

Rookwood Weir

White-throated Snapping Turtle Nest **Protection Plan RWW-GHD-ENV-PM-002**

Sunwater Limited

1 December 2023



The Power of Commitment



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Contents

Acro	onyms			v
1.	Introdu	ction		1
	1.1	Purpos	se of this report	1
	1.2	Backgr	round	2
	1.3	Project	t description	2
	1.4	, Turtle r	nest inundation offset	3
	1.5	Declara	ation of accuracy	vi
	1.6	Limitati	ions	5
2	Snecie	s backo	round	7
	21	Descrir	ntion	7
	2.1	Distrib	ution and habitat	7
	2.2	Ecolog		8
	2.0	U	y 	0
3.	Potenti	al resid	ual impact	9
	3.1	Expect	ed impact (EIS and AEIS)	9
	3.2	Pre-cle	earance surveys	9
	3.3	Predict	ted actual impact	13
4.	Nest Pr	otectio	n Management Plan	15
	4.1	Consei	rvation outcomes	15
	4.2	Timelin	ne	17
	4.3	Respo	nsible persons	17
	4.4	Manag	ement actions	19
		4.4.1	Priority Nest Protection Areas	19
		4.4.2	Habitat protection	20
		4.4.3	Broad-scale predator control	20
		4.4.4	Nest protection	20
		4.4.5	Hatching success	21
	15	4.4.0 Manag		21
	4.5	Monito	ring and contingency	22
	4.0		Nest babitat suitability	21
		4.6.2	Nesting activity	27
		4.6.3	Predator control	27
		4.6.4	Predator activity	28
		4.6.5	Nest predation rate	28
		4.6.6	Hatchling recruitment	28
		4.6.7	Contingency program	28
	4.7	Report	ing requirements	34
		4.7.1	Annual Nest Protection Management Plan Report	34
		4.7.2	Animal breeding place register	34
5.	Referen	nces		35

Table index

Table 1	Delivery documents relating to turtle offsets	1
Table 2	Pre-clearance nesting survey events	9
Table 3	Turtle nesting habitat suitability ratings from pre-clearance surveys within all study areas	11
Table 4	Extent of impact to confirmed turtle nesting habitat within Rookwood inundation area at 46.2 m FSL	13
Table 5	Management objectives and performance criteria	15
Table 6	Commonwealth and State Government conservation management strategies for the white-throated snapping turtle	16
Table 7	Roles and responsibilities of personnel associated with the Nest Protection Management Plan	18
Table 8	Nest Protection Management Plan	23
Table 9	Nest Protection Management Plan performance criteria monitoring and contingency program	29

Figure index

Figure 1	Rookwood Weir inundation area extent	6
Figure 2	White-throated snapping turtle captured within the Fitzroy River (February 2019)	7
Figure 3	Predated nests	10
Figure 4	Intact turtle nesting – Upper Inundation area 9 (UI9) with nest protection mesh fitted (August 2021)	10
Figure 5	Hatched nest – The Pocket – P3– and nesting habitat (October 2021)	11
Figure 6	Freshwater river turtle egg size chart (Limpus et al. 2011)	13

Appendices

- Appendix A Pre-clearance turtle nesting survey results
- Appendix B Predicted inundation of confirmed turtle nesting habitat
- Appendix C Pre-nesting Season Data Sheet
- Appendix D Nesting Season Data Sheet
- Appendix E Hatching Season Data Sheet

Acronyms

Acronym	Description
AEIS	Addendum Environmental Impact Statement
AHD	Australian Height Datum
AMTD	Adopted Middle Threat Distance
cm	Centimetre
CoG	Coordinator General
DAWE	Department of Agriculture, Water and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DoE	Department of Environment
DES	Department of Environment and Science
EIS	Environmental Impact Statement
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FSL	Full Supply Level
FRT	Fitzroy River Turtle
ha	Hectare
kg	Kilogram
km	Kilometre
KRT	Krefft's River Turtle
LFRIP	Lower Fitzroy River Infrastructure Project
m	Metre
NC Act	Nature Conservation Act 1992
NPMP	Nest Protection Management Plan
RL	Reduced Level
SMP	Species Management Plan
WTST	White-throated snapping turtle

Declaration of accuracy

In making this declaration, I am aware that section 491 of the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

CPLan / (0005 5 0023 13:44 GMT+ 0)

Full name: Chirs Delamont Organisation: Sunwater Limited EPBC Referral Number: EPBC 2009/5173 Rookwood Weir White-throated Snapping Turtle Nest Protection Plan (EPBC Offset Management Plan)

Date: 05/12/2023

1. Introduction

1.1 Purpose of this report

The purpose of this Nest Protection Management Plan is to fulfil the offset obligations required for the inundation of turtle nests, as required by Coordinator General (CoG) Condition Appendix 2. Imposed conditions – Rookwood Weir, Schedule 1 White-throated snapping turtle Part C. Turtle nesting impacts, Condition 5 Nest protection programs. The management plan provides a framework for the implementation of nest protection actions to achieve the conservation outcomes of a reduction in nest predation and increased recruitment of hatchlings into the population.

This Nest Protection Management Plan has been prepared generally in accordance with Appendix G of the AEIS: Offset Proposal for the Fitzroy River turtle and White-throated Snapping Turtle offset management plan. The actions proposed have been developed in consultation with turtle expert Dr Col Limpus, Chief Scientist Threatened Species Unit, Department of Environment and Science (DES), and align with priority actions within the National Recovery Plan for the White-throated snapping turtle (*Elseya albagula*) (Commonwealth of Australia, 2020), and The Biology and Management Strategies for Freshwater Turtles in the Fitzroy Catchment (Limpus *et al.*, 2011).

This report includes the following content:

- Introduction provides an overview of the Project and the white-throated snapping turtle offset requirements
- Species background describes the white-throated snapping turtle and presents known information on the species, distribution and habitat, ecology and nesting requirements
- Potential residual impact details the expected impact to turtle nests as predicted in the environmental impact statement (EIS), including an addendum (AEIS), and presents results of preclearance surveys to identify actual predicted impact
- Nest Protection Management Plan details the conservation outcomes, timeline and responsible person for the management plan as well as the management actions and monitoring and evaluation requirements. A detailed management plan for implementation is supported by a contingency program of corrective actions and reporting requirements.

A summary of the reports and plans relating to the delivery of offsets for the white-throated snapping turtle and Fitzroy River turtle (*Rheodytes leukops*) is provided in Table 1.

Offset requirement	Delivery documents		
Offset strategy	 The Rookwood Weir Offset Strategy Version 10 (RWW-SUN-NNV-SG- 0003.I0.FI_v10) 		
Inundation of Fitzroy River turtle nest sites within the weir impoundment areas	 Fitzroy River Turtle Nest Protection Management Plan (RWW-GHD- ENV-PM-001) White-throated Snapping Turtle Nest Protection Management Plan (RWW-GHD-ENV-PM-002) 		
Modifying aquatic habitat for the Fitzroy River turtle	 Turtle Management and Conservation Summary Report (RWW-GHD- ENV-RP-0020) 		
	 Turtle Habitat Enhancement Program: Expanded Feral Pest Animal Management Plan (RWP-ETR-ENV-MP-0001) 		
	 Turtle Infrastructure Design Process Report (RWW-GHD-ENV-RP- 0018) 		
	 Construction Species Management Program (42-29978-02-AP- RPT-0008) 		
	 Operations Species Management Program (RWW-GHD-ENV-MP- 003) 		

 Table 1
 Delivery documents relating to turtle offsets

1.2 Background

As a component of the Lower Fitzroy River Infrastructure Project (LFRIP; GHD, 2009), Rookwood Weir (the Project) is being constructed by Sunwater Limited, to satisfy short-to-medium-term water supply. The proposed Weir infrastructure will span 320 metres (m) across the river and have an approximate fixed crest of reduced level (RL) 46.2 m Australian Height Datum (AHD). Located at 265.3 kilometres (km) adopted middle threat distance (AMTD) on the Fitzroy River, the impoundment at full supply level (FSL) extends up the Fitzroy River and into the Mackenzie River (322 km AMTD) and Dawson River (10 km AMTD).

The threatened white-throated snapping turtle (*Elseya albagula*) is endemic to the Fitzroy River catchment and is known to occur within the footprint of Rookwood Weir. This species is listed as critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act).

An EIS, including AEIS was approved by the Queensland Government CoG in December 2016 (CoG, 2016) and the Federal Minister for Environment in February 2017 (EPBC 2009/5173), subject to conditions. At the time of the EIS, the white-throated snapping turtle was not listed as a threatened species under the EPBC Act. As such, legislative requirements for this species, as a matter of state environmental significance, were specified by the CoG under the NC Act. Conditions relating to the management and conservation of the white-throated snapping turtle include the requirement to prepare a Species Management Program (SMP), design and implement a Turtle Movement Study, and design, construct and monitor turtle passage infrastructure on the Rookwood Weir.

Unavoidable impacts to the white-throated snapping turtle are expected to remain in relation to inundation of turtle nest sites within the Weir impoundment area, downstream of the Weir and the modification of turtle aquatic habitat. As such, the following conditions were imposed by the CG to improve breeding success for the white-throated snapping turtle:

Condition Appendix 2. Imposed conditions – Rookwood Weir, Schedule 1 White-throated snapping turtle Part C. Turtle nesting impacts, Condition 5 Nest protection programs:

(a) Prior to construction submit to Department of Environment and Science, for approval, a nest protection management plan for the white-throated snapping-turtle

(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).

The Rookwood Weir Offset Strategy Version 10 (Earthtrade, 2022b) was approved by the Minister in November 2022. This strategy identified that to achieve the conservation outcome of a reduction in nest predation and increased recruitment of hatchlings into the population, a 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.

This white-throated snapping turtle Nest Protection Management Plan has been prepared as an attachment to the Rookwood Weir Operations Species Management Plan (GHD, 2022), to provide a framework for the implementation of turtle nest protection actions required to achieve the required conservation outcomes.

1.3 Project description

The proposed Rookwood Weir is located at a 'greenfield' site at 265.3 km AMTD on the Fitzroy River, approximately 85 km south-west of Rockhampton.

Rookwood Weir has a central concrete overflow with a smooth formed ogee spillway. The Weir has a deep smooth formed stilling basin that extends the full length of the spillway. The proposed infrastructure spans 320 m across the river and has an approximate fixed crest of RL 46.2 m AHD storing approximately 86,000 ML.

Rookwood Weir includes a fishway complex to provide adequate fish passage for the existing fish community within the Fitzroy River. A turtle passage facility in the form of a ramp and pool design will also be provided on the right bank to facilitate upstream and downstream movement of turtles.

The Project also includes:

- Replacing the low-level crossing at Riverslea with a new bridge and associated road approaches up-stream of the Weir
- Upgrading the existing low-level causeway at Hanrahan downstream of the Weir
- Upgrading the existing low-level causeway at Foleyvale upstream of the Weir; and
- 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.

Figure 1 shows the location of Rookwood Weir and inundation area extent which extends 323.3 km AMTD up the Mackenzie River and 10.3 km AMTD up the Dawson River.

1.4 Turtle nest inundation offset

Operation of the Project will have residual impacts on the 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 Weir-related water releases or spilling events result in an increase in water level downstream of the Weir.

Suitable nesting habitat for the 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 demonstrates that the species has the ability to colonise new habitat where suitable conditions occur (Limpus *et al.*, 2011). The white-throated snapping turtle has 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 white-throated snapping turtle is 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 white-throated snapping turtle is the lack of recruitment into the population (Commonwealth of Australia, 2020; Limpus *et al.*, 2011). 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, 2020; Limpus *et al.*, 2011). Current recruitment rates are not considered adequate to sustain populations within the catchment (Limpus *et al.*, 2011). As such, the protected matters attribute proposed to be protected and managed is hatching success of 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 and Mary River catchment with nest protection programs for other species (B. Crosbie pers. comm.).

Due to the existing extremely high predation rates (close to 100 per cent), it is considered that the future value of the birth rate without secure and consistent management from the proposed offset will be at a low level (rated as 5 out of 100). With protection and the implementation of management measures proposed, the future value of the white-throated snapping turtle birth rate is predicted to improve (rating of 95 out of 100). Based on proven results, the confidence in the proposed change in nesting success and improved recruitment of hatchlings is 90 per cent. It is therefore conservatively estimated that the time required for the proposed offset to achieve ecological benefits is five years. Accordingly, the Nest Protection Management Plan will be implemented for five years.

1.5 Limitations

This report has been prepared by GHD for Sunwater Limited (Sunwater) and may only be used and relied on by Sunwater for the purpose agreed between GHD and the Sunwater as set out in this report. GHD otherwise disclaims responsibility to any person other than Sunwater arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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Sunwater Rookwood Weir Project

Inundation Area

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Data source: DoR: Baseline Road (2021), Watercourse (2018); GHD: Full Supply Level 46.2m (2018), Project Location (2021); Imagery (2018). Created by: ilaifoo

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2. Species background

2.1 Description

The white-throated snapping turtle (Figure 2) is one of Australia's largest turtle species with adult females weighing up to nine kilograms (kg) with a shell up to 42 centimetres (cm) long. This species is sexually dimorphic, with females being much larger than males (Thomson *et al.*, 2006). Adults are heavily built, with a large, robust head. Adult females commonly have irregular white or cream markings on the sides and under surfaces of the head and neck. Males are easily distinguished from mature females by their much larger tail. Hatchlings and small juveniles have strongly serrated shell margins (Commonwealth of Australia, 2020; Thomson *et al.*, 2006).



Figure 2

White-throated snapping turtle captured within the Fitzroy River (February 2019)

2.2 Distribution and habitat

The white-throated snapping turtle occurs throughout the Fitzroy, Burnett, and Mary River catchments. The species inhabits permanent waters within flowing streams and is not thought to occur within farm dams, ephemeral swamplands, or brackish waters (Hamann *et al.*, 2007). The white-throated snapping turtle is also known to inhabit impounded pools with individuals recorded within the Fitzroy Barrage, Eden Bann Weir, Theodore Weir, Glebe Weir and Callide Dam. (Limpus *et al.*, 2011b).

The preferred habitat for this species is the permanent flowing reaches of the rivers that are characterised by steep sides, a sand-gravel substrate and an abundance of underwater refuge (e.g. rocks, logs and undercut banks) (Hamann *et al.*, 2007). During the day, the white-throated snapping turtle is generally found in deep pools (>6 m) either upstream or downstream from a riffle zone. At night the turtle moves into the shallow riffle zones (Gordos *et al.*, 2007; Hamann *et al.*, 2007). During the dry season, the white-throated snapping turtle inhabits less productive slow-moving pools where they compete for limited resources with other turtle species and aquatic fauna. The habitat and movement pattern of hatchling turtles is largely unknown.

The white-throated snapping turtle is known to occur within the Fitzroy, Mackenzie and Dawson Rivers, within, upstream and downstream of Rookwood Weir. A total of 86 white-throated snapping turtle have been captured within the vicinity of Weir over four years of the Rookwood Weir Turtle

Movement Study (GHD, 2018; 2019; 2020). Results of this study found that the white-throated snapping turtle was most commonly detected in large permanent pool habitat downstream of Rookwood to Lawries Bend and upstream from Rookwood to Gogango Creek. Turtles were commonly found within waters approximately 2 m deep but inhabited deeper water areas (up to 12 m deep) during March, April and November to December. These months coincided with periods of increased flow within the river (GHD, 2020).

2.3 Ecology

Nesting of the white-throated snapping turtle is primarily restricted to sand and loam alluvial deposits. Nests are generally laid on the front face and top of steep slopes, are an average of 5 m from the water's edge and are 3 m above the water level (McDougall *et al.*, 2015; Hollier, 2010; Hamann *et al.*, 2007). Nesting can, however, occur up to 60 m from the water's edge and over 8 m above the water level (Limpus *et al.*, 2011a). The white-throated snapping turtle has an extended breeding season with peak nesting occurring from April to August and hatching generally occurring September to December after an embryonic diapause over the winter (Limpus *et al.*, 2011a). Nesting aggregations occur with females often returning to the same nesting areas each year. The lack of hatchling and juvenile turtles within the population suggests that there has been very little recruitment into the population over the last decade (< 2 percent) (Hamann *et al.*, 2007).

Juvenile white-throated snapping turtles are carnivorous, while adult turtles are primarily herbivorous, feeding on fruit and leaves of riparian vegetation and aquatic macrophytes (Rogers, 2000). The white-throated snapping turtle can respire aquatically, with turtles obtaining approximately 40–60 percent of their oxygen requirements from the water (Mathie and Franklin 2006; Clark *et al.*, 2008).

Recent results from the Rookwood Weir turtle movement study (GHD, 2018; GHD 2019, GHD 2020) indicate that habitat use of the white-throated snapping turtle within the Fitzroy River varied according to the time of year. The majority of white-throated snapping turtles showed a high degree of residency during the monitoring period. The average linear home range for adult male turtles was 10.06 km (standard error = 1.61 km) and the average linear home range for adult female turtles was 7.88 km (standard error = 1.59 km). These home ranges are much larger than previous home range estimates of 500 m – 2.2 km (Hamann *et al.*, 2007; Micheli-Campbell *et al.*, 2017). Outside of home range movements, tagged white-throated snapping turtle also undertook large-scale movements in May and June 2017, October 2017, October 2018, early (January to May) 2019 and early (January to April) 2020. The maximum distance travelled by the white-throated snapping turtle was 33.77 km. Periods of increased activity by the species appeared to coincide with increases in flow and river height suggesting hydrology may be acting as a trigger for turtle movement. The timing and location of turtle movement also suggest some large-scale movement may be occurring in association with nesting/breeding behaviour (GHD, 2020).

3. Potential residual impact

3.1 Expected impact (EIS and AEIS)

The potential impact to white-throated snapping turtle nesting habitat as a result of inundation from Rookwood Weir was predicted in the following reports:

- Appendix G of the AEIS: Offset Proposal for the Fitzroy River Turtle and White-throated Snapping Turtle offset management plan
- Appendix L of the EIS: White-throated Snapping Turtle *Elseya albagula* technical report.

Nesting habitat expected to be impacted included:

- Three historical nesting banks at Redbank crossing (Fitzroy River downstream of Rookwood Weir), Glenroy crossing (Fitzroy River downstream of Rookwood Weir) and Boolburra Rail crossing (Dawson River upstream of the Rookwood Weir inundation area).
- Six confirmed nesting banks between 266 and 329 km AMTD within the Rookwood Weir Project footprint.
- One high potential nesting bank at 321 km AMTD within the Rookwood Weir Project footprint.

There were three sites within the upper reaches of the Rookwood Weir impoundment where potential nesting habitat was expected to remain above the full supply level associated with Rookwood Weir Stage 2. Conservatively, the Project was expected to impact up to 80% of nests within the inundation area with an approximate area of 2.0 ha of confirmed and potential nesting habitat expected to be inundated.

3.2 **Pre-clearance surveys**

As required by EPBC Act Condition 3, pre-clearance surveys for turtle nesting activity have been undertaken within, upstream and downstream of Rookwood Weir from 2019 to 2021. The turtle nesting surveys extended from below Hanrahan Crossing, approximately 18 km downstream of Rookwood Weir, to above Foleyvale Crossing, approximately 65 km upstream of Rookwood Weir. Surveys were also conducted further upstream on the Mackenzie River at Tartus Weir. A total of 12 pre-clearance surveys have been undertaken within the white-throated snapping turtle nesting and hatching season, as well during the nesting season of the Fitzroy River turtle (*Rheodytes leukops*) as summarised in Table 2.

Field survey event	Season
June 2019	White-throated snapping turtle nesting season
September 2019	Fitzroy River turtle nesting season
December 2019	Fitzroy River turtle hatching season
June 2020	White-throated snapping turtle nesting season
October 2020	Fitzroy River turtle nesting season
December 2020	Fitzroy River turtle hatching season
April 2021	White-throated snapping turtle nesting season
June 2021	White-throated snapping turtle nesting season
July 2021	White-throated snapping turtle nesting season
August 2021	Fitzroy River turtle nesting season
October 2021	Fitzroy River turtle nesting season
January 2022	Fitzroy River turtle hatching season

Table 2 Pre-clearance nesting survey events

Throughout the duration of the seasonal turtle nesting surveys, 46 potential turtle nesting sites have been assessed for turtle habitat suitability with 34 of these found to have confirmed evidence of turtle nesting (Table 3). Four additional sites have been assessed as having 'high', two with 'medium', and six with 'low' suitability for turtle nesting (Table 3).

Overall trends of nesting habitat suitability indicate a high level of habitat suitability for nesting across all sites demonstrated by the large increase in both the number of nests and number of eggs recorded in 2020 and 2021 compared to 2019 (Appendix A). Total number of nests recorded each year included:

- 2019 at least 27 nests with at least 69 eggs + fragments
- 2020 at least 130 nests with at least 417 eggs + fragments
- 2021 at least 247 nests with at least 917 eggs + fragments.

However, predation rates were very high with 100% nest predation recorded in 2019 and 92% in 2020 (Figure 3). In 2021, 21 intact nests (8.5 % of the 247 nests recorded in 2021) were identified within 24 hours of being laid and nest protection mesh applied (Figure 4), only one nest was found to have naturally hatched in 2021 (99.6% predation rate; Figure 5). Over the course of the three years of preclearance survey, a total of 11 turtle nests were observed to have hatched without nest protection, leading to an overall nesting success rate off 2.7%.



Figure 3 Predated nests



Figure 4 Intact turtle nesting – Upper Inundation area 9 (UI9) with nest protection mesh fitted (August 2021)





Figure 5 Hatched nest – The Pocket – P3– and nesting habitat (October 2021)

Table 3

Turtle nesting habitat suitability ratings from pre-clearance surveys within all study areas

Site ID	Site name	Location	Overall rating*
F3	Foleyvale downstream	Within inundation area	Confirmed
F4	Foleyvale downstream	Within inundation area	Confirmed
F5	Foleyvale downstream	Within inundation area	Confirmed
F6	Foleyvale downstream	Within inundation area	Medium
P1	The Pocket (upstream)	Within inundation area	Confirmed
P3	The Pocket	Within inundation area	Confirmed
P4	The Pocket	Within inundation area	High
G1	Gogango mouth 1	Within inundation area	High
G2	Gogango mouth 2	Within inundation area	Confirmed
G3	Gogango mouth 3	Within inundation area	Confirmed
G4	Gogango Creek mouth	Within inundation area	Confirmed
R5	Rookwood downstream of crossing	Within inundation area	Confirmed
R6	Rookwood north of crossing	Within inundation area	Confirmed
R7	Riverslea Crossing	Within inundation area	Low
R8	Riverslea to Rookwood 1	Within inundation area	Confirmed
R9	Riverslea Riffle complex	Within inundation area	Confirmed
R10	Riverslea downstream island	Within inundation area	High
UI1	Upper Inundation Area 1	Within inundation area	Low
UI2	Upper Inundation Area 2	Within inundation area	Confirmed
UI3	Upper Inundation Area 3	Within inundation area	Confirmed
UI4	Upper Inundation Area 4	Within inundation area	Confirmed
UI5	Upper Inundation Area 5	Within inundation area	Confirmed
UI6	Upper Inundation Area 6	Within inundation area	Low
UI7	Upper Inundation Area 7	Within inundation area	Confirmed
UI8	Upper Inundation Area 8	Within inundation area	Medium

Site ID	Site name	Location	Overall rating*
Ul8a	Upper Inundation Area 8a**	Within inundation area	Confirmed
UI9	Upper Inundation Area 9	Within inundation area	Confirmed
UI10	Upper Inundation Area 10	Within inundation area	Confirmed
UI11	Upper Inundation Area 11	Within inundation area	Confirmed
F1	Foleyvale Crossing	Upstream of inundation area	High
F2	Foleyvale downstream	Upstream of inundation area	Confirmed
F7	Foleyvale upstream	Upstream of inundation area	Low
F8	Foleyvale upstream	Upstream of inundation area	Confirmed
F9	Foleyvale upstream	Upstream of inundation area	Confirmed
F10	Foleyvale upstream	Upstream of inundation area	Confirmed
F11	Foleyvale upstream	Upstream of inundation area	Confirmed
H1	Hanrahan far downstream	Downstream of inundation area	Confirmed
R1	Lawries Bend	Downstream of inundation area	Confirmed
R2	Rookwood to Hanrahan Crossing	Downstream of inundation area	Confirmed
R3	Rookwood to Hanrahan Crossing	Downstream of inundation area	Low
R4	Hanrahan Crossing upstream	Downstream of inundation area	Confirmed
T1 DLB	Tartrus Weir to rockbar (left bank)	Upstream on Mackenzie River	Confirmed
T1 DRB	Tartrus Weir to rockbar (right bank)	Upstream on Mackenzie River	Confirmed
T2 DLB	Tartrus rockbar to culvert (left bank)	Upstream on Mackenzie River	Confirmed
T2 DRB	Tartrus rockbar to culvert (right bank)	Upstream on Mackenzie River	Low
T3 DLB	Tartrus downstream of culvert (left bank)	Upstream on Mackenzie River	Confirmed

* Highest nesting suitability rating used from all survey events for the site

In total, 21 of the 27 confirmed turtle nesting banks are located within the Rookwood Weir inundation area. Of these, white-throated snapping turtle nesting has been confirmed present at nine of these, with an additional seven confirmed white-throated snapping turtle nesting banks present outside the inundation area (refer to Table 3 and Appendix A). Nests of the white-throated snapping turtle as easily distinguished from other species by the large size of their eggs (Figure 6). All other confirmed nests recorded in the inundation area were identified to another turtle species (e.g. Fitzroy River turtle) or were unidentified to species level.

Overall, five sites have recorded aggregated nesting of the white-throated snapping turtle, defined as two or more confirmed white-throated snapping turtle nests located at an individual site.



Figure 6 Freshwater river turtle egg size chart (Limpus et al. 2011)

3.3 Predicted actual impact

In accordance with the methodology used in the EIS and AEIS, to calculate expected impacts to turtle nesting habitat, the predicted actual impact to turtle nesting habitat has been calculated based on the inundation of confirmed nesting sites within the Rookwood inundation area. This assessment identified that a total of 21 confirmed turtle nesting sites (nine of these known to support white-throated snapping turtle nesting) are located within the inundation area of Rookwood Weir and that at a Weir crest height of RL 46.2 m ADH, sufficient nesting habitat will remain above full supply level (FSL) at almost all sites (refer to Table 4 and Appendix B). Specifically:

No impact from inundation is expected at 11 of the 21 nesting sites located within the inundation area.

Eight sites are predicted to be partially inundated with sufficient nesting habitat remaining above full supply level to avoid impacts to turtle nesting. The largest area of impact to confirmed nesting habitat is expected to occur immediately upstream of the Weir site at R5 and R6, however, due to the large size of these sand banks, sufficient habitat is predicted to remain above FSL.

Only two sites, (a total area of 1.22 hectares (ha)), are expected to be lost within the Rookwood Weir inundation area.

Site ID	Site	Species	Inundation impact area (ha)	Extent of inundation
F3	Foleyvale downstream	Fitzroy River turtle / white-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL
F4	Foleyvale downstream	Fitzroy River turtle	0	No impact, 100% of nesting habitat remains above FSL
F5	Foleyvale downstream	Unknown	0	No impact, 100% of nesting habitat remains above FSL
P1	The Pocket (upstream)	Fitzroy River turtle / white-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL

Table 4 Extent of impact to confirmed turtle nesting habitat within Rookwood inundation area at 46.2 m FSL

Site ID	Site	Species	Inundation impact area (ha)	Extent of inundation
P3	The Pocket	Fitzroy River turtle	Partial inundation (0.08 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
G2	Gogango mouth 2	Fitzroy River turtle	0	No impact, 100% of nesting habitat remains above FSL
G3	Gogango mouth 3	White-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL
G4	Gogango Creek mouth	Fitzroy River turtle	0	No impact, 100% of nesting habitat remains above FSL
R5	Rookwood downstream of crossing	Fitzroy River turtle / white-throated snapping	Partial inundation (2.24 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
R6	Rookwood north of crossing	Unknown	Partial inundation (1.17 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
R8	Riverslea to Rookwood 1	Fitzroy River turtle / white-throated snapping turtle	Partial inundation (0.04 + 0.06 + 0.01 = 0.11 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
R9	Riverslea Riffle complex	Unknown	0	No impact, 100% of nesting habitat remains above FSL
UI2	Upper Inundation Area 2	Fitzroy River turtle	Partial inundation (0.22 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
UI3	Upper Inundation Area 3	Fitzroy River turtle / white-throated snapping turtle	Partial inundation (0.22 + 0.16 = 0.38 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
UI4	Upper Inundation Area 4	Fitzroy River turtle	0	No impact, 100% of nesting habitat remains above FSL
UI5	Upper Inundation Area 5	Unknown	Partial inundation (0.21 + 0.80 = 1.01 ha)	1.01 ha of lost nesting habitat, refer to Appendix B
UI7	Upper Inundation Area 7	Fitzroy River turtle / white-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL
UI8	Upper Inundation Area 8	Fitzroy River turtle	Partial inundation (0.21 ha)	0.21 ha of lost nesting habitat, refer to Appendix B
UI9	Upper Inundation Area 9	Fitzroy River turtle	Partial inundation (0.04 + 0.06 = 0.10 ha)	No impact - sufficient habitat remains above FSL, refer to Appendix B
UI10	Upper Inundation Area 10	Fitzroy River turtle / white-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL
UI11	Upper Inundation Area 11	Fitzroy River turtle / white-throated snapping turtle	0	No impact, 100% of nesting habitat remains above FSL

4. Nest Protection Management Plan

4.1 Conservation outcomes

This Nest Protection Management Plan will be implemented to specifically target the key threatening processes of high nest predation and low population recruitment. The key management objective, as defined in the Operations SMP, is the enhancement of white-throated snapping turtle nesting habitat, protection of turtle nests and increased recruitment of hatchlings into the population. The conservation outcomes and performance criteria of the Nest Protection Management Plan are detailed in Table 5.

Whilst this management plan been designed to specifically target the white-throated snapping turtle, the management actions proposed will provide a broad scale benefit to other turtle species and habitats.

Conservation outcomes		Performance criteria
Maintenance of functional turtle nesting habitat	Nesting habitat suitability	Suitable nesting habitat present within, upstream and/or downstream of Rookwood Weir as defined by the presence of high suitability, confirmed and/or functional nesting banks
	Nesting activity	Confirmed turtle nesting occurring at one or more Priority Nest Protection Area within, upstream and/or downstream of Rookwood Weir
Reduction in nest predation	Predator control	Successful implementation (>95%) of planned predator control measures/ annual reduction in predator abundance within target area
	Predator activity	80% reduction in evidence of predator activity at Priority Turtle Nest Protection Areas
	Nest predation rate	90% reduction in predation of turtle nests compared to pre-offset success at Priority Turtle Nest Protection Areas
Increased recruitment of hatchings into the population	Hatchling recruitment	90% increase in recruitment of hatchlings into the population compared to pre-offset success

Table 5 Management objectives and performance criteria

Commonwealth and State Government recommended conservation actions for the white-throated snapping turtle are described in:

- National Recovery Plan for the White-throated Snapping Turtle (*Elseya albagula*) (Commonwealth of Australia, 2020)
- The biology and management strategies for freshwater turtles in the Fitzroy Catchment, with particular emphasis on *Rheodytes leukops* and *Elseya albagula* (Limpus *et al.,* 2011b)

These plans address threats that impact on the population dynamics, habitats, and sustainability of the white-throated snapping turtle across the river system as a whole.

The management objectives and performance criteria for this Nest Protection Management Plan, as described in Table 5, align with the management strategies of the Commonwealth and State Government recommended conservation actions. The Commonwealth and State Government management strategies that will be supported through implementation of this Nest Protection Management Plan are highlighted in bold in Table 6.

Table 6

Commonwealth and State Government conservation management strategies for the white-throated snapping turtle

Relevant conservation advice and plans	Commonwealth and State Government management strategies
Approved National Recovery Plan for the White-throated Snapping Turtle	1. Strategy 1 (Substantially improve the recruitment of hatchlings and juveniles into the population)
(<i>Elseya albagula</i>) (Commonwealth of Australia, 2020)	 Design a hatchery or nest protection program to release large numbers of hatchlings into the rivers
	 Determine the survivorship of hatchlings from wild nests and captive incubated nests
	 Evaluate the success of the hatchery program
	 Search for and map nesting sites in each catchment
	 Identify the extent and nature of threats to nests and hatchlings at the local and sub-catchment levels
	 Develop an effective means to control predators of eggs over a catchment scale
	 Determine the impact of introduced or translocated stocked fish on the turtle
	 Monitor trends in population structure and abundance.
	 Strategy 2 – Decrease adult/subadult mortality and injury rates, and reduce barriers to movement along riverine habitats
	 Determine rates and sources of mortality and injury
	 Identify high risk (existing) water infrastructure and explore options to facilitate safe passage
	 Design (new) water infrastructure to allow the movement of turtles upstream and downstream with minimal injury and mortality
	 Monitor changes in turtle injury/mortality rates in response to management actions
	 Monitor the movement of the species near in-stream barriers.
	 Strategy 3 – Improve stream flow and habitat quality throughout the species' distribution
	 Identify habitat requirements and movement patterns
	 Determine the impact of river regulation on the survivorship of hatchlings and juveniles
	 Identify and locate areas of optimal or suboptimal habitat*
	 Strategy 4 – Increase public awareness and participation in conservation of the species and its habitat
	 Develop and implement a broad strategy to raise awareness and educate the general public about conservation for the species
	 Develop and implement a targeted strategy to promote the use of citizen science in relation to conservation for the species
	 Establish proactive ongoing roles for Traditional Owners in conservation and management actions for the species.
	 Strategy 5 – Improve the collation and availability of data to inform recovery actions
	 Collate all population information in a database and maintain long-term
	 Maintain a register of research, monitoring and management actions and resulting reports
	 Undertake all research and monitoring with Animal Ethics approval and relevant permits under the Qld <i>Nature</i> <i>Conservation Act</i>, 1992.
The biology and management	 Improve recruitment of hatchlings into the population
strategies for freshwater turtles in the Fitzroy Catchment, with particular	 Maintain functional turtle nesting banks throughout the catchment
emphasis on <i>Rheodytes leukops</i> and <i>Elseya albagula</i> (Limpus <i>et al.</i> 2011b)	 Maintain stream flow and high quality in-river habitat between impoundments

Relevant conservation advice and plans	Commonwealth and State Government management strategies
	 Maintain continuity of turtle populations throughout the catchment
	 Reduce the incidence of death and physical injury of turtles at existing and future impoundment structures
	 Manage recreational fishing and boating activities in impoundments to be compatible with maintenance of sustainable turtle populations and reduce unnecessary injury to turtles
	 Improve water quality within the Lower Fitzroy catchment
	 Increase the area of river and adjacent riverine habitat managed for conservation purposes
	 Increase stake-holder participation in conservation and management processes
	 Monitor the response of turtle populations in the Fitzroy Catchment to the management strategies and evaluate the effectiveness of these strategies
Bold highlighting indicates management stra Management Plan	tegies that will be supported through implementation of this Nest Protection

4.2 Timeline

The Nest Protection Management Plan will be implemented for five years. This aligns with the Offset proposal developed for the EIS which identifies five years until ecological benefit for the white-throated snapping turtle can be achieved.

The Nest Protection Management Plan will be implemented annually with management actions conducted during the following seasons:

- Pre-nesting season February March
- Nesting season April to August
- Hatching season September to January

The specific management actions that will be implemented during each season are detailed in the management plan provided in Section 4.5.

4.3 Responsible persons

All Sunwater staff and contractors associated with the Project are required to abide by the *Environmental Protection Act 1994*, EPBC Act and NC Act and comply with all procedures outlined in this Nest Protection Management Plan. Persons involved with the Project must not carry out any activities that may cause, or is likely to cause, environmental harm unless the person(s) involved take all reasonable and practicable measures to prevent or minimise harm (the General Environmental Duty). Parties who have active roles in the Nest Protection Management Plan are outlined in Table 7.

Table 7

Roles and responsibilities of personnel associated with the Nest Protection Management Plan

Role	Responsibilities
Sunwater Operations General Manager	 Operate Rookwood Weir in compliance with all legal requirements including approval conditions relating to the white-throated snapping turtle.
	 Allocate adequate resources and staff to allow effective implementation of the Nest Protection Management Plan.
	 Reporting environmental incidents to the Department of Environment and Science where required.
Sunwater Operations Environmental Manager	 Coordinate and oversee implementation of the Nest Protection Management Plan.
	 Engage Nest Protection Team, Predator Control Contractor/s and any other sub-contractors as required to implement Nest Protection Management Plan.
	 Inform all operational staff, Nest Protection Team, Predator Control Contractor/s and any other sub-contractors of their obligations under the Nest Protection Management Plan.
	 Approve selection of Priority Nest Protections Areas prior to the start of each nesting season.
	 Coordinate and oversee annual monitoring and evaluation of Nest Protection Management Plan against performance criteria measures of success for each conservation outcome.
	 Coordinate and oversee completion of Annual Nest Protection Management Plan Report and Animal Breeding Register.
	 Monitor, manage and report on corrective actions required to achieve conservation outcomes.
	 Reporting environmental incidents to the Sunwater Operational Manager for action.
Nest Protection Team	 Obtaining any licences and permits required to implement the Nest Protection Management Plan (e.g. high risk SMP under NC Act; animal ethics permit, rehabilitation permit).
	 Implement relevant management actions as per Nest Protection Management Plan.
	 Record details of management actions implemented and data collected
	 Support completion of Annual Nest Protection Management Plan Report and Animal Breeding Register.
	 Support annual monitoring and evaluation of Nest Protection Management Plan against performance criteria measures of success for each conservation outcome.
Predator Control	- Obtaining any licences and permits required to undertake predator control.
Contractors	 Implement broad-scale predator control management actions as per Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management (Earthtrade, 2022b).
	 Record details of management actions implemented and data collected.

4.4 Management actions

4.4.1 Priority Nest Protection Areas

Each nesting season, Priority Nest Protection Areas will be identified based on previously confirmed turtle nesting sites, nesting habitat suitability, access requirements, landholder agreements and suitability/condition of the site for nesting. The Priority Nest Protection Areas will be located within one or more of the following regions:

- Inundation area
- Upstream of the inundation area to the terrestrial offset area at Foleyvale Crossing, and/or
- Downstream of the Weir to Hanrahan Crossing.

The specific location/s of the Priority Nest Protection Areas within these regions are expected to change over the five years that the Nest Protection Plan is implemented. Initial Priority Nest Protection Areas will be established following first filling of the impoundment as well as any flooding events that occur. These initial areas are expected to align with confirmed aggregated nesting areas identified during pre-clearance surveys (refer to Section 3.3). Throughout the five years of the Nest Protection Plan, the condition, suitability and use of these areas by turtles for nesting will be monitored and alternative Priority Nest Protection Areas identified and established based on natural and/or Project-related fluctuations in habitat suitability and actual use by turtles for nesting. These factors will also influence the number and size of Priority Nest Protection Areas established annually.

A description of the Priority Nest Protection Areas will be recorded at the start of the nesting season as per the Pre-nesting Season Data Sheet provided in Appendix C. The following parameters will be recorded:

- Location
- Photographs of area (north, south, east and west at 50 m internals along bank).
- Bank height, length and width.
- Average bank slope: vertical (89–90°); steep (60–80°); moderate (30-60°); low (10–30°) and; flat (<10°).
- Average bank composition: percent of cobble/pebble; gravel; coarse sand; fine sand; and silt/clay.
- Riparian canopy vegetation cover including ground cover, scrub, canopy cover: none (none); little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%).
- Weed density overall; little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%).
- Weed density per species; little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%).
- Evidence of predator activity: little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%).
- Cattle disturbance: little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%).
- Pig disturbance: little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%).
- Flow level: none (isolated pools); low (<watermark); moderate (=watermark); high (>watermark); flood.
- Habitats adjacent: deep pool (>0.5 m); shallow pool (<0.5 m); run; riffle.

4.4.2 Habitat protection

The condition and nesting habitat suitability of the Priority Nest Protection Areas will be restored annually prior (February/March) to the nesting season of the white-throated river turtle, by undertaking the following specific management actions:

- Installing electric fence (e.g. 150 m perimeter fence) around the Priority Nesting Protection Areas to protect against predators and exclude other forms of potential nest disturbance such as cattle and/or vehicles.
- Removing/controlling terrestrial and aquatic weeds, where required, from within the Priority Nesting Protection Areas to facilitate turtle access to the area for nesting. Weed control activities shall comply with general biosecurity and Sunwater's weed management procedures, as outlined in Sunwater Operational Environmental Management Plan.

The location and type of activities conducted at Priority Nest Protection Areas will be documented as per the Pre-nesting Season Data Sheet provided in Appendix C.

4.4.3 Broad-scale predator control

Predator control will be undertaken for feral animals that occur at Priority Nest Protection Areas. Feral pest animal management area and the specific management actions that will be undertaken in managing and reducing the impacts of feral predators on turtle nesting sites are detailed in the Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management Plan. Activities in Priority Control Areas (PCAs) will be identified annually based on levels of activity and type of predators recorded during the pre-nesting season surveys. The PCAs will concentrate on high and medium priority nesting sites and the adjoining areas containing lacustrine, palustrine and/or riverine wetland areas up to one km either side of the high bank of the river, within the one km buffer zone either side of the centreline of the Fitzroy, Mackenzie and Dawson Rivers between Hanrahan Crossing and the northern boundary of Foleyvale. Activities will occur where access is permitted. The timing of the feral animals' management activities will be design around the nesting and hatching seasons of *Elseya albagula*.

Feral pest animal control measures will include culling (aerial and ground shooting), baiting, trapping of pigs, foxes, and wild dogs. The location and type of predator control activities planned and implemented will be documented as per the Predator Control Data Sheet within the Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management Plan. The monitoring of pest animal activity pre- and post-control operations will be undertaken using camera traps, and the recorded feral pest animal activity will be reported annually. This annual report, together with the findings of the Turtle Nest Protection Management reports, will determine future control methodology and effort as well as the duration of management/contingency program to be put in place.

4.4.4 Nest protection

Priority Nest Protection Areas will be monitored regularly (indicative frequency of three times per week) during the peak nesting season (August to December) for the purposes of identifying and protecting individual nests. Nesting is triggered by rainfall and monitoring will occur during and/or immediately following events.

Priority Nest Protection Areas will be examined for signs of nesting and predator activity (which included the presence of turtle tracks, diggings, nests and predated eggshells) using a single strip transect parallel to the water's edge, as per the standard methodology of Limpus *et al.* 2011. Transects will vary in length and width according to bank morphology and will cover all potentially suitably nesting habitat within the Priority Nest Protection Areas. Any evidence of turtle nesting and predator activity recorded as per Nesting Season Data Sheeting in Appendix D, will be photographed, and the GPS location recorded. If nests are detected, the following information will be recorded:

- Date
- GPS location of nest
- Weather conditions

- Survey team members
- Photographs of nesting bank, nest, and eggs or predated eggshell
- Distance of nest from water (m) and height above the water's surface (m)
- Flow level
- Habitats adjacent
- Bank slope, ground cover, riparian vegetation cover and weed density as per nesting bank characterisation ratings above
- Distance to first egg (m)
- Egg diameter (cm) and egg length (cm)
- Number of eggs within nest
- Nesting evidence and species where possible
- Cattle activity
- Evidence of predator activity as a percentage of bank disturbance overall, on upper bank, mid bank and lower bank
- Number of predated eggs observed (if relevant).

Nest protection cages will be installed, where possible and safe to do so, within 24 hours of nests being laid to minimise predation. Cages will be installed over nests *in-situ* or individual nests relocated to a communal protection cage/s located within the Priority Nest Protection Areas, as per DES methodology. Protected nests located within Priority Nest Protection Areas will be relocated to an alternative suitable nesting site if they are at risk of inundation from changes in impoundment levels and/or flooding.

Handling and relocation of eggs will occur in accordance with animal ethics and relocation permits/ approvals to minimise risk of embryo dislocation and other risks to egg viability.

Results of each nesting survey undertaken, details of nests detected, and nest protection activities implemented will be documented as per the Nesting Season Data Sheet provided in Appendix D.

4.4.5 Hatching success

The hatching success of individual nests protected will be recorded throughout the hatching season (September to December). Monitoring may include the use of remote cameras to record emergence of hatchings and/or the physical excavation of the nests to the top of the first egg to check for evidence of hatching. Physical excavation of hatched nests will be conducted by a field team member based on the timing and abundance of nests laid during the nesting season with hatching success monitoring conducted within two weeks of the expected date of hatching of each nest.

For those nests that have hatched, the number of eggs from which the hatchlings have successfully emerged will be recorded and compared to the total number of eggs laid. Predated eggshell and evidence of predators (e.g. tracks and scats) will also be recorded and photographed as per the Hatching Season Data Sheet provided in Appendix E. Nests that have not hatched at the time of survey will be covered over and reassessed during subsequent monitoring.

At the end of the hatching success monitoring, predator protection cages and electric fencing will be removed prior to wet season flow events.

4.4.6 Population monitoring

Monitoring of the turtle population within, upstream and downstream of Rookwood Weir will be implemented for the first five years of Project operation in accordance with the operational monitoring plan (Rookwood Weir Operation SMP). Surveys will be conducted twice per year during optimal turtle capture conditions. Locations selected for the turtle population surveys will include within the vicinity of the Priority Nest Protection Areas. Standardised turtle capture surveys will be undertaken and may include the use of fyke nets, cathedrals traps, seine nets and/or snorkelling. Turtles captured will be measured and tagged with passive integrated transponder tags, numbered monel metal foot tags and carapace notched. Acoustic tags may also be deployed on captured turtles if required to support the

Rookwood Weir Turtle Movement Study. Parameters recorded will include morphometric measurements, age and sexual maturity, reproductive biology and evidence of injury, mortality and disease.

The results of the population monitoring will provide information on the abundance and population dynamics of the white-throated river turtle within the vicinity of the Priority Nest Protection Areas. Continuous monitoring of turtle movement behaviour as part of the Turtle Movement Study will also provide evidence of breeding migrations and will identify potential locations of nesting activity.

The Rookwood Weir Operation SMP will be reviewed after five years and ongoing management requirements identified for incorporation into Weir operational plans and/or this Nest Protection Management Plan, as considered necessary and applicable (in collaboration with DES and the Department of Climate Change, Energy, the Environment and Water (DCCEEW)). The results of the Rookwood Weir Operation SMP and the Turtle Movement Study may provide causative evidence for the success or failure of this Nest Protection Management Plan, as determined through the assessment of performance criteria for conservation outcomes (Section 4.5). For example, low nesting activity within a particular area may be the cause of low population abundance rather than absence of suitable nesting habitat.

4.5 Management plan

Management actions proposed to achieve the conservation outcomes (as identified in Section 4.1) are detailed in Table 8.

This White-throated Snapping Turtle Nest Protection Management Plan will be implemented until the outcomes of the Offset Management Plan are achieved. The Offset Management Plan has identified ecological benefit will be achieved with implementation over five years. Implementation of this plan is expected to occur in conjunction with the Fitzroy River Turtle Nest Protection Management Plan. Together, management actions are expected to be undertaken by up to three field nest protection team members for a duration equivalent to two days per week for 48 weeks of the year, over five years. In addition, specialist predator control contractors are expected to implement predator control activities at the Priority Nest Protection Areas for up to three weeks annually.

Table 8 Nest Protection Management Plan

ID	Management action	Timing	Location	Responsible persons			
1	Identification and management of Priority Nest Protection Areas						
1a	Each nesting season, Priority Nest Protection Areas will be identified based on previously confirmed turtle nesting sites, nesting habitat suitability, access requirements, landholder agreements and suitability/condition of the site for nesting Initial Priority Nest Protection Areas to be established following first filling of the impoundment as well as any flooding events that occur, are expected to align with confirmed aggregated nesting areas identified during pre-clearance surveys (refer to Section 4.4.1).	Annually during pre- nesting season (February-March)	Within Rookwood Weir impoundment and/or Upstream of impoundment to Foleyvale Crossing and/or Downstream of Rookwood Weir to Hanrahan Crossing.	Sunwater Operations Environment Manager			
	The condition, suitability and use of these areas by turtles for nesting will be monitored and alternative Priority Nest Protection Areas identified and established based on natural and/or Project-related fluctuations in habitat suitability and actual use by turtles for nesting.						
1b	A description of the Priority Nest Protection Areas will be recorded at the start of the nesting season as per Pre-nesting Season Data Sheet provided in Appendix C.	-					
2	Habitat protection						
2a	The condition and nesting habitat suitability of the Priority Nest Protection Areas will be restored by undertaking the specific management actions (below), prior to the nesting season of the white-throated snapping turtle. Specific management actions will include:	Annually during pre- nesting season (February- March)	Within Priority Nest Protection Areas	Turtle Nest Protection Team			
	 Installing electric fence (e.g. 150 m perimeter fence) around the Priority Nesting Protection Areas to protect against predators and exclude other forms of potential nest disturbance such as cattle and/or vehicles. 						
2b	 Removing/controlling terrestrial and aquatic weeds, where required, from within the Priority Nesting Protection Areas to facilitate turtle access to the area for nesting. Weed control activities shall comply with general biosecurity and Sunwater's weed management procedures, as outlined in the Sunwater Operational Environmental Management Plan. 						
2c	The location and type of activities conducted at Priority Nest Protection Areas will be documented as per the Pre-nesting Season Data Sheet provided in Appendix C.						
3	Broad-scale predator control						

ID	Management action	Timing	Location	Responsible persons
3a	Predator control will be undertaken for predators that occur at Priority Nest Protection Areas. Activities will be identified annually based on levels of activity and type of predators recorded during the pre-nesting season. Activities may include culling, baiting, trapping of pigs, foxes, wild dogs.	Annually during pre- nesting, nesting and hatching seasons as required for specific	Within and adjacent to Priority Nest Protection Areas	Predator Control Contractor
3b	The location and type of predator control activities planned and implemented will be documented as Predator Control Data Sheet within the Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management Plan.	control methods		
4	Nest protection			
4a	Priority Nest Protection Areas will be monitored regularly during the peak nesting season for the purposes of identifying and protecting individual nests. Priority Nest Protection Areas will be examined for signs of nesting (which included the presence of turtle tracks, diggings, nests and predated eggshells) using a single strip transect parallel to the water's edge, as per the standard methodology of Limpus <i>et al.</i> , 2011. Transects will vary in length and width according to bank morphology and will cover all potentially suitably nesting habitat within the Priority Nest Protection Areas.	Regular monitoring (indicative frequency of three times per week) during nesting season (April to August) Monitoring to occur during and immediately prior to rainfall events during nesting season.	Within Priority Nest Protection Areas	Turtle Nest Protection Team
4b	 If nests are detected, the following information will be recoded: GPS location of nest. Photographs of nesting bank, nest, egg or predated egg shell. Distance of nest from water (m) and height above the water's surface (m). Bank slope, ground cover and riparian vegetation cover as per ratings nesting bank characterisation ratings above. Distance to first egg (m). Egg diameter (cm) and egg length (cm). Number of eggs within nest. Species of nest. Evidence of predator activity. Number of predated eggs observed (if relevant). 	Upon identification of confirmed turtle nest		
4c	Nest protection cages will be installed within 24 hours of nests being laid, where safe to do so, to minimise predation. Cages will be installed over nests <i>in-situ</i> or individual nests relocated to a communal protection cage/s located within the Priority Nest Protection Areas, as per DES methodology. Handling			

ID	Management action	Timing	Location	Responsible persons
	and relocation of eggs will occur in accordance with animal ethics permit approvals to minimise risk of embryo dislocation and other risks to egg viability.			
4d	Protected nests located within Priority Nest Protection Areas will be relocated to an alternative suitable nesting site if they are at risk of inundation from changes in impoundment levels and/or flooding.	In the event that protected nests are at risk of inundation from changes in impoundment levels and/or flooding		
4e	Results of each nesting survey undertaken, details of nests detected, and nest protection activities implemented will be documented as per the Nesting Season Data Sheet provided in Appendix D.	During each monitoring event		
5	Hatching success			
5a 5b 5c	The hatching success of individual nests protected will be recorded throughout the hatching season. Monitoring may include the use of remote cameras to record emergence of hatchlings and/or the physical excavated of the nests to the top of the first egg to check for evidence of hatching. At the end of the hatching success monitoring, predator protection cages and electric fencing will be removed prior to wet season flow events. For those nests that have hatched, the number of eggs from which the hatchlings have successfully emerged will be recorded and compared to the total number of eggs laid. Predated eggshell and evidence of predators (e.g. tracks and scats) will also be recorded Hatching Season Data Sheet provided in Appendix E. Nests that have not hatched at the time of survey will be covered over and reassessed during subsequent monitoring. At the end of the hatching success monitoring, predator protection cages and electric fencing will be removed prior to wet season flow events	Throughout hatching season (September to December) Physical excavation of hatched nests will be conducted based on the timing and abundance of nests laid during the nesting season with hatching success monitoring conducted within two weeks of the expected date of hatching of each nest.	Within Priority Nest Protection Areas	Turtle Nest Protection Team
6	electric tencing will be removed prior to well season flow events.			
62	Monitoring of the turtle population within unstream and downstream of	Twice per year during	Within vicinity of Priority Nest	Supwater
Ua	Rookwood Weir will be implemented for the first five years of Project operation in accordance with Rookwood Weir Operation SMP.	optimal turtle capture conditions as part of	Protection Areas.	Operations Environment
	Surveys will be conducted twice per year during optimal turtle capture conditions. Locations selected for the turtle population surveys will include within the vicinity of the Priority Nest Protection Areas.	Operational SMP		manager

ID	Management action	Timing	Location	Responsible persons
	Standardised turtle capture surveys will be undertaken and may include the use of fyke nets, cathedrals traps, seine nets and/or snorkelling.			
	Turtles captured will be measured and tagged with passive integrated transponder tags, numbered monel metal foot tags and carapace notched. Acoustic tags may also be deployed on captured turtles if required to support the Rookwood Weir Turtle Movement Study.			
	Parameters recorded will include morphometric measurements, age and sexual maturity, reproductive biology and evidence of injury, mortality and disease.			
6b	The Rookwood Weir Operation SMP will be reviewed after five years and ongoing management requirements identified for incorporation into Weir operational plans and/or this Nest Protection Management Plan, as considered necessary and applicable (in collaboration with DES and DCCEEW).	After 5 years of Project operation	NA	Sunwater Operations Environment Manager

4.6 Monitoring and contingency

The success of the Nest Protection Management Plan will be evaluated annually against the performance criteria for each conservation outcome. The suitability of the management actions will be assessed and the requirement for adaptive management identified in light of new information and developments in technology.

Data collected throughout the pre-nesting, nesting, and hatching seasons will be analysed in accordance with the performance criteria to provide an assessment of compliance with conservation outcomes.

4.6.1 Nest habitat suitability

Measure of success: Suitable nesting habitat present within, upstream and/or downstream of Rookwood Weir as defined by the presence of high suitability, confirmed and /or functional nesting banks.

Evaluation methodology: Based on the description of the Priority Turtle Nest Protection Areas as recorded during/prior to the nesting season (refer to Section 4.4.1) and results of nest protection and hatching success monitoring (refer to Sections 0 and 4.4.5, respectively), a nesting habitat suitability rating will be assigned for each Priority Turtle Nest Protection Area based on the following categories:

- Low riverbank with a relatively low gradient slope; and/or predominantly unsuitable substrate (e.g. Gravel); and/or high density of ground/scrub layer vegetation cover; and/or high density of weed species; and/or high density of predator activity.
- Medium riverbank with a relatively medium to steep slope; predominantly sand/loam substrate; and/or medium ground/scrub layer vegetation cover; and/or medium density of weed species; and/or medium density of predator activity.
- High riverbank with a relatively steep slope; sand/loam substrate; and/or low ground/scrub layer vegetation cover; and/or low abundance of terrestrial/aquatic weed species; and/or low abundance of predators.
- Confirmed riverbank in which direct evidence of turtle nesting (e.g. turtle nest or predated egg shell) is observed.
- Functional riverbank were turtle nests successfully hatch leading to recruitment of hatchlings into the population.

Nesting habitat suitability ratings will be assessed to identify if suitable nesting habitat is present within, upstream and/or downstream of Rookwood Weir, as defined by the presence of high suitability, confirmed and/or functional nesting banks.

4.6.2 Nesting activity

Measure of success: Confirmed turtle nesting occurring at one or more Priority Nest Protection Areas within, upstream and/or downstream of Rookwood Weir

Evaluation methodology: Nesting activity including presence/absence of confirmed turtle nesting banks (as defined in Section 4.6.1), number of confirmed turtle nests laid, and distribution of nesting activity (i.e. number of separate nesting banks and location in relation to Rookwood Weir). Measure of success will be determined based on results of nest protection and hatching success monitoring (refer to Sections 4.4.4 and 4.4.5).

4.6.3 Predator control

Measure of success: Successful implementation (>95%) of planned predator control measures each year achieving.

Evaluation methodology: Actual predator control measures implemented will be identified and compared to planned activities. Total numbers of predators removed from the population will be calculated based on number of success culling, trapping and estimates of success based on baiting.

4.6.4 Predator activity

Measure of success: 80% reduction in evidence of predator activity at Priority Nest Protection Areas.

Evaluation methodology: Evidence of predator activity within Priority Nest Protection Areas throughout the turtle nesting season will be recorded during nest protection monitoring (refer to Section 4.4.4) and compared to levels of predator activity recorded prior to the nesting season (refer to Section 4.4.1).

4.6.5 Nest predation rate

Measure of success: 90% reduction in predation of turtle nests compared to pre-offset success.

Evaluation methodology: Nest predation rates within the Priority Nest Protection Areas, as defined by the number of nests wholly or partially predated, will be determined throughout the nesting season (refer to Section 4.4.4 and 4.4.5). The percentage of nests predated within Priority Nest Protection Areas will be compared to the percentage of nest predation recorded during pre-clearance surveys prior to Weir operation. The percentage of nest predation recorded prior to Weir operation to be defined following completion of final pre-clearance surveys in 2022.

4.6.6 Hatchling recruitment

Measure of success: 90% increase in hatching success and recruitment of hatchlings into the population compared to pre-offset success.

Evaluation methodology: Hatching success of nests laid within the Priority Nest Protection Areas and recruitment of hatchlings into the population, as defined by number nests that wholly or partially hatch and the percentage of successful hatchings within each nest, will be determined throughout the nesting season (as defined in Section 4.4.5). Hatching success and recruitment into the population within Priority Nest Protection Areas will be compared to success recorded during pre-clearance surveys prior to Weir operation. The percentage of hatching success and recruitment into the population recorded prior to Weir operation to be defined following completion of final pre-clearance surveys in 2022.

4.6.7 Contingency program

In accordance with the process detailed in Section 6.2 of Rookwood Weir Operations Species Management Plan, in the event that the performance criteria of the Nest Protection Management Plan are not met, as determined through compliance with the measures of success for each performance criteria, corrective actions will be implemented as per the triggers outlined in Table 9.

Table 9 Nest Protection Management Plan performance criteria monitoring and contingency program

Performance criteria	Type of monitoring	Frequency	Monitoring methodology and timing	Contingency program
1. Suitable nesting habitat present within, upstream and/or downstream of Rookwood Weir as defined by the presence of high suitability, confirmed and /or functional nesting banks.	Identification and monitoring of Priority Nest Protection Areas.	Nesting habitat suitability assessed annually during pre- nesting season (February to March); for duration of Nest Protection Management Plans Nesting activity within Priority Nest Protection Areas monitored regularly (indicative frequency of three times per week) during the peak nesting season (April to August).	 Based on the description of the Priority Turtle Nest Protection Areas as recorded during/prior to the nesting season and results of nest protection and hatching success monitoring (as per methodology within Nest Protection Management Plans), a nesting habitat suitability rating will be assigned for each Priority Turtle Nest Protection Area based on the following categories: Low – riverbank with a relatively low gradient slope; and/or predominantly unsuitable substrate (e.g. Gravel); and/or high density of ground/scrub layer vegetation cover; and/or high density of weed species; and/or high density of predator activity. Medium – riverbank with a relatively medium to steep slope; predominantly sand/loam substrate; and/or medium ground/scrub layer vegetation cover; and/or medium density of predator activity. High – riverbank with a relatively steep slope; sand/loam substrate; and/or low ground/scrub layer vegetation cover; and/or low abundance of terrestrial/aquatic weed species; and/or low abundance of predators. Confirmed – riverbank in which direct evidence of turtle nesting (e.g. turtle nest or predated egg shell) is observed. Functional – riverbank were turtle nests successfully hatch leading to recruitment of hatchlings into the population. Nesting habitat suitability ratings will be 	 If no high suitability, confirmed and /or functional nesting banks are found within, upstream or downstream of Rookwood Weir, corrective actions will be developed and implemented. Options may include: Implement additional restoration and rehabilitation works within Priority Nest Protection Areas to achieve high suitability nesting habitat. Restoration and rehabilitation works may include additional predator and weed control, removal of debris from riverbank and/or further exclusion of vehicle/people/cattle. Where a change in bank conditions reduces nesting habitat suitability throughout the nesting season (e.g. following flood event), an alternative Priority Nest Protection Areas may be selected.

Performance criteria	Type of monitoring	Frequency	Monitoring methodology and timing	Contingency program
			assessed to identify if suitable nesting habitat is present within, upstream and/or downstream of Rookwood Weir, as defined by the presence of high suitability, confirmed and/or functional nesting banks.	
2. Confirmed turtle nesting occurring at one or more Priority Nest Protection Area/ within, upstream and/or downstream of Rookwood Weir.	Monitoring of Priority Nest Protection Areas.	Nesting activity within Priority Nest Protection Areas monitored regularly (indicative frequency of three times per week) during the peak nesting season (April to August).	Priority Nest Protection Areas will be monitored regularly (indicative frequency of three times per week) during the peak nesting season (August to December) for the purposes of identifying and protecting individual nests. Nesting is triggered by rainfall and monitoring will occur during and/or immediately following events. Priority Nest Protection Areas will be examined for signs of nesting (which included the presence of turtle tracks, diggings, nests and predated eggshells) using a single strip transect parallel to the water's edge, as per the standard methodology of Limpus <i>et al.</i> 2011. Transects will vary in length and width according to bank morphology and will cover all potentially suitably nesting habitat within the Priority Nest Protection Areas. Any evidence of turtle nesting will be photographed, and the GPS location recorded. Nesting activity including presence/absence of confirmed turtle nests laid, and distribution of nesting activity (i.e. number of separate nesting banks and location in relation to Rookwood Weir). Measure of success will be determined based on results of nest protection and hatching success monitoring.	 If confirmed turtle nesting is not recorded at one or more Priority Nest Protection Areas, corrective actions will be developed and implemented. Options may include: Review results of Broad-Scale turtle Population Monitoring to identify the relative abundance and dynamics of turtles present within the vicinity of the Priority Nest Protection Areas. Review results of Turtle Movement Study to identify potential turtle nesting locations based on movement behaviour. Undertake surveys to identify if turtle nesting activity is occurring outside of Priority Nest Protection Areas. Surveys to be conducted within the impoundment, upstream of the impoundment to Foleyvale Crossing and downstream of the Weir to Hanrahan Crossing to identify turtle nesting activity. Continue to conduct surveys for turtle nesting activity as part of Nest Protection Management Plan until confirmed nesting is recorded.
3. Successful implementation (>95%) of planned predator control	Predator control.	Annually during pre- nesting, nesting and hatching seasons for duration of Nest	Broad-scale predator control will be conducted in accordance with the Turtle Habitat Enhancement Program: Extended	If less than 95% of planned predator control measures are not implemented annually, ccorrective actions will be developed and

Performance criteria	Type of monitoring	Frequency	Monitoring methodology and timing	Contingency program
measures/annual reduction in predator abundance within target area.		Protection Management Plan as per the Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management Plan.	Feral Pest Animal Management Plan. The monitoring of pest animal activity pre- and post-control operations will be undertaken using camera traps, and the recorded feral pest animal activity will be reported annually. This annual report, together with the findings of the Turtle Nest Protection Management reports, will determine future control methodology and effort as well as the duration of management/contingency program to be put in place. The location and type of predator control activities planned and implemented will be documented as per the Predator Control Data Sheet provided in the Turtle Habitat Enhancement Program: Extended Feral Pest Animal Management Plan. Actual predator control measures implemented will be identified and compared to planned activities. Total numbers of predators removed from the population will be calculated based on number of success culling, trapping and estimates of success based on baiting.	implemented. Options may include: Identify the cause for predator control measures not implemented and redesign program to address deficiencies. Implement additional monitoring of Priority Nest Protection Areas to identify predator species (e.g. use of remote cameras) and develop targeted control program where required to achieve reduction in predator activity.
4. 80% reduction in evidence of predator activity at Priority Turtle Nest Protection Areas.	Predator activity.	Predator activity within Priority Nest Protection Areas monitored regularly (indicative frequency of three times per week) during the peak nesting season.	Priority Nest Protection Areas will be examined for signs of predator activity (as a percentage of bank disturbance overall, on upper bank, mid bank and lower bank; evidence predated nests/eggshells) using a single strip transect parallel to the water's edge, as per the standard methodology of Limpus <i>et al.</i> 2011. Transects will vary in length and width according to bank morphology and will cover all potentially suitably nesting habitat within the Priority Nest Protection Areas. Any evidence of predator activity will be photographed, and the GPS location recorded.	 If less than an 80% reduction in evidence of predator activity is recorded at Priority Turtle Nest Protection Areas, ccorrective actions will be developed and implemented. Options may include: Implement additional predator exclusion measures at Priority Nest Protection Areas during the nesting season. Measures may include additional electric fencing, submerged fencing to prevent burrowing, predator cages. Implement additional board-scale predator

Performance criteria	Type of monitoring	Frequency	Monitoring methodology and timing	Contingency program
			Evidence of predator activity within Priority Nest Protection Areas throughout the turtle nesting season will be recorded during nest protection monitoring and compared to levels of predator activity recorded prior to the nesting season (during identification of Priority Nest Protection Areas).	control measures.
5. 90% reduction in predation of turtle nests within Priority Nest Protection Areas compared to pre-offset success.	Nesting and hatching success.	Annually during nesting and hatching seasons.	Nest predation rates within the Priority Nest Protection Areas, as defined by the number of nests wholly or partially predated, will be determined throughout the nesting season as part of nest protection monitoring. The percentage of nests predated within Priority Nest Protection Areas will be compared to the percentage of nest predation recorded during pre-clearance surveys prior to Weir operation. The percentage of nest predation recorded prior to Weir operation to be defined following completion of final pre- clearance surveys in 2022.	 If less than a 90% reduction in predation of turtle nests is recorded, ccorrective actions will be developed and implemented. Options may include: Implement additional predator exclusion measures and broad-scale predator control as defined above. Should evidence of nest predation or other risks to egg survival (e.g. flood event) become apparent, eggs will be removed from the Priority Nest Protection Areas for relocation to an alternative location within the same reach of river (i.e. within impoundment, upstream to Foleyvale Crossing or downstream to Hanrahan Crossing), or for artificial incubation. The methodology for nest excavation, transport, selection of relocation site, and/or artificial incubation will occur in accordance with fauna rehabilitation and animal ethics permits.
6. 90% increase in recruitment of hatchlings into the population compared to pre-offset success.	Hatching success.	Annually during the hatching season (September to December).	Hatching success of nests laid within the Priority Nest Protection Areas and recruitment of hatchlings into the population, as defined by number nests that wholly or partially hatch and the percentage of successful hatchings within each nest, will be determined throughout the nesting season as part of hatchling success monitoring. Monitoring may include the use of remote cameras to record emergence of hatchlings	 If less than a 90% increase in recruitment of hatchlings into the population is achieved, ccorrective actions will be developed and implemented. Options may include: Identify cause of unsuccessful hatching. If predator related, then implement corrective actions associated with reduction in nest predation conservation outcome. If unsuccessful nesting is not related to

Performance criteria	Type of monitoring	Frequency	Monitoring methodology and timing	Contingency program
			and/or the physical excavation of the nests to the top of the first egg to check for evidence of hatching. Hatching success and recruitment into the population within Priority Nest Protection Areas will be compared to success recorded during pre-clearance surveys prior to Weir operation. The percentage of hatching success and recruitment into the population recorded prior to Weir operation to be defined following completion of final pre-clearance surveys in 2022.	 predation, undertake a review, including potentially handling, transporting, relocating and artificially incubating turtle eggs to identify cause of egg mortality. Modify methodology as required. Monitor environment conditions within predator protection cages (e.g. temperature, moisture content) and modify design/location if environmental conditions are found to be contributing to egg mortality. Review all performance criteria for the Nest Protection Management Plan and identify cause/s of insufficient hatchling recruitment. Implement correction actions as required for relevant performance objectives and modify Nest Protection Management Plan to improve recruitment success.

4.7 Reporting requirements

Reporting requirements associated with this Nest Protection Management Plan are described below.

4.7.1 Annual Nest Protection Management Plan Report

An Annual Nest Protection Management Plan Report will be prepared to document the management actions implemented each year and the assess the success of actions against the performance objectives for each conservation outcome. The report will be provided to DES and DCCEEW twelve months after the completion of construction and annually thereafter for the duration of the Nest Protection Management Plan. Specifically, the report will include:

- Introduction project background, legislative requirements and propose of the Nest Protection Management Plans
- Management actions location and description of Priority Nest Protection Areas and justification for selection, description of habitat protection and broad scale predator control measures implemented during the pre-nesting season
- Nest monitoring and protection description of nest protection monitoring conducted throughout the nesting season; details of all confirmed nest and protection measures implemented
- Hatching success hatching success results and recruitment into the population
- Discussion monitoring and evaluation of the Nest Protection Management Plan in accordance with the performance objectives and measures of success for each conservation outcomes. Relevant results of Broad-Scale Turtle Population Monitoring and Turtle Movement Study
- Compliance with success criteria assessment of results against success criteria and identification of any non-compliance triggering contingency program corrective actions
- Correction actions recommendations for adaptive management.

4.7.2 Animal breeding place register

An animal breeding place register (available at: https://environment.des.qld.gov.au/licencespermits/plants-animals/species-management-program) will be maintained. This register will be update when survey / nest protection activities are occurring. The register will maintain accurate records of daily site observations and location of any turtle nests detected. Records will be maintained on any of the actions undertaken in regard to management any known or suspected disturbance or tampering with (including destroyed) nests and any corrective actions implemented. The breeding place register will be made available to DES upon request, within 24 hours of an interaction, and within 10 business days after the expiry of the approved high risk SMP under the NC Act.

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Appendix A Pre-clearance turtle nesting survey results

Site ID	Site location	2019			2020			2021				Total	Total
		Jun	Sep	Dec	Jun	Oct	Dec	Jun	Jul	Aug	Oct	FRT	ALL
Inundation	extent												
F3	Foleyvale downstream			2 nests, 6 eggs + fragments	Faint turtle tracks	6 nests, ~9 eggs + fragments	3 nests, ~25 eggs + fragments				2 nests, ~5 eggs	11 nests, ∼39 eggs	13 nests, ∼45 eggs
F4	Foleyvale downstream			1 nest, ~7 empty nests, 17 eggs	-	1 nest, ~19 eggs + fragments, tracks	1 nest, Shell fragments					1 nest, ~19 eggs + fragments, tracks	3 nests, ~36 eggs
F5	Foleyvale downstream			-	-	1 nest, ~10 eggs + fragments	1 nest, 1 egg + fragments				2 sets of turtle tracks		2 nests, ~11 eggs
F6	Foleyvale downstream	None record	None recorded										
P1	The Pocket			4 nests, ~7 eggs + fragments	Recent track with several nesting attempts.	31 nests, >45 eggs + fragments, recent tracks	6 nests, ~28 eggs + fragments**		1 nest, ∼9 eggs	1 nest, ~ 4 eggs	24 nests, >24 eggs + fragments	31 nests, ∼56 eggs	67 nests, ∼117 eggs
P3	The Pocket									1 nest, ∼1 egg	11 nests, >12 eggs + fragments	12 nests, ≻13 eggs	12 nests, ≻13 eggs
G1	Gogango Mouth 1	None record	ed	·	·	·							
G2	Gogango Mouth 2	-	-	-	-	3 nests, ~15 eggs + fragments					1 nest, ~5 eggs+ fragments	1 nest, ~5 eggs+ fragments	4 nests, ~20 eggs + fragments
G3	Gogango Mouth 3	-	-	-	1 nest, Shell fragments	-							1 nest, Shell fragments
G4	Gogango Creek mouth										3 nests, ~3 eggs*	2 nests, ~2 eggs*	2 nests, ~2 eggs
R5	Rookwood downstream	-	2 nest attempts	3 nests, ∼26 eggs	Turtle tracks with	2 nests, 4 eggs +	Faint track						5 nests, ∼30 eggs

Site ID	Site location	2019	2019					2021				Total	Total
		Jun	Sep	Dec	Jun	Oct	Dec	Jun	Jul	Aug	Oct	FRT	ALL
	of crossing		and turtle tracks	+ fragments	nest attempt	fragments							+ tracks
R6	Rookwood north of crossing	-	-	-	-	1 nest, ~3 eggs	3 nests, Shell fragments						4 nests, ∼3 eggs
R7	Riverslea Crossing	None record	ed										
R8	Riverslea to Rookwood 1	-	-	-	-	13 nests, ~29 eggs + fragments	3 nests, ~36 eggs + fragments		Shell fragments	1 nest, ~1 egg	11 nests, ∼1 egg*	12 nests, >2 eggs	28 nests, ~69 eggs
R9	Riverslea Riffle Complex	-	-	-	-	-	1 nest, Shell fragments						1 nest
R10	Riverslea downstream island	None record	e recorded										
UI1	Upper Inundation Area 1	Not assesse	d (first asses	ssment occurre	ed in June 2021)		None record	ed				
UI2	Upper Inundation Area 2	Not assesse	d (first asses	ssment occurre	ed in June 2021)					1 nest, ~1 egg*	1 nest, ~1 egg*	1 nest, ~1 egg*
UI3	Upper Inundation Area 3	Not assesse	d (first asses	ssment occurre	ed in June 2021)		1 set of turtle tracks			11 nests, ~11 eggs*	11 nests, ∼11 eggs*	11 nests, ~11 eggs*
UI4	Upper Inundation Area 4	Not assesse	Not assessed (first assessment occurred in June 2021)								2 nests, ~2 eggs*	2 nests, ~2 eggs*	2 nests, ~2 eggs*
UI5	Upper Inundation Area 4	Not assesse	Not assessed (first assessment occurred in June 2021)								1 set of turtle tracks		1 set of turtle tracks
UI6	Upper Inundation Area 6	Not assesse	d (first asses	ssment occurre	ed in June 2021))		None record	ed				
UI7	Upper Inundation Area 7	Not assesse	d (first asses	ssment occurre	ed in June 2021)		1 nest, ~9 eggs	1 set of turtle tracks		10 nests, ~10 eggs +	10 nests, ∼10 eggs +	11 nests, ~19 eggs +

Site ID	Site location	2019	2019					2021				Total	Total
		Jun	Sep	Dec	Jun	Oct	Dec	Jun	Jul	Aug	Oct	FRT	ALL
											fragments	fragments	fragments
UI8	Upper Inundation Area 8	Not assesse	d (first asses	sment occurre	ed in June 2021	1)					6 nests, ~6 eggs + fragments	6 nests, ~6 eggs + fragments	6 nests, ~6 eggs + fragments
UI9	Upper Inundation Area 9	Not assesse	d (first asses	sment occurre	ed in June 2021	1)				1 nest, ∼5 eggs	13 nests, ∼13 eggs	14 nests, ∼18 eggs	14 nests, ∼18 eggs
UI10	Upper Inundation Area 10	Not assesse	d (first asses	sment occurre	ed in June 2021	1)		2 nests, ~5-10 eggs		1 nest, ~4 eggs	6 nests, ∼6 eggs	7 nests, ~10 eggs	9 nests, ∼20 eggs
UI11	Upper Inundation Area 11	Not assesse	d (first asses	sment occurre	ed in June 2021	1)		2 nests, ~10-15 eggs			2 nests, ~2 eggs + fragments	2 nests, ~2 eggs + fragments	4 nests, ~17 eggs
Subtotal:	27 sites	0 nests, 0 eggs	2 nest attempts and turtle tracks	10 nests, ~56 eggs + fragments	1 nest, fragments + turtle tracks	58 nests, ~144 eggs + fragments	18 nests, ~90 eggs + fragments	5 nests, ~30 eggs + fragments	1 nest, ~9 eggs + fragments	5 nests, ~15 eggs + fragments	103 nests, ~101 eggs + fragments	123 nests, ~196 eggs + fragments	326 nests, ~641 eggs + fragments
Upstream of	of inundation e	extent											
F1	Foleyvale Crossing	None record	ed										
F2	Foleyvale downstream			~16 possible nests, 7 nests with egg fragments	-	Test nest with faint tracks.	4 nests, ~5 eggs + fragments				1 nest, 1 egg + fragments	5 nests, ~6 eggs + fragments	~12 nests, ~6 eggs + fragments
F7	Foleyvale upstream	None record	ed										
F8	Foleyvale upstream	None record	lone recorded										
F9	Foleyvale upstream	-	-	1 nest, Shell fragments	-	-	-						1 nest, Shell fragments
F10	Foleyvale upstream	-	-		-	2 nests, ~15 eggs + fragments	1 nest, Shell fragments						3 nests, ~15 eggs + fragments

Site ID	Site location	2019			2020		2021				Total	Total	
		Jun	Sep	Dec	Jun	Oct	Dec	Jun	Jul	Aug	Oct	FRT	ALL
F11	Foleyvale upstream	-	-	10 nests, ~13 eggs + fragments	-	6 nests, ~10 eggs + fragments	3 nests, ~5 eggs + fragments						19 nests, 28 eggs + fragments
Subtotal:	7 sites	0 nests, 0 eggs	0 nests, 0 eggs	17 nests, ~13 eggs + fragments	0 nests, 0 eggs	8 nests, ~25 eggs + fragments	8 nests, ~10 eggs + fragments	0 nests, 0 eggs	0 nests, 0 eggs	0 nests, 0 eggs	1 nest, 1 egg + fragments	5 nests, ~6 eggs + fragments	35 nests, ~49 eggs + fragments
Downstream	n of inundation a	area											
H1	Hanrahan far downstream	-	-	-	-	2 nests, ~17 eggs + fragments	1 nest, Shell fragments				9 nests, ~35 eggs + fragments	9 nests, ~35 eggs + fragments	12 nests, ~52 eggs + fragments
R1	Lawries Bend	Shell fragments + multiple turtle tracks	-	-	Very recent turtle tracks and nest attempt	-	-				7 nests, ~7 eggs + fragments	7 nests, ~7 eggs + fragments	7 nests, ~7 eggs + fragments
R2	Rookwood to Hanrahan Crossing	-	-	-	Multiple turtle tracks	-	-				7 nests, ~7 eggs + fragments	7 nests, ~7 eggs + fragments	7 nests, ~7 eggs + fragments
R3	Rookwood to Hanrahan Crossing	None record	ed	1	1	1	1	1	1	1			
R4	Hanrahan Crossing upstream	Multiple turtle tracks	-	-	Turtle track with no nesting attempt	1 nest, 1 egg in fragments	3 nests, ~44 eggs + fragments				10 nests, ~56 eggs + fragments	13 nests, ~100 eggs + fragments	14 nests, ~101 eggs + fragments
Subtotal:	5 sites	Shell fragments + turtle tracks	0 nests, 0 eggs	0 nests, 0 eggs	Multiple turtle tracks	3 nests, ~18 eggs + fragments	4 nests, ~44 eggs + fragments	0 nests, 0 eggs	0 nests, 0 eggs	0 nests, 0 eggs	33 nests, ~105 eggs + fragments	36 nests, ~149 eggs + fragments	40 nests, ~167 eggs + fragments
Upstream o	n the Mackenzie	e River											
T1 DLB	Tartrus Weir to rockbar (left bank)	Not assesse	d (first asses	sment occurre	ed in December	2020)	5 nests, ~7 eggs + fragments	9 nests, ~87 eggs + fragments	3 nests, ~ 18 eggs + fragments		13 nests, ~13 eggs + fragments	13 nests, ~13 eggs + fragments	30 nests, ~125 eggs + fragments

Site ID	Site location	2019	2019			2020						Total	Total
		Jun	Sep	Dec	Jun	Oct	Dec	Jun	Jul	Aug	Oct	FRT	ALL
T1 DRB	Tartrus Weir to rockbar (right bank)	Not assesse	Not assessed (first assessment occurred in December 2020)					6 nests, ~67 eggs + fragments	1 Nest, ~13 eggs + fragments		13 nests, ~66 eggs + fragments	13 nests, ~66 eggs + fragments	34 nests, ~185 eggs + fragments
T2 DLB	Tartrus rockbar to culvert (left bank)	Not assesse	lot assessed (first assessment occurred in December 2020)						3 nests, ~24 eggs + fragments		6 nests, ~24 eggs + fragments	6 nests, ~24 eggs + fragments	12 nests, ~69 eggs + fragments
T2 DRB	Tartrus rockbar to culvert (right bank)	Not assesse	d (first asses	sment occurre	ed in Decembe	r 2020)	None recorde	ed					
T3 DLB	Tartrus downstream of culvert (left bank)	Not assesse	d (first asses	sment occurre	ed in December	r 2020)	8 nests, ~19 eggs + fragments	1 set of turtle tracks			1 nest, ~6 eggs + fragments	1 nest, ~6 eggs + fragments	9 nests, ~25 eggs + fragments
Subtotal	5 sites	Not assesse	Not assessed (first assessment occurred in December 2020)					15 nests, ~163 eggs + fragments	7 nests, ~55 eggs + fragments	0 nests, 0 eggs	33 nests, ~109 eggs + fragments	33 nests, ~109 eggs + fragments	52 nests, ~304 eggs + fragments
Total	44 sites	Shell fragments + turtle tracks	2 nest attempts and turtle tracks	27 nests, ~69 eggs + fragments	1 nest, fragments + turtle tracks	69 nests, ~187 eggs + fragments	60 nests, ~230 eggs + fragments	19 nests, >146 eggs + fragments	8 nests, ~64 eggs + fragments	43 nests, ~361 eggs + fragments	177 nests, >347 eggs + fragments	197 nests, ~460 eggs + fragments	404 nests, ~1,404 eggs + fragments
Note: * den	otes nests fitted	with nest prote	ection, green	shading – Fitz	zroy River turtle	e nests, grey s	hading – unider	ntified nests du	iring Fitzroy Ri	ver turtle breed	ding season		

Appendix B

Predicted inundation of confirmed turtle nesting habitat

Site ID	Site	Inundation impact area (ha)
F4 F5	Foleyvale downstream Foleyvale downstream	No impact to turtle nesting
P1	The Pocket (upstream)	No impact to turtle nesting



Site ID	Site	Inundation impact area (ha)
G4	Gogango Creek mouth	No impact to turtle nesting
R5	Rookwood downstrea m of crossing	Measure 2 Total 2.241 ha hectares * Cartesian • Elipsoidal F Info
R6	Rookwood north of crossing	tew configuration Cose Heb





Site ID	Site	Inundation impact area (ha)
UI2	Upper Inundation Area 2	Measure X Total 0.216 ha hectares Cartesian Image: Ellipsoidal Info Image: Measure X

UI3 Upper	
Inndation Area 3	lose Help

Site ID	Site	Inundation impact area (ha)
		Measure
		Total 0.161 ha hectares
		Cartesian
		Info New Configuration Cose Help
UI5	Upper Inundation Area 5	Mesure Image: Contestant Imag



Site ID	Site	Inundation impact area (ha)
UI8	Upper Inundation Area 8	2 Maave Tel 0.408 ha incluis info ge: ontgoete: don tele
U19	Upper Inundation Area 9	
UI1 0	Upper Inundation Area 10	No impact to turtle nesting

Site ID	Site	Inundation impact area (ha)
		LUIIO
UI1 1	Upper Inundation Area 11	No impact to turtle nesting

Appendix C Pre-nesting Season Data Sheet

Pre-nesting Season Data Sheet

Date:			
Survey team members:			
Location: (latitude and longitude)			
Priority Nest Protection Bank: (name and site identification number)			
Weather conditions:			
Photograph reference numbers:			
internals along bank)			
Bank profile (m):	Height:	Length:	Width:
Average bank slope: (vertical (89–90°); steep (60–80°); moderate (30-60°); low (10–30°) and; flat (<10°))			
Average bank composition (%):	Cobble/pebble (%):	Gravel (%):	Coarse sand (%):
	Fine sand (%):	Silt/clay (%):	Other (%):
Riparian canopy vegetation: (None (none); little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%))	Ground cover:	Scrub cover:	Canopy cover:
Weed density:	Overall density:	Density per species:	
(little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%))			
Evidence of predator activity: (little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%))	Overall activity per species (%):	Upper bank activity per species (%):	Mid bank activity per species (%):

	Lower bank per species activity (%):		
Evidence of cattle activity: (little (1–10%); some (10–25%);	Overall activity (%):	Upper bank activity (%):	Mid bank activity (%):
moderate (25–50%) and extensive (>50%))			
	Lower bank activity (%):		
Flow level:			
(None (isolated pools); low (<watermark); moderate<br="">(=watermark); high (>watermark); flood)</watermark);>			
Habitats adjacent:			
(deep pool (>0.5 m); shallow pool (<0.5 m); run; riffle)			

Habitat protection activities

Activity	Date implemented	Location	Details

Appendix D Nesting Season Data Sheet

Nesting Season Data Sheet

Date:			
Survey team members:			
Priority Nest Protection Bank: (name, site identification number)			
Nesting survey transit:			
(length and width of each transit), GPS coordinates - latitude and longitude - for start and end locations)			
Weather conditions:			
Photograph reference numbers:			
(north, south, east and west at 50 m internals along bank)			
Riparian canopy vegetation:	Ground cover:	Scrub cover:	Canopy cover:
(None (none); little (1–10%); some (10– 50%); moderate (50–75%) and extensive (>75%))			
Weed density:	Overall density:	Density per species:	
(little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%))			
Evidence of predator activity: (little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%))	Overall activity per species (%):	Upper bank activity per species (%):	Mid bank activity per species (%)"
	species activity (%):		
	Overall activity (%):	Linner hank activity	Mid bank activity
Evidence of cattle activity: (little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%))		(%):	(%)"
	Lower bank activity (%):		

Flow level: (None (isolated pools); low (<watermark); (="watermark);<br" moderate="">high (>watermark); flood)</watermark);>	
Habitats adjacent: (deep pool (>0.5 m); shallow pool (<0.5 m); run; riffle)	
Evidence of nesting: (number of tracks, test holes, confirmed nests, predated nests)	

Nesting record

Nesting record identification number:			
Priority Nest Protection Bank: (name and site identification number)			
Date:			
Location of nesting record: (latitude and longitude)			
Type of nesting activity: (track, test hole, nest, egg shell)			
Turtle species:			
Photograph reference numbers:			
(photographs of nesting activity -nest, eggs, egg shell)			
Average bank slope:			
(vertical (89–90°); steep (60–80°); moderate (30-60°); low (10–30°) and; flat (<10°))			
Distance of nest from water (m):			
Height above the water's surface (m):			
Average bank composition (%):	Cobble/pebble (%):	Gravel (%):	Coarse sand (%):
	Fine sand (%):	Silt/clay (%):	Other (%):
Depth of nest to top of egg (cm):		I	1
Egg diameter (cm):			
Egg length (cm):			
Number of eggs within nest:			
Evidence of nest predation:			
(number of eggs predation, species of predator)			
Predator protection actions implemented:			

Appendix E Hatching Season Data Sheet

Hatching Season Data Sheet

Date:			
Survey team members:			
Location: (latitude and longitude)			
Priority Nest Protection Bank: (name and site identification number)			
Weather conditions:			
Photograph reference numbers: (north, south, east and west at 50 m internals along bank)			
Riparian canopy vegetation: (None (none); little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%))	Ground cover:	Scrub cover:	Canopy cover:
Weed density: (little (1–10%); some (10–50%); moderate (50–75%) and extensive (>75%))	Overall density:	Density per species:	<u>.</u>
Evidence of predator activity: (little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%))	Overall activity per species (%):	Upper bank activity per species (%):	Mid bank activity per species (%):
	Lower bank per species activity (%):		
Evidence of cattle activity: (little (1–10%); some (10–25%); moderate (25–50%) and extensive (>50%))	Overall activity (%):	Upper bank activity (%):	Mid bank activity (%):
	Lower bank activity (%):		

Flow level: (None (isolated pools); low (<watermark); moderate<br="">(=watermark); high (>watermark); flood)</watermark);>	
Habitats adjacent: (deep pool (>0.5 m); shallow pool (<0.5 m); run; riffle)	

Nesting record

Nest identification number	Number of eggs in nest	Number of eggs hatched	Number of eggs unviable	Number of eggs predated

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