunwater addressed offset requirements in the State vegetation clearing approval application. Approval conditions require MSES vegetation to be offset prior to inundation.
DES	Fauna habitat offsets	Land-based offset delivery for vegetation and fauna habitat	Offsets for impacts to State fauna species were outlined in the	Nil. DES comfortable with the proposed offset delivery process and overlap with MNES offsets.

Stakeholder (Agency/ Department/ Landholder)	Matter/Topic	Matters raised/discussed and date	Outcomes	Actions
		Various phone meetings between late 2019 and mid-2020	State Species management Program.	
Dr Paul Lawrence Executive Director, Science Delivery and Knowledge Science and Technology Division Department of Environment and Science	Water quality	Water quality offsets Sediment and nutrient load interception. Utilising the Reef Modelling and Brigalow Catchment Study results and modelling to underpin project design for sediment and nutrient interception. 23.02.2018 28.03.2019 02.03.2020 15.02.2020	Referred to several DES members of staff to discuss with and also to Dan Rattray for modelling support.	Contact Dan Rattray to undertake modelling using Sednet, Source Catchments and Paddock to Reef to advise the amount of sediment and nutrients that could be intercepted. Subsequently reviewed the Technical Memo developed by Dan Rattray and endorsed the methodology and findings. A long-term research and monitoring program are to be discussed and designed by DES Science and Technology post the baseline data collection and agreement with DAWE on the terrestrial offset.
Roger Shaw Chair Fitzroy Regional NRM Group Science Panel	Water quality and nitrogen	Water quality offsets Sediment and nutrient load interception. Utilising the Reef Modelling and Brigalow Catchment Study results and modelling to underpin project design for sediment and nutrient interception. 09.07.2019 02.08.2019 29.01.2020 02.03.2020 18.03.2020 17.06.2020	Concurred with Dr Paul Lawrence and the modelling approach proposed to determine the sediment and nutrient interception for the offset site. Proposed that the offset site be established as a long-term research and monitoring site to provide updated and field verified data to support the models used for the GBR water quality modelling	
Dan Rattray Director Horizon Soil Science and Engineering	Water quality modelling	11.07.2019 24.10.2019 29.10.2019 07.11.2019 02.03.2020	The modelling demonstrated that the proposed interception of adequate amounts of sediment and attached N and P were sufficient to offset the potential impacts from decaying	Modelling undertaken as per the advice from Dr Paul Lawrence and Roger Shaw. Results presented to Sunwater in a Technical Memo dated 6 December 2019

Stakeholder (Agency/ Department/ Landholder)	Matter/Topic	Matters raised/discussed and date	Outcomes	Actions
			vegetation in the inundation area. The modelling indicated that the stabilisation of the banks within the proposed offset area would provide over 90% of the benefit as opposed to the assumed interception of sediment from overland flow.	
Fiona Waterhouse CEO Utilitas Biohub developers	Interception of nutrients from point source pollutants prior to entering the waterways	23.02.2018 16.09.2021 Anerobic digestion of waste and subsequent reuse as fertiliser and the water for irrigation. N and P removal. Techno economic model required to assess the feasibility on different potential point source pollutant sites. 95-100% certainty in the interception of N and P.	Potential to utilise this technology included in the BOS (refer to Appendix B). This has the potential to augment the proposed water quality offset and intercept point source nutrients including nitrogen from entering a waterway.	Further discussions planned as required.

5.4 Strategy for terrestrial vegetation and fauna habitat offsets

Sunwater's preferred option is for direct land-based offsets for impacts to terrestrial vegetation and fauna. As per policy principle 4, the offset must be an area and scale proportionate to the residual impact on the protected matter. Prior to selecting an offset site, an estimate of the size and scale of the impact must be known as well as an estimate of the offset multiplier or scale of the offset required. For the terrestrial offsets, an estimate of the impact areas was outlined in the EIS, AEIS and approval conditions. An estimate of the potential offset area required was determined based on professional experience, size and scale of similar offsets that have previously been delivered and State and Commonwealth offset policies.

Sunwater will comply with the current EPBC EOP for direct offsets, and offsets will be selected on the basis they contain, or have ability to enhance, habitats that support the listed threatened species and/or ecological communities required to be offset. They may include:

- Improving existing habitat for the protected matter
- Reducing threats to the protected matter
- Averting the loss of a protected matter or its habitat that is under threat.

5.4.1 Vegetation and fauna habitat offset area site selection

The EPBC EOP states that 90 percent of the total requirements can consist of direct offsets and 10% can be other complementary measures. Offsets should be consistent with the principles of ecologically sustainable development and should aim to maintain or enhance the environment and aid in the recovery of listed threatened species and ecological communities.

A regional scale desktop analysis has been completed to assess the availability of potential offset sites that could be used as a direct offset for the life-of-Project offset requirements. This analysis was intended to establish the total area of remnant and non-remnant vegetation associated with each MNES and MSES. A desktop analysis was completed to select offset sites. Geospatial analysis was used to identify the sites that have the potential to meet the requirements of the offsets policies.

To identify potential terrestrial offset areas, first a regional scale sub-catchment analysis, referred to as "area of interest" was modelled using GIS to calculate the potential area of offsets available for each of the MNES to be potentially impacted. Potential offset sites were assessed against the following criteria:

- Located within 1km of the centreline of stream orders 5 and above
- Contains suitable pre-clear vegetation
- Contains suitable regrowth vegetation
- Not covered by an existing development permit
- Not a declared protected area
- Contains fauna habitat as per the habitat definitions are as per the EIS and AEIS
- For the Fitzroy River turtle and white-throated snapping turtle, habitat is within the known species distribution of the species.

Modelling encompassed the Fitzroy, Nogoa, Mackenzie, Isaacs, Connors, and Dawson Rivers from the Fitzroy River Barrage to the Peak Downs Highway in the north, Bingegang Weir on the Mackenzie River to the west and the Dawson Weir at Theodore in the south.

The desktop analysis identified an initial 81 properties that were subsequently shortlisted to the top 25. These properties were further shortlisted by constraining their location by proximity to major rivers with a bias to the Mackenzie and Dawson Rivers to maximise the potential for intersecting Fitzroy River and white-throated snapping turtle habitat. Further refinement was undertaken following the landholder's initial level of interest and if they were willing to consider having an offset on their property and if so, the potential land area available for offsets.

The refined shortlisted properties were then aligned against the potential offset yield (e.g. >2,500 ha) and the number of species that could potentially be present on the property (i.e. the larger the potential area of habitat, the greater the number of species potentially present). Further assessment in these properties was undertaken to assess the potential management actions required and if any potential issues may arise when legally securing the offset area.

This assessment identified two main properties that had the highest potential to provide the requisite terrestrial offsets: Foleyvale and Stoney Creek. Foleyvale is a 10,700-ha property owned under Deed of Grant in Trust by Woorabinda Aboriginal Shire Council (**WASC**). Stoney Creek is a 4,876-ha freehold property that borders Foleyvale to the east and is owned by the Woorabinda Pastoral Company (**WPC**). The Woorabinda Aboriginal Shire Council is the sole shareholder of the Woorabinda Pastoral Company.

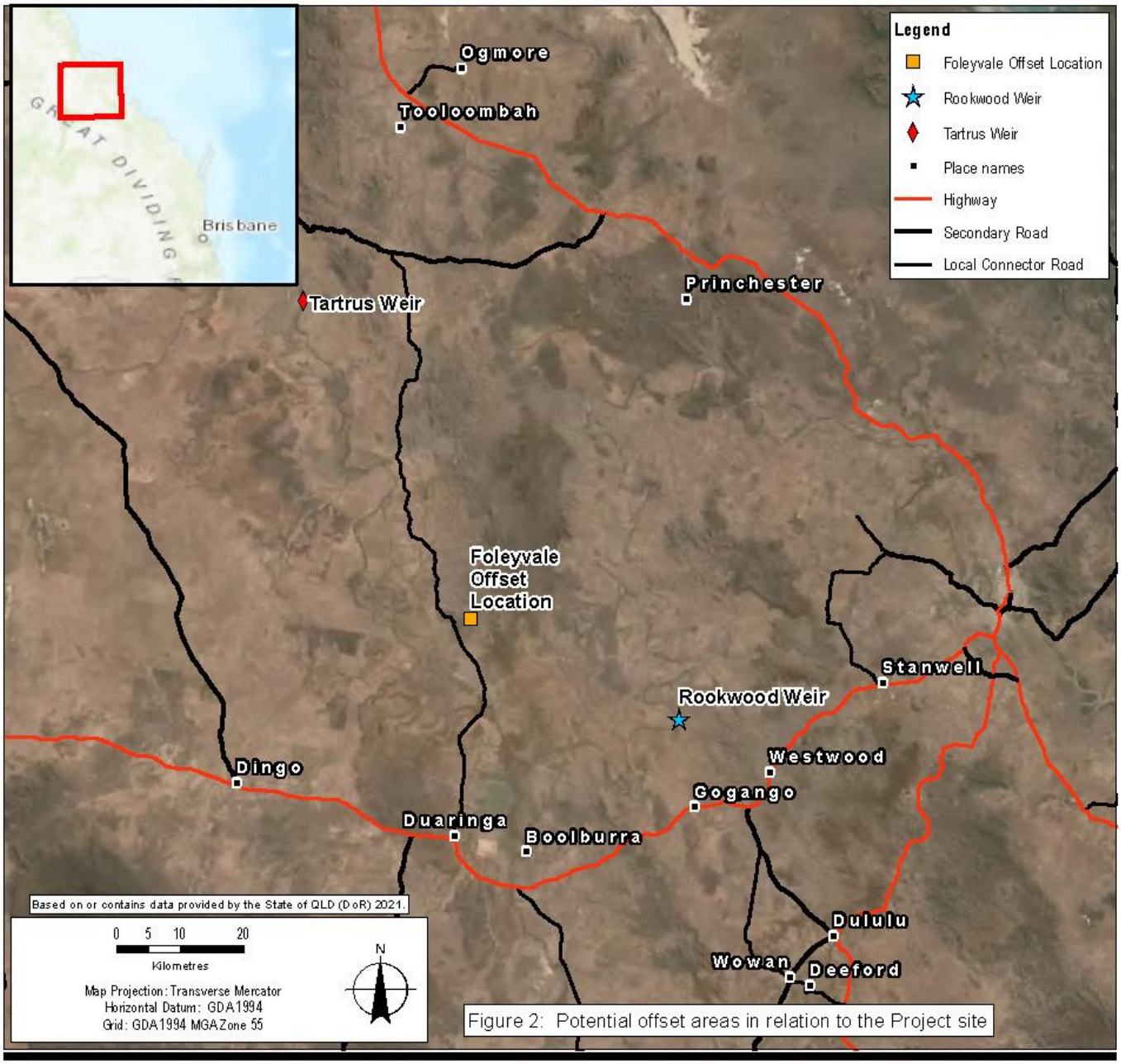
Foleyvale and Stoney Creek are located approximately 170km south-west of Rockhampton, and 21km north of the township of Duaringa. The survey area is approximately 30km straight-line distance west of the Rookwood weir site and approximately 60 km AMTD from the Rookwood weir site (see *Figure 2*). The Mackenzie River is the main watercourse adjoining the boundary of the entire survey area and flows in a north to south-east direction.

The southern boundaries of the properties are on the Mackenzie River and are immediately upstream of the Rookwood Weir inundation area. The properties have large areas that could be managed to allow the areas to regenerate naturally to provide offsets to the required environmental matters. The Mackenzie River and the proposed terrestrial habitat, turtle habitat and turtle nest offset area includes corridors that are of State, Regional and Local biodiversity significance (refer to *Figure 3*). Additionally, the river at these properties has a number of large sandbanks that could be become suitable nesting habitat for the Fitzroy and white-throated snapping turtles with remediation (refer to *Section 5.5*).

WASC established three offsets with mining companies in 2015 (Baralaba Coal, BMA, and BMC) and these projects were launched by the then Treasurer of Queensland and Minister for the Department of Aboriginal and Torres Strait Islanders Partnerships (**DATSIP**). The project was viewed as a ground-breaking approach and partnership between the Aboriginal community and State Government whereby local rangers manage the biodiversity offsets.[20]

[20] https://www.abc.net.au/news/rural/2015-08-27/woorabinda-mining-deal/6729796

Figure 2: Potential offset areas in relation to the Project site



Desktop assessment determined these two properties provide the necessary environmental and ecological attributes to address the offset requirements of the Rookwood Weir project. Importantly, these two properties provide a strong opportunity to establish an offset project that assists in addressing social, economic, and cultural needs of the Woorabinda community in a similar manner to that achieved with the 2015 agreement outlined above.

Based on the abovementioned desktop results, field based ecological assessments were undertaken at the potential available offset sites to ground-truth the desktop assessment, to determine the terrestrial habitat quality of land-based offsets, to assess the current quality of the available habitat and to determine the types and scale of management actions required (refer to *Appendix A*). Early discussions were also held with the WASC and WPC on the potential to locate the Rookwood offsets within the two properties and both parties are fully supportive. These discussions are ongoing.

Ecological assessments of Foleyvale and Stone Creek were undertaken in to identify suitable offset areas to accommodate the offsets required as a result of impacts to MNES and MSES as shown in *Table 11* and *Appendix A*. *Table 11* also outlines potential habitat availability for other MNES species that are potentially impacted by the project but that offsets aren't legally required to be provided.

The objective of the assessments was to:

- Conduct a desktop review of vegetation mapping and database records for the survey area
- Field verify the mapped REs and vegetation communities throughout the survey area, including an assessment of condition, composition, and structure
- Conduct habitat assessments and targeted searches for the key MNES species requiring direct offsets within the survey area.

The ecological assessment focused on vegetated areas, particularly those along, and adjacent to, the riparian corridor of the Mackenzie River. These areas comprised areas of regulated vegetation mapped by the DNRME, including remnant and regrowth vegetation and non-remnant vegetation associated with alluvial plains.

The potential offsets area comprises approximately 2,793ha located along a 23km section of land associated with the Mackenzie River bioregional corridors and surrounding vegetation on alluvial plains (see *Figure 3*). The area is dissected by a number of relic river channels which carry significant volumes of water even during low level floods. These channels leave the river within the offset area or north of it and then re-enter the main channel above the Apis Creek Road crossing.

Field surveys identified the ground-truthed vegetation within the potential offset area is generally similar to that currently mapped in the Department of Resources (**DoR**) RE mapping (*Figure 4*) (refer to *Appendix A*). Field assessment confirmed the presence of remnant vegetation, some of which differs in the extent and composition of the DoR mapped regulated vegetation, and areas mapped as non-remnant vegetation. The field survey also identified evidence of historical vegetation clearing processes.

Figure 3: Offset property selection – Foleyvale and Stoney Creek with bioregional corridors

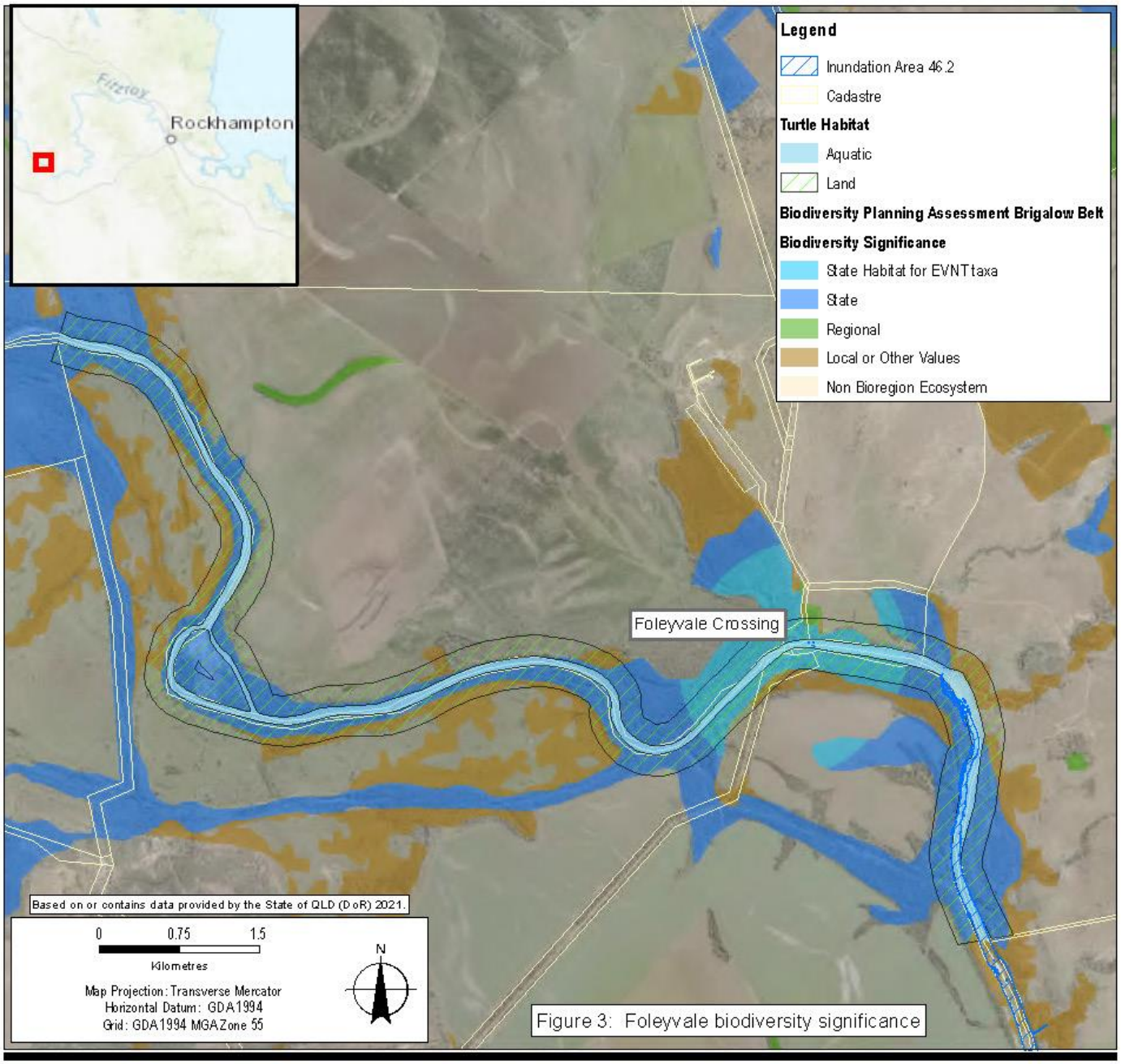


Figure 3: Foleyvale biodiversity significance

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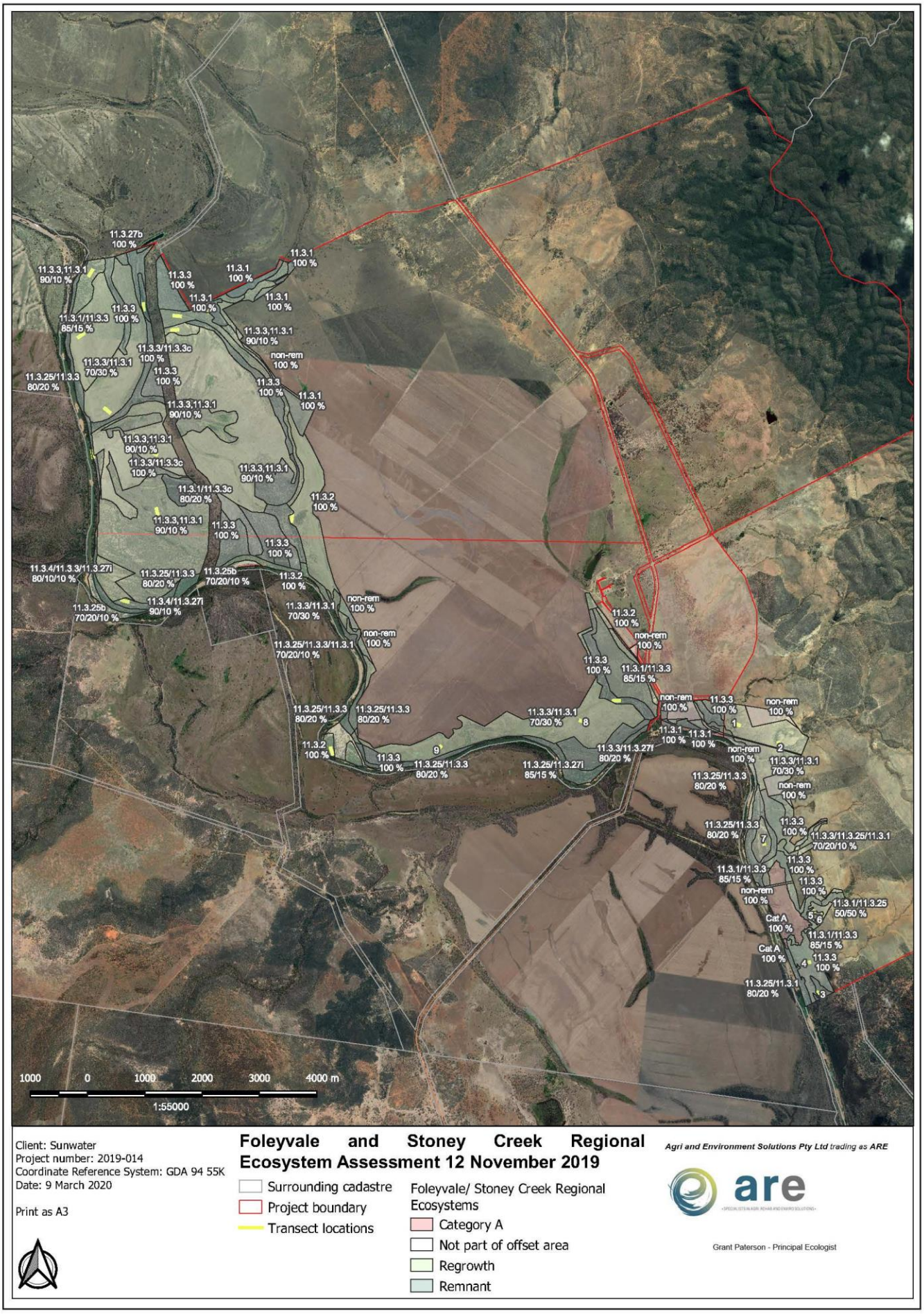
Data source: DoR: Watercourse Areas (2019), Cadastre (2019), Biodiversity Significance (2018), Imagery (2016); SKI: Inundation Area 46.2 (2019); GHD: Turtle Habitat (2020); Topographic Map: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap

Figure 4: Field verified regional ecosystems – Foleyvale and Stoney Creek



Seven threatened fauna species, including a pair of red goshawks were detected during the field assessment and significant areas of suitable habitat occurs throughout potential offset site. Other threatened species to be identified include the greater glider, squatter pigeon and koala. Although the powerful owl was not detected during the field assessments, significant area of suitable habitat was observed, and large numbers of the owl's preferred prey species were also observed. In addition, field assessments identified the threatened Black Ironbox within the potential offset area. Several weeds (rubber vine, lantana, parkinsonia and parthenium) and pest animals (rabbit, European brown hare, fox, feral cat, feral pig, and feral dogs) were observed. In addition, two threatened flora species were identified within the proposed offset area including the Black Ironbox and Ooline. The Black Ironbox was sporadically present along the riverbank on the western edge of the two properties with many large healthy specimens observed. These areas will be managed to improve Black Ironbox habitat quality and if required, additional individuals will be planted and managed until they achieve a height of 5m and therefore they will be at low risk of not reaching maturity.

Field assessment verified the presence of significant areas of remnant and regrowth brigalow, consisting of RE 11.3.1, within the offset investigation area. The brigalow offset will be managed until it achieves the outcomes required, which will be prescribed in the Offset Area Management Plan to be developed.

The principal corridor providing connectivity across the survey area is the Mackenzie River, which borders the western boundary of the potential offset area. The network of streams within Foleyvale provide significant connectivity at a landscape level. The statewide corridor mapping shows a state level corridor that follows the Mackenzie River and a 10 km wide, state terrestrial biodiversity corridor covering the majority of the Foleyvale component of the survey area (refer to *Figure 3*). The corridor occurs in a general east-west direction through the survey area. The restoration of the non-remnant areas within the survey area will fill a significant gap in this corridor. The offset area was chosen because of its strategic importance in reinstating this corridor.

Based on the habitat values within the potential offset areas, it is expected that once the offset area calculations are finalised, the offset areas will be sufficient to meet the offset obligations of the Rookwood Weir project. However, further consultation is being undertaken with the WASC regarding other properties that have the potential to provide any shortfall in the required offsets. These properties include one of the WASC properties on the opposite bank of the McKenzie River to the proposed offset area as well as another option being explored, which is an area on Woorabinda Station itself. This has habitat for a range of MNES. A further option is located within a property on the Isaac River, upstream of the Mackenzie River, that is being investigated as part of a larger, strategic offsets area. Preliminary ecological investigations have indicated this property has similar habitat values as those on the Foleyvale and Stoney Creek properties.

Table 11: Field verified MSES and MNES habitat within the proposed offset properties

MNES or MSES	Matter requiring offsets	Rookwood Weir impacts[21]	Approximate area available (ha) for each matter within the Offset Investigation Area
MSES	RE 11.3.3[#]	36.17 ha	1,327.3
	Regional ecosystems located within a defined distance of the defining banks of a watercourse	188.73ha RE 11.3.25 6.63ha RE 11.3.3 Total of 195.36 ha	1,267.1
	Connectivity areas	316.97 ha	1,682.5
	Powerful owl (*Ninox strenua*) nesting habitat	15.6 ha	1,758.7
MNES	Brigalow TEC (*Acacia harpophylla* dominat and co-dominant)	0.5 ha	477.3
	Black ironbox (*Eucalyptus raveretiana*)	233 (individuals)	Sufficient habitat and area for along the riparian fringe as well as locations to plant individuals if required
	Nesting habitat for Red Goshawk *Erythrotriorchis radiatus*)	187.9 ha	1,160.7*
	Foraging habitat for Red Goshawk *Erythrotriorchis radiatus*)	53.87	1,327.3
	Greater Glider (*Petauroides volans volans*)	n/a	1,541.1
	Squatter Pigeon (Southern) (*Geophaps scripta scripta*)	n/a	2,779.3
	Ornamental Snake (*Denisonia maculata*)	n/a	1,330.3

Notes:[1] Values shown for MSES regional ecosystems, watercourse and connectivity vegetation are those impacts for MSES impacts amended by Changed decision notice 2205-29032 SPD dated 1 July 2022.

*Includes RE 11.3.4, 11.3.25 and 11.3.27 only. Discussions continue about whether RE 11.3.3 can also be classified as breeding habitat and if added, there would be approximately 2,500ha of potential breeding habitat for the Red Goshawk within the Offset Investigation Area (refer to draft OAG outputs at *Attachment 3*).

[#]Under the Queensland offsets policy, impacts to regional ecosystems can be offset by other similar vegetation communities, rather than like for like REs.

[21] Executive Summary: Rookwood Weir Project EPBC Act Pre-clearance Report Sunwater GHD dated 20 October 2021

5.5 Strategy for turtle habitat offsets

The initial intent to offset impacts to turtle habitat was via a financial offset, as outlined in Appendix G of the EIS and AEIS. However, the EPBC approval conditions do allow for flexibility in the offset delivery mechanism for these impacts and it was Sunwater's intent to investigate whether alternate offset options could be explored. The aim of this investigation was to determine whether other options could provide a better ecological and social outcome and were more cost-effective. To this end, initial consultation with DES, FBA, and turtle experts at GHD was undertaken to assess potential direct and land-based offset options., while still retaining the option of a financial offset.

The consultation outcomes and reviews of relevant literature identified two main options:

- Installation of a turtle passage at a known location that is currently a barrier to effective turtle movement, particularly to the area upstream of the barrier. One potential option was the reinvigoration of the turtleway that was proposed at Tartrus Weir upstream of Rookwood and the Foleyvale and Stoney Creek properties on the Mackenzie River. Field surveys undertaken by the Queensland Government in 2011 identified for the first time that water management infrastructure could provide a physical barrier to turtle movement and connectivity within a river system. To address this issue, Sunwater and the Queensland Government proposed a turtleway prototype at Tartrus Weir in 2011 to investigate the design, development, and installation of passages to allow turtles to migrate safely over a range of barriers. Although funding was originally provided, the turtleway never eventuated. DES determined during ongoing consultations that this option would not be supported as an offset due to the uncertainty of the turtleway succeeding. However, as a side note, a fish passage is currently being examined at Tartrus Weir as the preferred option of addressing the fish offsets as required under the Queensland EIS approval conditions. Detailed discussions with a fish biologist at Queensland Department of Agriculture and Fisheries (**DAF**) and turtle experts indicated that a turtleway could be included in the fish passage design. This concept is being further investigated and if feasible and ultimately successful, will result in the movement of turtles past a known barrier and will increase connectivity to upstream habitat.
- Habitat enhancement or remediation to allow an increase in available habitat by improving the quality of currently unsuitable habitat. Habitat quality enhancement programs have previously been undertaken along riparian zones for a range of aquatic species including the white-throated snapping turtle in the Burnett Region following Commonwealth funding to the Burnett Catchment Care Association as part of the 20 Million Trees Program. Increasing habitat quality is a key management action for both turtle species and has been outlined in the *White-throated Snapping Turtle Recovery Plan* and *Management Actions and Strategies for the Fitzroy River Turtle and the White-throated Snapping Turtle* in response to the installation of water management infrastructure at Rookwood (Limpus et al., 2007; Limpus et al., 2011). Consultation with DES (including with Dr Col Limpus and Duncan Limpus) indicated that a detailed habitat quality improvement program would be supported. As such, and in further consultation with DES and other turtle experts, further investigations have been undertaken to determine suitable sites within close proximity to Rookwood Weir that would be suited to a habitat quality improvement program as outlined below. It was also discussed on several

occasions that one of the key management actions to improve habitat, particularly for turtle nesting, was the removal of known predators, and this will be a key focus.

5.5.1 Turtle habitat offset area selection

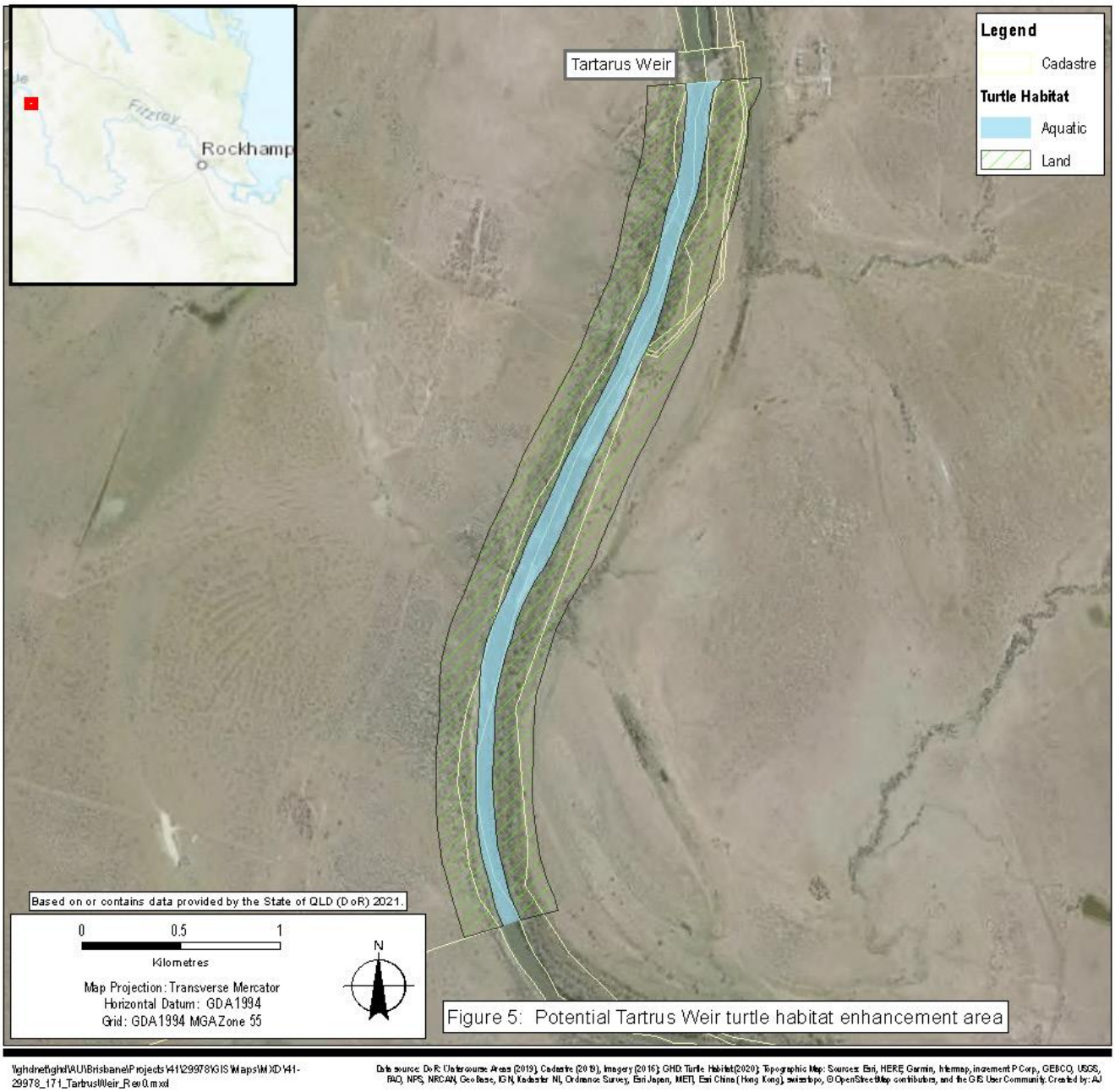
Following the discussion with DES, the habitat quality improvement and enhancement was investigated by firstly assessing potentially suitable areas for improvement. In a similar vein to terrestrial offsets, potentially suitable habitat offset areas were assessed. Potential locations of the proposed habitat enhancement areas were selected based on the following criteria:

- Areas that are currently known or expected to provide suitable turtle habitat, including nesting habitat, following inundation of the project footprint
- Existing barriers known to restrict turtle passage in the lower Fitzroy River catchment
- Located upstream or downstream of the inundation footprint
- Minimises the number of landholders impacted by the enhancement areas
- Suitable access by road and/or boat.

The potential area of aquatic and bank habitat was calculated based on the length and width of the mapped waterway across the defined locations. The area of aquatic habitat was calculated using the Queensland Government watercourse area polygon in ArcGIS. This spatial layer defined the boundary of the watercourse and was used to calculate total aquatic habitat area in hectares within the defined location of the habitat enhancement area. The area of bank enhancement works was calculated by multiplying the length of the waterway within the habitat enhancement area by the nominal width of the riparian area. This analysis identified four potentially suitable locations for the habitat enhancement works based on the above criteria and include:

- Tartrus Weir: The weir is located on the Mackenzie River, approximately 160 km AMTD upstream from Rookwood Weir. Isolated nesting of both turtle species has previously been identified downstream of Tartrus. A potential area for habitat quality enhancement that extends approximately 4 km downstream was identified and includes approximately 50 ha of aquatic and 180 ha of bank habitat (refer to *Figure 5*).
- Downstream of Rookwood Weir: Rookwood Weir is located at 265 km AMTD on the Fitzroy River. A potential location for the habitat enhancement works at Rookwood Weir, extends 13 km downstream of the weir to Lowrie's Bend. This area includes approximately 200 ha of aquatic habitat and 540 ha of bank habitat.
- Redbank and Glenroy Crossings: Both crossings are located downstream of Rookwood Weir, approximately 80 km AMTD and 70 km AMTD on the Fitzroy River, respectively. The crossings are located upstream of the existing Eden Bann Weir impoundment. The potential location for the habitat enhancement works at Redbank and Glenroy Crossings includes approximately 160 ha of aquatic habitat and 300 ha of bank habitat.
- Foleyvale Crossing: Foleyvale Crossing is located upstream approximately from Rookwood Weir at approximately 60 km AMTD from Rookwood Weir and is immediately adjacent to the Foleyvale and Stoney Creek properties that are the preferred areas for the terrestrial offsets as outlined in *Section 5.4*. The proposed location for the habitat enhancement works at Foleyvale Crossing extends upstream and downstream of the existing crossing and includes approximately 140 ha of aquatic habitat and approximately 630 ha of bank habitat.

Figure 5: Potential Tartrus Weir turtle habitat enhancement area



5.5.2 Turtle habitat enhancement site location – Foleyvale Crossing

Of these four potential options for habitat quality enhancement, Foleyvale Crossing is the preferred (refer to *Figure 6*). Potentially suitable nesting banks have been recorded throughout this region during the Rookwood Weir Turtle Movement Study (GHD, 2019). Located at the upper extent of the Rookwood Weir inundation, this area is expected to provide suitable aquatic and nesting habitat for the two turtle species following inundation of the project footprint.

Previous studies have shown where suitable habitat conditions exist, the Fitzroy River turtle and white-throated snapping turtle will inhabit and nest within the upper reaches of impoundments. (Limpus et al., 2011a; 2011b; Hollier, 2010). Specifically, important habitat areas supporting aggregated turtle nesting of one or both of these species has been recorded in the upper reach of the impoundments at the Fitzroy River Barrage (Limpus et al., 2011a), Tartrus Weir (Limpus et al., 2011b) and Ben Andersen Barrage (Hollier, 2010). The suitability of impoundments for turtle foraging, sheltering, breeding, and nesting is primarily dependent on the habitat characteristics of the area, fluctuations in water levels and extent of habitat degradation. Recent investigations at Paradise Dam indicate that ten years post construction of the dam, habitat conditions within the upper reaches of the impoundment do not support nesting of the white-throated snapping turtle, despite potential nesting habitat being present in the area (Dr Limpus pers. comm.). These observations indicate that the enhancement of riverine and bank habitat conditions within and above the upper reaches of impoundments can directly impact the suitability of these areas to support both the Fitzroy River turtle and white-throated snapping turtle.

Further, suitable nesting habitat for the Fitzroy River turtle and white-throated snapping turtle is expected to persist in the upper reaches of the Rookwood impoundment with potential nesting habitat remaining above the full supply level. The existence of aggregated nesting in the upper reaches of the Fitzroy River Barrage and the Tartrus Weir impoundment, demonstrates that these species have the ability to colonise new habitat where suitable conditions occur (Limpus et al., 2011a; b).

Habitat enhancement activities at Foleyvale Crossing will remediate areas of habitat degradation and create suitable habitat conditions for the two turtle species within and above the upper reaches of the Rookwood Weir impoundment. Baseline turtle nesting suitability surveys indicate that existing habitat conditions within the Foleyvale Crossing habitat enhancement area are impacted by high levels of degradation including riparian vegetation clearing, erosion and sedimentation, disturbance from people, vehicles and cattle, and high density of weed and pest (feral dogs and pigs) species (GHD, 2019, GHD, 2020a, 2020b). Pest and weed management will be a key focus as the area currently has significant densities of feral pigs and the Foleyvale and Stoney Creek properties have several significant weed species that also extend to the riparian zone.

The protection and restoration of in-stream, riparian and nesting habitat are identified as priority actions within the Approved Conservation Advice for *Rheodytes leukops* (Fitzroy Tortoise) (Commonwealth of Australia, 2008); National Recovery Plan for the White-Throated Snapping Turtle (*Elseya albagula*) (Commonwealth of Australia 2017) and The Biology and Management Strategies for Freshwater Turtles (Limpus et al. 2011b). Loss of in-stream and bank vegetation, trampling by grazing stock, degradation by pest and weeds and decreased water

quality have all been identified as major threats to freshwater turtle species. To counteract these issues, a successful habitat enhancement program has been undertaken previously for the white-throated snapping turtle which was undertaken within the Burnett River in 2016 and 2017 as part of the 20 Million Trees Programme (BCCA, 2018).

Locating habitat offsets at Foleyvale has the added benefit of being able to be integrated with the terrestrial offset program. This would provide a greater conservation gain to both turtle species as the habitat offset area will benefit from the broader management actions that would be undertaken on the Foleyvale and Stoney Creek properties and the improvement of water quality. Locating this offset at Foleyvale Crossing would also provide enhanced cost-effective management solutions by combining management actions for a number of MNES and would also provide positive social outcomes for the local Aboriginal people through expansion of the WASC Ranger program to include training relevant to riparian habitat enhancement, monitoring, and turtle nest identification.

Ongoing consultation is being undertaken with a range of stakeholders including DES, DRDMW, GHD, FBA, WASC, WPC and suitably qualified experts with experience in turtle habitat remediation and enhancement (WYLD Projects) to further investigate this offset option and to determine the range and scale of management actions to be undertaken. In addition, consultation is also being undertaken with Rockhampton Regional Council (**RRC**) and FBA to:

1) identify additional potentially suitable areas that could also be investigated for habitat enhancement
2) to potentially link in with their proposed and/or planned program of works to provide a better overall conservation outcome
3) to potentially utilise their expertise in undertaking the anticipated remediation and management actions required. For example, RRC, FBA and WYLD have undertaken a range of successful riparian habitat enhancement programs in the past and we would look to build on that knowledge to maximise the success of any habitat enhancement program.

The habitat enhancement program is proposed to occur at adjacent to the Foleyvale crossing as shown on *Figure 6*. This area has been identified as comprising 140 ha of aquatic area and 630 ha of streambank/riparian. Some of this habitat is currently being utilised as nesting habitat (refer to *Appendix C*). However, significant areas have the potential to become suitable nesting habitat and potential foraging habitat to include nesting habitat, particularly when this location borders the upper reaches of the impoundment. As part of the ongoing turtle movement study, GHD have undertaken habitat suitability and nest surveys within this area and have identified this area as potentially suitable for both habitat and nest offsets (refer to *Appendix C*). Further, DES have been consulted on the potential of the Foleyvale area to provide suitable offsets and are supportive of such a measure.

In order to achieve a conservation outcome and to enhance and improve habitat quality, a range of specific and targeted management actions will be required in a similar vein to that required for terrestrial offset sites. A range of potential management actions are outlined below and will be further developed in consultation with key stakeholders and subject matter experts:

- Pest animal management, including but not limited to pigs and foxes, which are known predators of turtle eggs. Pigs are also known to heavily degrade habitats.
- Weed management to allow accessibility to breeding areas
- Riparian revegetation and vegetation management
- Riparian zone and streambank stabilisation
- Installation of fencing to exclude access by domestic stock and installation of strategic off stream stock watering points to reduce the need for stock to access the river
- Install suitable in-river habitat structures such as logs to provide refuge and foraging habitat. If installed strategically, such structures could withstand flooding events
- Engage the adjacent landholders and the traditional owners in the on-going program implementation and management. WYLD Projects have already commenced training programs for local Indigenous groups and this would continue with this program.
- Monitor the effectiveness of the program and implement corrective actions in accordance with the requirements of the future management plan.

Progressing with a habitat quality enhancement program would ultimately link in with the nest protection program outlined in *Section 5.6* below. The overarching conservation outcome would be to enhance habitat quality to:

1) allow densities of local turtle populations to increase
2) turtle nesting opportunities to increase
3) protect any nests that have been laid.

DES have reiterated that the single largest threat to these turtle populations is predation. Therefore, and as previously discussed with the DAWE during the preparation of this strategy, a viable option for the best conservation outcome for the two turtle species could be a systematic and targeted predator control program that allows turtles access to nesting areas that are predator-free, or as predator-free as possible. This could potentially be coupled with exclusion fencing to inhibit cattle from trampling nests.

As per Condition 5 of the EPBC approval, offsets for impacts to turtle habitat offsets can also be delivered via a financial offset. This delivery mechanism has been discussed with DAWE and an expanded pest animal and weed control program will be initiated and conducted. The area to be concentrated on will be centred on the Fitzroy River from the large sandbanks at Hanrahan's Crossing upstream to Tartarus Weir. Participation in the program will be voluntary and targeted at the landholders either side of the river within the target area.

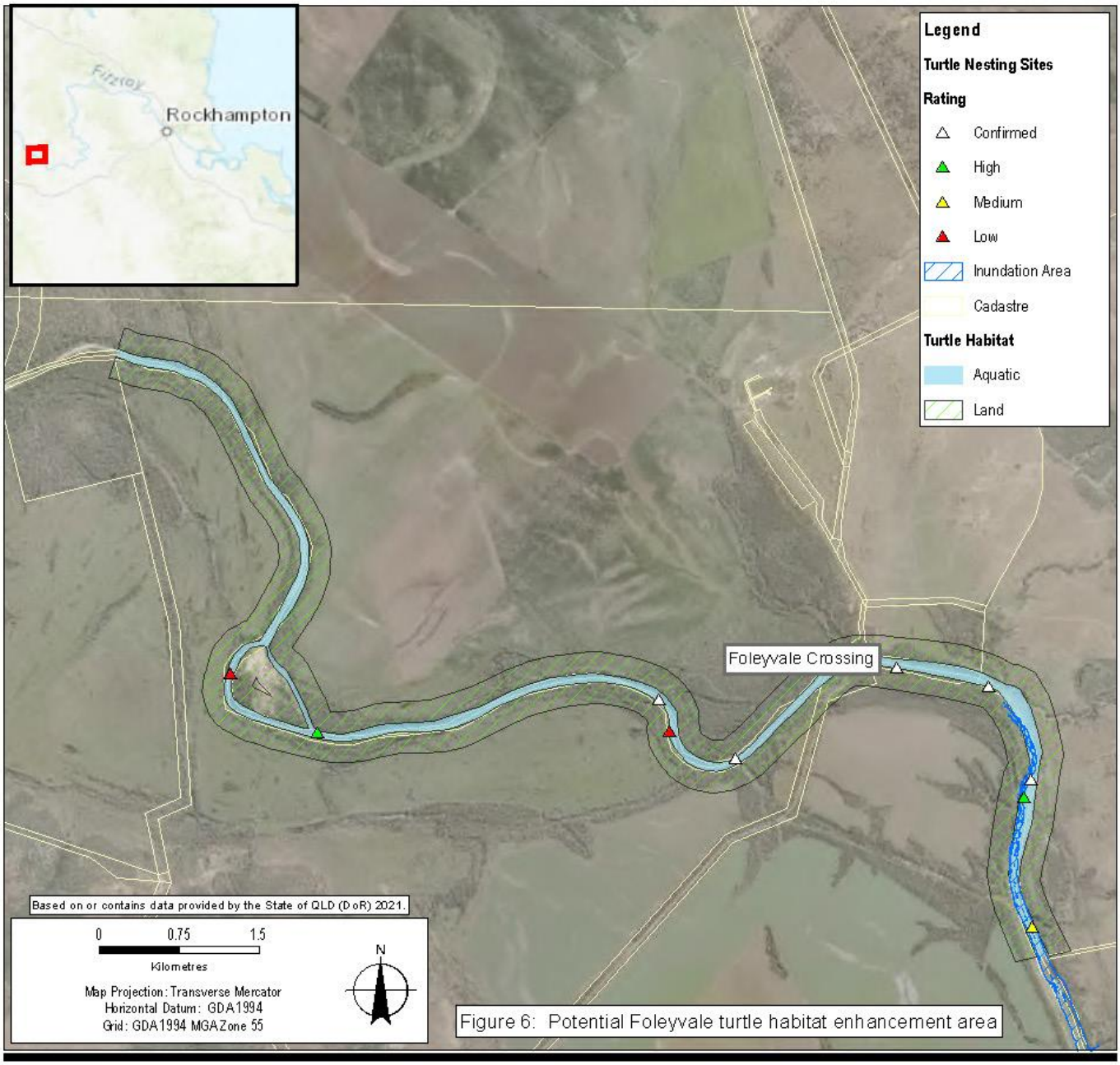
The program will utilise the balance of funds that were calculated for the Financial Offset. This is estimated as follows:

- Financial Settlement is $9,400,000
- Minus turtle programs already committed of $5,100,000
- $4.3M for the expanded pest animal control program (over a 20-year period).

The implementation of the expanded pest animal control program will be related to triggers of pig behaviour which is usually triggered by a rain event and the subsequent breeding cycle.

The final triggers and corrective actions will be developed by Sunwater and DAWE and detailed within the Offset Area Management Plan.

Figure 6: Potential Foleyvale turtle habitat enhancement area



5.6 Strategy for turtle nest offsets

The Project EIS and AEIS identified that construction and operation of the Project has the potential to impact the Fitzroy River turtle and white-throated snapping turtle. The avoidance and mitigation of potential impacts to these species resulting from the Project will be managed through implementation of a Construction Phase Turtle Species Management Program (**SMP**) and Operational Phase Turtle SMP (both required to address EPBC Condition 6: Construction Phase SMP has been approved). Unavoidable impacts to the Fitzroy River turtle and white-throated snapping turtle are expected to remain in relation to operational activities.

Operation of the Project will have residual impacts on the Fitzroy River turtle and white-throated snapping turtle as a result of nest inundation. Confirmed and potential turtle nest habitat within the impoundment area may be inundated when inflows occur and the storage level within the impoundment increases between the period of turtle nesting and hatching. This will result in the flooding of turtle nests. Inundation of turtle nests may also occur when water releases or spilling events result in an increase in water level downstream of Rookwood Weir. Conservatively, the Project is expected to impact up to 80% of nests within the inundation area with an approximate area of 2.0ha of confirmed and potential nesting habitat expected to be inundated. The actual impact will be determined during ongoing turtle nesting surveys that will continue throughout 2021 and 2022.

Suitable nesting habitat for the Fitzroy River turtle and white-throated snapping turtle is expected to persist in the upper reaches of the impoundment with potential nesting habitat remaining above the full supply level. Suitable nesting habitat is also expected to be created in flood deposition areas over time. The existence of aggregated nesting in the upper reaches of the Fitzroy River Barrage and the Tartrus Weir impoundment, demonstrates that the species has the ability to colonise new habitat where suitable conditions occur (Limpus et al. 2011a; b). The Fitzroy River turtle and white-throated snapping turtle have also demonstrated some adaptability to fluctuations in nesting habitat conditions following natural events such as flooding, or degradation from weed and pest species (Dr Col Limpus pers comm.). These behaviours indicate that the Fitzroy River turtle and white-throated snapping turtle are expected to continue nesting within, upstream and downstream of Rookwood Weir during operations, where suitable habitat occurs.

The biggest threat to the survival of the Fitzroy River turtle and white-throated snapping turtle is the lack of recruitment into the population (Commonwealth of Australia 2008; Limpus et al. 2011b; Commonwealth of Australia 2017). Predation of nests by feral animals, goannas, and water rats, plus trampling of nests by cattle results in extremely poor survival of egg clutches (close to 100% of clutches predated each season). The bias in favour of adult turtles within the Fitzroy Basin catchment indicates that low recruitment of hatchlings has been occurring over many decades (Commonwealth of Australia, 2008; Limpus et al., 2011b; Commonwealth of Australia, 2017).

Current recruitment rates are not considered adequate to sustain populations within the catchment (Limpus et al. 2011b). As such, the protected matters attribute proposed to be protected and managed is hatching success of Fitzroy River turtle and white-throated snapping turtle egg clutches. The protection and management of nests will improve hatching success and thus birth rate, will target Project-specific impacts, as well as address the key processes

currently threatening the survival of these species throughout the catchment. These actions will reduce nest predation, increase population recruitment, and promote the recovery of the species.

Nest protection programs implemented in the Fitzroy River catchment under guidance from DES and in other river systems throughout Australia (Connell and Wedlock, 2006; Connell, 2011; Connell, 2012; Stockfeld and Kleinert, 2013), are shown to immediately improve turtle nesting success and recruitment of hatchlings within a single breeding season. For example, in 2007 the Greening Australia team protected over 110 nests with an average of 15 eggs per nest. The sites were searched every morning at dawn for evidence of new nests between mid-September and the end of November (Hale, 2009). A protective mesh was placed over nests found to keep predators from gaining access but still allowing the turtles to hatch and make their way to the water. It is estimated that over 1,700 hatchlings reached the Fitzroy River (Hale, 2009). This success was repeated in 2008 (Hale, 2009). Similar levels of success have been recorded in the Burnett River catchment with current nest protection programs (B. Crosbie *pers. comm.*). It is therefore conservatively estimated that the time required for the proposed offset to achieve ecological benefits is five years.

5.6.1 Turtle nest protection site locations

To achieve the offset outcomes, a Fitzroy River turtle and white-throated snapping turtle nest protection program will be implemented as a direct offset for residual impacts to nest inundation. The offset will be in accordance with Appendix G of the AEIS: Offset Proposal for the Fitzroy River Turtle and White-throated Snapping Turtle offset management plan.

Sunwater has and is continuing to consult with DES and other turtle experts to confirm the specific actions to be implemented in the nest protection program. This is to achieve the conservation outcome of a reduction in nest predation and increased recruitment of hatchlings into the population. The actions being considered align with priority actions within the Approved Conservation Advice for *Rheodytes leukops* (Fitzroy Tortoise) (Commonwealth of Australia 2008); National Recovery Plan for the White-Throated Snapping Turtle (*Elseya albagula*) (Commonwealth of Australia 2017) and The Biology and Management Strategies for Freshwater Turtles in the Fitzroy Catchment (Limpus et al., 2011b).

Priority areas to be targeted for implementation of the nest protection monitoring program are currently being identified and discussed with DES. Site selection will be based on access requirements, landowner agreement and suitability of sites for nesting (e.g. existing aggregations).

To facilitate the identification of sites suitable for turtle nesting, baseline surveys will be conducted within upstream and downstream of Rookwood Weir. A standardised methodology for the baseline nesting surveys has been prepared and submitted to DES for approval prior to implementation. These baseline surveys will build on turtle nesting suitability surveys conducted within the area in 2019 and 2020 as part of the Rookwood Weir Turtle Movement Study (EPBC Condition 7 (b) and the Queensland Coordinator General's Conditions in Appendix 2 Condition 2). Turtle nesting surveys conducted as part of the Turtle Movement Study monitored the suitability of nesting banks and nesting activity during the nesting and hatching seasons of the Fitzroy River turtle and white-throated snapping turtle in 2019 and 2020 (refer to

Appendix C for a summary of the results and GHD, 2019; GHD, 2020a; 2020b). Surveys were conducted from approximately 15 km downstream of the proposed Rookwood Weir to 15 km upstream and at the proposed Foleyvale offset site shown on *Figure 6* (refer to Appendix C for the nest locations). Overall, confirmed turtle nesting of both species has been recorded within, upstream and downstream of the Rookwood Weir impoundment and at the proposed Foleyvale offset site (refer to *Appendix C*). All confirmed turtle nests recorded had been predated with a high level of bank disturbance from predators, weeds, cattle, and vehicles (GHD, 2019; GHD, 2020a; 2020b).

Nesting within the impoundment area as well as at the proposed Foleyvale offset site (shown on *Figure 6*) will be monitored further in 2021 as part of the baseline surveys to describe the existing habitat conditions and level of nesting activity prior to the implementation of the Offset Management Plan (EPBC Condition 5). Monitoring will be undertaken during the peak turtle nesting and hatching periods for both turtle species. Individual monitoring events for nesting activity will follow periods of rainfall. Parameters recorded will include: bank characteristics (bank width, height, slope, substrate, vegetation), levels of disturbance, presence of weeds and pests, nesting activity (number and location of turtle nests or attempted nesting), nest characteristics (distance from water's edge, depth, number of eggs, species), and nesting success (number of successful hatchings).

Methods undertaken to protect the identified turtle nests will largely follow those outlined in Appendix G of the AEIS but will be adapted to reflect current best practice, as outlined in the below dot points, and in consultation with DES. Discussions with DES Threatened Species Unit officers and the Chief Scientific Officer indicated that the physical mechanism of protecting turtle nests is constantly being refined. Although physical predator-proof cages are placed over each nest, the size, shape, and construction material vary. As such, the configuration of the nest cages will be based on further consultation with DES and based on best-practice management.

WYLD Projects (B. Crosbie *pers. comm.*) DES (C and D Limpus *pers. comm*) and Kimberley Robinson are currently undertaking a number of nest protection programs and are currently implementing the following management actions as approved by DES.

- Each nesting season confirm where turtles preferred nesting sites are located and confirm priority nesting sites;
- Install electric fence to protect against predators (e.g. 150m perimeter fence);
- Predator control including culling, baiting, trapping of pigs, foxes, wild dogs, feral cats that are traced to the nesting sites;
- Install nest protection cages within 24 hours of laying the eggs to minimise predation;
- Should evidence of predation occurring become apparent, remove, and store eggs in accordance with DES requirements and approval;
- Monitoring and recording of the hatching success during the season; and
- Monitor and evaluate the success of the program and implement corrective actions as required (these will be included in the yet to be developed management plan).

It was also reiterated by DES that the single largest threat to hatching success and hence, the conservation of turtle populations in general, is predation. Unless significant effort to control and/or eradicate predators has been undertaken within the broader priority nest protection

areas, protecting only a subset of nests will likely have limited benefit. Far greater benefit could be achieved by solely focusing on predator control in the first instance and once acceptable outcomes were achieved, only then progressing to physical protection of individuals nests. Sunwater will continue to consult and work with DES and DAWE to determine the most time and cost-efficient method(s) of protecting turtle nests that achieves the greatest conservation outcome for the Fitzroy River turtle and white-throated snapping turtle.

5.7 Strategy for water quality offsets

Research has indicated that the clearing of native vegetation can result in increased runoff and subsequent pollutant loads including nitrogen, that often cause adverse impacts downstream (Elledge & Thornton, 2017).[22] As outlined in the EIS and AEIS (GHD, 2015) the intent is to retain most of the inundated vegetation within the impounded area and undertake minimal clearing. Therefore, potential impacts on water quality could result from the decaying of vegetation overtime once the weir is commissioned and the impoundment is filled. As the decaying process occurs, nutrients may be released into the system.

There is a potential that approximately 358 tonnes of nitrogen may be released during the first year of filling. However, the actual impact will be assessed by the water quality monitoring program required to address Condition 1 of the EPBC approval (this program is currently being finalised for submission to DAWE). The water quality monitoring will confirm and give validation to the actual impacts as per Condition 1 b) ii) that states: "unless the monitoring required by Condition 1b) i) conclusively determines that the impact is less than predicted".

The preferred approach to offsetting potential impacts to water quality and increases in nitrogen, is to intercept/reduce sediment loads and hence bound nitrogen, from entering the waterway through streambank erosion protection and adjacent land management at the terrestrial ecology offset site at Foleyvale and Stoney Creek. However, as outlined below, several other options are also being investigated should this approach fail to yield the required offsets that will ultimately be determined from the Water Quality Monitoring Program (**WQMP**).

The time to ecological benefit for the Great Barrier Reef World Heritage Area and Marine Park, is an important consideration for completing offsets related to water quality impacts. The DAWE recommended a maximum of six years 'time to ecological benefit' or completion of offset outcomes for water quality, as the optimum to reduce impacts on the reef. This six-year period is equivalent to the total estimated duration of the impact (GHD, 2015) and would start when water quality impacts begin from inundation, or at any earlier date that a water quality impact is found from the WQMP.

To allow monitoring to determine the actual water quality impacts from the action while balancing the time to ecological benefit of the offsets, a staged and adaptive management approach is proposed to meeting water quality offset targets, as show in *Table 12* below.

[22] Elledge, A., & Thornton, C. (2017). Effect of changing land use from virgin brigalow (*Acacia harpophylla*) woodland to a crop or pasture system on sediment, nitrogen, and phosphorus in runoff over 25 years in subtropical Australia. *Agriculture, ecosystems & environment*, *239*, 119-131.

Table 12: Staged approach to water quality offsets

Stage 1 Actions 0-2 years from commencement of weir inundation	Water Quality Offset Review and Report Submitted to DAWE 2 years from commencement of weir inundation	Stage 2 Actions To be enacted once Water Quality Offset Review and Report approved by DAWE
Undertake Foleyvale and Stoney Creek water quality offset measures as per Section 5.7	Must use analysis of monitoring results to discuss residual water quality impacts and to calculate gains made towards water quality offsets	Actions must be implemented as per approved Water Quality Offset Review and Report.
Investigation/scope other options for water quality offsets e.g. biodigesters, water weed harvesting, larger streambank stabilisation program	Must assess and project success towards six-year ecological benefit for water quality offsets and measures required to meet offset outcomes in six-year timeframe	
	Must propose appropriate actions for Stage 2 to complete water quality offsets against residual impacts	

Stage 1 will begin as soon as possible or at the latest, following commencement of inundation of the weir. See below for actions to occur during Stage 1.

A Water Quality Offset Review and Report will be drafted by Sunwater and submitted to DAWE two years from commencement of weir inundation. This report will contain analysis of monitoring results for the offset sites and the Water Quality Monitoring Program as per Condition 1 and will include calculation of the amount of sediment and hence, nitrogen saved from offset actions taken to date. Progress towards the 358t nitrogen target should be assessed, and statistically robust data should be used to assess the actual tonnes of nitrogen saved, as measured in the WQMP.

The preferred option for the interception of the Nitrogen is for Sunwater to work with Rockhampton Regional Council to install a biodigester plant a Sewerage Treatment Plant to remove the N from the licensed discharge (being a point source pollutant). The modelling from the commercial provider of the biodigester technology indicates that they can intercept circa 100t N/annum with the biodigester.

With regards sediment, there is no increase in sedimentation due to the construction of the weir. If there was any increase in sedimentation during construction of the weir, there are construction safeguards in place to mitigate this and these mitigating actions were approved at the time of the Waterway Barrier Works being approved. Additionally, on the terrestrial offset site, Sunwater is fencing off 52km of riparian vegetation to prevent cattle from accessing the riparian areas and the bed and banks, thereby reducing impacts, sedimentation and also cattle effluent in the water. Refer to the sediment and attached Nitrogen methodology at *Attachment 2* for the modelled mounts of sediment and attached nitrogen will be intercepted at the terrestrial offset site.

There is no other water quality offset required at this stage, these will be required if the water quality program finds a decrease in water quality. Any increases covered by the Land Management Code of Practice.

Irrigators in Qld require an Environmentally Relevant Activity (ERA) licence, issued by the Department of Environment and Science under the *Environmental Protection Act 1999*, to access the water from Rookwood Weir prior to being able to irrigate. These requirements are addressed in the Land Management Code of Practice.

If it is found during the monitoring undertaken with the WQMP that irrigators cause a decrease in water quality, and it is detected above baseline levels, the irrigators will be non-compliant with the Land Management Code of Practice and will be required to mitigate their impact. This could include the non-compliant irrigator building soil erosion measures, water recycling measures and or other mitigation measures that result in the impact being offset. To better determine which Irrigator is non-compliant, Sunwater is revising the Land Management Code of Practice to include the measures required to provide extra confidence.

Recommendations as to whether further options should be enacted to ensure water quality targets are reached should be made, for enaction in Stage 2. Stage 2 will occur upon approval of the Water Quality Offset Review Report by DAWE.

The measures to reduce sediment from entering the waterways will be undertaken as outlined below. The proposed approach aligns with the Fitzroy Catchment Water Quality Improvement Plan (**WQIP**) and the three major strategies of the FBA, as shown below.

- *Central Queensland Sustainability Strategy: 2030 (**CQSS: 2030**) draws on the best available knowledge so we can work together to protect our natural assets: it's vital for our region's continued balanced growth.*
- *Strategic Plan – key goals including river health and water quality / ecosystems that align with management practices that relate to streambank / gully erosion rehabilitation*
- *WQIP – regional programs that align with Reef 2050 Water Quality Improvement Plan and focus on addressing the key issues across the region for water quality*

Two of the above strategies, the CQSS2030 and WQIP, drive initiatives to deliver improved water quality through a range of practice changes and on-ground actions. Data is collected through the programs within the region and various direct monitoring programs to track changes in the region over time. While sediment is the focus within the Fitzroy the mobilisation of nutrients through erosion processes has been identified and nutrients are directly monitored and reported on.

Sunwater has sought extensive advice from the DES including Dr Paul Lawrence, Executive Director, Science Delivery, the FBA and Dr Roger Shaw, co-chair of the FBA Scientific Panel and chair of the Wet Tropics Scientific Panel, regarding the Great Barrier Reef water quality modelling and water quality offsets. On the advice from Dr Lawrence and Dr Shaw, Sunwater engaged subconsultants from Horizon Soil Science and Engineering (a regular consultant to DES (Science Section)) to develop a concept model for the Project. This was to calculate the amount of sediment, and attached nitrogen, that will be intercepted by returning areas that are currently heavily grazed pasture areas, to a vegetation community as well as implementing a range of management measures aimed at reducing sediment and therefore nutrient loss (refer to *Appendix D*).

The model used methodology agreed to by Dr Paul Lawrence and Dr Roger Shaw (FBA Scientific Panel) (refer to *Appendix D*) and was populated with data from soils reports for the area (to justify parameter selection for possible soils on-site), and a summary of the findings of the Brigalow Research Station water quality data to benchmark the model outcomes. Slope and drainage data for the site was reviewed for model parameterisation. The modelling also integrated the peer reviewed models developed for the Reef Water Quality 2050 plan. The Revised Universal Soil Loss Equation as used in the Paddock to Reef Source Catchments model, was used to estimate soil erosion in areas such as the remnant vegetation and grazing area (Waters et al., 2014). Source model data for the 2017 and 2018 Report Cards (Reef 2050 WQIP, 2019) was provided by the Paddock to Reef modelling team (Darr, *pers. comm*. 2019). The modelling was undertaken using the models that underpin the Reef WQIP.[23] Further, the models used follow a similar process to that outlined in the Gully and Stream Bank Toolbox and the methods used by the FBA Natural Resource Management Group in developing their gully and streambank erosion protection priority list.

The preliminary model identified that from land use changes including the exclusion of cattle from the riverbanks and larger gullies and streambank protection, a sufficient reduction in sediment and attached nitrogen to offset the potential impacts of 400 tonnes of nitrogen could be achieved (refer to *Appendix D*, Tables 2, and Tables 3 (Horizon Soil Science and Engineering Report)). Using a soil nitrogen concentration factor of 0.23% as outlined in *Appendix D*, the required 400t of nitrogen offsets would be realised in 25 years and within the life of the EPBC approval. However, this is based on a high-level desktop assessment using a range of generic inputs and it is expected the site-specific field survey would result in an increased amount of nitrogen that could be reduced from entering the river.

It is recognised that while the concept desktop model currently suggests the time required to deliver the potentially required nitrogen offset is within the EPBC approval timeframe, it is potentially longer than the six-year time frame currently being suggested by DAWE. This also follows discussions with CSIRO (A. Shields *pers. comm.*). The intent of the preliminary model was to determine whether this approach to addressing water quality offsets was feasible and had the support of key subject matters experts and was likely to provide the required offsets.

To refine the modelling further and to confirm the quantum of nitrogen that can be intercepted and hence, the timeframe over which the benefits of the offset will be realised, targeted site-specific soil sampling on the offset site will be undertaken to verify the soil types, slope and current estimated erosion types and rates and also utilise historical aerial imagery to assess long term groundcover. This data will be entered into the model to calculate more site-specific outputs. This baseline data will be a critical input to the water quality monitoring and proposed water quality research project discussed below.

If the site-specific model indicates that the offset is unlikely to be delivered in a timely manner, additional and/or alternate options are being investigated as discussed with DAWE. Consultation is ongoing, with FBA, RRC and others on range of additional options that will

[23] Note that Dan Rattray (Horizon Soil Science and Engineering) who undertook the modelling also authored the HowLeaky modelling in the Great Barrier Reef catchments, Technical Report, Great Barrier Reef Report Card 2019.

continue to be investigated during the Stage 1 actions and included in the Water Quality Offset Review and Report (refer to *Table 12*). Additional options include:

- Point source interception: This involves the retrofitting of advanced technology on licenced point source pollutants to remove those discharges from the system. Sunwater has progressed this research and further discussions are planned with service providers to examine the potential use, feasibility study and the business case for the use of biodigesters as a means to remove nitrogen (and other compounds associated with licenced point source pollutants) from entering waterways (refer to *Appendix B* for an example).
- Additional streambank protection locations: The FBA and RRC are revising their current streambank prioritisation list which includes targeted priority action areas for streambank stabilisation works and an estimate on the amount of sediment and nitrogen that is:
  1) currently entering the waterway; and
  2) would be prevented from entering the waterway following remediation actions on those prioritised sites.

  Further consultation is planned to identify potential locations that could be used additional locations if required for Stage 2.
- Weed harvesting: Discussions with FBA, RRC and DES have highlighted the need to undertake a more sustainable and environmentally friendly means of removing aquatic weeds as management primarily involves spraying. Aquatic weeds can clog waterways, reduce dissolved oxygen, and inhibit some species such as turtles, from accessing breeding areas. In addition, aquatic weeds ultimately wash out to sea where the reaction with saltwater breaks down the plants and releases a range of compounds including nitrogen.

  Previous work by FBA has estimated that for each 1,000 tonnes of aquatic weed that is removed equates to approximately 30 tonnes of nitrogen. Additional consultation is planned to examine the cost/benefit of weed removal as a means to offset impacts to water quality. This process a would also significantly benefit the aquatic ecosystem, including turtles as it is considered that aquatic weeds could be a key threatening process for listed turtle species.

In addition, should the proposed sediment and nitrogen reduction projects be implemented at the Foleyvale and Stoney Creek sites (noting that this is subject to agreement with the Woorabinda Aboriginal Shire Council and Traditional Owners), DES have indicated that the site should be established and utilised as a long-term research and monitoring site. This is proposed for both the recovery of terrestrial habitat and for gathering data to strengthen the existing water quality models. Currently these models are heavily dependent on the Brigalow Catchment Study for long term data inputs. The research would include monitoring and assessment of the impacts of long-term management actions and their input to achieving the various terrestrial and water quality offsets outcomes.

5.7.1 Reef 2050 Plan and net benefit principles

A number of threats to the GBR have been identified and include nutrient runoff and sediment runoff, amongst others (refer to *Appendix E*). The Reef 2050 Plan outlines targets and actions across a range of key areas including but not limited to, biodiversity, ecosystem health and water quality and the targets and actions include amongst other things:

- Reducing sediment, nitrogen and pesticides running into the reef
- Working with land managers to put in place accredited best management farm practices
- Strengthening engagement with Traditional Owners in the management of the reef
- Strengthening protection of natural wetlands and riparian vegetation.

The purpose of the proposed water quality offsets approach is primarily to reduce sediment and therefore nitrogen (that is attached to the clay particles) from entering the waterway from a range of management measures including:

- streambank and gully erosion protection
- exclusion of stock from the riparian area
- the provision of off stream watering points
- riparian vegetation management.

This approach will also involve working with the WPC and traditional owners to assess land management practices and to assist, in consultation with other key stakeholders, implementation of alternate practices that could lead to reduced sediment and nitrogen from entering the waterway. The proposed water quality offset approach is also intended, subject to further consultation with DES, to become a working case study research site and the results from the study could be used to support learning and ongoing improvements that would support an adaptive management approach for actions within the Reef 2050 WQIP. In addition, the intent is to co-locate a range of offsets as outlined above and in doing so, a greater conservation outcome will be achieved that benefits biodiversity and ecosystem health than would be achieved in a piecemeal offset delivery approach.

The FBA and CQU were engaged to prepare the water quality monitoring program and the FBA are engaged to undertake baseline water quality monitoring which started in early 2020. A key driver in working with the FBA, CQU and the Scientific Panel was to engage with key stakeholders and subject matter experts that are at the coal face of implementing the requirements of the Reef 2050 Plan and the objectives therein. The FBA have also suggested that one of their key roles will be assisting users of the impounded water to implement the Land management Code of Practice, which is being developed as a requirement of Condition 2. Implementation of the practice will ensure all water uses are undertaking land management practices in accordance with the requirements of the Reef 2050 Plan and State legislation requirement such as the recent Reef Regulations.

The Net Benefit Policy's objective was to outline actions to reduce pressures and impacts on the Great Barrier Reef, where a net benefit relates to an overall improvement in the condition and/or trend of a Great Barrier Reef value. Through approval of the LFRIP, the Commonwealth authorised impacts to water quality values, provided those impacts are offset. In addressing this

offset requirement, the first priority is achieving a no net loss (i.e. offsets are provided for the full quantum of impacts requiring offsets).

The approach for achieving a net benefit is outlined in the staged approach to water quality offsets (refer to *Section 5.7*).

6. Offsets delivery method

This section provides a summary of the offset delivery methodology and integration for each of the above matters.

6.1 Confirmation of areas of required offsets

The process of confirming the offset area is progressing following field verification of the inundation areas. These surveys assessed the habitat quality of the impact area and the required offset areas are being determined using the EPBC offset calculator.

A detailed ecological assessment of the offset area will be undertaken, assuming commercially viable contractual arrangements can be negotiated between Sunwater and the respective landholders. To this end, Sunwater is in detailed discussions with WASC and the WPC in relation to legally securing the sole right to secure the terrestrial and water quality offset areas within Foleyvale and Stoney Creek.

For the terrestrial and water quality offsets, the negotiations are also investigating the potential risks, threats, management actions, and monitoring and reporting requirements. Aquatic offsets are being assessed and discussed with a range of stakeholders including State Government agencies (DES, DAF and DRDWM, RRC, and FBA).

Once this process and commercial terms are established, detailed habitat quality assessments will be undertaken by a suitably qualified ecologist, using methods aligned to both Commonwealth and State survey guidelines to determine the habitat condition and MNES present or have the likelihood of the relevant species utilising the offset site.

6.2 Establishing management requirements and offset completion criteria

Confirmation and securing the offset areas will include developing landholder agreements and additional ground-truthing as required to confirm:

- Location of the final offset area on the property/s
- Agreed management actions required
- Interim targets for improvement, presence, and completion criteria for each MNES.

Responsible parties for managing and monitoring will also be confirmed during the development of the OMP.

6.3 Additional benefits of this offset strategy

The offset has been selected as, in addition to the MNES and MSES that are required for the projects impacts, it has the potential to provide additional environmental, cultural, social, and economic outcomes for the Woorabinda Aboriginal Community.

The Woorabinda Aboriginal Community is one of the most disadvantaged communities in Australia with an unemployment rate of circa 80%. The Rookwood Weir project is providing opportunities for the further development of a Ranger Program that is being discussed with

WASC and several mining companies. This program would look to upskill and employ members of the local community to manage the offset areas and to incorporate traditional land management knowledge into that management. This will not only provide employment opportunities; it could also act as a stepping-stone to managing land for the resources sector in Central Queensland as well as public lands. Additionally, as the community is in Central Queensland, there are efficiencies in management and costs associated with bringing in skilled labour from outside the area.

Sunwater is also in discussions with the DES Science and Knowledge Precinct, via Dr Paul Lawrence, to investigate the opportunity to establish the offset site as a long-term research project into sediment and nutrient reduction, land management, ecological monitoring including vegetation, fauna, turtle nests, pest management, the recovery of ecosystems and habitat as well as real time inputs into the use of remote sensing for vegetation and habitat monitoring. This would involve scientists from the Central Queensland University as well as the DES Science and Knowledge Precinct and would contribute invaluable data to the current models such as Paddock to Reef that are very broad and in need of additional long-term data that is site-specific.

The exposure to these scientists and researchers would hopefully encourage some of the Rangers to seek continuing education and upskilling in these disciplines.

7. Offset management plan and next steps

The development of the Offset Management Plan is well progressed and the tasks and associated proposed timelines are below, noting that the Offset Management Plan will cover all MNES and MSES.

- Turtle nest surveys – commenced in 2019 and are continuing throughout 2021 and 2022.
- Soil surveys and updated modelling for sediment and nutrient interception – late 2021.
- Draft Offset Management Plan to be submitted to DAWE – Q1 2022.
- Finalisation of Offset Management Plan with DAWE – Q2 2022.
- The offset will be legally secured and implementation of the management plan started in June 2023.

7.1 Additional offset area management and protection

Establishing an offset area on the proposed area would add additional protection for biodiversity values from clearing,[24] and provide additional biosecurity management.

In relation to clearing, the offset area is currently not protected by the *Vegetation Management Act 1999* (Qld) (**VM Act**) or the EPBC Act (due to the exemption related to continuing use of the land) from activities such as timber harvesting, the inappropriate use of hot fires or under-sowing of exotic pasture species. Only the remnant vegetation areas are protected from broadscale clearing under the VM Act. Maintaining the existing condition of regulated vegetation and land for habitat values is not addressed under the VM Act.

[24] *Vegetation Management Act 1999* (schedule definitions)

In relation to biosecurity, the *Biosecurity Act 2014* (Qld) (the Biosecurity Act) imposes a 'general biosecurity obligation' (refer to *Table 13*) on all Queenslanders to manage biosecurity risks in an area under their control and that they know about or could reasonably be expected to know about.[25] In practical terms, this means that:

- If you are a livestock owner, you are expected to stay informed about pests and diseases that could affect or be carried by your animals, as well as weeds and pest animals that could be on your property. You are also expected to manage them appropriately.
- If you are a landowner, you are expected to stay informed about the weeds and pest animals (such as wild dogs) that could be on your property. You are also expected to manage them appropriately.

Table 13: Biosecurity Act 2014 *(Qld) obligations*

Category	What is required	Examples
3	Must not distribute, be traded, or released into the environment	Most invasive weeds, pest animals, noxious fish
4	Must not move	Certain weeds, pest animals, noxious fish such as feral pigs, feral deer, rabbits, Hudson pear and jumping cholla cactus,
5	Must not possess or keep	Rabbits, carp, bunny ears cactus
6	Must not feed (except if undertaking a control program)	Feral deer, wild dogs, rabbits, foxes, noxious fish (tilapia, gambusia)

The management actions that will be contained within the OMP are additional to these general obligations, in that control is required once thresholds are met which initiates the respective controlling actions. For example, there will be a requirement to control feral pigs if numbers in excess of 12 are observed in any one property inspection; this is above and beyond the requirements of the Biosecurity Act as is the reduction of weed species to 10% of the offset area over the life of the management plan.

The Isaacs Regional Council identifies the offset area as Rural in their planning scheme and offers no protection from the current ongoing land use. The council does not have a Biosecurity Plan and only refers to the Biosecurity Act.

8. Legally securing offsets

Condition 4 (c) (i) of the EPBC Act approval requires the proposed legal mechanism for securing the offset(s) to be described. An environmental offset is required to be legally secured on title to ensure the MNES values within the approved offset area are protected from future development, and that this requirement is binding on current and future landowners. The EPBC Act EOP requires that an offset should be legally secured for at least the duration of the

[25] See https://www.daf.qld.gov.au/business-priorities/biosecurity/policy-legislation-regulation/biosecurity-act-2014/general-biosecurity-obligation

impact. The best securement mechanisms are permanent and difficult to alter and should be able to be monitored and enforced.

Relevant offsets for Rookwood Weir will:

- be legally secured in accordance with options available under Queensland legislation as set out in the Queensland Environmental Offsets Policy (version 1.6) dated June 2018
- meet EPBC Offset Policy requirements including:
    - legally secured for conservation purposes for at least the duration of the impact
    - actively monitored for compliance, with covenant requirements enforced
    - secure to change in legal status, i.e. any change should require Ministerial or statutory approval.

  Offsets on Indigenous-owned lands will have customary law protection with Traditional Owners holding a non-transferable interest in the land with a commitment to its long-term protective management as well as a commitment from Traditional Owners to accept and manage the offset.

Potential relevant options for securing the offset lands include:

- An environmental offset protection area under section 30 of the *Environmental Offsets Act 2014*
- An area declared as an area of high nature conservation value under section 19F of the VM Act, where it is secured for the purposes of an offset
- Declaration as a nature refuge under section 46 of the *Nature Conservation Act 1992* (**NC Act**) where it is secured for the purposes of an offset
- Declaration as a protected area under section 29(1) of the NC Act, where it is secured for the purposes of an offset
- Declaration as a special wildlife reserve under section 43D of the NC Act, where it is secured for the purposes of an offset
- Secured as a statutory covenant for environmental purposes under the *Land Act 1994* or *Land Title Act 1994*.

8.1 Terrestrial and water quality offsets

Sunwater will secure the terrestrial offsets for the Rookwood Weir through a declaration of the offset as an area of 'high nature conservation value' under the VM Act. This is achieved through submission of a declared area request from the landowner. This process provides a simplified and streamlined procedure for landholders seeking to voluntarily protect native vegetation on their land. The declaration provides a binding mechanism linked to the title, with direct reference to the approved management plan that includes information on the area protected as the offset and requirements that must be met.

For the proposed water quality offsets, if the detailed field investigations of the terrestrial offset site determine nitrogen and water quality offset can occur within the site and offsets can be achieved over a suitable timeframe, it is envisaged that legal security could also come under the VDec where management actions occur within the cadastre boundary of the properties. For streambank stabilisation works that occur within Queensland unallocated state land (USL), legal security can be via agreements between Sunwater (as a Queensland Government Owned

Corporation) and the administering agency such as the Department of Resources. Sunwater has consulted with Queensland Government agencies and further discussion is planned in Q2 and Q3 2021.

It is envisaged that legal security would occur within 12 months of the impact occurring that requires offsetting, and this timeframe is consistent with other projects requiring legal security of offsets areas for impacts to MNES.

8.2 Turtle habitat and nest protection

It is Sunwater's intent and preference for the Fitzroy River habitat enhancement and turtle nest protection areas to be adjacent to, and co-located with, the terrestrial offsets along the riverbank. Where these areas are located within the cadastre boundaries, it is envisaged the legally binding mechanism will be via a declaration request.

Where habitat enhancement and nest protection areas occur within USL, a declaration request is not possible and alternate arrangements or legally binding mechanisms will be required. While legal security of offset sites is preferred, it is recognised by Queensland Government agencies (DAF, DoR, and DES) that there may be circumstances where the best conservation outcome can be achieved at a direct offset site which may not be able to be practically legally secured. This is particularly pertinent for offsets for impacts to aquatic or semi-aquatic species (turtles, for example) where the offset involves waterways and USL and the offset area of waterway habitat is subject to use by the general public or the immediately adjacent landowners. In such circumstances, DAF and DES have provided guidance that in lieu of legal security, several guiding principles should be considered to support why not achieving legal security will not hinder the ability of the offset area to achieve a conservation outcome. The main guiding principles are:

- Is there another form of protection afforded to the offset that emulates legal security (e.g. a development approval)?
- Is the risk of future impact by other prescribed activities low?
- Is achieving legal security over the site demonstrably impractical?
- Is the chosen offset site providing a superior conservation outcome to alternatives that could potentially be practically legally secured?

Sunwater has examined this situation with DAF in regard to providing offsets for impacts to MSES (fish habitat) and approval of the State Offset Delivery Plan. Further detailed consultation is planned with DAF, DoR, and DES in relation to fish and turtle offsets and the most appropriate mechanism or agreement to secure the offset area.

Approval holder declaration

I declare that:

1. To the best of my knowledge, all the information contained in, or accompanying the *Management Plan/Strategy Title, revision number and date* is complete, current, and correct.

2. I am duly authorised to sign this declaration on behalf of the approval holder.

3. I am aware that:

a. Section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading.

b. Section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth) where the person knows the information or document is false or misleading.

c. The above offences are punishable on conviction by imprisonment, a fine or both.

Signed

_____

Full name (please print)

_____

Organisation (please print)

_____

Date ____/__/__

Appendix A: Terrestrial offset area suitability assessment report

Appendix B: Biodigesters

Anaerobic digestion is not a new technology, but it is new to Australia having been standardised and refined through prolific use and development by industry in Europe (particularly Germany) and Britain over the last 15 years.

This process, subject to commercial negotiations could intercept 100% of the licenced discharge from a municipal wastewater treatment plant that is discharging into the catchment thus contributing to the outcomes required of the Project to lower nitrogen in the Fitzroy catchment that subsequently flows into the Great Barrier Reef catchment. Additionally, if a number of other licenced commercial dischargers were involved in the process, then additional N and P would be intercepted.

Biodigesters use a process called anaerobic digestion to convert commercial and industrial waste into onsite electricity, heat, and clean methane gas. The organic waste streams that feed the plants range from supermarket, kitchen, dairy, vegetable, abattoir and fishery waste to grain and legume surplus, to ordinary garden waste. The cleaned methane fraction can be stored, pressurised, and used to generate onsite power and heat, with surplus fed into the electricity grid, or used to power equipment and vehicles.

The digestate by-product of the process can be readily and safely used as a commercial organic compost or fertiliser.

A regional bioHub (see Utilitas example in link below) will typically be co-located with an industrial or municipal wastewater treatment plant "anchor tenant" (for example Emerald STP, Rockhampton etc.). Sludge from the treatment plant is blended with other co-substrates such as food processing waste, abattoir waste and digested in European style tank based anaerobic digesters. The electricity and heat produced (in excess of the parasitic demand for the bioHub) is exported to neighbouring municipal and industrial facilities. The digestate produced will be liquid and solids which are separated, with solids sold locally as a soil conditioner and the liquid phase processed through an Evaled Evaporator to produce a concentrate liquid nutrient product that can displace chemically derived fertiliser products. The remaining condensate is recycled back to the digester in-feed to dilute higher solids organic waste to make them optimal for digestion and/or made available for irrigation. In more urban environments where limited irrigation opportunities exit it could be used as recycled water or disposed of to sewer at minimal cost (low nutrient).

This type of project contributes to the Queensland Government Bio futures Acceleration Program:

https://www.statedevelopment.qld.gov.au/industry/priority-industries/biofutures

Example:

A new $18 million biorefinery project in Bundaberg by Queensland-based bioHub developer, Utilitas, could generate more than 30 local jobs and position the region as an emerging biotechnology location. The project, which will receive support from the BAP, is seeking to convert organic trade and agricultural waste into green electricity and biocrude. Over the longer term, the biorefinery could produce biofuels and value-adding bioproducts, including bioplastics

http://utilitas.com.au/news/bundaberg-biohub/

Appendix C: Turtle nest survey and offset area summary report

Appendix D: Water quality offset concept modelling report

Appendix E: Threats to the Reef's values

Appendix D: Threats to the Reef's values

The Great Barrier Reef Outlook Report 2014 assessed the risk of 41 current and potential threats to the Reef's ecosystem and heritage values. The close connection between the Reef's ecosystem and heritage values means that the projected risk is almost the same for both assessments. Ten threats present a very high risk to the Reef's ecosystem and heritage values and a further eight present a high risk. These are grouped into four influencing factors— climate change, land use change, land-based run-off and direct use. Threats assessed as very high risk are mainly influenced by external factors, are expected to have an effect over a broad scale and are mostly already having an effect.

Risk

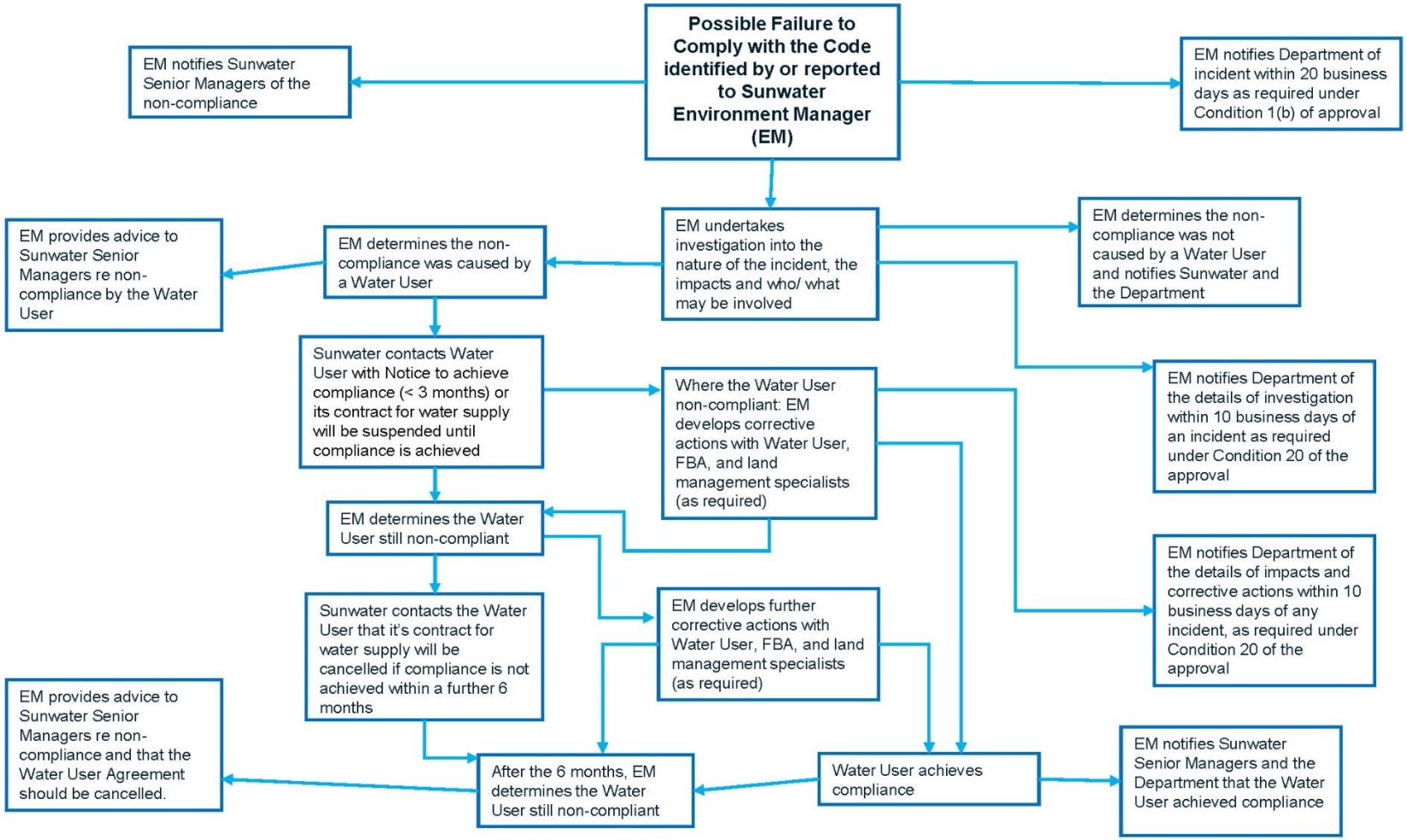
- Low
- Medium
- High
- Very high

Timing

- ◆ Now
- 10+ More than 10 years

	Threat	Risk		Influencing factors				
		Ecosystem	Heritage values	Timing	Climate change	Coastal development	Land-based run-off	Direct use
Region-wide	Altered weather patterns			◆	●			
	Sea temperature increase			◆	●			
	Ocean acidification			10+	●			
	Sea level rise			10+	●			
	Modifying coastal habitats			◆		●		
	Nutrient run-off			◆			●	
	Sediment run-off			◆			●	
	Outbreak of crown-of-thorns starfish			◆			●	
	Illegal fishing and poaching			◆				●
	Incidental catch of species of conservation concern			◆				●
	Barriers to flow			◆		●		
	Marine debris			◆			●	●
	Incompatible uses			◆				●
	Discarded catch			◆				●
	Extraction of predators			◆				●
	Extraction of particle feeders			◆				●
	Altered ocean currents			10+	●			
Local or regional	Pesticide run-off			◆			●	
	Disposal of dredge material			◆		●		●
	Extraction from spawning aggregations			◆				●
	Outbreak of disease			◆	Cumulative effect of many factors			
	Outbreak of other species			◆	Cumulative effect of many factors			
	Terrestrial discharge			◆			●	
	Acid sulphate soils			◆		●	●	
	Artificial light			◆		●		●
	Damage to reef structure			◆				●
	Damage to seafloor			◆				●
	Dredging			◆		●		●
	Exotic species			◆			●	●
	Extraction of herbivores			◆				●
	Grounding large vessel			◆				●
	Illegal activities—other			◆				●
	Noise pollution			◆		●		●
	Spill—large chemical			◆				●
	Spill—large oil			◆				●
	Vessel strike			◆				●
	Vessel waste discharge			◆				●
	Wildlife disturbance			◆				●
	Grounding small vessel			◆				●
	Spill—small			◆				●
	Atmospheric pollution			◆		●		●

Attachment 1: Flowchart of the incident response procedure from the Land management code of practice irrigation water from Rookwood Weir



Attachment 2: Nitrogen modelling

2.1 Impact modelling[26]

The potential rate at which the nitrates (N) and phosphates (P) will break down within the impoundment areas during the Project's operation was determined by calculating the above ground vegetation biomass, and the amount of N and P contained within that biomass, using the Full Carbon Accounting Model (FullCAM) (Richards and Evans 2000).

The program identifies a number of parameters, including: soil data; regional soils list; maximum above ground forest biomass; forest productivity index (annual rate); average air temperature; rainfall; open-pan evaporation; forest topsoil moisture deficit; and tree species groups for Queensland.

Running the FullCAM program provided an output which shows the total dry mass of above ground biomass per hectare. Below ground biomass was calculated using the National Carbon Accounting System (Australian Greenhouse Office, 2002). The proportion of above ground biomass for coarse and fine root masses, as well as stems, bark, branches, and leaves were identified. A range of literature was used to derive an approximate proportion of nutrient to dry mass for acacia woodland and eucalypt woodland (1.02 per cent nitrogen component of dry mass per hectare). A decay coefficient of 0.62 yr -1 was adopted. The calculations for the phosphorus component also adopt literature figures for the approximate proportions of nutrient to dry mass for acacia woodland and eucalypt woodland (0.18 per cent phosphorous component of dry mass per hectare). A decay coefficient of 0.51 yr -1 was adopted.
The results show that that more than half the available TN and TP is liberated in the first year of impoundment and will reduce significantly in each subsequent year for a period of approximately six years.[27]

This methodology was repeated in June 2022 after the preclearance vegetation surveys of the impoundment area were undertaken. The results of this recalculation using filed validated data and the revised weir height of 46.2m is at *Attachment 1*.

Rookwood 46.2m - Field Verified REs 2021 - without non-rem							
Total Biomass/ha	**Total Ha**	**Total biomass**	**Total**	**Biomass total ton/ha**	**N ton total**	**Decay coefficient (e -0.62x1)**	**Year 1 decay**
143.05	53.87	7706.37	90.12	103467.43	664.88	0.54	357.67
143.05	1.09	156.46	90.12				
143.05	5.65	807.95	90.12				
143.05	181.30	25934.37	90.12				
143.05	183.91	26307.32	90.12				
143.05	6.54	935.05	90.12				
143.05	290.95	41619.91	90.12				

[26] EIS, Volume 1, Chapter 11, Section 11.1.4.3
[27] EIS, Volume 1, Chapter 11, Section 11.3.2.1

2.2 Offset modelling

Stage 1: Management improvements at Foleyvale and Stoney Creek to reduce nitrogen

Earthtrade engaged Horizon Soil Science and Engineering (Horizon) to assess the reduction in total nitrogen loss that could be achieved through improved management of the Foleyvale property and the downstream neighbouring property Stoney Creek on the Mackenzie River. The table below summarises the estimated reductions in suspended sediment and particulate nitrogen using assumptions outlined in the Nitrogen Offset Management Plan (Earthtrade, 2022). The 15.9 t/yr reduction in total particulate nitrogen is an average annual value.

Table 1: Estimated reduction of suspended sediment and particulate nitrogen under "A" class management

Site	Area or distance	Suspended sediment reduction rate	Total suspended sediment	Total particulate nitrogen
Foleyvale				
Assessment Area 1 Remnant and regrowth	2,800 ha	0.01 t/ha/yr	25.00 t/yr	0.06 t/yr
Gully erosion	2,800 ha	0.05 t/ha/yr	140.00 t/yr	0.35 t/yr
Streambank	22 km	225.00 t/km/yr	4,950.00 t/yr	11.4 t/yr
			Sub-total for Foleyvale	11.81 t/yr
Stoney Creek				
Assessment Area 3 Remnant and regrowth	290 ha	0.03 t/ha/yr	7.40 t/yr	0.02 t/yr
Gully erosion	5,290 ha	0.05 t/ha/yr	265.00 t/yr	0.61 t/yr
Streambank	6 km	170.00 t/km/yr	1,020.00 t/yr	2.35 t/yr
			Sub-total for Stoney Creek	2.98 t/yr
			Total:	**14.79 t/yr**
			Total over 5 years:	**73.95 t**

Stage 2: Nitrogen offset potential from point source interception at STPs in the Fitzroy River catchment

This option looks to capture nitrogen by intercepting effluent to produce energy and fertiliser by collocating a biodigester with an existing Sewerage Treatment Plant (STP) and intercepting the waste that is generated and therefore the licensed discharge into the Fitzroy River system. The preferred option for the interception of the nitrogen is for Sunwater to work with Rockhampton City Council to install a biodigester at a sewage treatment plant to remove the nitrogen from

the licensed discharge (being a point source pollutant). The modelling from Utilitas, the commercial provider of the biodigester technology known as a BioHub, indicates that with the biodigester they can intercept circa 100 tonnes of nitrogen per year. The table below indicates the options being explored by Sunwater

Table 2: Nitrogen offset potential from STPs in the Fitzroy River catchment

Wastewater treatment plant	Approx. population	Sludge generation, t/y (wet)	N interception, t/y	N interception - 5 years total, t/y
North Rockhampton Sewage Treatment Plant	45,000	10,266	41.1	**205.31**
South Rockhampton Sewage Treatment Plant	25,000	5,703	22.8	**114.06**
Central Highlands Regional Council				**137.31**
Emerald (Black Gully)	19,000	4,334	17.3	86.7
Blackwater	8,865	2,022	8.1	40.4
Capella	1,100	251	1.0	5.0
Rolleston	260	59	0.2	1.2
Springsure	870	198	0.8	4.0
Banana Shire Council				**38.78**
Biloela	7,000	1,597	6.4	31.9
Theodore	800	183	0.7	3.7
Taroom	700	160	0.6	3.2
			Total	**495.46**

Attachment 3: Offset assessment guide output for red goshawk

Nesting habitat

Offsets Assessment Guide

For use in determining offsets under the Environment Protection and Biodiversity Conservation Act 1999
2 October 2012

Matter of National Environmental Significance	
Name	Red Goshawk
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definition	0.2%

Impact calculator

Ecological communities

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Information source
Area of community	No		Area *(Hectares)*		
			Quality *(Scale 0-10)*		
		Total quantum of impact *(Adjusted Hectares)*			

Threatened species habitat

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Information source
Area of habitat	Yes	RE 11.3.25	Area *(Hectares)*	53.87	OHD Pre-clearance report
			Quality *(Scale 0-10)*	5	
		Total quantum of impact *(Adjusted Hectares)*		26.94	

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Information source
Number of features e.g. Nest hollows, habitat trees	No			
Condition of habitat Change in habitat condition, but no change in extent	No			

Threatened species

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Information source
Birth rate e.g. Change in nest success	No			
Mortality rate e.g Change in number of road kills per year	No			
Number of individuals e.g. Individual plants/animals	No			

Offset calculator

Ecological Communities

Protected matter attributes	Attribute relevant to case?	Total quantum of impact *(Adjusted Hectares)*	Proposed offset	Time Horizon *(Years)*		Start area and quality		Future area and quality without offset *(adjusted hectares)*		Future area and quality with offset *(adjusted hectares)*		Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value *(adjusted hectares)*	Offset Result		Cost *($ total)*	Information source
Area of community	Yes			Risk-related time horizon *(max. 20 years)*		Start area *(hectares)*		Risk of loss without offset *(%)*		Risk of loss with offset *(%)*		0.00		0.00	0.00	Overall net present value	0.00		
				Time until ecological benefit		Start quality *(scale of 0-10)*		Future quality without offset *(scale of 0-10)*		Future quality with offset *(scale of 0-10)*		0.00		0.00	0.00	% of impact offset	0.00%		
								Future area without offset	0.0	Future area with offset	0.0			Minimum [90%] direct offset requirement met?			FALSE		

Threatened species habitat

Protected matter attributes	Attribute relevant to case?	Total quantum of impact *(Adjusted Hectares)*	Proposed offset	Time Horizon *(Years)*		Start area and quality		Future area and quality without offset *(adjusted hectares)*		Future area and quality with offset *(adjusted hectares)*		Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value *(adjusted hectares)*	Offset Result		Cost *($ total)*	Information source
Area of habitat	Yes	26.94	11.3.25, 11.3.4	Risk-related time horizon *(max. 20 years)*	20	Start area *(hectares)*	170	Risk of loss without offset *(%)*	1%	Risk of loss with offset *(%)*	1%	0.00	100%	0.00	0.00	Overall net present value	27.47		
				Time until ecological benefit	20	Start quality *(scale of 0-10)*	5	Future quality without offset *(scale of 0-10)*	5	Future quality with offset *(scale of 0-10)*	7	2.00	85%	1.70	1.63	% of impact offset	101.99%		
								Future area without offset	168.2	Future area with offset	168.2			Minimum [90%] direct offset requirement met?			TRUE		

Protected matter attributes	Attribute relevant to case?	Quantum of impact	Proposed offset	Time horizon *(years)*	Start Value	Future value without offset	Future value with offset	Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value	% of impact offset	Minimum [90%] direct offset requirement met?	Cost *($ total)*	Information source
Number of features e.g. Nest hollows, habitat trees	No							0.00		0.00	0.00	0.00%	FALSE		
Condition of habitat Change in habitat condition, but no change in extent	No							0.00		0.00	0.00	0.00%	FALSE		

Threatened species

Protected matter attributes	Attribute relevant to case?	Quantum of impact	Proposed offset	Time horizon *(years)*	Start Value	Future value without offset	Future value with offset	Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value	% of impact offset	Minimum [90%] direct offset requirement met?	Cost *($ total)*	Information source
Birth rate e.g. Change in nest success	No							0.00		0.00	0.00	0.00%	FALSE		
Mortality rate e.g Change in number of road kills per year	No							0.00		0.00	0.00	0.00%	FALSE		
Number of individuals e.g. Individual plants/animals	No							0.00		0.00	0.00	0.00%	FALSE		

Summary

					Cost ($)		
Protected matter attributes	Quantum of impact	Net present value	% of impact offset	Direct offset adequate?	Direct offset	Other compensatory measures	Total
Birth rate	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Mortality rate	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Number of individuals	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Number of features	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Condition of habitat	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Area of habitat	26.94	27.47	1.02	TRUE	0.00	N/A	0.00
Area of community		0.00	0.00	FALSE	0.00	N/A	0.00
					$0.00	**$0.00**	**$0.00**

Offsets Assessment Guide

For use in determining offsets under the Environment Protection and Biodiversity Conservation Act 1999
2 October 2012

Matter of National Environmental Significance	
Name	Red Goshawk
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definition	0.2%

Impact calculator

Ecological communities

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Information source
Area of community	No		Area *(Hectares)*		
			Quality *(Scale 0-10)*		
		Total quantum of impact *(Adjusted Hectares)*			

Threatened species habitat

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact		Information source
Area of habitat	Yes	RE 11.3.25	Area *(Hectares)*	53.87	OHD Pre-clearance report
			Quality *(Scale 0-10)*	5	
		Total quantum of impact *(Adjusted Hectares)*		26.94	

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Information source
Number of features e.g. Nest hollows, habitat trees	No			
Condition of habitat Change in habitat condition, but no change in extent	No			

Threatened species

Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Information source
Birth rate e.g. Change in nest success	No			
Mortality rate e.g Change in number of road kills per year	No			
Number of individuals e.g. Individual plants/animals	No			

Offset calculator

Ecological Communities

Protected matter attributes	Attribute relevant to case?	Total quantum of impact *(Adjusted Hectares)*	Proposed offset	Time Horizon *(Years)*		Start area and quality		Future area and quality without offset *(adjusted hectares)*		Future area and quality with offset *(adjusted hectares)*		Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value *(adjusted hectares)*	Offset Result		Cost *($ total)*	Information source
Area of community	Yes			Risk-related time horizon *(max. 20 years)*		Start area *(hectares)*		Risk of loss without offset *(%)*		Risk of loss with offset *(%)*		0.00		0.00	0.00	Overall net present value	0.00		
				Time until ecological benefit		Start quality *(scale of 0-10)*		Future quality without offset *(scale of 0-10)*		Future quality with offset *(scale of 0-10)*		0.00		0.00	0.00	% of impact offset	0.00%		
								Future area without offset	0.0	Future area with offset	0.0			Minimum [90%] direct offset requirement met?			FALSE		

Threatened species habitat

Protected matter attributes	Attribute relevant to case?	Total quantum of impact *(Adjusted Hectares)*	Proposed offset	Time Horizon *(Years)*		Start area and quality		Future area and quality without offset *(adjusted hectares)*		Future area and quality with offset *(adjusted hectares)*		Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value *(adjusted hectares)*	Offset Result		Cost *($ total)*	Information source
Area of habitat	Yes	26.94	11.3.3	Risk-related time horizon *(max. 20 years)*	20	Start area *(hectares)*	170	Risk of loss without offset *(%)*	1%	Risk of loss with offset *(%)*	1%	0.00	100%	0.00	0.00	Overall net present value	27.47		
				Time until ecological benefit	20	Start quality *(scale of 0-10)*	5	Future quality without offset *(scale of 0-10)*	5	Future quality with offset *(scale of 0-10)*	7	2.00	85%	1.70	1.63	% of impact offset	101.99%		
								Future area without offset	168.2	Future area with offset	168.2			Minimum [90%] direct offset requirement met?			TRUE		

Protected matter attributes	Attribute relevant to case?	Quantum of impact	Proposed offset	Time horizon *(years)*	Start Value	Future value without offset	Future value with offset	Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value	% of impact offset	Minimum [90%] direct offset requirement met?	Cost *($ total)*	Information source
Number of features e.g. Nest hollows, habitat trees	No							0.00		0.00	0.00	0.00%	FALSE		
Condition of habitat Change in habitat condition, but no change in extent	No							0.00		0.00	0.00	0.00%	FALSE		

Threatened species

Protected matter attributes	Attribute relevant to case?	Quantum of impact	Proposed offset	Time horizon *(years)*	Start Value	Future value without offset	Future value with offset	Raw gain	Confidence in result *(%)*	Adjusted gain	Net present value	% of impact offset	Minimum [90%] direct offset requirement met?	Cost *($ total)*	Information source
Birth rate e.g. Change in nest success	No							0.00		0.00	0.00	0.00%	FALSE		
Mortality rate e.g Change in number of road kills per year	No							0.00		0.00	0.00	0.00%	FALSE		
Number of individuals e.g. Individual plants/animals	No							0.00		0.00	0.00	0.00%	FALSE		

Summary

					Cost ($)		
Protected matter attributes	Quantum of impact	Net present value	% of impact offset	Direct offset adequate?	Direct offset	Other compensatory measures	Total
Birth rate	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Mortality rate	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Number of individuals	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Number of features	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Condition of habitat	0.00	0.00	0.00	FALSE	0.00	N/A	0.00
Area of habitat	26.94	27.47	1.02	TRUE	0.00	N/A	0.00
Area of community		0.00	0.00	FALSE	0.00	N/A	0.00
					$0.00	**$0.00**	**$0.00**