Rookwood Weir

Operations Phase - Annual Turtle Monitoring Report 2024-25

Tunuba and Sunwater

20 June 2025

→ **The Power of Commitment**

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Executive summary

The purpose of this Operations Phase Annual Monitoring Report 2024-25 is to assess the effectiveness of the Rookwood Weir turtle passage infrastructure and turtle protection design features against agreed success criteria, and provide information on the relative abundance, dynamics, health and movement behaviour of the white-throated snapping turtle (*Elseya albagula*) and Fitzroy River turtle (*Rheodytes leukops*) population within the vicinity of Rookwood Weir. This monitoring has been conducted in accordance with the Rookwood Weir Operations Species Management Plan (SMP) to fulfil State and Commonwealth project approval conditions.

Year 1 2024-25 involved monitoring of turtle movement behaviour within the turtle passage constructed at Rookwood Weir, and broad-scale monitoring at areas upstream and downstream of the weir. Methods used for the turtle passage monitoring included turtle capture surveys, acoustic telemetry, passive integrated transponder (PIT) and camera monitoring, supported by inspectional and observational records. Broad-scale monitoring methods included turtle capture surveys and acoustic telemetry.

Turtle capture surveys recorded four turtles from within the turtle passage: one female sub-adult Fitzroy River turtle, two male Krefft's River turtles (*Emydura macquarii krefftii*), and one female saw-shelled turtle (*Wollumbinia latisternum*). In addition, 433 turtles were captured upstream or downstream of the weir during broad-scale monitoring. Of the 63 white-throated snapping turtles captured in Year 1 2024-25, 51 were tagged with acoustic tags bringing the total number of turtles tagged since 2017 to 97. A total of 16 Fitzroy River turtles were capture in Year 1 2024-25 with 14 of these tagged with acoustic tags to achieve a total of 76 turtles tagged since 2017.

Of the 97 acoustic tags deployed on white-throated snapping turtle before March 2025, 35 white-throated snapping turtle were detected in 2024-25. During this time, 26 turtles were recorded downstream from Rookwood Weir, and 14 were recorded upstream between the weir and The Pocket. Five white-throated snapping turtle were detected making a complete movement past Rookwood Weir (i.e. recorded both upstream and downstream of the weir) between January 2024 and March 2025. Three white-throated snapping turtle were recorded moving in a downstream direction during weir overtopping events and two turtles moved upstream. Although the turtles that moved upstream were not detected by the acoustic hydrophones, it is assumed these turtles moved upstream via the turtle passage as the turtles were not recorded within the fishway. In addition, three white-throated snapping turtle were detected at the receiver station placed in resting pool DSRP8 in November 2024 indicating that the turtles successfully found the turtle ramp entrance and ascended to the first resting pool. One adult female white-throated snapping turtle was captured by the remote cameras within the USRP1 indicating the turtle had successfully ascended the ramp sections to reach the abutment tunnel. A total of 18 white-throated snapping turtle appeared to be attracted to the turtle passage being detected by the acoustic hydrophone located at the downstream ramp entrance. In total, the operations phase monitoring detected six white-throated snapping turtle attempting to use the turtle passage with of two turtles successfully moving upstream past Rookwood Weir.

Of the 76 acoustic tags deployed on Fitzroy River turtle before March 2025, 18 were detected in 2024-25. During this time (2024-25), 14 turtles were recorded downstream from Rookwood Weir and five were detected upstream between the weir and The Pocket. One tagged Fitzroy River turtle was detected on both sides of the weir and is assumed to have moved downstream via the spillway during weir overtopping in February 2024. No Fitzroy River turtle were detected at any of the receivers positioned within the turtle passage. However, one Fitzroy River turtle was observed by Sunwater within a resting pool adjacent to the abutment tunnel on the upstream side of the passage (USRP 1-3) and the one sub-adult identified within the turtle passage during turtle capture surveys recorded the successful movement of this species through the turtle passage past Rookwood Weir. Nine Fitzroy River turtle appeared to be attracted to the turtle passage being detected by the acoustic hydrophone located at the downstream ramp entrance. In total, the operations phase monitoring detected two Fitzroy River turtle attempting to use the turtle passage with of one turtle successfully moving upstream past Rookwood Weir.

In addition, remote cameras recorded an additional nine unidentified turtles using the turtle passage between November 2024 and March 2025. Captured imagery indicates that turtles are utilising both the resting pools and the ramp sections. It is suspected that individuals may remain in resting pools for several hours to multiple days.

Since the commencement of weir operations, the distribution of white-throated snapping turtles within the study area has decreased. Prior to 2024, turtles were detected throughout the full extent of the acoustic array with the

highest number of detections recorded around Rookwood, Gogango Creek and Lawries bend. Since weir operations commenced, the greatest numbers of tagged turtles have been detected immediately upstream and downstream of the weir with very few turtles detected at the outer limits of the array upstream of Riverslea and below Lawries bend.

The average home range occupied by a tagged white-throated snapping turtle for the whole tracking duration was 11.0 km (SE = 0.97 km), with the home range for adult males (13.7 km, SE = 1.35 km) higher than that of adult females (8.48 km, SE = 1.32 km). The extent of river occupied by male white-throated snapping turtle were generally larger than females between October – April, with males having the largest home ranges between December and March. Female home ranges were however typically larger than male home ranges between May – August, the nesting season for this species. Comparison of home ranges between pre-construction and operation indicates that mean monthly home range of female white-throated snapping turtle were greatest between 2017–2019, then gradually decreased in size from 2020 onwards to the smallest home range size in 2024. Mean monthly home range of males was similar between years. As observed during pre-construction and construction phases, large movements of white-throated snapping turtle were detected in association with flow events. The majority of movements were undertaken by turtles located downstream of the weir with movements typically between Rookwood, Lawries bend and Hanrahan Crossing. One female white-throated snapping turtle was recorded moving upstream from Rookwood Weir to Gogango Creek during the nesting season then returning to the weir. Prior to operation of Rookwood Weir, Gogango Creek was identified as a white-throated snapping turtle nesting area based on the relatively high numbers of females recorded moving to this area during the nesting season.

Similarly, since the commencement of weir operations, the distribution of Fitzroy River turtles within the study area has decreased. This species was previously concentrated around the Riverslea and Rookwood pool-riffle sequences and pools immediately downstream. From 2024 onwards, greater numbers of tagged Fitzroy River turtle were detected downstream of the weir between Rookwood Weir site and Rookwood far downstream with only five tagged Fitzroy River turtle detected upstream of the weir site from 2024 onwards. The large number of turtles previously recorded around Riverslea have either left the acoustic array or the batteries within the acoustic tags have gone flat since the weir commenced operations.

The average extent of river occupied by a tagged Fitzroy River turtle for the entire tracking duration was 5.03 km (SE = 0.76 km) with the home range of adult females (6.44 km, SE = 1.05 km) generally larger than that of males (3.78 km, SE = 0.79 km). The home range of male Fitzroy River turtle, peaked during April (mean = 1.88 km, SE = 0.39 km, n = 27 replicates), with individuals maintaining highly confined home ranges (mean <0.4 km) between the months of July – November. In contrast, female Fitzroy River turtle occupied large (mean >1.0 km) monthly home ranges in September and October (coinciding with the Fitzroy River turtle nesting season, with another peak in home range size between March and May. Mean monthly home range size of females since weir operations commenced is similar to pre-development and construction phases while mean monthly home range size of male Fitzroy River turtles was higher in 2024 than previous years. Three female Fitzroy River turtle were recorded undertaking large distance migrations during the moderate flows in January 2025. These turtles all moved in a downstream direction from Rookwood Weir to Lawries bend or from Lawries bend to Hanrahan Crossing.

Overall, there was an increase in the number of white-throated snapping turtles with minor and major injuries was detected in Year 1 2024-25 in comparison to pre-construction and construction phase monitoring. Rates of injuries in Fitzroy River turtles were lower in Year 1 2024-25 in comparison to previous monitoring, however, one deceased adult Fitzroy River turtle was found by Sunwater on the right bank immediately adjacent to the Rookwood Weir abutment. The turtle was found in the advanced stages of decay, and the turtle's carapace had sustained severe damage indicative of forceful contact with a hard structure.

As required by Project approval conditions, the results of the operations phase monitoring were assessed against 18 success criteria developed for the protection of turtles, turtle movement and habitat. Of the success criteria assessed, six were achieved, six were partially achieved and four were not achieved in Year 1 2024-25 of Rookwood Weir operations. The success criteria which were not achieved were primarily related to percentage and/or number of turtles successfully using the turtle passage. Corrective actions were recommended for ten success criteria; those that were either not achieved or partially achieved. The key assessment findings included:

– Both the white-throated snapping turtle and Fitzroy River turtles were confirmed successfully ascending the turtle passage ramp and pools sections, moving through the abutment tunnel and descending into the weir

pool to successfully move upstream pass Rookwood Weir. However, the number of turtles that successfully moved upstream past the weir was low in relation to those recorded partially utilising the turtle ramp. The number of turtles attracted to the turtle passage entrance was also higher than the number of turtles locating and ascending the turtle passage. Overall, the number of turtles utilising the turtle passage was too low to assess seasonal and sex-related differences in movements.

– There was no evidence of predation of turtles within the turtle passage however, monitoring indicates the weir and/or turtle passage has increased the rate of minor and major injuries in the white-throated snapping turtle and there was one mortality of a Fitzroy River turtle as a result of major shell damage. There was no evidence of turtle injury/mortality associated with the weir trash screens, inlets or fishway.
– Overall, habitat conditions within the turtle passage were suitable for turtles however, the small attraction flow at the funnel shaped entrance, high velocity flow on the ramp sections, algae growth, and sediment build up within resting pools were identified as having potential to impact turtle movement and/or habitat suitability.
– Suitable habitat for white-throated snapping turtle and Fitzroy River turtles remains present within, upstream and downstream of Rookwood Weir. Both species were confirmed present with the Rookwood Weir impoundment although, number of turtles captured and detected by the acoustic hydrophones was lower upstream of the weir than downstream. The distribution of turtle recorded by the acoustic hydrophones has constricted since the start of weir operations with the majority of turtles now located immediately upstream and downstream of Rookwood Weir. The mean monthly home range size of female white-throated snapping turtles has reduced since weir operations. Suitable nesting habitat with confirmed evidence of nesting was observed on the left bank immediately downstream of Rookwood Weir and at Hanrahan Crossing. The capture of two hatchling turtles (one white-throated snapping turtle and one Krefft's river turtle) at Gogango Creek indicates nesting of these species may have occurred within the Rookwood Weir pool since initial impoundment.

Ten success criteria were not achieved or only partially achieved in Year 1 2024-25, with all meeting the threshold for corrective action. However, practical and technical difficulties with monitoring equipment limited the information available for assessment and as such, it is recommended that more data is obtained to accurately access compliance with success criteria before corrective actions are initiated. Specifically, it is recommended that the placement, type and number of remote cameras is reviewed to allow continuous monitoring of turtle behaviour along the full length of the turtle passage. The PIT tag readers within the turtle passage required review to confirm they are operating as intended and repaired if required. The additional 51 and 14 acoustic tags deployed on white-throated snapping turtle and Fitzroy River turtles, respectively, during Year 1 2024-25 will provide additional acoustic data for analysis in future monitoring. Capture and monitoring of Fitzroy River turtles upstream of Rookwood Weir is expected to continue to be difficult due to the limited turtle capture methods available for this species within the weir pool habitat. Identification of potentially suitable turtle capture locations within the weir pool should be investigated and targeted for future monitoring where possible to increase the number of Fitzroy River turtles with acoustic tags located upstream of Rookwood Weir. It is recommended that monitoring of turtle passage conditions continues regularly as required and maintenance / repairs conducted as required. Standardisation of *in-situ* water quality measurements and assessments is recommended as results differed between Sunwater and GHD.

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Acronyms and abbreviations

Acronyms and abbreviations	Description
AEIS	Addendum Environmental Impact Statement
AHD	Australian Height Datum
AMTD	Adopted Middle Threat Distance
°C	Degrees Celsius
cm	Centimetres
COA	Centres of Activity
CoG	Coordinator General
Cumecs or m^3/s	Cubic Metre per Second
DA	Development Application
DCCEW	Department of Climate Change, Energy, Environment and Water
DETSI	Department of Environment, Tourism, Science and Innovation
DSRP	Downstream Resting Pool
EC	Electrical conductivity
EHP	Department of Environment and Heritage
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FRT	Fitzroy River turtle
FNU	Formazin Nephelometric Units
FSL	Full Supply Level
g	Grams
ha	Hectare
HW	Headwater
km	Kilometre
km^2	Square kilometre
kg	Kilogram
LFRIP	Lower Fitzroy River Infrastructure Project
m	Metre
m/s	Meters per second
max	Maximum
min	Minimum
mg	Milligrams
ML	Megalitres
mm	Millimetres
µS	Microsiemens
NC Act	*Nature Conservation Act 1992*
NPMP	Nest Protection Management Plan
NTU	Nephelometric Turbidity Units
PIT	Passive Integrated Transponder
RL	Relative Level

Acronyms and abbreviations	Description
SCL	Straight carapace length
SMP	Species Management Plan
TW	Tailwater
USRP	Upstream Resting Pool
WTST	White-throated snapping turtle

1. Introduction

1.1 Purpose of this report

The purpose of this Operations Phase Annual Monitoring Report 2024-25 is to assess the effectiveness of the Rookwood Weir turtle passage infrastructure and turtle protection design features against agreed success criteria, and provide information on the relative abundance, dynamics, health and movement behaviour of the white-throated snapping turtle (*Elseya albagula*) and Fitzroy River turtle (*Rheodytes leukops*) population within the vicinity of Rookwood Weir. Operations phase monitoring has been completed to comply with approval conditions (EPBC 2009/5173 and Coordinator General (CoG) Evaluation Report, CoG, 2016) and management actions outlined in the Rookwood Weir Operations Species Management Plan (SMP; RWW-GHD_ENV-MP-003; GHD, 2023). This report is required to be submitted to the Queensland Department of Environment, Tourism, Science and Innovation (DETSI) and the Commonwealth Department of Climate Change, Energy, Environment and Water (DCCEEW), and published online, within 12 months of the completion of construction of Rookwood Weir and annually thereafter for five years.

This report has been prepared by GHD Pty Ltd (GHD) on behalf of Tunuba Pty Ltd (Tunuba) and Sunwater Limited (Sunwater) to address this requirement. The report outlines the methodology and results from the first year of turtle passage and broad-scale turtle monitoring conducted under the Rookwood Weir Operation Phase Turtle Monitoring Specification. As required under the Project's approval conditions, the report includes an assessment of turtle movement and the observed performance of relevant infrastructure and design features, in the context of the established success criteria. This document represents the first of five planned annual reports, covering the period from April 2024 to May 2025.

Specifically, the report includes:

- **Introduction** – describes the Project background including aims and objectives of the operations phase monitoring.
- **Methodology** – describes the turtle passage and broad-scale monitoring methodologies implemented during Year 1 2024-25 of Rookwood Weir operational phase, including maps of monitoring locations, and imagery of turtle capture techniques and tagging procedures.
- **Results and discussion** – presents and discusses the results of turtle capture field surveys and tracking of turtle movements.
- **Compliance with success criteria** – assessment of results against success criteria.
- **Corrective actions** – outlines any corrective actions required based on success criteria that were not achieved.
- **Conclusions and recommendations** – provides a summary of the assessment findings and future recommendations.
- **Supporting documentation** – including data, photographs, observation and inspection forms, and curricula vitae.

1.2 Project background

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

As a component of the Lower Fitzroy River Infrastructure Project (LFRIP), Rookwood Weir has been constructed by Sunwater to satisfy short-to medium- term water supply. The weir infrastructure spans 210 metres (m) across the river and has an approximate fixed crest of relative level (RL) 46.2 m Australian Height Datum (AHD). The Weir site is approximately 15 kilometres (km) north of Gogango adjacent to Thirsty Creek Road (Figure 1.1). Gogango lies approximately 66 km southwest of Rockhampton along the Capricorn Highway. The impoundment at full supply level (FSL) extends up the Fitzroy River and into the Mackenzie River (322 km Adopted Middle Thread

Distance (AMTD)) and Dawson River (10 km AMTD). The construction phase of Rookwood Weir commenced in December 2020 and was completed in November 2023. Operation of the weir officially commenced in June 2024, following a commissioning period.

An environmental impact statement (EIS) (GHD, 2015), including an addendum (AEIS) (GHD, 2017) was approved by the Queensland Government's CoG in December 2016 (CoG, 2016) and the Federal Minister for Environment in February 2017 (EPBC 2009/5173), subject to conditions. These conditions included the requirement to design, construct and monitor turtle passage infrastructure and turtle protection design features at Rookwood Weir.

In accordance with EPBC Act Approval Condition 7 and CoG Appendix 2, Schedule 1, Part B Condition 2, a Turtle Movement Study was conducted during the Project design phase to collect baseline data on turtle movement patterns and home range size. The Turtle Movement Study was conducted for four years prior to construction and three years during construction (total seven years implementation (2017 – 2023)). Results of the Turtle Movement Study informed the design of the turtle passage infrastructure and turtle protection design features of the weir, and the development of quantifiable success criteria for demonstrating successful turtle movement (refer to Section 1.2.2).

The turtle passage infrastructure at Rookwood Weir consists of a 172 m long by 2 m wide sloped turtle ramp with resting pools every 15 m (Figure 1.2). The ramp varies in slope up to a maximum of 45 degrees and is textured with exposed aggregate (5 mm greencut) to create a roughened surface for the turtles to grip. Stainless steel resting pool shelters provide shade and protection within each resting pool. A small attraction flow is provided down the ramp and permanent water is contained within the resting pools. The water is distributed through pipework with hand valves used to evenly distribute the discharge through each resting pool.

The turtle passage operates from 0.5 m below minimum headwater and tailwater levels, up to a 1 in 5-year spilling event. The entry and exit points of the turtle passage are located at the river margins where turtles can access them during low velocity conditions. A widened (6 m) funnel entrance/exit is provided both upstream and downstream to increase the area over which turtles can access the turtle passage at minimum headwater and tailwater conditions. The downstream entrance is immediately adjacent to the low flow outlet and fishway.

The turtle passage was required to pass through the right abutment to minimise the length of the ramp and comply with dam safety requirements. The abutment throughfare has been positioned as close to the surface as possible and a mesh grid roof provided to maximise natural light and provide a view to the sky.

The structural components of Rookwood Weir and the turtle passage infrastructure have been designed to avoid/minimise risk of turtle injury and mortality. Key turtle protection design features within the Rookwood Weir include:

- A fixed crest Conventional Vibrated Concrete (CVC) ogee spillway to provide a smooth formed surface finish at the crest of the weir in the spillway section.
- Stilling basin that extends across the full length of the spillway to prevent turtles being projected against hard concrete during spilling events.
- Type 1 stilling basin without baffles or dissipator teeth to avoid turtles contacting hard structures.
- A smooth stilling basin floor with a 45-degree sloped end sill below lowest tailwater to allow turtles to move freely between the stilling basin and downstream approach channel.
- Computational fluid dynamics modelling of turbulence conditions in the stilling basin was undertaken to provide hydraulic flow paths that allow turtles to escape extreme turbulence locations.
- A minimum tailwater depth of 2 m is provided during non-spilling conditions to provide sufficient water depth for downstream turtle passage at commence of spilling and during non-spilling conditions.
- Trash and inlet screens are provided to prevent turtles entering the outlet works from the impoundment.
- The inlet screens for the outlets are designed to prevent turtles being trapped by high water pressures on the upstream side of the outlet works. The outlet screens are inclined at 45 degrees to the flow channel. Screen openings are 20 mm with a maximum water velocity through the screen of approximately 0.3 m/s. The 0.3 m/s velocity occurs at a maximum discharge of 15 m^3/s through the outlet, which will occur infrequently. There is no discharge/flow through the outlet screens during spilling conditions.

- 500 mm wide fishway attraction slots are designed to allow turtle access to the fishway lock chambers and prevent turtles getting stuck in the slots.
- Lock chambers are designed to minimise turbulence conditions within the chambers and avoid injury of turtles.
- Diffusers are included within the lock chambers to present turtle access to outlets and provide safe hydraulic conditions during attraction flow release.
- Height of low flow outlet weir (>6 m) is designed to prevent turtle access during non-spilling conditions.
- Side-winder gate included in low flow outlet to allow turtles to exit the area following elevated tailwater.
- Selector bulks used to select the draw off level for water quality control in discharges.
- Actuators exposed to the environment feature leakage chambers attached to a leakage drain line for collection to prevent contamination of oil to the waterway in the event of actuator leak.
- Shelters are positioned within all resting pools to provide protection to turtles along the turtle passage.
- Turtle passage ramp and pools contain 0.5 m high inward sloping walls and smooth surfaces (anti-graffiti paint) to prevent turtles falling or climbing unsafe locations.
- Turtle passage infrastructure is textured with exposed aggregate (5 mm) to create a roughened surface for the turtles to grip and minimise risk of falls.
- Constant water supply provided within the turtle passage infrastructure to maintain water quality conditions within resting pools.
- Access to weir infrastructure for monitoring of turtle populations is facilitated.

In accordance with Project approval conditions (refer to Section 1.2.1), the turtle passage infrastructure and turtle protection design features are required to be monitored to assess their effectiveness against the approved success criteria (refer to Section 1.2.2). The deployment of identification and acoustics tags on white-throated snapping turtles and Fitzroy River turtles, completed as part of the baseline and construction phase Turtle Movement Study, will facilitate ongoing monitoring of the turtle passage infrastructure and turtle protection design features throughout Project operation.

The turtle passage infrastructure design is experimental and although based on best available information, it is not yet known whether the turtles will use the passage or if the success criteria developed are appropriate for the two threatened turtle species. The operations phase monitoring will occur during a period when turtle movement behaviour is likely to be impacted by the completion of construction and commencement of operation. It is unknown how long it may take for habitat conditions to stabilise and turtle movement behaviour to reflect operational conditions following the completion of construction and associated river impoundment. The operations phase monitoring is therefore expected to be adaptive to account for unforeseen circumstances, as well as expected variability in environmental conditions (e.g., flow events) that can influence monitoring methodology. A range of monitoring techniques have been selected for implementation to allow for contingency in data capture. Over time, results of the monitoring program are expected to inform refinement of the monitoring program design.

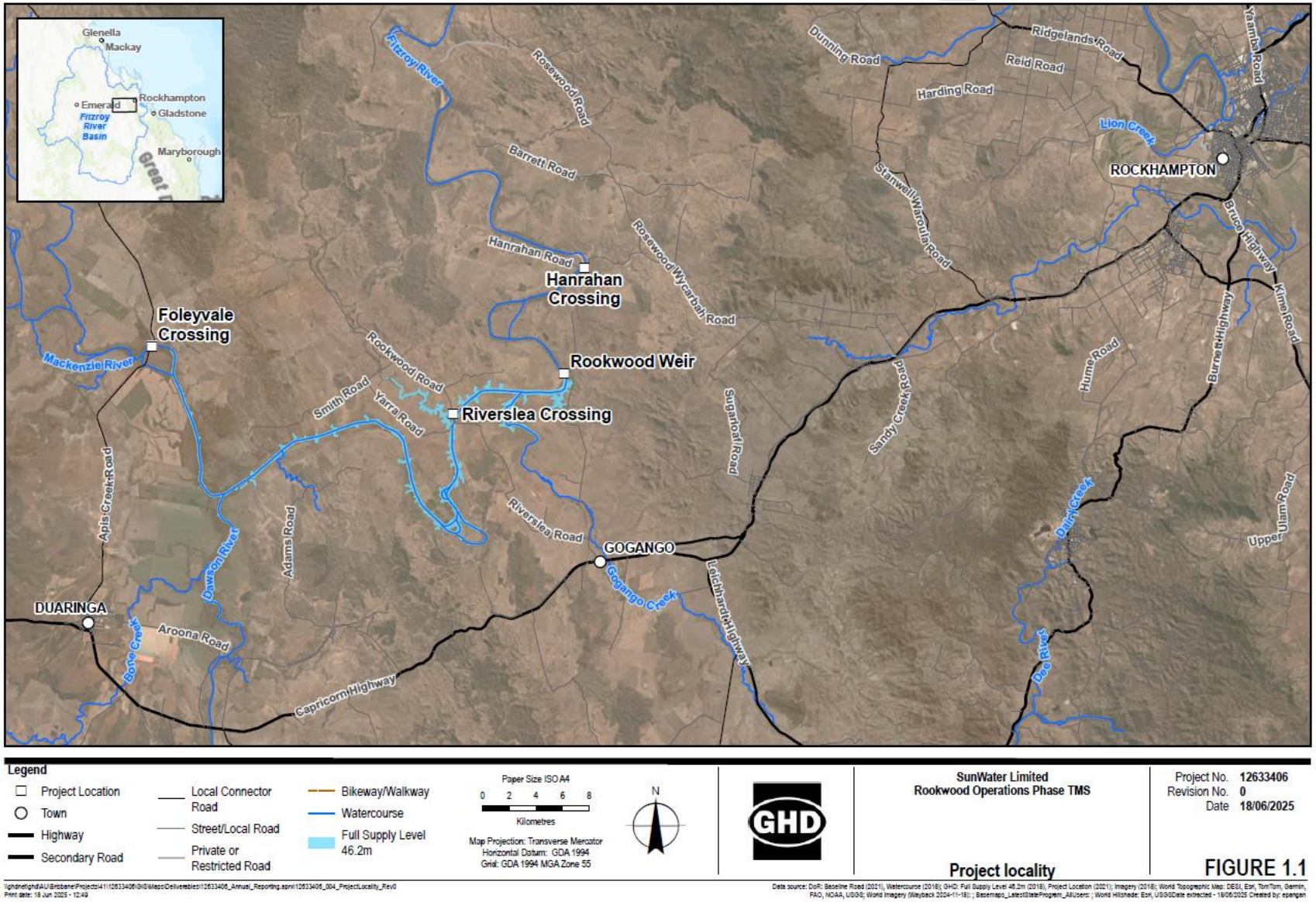

Figure 1.1 Rookwood Weir locality

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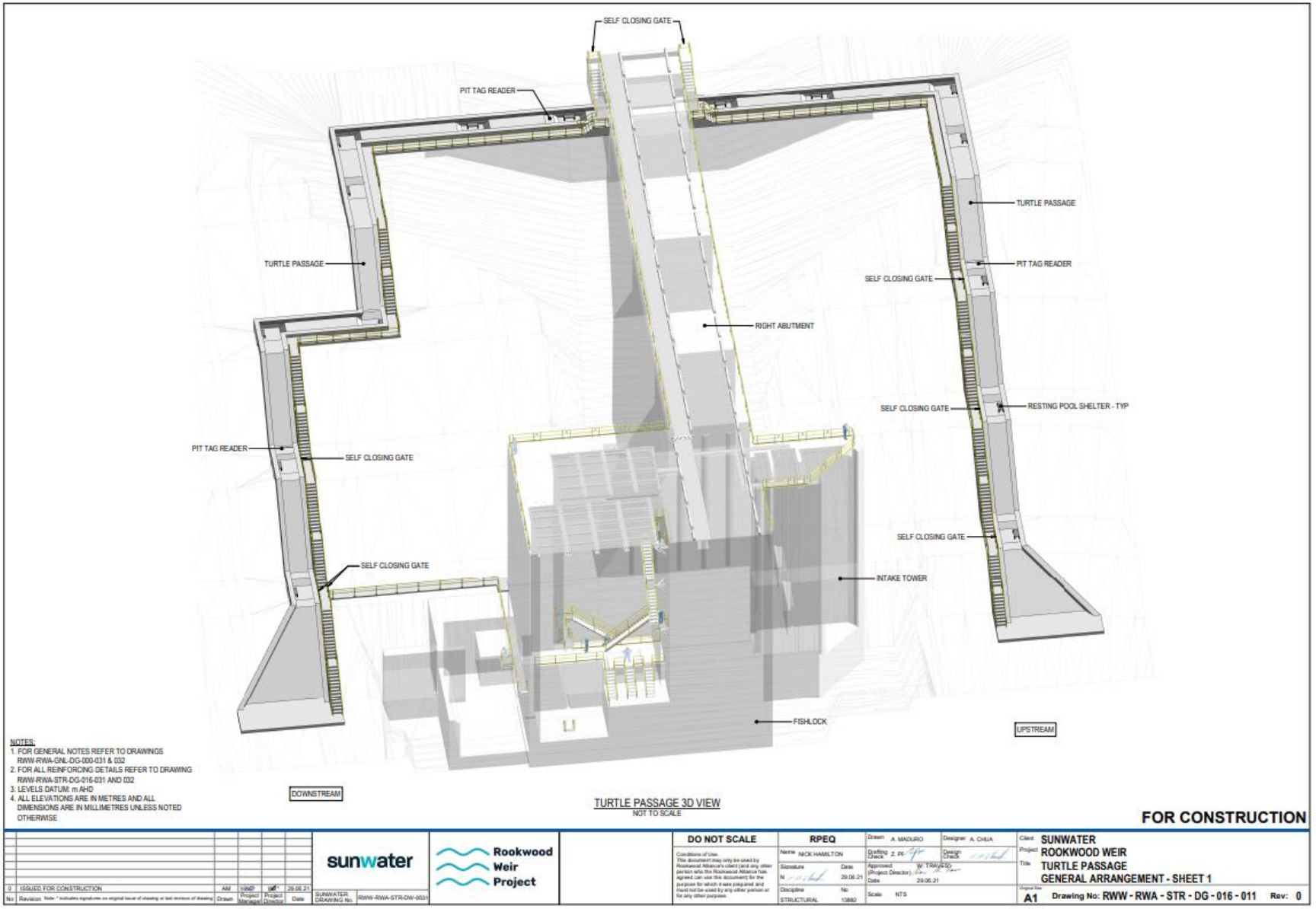

Figure 1.2 Turtle passage general arrangement

1.2.1 Legislative requirements

At the time of the LFRIP EIS, the white-throated snapping turtle was not listed as a threatened species under the EPBC Act. As such, legislative requirements for this species have been specified by the CoG under the NC Act, while requirements for the Fitzroy River turtle have been conditioned by the Federal Minister for Environment under the EPBC Act. Specifically, approval conditions related to the Operations Phase Turtle Monitoring are as follows:

CoG Appendix 2. Imposed conditions — Rookwood Weir, Schedule 1. White-throated snapping turtle, Part B. Turtle movement study and passage:

Condition 3. Turtle passage infrastructure -

(d) Monitor the effectiveness of the turtle passage infrastructure against the success criteria approved in accordance with Condition 2(d) (which states the turtle movement success criteria must be approved by department of Environment and Heritage Protection (DEHP) (now DESTI), in writing, prior to the construction of turtle passage infrastructure at the weir site).

(e) Report to DEHP (now DETSI) on the effectiveness of the turtle passage infrastructure in relation to the turtle movement success criteria twelve months after the construction of the relevant stage of the weir and annually thereafter.

(f) The monitoring methodology and reporting of the effectiveness of the turtle passage infrastructure must be externally peer reviewed and undertaken by a suitably qualified person.

(g) If monitoring evidence indicates that the turtle movement success criteria are not being met, the turtle passage infrastructure is to be modified to achieve the success criteria.

EPBC Act Condition 7 Turtle passage infrastructure:

a) At each Weir (Eden Bann and Rookwood), the approval holder must:

(iv) monitor the effectiveness of the turtle passage infrastructure against the success criteria approved by the Minister (at conditions 7c) iii. and 7d)) twelve months after the construction of the relevant weir; and

(v) report to Department of Environment and Science (DES) (now DESTI) on the effectiveness of the turtle passage infrastructure in relation to the turtle movement success criteria, (taking account of wet and dry seasons and a full year of turtle movement, breeding and nesting distribution) twelve months after the construction of the relevant weir and thereafter annually and include a copy as part of the annual environmental report required under condition 10.

c) The Study (…) must:

(i) be prepared and undertaken by a suitably qualified person in accordance with a methodology determined in consultation with DES (now DETSI).

(ii) collect data on seasonal movement patterns and home ranges of the Fitzroy River turtle. The study must include wet and dry season movements, breeding periods and nesting distribution; and

(iii) inform the development of criteria for demonstrating successful movement of Fitzroy River turtles around the relevant weir (success criteria).

f) The monitoring and reporting of the effectiveness of the turtle passage infrastructure (condition 7a) iv.) must be undertaken by a suitably qualified person and externally peer reviewed.

g) If the monitoring specified by conditions 7a) iv. and 7a) v. fails to demonstrate that the success criteria are being met, the turtle passage infrastructure must be modified in accordance with advice provided by DES (now DESTI) with the aim of achieving the success criteria.

Species Management Plan

The Rookwood Weir Operations SMP (RWW-GHD-ENV-MP- 003; GHD, 2023), was developed to fulfil the legislative approval requirements of the Project and assist Sunwater and its contractors in the avoidance and mitigation of potential impacts to the white-throated snapping turtle and Fitzroy River turtle during the operation phase of the Rookwood Weir. Under the approved Operations SMP, there are defined management strategies requiring implementation during Rookwood Weir operations to minimise the Project's impacts that have the potential to contribute to the existing threatening processes impacting the white-throated snapping turtle and Fitzroy River turtle. The Operations SMP includes four management strategies:

– Management Strategy 1: Turtle movement (to maintain upstream and downstream movement of turtles)
– Management Strategy 2: Turtle protection (to avoid/minimise the potential for turtle injury and mortality)
– Management Strategy 3: Protection of nesting habitat and increase in recruitment
– Management Strategy 4: Protection of habitat.

Each management strategy includes objectives, alignment with species conservation/recovery plans, management actions, success criteria, monitoring and corrective actions and reporting.

The following actions from the Operations SMP apply to the Operations Phase Turtle Monitoring:

– *Action 1B: Effectiveness of turtle passage infrastructure against success criteria and adaptive management implemented if required:*
    - *1B1: Operation Phase Turtle Movement Study to be conducted by suitably qualified persons (as outlined below and as agreed with DESTI and DCCEEW) for five years from the time the turtle passage becomes operational following completion of construction and once the storage reaches 8,000 ML (EL 35.20m AHD).*
    - *1B2: Notify DESTI and DCCEEWW of the commencement of turtle passage operation and initiation of the Operations Phase Turtle Movement Study.*
    - *1B3: Safe access to the turtle passage infrastructure will be maintained during operation for monitoring and compliance purposes.*
    - *1B4: Fisheries monitoring program to record incidental observation of turtles during monitoring of the fishway and broad-scale fish community monitoring.*
    - *1B5: Incidental observations and fishway PIT tag reader results to be provided to Operations Phase Turtle Movement Study team for inclusion in Turtle Movement Study Annual Report.*
    - *1B6: A report (Turtle Movement Study Annual Report) on the effectiveness of the turtle passage infrastructure in relation to the turtle movement success criteria will be provided to DESTI and DCCEEW (and published online) twelve months after the completion of construction and annually thereafter for the duration of the Operations Phase Turtle Movement Study*
    - *1B7: The monitoring methodology and reporting of the effectiveness of the turtle passage infrastructure will be externally peer reviewed and undertaken by a suitably qualified person. The monitoring report and evidence of the suitably qualified expert will be submitted to DESTI and the environmental audit and compliance section within DCCEEW.*
    - *1B8: An annual meeting with DESTI and DCCEEW (and all other relevant stakeholders- independent reviewer, monitoring program technical lead). The meeting will discuss the Turtle Movement Study Annual Report and the findings of the independent reviewer.*
    - *1B9: Raw data from the Operation Phase Turtle Movement Study will be provided to DESTI Threatened Species Operations for inclusion into the DES freshwater Turtle Database.*
    - *1B10: the monitoring fails to demonstrate that the success criteria are being met, the turtle passage infrastructure will be modified in accordance with advice provided by DESTI with the aim of achieving the success criteria. The process that will be implemented in the event that monitoring indicates that the success criteria are not being met is outlined in Section 6 with corrective actions for each success criteria identified below.*

- *1B11: If the monitoring demonstrates that the success criteria are not being met, the approval holder must implement an ongoing catch and release program for the Fitzroy River turtle and white-throated snapping until the criteria are met.*
- *1B12: At the completion of five years of Operations Phase Turtle Movement Study monitoring, a report will prepare detailing the results of the monitoring and compliance of the turtle passage with the success criteria, as well as recommendations for ongoing monitoring to enable reporting against the success criteria. This report will be submitted to DESTI and the environmental audit and compliance section within DCCEEW for review to inform a decision on what is appropriate for ongoing monitoring.*
- *1B13: Annual environmental monitoring and reporting undertaken for the life of the approval (i.e. 2046), as per Condition 10, will include reporting on the ongoing effectiveness of the turtle passage infrastructure.*

– *Action 2C: Evidence of turtle injury/mortality monitored against success criteria and adaptive management implemented if required.*
- *2C1: Operation phase Turtle Movement Study (refer to Management Strategy Action 1B) to monitor and assess efficiency of turtle protection design features and weir operating strategy at achieving turtle protection success criteria.*
- *2C2: Fisheries monitoring program to record incidental observation of turtles injury/mortality during monitoring of the fishway and broad-scale fish community monitoring.*
- *2C3: A report (Turtle Movement Study annual report) on the effectiveness of the turtle protection design features against the success criteria will be provided to DESTI and DCCEEW twelve months after the completion of construction and annually thereafter for the duration of the Operations phase Turtle Movement Study.*
- *2C4: The monitoring methodology and reporting of the effectiveness of the turtle protection design features and operating strategy will be externally peer reviewed and undertaken by a suitably qualified person. The monitoring report and evidence of the suitably qualified expert will be submitted to DESTI and the environmental audit and compliance section within DCCEEW.*
- *2C5: An annual meeting with DESTI and DCCEEW (and all other relevant stakeholders - independent reviewer, monitoring program technical lead). The meeting will discuss the Turtle Movement Study Annual Report and the findings of the independent reviewer.*
- *2C6: Raw data on turtle injuries/mortality will be provided to DESTI Threatened Species Operations for inclusion into the DESTI freshwater Turtle Database.*
- *2C7: If the monitoring fails to demonstrate that the success criteria are being met, the turtle protection design features will be modified in accordance with advice provided by DES with the aim of achieving the success criteria.*
- *2C8: At the completion of five years of operational phase Turtle Movement Study monitoring, a report will prepare detailing the results of the monitoring and compliance the turtle protection design features with the success criteria, as well as recommendations for ongoing monitoring to enable reporting against the success criteria. This report will be submitted to DCCEEW and DES. The departments (DCCEEW and DES) will provide comments on the report. Within 3 months of receiving the comments on the report, and after incorporating the comments submitted by DCCEEW and DES, the report will be submitted to the Minister for approval.*

– *Action 4C: Implementation of broad-scale turtle population monitoring program*
- *4C1: A Broad-Scale Turtle Population Monitoring Program will be developed and implemented to monitor the turtle population within, upstream and downstream of the Weir. Monitoring will be conducted for five years from the time the turtle passage becomes operational following completion of construction and once the storage reaches 8,000 ML.*
- *4C2: Results of the Broad-Scale Turtle Population Monitoring Program will be included in the Turtle Movement Study Annual Report and Annual Nest Protection Management Plan Report.*
- *4C3: An annual meeting with DESTI and DCCEEW (and all other relevant stakeholders - independent reviewer, monitoring program technical lead). The meeting will discuss the Turtle Movement Study Annual Report and the findings of the independent reviewer.*

- *4C4: Raw data on turtle injuries/mortality will be provided to DESTI Threatened Species Operations for inclusion into the DESTI freshwater Turtle Database.*
- *4C5: If the monitoring fails to demonstrate that the success criteria are being met, corrective actions will be implemented in accordance with advice provided by DESTI and DCCEEW with the aim of achieving the success criteria.*
- *4C6: The Broad-scale Turtle Population Monitoring Program will be reviewed after five years and ongoing management requirements identified for incorporation into Weir operational plans and/or Nest Protection Management Plans, as considered necessary and applicable (in collaboration with DESTI).*

1.2.2 Success criteria

As defined in the Operations SMP (GHD, 2023), success criteria have been developed to provide a measurable target to determine if management actions are effectively minimising potential Project-related impacts on turtle movement and survival. As per approval conditions (refer to Section 1.2.1), this Operations Phase Turtle Monitoring Annual Report must assess whether the success criteria are being met and, where they are not, provide recommendations in line with the corrective actions outlined in the Operations SMP.

The following success criteria have been defined under the Operations SMP:

1. 75% of white-throated snapping turtles and Fitzroy River turtles that attempt to use the turtle passage each year for upstream passage will do so successfully.
2. Turtle monitoring downstream of the weir demonstrates no turtle injury/mortality during downstream turtle passage over the spillway, as evidence by impact damage to turtles.
3. The turtle passage remains operational (attraction flow is provided and passage unobstructed) continuously when the storage is above 8000 ML up to a 1 in 5-year spilling event.
4. The turtle passage operates for one week after each four weeks of non-operation when the storage is below 8000 ML.
5. 75% of adult white-throated snapping turtles and Fitzroy River turtles recorded within 50 m of the turtle ramp and fishway entrances within a 12-month period, are attracted to and can successfully locate the turtle passage entrance (as defined as entering the funnel shaped ramp).
6. 75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can successfully ascend the ramp and pool arrangement to reach the abutment throughfare.
7. 75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can successfully move through the abutment throughfare.
8. 75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp can successfully descend the turtle ramp from the abutment throughfare into the impoundment to complete passage past the weir.
9. Turtle monitoring demonstrates no predation of turtles from within the turtle passage infrastructure.
10. Turtle monitoring demonstrates no turtle injury and/or mortality from within the turtle passage as a result of falls.
11. The ratio of adult male and female white-throated snapping turtles and Fitzroy River turtles successfully moving upstream through the turtle ramp within a 12-month period is equivalent to pre-development ratios of turtles moving outside their home range.
12. Seasonal variation in use of the turtle ramp by adult male and female white-throated snapping turtle and Fitzroy River turtle is equivalent to pre-development seasonal trends over a 12-month period.
13. Measurement of the turtle ramp attraction flow during inspections and turtle capture monitoring events indicates that the depth of water flow on the upstream ramp remains suitable for turtles to climb as per annual depth criteria.
14. Over a 12-month period, habitat conditions within the resting pools remain suitable for adult white-throated snapping turtles and Fitzroy River turtles, as evidenced by achievement of suitable pool depth criteria, compliance with water quality objectives and long-term availability of shelters.
15. Annual monitoring downstream of the weir trash screens and inlets indicates no entrapment or drowning of white-throated snapping turtles or Fitzroy River turtles.

16. Monitoring of the fishway over a 12-month period indicates no injury/mortality of white-throated snapping turtles or Fitzroy River turtles occurred within the fishway complex.
17. At least 20 adult Fitzroy River turtles and white-throated snapping turtles recorded attempting to use the turtle passage within a 12-month period.
18. Suitable turtle habitat is present within, and/or upstream and/or downstream of Rookwood Weir.

As recommended by DETSI and DCCEEW, if sampling sizes for the Fitzroy River turtle and white-throated snapping turtle are too low to allow the success criteria to be assessed (less than 20 turtles recorded using the turtle ramp within a 12-month period), corrective actions will be implemented and may include:

– Expansion of the Turtle Movement Study to include monitoring of the common Krefft's river turtle (*Emydura macquarii krefftii*). Data from the Krefft's River turtle would then be used to infer suitability of ramp for the threatened species. Initially, monitoring via PIT tags readers, cameras, turtle capture surveys, observations and inspections to occur following the first year of non-compliance. Inclusion of acoustic tags to be considered following the second consecutive year of non-compliance.
– Artificial experimentation involving the relocation of tagged turtles from upstream of the Weir to the downstream entrance of the turtle passage and/or to within the turtle passage to obtain results on the physical suitability of the turtle passage for the Fitzroy River turtle and white-throated snapping turtle.

If monitoring evidence indicates that the success criteria are not being met, as per the triggers and monitoring frequency outlined within each management strategy, corrective/contingency actions will be implemented. These are provided in detail in the Operations SMP (GHD, 2023).

1.2.3 Suitably qualified and experienced persons

As per approval conditions (refer to Section 1.2.1), the operation phase turtle passage monitoring, broad-scale turtle monitoring, and annual reporting are required to be conducted by suitably qualified persons. The monitoring was designed and implemented by the following suitably qualified persons:

– **Dr Natalie Clark** – freshwater turtle specialist, GHD. The operations phase turtle monitoring and Operations Phase Annual Monitoring Report was led by Dr Natalie Clark. Natalie was trained by Dr Col Limpus (DETSI) on the capture, measuring and tagging of freshwater turtles within the Fitzroy River and Burnett River catchments in 2003. Natalie completed her Honours and PhD research on freshwater turtles, including the white-throated snapping turtle and Fitzroy River turtle. Over the past 17 years, Natalie has supported Sunwater with the delivery of the Rookwood Weir Project including informing the design of the turtle passage infrastructure and turtle protection design features, developing and implementing the Turtle Movement Study during baseline and construction phases, and developing the operational plans and associated success criteria including the Operations SMP, turtle monitoring methodology, nest protection plans and turtle-specific offset requirements.
– **Dr Ross Dwyer** – Senior Lecturer in Animal Ecology, University of the Sunshine Coast. Dr Ross Dwyer has over 20 years of experience tagging animals with tracking devices, and he has tagged and tracked over 150 freshwater turtles with acoustic tags in the Fitzroy and Mary rivers. He has also designed five acoustic arrays throughout Queensland to track aquatic animal movements. Dr Dwyer is an authority on the analysis of animal tracking data and has published three software packages, > 50 research papers and one book chapter on animal tracking techniques. Ross conducted turtle capture field surveys for the white-throated snapping turtle and Fitzroy River turtle during the Turtle Movement Study and he designed the acoustic array and completed the acoustic telemetry analysis for the operations phase monitoring.
– **Chris Pietsch** – Chris is a Principal Aquatic Ecologist with a Bachelor of Applied Sciences. Chris has 16+ years' experience undertaking aquatic ecology surveys and has conducted extensive surveys for the white-throated snapping turtle and Fitzroy River turtle within the Fitzroy River Catchment as part of the Turtle Movement Study during baseline and construction phases. Chris was the field team lead for the operations phase monitoring.
– **Lauren Pratt** – Lauren is a Senior Aquatic Ecologist with a Bachelor of Marine Studies, Honours Class 1A. Lauren has 16 years' experience in aquatic ecology and has conducted numerous surveys for the white-throated snapping turtle and Fitzroy River turtle as part of the construction and establishment phases for Rookwood Weir. Lauren conducted field surveys and reporting for the operations phase monitoring.

Curricula vitae for each person are provided in Appendix A.

Field surveys were supported by Tunuba Rangers – Kobe Watts, Tremaine Hill, Buzz Broome and Sheldon Edmund. Field surveys and/or reporting were also supported by additional GHD staff - Yani Mouland-Vail (Ecologist) and Sarah Hampson (Graduate Ecologist). All GHD team members are either experienced with threatened turtle species, undertaken multiple surveys for Rookwood Weir previously or were supervised by experienced personnel.

1.3 Species background

1.3.1 White-throated snapping turtle *(Elseya albagula*)

The white-throated snapping turtle is one of Australia's largest turtle species with adult females weighing up to ten kilograms (kg) with a shell up to 38 centimetres (cm) long. This species is sexually dimorphic, with females being much larger than males (Thomson *et al.,* 2006). The white-throated snapping turtle occurs throughout the Fitzroy, Burnett and Mary River catchments. Juvenile white-throated snapping turtle 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 % of their oxygen requirements from the water (Mathie and Franklin, 2006; Clark *et al.,* 2008).

The white-throated snapping turtle 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 species 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.,* 2007). 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. Turtle movement studies conducted at Rookwood Weir between 2017 and 2023 supported this (GHD, 2024), finding that this species is most commonly detected in large permanent pool habitat downstream of Rookwood to Lawries Bend and upstream from Rookwood to Gogango Creek. Prior to inundation, this region was composed of sandy bank areas, deep pools, and significant rock bars that provided good foraging and nesting habitat. Turtle capture surveys also found there were greatest numbers of white-throated snapping turtle caught in the Rookwood Weir pool-riffle sequence (39 individuals caught between 2017-2023). This corroborates how, at night, this species is known to move into shallow riffle zones (Gordos *et al.,* 2007; Hamann *et al*., 2007). During the dry season, 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 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 months (Limpus *et al.,* 2011a). Nesting aggregations can occur with females often returning to the same nesting areas each year. 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 *e*t al., 2007). However, nesting can occur up to 60 m from the water's edge and over 8 m above the water level (Limpus *et al*., 2011b). The lack of hatchling and juvenile turtles within the population in the early 2000s suggested limited recruitment over the preceding two decades—estimated at less than two percent (Hamann *et al*., 2007). High rates of nest predation by foxes, pigs, goannas, feral cats, and water rats have been identified as a major contributing factor. In total, white-throated snapping turtle nesting has been confirmed present at eight nesting banks:

– Foleyvale downstream
– Foleyvale upstream
– The Pocket upstream
– Gogango Creek mouth
– Lawries Bend
– Rookwood to Hanrahan's Crossing
– Hanrahan's Crossing upstream
– Rookwood downstream of crossing.

Radio tracking of the white-throated snapping turtle within the Burnett River indicated that the home range size of the species was generally small (i.e. less than 500 m) and usually restricted to the one pool (Hamann *et al*., 2007). This observation was supported by acoustic monitoring of the species within the Mary River catchment, where a home range of <2.2 km was recorded (Micheli-Campbell *et al*., 2017). However, since these studies, further studies of white-throated snapping turtles tagged by GHD during the construction and establishment phases of Rookwood Weir (2017-2023) revealed widespread habitat use by *Elseya albagula* along the Fitzroy River.

Tracking data showed an overall linear home range of 12.04 km (SE = 1.18 km), with adult males occupying significantly larger ranges (15.3 km, SE = 1.7 km) than females (8.38 km, SE = 1.4 km). Notably, female turtles expanded their home range and travel distances beyond those of males during the nesting season (May–September), while males were most active during the breeding season (November–April). Movement patterns of females were also variable over time, and over half of the tagged turtles undertook substantial directional movements, with long distance migrations of up to 38.54 km. These long-distance movements—particularly in males—were typically triggered by receding river flows, while females were observed making shorter upstream movements during the nesting season, often returning annually to key sites such as Gogango Creek and The Pocket (GHD, 2024). Similar findings have been reported by Hamann *et al*. (2007), who documented occasional long-distance movements (10 to 55 km) associated with dispersal, courtship, nesting, or repositioning after flood events. However, any overland movement is generally limited to travel between adjacent pools. Rainfall is also considered a movement cue, with individuals observed attempting to bypass impoundments during periods of rainfall and minor overtopping events (Hamann *et al*., 2007; Limpus *et al*., 2007). These findings collectively demonstrate how the white-throated snapping turtle can exhibit varying home range sizes across different catchments, and how these differences are likely influenced by factors such as river morphology, habitat connectivity, and flow regimes.

1.3.2 Fitzroy River turtle *(Rheodytes leukops*)

The Fitzroy River turtle is endemic to the Fitzroy Basin catchment. The species has a known distribution extending from the Fitzroy Barrage to at least Theodore Weir (at 228.7 km AMTD) on the Dawson River, and within the lower reaches of the Nogoa River and upper reaches of the Connors River (95.7 km AMTD).

The Fitzroy River turtle is considered to be a specialist species that occupies freshwater habitats within the river channel. Riffle zones are considered particularly important habitat; however, the species also inhabits pools, runs and creeks. Foraging in these habitats is generally associated with in-stream debris such as fallen logs. Undercut banks, root mats, logs and rocks provide important sheltering and foraging habitat. Whilst flowing waters are thought to be preferred by the species, the Fitzroy River turtle retreats into non-flowing, potentially isolated pools during the dry season (Limpus *et al.,* 2011a). The Fitzroy River turtle is also known to inhabit the shallow upstream margins of impoundments such as the Fitzroy Barrage and Neville Hewitt Weir impoundments (Limpus *et al.,* 2011a). However, the deep-water areas (>5 m) of impoundments are largely uninhabitable to the turtle species due to very low oxygen levels, little or no light penetration and cold temperatures. The Fitzroy River turtle is not known to occur in off-stream habitats such as farm dams, billabongs, or flood plains (Limpus *et al.,* 2011a).

The Fitzroy River turtle is known to occur within the Fitzroy, Mackenzie and Dawson Rivers, within, upstream and downstream of Rookwood Weir. Results of the Turtle Movement Study found that the Fitzroy River turtle was mostly captured and detected in areas within or immediately downstream of riffles. Key habitat areas supporting high abundance of turtles included the Rookwood Weir site pool-riffle sequence, pool-riffle sequence upstream from Riverslea Crossing, at Lawries Bend and within Hanrahan's Crossing pool-riffle sequence. Large numbers of turtle detections were also observed between Rookwood and Lawries Bend. While habitats in the upstream extent of this sequence include shallow pools (<0.5 m) with runs and riffles habitats, a high number of tagged Fitzroy River turtle were detected in the lower flow section downstream the rock bar located below the Rookwood Weir site. This section also includes isolated deep pools (1-3 m).

The Fitzroy River turtle is one of a unique group of Australian freshwater turtles that can extract oxygen from both the air and the water. Aerial respiration is achieved via the lungs at the water's surface, whilst aquatic respiration occurs underwater via gill like structures in the cloaca (Priest and Franklin, 2002). The ability to respire aquatically allows the Fitzroy River turtle to remain underwater for weeks at a time during ideal conditions (Priest, 1997; Gordos *et al.,* 2003). Benefits of aquatic respiration include increased time available for foraging and breeding, and reduced exposure to predation and reduced energy expenditure (Gordos, 2004; Clark, 2008). The ability of the

Fitzroy River turtle to respire aquatically also allows this species to inhabit fast-flowing riffle zones where primarily air-breathing species may be excluded (Gordos, 2004).

The Fitzroy River turtle has a unique foraging technique of 'scrape feeding' whereby the turtle uses the horny sheaths of the upper jaw to scrape the surface of the substrate, particularly submerged logs and rocks. This method of foraging primarily captures slow moving benthic invertebrates, invertebrate eggs, aquatic insects, sponges and algae (Leger and Cann, 1980; Rogers, 2000; Tucker *et al.,* 2001; Limpus *et al.,* 2011a). Food resources for the Fitzroy River turtle can often be in short supply within natural pools and impounded habitats. Access to highly productive riffle zones or flowing shallow water margins assist in the accumulation of fat reserves that are utilised by the species for breeding during the dry season (Limpus *et al.,* 2011a).

Nesting in the Fitzroy River is generally restricted to alluvial sand/loam banks, which are deposited during flood events. Banks with a relatively steep slope, low density of ground/understorey vegetation and partial shade cover appear to be preferred (Limpus *et al.,* 2011a). Nesting generally occurs approximately 5 to 6 m from the water's edge (Hamann *et al.,* 2007; Limpus *et al.,* 2011a). Females can lay two or more egg clutches per year between August and December with hatching occurring during summer (November to February) (Limpus *et al.,* 2011a;b). Their eggs are approximately ~3.2 cm long and 2.4 cm wide. Nesting aggregations occur with females often returning to the same nesting areas each year. Seasonal turtle nesting surveys conducted as part of Rookwood Weir pre-clearance surveys identified 34 banks with confirmed nesting between Foleyvale Crossing (upstream of Rookwood Weir) and Hanrahan Crossing (downstream of Rookwood Weir). Aggregated nesting of the Fitzroy River turtle has been confirmed present at Rookwood, the upper inundation area (upstream and downstream of the junction between the Fitzroy River and Mackenzie River), downstream of Foleyvale Crossing, The Pocket, and Hanrahan Crossing (GHD, 2022).

Prior to the turtle movement studies conducted at Rookwood Weir for construction and establishment phases, little was known about the movement patterns of Fitzroy River turtle. A single radio tracking study conducted on the species suggested that home range size was relatively small (mean range 2.4-4.0 hectares) with local movement generally occurring between riffle zones and adjacent pools (Tucker et al., 2001). The study recorded a single long-distance movement of 6.8 km downstream, with the return of the individual six month later (Tucker et al., 2001). The Rookwood Weir turtle movement studies found similarly small home ranges for Fitzroy River turtle, with an average home size range of 5.03 km (SE = 0.76 km) for turtles tracked between 2017 and 2023. The average linear home range for adult males was smaller (3.33 km, SE = 0.82) than that of adult females (6.15 km, SE = 1.15 km).

Identification tagging and observations of the species within the Fitzroy catchment by Dr Col Limpus, suggest large-scale movements in the order of tens of kilometres may have potentially occurred for the purpose of dispersal, courtship and nesting migrations and repositioning following flood displacement (Dr Col Limpus pers. comm.). Indeed, large distance migrations outside of home range movements have been recorded in approximately one third of tagged Fitzroy River turtle throughout the Turtle Movement Study (2017-2023). However, these large directional movements were observed less frequently and over shorter distances in Fitzroy River turtle than in white-throated snapping turtle. Interestingly, male Fitzroy River turtles appeared to undertake large-distance migration on the recession of peak flow events, however this was not observed in 2022-2023 during construction of Rookwood Weir. Comparatively, large distance migrations for female Fitzroy River turtle typically occurred in response to flow events during Summer and Autumn (i.e. mid to late nesting season), and a number of females have also been recorded moving outside their home range during the nesting season.

Movement of Fitzroy River turtles over land is only known to occur between adjacent pools. Rainfall is thought to act as a trigger for turtle movement with individuals observed attempting to move past impoundments during rainfall and small flow events (Limpus *et al.*, 2007; Limpus *et al.,* 2011a; Limpus *et al.,* 2011b). The habitat and movement requirements of hatchling turtles are still unknown.

1.4 Scope and limitations

Sunwater have engaged Tunuba, in collaboration with GHD, to complete the turtle monitoring requirements of the Operations SMP. Specifically, the turtle monitoring scope of work is detailed within the Rookwood Weir Specification of Services: Turtle Monitoring (Sunwater, November 2023).

This report has been prepared by GHD for Tunuba and Sunwater and may only be used and relied on by Tunuba and Sunwater for the purpose agreed between GHD and Tunuba and Sunwater as set out in Section 1.1 of this

report. GHD otherwise disclaims responsibility to any person other than Tunuba and 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.

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

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points. Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location vegetation or accessibility limits. As a result, not all relevant site features and conditions may have been identified in this report.

GHD has prepared this report on the basis of information provided by Tunuba and Sunwater and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

This Operations Phase Annual Turtle Monitoring Report does not include monitoring or reporting (i.e. Annual Nest Protection Management Plan Report) associated with enhancement of turtle nesting habitat, protection of turtle nests or increase recruitment of hatchlings (Management strategy 2 of the Operations SMP).

1.5 Assumptions

This report has been prepared based on the following information provided by Sunwater and Tunuba:

Sunwater

– PIT tag data recorded along the turtle passage and fishway from June 2024 up to and including May 15, 2025
– Rookwood Weir data for water level (mean daily mAHD) and flow (mean ML/day) for headwater (HW) and tailwater (TW), and weir storage level (mean %) were provided by Sunwater from June 2024 up to and including May 15, 2025.
– Reviewed remote camera imagery of turtles and other fauna in the turtle passage captured from February 2024 up to and including May 15, 2025.
– Turtle passage inspection, turtle observation and turtle injury/mortality forms completed from June 2024 up to May 15, 2025.

Tunuba

– Confirmed locations of Priority Turtle Nesting Areas.

Drafting note: Fishway PIT tag data required from Sunwater to determine if turtles have used the fishway for upstream/downstream movement past the weir

2. Methodology

Year 1 2024-25 of Rookwood Weir operations phase monitoring was conducted in accordance with the approved methodologies described in the Rookwood Weir Operations SMP (GHD, 2023). Year 1 2024-25 involved monitoring of turtle movement behaviour within the turtle passage constructed at Rookwood Weir, and broad-scale monitoring at areas upstream and downstream of Rookwood Weir. Methods used for the turtle passage monitoring included turtle capture surveys, remote telemetry (acoustic and PIT) and camera monitoring, supported by inspectional and observational records (Figure 2.1). Broad-scale monitoring methods included turtle capture surveys and remote telemetry (acoustic) (Figure 2.2 and Figure 2.4). The methods used for these two distinct, but associated monitoring programs are described below.

2.1 Survey area

2.1.1 Turtle passage monitoring

The survey area for the turtle passage monitoring comprises the entire constructed turtle passage at Rookwood Weir, in addition to the upstream and downstream approach channels and stilling basin immediately downstream of the weir (Figure 2.1). This represents the area within which turtles may access turtle passage infrastructure. Sections of the turtle passage have been named according to Sunwater designations to ensure consistent terminology across reporting commitments. Naming conventions for the turtle passage include Downstream Resting Pools (DSRP) and Upstream Resting Pools (USRP). These pools are numbered sequentially based on their distance from the highest point of Rookwood Weir. Specifically, DSRP1 and USRP1 are the closest resting pools downstream and upstream of the weir crest, respectively. In contrast, DSRP8 and USRP7 are the furthest from this point in their respective directions, however typically USRP6 and USRP7 are inundated within the weir pool.

2.1.2 Broad-scale monitoring

The broad-scale monitoring program covers a large area upstream and downstream of Rookwood Weir, however the extent of the surveyed area depends on the methodologies.

For remote telemetry (i.e. the hydrophone array), the survey area encompasses a 33 km reach of the Fitzroy River ranging from The Pocket, approximately 17 km upstream of the Rookwood Weir impoundment, to Hanrahan's Crossing, approximately 16 km downstream of Rookwood Weir (Figure 2.4).

For turtle capture surveys the survey area extends to the upper limit of the Rookwood Weir impoundment at Foleyvale, located approximately 65 km upstream from Rookwood Weir and downstream to Hanrahan's Crossing (Figure 2.2). The Foleyvale site has been included due to the presence of a Priority Nesting Protection Area as identified in 2025. The areas of the turtle capture for broad-scale monitoring were selected based on the diversity and location of habitat types (i.e. pools, riffles, runs, creeks, floodplains, potential nesting banks), turtle population size/capture success and access. The specific locations within the survey areas targeted during each survey event was dependent upon conditions at each survey location at the time of survey, success of turtle capture, and distribution of previously tagged turtles within the survey area.

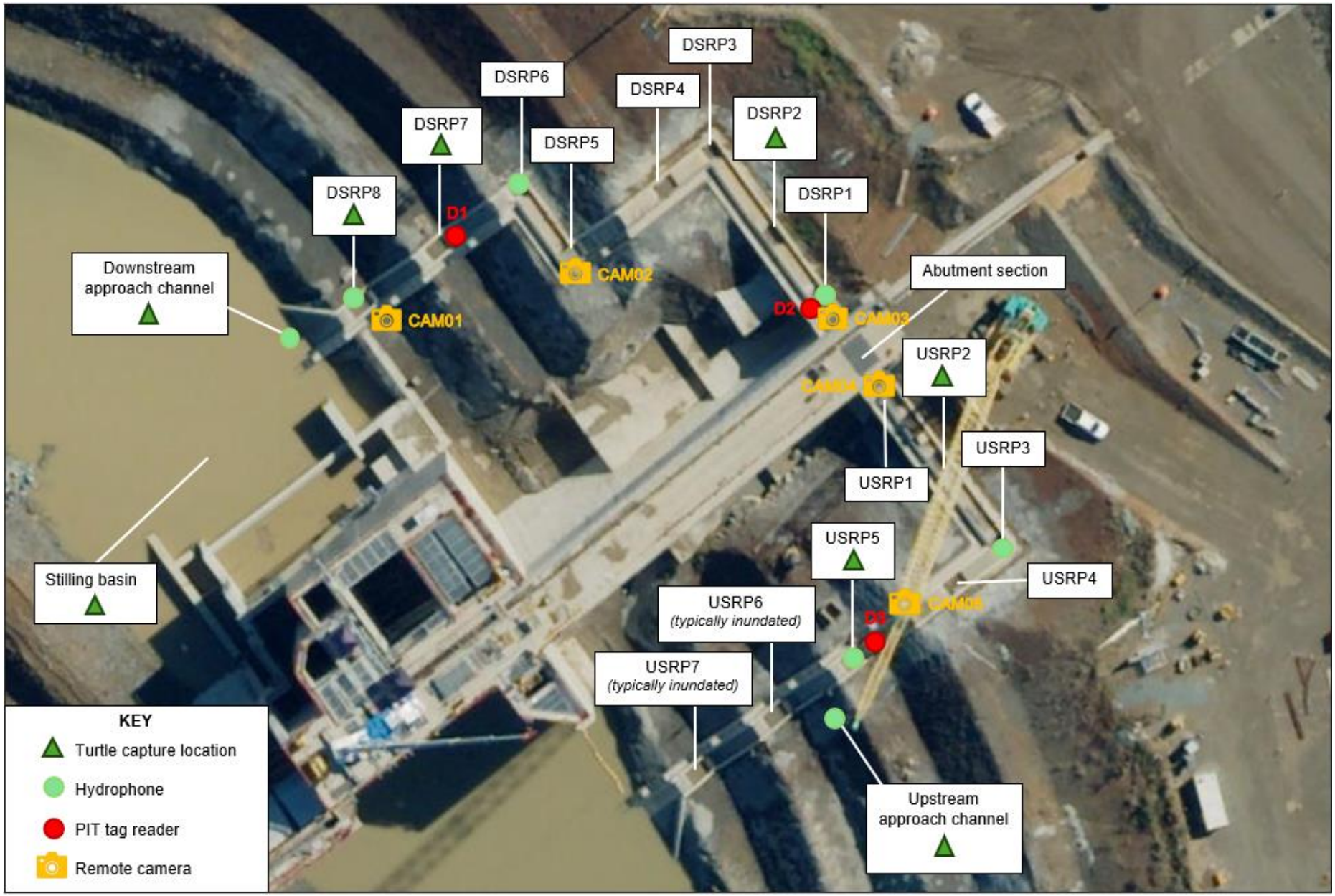

Figure 2.1 Turtle passage monitoring locations

2.2 Survey effort and timing

Field survey effort for Year 1 2024-25 is presented in Table 2.1. Survey events were split into either one of two types:

- **Hydrophone survey:** download and retrieval of hydrophone data from within turtle passage and broad-scale monitoring arrays
- **Turtle capture survey:** capture and tagging of targeted turtle species within turtle passage and across broad-scale monitoring turtle capture locations.

Data retrieved during these two types of surveys are intended to contribute to both the turtle passage and broad-scale monitoring programs, supporting a coordinated and efficient approach to monitoring. At the time of preparing this report four hydrophone surveys had been conducted – April, September and December 2024, and March 2025 (Table 2.1). There was another hydrophone survey event completed in June 2025 for Year 1 as per the Operations SMP and 2024-25 Annual Monitoring Plan – Turtle Monitoring, with this data to be included in the Year 2 2025-26 Annual Report.

During Year 1 2024-25 of operations phase monitoring, there have been two turtle capture surveys conducted, targeting the white-throated snapping turtle and Fitzroy River turtle. The first turtle capture survey event occurred in October/November 2024. The second turtle capture survey occurred in May 2025 (Table 2.1).

Remote monitoring (refer to Section 2.6) occurred quarterly for acoustic hydrophones and continuously for PIT tags and remote cameras during the monitoring period (April 2024 – May 2025).

Table 2.1 Survey effort Year 1 2024-25

Survey	Dates	Field team (GHD)	Field team (Tunuba)
April 2024 Hydrophone Survey	14 – 18 April 2024	Lauren Pratt and Chris Pietsch	Sheldon Edmund
September 2024 Hydrophone Survey	23 – 27 September 2024	Lauren Pratt and Chris Pietsch	Sheldon Edmund
October/November 2024 Turtle Capture Survey	29 October – 7 November 2024	Natalie Clark, Lauren Pratt, Chris Pietsch and Sarah Hampson	Tremaine Hill and Kobe Watts
December 2024 Hydrophone Survey	9 – 13 December 2024	Lauren Pratt and Chris Pietsch	Tremaine Hill
March 2025 Hydrophone Survey	4 - 5 March 2025	Chris Pietsch and Tim Moeser	Kobe Watts
May 2025 Turtle Capture Survey	4 – 15 May 2025	Lauren Pratt, Chris Pietsch and Yani Mouland-Vail	Buzz Broome
June 2025 Hydrophone Survey	9 – 13 June 2025 *	Chris Pietsch and Yani Mouland-Vail	Buzz Broome

* Data to be included in the Year 2 2025-26 Annual Report

2.3 Survey conditions

Environmental conditions were recorded during the Year 1 2024–25 monitoring to describe habitat at survey sites. This information was used to identify preferred habitat conditions for turtles and to facilitate the identification of optimal survey conditions for turtle capture.

For the purposes of this report, survey conditions are presented from June 2024, when operations at Rookwood Weir officially commenced.

2.3.1 River flow

Flow data for the broad-scale turtle monitoring survey area were retrieved via the online Queensland Government Water Monitoring Information Portal (DRDMW, 2025). This comprised daily flow data (mean ML/day) from stations upstream of Rookwood Weir along the Fitzroy River (130003B), Dawson River (130302A) and Mackenzie River (130105B), as well as downstream of Rookwood Weir at Hanrahan's Crossing (130010A) (DRDMW, 2025). Additionally, river level data were sourced from the Fitzroy River at Riverslea Station (130003B). This station has pre-defined minor, moderate and major flood levels (BOM, 2024) which were used to inform whether any flooding events occurred during Year 1 2024-25 of the operations phase monitoring.

2.3.2 Rookwood Weir water level and releases

Rookwood Weir data for water level (mean daily mAHD) and flow (mean ML/day) for headwater and tailwater, and weir storage level (mean %) were provided by Sunwater up to and including 15 May 2025. These data gave insight into overtopping events and flow conditions immediately upstream and downstream of the weir.

2.3.3 Conditions during the surveys

Minimum and maximum daily temperature data during the survey events were sourced from the Rockhampton Aero Station (039083) via the Australian Bureau of Meteorology (BOM, 2025). Rainfall data were sourced from the Fitzroy River at Riverslea Station (130003B). These data characterise the general weather conditions during survey events.

2.3.4 *In-situ* water quality

In-situ water quality data was collected opportunistically during turtle capture and hydrophone download field survey events. This data was recorded using a handheld multiparameter water quality meter that had been calibrated in accordance with the manufacturer's specifications and used in accordance with operating protocols defined in the *Monitoring and Sampling Manual 2018* (DES, 2018). Parameters recorded included:

- Water temperature (°C)
- pH (pH units)
- Electrical conductivity (EC) (µS/cm)
- Dissolved oxygen (DO) concentrations (mg/L and percent saturation)
- Turbidity (NTU).

In-situ measurements of physiochemical conditions were taken at least 1 m from the edge of the waterway, within 0.1 m to 0.5 m of the water surface, and 0.1 m from the substrate where water depth allowed. Results were compared against pre-action baseline values for selected water quality parameters, as defined in the Rookwood Weir Lower Fitzroy Water Quality Monitoring and Reporting Program submitted to DCCEEW in May 2024 (Sunwater, 2024), and Water Quality Objectives (WQO) defined under the Environmental Protection (Water) Policy for Fitzroy River sub-basin fresh waters and lakes/reservoirs (DEHP, 2013).

Sunwater collected *in-situ* water quality data in all turtle passage resting pools in January and March 2025 during the Year 1 2024-25 monitoring period. These data have also been included to characterise conditions in the turtle passage in comparison to background conditions in the Fitzroy River.

Raw *in-situ* water quality data is provided in Appendix B.

2.3.5 Habitat assessment

At each turtle capture site, habitat characteristics were recorded and photographed to document conditions at the time of the field survey event. The habitat assessment included noting water flow velocity, water depth, in-stream habitat, riparian vegetation cover and assessment of nesting banks if applicable.

2.3.6 Operational inspections and observations

As per the approved Rookwood Weir Operations SMP, an Inspection Form was completed by Sunwater during all inspections of the turtle passage infrastructure and by GHD during all operations phase field surveys to document the operating conditions (Appendix C). Parameters recorded included *in-situ* water quality, build-up of algae, water levels and flow, presence of fish, presence of predatory birds, presence of sediment and debris. Inspections were completed during various river cycle conditions (including low headwater and tailwater conditions, during and following flooding events). The form also documented whether any repair or maintenance was required and/or completed.

In addition to the Inspection Form, a Turtle Observation Form and Turtle Injury/Mortality Form were used to record incidental turtle observations and any identified injury/mortalities, respectively (Appendix D and Appendix E). These forms captured operating conditions, location and behaviour of turtles, species and age class (where possible). Observations were recorded during Sunwater site visits, maintenance and inspections during Year 1 2024-25.

2.4 Turtle capture

2.4.1 Turtle passage monitoring

During Year 1 2024-25 of operations phase monitoring, turtle capture surveys were undertaken within and adjacent to the turtle passage infrastructure, with one resting pool trapped per 24 hours along the passageway and approach channels and active trapping within the stilling basin (Table 2.2). Surveys were conducted at a total of nine sites within Year 1 2024-25 of operations phase monitoring.

The main technique employed during turtle passage monitoring was a modified fyke net within the turtle passage, with cathedral traps and seine netting used in the approach channels and stilling basin respectively (Plate 2.1). During the May 2025 turtle capture survey, muddling was also opportunistically conducted in one downstream resting pool (DSRP3) (Plate 2.1)

Overall, in October/November 2024, turtle capture was undertaken at seven sites (Table 2.2). The downstream approach channel was unable to be surveyed due to unsuitable trapping conditions as a result of regulated flows. Trapping within the stilling basin was difficult due to the water level being both too shallow and too deep, and/or obstructions (e.g. large rocks) which prevented effective seine netting (Plate 2.1). During the May 2025 turtle capture survey, the weir was overtopping so the water velocity in the stilling basin and approach channels was too high and the area unsafe to access preventing deployment of any capture techniques (Plate 2.2). One resting pool (USRP5) was not trapped due to unforeseen equipment complications during the survey. As such, trapping was conducted at four sites with a fifth resting pool (DSRP3) muddled for the turtle passage monitoring scope during the May 2025 survey.

Table 2.2 presents the specific turtle passage survey locations accessed during the October/November 2024 and May 2025 turtle capture surveys. Table 2.3 and Table 2.4 summarise the survey effort specific to turtle passage monitoring for October/November 2024 and May 2025 turtle capture surveys, respectively.

Table 2.2 Turtle passage monitoring – turtle capture locations and effort

Site	October/November 2024	May 2025	Latitude	Longitude
Upstream approach channel	✓	Weir overtopping – considered unsafe for access	-23.54050	150.01675
USRP5	✓	Survey not completed due equipment complications	-23.54042	150.01679
USRP2	✓	✓	-23.54022	150.01689
DSRP2	✓	✓	-23.53999	150.01670
DSRP3	–	✓	-23.53982	150.01663

Site	October/November 2024	May 2025	Latitude	Longitude
DSRP7	✓	✓	-23.53999	150.01633
DSRP8	✓	✓	-23.54005	150.01624
Downstream approach channel	Regulated flow – unsuitable conditions for capture	Weir overtopping – considered unsafe for access	-23.53990	150.01622
Stilling basin	✓	Weir overtopping – considered unsafe for access	-23.54062	150.01485

Plate 2.1 *Turtle passage capture techniques: cathedral traps at upstream approach channel (top left); seine netting in stilling basin (top right); muddling in resting pools (bottom left) and modified fyke net in a resting pool (bottom right)*

Table 2.3 *Turtle passage trapping and survey effort – October/November 2024*

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
DSRP8	Fyke	1	30/10/2024	08:00	30/10/2024	17:00	9 hrs
	Fyke	1	30/10/2024	17:00	31/10/2024	08:00	15 hrs
DSRP7	Fyke	1	31/10/2024	08:00	31/10/2024	17:00	9 hrs
	Fyke	1	31/10/2024	17:00	1/11/2024	08:00	15 hrs
DSRP2	Fyke	1	1/11/2024	08:00	1/11/2024	17:00	9 hrs
	Fyke	1	1/11/2024	17:00	2/11/2024	08:00	15 hrs
USRP2	Fyke	1	2/11/2024	08:00	2/11/2024	17:00	9 hrs

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
	Fyke	1	2/11/2024	17:00	3/11/2024	08:00	15 hrs
Stilling basin	Seine	1	4/11/2024	11:00	4/11/2024	11:15	15 mins
	Seine	1	4/11/2024	11:20	4/11/2024	11:40	20 mins
USRP5	Fyke	1	4/11/2024	08:00	4/11/2024	17:00	9 hrs
	Fyke	1	4/11/2024	17:00	5/11/2024	08:00	15 hrs
Upstream approach channel	Cathedral	2	5/11/2024	16:00	6/11/2024	08:00	16 hrs

Table 2.4 Turtle passage trapping and survey effort – May 2025

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
USRP3	Muddling	2	09/05/2025	13:00	09/05/2025	13:20	20 mins
DSRP8	Fyke	1	10/05/2025	07:00	10/05/2025	13:00	6 hrs
	Fyke	1	10/05/2025	13:00	11/05/2025	07:00	18 hrs
DSRP7	Fyke	1	11/05/2025	07:00	11/05/2025	13:00	6 hrs
	Fyke	1	11/05/2025	13:00	12/05/2025	07:00	18 hrs
DSRP2	Fyke	1	12/05/2025	07:00	12/05/2025	13:00	6 hrs
	Fyke	1	12/05/2025	13:00	13/05/2025	07:00	18 hrs
USRP2	Fyke	1	13/05/2025	07:00	13/05/2025	13:00	6 hrs
	Fyke	1	13/05/2025	13:00	14/05/2025	07:00	18 hrs

Plate 2.2 Water release from the low flow outlet during October/November 2024 turtle capture surveys (left) and weir and overtopping during May 2025 turtle capture surveys (right)

2.4.2 Broad-scale monitoring

As per the Rookwood Weir Operations SMP (GHD, 2023) broad-scale turtle population monitoring was conducted at sites upstream, and downstream of Rookwood Weir, including within the vicinity of Priority Nest Protection Areas (Figure 2.2). Priority Nest Protection Areas for 2025 were defined in the 2025 Annual Nest Protection Plan (Tunuba, 2025). During Year 1 2024-25 turtle capture surveys were conducted at the following locations:

Upstream of Rookwood Weir

- Foleyvale Crossing (Priority Nest Protection Area)

Within Rookwood Weir

- Gogango Creek (Priority Nest Protection Area)
- Rookwood Weir pool immediately upstream

Downstream of Rookwood Weir

- Rookwood downstream pool and riffle complex (left bank as a Priority Nest Protection Area)
- Hanrahan Crossing (Priority Nest Protection Area).

The survey locations targeted during each survey event were dependent upon conditions at each survey location at the time of survey, success of turtle capture, distribution of previously tagged turtles within the survey area and timing in relation to turtle nesting periods. As such, not all sites were surveyed in each turtle capture survey event (Table 2.5).

Approximate turtle capture site locations and site-specific effort for broad-scale monitoring turtle capture surveys are presented in Table 2.6 and Table 2.7 summarise the survey effort specific to broad-scale turtle monitoring for October/November 2024 and May 2025 turtle capture surveys, respectively. In October/November 2024, cathedrals traps were set at three sites, and fyke nets deployed at the riffle complex downstream of the Rookwood downstream pool. For May 2025 broad-scale turtle capture surveys, cathedral traps were deployed at four sites, and fyke nets deployed again at the riffle complex downstream of Rookwood pool, in addition to the riffle complex at Hanrahan crossing.

Table 2.5 Broad-scale monitoring – turtle capture locations and effort

Site	Location	October/November 2024	May 2025	Latitude	Longitude
Foleyvale Crossing	Approximately 57.7 km upstream of Rookwood Weir	✓	-	-23.528551	149.712391
Gogango Creek	Approximately 4.5 km upstream of Rookwood Weir	-	✓	-23.554382	149.984191
Rookwood Weir pool	Approximately 710 m upstream of Rookwood Weir	✓	✓	-23.544425	150.016854
Rookwood downstream pool and riffle complex	Approximately 1.1 – 2.1 km downstream of Rookwood Weir	✓	✓	-23.537163	150.011421
Hanrahan Crossing	Approximately 16.7 – 18.1 km downstream of Rookwood Weir	-	✓	-23.467990	150.027247

For the broad-scale monitoring, turtle capture involved primarily cathedral traps and fyke netting (Plate 2.3). Cathedral traps were baited and set at survey locations for up to 24 hours (traps were checked twice during this period). Similarly, fyke nets were set for up to 24 hours (nets were checked twice during this period), however these were limited to shallow sections of the Fitzroy River, including riffle habitat downstream of Rookwood Weir and downstream of Hanrahan's Crossing. The high flow velocity present within the Fitzroy River during the survey in May 2025 made setting the nets difficult. The extensive water lettuce (*Pistia stratiotes*) downstream of Rookwood Weir also impacted trapping with fyke nets filled with plants overnight during this survey (Plate 2.3).

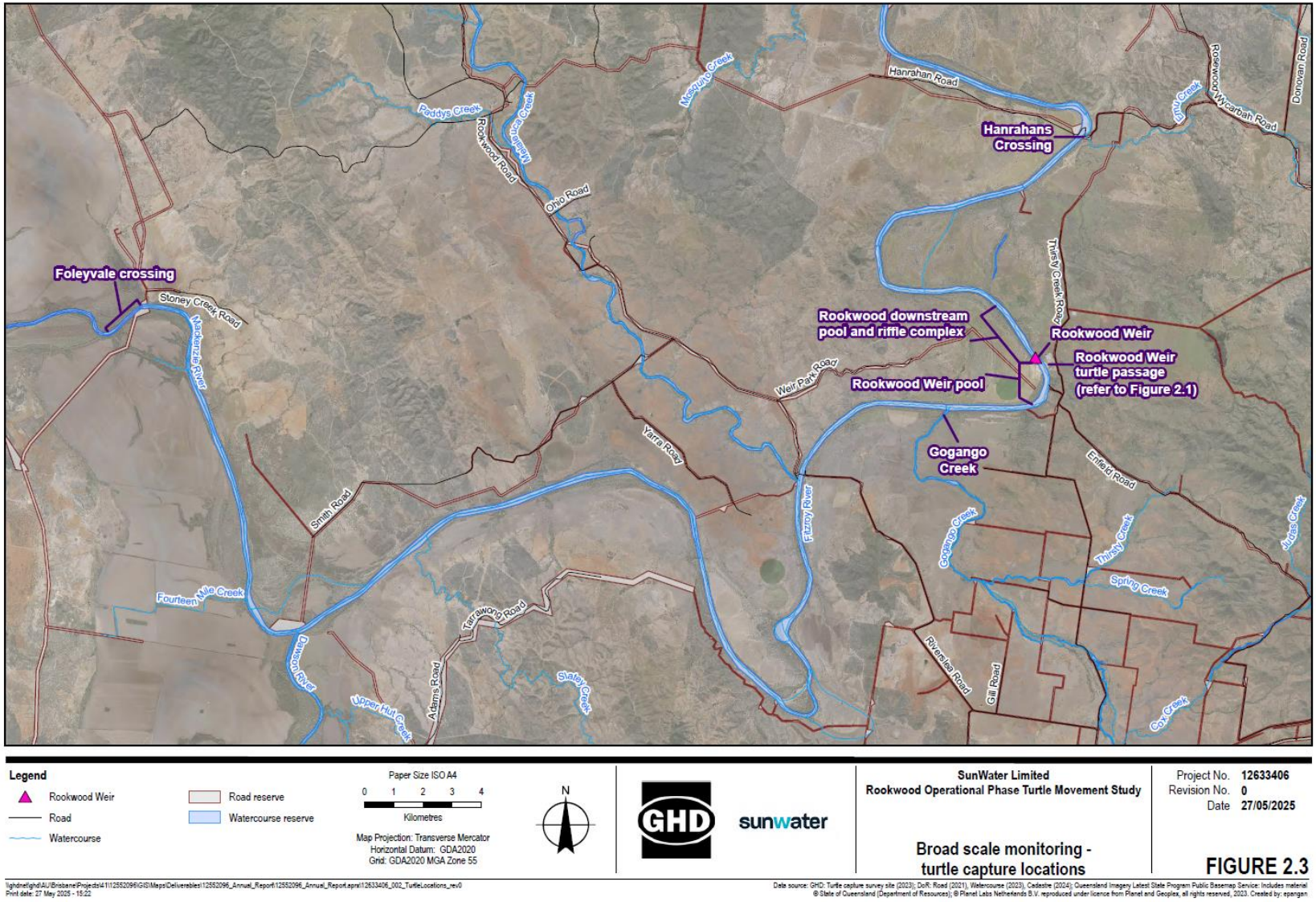

Figure 2.2 Broad-scale monitoring – turtle capture locations

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Plate 2.3 ***Broad-scale monitoring capture techniques: cathedral traps deployed (top left) and retrieved (top right), and fyke nets deployed in riffle habitats (bottom left), with flow contributing to accumulation of water lettuce in nets over time (bottom right).***

Table 2.6 ***Broad-scale trapping and survey effort – October/November 2024***

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
Rookwood Weir pool – at Rookwood camping reserve	Cathedral	10	30/10/2024	09:30	30/10/2024	15:30	6 hrs
	Cathedral	10	30/10/2024	15:30	31/10/2024	08:30	17 hrs
	Cathedral	10	31/10/2024	08:30	31/10/2024	15:15	6 hrs 45 mins
	Cathedral	10	1/11/2024	15:15	2/11/2024	08:00	17 hrs 15 mins
Rookwood downstream – pool	Cathedral	10	1/11/2024	10:30	1/11/2024	14:30	4 hrs
	Cathedral	10	2/11/2024	08:45	2/11/2024	14:00	5 hrs 15 mins
Rookwood downstream – riffle complex	Fyke	3	2/11/2024	08:00	2/11/2024	14:30	6 hrs 30 mins
Rookwood downstream – pool	Cathedral	10	2/11/2024	14:30	3/11/2024	08:45	18 hrs 15 mins
Rookwood downstream – pool	Fyke	3	2/11/2024	14:00	3/11/2024	08:00	18 hrs
	Fyke	3	3/11/2024	08:00	3/11/2024	15:00	7 hrs
Rookwood downstream – pool	Cathedral	10	3/11/2024	08:45	3/11/2024	14:00	5 hrs 15 mins
	Cathedral	10	3/11/2024	14:00	4/11/2024	08:30	18 hrs 30 mins

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
Rookwood downstream – riffle complex	Fyke	3	3/11/2024	14:30	4/11/2024	08:00	17 hrs 30 mins
Rookwood downstream – pool	Cathedral	10	4/11/2024	08:30	4/11/2024	14:45	6 hrs 15 mins
	Cathedral	10	4/11/2024	14:45	5/11/2024	08:15	17 hrs 30 mins
Rookwood downstream – riffle complex	Fyke	3	4/11/2024	15:00	5/11/2024	08:45	17 hrs 45 mins
Rookwood downstream – pool	Cathedral	10	5/11/2024	08:15	5/11/2024	15:00	6 hrs 45 mins
	Cathedral	8	5/11/2024	15:00	6/11/2024	08:30	17 hrs 30 mins
Foleyvale Crossing – upstream pool	Cathedral	8	6/11/2024	14:30	7/11/2024	09:00	18 hrs 30 mins

Table 2.7 Broad-scale trapping and survey effort – May 2025

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
Hanrahan crossing – upstream pool	Cathedral	10	06/05/2025	14:30	07/05/2025	07:30	17 hrs
	Cathedral	10	06/05/2025	07:30	06/05/2025	14:30	7 hrs
	Cathedral	10	07/05/2025	14:30	08/05/2025	07:00	16 hrs 30 mins
Rookwood downstream – pool	Cathedral	10	08/05/2025	16:00	09/05/2025	07:15	15 hrs 15 mins
	Cathedral	10	08/05/2025	07:15	08/05/2025	15:45	8 hrs 30 mins
	Cathedral	10	08/05/2025	15:45	09/05/2025	07:00	16 hrs 45 mins
	Cathedral	10	09/05/2025	07:00	09/05/2025	14:45	7 hrs 45 mins
	Cathedral	10	09/05/2025	14:45	10/05/2025	07:00	16 hrs 15 mins
Rookwood Weir pool – at Rookwood camping reserve	Cathedral	10	10/05/2025	16:00	11/05/2025	07:00	15 hrs
	Cathedral	10	11/05/2025	07:00	11/05/2025	14:45	7 hrs 45 mins
	Cathedral	10	11/05/2025	14:45	12/05/2025	07:00	16 hrs 15 mins
	Cathedral	10	12/05/2025	07:00	12/05/2025	14:45	7 hrs 45 mins
Gogango Creek – confluence pool	Cathedral	10	12/05/2025	13:15	13/05/2025	07:45	18 hrs 30 mins
	Cathedral	10	13/05/2025	07:45	13/05/2025	15:45	8 hrs
	Cathedral	10	13/05/2025	15:45	14/05/2025	07:40	15 hrs 55 mins
Hanrahan crossing – riffle complex	Fyke	5	05/05/2025	10:00	05/05/2025	15:30	5 hrs 30 mins
	Fyke	5	05/05/2025	15:30	06/05/2025	08:00	16 hrs 30 mins
	Fyke	5	06/05/2025	08:00	06/05/2025	14:45	6 hrs 45 mins
	Fyke	5	06/05/2025	14:45	07/05/2025	08:00	17 hrs 15 mins
Rookwood downstream – riffle complex	Fyke	1	7/05/2025	15:30	8/05/2025	07:45	16 hrs 15 mins
	Fyke	1	7/05/2025	15:30	8/05/2025	08:00	16 hrs 30 mins
	Fyke	1	8/05/2025	07:45	8/05/2025	15:30	7 hrs 45 mins
	Fyke	1	8/05/2025	08:00	8/05/2025	15:30	7 hrs 30 mins
	Fyke	2	8/05/2025	15:00	09/05/2025	07:30	16 hrs 30 mins
	Fyke	2	8/05/2025	15:30	9/05/2025	08:00	16 hrs 30 mins
	Fyke	2	9/05/2025	07:30	9/05/2025	15:15	7 hrs 45 mins
	Fyke	2	9/05/2025	08:00	9/05/2025	15:45	7 hrs 45 mins

Site	Method	Units	Date in	Time in	Date out	Time Out	Duration
	Fyke	2	9/05/2025	15:15	10/05/2025	07:30	16 hrs 15 mins
	Fyke	3	9/05/2025	15:45	10/05/2025	08:00	16 hrs 15 mins
	Fyke	2	10/05/2025	07:30	10/05/2025	14:45	7 hrs 15 mins
	Fyke	2	10/05/2025	08:00	10/05/2025	15:00	7 hrs
	Fyke	2	10/05/2025	14:45	11/05/2025	08:00	17 hrs 15 mins
	Fyke	2	10/05/2025	15:00	11/05/2025	08:30	17 hrs 30 mins
	Fyke	2	11/05/2025	08:00	11/05/2025	15:45	7 hrs 45 mins
	Fyke	2	11/05/2025	08:30	11/05/2025	16:00	7 hrs 30 mins
	Fyke	2	11/05/2025	15:45	12/05/2025	08:00	16 hrs 15 mins
	Fyke	2	11/05/2025	16:00	12/05/2025	08:15	16 hrs 15 mins
	Fyke	2	12/05/2025	08:00	12/05/2025	16:20	8 hrs 20 mins
	Fyke	2	12/05/2025	08:15	12/05/2025	16:30	8 hrs 15 mins
	Fyke	2	12/05/2025	16:20	13/05/2025	08:30	16 hrs 10 mins
	Fyke	2	12/05/2025	16:30	13/05/2025	08:45	16 hrs 15 mins
	Fyke	2	13/05/2025	08:30	13/05/2025	16:00	7 hrs 30 mins
	Fyke	2	13/05/2025	08:45	13/05/2025	16:10	7 hrs 25 mins
	Fyke	2	13/05/2025	16:00	14/05/2025	08:45	16 hrs 45 mins
	Fyke	2	13/05/2025	16:10	14/05/2025	09:00	16 hrs 50 mins

2.5 Measuring and tagging

All white-throated snapping turtles and Fitzroy River turtles captured during the field survey events were measured and tagged in accordance with standard DETSI procedures, animal ethics approval conditions (refer to Section 2.7), and as specified in the Rookwood Weir Operations SMP (GHD, 2023).

The following measurements were recorded to provide biological baseline data on each individual:

- **Straight carapace length** (SCL) – measured from the anterior midline margin of the carapace to the posterior midline margin of the carapace
- **Straight carapace width** – measured at the widest part of the carapace perpendicular to the midline axis of the carapace
- **Plastron length** – measured from the middle anterior to the middle posterior of the plastron
- **Plastron width** – measured perpendicular to the midline axis of the plastron immediately anterior to the bridges
- **Head length** – measured from the anterior tip of the maxillary sheath of the jaw to the posterior tip of the supra-occipital process
- **Head width** – measured across the widest part of the head behind the ears at the quadrate bones
- **Tail** – measured from the tip of the firmly out-stretched tail to the plastron, to the anterior of the vent and to the posterior mid-point of the carapace
- **Weight** – weighed with either a hanging spring or electric balance
- **Plastron curvature** – scored as concave, convex or flat by inspection with a straight edge laid over each of the length and width of the mid plastron
- **Gravid** (carrying eggs) – adult female turtles were assessed for oviductal eggs via inguinal palpation.

All turtles captured were carapace notched and fitted with passive integrated transponder (PIT) tags and monel foot tags (Plate 2.4). These mark-recapture measures allow for the identification of individuals and will facilitate the long-term monitoring of the turtle population throughout the catchment over the life of the Project. The multiple

techniques selected and used in parallel will increase the probability that one form of identification will persist over a long period of time and will allow for identification under differing scenarios and monitoring methods.

Specifically, each turtle was individually tagged with the following methods (Plate 2.4):

- **Coded carapace notching** – marginal scutes of the carapace were assigned a three letter code in order from the right front in a clockwise direction; one or more notches were cut using an electric grinder into the marginal scutes each to a depth of approximately one third of the width of the scute to provide a series of coded turtles. No more than one notch was applied per marginal scute. Carapace notches allow for the identification of deceased turtles if shells are located.
- **Numbered self-piercing, self-locking, monel tags –** monel tags were applied through the webbing between digits four and five of the turtle's rear foot. Pressure was applied to the tag to cause the sharp point to puncture through the webbing. The tags were then closed using pliers. Monel foot tags provide a form of identification (i.e. tag number) that can be easily recorded and reported by persons not involved in the operations phase monitoring and will provide identification when the carapace of the turtle is damaged.
- **Passive integrated transponder (PIT) tags** – sterilised glass-encased PIT tags consisting of polymer shells (11.4 mm x 2.18 mm) with a frequency of 134.2 kHz certified to ISO 11784/11785. These tags were injected intramuscularly, immediately below the anterior carapace below the junction of the first vertebral scute and the first left costal scute. The skin of the turtle was swabbed with a topical antiseptic (e.g. betadine/ethanol) prior to injection of the PIT tag with the insertion needle. A pocket reader was used to record the tag number prior to release. PIT tagging will allow for the remote detection of individuals. The PIT tags are compatible with the fixed PIT tag readers installed within the turtle passage infrastructure and within the fishway at Rookwood Weir.

Year 1 2024-25 of the operations phase monitoring aimed to attach acoustic transmitters (V13 Vemco Amirix Systems Ltd, NS, Canada; Plate 2.5) to as many individuals of each of the two target turtle species as possible, provided this was within the approved research permit conditions for each species (refer to Section 2.7). Hatchling/juvenile turtles were not targeted for capture; however, four smaller acoustics tags (V9 Vemco Amirix Systems Ltd, NS, Canada) were available for deployment on any smaller individuals (e.g. juveniles) captured during the field survey events.

Acoustic transmitters were attached to the posterior marginal scutes of the carapace using a purpose-built cap, plastic saddle and PVC nut and bolts (1.5 mm). Two holes (2.5 mm diameter) were drilled vertically through the carapace and the transmitter screwed into place. The ends of the bolts were covered in a 2-part epoxy putty to prevent abrasion with the turtle's skin (Micheli-Campbell *et al*., 2017), which was painted in black nail polish, providing camouflage (Plate 2.4).

The V13 acoustic transmitters were ~12 grams (g) in weight with dimensions of 45 mm length x 13 mm depth. The V9 transmitters were ~6 g in weight with dimensions of 41 mm length x 13 mm depth. Total weight of the tags was <1 % of an individual's body weight. The expected battery life of the V13 and V9 transmitters is approximately 1130 and 582 days, respectively, at which point they cease to function.

Plate 2.4 ***Turtle mark-recapture methods: field set up for measuring and tagging turtles (top left), turtle tagging equipment (bottom left) including from left to right – PIT tag applicator, PIT tag, monel foot tag, V13 acoustic tag, and coded carapace notching (right).***

Plate 2.5 ***Acoustic tag before (left) and after camouflage painting (right)***

2.6 Remote monitoring

2.6.1 Acoustic telemetry

Acoustic hydrophones are being used to monitor movement behaviour of turtles for turtle passage and broad-scale monitoring within the 33 km reach of river. The hydrophones work by detecting and logging the acoustic pulses from acoustic tags attached to turtles during Year 1 2024-25 of the operations phase or in earlier monitoring programs (e.g. Turtle Movement Study). Unlike PIT tags, which remain embedded in turtles, acoustic tags are externally attached and may detach over time or stop transmitting. Hydrophone data is intended to be downloaded on a quarterly basis for five years, involving physical retrieval of each hydrophone and connection to computer software.

For turtle passage monitoring, seven hydrophones were positioned within resting pools or adjacent to the turtle passage infrastructure in April 2024 to capture fine scale movements (Figure 2.3). An eighth hydrophone will be installed in the stilling basin during Year 2 2025-26. Installation of hydrophones involved attachment of each hydrophone via a multi-strand stainless steel cable to various anchor points located on the turtle passage containment walls. As such, some hydrophones have identical anchorage points, but the hydrophones themselves are located in different locations. A floating buoy was attached to keep the hydrophone in a vertical position in the water column (Plate 2.6).

The hydrophone array for broad-scale turtle monitoring currently consists of 24 hydrophones along the 33 km length of the Fitzroy River to capture larger scale movement within the study area (Table 2.8 and Figure 2.4). Broad-scale monitoring hydrophones have a mean distances between each of approximately 1.38 km (minimum = 0.22 km, maximum = 3.38 km) along the course of the river. The detection range of each hydrophone along the broad-scale array is approximately 200 – 400 m depending on river topography. For example, during the May 2025 surveys, the detection range in the Rookwood Weir pool was found to be between 380-400 m. The majority of hydrophones in this array were installed as part of the Turtle Movement Study and have been receiving data since April 2017. For the purposes of this report, hydrophone data analysis includes all data recorded from 22 April 2017 to the most recent hydrophone retrieval (March 2025). The inclusion of these data aim to provide historical context to the results for Year 1 2024-25 of broad-scale monitoring during Rookwood Weir operations. For installation, each hydrophone was secured to a concrete anchor (15 kg) and moored to a tree on the riverbank by a 6 mm multi-strand stainless steel cable, with alterations when required. Since the commencement of Rookwood Weir operations, some hydrophones became inaccessible due to a combination of restricted access (i.e. inundation) and being physically stuck by debris/sediment, resulting in their slight relocation or removal from the array during Year 1 2024-25 (GHD, 2024). Specifically, three hydrophones that were unretrievable at the start of operations were later successfully retrieved; two of these had already been replaced by nearby units, while one was removed from the array upon retrieval as it was no longer required.

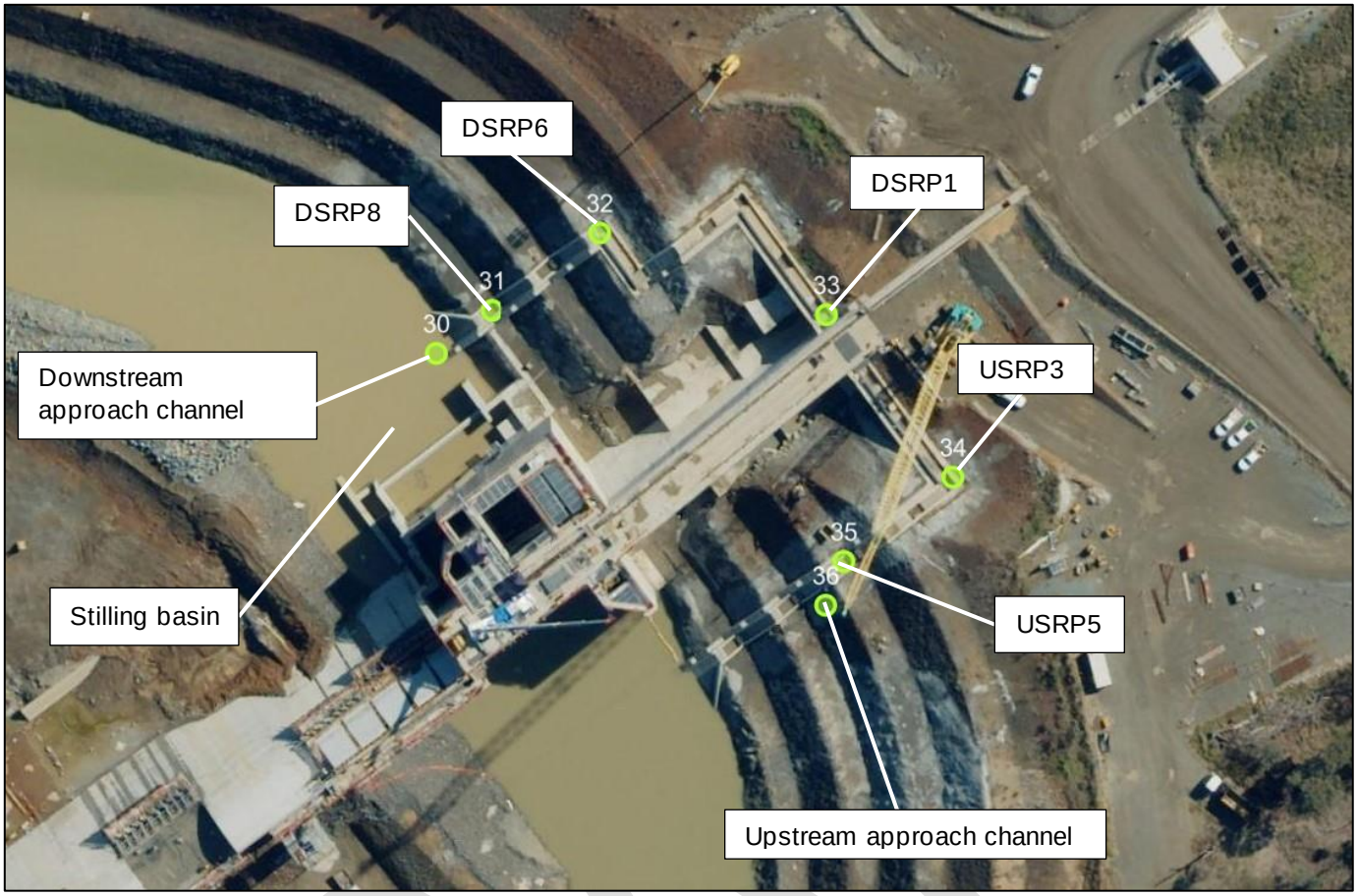

Figure 2.3 *Turtle passage monitoring – acoustic hydrophone array (shown as green circles)*

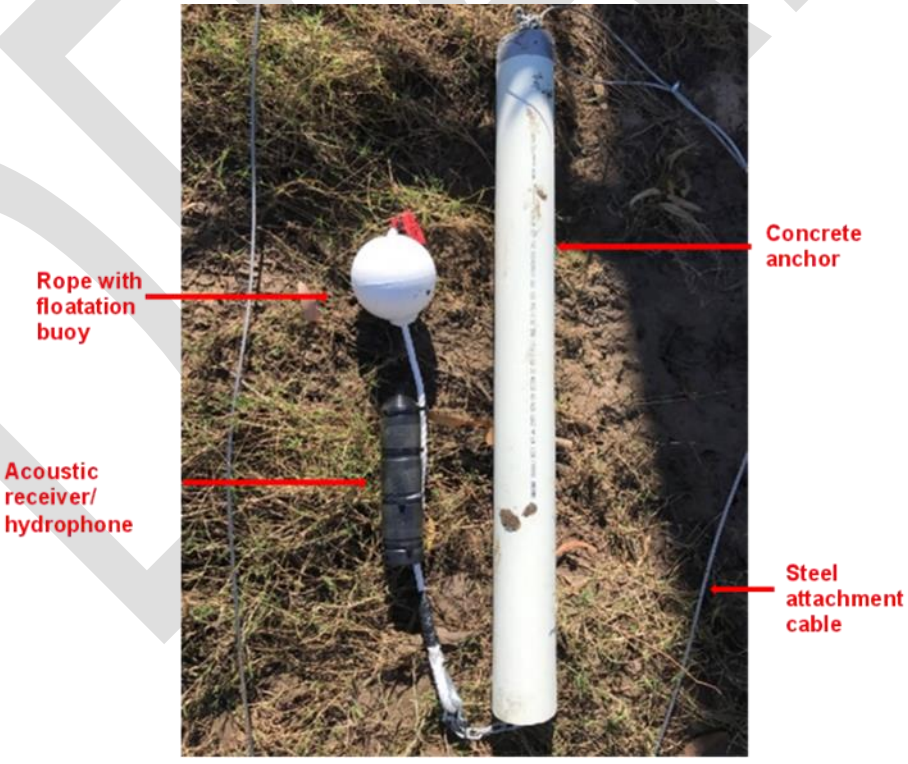

Plate 2.6 *Vemco VR2-W underwater acoustic hydrophone mounted to 12 mm rope with floatation buoy and steel attachment cable*

Table 2.8 Hydrophones deployed as of March 2025

Site number	Hydrophone ID	Latitude	Longitude	Station name
Rookwood Weir turtle ramp and approach channels				
30	139606	-23.54005	150.01624	Ramp entrance downstream
31	139608	-23.54005	150.01624	Lower resting pool downstream (DSRP8)
32	139607	-23.53992	150.01642	Mid resting pool downstream (DSRP6)
33	135473	-23.54006	150.01676	Upper resting pool downstream (DSRP1)
34	131270	-23.54030	150.01696	Upper resting pool upstream (USRP1)
35	137823	-23.54039	150.01680	Lower resting pool upstream (USRP5)
36	135475	-23.54039	150.01680	Approach channel upstream
Rookwood Weir site to The Pocket				
37	131256	-23.54421	150.01574	Left bank weir pool
11	139604	-23.54476	150.01779	Rookwood mid
24	139605	-23.54716	150.01729	Rookwood crossing
25	135474	-23.53937	150.01471	Rookwood upstream riffle
12	131266	-25.55357	150.01224	Rookwood upstream
13	131477	-23.55455	150.00468	Rookwood far upstream
14	131268	-23.55360	149.98615	Gogango Creek Mouth
15	131269	-23.55662	149.98224	Gogango Creek
16	136829	-23.55377	149.96327	Gogango Creek upstream
17	131262	-23.56267	149.94464	Riverslea downstream
18	137824	-23.58440	149.93451	Riverslea upstream
27	136828	-23.58760	149.93434	Riverslea riffle downstream
19	131272	-23.61807	149.93398	The Pocket downstream
20	131273	-23.62778	149.93164	The Pocket upstream
Hanrahan's to Rookwood Weir site				
3	131260	-23.47059	150.02428	Hanrahan pool
4	134045	-23.47945	150.01399	Hanrahan upstream

Site number	Hydrophone ID	Latitude	Longitude	Station name
5	134044	-23.49010	149.99245	Hanrahan far upstream
6	137825	-23.49393	149.97441	Lawries bend far downstream
7	131257	-23.50297	149.96007	Lawries bend downstream
22	131265	-23.51043	149.96030	Lawries bend mid
8	136830	-23.51900	149.97880	Lawries bend upstream
9	131258	-23.52593	150.00407	Rookwood far downstream
10	131264	-23.53303	150.00926	Rookwood downstream
23	131261	-23.54997	150.01677	Rookwood Weir site

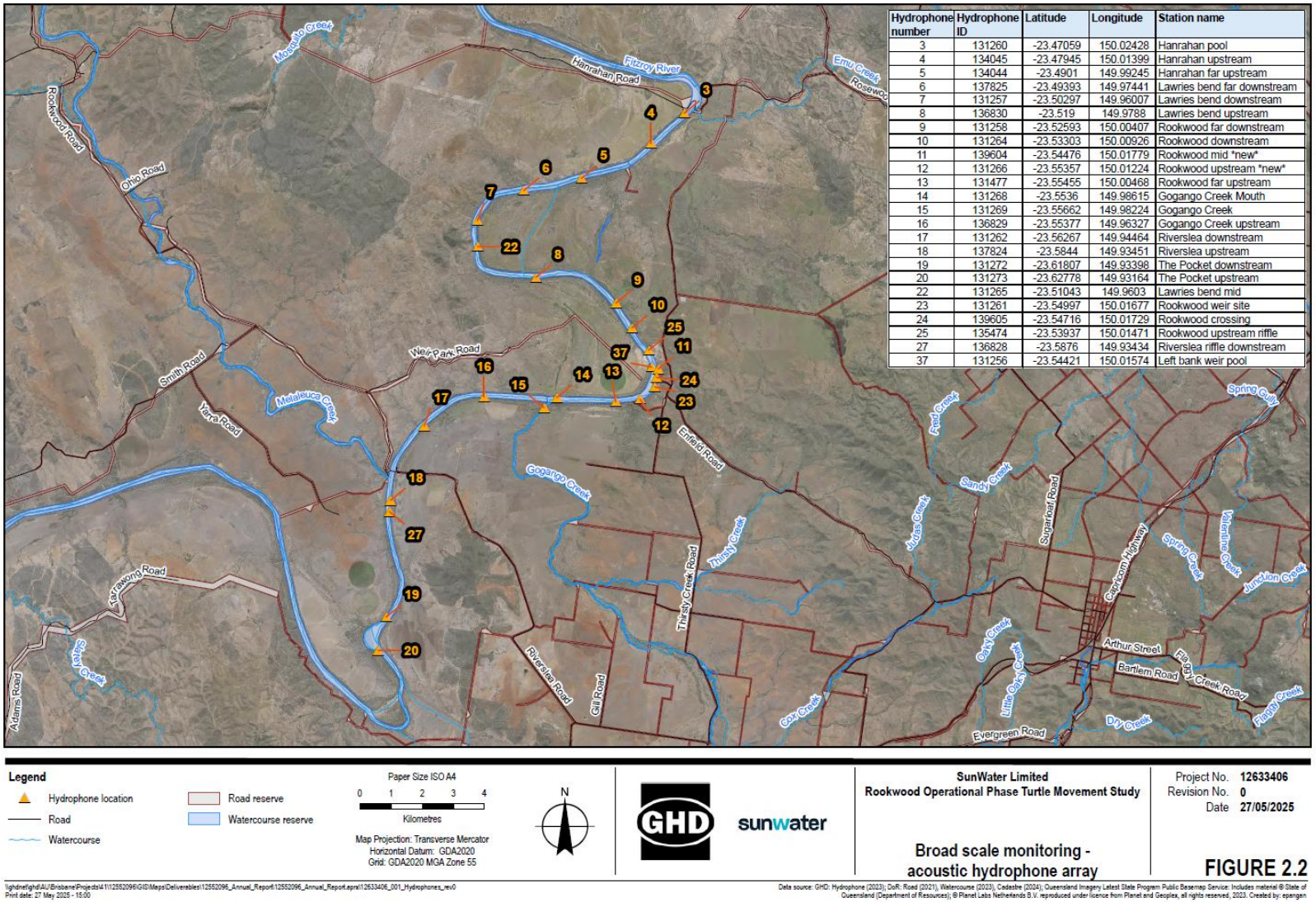

Figure 2.4 Broad-scale monitoring - acoustic hydrophone array

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2.6.2 PIT tag readers

As part of turtle passage monitoring, PIT tag readers were installed on the turtle passage (D1 at DSRP7, D2 at DSRP1 and D3 at USRP5) and within the fishway during construction (Figure 2.1 and Plate 2.7). These PIT tag readers intend to detect the PIT tag numbers of white-throated snapping turtles and Fitzroy River turtle that were tagged either during Year 1 2024-25 of operations phase monitoring, or in earlier monitoring programs (e.g. Turtle Movement Study). PIT tags are designed to remain embedded in the turtle's tissue for life, allowing for long-term identification and monitoring of individuals across years.

Collected PIT tag data was downloaded from the third-party website nominated by Sunwater's representative from June 2024 up to and including May 15, 2025 (i.e. Year 1 2024-25). These data were then analysed to identify turtles utilising the turtle passage infrastructure and/or fishway. Data was also interrogated to determine the number, species, and sex of turtles detected by each PIT tag reader, as well as calculate the percentage of turtles utilising the turtle passage infrastructure and/or fishway that successfully completed passage, and the timing/environmental conditions of detections.

PIT tag data are considered limited for Year 1 2024-25 due to interference of the turtle passage pump with PIT tag reader operation. This was rectified by Sunwater in March 2025.

PIT tag data are only relevant to the turtle passage monitoring, and do not inform broad-scale monitoring except for identification of recaptured turtles.

Plate 2.7 ***Location of three installed PIT tag readers along turtle passage (top left): D1 (top right), D2 (bottom left) and D3 (bottom right)***

2.6.3 Remote cameras

In (Sunwater to provide date/month of installation) 2024, five remote cameras (Sunwater to provide information on model camera) were installed on the turtle passage infrastructure by Sunwater to view the entrance, middle and exit of the turtle passage (Figure 2.5). The cameras are motion triggered with photographs recorded on SD cards. This data is intended to assist in visually observing turtle movement and behaviour within the turtle passage infrastructure. Additionally, these cameras have been, and continue to be used in monitoring for falls, signs of predation and/or turtle aggression. Imagery captured by the cameras has been reviewed by Sunwater up to May 15, 2025, for Year 1 2024-25 of the operations phase monitoring. Images of turtles, and other fauna in or around the passageway were the uploaded to a central SharePoint for interpretation and integration into this report.

Drafting note: Sunwater to provide date/month of installation of remote cameras and information on camera model

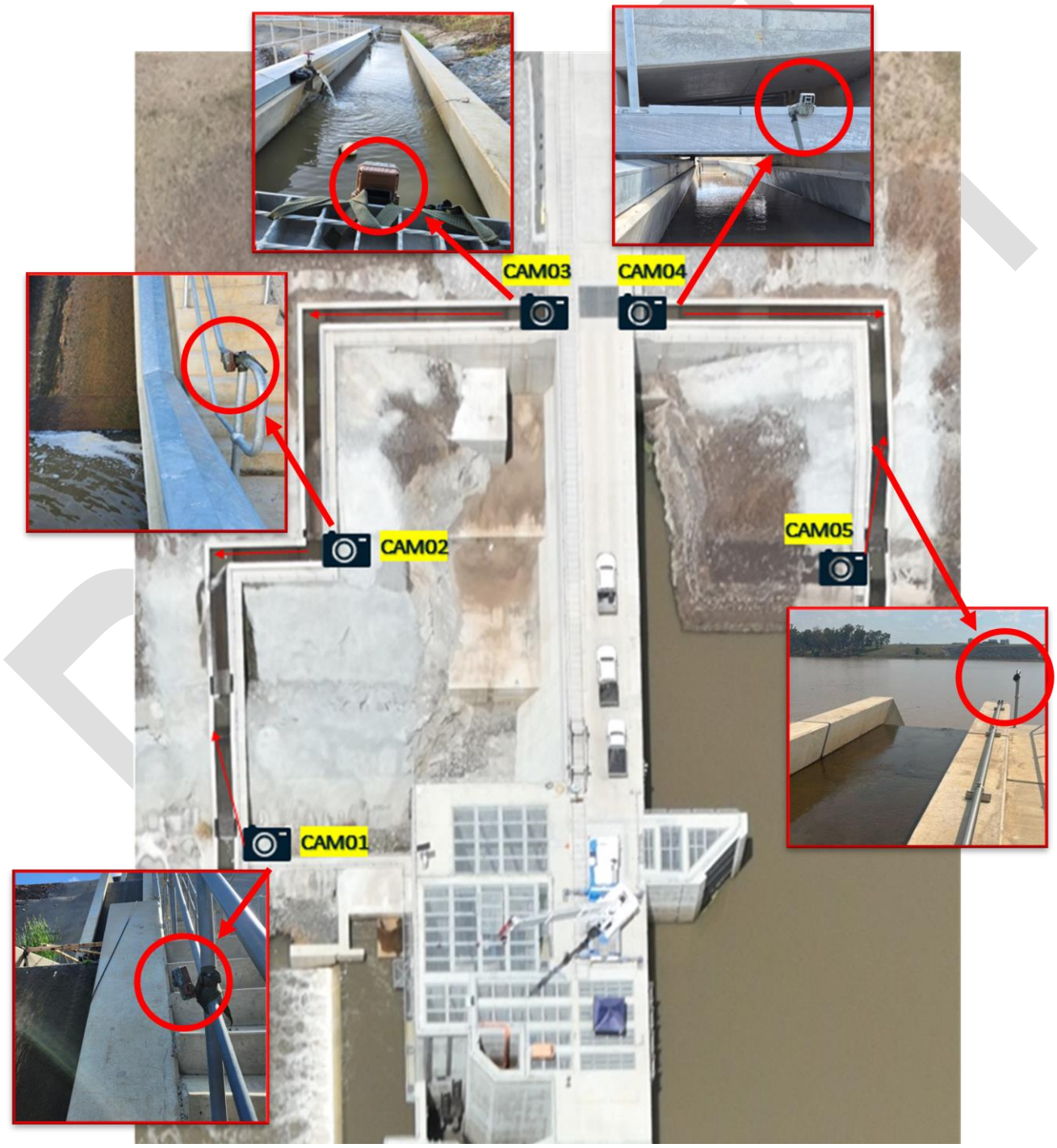

Figure 2.5 Turtle passage – remote camera locations

2.7 Permits and approvals

Turtle capture and tagging procedures were conducted in accordance with the following Acts and permits:

- Queensland Animal Care and Protection Act 2001
- Queensland Fisheries Act 1994
- General Fisheries Permit (Permit number 266945; expiry 18 September 2026)
- GHD Scientific Users Registration Certificate (Registration Number 132; expiry 17 December 2028)
- GHD Scientific Purposes Permit (Permit number P-SPP-100816242; expiry 17 March 2030)
- GHD Animal Ethics Committee Animal Research Authority (GHD QLD ARA-2024-12633406; ARA-2025-12633406)

2.8 Data analysis

2.8.1 Mark-recapture identification tags

Identification tags of recaptured turtles were recorded and standard measurements retaken. Acoustic tags were re-attached where they had detached.

2.8.2 Acoustic telemetry

2.8.2.1 Data collection and preparation

Following the recovery, download and redeployment of the 31 underwater receivers (turtle passage: seven hydrophones; broad-scale: 24 hydrophones) in April, September and December 2024, and March 2025, detections of acoustic-tagged turtles were uploaded into a central Vemco VUE database (www.lnnovasea.com**).** Once compiled, the detection dataset was exported as a single .CSV file (comma separated file format) for analysis in the R statistical program (R Core Team, 2025). Abacus plots of detections at acoustic receivers through time were generated using the ggplot2 package in R. To visualise the movements of tagged turtles along the river, the locations of acoustic receiver stations were plotted according to their river distance (AMTD) between the farthest upstream receiver (The Pocket Upstream) and the receiver positioned below Hanrahan Crossing: ID 1 = Hanrahan's Far Downstream (AMTD 0).

2.8.2.2 Data analysis

Using the VTrack package (Campbell et al., 2012) in R, the departure and arrival times when acoustic transmitters moved between the detection fields of adjacent receivers were extracted using the RunResidenceExtraction function. Linear home range estimates were calculated by extracting the extent of river (AMTD) between the most upstream and downstream receivers where a tagged turtle was detected. If a turtle was detected in multiple branches of the river network, the extent of river occupied also included the distance between the main trunk and the most upstream receiver in the tributary.

2-dimensional home range estimates were calculated using the Brownian bridge kernel density estimator in the Animal Tracking Toolbox extension of the VTrack R package (Udyawer et al., 2018; Campbell et al., 2012) in R (R Core Team, 2025). For this analysis, raw detections were converted into 12-hour centres of activity (COA) estimates projected into the GDA94/MGA zone 55 coordinate datum. The Brownian bridge kernel approach was chosen over the standard kernel utilisation distribution to account for serial autocorrelation between successive relocations (Horne et al., 2007). Brownian bridge estimation relies on two smoothing parameters: sig1 and sig2. The parameter sig1 is related to the speed of the animal and describes how far from the line joining two successive relocations the animal can go during one time unit (here the time is measured in second). The parameter sig2 is equivalent to the parameter h of the classical kernel method and is related to the inaccuracy of the relocations. The 95% kernel utilisation distribution (95% BBKUD) contours were extracted for each turtle and were 'stacked' on top of one another on a map of the study area to provide a spatial representation of the areas occupied by each turtle species.

The minimum distance travelled by a tagged turtle during the study period was calculated by summing all consecutive upriver and downriver movements between underwater receivers along the course of the river. As there were sections of our acoustic array that had overlapping detection fields, there were occasions where animals could be detected at two hydrophones at the same point in time. This had the undesirable effect of greatly inflating our estimates of distance travelled. As recommended by Udyawer *et al.* (2018), prior to estimating travel distances we transformed raw acoustic detections into 12-hour COA estimates. These estimated positions of tagged animals within fixed 12-hour time steps weighted by the number of detections at each hydrophone which removed the problem of overlapping detection areas and lead to more precise estimates of distance travelled.

Space usage by tagged turtles across the broad-scale survey area was quantified through using the following metrics: maximum extent of river utilized by a tagged turtle over the entire tracking period, monthly mean extent of river utilized by a tagged turtle, distance travelled per day and distance travelled per month. Specific to turtle passage monitoring, detections within and adjacent to the turtle passage (i.e. on the turtle passage hydrophone array) were compared to identify successful movement of acoustically tagged turtles through the turtle passage.

2.9 Success criteria assessment

The Operations Phase turtle monitoring program includes a range of monitoring techniques, including remote telemetry (PIT tags and acoustic hydrophones), cameras, turtle capture, observations and operational inspections to provide data to assess compliance with the approved success criteria. How each success criteria was assessed in presented in Table 2.9.

Table 2.9 Success criteria assessment methodology

No.	Success criteria	Monitoring methods	Assessment
Management strategy 1 – Turtle movement **Management strategy 2 – Turtle protection**			
1	75% of white-throated snapping turtles and Fitzroy River turtles that attempt to use the turtle passage each year for upstream passage will do so successfully.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations	***Comparison between the turtles attempting to use the turtle passage and those that were detected upstream.*** Turtles attempting to use the turtle passage was defined by the number of turtles that were detected by any methodology within the first downstream resting pool (DSRP8). This was compared to the turtles that were considered to have successfully used the turtle passage which were defined by the number of turtles that were detected within the weir pool by any methodology. Where the percentage of turtles successfully using the turtle passage was less than 75% the success criteria was not achieved and where it was lower than 50% corrective actions were triggered.
2	Turtle monitoring downstream of the weir demonstrates no turtle injury/mortality during downstream turtle passage over the spillway, as evidenced by impact damage to turtles.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations Operational inspections	***Comparison between the number of turtles observed with damage and the total number recorded within 500 m downstream of the weir during the monitoring period.*** The monitoring methods were reviewed for evidence of turtles moving downstream over the spillway which was primarily inferred from any injuries from turtles captured during surveys. This was further supported by evidence obtained from the other monitoring methods. This was then compared with the total number of turtles captured during the turtle capture survey. This success criterion was achieved where less than 5% of turtles recorded within 500 m downstream of the weir showed evidence of impact damage. Where more than 5% of turtles had impact damage which was likely to be the result of movement over the spillway, the success criterion was not achieved, and corrective actions were triggered.
3	The turtle passage remains operational (attraction flow is provided and passage unobstructed) continuously when the storage is above 8,000 ML up to a 1 in 5-year spilling event.	Operational inspections	Sunwater to complete this assessment
4	The turtle passage operates for one week after each four weeks of non-operation when the storage is below 8,000 ML.	Operational inspections	Sunwater to complete this assessment
5	75% of adult white-throated snapping turtles and Fitzroy River turtles recorded within 50 m of the turtle ramp	Remote telemetry (acoustic) Cameras	***Comparison between the number of turtles detected at the turtle passage entrance and the number of turtles attempting to use the turtle passage.***

No.	Success criteria	Monitoring methods	Assessment
	and fishway entrances within a 12-month period are attracted to and can successfully locate the turtle passage entrance (as defined as entering the funnel-shaped ramp).	Turtle capture surveys Observations	Turtles attempting to use the turtle passage was defined by the number of turtles that were detected by any methodology within the first downstream resting pool (DSRP8). This was compared with number of turtles detected on the hydrophone within the downstream approach channel (as indicative of turtles within 50m of ramp entrance). Where the percentage of turtles successfully locating the turtle passage was less than 75% this success criterion was not achieved and where it was lower than 50% corrective actions were triggered.
6	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can successfully ascend the ramp and pool arrangement to reach the abutment throughfare.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations	***Comparison between turtles attempting to use the turtle passage and those that were detected at the downstream upper resting pool (DSRP1).*** Turtles attempting to use the turtle passage was defined by the number of turtles that were detected by any methodology within the first downstream resting pool (DSRP8). This was compared with number of turtles detected by any method within the downstream upper resting pool (DSRP1). Where the percentage of turtles successfully ascending the ramp and pool arrangement was less than 75% this success criterion was not achieved and where it was lower than 50% corrective actions were triggered.
7	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can successfully move through the abutment throughfare.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations	***Comparison between turtles attempting to use the turtle passage and those that were detected at the upstream upper resting pool (USRP1).*** Turtles attempting to use the turtle passage was defined by the number of turtles that were detected by any methodology within the first downstream resting pool (DSRP1). This was compared with number of turtles detected by any method within the upstream upper resting pool (USRP1). Where the percentage of turtles successfully moving through the abutment thoroughfare was less than 75% this success criterion was not achieved and where it was lower than 50% corrective actions were triggered.
8	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp can successfully descend the turtle ramp from the abutment throughfare into the impoundment to complete passage past the weir.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations	***Comparison between turtles that had moved through the abutment and those that were detected within the weir.*** Turtles that had moved through the abutment were defined by the number of turtles that were detected by any methodology within the first upstream resting pool (USRP1). This was compared with number of turtles detected by any method within the weir pool that had also been detected in resting pool USRP1. Where the percentage of turtles successfully moved from the upstream abutment to the weir pool was less than 75% this success criterion was not achieved and where it was lower than 50% corrective actions were triggered.
9	Turtle monitoring demonstrates no predation of turtles from within the turtle passage infrastructure.	Remote telemetry (acoustic) Cameras Observations	***Comparison of the number of turtles which were predated and/or attempted predation within the turtle passage and total number of turtles recorded on the turtle passage.*** All monitoring methods were reviewed for evidence of predation of turtles by assessing behaviour of potential predators when in the presence of turtles.

No.	Success criteria	Monitoring methods	Assessment
			This was compared with the total number of turtles recorded by any method within the turtle passage. This success criterion was achieved if less than 5% of turtles recorded within the turtle ramp within a 12-month period were subject to predation or attempted predation. If more than 5% of turtles experienced predation or attempted predation, corrective actions were triggered.
10	Turtle monitoring demonstrates no turtle injury and/or mortality from within the turtle passage as a result of falls.	Cameras Turtle capture surveys Observations	***Comparison between the number of turtles recorded falling from the turtle passage and the total number of turtles recorded on the turtle passage.*** All monitoring methods were reviewed for footage or evidence of turtles falling from the turtle passage and inference from any injuries from turtles captured during surveys. This was compared with the total number of turtles recorded by any method within the turtle passage. This success criterion was achieved if less than 5% of turtles recorded within the turtle passage were observed falling within or from the turtle ramp resulting in serious turtle injury/mortality. If more than 5% of turtles experienced serious injury or mortality from falling from the turtle passage, corrective actions were triggered.
11	The ratio of adult male and female white-throated snapping turtles and Fitzroy River turtles successfully moving upstream through the turtle ramp within a 12-month period is equivalent to pre-development ratios.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys	***Comparison between the number of male and female turtles moving upstream through the turtle passage during operations and the number of male and female turtles moving upstream between the Rookwood Weir location during pre-construction.*** The number of male and female turtles successfully moving upstream through the turtle ramp as defined by turtles being recorded attempting to use the ramp which were then recorded in the weir pool. This was then compared with the mean number of male and female turtles moving upstream from the Rookwood Weir site hydrophone to the Rookwood Mid hydrophone (i.e. past the Rookwood Weir location) during pre-development (2017 to 2020). If the ratio of adult male to female turtles successfully utilising the turtle passage for upstream movement was substantially different to pre-development ratios of turtles this success criterion was not achieved and corrective actions triggered.
12	Seasonal variation in use of the turtle ramp by adult male and female white-throated snapping turtles and Fitzroy River turtles is equivalent to pre-development seasonal trends over a 12-month period	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations	***Comparison between the number of male and female turtles moving upstream through the turtle passage during operations and the number of male and female turtles moving upstream between the Rookwood Weir location during pre-construction by month.*** The number of male and female turtles by month successfully moving upstream through the turtle ramp as defined by turtles being recorded attempting to use the ramp which were then recorded in the weir pool. This was then compared with the season that had the maximum number of turtle movements of male and female turtles by month moving upstream from the Rookwood Weir site hydrophone to the Rookwood Mid hydrophone (i.e. past the Rookwood Weir

No.	Success criteria	Monitoring methods	Assessment
			location) during pre-development (2017 to 2020) to determine the specific months that turtles moved. If the seasonal use of the turtle ramp (measured by attempted use and successfully passage per month) by adult white-throated snapping turtles and Fitzroy River turtles is substantially different to pre-development seasonal trends in movement behaviour this success criterion was not achieved and corrective actions triggered.
13	Measurement of the turtle ramp attraction flow during inspections and turtle capture monitoring events indicates that the depth of water flow on the upstream ramp remains suitable for turtles to climb as per annual depth criteria	Cameras Observations Operational inspections	***Comparison of water flow on the turtle passage with the annual depth criteria.*** Information and data on attraction flow was collected with the mean flow depth on the horizontal sections of ramp compared with the annual depth criteria (initially defined as 5 cm). Where the difference was greater than 25% this success criterion was not achieved, and corrective actions were triggered.
14	Over a 12-month period, habitat conditions within the resting pools remain suitable for adult white-throated snapping turtles and Fitzroy River turtles, as evidenced by achievement of suitable pool depth criteria, compliance with water quality objectives, and long-term availability of shelters	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations Operational inspections	***Comparison between resting pool conditions (in-situ water quality and physical conditions) and the annual pool suitability criteria.*** Mean habitat conditions within resting pools (as measured at three locations) were calculated for water depth, water quality (temperature, pH, dissolved oxygen, conductivity and turbidity) and the shelters within resting pools assessed for availability and functionality (i.e. not damaged, broken or buried under silt). This was then compared with mean water quality data for the Fitzroy River – upstream and downstream of Rookwood Weir, current Fitzroy River water quality and pre-action water quality. If the resting pool water quality was more than 25% different to annual pool suitability criteria (initially defined as 0.50 m water depth, water quality equivalent to background levels (temperature, pH, dissolved oxygen, conductivity and turbidity compliant (±25%) with conditions within similar depth habitat upstream and/or downstream), and shelter is available/functioning), the success criterion was not achieved and corrective actions triggered.
15	Annual monitoring downstream of the weir trash screens and inlets indicates no entrapment or drowning of white-throated snapping turtles or Fitzroy River turtles.	Operational inspections Turtle capture surveys Observations	***Comparison between the number of turtles with injury/mortality as a result of the weir trash screens and the total number of turtles recorded within 500 m upstream or downstream of the weir.*** All monitoring methods were used to determine the number of turtles with injuries or mortalities that were likely the result of the weir trash screens and inlets. The weir trash screens were inspected for deceased turtles. This was then compared with the total number of turtles captured during the turtle capture surveys. If more than 5% of turtles recorded within 500 m upstream and downstream of the weir showed evidence of entrapment/drowning on the weir trash screens or inlets, this success criterion was not achieved and corrective actions triggered.

No.	Success criteria	Monitoring methods	Assessment
16	Monitoring of the fishway over a 12-month period indicates no injury/mortality of white-throated snapping turtles or Fitzroy River turtles occurred within the fishway complex.	Fishway monitoring Turtle capture surveys Observations	***Comparison between the number of turtles with injury/mortality as a result of the fishway and the total number of turtles recorded within 500 m upstream or downstream of the weir.*** All monitoring methods were used to determine the number of turtles with injuries or mortalities that were likely the result of the fishway complex either from the structure itself or the operation of the fishway (as evidenced by entrapment/drowning within fishway and/or crushing injuries from gates). This was then compared with the total number of turtles captured during the turtle capture surveys. If more than 5% of turtles recorded within 500 m upstream and downstream of the weir showed evidence of injury or mortality from the fishway complex, this success criterion was not achieved and corrective actions triggered.
17	At least 20 adult Fitzroy River turtles and white-throated snapping turtles recorded attempting to use the turtle passage within a 12-month period.	Remote telemetry (acoustic and PIT) Cameras Turtle capture surveys Observations Operational inspections	***Count of the number of turtles attempting to use the turtle passage.*** All monitoring methods were used to calculate the total number of Fitzroy River turtles and white-throated snapping turtles attempting to use the turtle passage. Turtles attempting to use the turtle passage was defined by the number of turtles that were detected by any methodology within the first downstream resting pool (DSRP8). If there were less than 20 of each target turtle species recorded attempting to use the turtle passage this success criterion was not achieved and corrective actions triggered.
Management strategy 4 – Protection of habitat			
18	Suitable turtle habitat is present within, and/or upstream and/or downstream of Rookwood Weir.	Remote telemetry (acoustic) Turtle capture	***Assessment of in-situ water quality, potential nesting banks, aquatic habitat and presence of turtles and turtle condition upstream and downstream of the weir.*** Suitable turtle habitat was assessed through analysis of: – Water quality in the Fitzroy River with comparison to WQOs and pre-development baseline conditions – Suitability of nesting habitat of the priority turtle nesting banks as identified for 2025 – Availability of aquatic habitat including woody debris and food sources (e.g. aquatic plants, algae, periphyton, crustaceans, invertebrates etc.). If turtle habitat conditions were poor, there were no turtles identified within the impoundment or within 1 km downstream and turtles captured in these areas were in a poorer health than those recorded during baseline surveys (as measured by higher rates of injury/mortality/illness) then this success criterion was not achieved and corrective actions triggered.

3. Results and discussion

3.1 Survey conditions

3.1.1 River flow

Average daily flow (ML/day) at sites upstream and downstream of Rookwood Weir during Year 1 2024-25 of turtle passage and broad-scale monitoring (i.e. June 2024 to May 2025) are presented in Figure 3.1. No major flow events coincided with hydrophone or turtle capture surveys. Two major flow events occurred on the Fitzroy River in February and April 2025, originating from the Mackenzie River, with mean daily flows exceeding 100,000 ML/day and 200,000 ML/day, respectively. While the turtle capture survey in May 2025 occurred following peak flows, flow velocity was still elevated during turtle capture (approximately 22 cumecs).

Conversely, the Dawson River consistently recorded lower flows than the Fitzroy and Mackenzie Rivers. However, changes in flow at the Dawson River generally followed similar timing, though at a reduced scale. For example, the Dawson River peaked at approximately 25,000 ML/day in early April 2025. The one deviation from this pattern was in December 2024, when the Dawson River experienced a small peak (~10,000 ML/day) while flows at other sites remained low.

Based on recorded mean stream level at Riverslea which is an indicator of Rookwood Weir impoundment water level, water levels were relatively consistent throughout the year, including across hydrophone and turtle capture surveys (Figure 3.2). Water level at Riverslea was lowest in December 2024 but increased back to the weir FSL in January 2025. There were two minor flood events (>15 m at Riverslea) in mid-February 2025, and April 2025 (Figure 3.3), coinciding with higher flows during this period (Figure 3.1). No flooding occurred during hydrophone or turtle capture survey events.

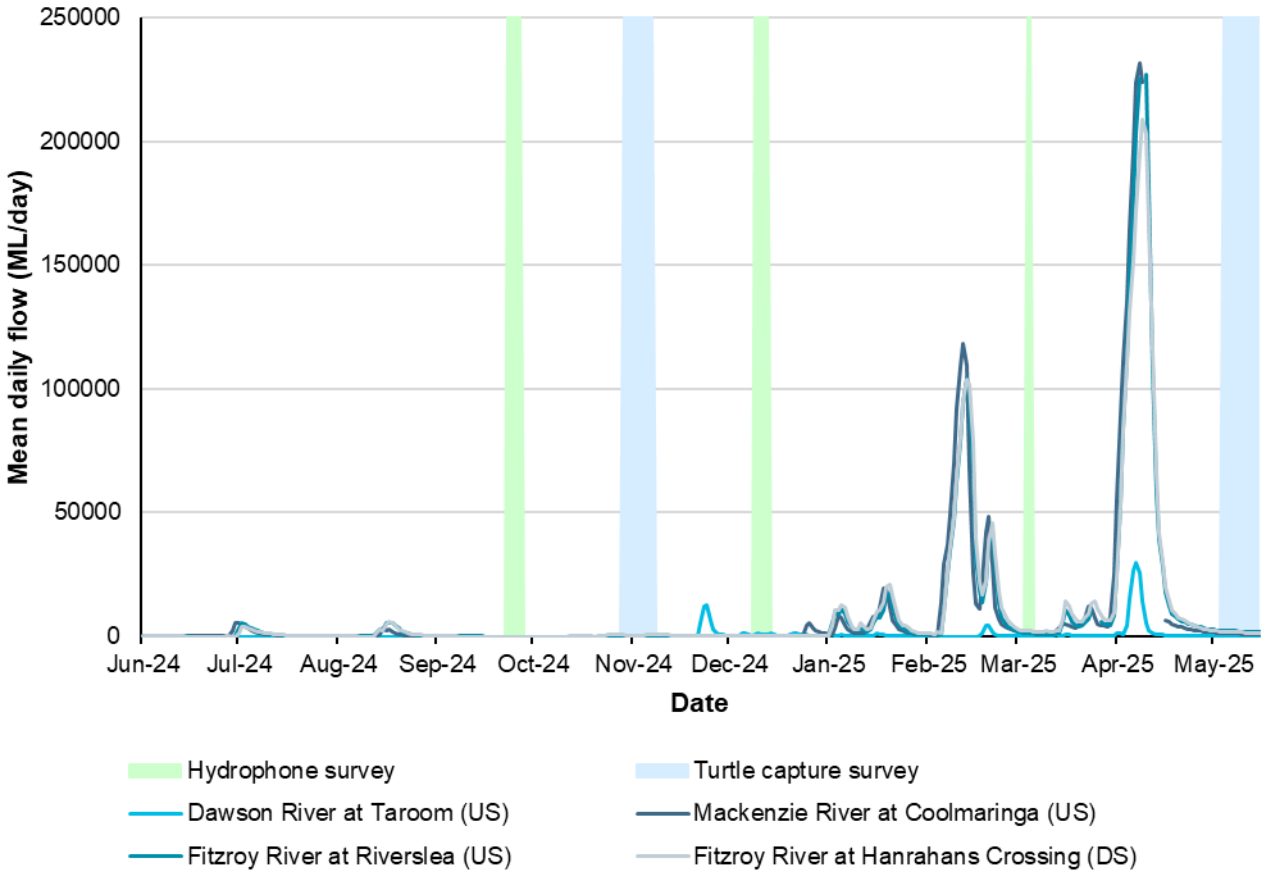

Figure 3.1 *Mean daily flow (ML/day) at sites upstream (US) and downstream (DS) of Rookwood Weir from June 2024 – May 2025*

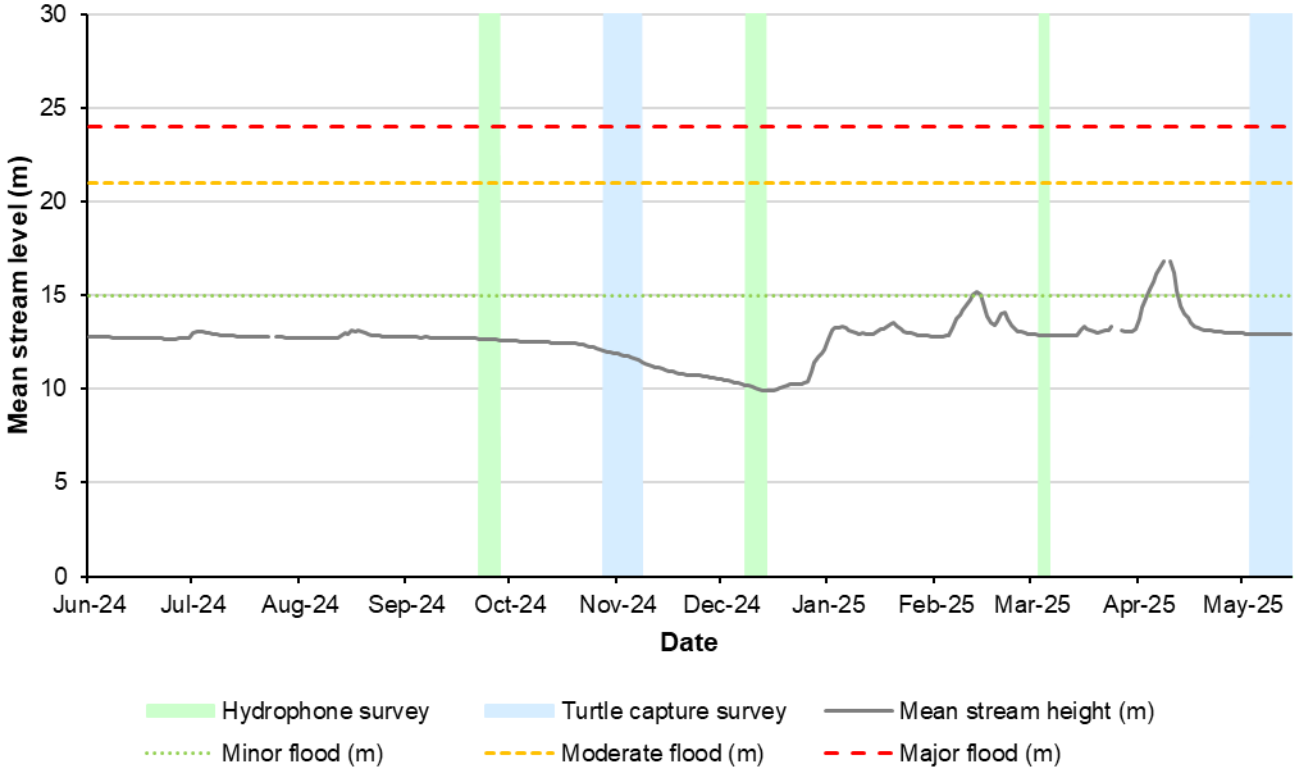

Figure 3.2 *Mean stream level (m) for Fitzroy River at Riverslea (130003B) and define flood levels from June 2024 – May 2025*

3.1.2 Rookwood Weir water level and releases

Drafting note: Sunwater to provide Rookwood Weir water level and releases for 1 January 2024 to 31 May 2024

Sunwater has provided data on weir storage, headwater and tailwater water levels and flows for Rookwood Weir up to and including May 15, 2025 (Figure 3.3 and Figure 3.4). From June 2024 to May 2025, the weir generally operated at or above full supply level (FSL), with levels falling below FSL (headwater <46.2 mAHD), for approximately 3½ months during spring to early summer (15 September 2024 to 1 January 2025). The lowest recorded supply level occurred on 15 December 2024, and highest capacity on 9 April 2025 at approximately 60% and 170% capacity respectively.

Notable overtopping events were observed during four key periods: prior to 1 March 2024 to 7 June 2024, 1 July to 2 August 2024, 13 August to 12 September 2024, and 2 January to 15 May 2025 (with potential continuation beyond the available dataset). The largest overtopping events were from January 2025 onwards, coinciding with the highest recorded storage capacity, and similarly high flows both at the weir (Figure 3.2) and at upstream locations along the Fitzroy River and Mackenzie River (Figure 3.1). The weir was overtopping at the time of the second turtle capture survey in May 2025, with mean daily flow ranging from 1489 ML/day to 2007 ML/day downstream at Hanrahan Crossing (station 130010A) (Figure 3.3). In total, Rookwood Weir overtopped for approximately 207 days, representing around 60% of the monitoring period from June 1, 2024, to May 15, 2025.

During the October/November 2024 turtle capture survey, whilst Rookwood Weir was not overtopping, water was being discharged from the low flow outlet. This release resulted in mean daily flow ranging from 393 ML/day to 744 ML/day downstream at Hanrahan Crossing (station 130010A) throughout the survey period (Figure 3.4).

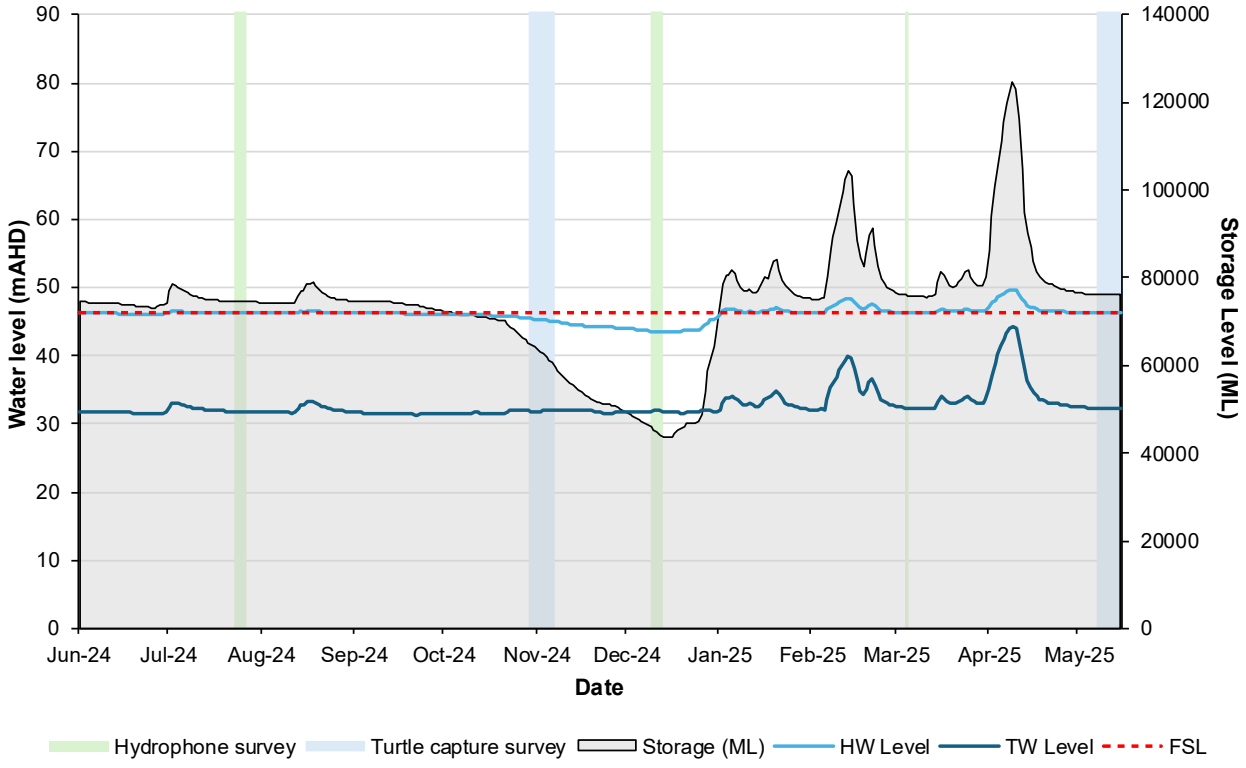

Figure 3.3 ***Headwater (HW) and tailwater (TW) levels (mean daily mAHD), full supply level (FSL 46.2 mAHD RL) and storage level (mean daily ML) at Rookwood Weir from June 2024 – May 2025***

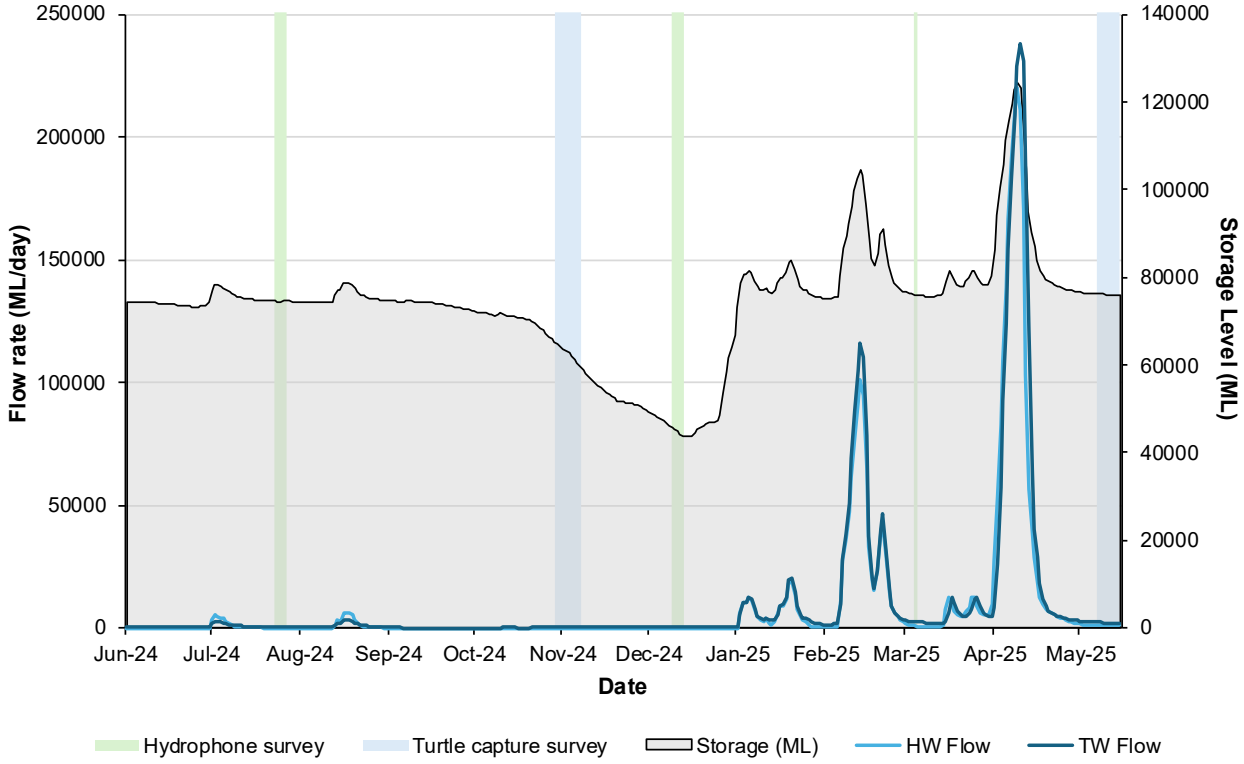

Figure 3.4 ***Headwater (HW) and tailwater (TW) daily flow rate (mean ML/day) and storage level (mean daily ML) at Rookwood Weir from June 2024 – May 2025***

3.1.3 Conditions during the surveys

Rainfall at Riverslea (upstream from Rookwood Weir) is presented in Figure 3.5. Rainfall in the month prior to survey events was <10 mm for all survey events except for the turtle capture survey in October/November 2024, and hydrophone survey in March 2025, with 59 mm and 74 mm respectively in the month prior to survey commencement. During surveys, rainfall was typically low (≤1 mm) except for the hydrophone survey in December 2024, which recorded 13 mm fall over the 5-day survey period.

Average minimum and maximum temperatures during the survey events show seasonal differences in survey conditions (Table 3.1). As expected, temperatures were typically cooler during the winter months (~15-28°C), and warmer during summer months (~20-34°C).

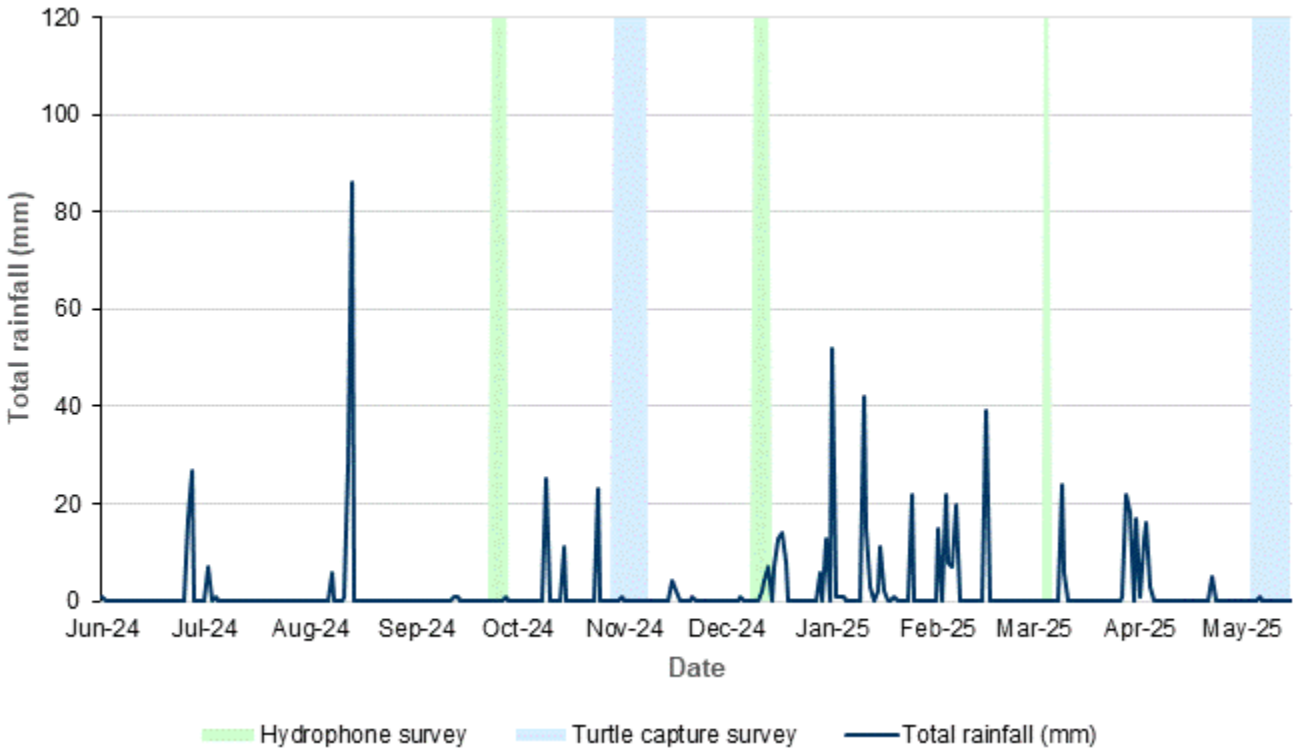

Figure 3.5 Rainfall (mm) during survey events from June 2024 – May 2025

Table 3.1 Mean minimum and maximum temperature (°C) during survey events

Survey	Dates	Mean min temperature (°C)	Mean max temperature (°C)
Hydrophone survey	23 – 27 September 2024	15.76	28.86
Turtle capture survey	29 October – 7 November 2024	19.00	33.82
Hydrophone survey	9 – 13 December 2024	24.14	33.28
Hydrophone survey	4 – 5 March 2025	22.60	34.55
Turtle capture survey	4 – 15 May 2025	16.84	27.55

3.1.4 *In-situ* water quality

Raw surface water quality results are provided in Appendix B, with general observations summarised below. In total, there were 43 instances where water quality was recorded opportunistically throughout Year 1 2024-25 of the operations phase monitoring by GHD, the most being during the May 2025 turtle capture survey, with 15 site records predominantly within the turtle passage. Sunwater recorded *in-situ* water quality of all accessible resting pools along the turtle passage in January and March 2025, however this was at inconsistent depths, and without records for background conditions at Fitzroy River, these data are unlikely to be reliably comparable (Appendix B).

3.1.4.1 Temperature

Surface water temperature within the Fitzroy River recorded during Year 1 2024-25 survey events was generally consistent across survey locations ranging from 19.0°C to 30.4°C and were typical for a large order waterway with large deep pools. Variation in temperature between survey events generally reflected natural seasonal variability. Notably, the lowest and highest water temperatures were both recorded during the October/November 2024 turtle capture survey event at the approach channel downstream of the turtle passageway (19.0°C) and Foleyvale Crossing (30.4°C), respectively. However, this variation is more likely due to the broader range of locations sampled during this turtle capture survey, which covered more sites than hydrophone surveys. Recorded water temperatures were within the expected range (15.3 – 31.3°C) based on pre-action baseline conditions.

Within the turtle passage resting pools water temperature had a similar range to the Fitzroy River with water temperature recorded between 19.9°C and 28.1°C.

3.1.4.2 pH

During Year 1 – 2024-25 survey events, pH within the Fitzroy River and Mackenzie River ranged between a neutral 7.0 to a highly alkaline 9.7 (Appendix B). There were no clear differences in pH between survey locations, with most pH records ranging from 7.0 to 7.9. The one exception was at Foleyvale Crossing on the Mackenzie River, with a recorded pH of 9.7 on 5 November 2024. This coincided with high dissolved oxygen and visually observed green pigmentation (likely algae) of the water (Plate 3.1). Excluding this record at Foleyvale Crossing, all pH levels recorded fell within the recommended WQO for Fitzroy River freshwaters and lakes/reservoirs. Occasionally pH was recorded below pre-action baseline conditions (7.3-8.4) however this was to a fairly limited extent (between 7.0-7.3), and still within the expected range for surface waters.

Within the turtle passage resting pools pH ranged from 7.1 to 8.4 based on data collected by GHD. This range was similar to the pH range of the Fitzroy River, however the turtle passage resting pools had a slightly higher maximum pH. Conversely, data collected in turtle passage resting pools by Sunwater ranged from a pH of 6.3 – 7.7, which was slightly lower than for Fitzroy River (Appendix B). However it is not known what the water quality of the Fitzroy River was at the time of these *in-situ* samples from Sunwater.

3.1.4.3 Electrical conductivity

During Year 1 – 2024-25 survey events, electrical conductivity ranged from 147 µS/cm to 254 µS/cm (Appendix B). Electrical conductivity was relatively consistent between sites upstream and downstream of Rookwood Weir, and within the turtle passage. Conductivity tended to be highest during the May 2025 turtle capture survey event (>225 µS/cm). All recorded values were below both the pre-action baseline (<269 µS/cm) and below the recommended WQO (Appendix B).

Within the turtle passage resting pools electrical conductivity had a similar range to the Fitzroy River with electrical conductivity recorded between 167 µS/cm and 232 µS/cm. Data collected within the turtle passage by Sunwater was similar, ranging from 166 µS/cm to 220 µS/cm.

3.1.4.4 Dissolved oxygen

During Year 1 2024-25 survey events, dissolved oxygen (DO) ranged between 22.1% saturation (2.0 mg/L) and 105.6% saturation (9.1 mg/L) on the Fitzroy River, with no consistent spatial or temporal patterns observed (Appendix B). However, upstream on the Mackenzie River the maximum dissolved oxygen concentration was substantially higher at 145.5% saturation (10.5 mg/L). As prefaced above, this coincided with elevated pH and notably green pigmentation (likely algae) of the water column (Plate 3.1). DO was generally recorded below the recommended pre-action baseline and relevant WQO for Fitzroy River. The lowest values were recorded downstream of the weir low flow outlet (22.1% in October/November 2024), at 3 m depth within the Rookwood Weir pool at Rookwood Camping Reserve (27.1% in October/November 2024), and within the upstream approach channel of the turtle passage (39.1% in March 2025). These results reflect limited oxygenation at depth within the weir pool and the release of this low oxygenation water via the low flow outlet due to malfunction in the selective withdrawal inlet. DO levels within or above WQOs were generally confined to downstream locations or along the turtle passage.

Within the turtle passage resting pools dissolved oxygen had a similar or better range to the Fitzroy River with dissolved oxygen recorded between 67.2% saturation and 105.6% saturation. Sunwater's *in-situ* DO readings were notably lower, ranging from 3.5% to 98%, and were accompanied by very high turbidity. These low values may reflect probe placement near or within bottom sediments, where DO is naturally lower due to decomposition processes and limited circulation. As such, these readings may not be directly comparable to surface water measurements.

3.1.4.5 Turbidity

During Year 1 2024-25 survey events, turbidity levels in the Fitzroy River ranged from 24 NTU to 147 NTU (Appendix B). Variation between surveys is driven by the source of runoff and time of year. Small flows from the Dawson River sub-basin in February and April 2025 (Figure 3.1) were observed to result in highly turbid waters in

subsequent months (>80 NTU in March and May 2025) compared to less turbid waters from the flows from the Mackenzie River sub-basin. Turbidity was also slightly higher during the September 2024 survey event (>90 NTU); however this did not coincide with any notable flow, rainfall events, or releases. Recorded turbidity was consistently lower than pre-action baseline conditions (<190.5 NTU). However, turbidity was generally above the recommended WQO for Fitzroy River sub-basin freshwaters (>50 NTU) and lakes/reservoirs (>20 NTU) across all survey events during Year 1 2024-25. The exception to this were sites downstream from Rookwood Weir during the October/November 2024 and December 2024 survey events (<50 NTU; Appendix B). This period coincided with minimal flows across the Fitzroy River and lowering of Rookwood Weir storage level.

During Year 1 2024–2025 survey events, turbidity levels in the turtle passage resting pools ranged from 30 NTU to 105 NTU. These values were comparable to those recorded in the Fitzroy River, with resting pool conditions closely reflecting river turbidity across survey periods. Low turbidity in the river corresponded with low turbidity in the pools, and high river turbidity was similarly mirrored in the resting pools (Appendix B). Sunwater's turbidity data, by comparison, ranged from 50 to 1200 FNU (a unit comparable to NTU) suggesting potential sampling near bottom sediments or disturbed conditions.

Plate 3.1 Green colouration (likely algae) of water at Foleyvale Crossing during October/November 2024 turtle capture survey

3.1.4.6 *In-situ* water quality comparison between turtle passage and broad-scale monitoring survey areas

Table 3.2 presents average surface water quality parameters recorded at the turtle passage (separated into resting pools and approach channels), and across broad-scale monitoring sites (separated into upstream and downstream of Rookwood Weir). Measurements below 0.1 m depth and those from the outlet discharge pool (which is not accessed by aquatic fauna) have been excluded to allow a consistent comparison of surface water conditions between turtle passage and broad-scale monitoring survey areas.

In general, surface water quality within the turtle passage and approach channels was relatively similar to conditions in the broad-scale monitoring area—upstream and downstream of Rookwood Weir. The mean pH and electrical conductivity were marginally higher in turtle passage resting pools compared with the approach channels and conditions upstream and downstream of Rookwood Weir. However, the mean pH and electrical conductivity measurements were within the water quality objectives and pre-action baseline concentrations for all locations. Similarly, mean water temperature was within the pre-action baseline range within the turtle passage resting pools and more broadly on the Fitzroy River. Mean turbidity was similar at all locations and while concentrations were

higher than the water quality objectives, concentrations were lower than the pre-action baseline levels. Mean dissolved oxygen concentrations within the turtle passage resting pools was within both the water quality objective and pre-action baseline conditions whereas, the Fitzroy River dissolved oxygen concentration was lower than both. This was expected as the inundation of vegetation leads to the decomposition of organic matter which consumes oxygen.

Table 3.2 ***Average in-situ surface water quality parameters recorded across turtle passage, approach channels, and sites along Fitzroy River upstream and downstream of Rookwood Weir***

Location	Temp.	pH	EC	DO	Turb.
	°C	pH units	µS/cm	% saturation	NTU
WQO: Freshwaters [1]	–	6.5-8.5	<445 (base flow) <250 (high flow)	85-110	<50
WQO: Lakes and Reservoirs [2]	–	6.5-8.0	<250	90-110	1-20
Pre-action Baseline [3]	15.3-31.3	7.3-8.4	269	89-101	191
Turtle Passage Resting Pools [2,3]	24.1	7.8	211	93	75
Turtle Passage Approach Channels [1,3]	23.8	7.4	202	81	81
Rookwood Weir Upstream [2,3]	25.6	7.5	196	70	73
Rookwood Weir Downstream [1,3]	23.3	7.4	196	82	68

1 Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part) including all waters of the Fitzroy River Sub-basin – surface fresh waters – main trunk fresh waters – moderately disturbed
2 Fitzroy River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part) including all waters of the Fitzroy River Sub-basin – surface fresh waters – Freshwater lakes/reservoirs – moderately disturbed
3 Pre-action baselines are presented as 75th percentile unless indicated as a range (Sunwater Limited 2024)
Red text denotes parameters that were higher or lower than the water quality objectives
Yellow shading denotes parameters that were higher or lower than the pre-action baseline

3.1.5 Habitat assessment

Based on observations across the different survey events, there were a variety of habitat types considered suitable for both target species. For white-throated snapping turtles, deep pool habitat with vegetated margins comprising root overhang and large woody debris was available both upstream and downstream of the weir infrastructure. However, water quality across the surveyed sites had low dissolved oxygen content, which is potentially due to the breakdown of inundated vegetation upstream of the weir. For Fitzroy River turtles, turtles preferred shallow (<1 m) riffle habitat was available downstream connecting deeper pool habitats.

Priority Turtle Nesting Areas identified for 2025 were located downstream: Rookwood downstream pool left bank, Hanrahan Crossing; and upstream: Gogango Creek and Foleyvale Crossing (Table 3.3). Predation of nests was observed at the downstream nesting bank (Plate 3.2), and whilst no predation was observed at Foleyvale, feral pig tracks were present.

Plate 3.2 ***Predation at nesting bank downstream of weir (left) and nesting bank upstream at Foleyvale Crossing (right)***

Table 3.3 Description of key turtle capture locations

Survey location	Habitat description	Photographs
Rookwood Weir areas		
Turtle passage and approach channels	The turtle passage infrastructure at Rookwood Weir consists of a 172 m long by 2 m wide sloped turtle ramp with resting pools every 15 m. The entry and exit points of the turtle passage are located at the river margins where turtles can access them during low velocity conditions. A widened (6 m) funnel entrance/exit is provided both upstream and downstream to increase the area over which turtles can access the turtle passage at minimum headwater and tailwater conditions. The downstream entrance is immediately adjacent to the low flow outlet and fishway. The ramp varies in slope up to a maximum of 45 degrees and is textured with exposed aggregate to create a roughened surface for the turtles to grip. The entry and exits into each resting pool are sloped for easy turtle access. Resting pool shelters provide shade and protection within each resting pool. A small attraction flow is provided down the ramp and permanent water contained within the resting pools. Passive Integrated Transponder (PIT) tag readers are included at the entrance, middle and exit of the turtle passage to facilitate turtle monitoring. The approach channels (upstream and downstream) are within the Fitzroy River and are immediately upstream and downstream of the entrance ramps to the turtle passage.	
Rookwood Weir pool	Rookwood Weir pool is the impoundment at, and immediately upstream of Rookwood weir. Since inundation, the habitat has become dominated by deep (<15 m) and relatively still pool habitat with a large amount of large woody debris along the margins where past banks and vegetation are now underwater and in various states of decay. Substrate is dominated by silts and clays. There was some undercut banks and root overhang along the banks providing some in-stream habitat. The riparian zone was dominated by Eucalyptus and was continuous throughout the surveyed reach. There is extensive aquatic weed, water lettuce (*Pistia stratiotes*), within the weir pool with these plants being transported downstream in autumn 2025 when the weir was overtopping.	

Survey location	Habitat description	Photographs
Upstream areas		
Gogango Creek	Gogango Creek is a tributary of the Fitzroy River, approximately 4.4 km upstream of Rookwood Weir and has been identified as a priority turtle nesting area for 2025. Since the inundation of the impoundment, Gogango Creek has been modified from a small shallow creek to a much wider and deeper channel. Water velocity is negligible which maintains pool habitat is similar to pre-construction conditions. Banks are steep but low and predominantly compacted earth. Riparian vegetation has been inundated and begun decaying with the woody debris creating complex aquatic habitat.	
Foleyvale crossing	Foleyvale crossing is located approximately 55 km upstream of Rookwood Weir, and has been identified as a priority turtle nesting area for 2025. This location is at the very upper limits of the impoundment with habitat conditions largely the same as pre-construction conditions. Habitats include deep pool (<1.5 m) connected by shallower (<0.5m) slow moving sections. There is some large woody debris, undercut banks and root overhang present in deeper habitats. Substrate is primarily sand with sections of gravel and pebbles. Banks are 1-2 m high and dominated by mature Melaleuca species, with relatively sparse undergrowth.	

Survey location	Habitat description	Photographs
Downstream areas		
Stilling basin and associated pool	The stilling basin is at the base of Rookwood weir which is connected with the pool directly downstream of the weir. The pool extends from the stilling basin approximately 100 m downstream before connecting with the larger, deeper pool (Rookwood downstream pool). The channel is approximately 230 m at its' widest point and 10 m at its' narrowest (downstream) point which represents the approach channel for the turtle passage. This pool is approximately 5 m deep with flow velocity and water depth highly influenced by releases from the weir and uncontrolled spilling events. There is a large, high quality sand bank on the left bank with slumping of the earthen upper bank. Substrate consists of a mix of bedrock, gravel and sand. There is extensive aquatic weed, water lettuce (*Pistia stratiotes*), which is being transported downstream from the weir pool in autumn 2025 when the weir was overtopping.	
Rookwood downstream pool	This Rookwood downstream pool is approximately 0.45 km downstream from Rookwood Weir. This pool is deep (<2 m), wide (70 m) and slow flowing and is connected with and downstream of the stilling basin (and its' associated pool). Substrate is varied, including predominantly bedrock, boulders and cobbles within the channel and sandy, silt/clay on the banks. There is some woody debris present, primarily on the bank margins where erosion is also visible. Banks are 1-2 m tall and primarily dominated by Melaleuca vegetation, with root overhang in eroded sections. There is extensive aquatic weed, water lettuce (*Pistia stratiotes*), which is being transported downstream from the weir pool in autumn 2025 when the weir was overtopping.	

Survey location	Habitat description	Photographs
Rookwood riffle	Rookwood riffle is the approximately 0.6 km downstream of Rookwood Weir and connected with the Rookwood downstream pool. Habitat comprises shallow (<1 m) riffle and run which is created due to the bedrock, cobble, pebble and gravel substrate. The riffle section is approximately 85 m wide and 60 m in length. There is minimal detritus and woody debris, however there is the occasional young melaleuca in-stream. There has been extensive periphyton and filamentous algae noted on the substrate throughout surveys. Bank height to 2 m on the left bank and up to 10 m on the right bank. Banks were low and moderately stable, with mostly cleared riparian vegetation. There is extensive aquatic weed, water lettuce (*Pistia stratiotes*), which is being transported downstream from the weir pool in autumn 2025 when the weir was overtopping.	
Hanrahan Crossing	Hanrahan Crossing is located approximately 17 km downstream from the Rookwood Weir. Hanrahan Crossing consisted of deep pool habitat with sections of run downstream of the crossing. Substrate was generally fine coarse sands and silts, with some gravel. Banks had some aquatic habitat with some overhanging and trailing bank vegetation. Root overhangs were also scattered throughout the reach. Bank vegetation generally comprised a band of large canopy trees with a grassy/weedy understorey.	

3.2 Turtle capture

During Year 1 2024-25 of the operations phase monitoring, two turtle capture survey events were undertaken; the first from 29 October and 7 November 2024, and the second from May 4 to May 15, 2025. Both surveys encapsulated the turtle passage and broad-scale monitoring, with results presented in Section 3.2.1 and Section 3.2.2.

3.2.1 Turtle passage capture

3.2.1.1 October/November 2024

During the October/November 2024 turtle capture survey, no turtles were captured in the turtle passage, upstream approach channel, or the Rookwood Weir stilling basin.

3.2.1.2 May 2025

In May 2025, four individual turtles were captured within the turtle passage. There were two male Krefft's River turtles (*Emydura macquarii krefftii*), one female saw-shelled turtle (*Wollumbinia latisternum*) and one female sub-adult Fitzroy River turtle (Table 3.4; Plate 3.3). The Fitzroy River turtle was captured in the upper resting pool on the downstream side of the abutment thoroughfare (DSRP2) and recaptured the following day in the upper resting pool on the upstream side of the abutment thoroughfare (USRP2), suggesting successful upstream movement through the abutment.

The Fitzroy River turtle was PIT tagged, foot tagged, and carapace notched. The turtle was not acoustically tagged as the tag was > 1% of the turtle's body weight. This turtle showed minor plastron grazes but was otherwise healthy (Plate 3.3).

Trapping within the stilling basin was not conducted due to safety concerns, as access was restricted because the weir was overtopping.

One eastern brown snake (*Pseudonaja textilis*) was also observed within the passage (Plate 3.3). No fish were captured within the turtle passage during the survey.

Table 3.4 Turtle passage survey results – May 2025

Species	Common name	Capture technique and location	Total
Wollumbinia latisternum	Saw-shelled turtle	Muddling in DSRP3	1 (Female)
Emydura macquarii krefftii	Krefft's river turtle	Fyke net in DSRP7 (1) Muddling in DSRP3 (1)	2 (Male)
Elseya albagula	White-throated snapping turtle	–	0
Rheodytes leukops	Fitzroy River Turtle	Fyke net in DSRP2 Fyke net in USRP2 (same individual)	1 (Female)
Total			**4**

Plate 3.3 ***Muddling in resting pool DSRP3 (top left), Krefft's river turtle caught in turtle passage (top right), Fitzroy River turtle captured within turtle passage (middle left), damage to plastron of Fitzroy River turtle captured within turtle passage (middle right), saw-shelled turtle using turtle passage (bottom left), eastern brown snake observed in DSRP2 (bottom right).***

3.2.2 Broad-scale turtle capture

3.2.2.1 October/November 2024

A total of 161 turtles were captured over ten days at Rookwood Weir pool (at Rookwood Camping Reserve), Rookwood downstream pool, Rookwood riffle and Foleyvale Crossing. Of these, 31 were the target freshwater turtle species which included 26 white-throated snapping turtles and five Fitzroy River turtles (Table 3.5).

Of the target turtle species (Plate 3.4), 26 were acoustically tagged (Table 3.6 and Table 3.6), comprising 11 adult male and 10 adult female white-throated snapping turtles and one adult male and four adult female Fitzroy River turtles. Five white-throated snapping turtles were unable to be tagged because the supply of acoustic tags was exhausted.

One white-throated snapping turtle had severe damage to the posterior carapace indicative of contact with a hard structure (Plate 3.4). The damage appeared to be old and healed with the turtle otherwise appearing to be healthy. This turtle was not acoustically tagged. The field team further stabilised the carapace with epoxy before release. Overall, there was major damage to two and minor damage to five white-throated snapping turtles within 500 m downstream of Rookwood Weir (Rookwood downstream pool and riffle). For Fitzroy River turtles, there was one individual with damage to the eye, and one individual with minor scute damage, both of which were captured at Rookwood downstream riffle. All turtles observed with damage exhibited only old, healed damage, with no evidence of recent injury.

Two of the target turtle species (one white-throated snapping turtle and one Fitzroy River turtle) that were captured and tagged were recaptured within the same survey. Additionally, one Krefft's river turtle was captured which had carapace notching and a foot tag from a separate program. This turtle was PIT tagged.

Of the non-target turtle species captured, 127 were Krefft's river turtles, two were saw-shelled turtles and one Eastern long-necked turtle (*Chelodina longicollis*) (Table 3.5).

Table 3.5 Broad-scale turtle capture survey results – October/November 2024

Species	Common name	Rookwood Weir pool (at Rookwood Weir Camping Reserve)	Rookwood downstream pool	Rookwood riffle	Foleyvale Crossing (upstream)	Total
Chelodina longicollis	Eastern long-necked turtle	0	1	0	0	**1**
Wollumbinia latisternum	Saw-shelled turtle	0	2	0	0	**2**
Emydura macquarii krefftii	Krefft's river turtle	18	77	7	25	**127**
Elseya albagula	White-throated snapping turtle	6	12	8	0	**26**
Rheodytes leukops	Fitzroy River turtle	0	0	5	0	**5**
Total		**24**	**92**	**20**	**25**	**161**

Table 3.6 Broad-scale summary of acoustic tagging results – October/November 2024

Species	Common Name	Number of turtles tagged with acoustic tags			
		Male	Female	Juvenile	Total
Elseya albagula	White-throated snapping turtle	11	10	0	**21**
Rheodytes leukops	Fitzroy River turtle	1	4	0	**5**
Total		**12**	**14**	**0**	**26**

Plate 3.4 ***White-throated snapping turtle (top left); Fitzroy River turtle (top right) caught during October/November 2024 turtle capture surveys, and damaged carapace of a white-throated snapping turtle (bottom left); with carapace stabilised by epoxy (bottom right).***

3.2.2.2 May 2025

A total of 272 turtles were captured over ten days at Rookwood Weir pool (at Rookwood Camping Reserve), Rookwood downstream pool, Rookwood riffle, Gogango Creek, Hanrahan Crossing upstream pool and Hanrahan Crossing riffle. Of these, 48 were the target freshwater turtle species which included 37 white-throated snapping turtles and 11 Fitzroy River turtles (Table 3.7; Plate 3.5). The majority of female white-throated snapping turtles captured at both Hanrahan Crossing riffle and Rookwood riffle were gravid. This supports the suitability of Priority Nest Protection Areas located adjacent to both of these sites.

Of the target turtle species, 40 were acoustically tagged (Table 3.8), comprising two adult males (including one recapture) and 29 adult female white-throated snapping turtles, and four adult male and five adult female Fitzroy River turtles. Eight turtles of the target species (six white-throated snapping turtles and two Fitzroy River turtles) were not tagged as they were either too small or captured outside of the array (i.e. Hanrahan Crossing riffle).

Of these smaller target species caught, two were sub-adult female white-throated snapping turtles; one captured at Hanrahan Crossing pool (SCL 275 mm) and one within the Rookwood Weir pool at Rookwood Camping Reserve (SCL 242 mm). Additionally, there was one white-throated snapping turtle hatchling captured within a cathedral trap around Gogango Creek at the confluence with the Fitzroy River within the Rookwood Weir pool. One Krefft's river turtle hatchling was also captured within this area. These turtles would have hatched at the end of 2024 and/or start of 2025 indicating nesting of both species may have occurred within the Rookwood Weir pool since initial impoundment.

One male white-throated snapping turtle was recaptured after originally being tagged in June 2018. The acoustic tag had detached (as designed), however the carapace notching and Monel foot tag were used to identify the individual. A new acoustic tag was attached to this individual.

Of the non-target turtle species captured, 223 were Krefft's river turtles and one was a saw-shelled turtle.

During this survey, there was notably more visible damage to several turtles, including both target and non-target species, but primarily to white-throated snapping turtles (Plate 3.6). Within 500 m downstream of Rookwood Weir, there was major damage to the carapace of one white-throated snapping turtle, and minor damage to the carapace and plastron of nine white-throated snapping turtles. A subset of these turtles had fresh injuries, including raw damage to the edges of scutes, carapace, and plastron (Plate 3.6). One Fitzroy River turtle had one opaque eye, a condition commonly observed even before the construction of Rookwood Weir. These turtles were all captured at Rookwood downstream riffle and following the minor flooding event in April 2025 which resulted in the overtopping of the weir. This contrasts with the previous turtle capture survey in October/November 2024, where any observed damage appeared to be older, with no signs of recent injury.

Table 3.7 Broad scale turtle capture survey results – May 2025

Species	Common name	Rookwood downstream pool	Rookwood Weir pool (at Rookwood Camping Reserve)	Gogango Creek (weir pool at confluence)	Rookwood riffle	Hanrahan Crossing upstream pool	Hanrahan Crossing riffle	Total
Wollumbinia latisternum	Saw-shelled turtle	0	1	0	0	0	0	**1**
Emydura macquarii krefftii	Krefft's river turtle	69	23	57	27	47	0	**223**
Elseya albagula	White-throated snapping turtle	2	1	1	27	0	6	**37**
Rheodytes leukops	Fitzroy River turtle	0	0	0	10	0	1	**11**
Total		**71**	**25**	**58**	**64**	**47**	**7**	**272**

Table 3.8 Broad scale summary of tagging results – May 2025

Species	Common Name	Number of turtles tagged with acoustic tags			
		Male	Female	Juvenile	Total
Elseya albagula	White-throated snapping turtle	2 *	29	0	**31**
Rheodytes leukops	Fitzroy River turtle	4	5	0	**9**
Total		**6**	**34**	**0**	**40**

* One recapture which was re-tagged with an acoustic tag

Plate 3.5 ***White-throated snapping turtle (top left), Fitzroy River turtle (top right), and white-throated snapping turtle hatchling (bottom left and right) caught during May 2025 turtle capture surveys***

Plate 3.6 ***Examples of visible damage of turtles captured during May 2025 survey event, including: Krefft's turtle carapace damage (top left), white-throated snapping turtle fresh plastron graze (top right), and healed (middle row) and fresh (bottom row) carapace damage for several white-throated snapping turtles***

3.3 Acoustic telemetry

3.3.1 Data summary

Between 1 January 2024 and 5 March 2025, 3,163,202 detections were obtained on acoustic receivers from turtles tagged with acoustic transmitters. Of these, 1,518,714 detections were from tagged white-throated snapping turtle, and 1,644,488 detections were from tagged Fitzroy River turtle.

From the commencement of acoustic tagging (22 April 2017) to 5 March 2025, 16,458,70 detections were obtained on acoustic receivers from turtles tagged with acoustic transmitters. Of these, 7,539,240 detections were from tagged white-throated snapping turtle, and 8,919,029 detections were from tagged Fitzroy River turtle (Table 3.9).

Five hydrophone locations were discontinued in April 2024 as they were either no longer relevant to the objectives of the operations phase program or the inundation of the impoundment caused the overlapping of hydrophone detection ranges creating duplication. Of the five hydrophones that were removed, three were at the most downstream reach of the array (Hanrahan far downstream, Hanrahan downstream, Hanrahan Creek) and two locations were upstream of the weir (Rookwood riffle and Riverslea riffle upstream).

Table 3.9 Summary table of white-throated snapping turtle (n = 95) and Fitzroy River turtle (n = 72) detections at 36 acoustic receiver stations between April 2017 and March 2025

Station name	White-throated snapping turtle		Fitzroy River turtle		Latitude	Longitude
	No. detections	No. tagged turtles	No. detections	No. tagged turtles		
Downstream of Rookwood Weir						
Hanrahan far downstream *	4,831	8	9,620	2	-23.461	150.018
Hanrahan downstream *	27,761	12	756	3	-23.463	150.027
Hanrahan creek *	323,820	17	13,234	4	-23.470	150.029
Hanrahan pool	474,707	24	210,370	4	-23.471	150.024
Hanrahan upstream	30,620	24	58,262	4	-23.479	150.014
Hanrahan far upstream	16,189	27	9,192	5	-23.490	149.992
Lawries bend far downstream	163,198	29	5,282	5	-23.494	149.974
Lawries bend downstream	191,229	33	4,685	6	-23.503	149.960
Lawries bend mid	529,106	32	925	5	-23.510	149.960
Lawries bend upstream	74,259	41	161,911	15	-23.518	149.978
Rookwood far downstream	623,705	58	385,986	43	-23.526	150.004
Rookwood downstream	555,585	59	1,465,511	44	-23.533	150.009
Rookwood Weir site	733,779	42	947,076	40	-23.539	150.015
Turtle passage						
Ramp entrance downstream	34,313	18	3,053	9	-23.540	150.016
Lower resting pool downstream (DSRP8)	660	3	0	0	-23.540	150.016
Mid resting pool downstream (DSRP6)	0	0	0	0	-23.540	150.016
Upper resting pool downstream (DSRP1)	0	0	0	0	-23.540	150.017
Upper resting pool upstream (USRP1)	0	0	0	0	-23.540	150.017
Lower resting pool upstream (USRP5)	10	1	0	0	-23.540	150.017
Approach channel upstream	15,546	11	74	1	-23.540	150.017

Station name	White-throated snapping turtle		Fitzroy River turtle		Latitude	Longitude
	No. detections	No. tagged turtles	No. detections	No. tagged turtles		
Upstream of Rookwood Weir						
Left bank weir pool	40,407	10	64,544	1	-23.544	150.016
Rookwood mid	424,511	39	608,845	33	-23.545	150.017
Rookwood crossing	467,010	30	866,852	24	-23.547	150.017
Rookwood riffle *	437,115	26	1,047,809	24	-23.549	150.017
Rookwood upstream riffle	169,590	30	169,017	16	-23.550	150.017
Rookwood upstream	420,650	41	127,437	9	-23.554	150.012
Rookwood far upstream	295,076	42	186,639	11	-23.555	150.005
Gogango Creek mouth	62,313	36	26,268	11	-23.554	149.986
Gogango Creek	100,650	30	1,001	7	-23.557	149.982
Gogango Creek upstream	184,487	27	297,597	10	-23.554	149.963
Riverslea downstream	233,216	29	40,279	9	-23.563	149.945
Riverslea upstream	577,229	21	1,131,013	18	-23.584	149.935
Riverslea riffle downstream	77,227	15	872,471	17	-23.588	149.934
Riverslea riffle upstream *	52,017	11	195,646	15	-23.593	149.935
The Pocket downstream	99,154	14	5,712	5	-23.618	149.934
The Pocket upstream	99,269	12	1,962	2	-23.628	149.932

* Site discontinued in April 2024

3.3.1.1 White-throated snapping turtle detections in the broader array

Of the 97 white-throated snapping turtle fitted with acoustic tags between 1 April 2017 and 2 November 2024, 95 white-throated snapping turtles have been detected on the acoustic array. The two acoustic-tagged white-throated snapping turtle that were not detected on the array were turtle identification ID 467 and ID 471. Only one turtle (male ID 11324) appeared to have left the array since the weir became operational. On average 79,360 ± 6919 detections (mean ± standard error (SE)) were detected from each white-throated snapping turtle, with the greatest number of detections being 347,089 detections from white-throated snapping turtle ID 11290, and the fewest number of detections being 712 detections from white-throated snapping turtle ID 11296. Tagged white-throated snapping turtle were detected for periods ranging between seven days and 1,646 days (mean = 548 days). Twenty-six tagged adult white-throated snapping turtle have been detected for more than 900 days (14 male, 12 female), 40 white-throated snapping turtle (18 females, 22 males) have been detected for more than 600 days.

Based on all the data collected between 22 April 2017 and 5 March 2025, the greatest number of tagged white-throated snapping turtle were detected at Rookwood downstream (59 transmitters, 555,585 detections) and Rookwood far downstream (58 transmitters, 623,705 detections) (Figure 3.6, Table 3.10). In addition, relatively higher numbers of tagged white-throated snapping turtle were also detected at Lawries bend upstream (41 transmitters), Rookwood Weir site, (42 transmitters), Rookwood upstream (41 transmitters) and Rookwood far upstream (42 transmitters). The receiver stations that received the fewest number of detections of tagged white-throated snapping turtle were the new receivers within the turtle passage and ramp entrance/approach channel (0-18 transmitters). Low numbers of white-throated snapping turtle were also detected at those receiver stations positioned at the extremities of the array at the most downstream (Hanrahan far downstream: eight tagged white-

throated snapping turtle, 4,831 detections), and most upstream sites (the Pocket upstream: 12 tagged white-throated snapping turtle, 99,269 detections).

Of the 97 tags deployed on white-throated snapping turtle before March 2025, 35 white-throated snapping turtle were detected in 2024-25 (Table 3.10). During this time, 26 tagged white-throated snapping turtle were detected downstream from Rookwood Weir (<=19.45 km AMTD 0) and 14 tagged white-throated snapping turtle were detected upstream between the weir and The Pocket (Figure 3.7). These detections include five turtles that were recorded both upstream and downstream of Rookwood Weir in 2024-25 (ID 10254, 11316, 11322, 11324 and 11566 - refer to Section 3.3.2).

One white-throated snapping turtle (ID 16336) which was tagged in the vicinity of Hanrahan Creek in mid-2021 was detected at Hanrahan far downstream in Jan – May 2024 after a three-year absence from the acoustic array (previous detection Hanrahan downstream).

Figure 3.6 ***Abacus plot of detections of acoustically tagged white-throated snapping turtle (n = 95 tags) detected at fixed receiver stations. Colour and size of the points represents the number of tagged turtles detected per day***

Table 3.10 Summary table of 95 white-throated snapping turtles tracked via acoustic telemetry

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
F	390	15786	23,182	2020-02-18	2020-04-26	Rookwood upstream riffle	Rookwood upstream riffle	68
F	395	16030	11,632	2017-05-03	2017-07-11	Hanrahan pool	Hanrahan downstream	69
F	410	15798	9,042	2017-09-15	2017-11-27	Hanrahan pool	Hanrahan upstream	73
F	385	10262	10,747	2024-11-01	2025-02-28	Rookwood Weir site	Rookwood Weir site	119
F	378	10240	12,284	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood Weir site	122
F	393	11562	14,702	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood downstream	122
F	430	11564	4,939	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood downstream	122
F	372	10260	26,099	2024-11-01	2025-03-04	Left bank weir pool	Rookwood mid	123
F	385	10266	11,834	2024-11-01	2025-03-05	Rookwood Weir site	Rookwood Weir site	124
F	360	10270	41,305	2024-10-31	2025-03-04	Left bank weir pool	Rookwood crossing	124
F	384	10272	23,866	2024-10-31	2025-03-04	Left bank weir pool	Gogango creek mouth	124
F	291	11326	54,155	2024-10-31	2025-03-04	Left bank weir pool	Rookwood mid	124
F	271	11328	30,533	2024-10-31	2025-03-04	Left bank weir pool	Rookwood upstream riffle	124
F	340	473	20,575	2019-08-26	2020-02-11	Rookwood downstream	Gogango creek	169
F	400	16010	29,851	2017-09-09	2018-02-28	Rookwood upstream	Gogango creek	172
F	395	16024	62,395	2017-09-08	2018-08-08	Rookwood upstream	Rookwood far upstream	334
F	380	11294	99,124	2022-07-20	2023-08-29	Rookwood crossing	Rookwood Weir site	405
F	388	15802	43,435	2018-10-16	2020-01-29	Riverslea downstream	Riverslea downstream	470
F	244	11711	202,034	2020-06-11	2021-11-12	Riverslea upstream	Riverslea riffle downstream	519
F	408	16016	77,989	2017-08-27	2019-02-02	Lawries bend downstream	Lawries bend mid	524
F	375	16358	3,688	2020-10-06	2022-05-09	Hanrahan pool	Riverslea riffle downstream	580
F	395	16360	21,411	2020-10-04	2022-05-19	Hanrahan pool	Gogango creek	592
F	375	11310	194,427	2023-03-07	2025-02-26	Rookwood far downstream	Rookwood upstream riffle	722

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
F	390	11304	224,774	2023-03-01	2025-03-04	Rookwood downstream	Rookwood Weir site	734
F	213	11290	347,089	2023-02-28	2025-03-05	Rookwood downstream	Rookwood far downstream	736
F	385	14289	89,321	2019-06-16	2021-06-26	Rookwood riffle	Lawries bend downstream	741
F	400	12856	77,399	2019-09-13	2021-11-12	Hanrahan creek	Hanrahan far downstream	791
F	378	16008	65,553	2017-05-06	2019-10-06	Lawries bend downstream	Lawries bend far downstream	883
F	363	14291	137,034	2019-06-27	2022-01-13	Rookwood riffle	Lawries bend upstream	931
F	365	16026	106,504	2017-09-08	2020-03-29	Rookwood upstream	Gogango creek mouth	933
F	404	12862	238,209	2019-09-14	2022-05-22	Rookwood crossing	Rookwood Weir site	981
F	350	12858	160,771	2019-09-16	2022-05-28	Rookwood mid	Rookwood far downstream	985
F	407	15810	121,962	2018-10-12	2021-09-24	Rookwood riffle	Rookwood upstream riffle	1078
F	398	16336	3,997	2021-04-14	2024-04-06	Hanrahan creek	Hanrahan far downstream	1088
F	375	16342	228,913	2022-02-28	2025-02-27	Rookwood Weir site	Rookwood Weir site	1095
F	330	16366	160,832	2020-09-29	2023-09-29	Rookwood downstream	Hanrahan pool	1095
F	388	15796	129,718	2019-03-18	2022-04-13	Rookwood downstream	Rookwood far downstream	1122
F	420	16040	266,485	2017-05-10	2020-06-11	Lawries bend downstream	Lawries bend mid	1128
F	392	11717	60,920	2020-06-11	2023-11-05	Riverslea upstream	Riverslea upstream	1242
F	377	15820	99,228	2018-06-19	2022-12-22	Rookwood upstream	Riverslea upstream	1647
M	270	11296	714	2022-03-02	2022-03-09	Rookwood downstream	Hanrahan far downstream	7
M	266	11324	5,943	2023-12-06	2024-01-21	Rookwood crossing	Hanrahan far downstream	46
M	271	16038	19,892	2017-04-28	2017-07-13	Rookwood downstream	Rookwood downstream	76
M	258	10248	7,154	2024-11-02	2025-02-06	Rookwood Weir site	Rookwood Weir site	96
M	283	10268	33,295	2024-10-31	2025-02-15	Left bank weir pool	Riverslea downstream	107
M	280	10254	8,405	2024-11-02	2025-02-25	Rookwood Weir site	Rookwood far upstream	115
M	285	11568	5,396	2024-11-03	2025-02-28	Rookwood Weir site	Rookwood Weir site	117

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
M	264	10246	7,931	2024-11-02	2025-02-28	Rookwood Weir site	Rookwood Weir site	118
M	256	10256	10,109	2024-11-02	2025-03-03	Rookwood Weir site	Rookwood Weir site	121
M	292	10264	10,714	2024-11-01	2025-03-02	Rookwood Weir site	Rookwood Weir site	121
M	299	11566	15,202	2024-11-03	2025-03-04	Rookwood Weir site	Gogango creek mouth	121
M	269	10238	12,058	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood Weir site	122
M	261	10242	16,563	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood far downstream	122
M	297	10258	19,223	2024-11-02	2025-03-05	Rookwood Weir site	Rookwood Weir site	123
M	264	12860	12,140	2019-09-13	2020-02-08	Hanrahan pool	Lawries bend upstream	148
M	269	16012	24,783	2017-05-08	2017-10-07	Lawries bend upstream	Hanrahan creek	152
M	289	16022	23,541	2017-05-07	2017-10-27	Lawries bend upstream	Rookwood far downstream	173
M	279	16028	7,155	2017-05-02	2017-11-06	Lawries bend downstream	Hanrahan downstream	188
M	285	16036	23,911	2017-05-06	2017-11-23	The Pocket downstream	The Pocket upstream	201
M	296	15824	41,617	2018-06-23	2019-02-23	Rookwood upstream	Gogango creek	245
M	252	16356	70,421	2022-01-20	2022-09-25	Rookwood crossing	The Pocket upstream	248
M	283	1084	10,450	2019-06-16	2020-04-01	Rookwood mid	The Pocket upstream	290
M	270	11747	52,740	2020-06-13	2021-04-19	Riverslea upstream	Riverslea riffle downstream	310
M	269	16006	48,954	2017-04-30	2018-05-10	Rookwood downstream	Gogango creek mouth	375
M	264	16032	56,828	2017-09-08	2018-10-14	Rookwood upstream	Rookwood upstream	401
M	281	11729	21,748	2020-06-11	2021-08-24	Riverslea upstream	Riverslea upstream	439
M	271	12864	7,322	2019-09-12	2021-01-06	Hanrahan creek	Hanrahan far downstream	482
M	279	16042	91,345	2017-05-06	2018-09-01	The Pocket downstream	The Pocket upstream	483
M	282	11322	248,611	2023-08-15	2025-01-04	Rookwood crossing	Rookwood downstream	508
M	272	16334	80,049	2021-04-10	2022-11-03	Rookwood far upstream	Rookwood far upstream	572

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
M	285	16004	116,882	2017-04-29	2018-12-11	Rookwood downstream	Rookwood mid	591
M	267	16020	124,155	2017-05-02	2018-12-24	Lawries bend downstream	Lawries bend downstream	601
M	294	16364	16,870	2021-06-01	2023-03-09	Lawries bend far downstream	The Pocket upstream	646
M	278	14295	12,428	2019-03-06	2021-01-06	Rookwood downstream	Gogango creek	672
M	275	16346	67,822	2022-03-01	2024-02-16	Rookwood Weir site	Hanrahan far downstream	717
M	278	16340	33,958	2021-04-12	2023-04-02	Lawries bend mid	Hanrahan far downstream	720
M	272	11308	295,746	2023-03-09	2025-02-28	Rookwood far downstream	Gogango creek mouth	722
M	281	11320	75,218	2023-03-03	2025-03-04	Rookwood downstream	Lawries bend mid	732
M	282	15814	135,857	2018-07-02	2020-11-11	Rookwood downstream	Rookwood far upstream	863
M	274	12854	62,406	2020-03-31	2022-11-23	Rookwood mid	Lawries bend downstream	967
M	285	14293	165,558	2019-03-07	2021-11-10	Rookwood downstream	Rookwood far downstream	979
M	290	12834	149,167	2020-04-01	2022-12-12	Rookwood mid	Gogango creek upstream	985
M	303	16368	89,811	2020-09-29	2023-07-08	Hanrahan downstream	Hanrahan far downstream	1012
M	276	16338	178,365	2022-03-03	2025-03-01	Rookwood far downstream	Rookwood Weir site	1094
M	260	16370	176,266	2020-09-29	2023-09-28	Hanrahan downstream	Hanrahan creek	1094
M	290	16372	273,170	2020-09-29	2023-09-28	Hanrahan downstream	Hanrahan pool	1094
M	257	15822	143,612	2018-07-10	2021-07-31	Rookwood downstream	Rookwood downstream	1117
M	255	15812	109,780	2018-10-11	2021-11-05	Riverslea downstream	Riverslea downstream	1121
M	269	15816	204,215	2018-10-07	2021-11-03	Rookwood upstream	Rookwood upstream	1123
M	269	11725	312,931	2020-06-11	2023-11-10	Riverslea upstream	Riverslea upstream	1247
M	270	11316	69,400	2021-08-18	2025-03-05	Riverslea downstream	Lawries bend far downstream	1295
M	261	11721	67,281	2020-06-19	2024-01-16	The Pocket downstream	Riverslea riffle upstream	1306

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
J	218	10274	50,068	2023-11-09	2025-03-05	Rookwood downstream	Rookwood far downstream	482
J	187	465	33,632	2017-09-09	2019-03-04	Rookwood upstream	Rookwood upstream	541
J	190	469	32,469	2017-09-09	2019-04-16	Rookwood upstream	Rookwood far upstream	584

Blue shading indicates turtles active on the array from January 2024 to May 2025

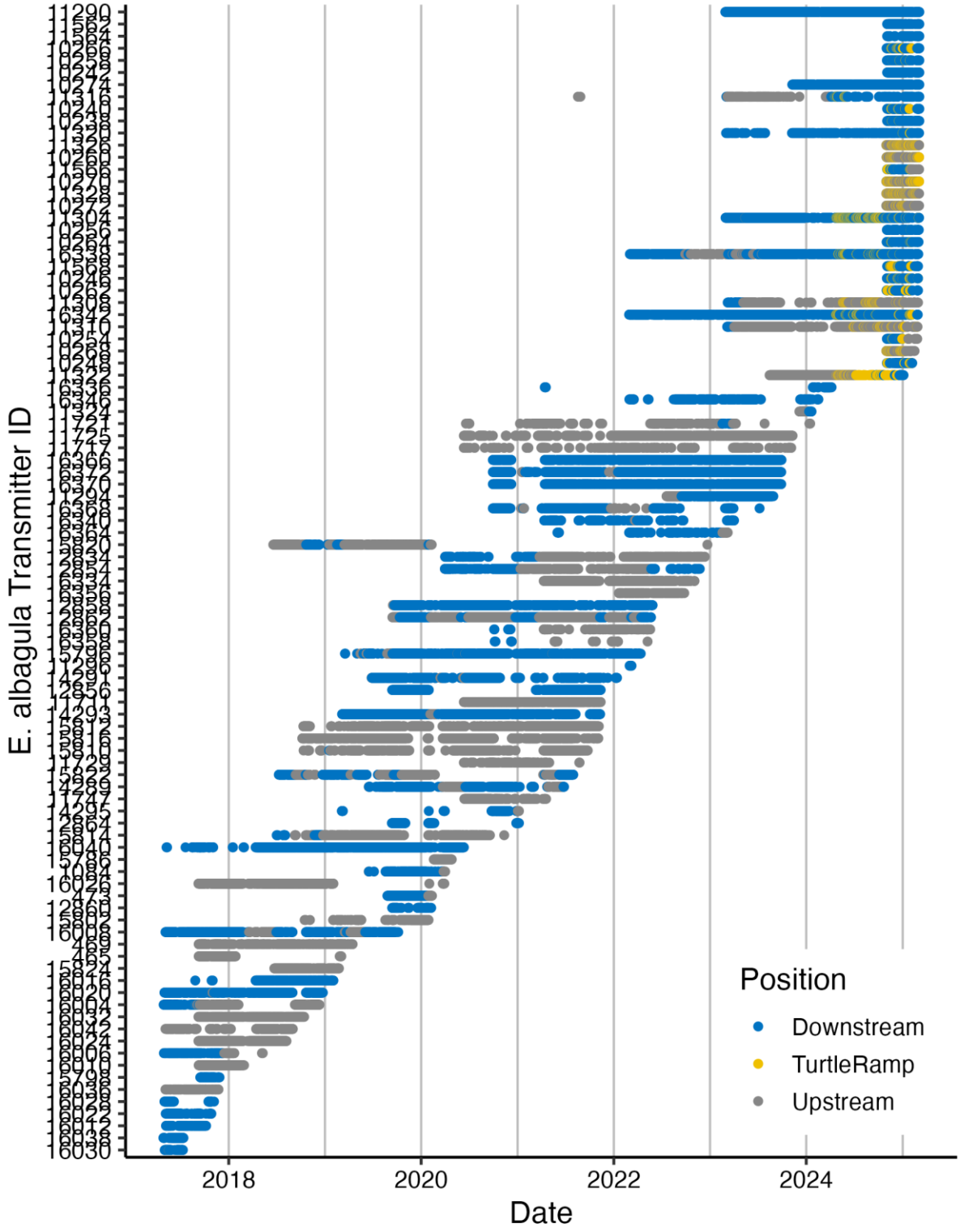

Figure 3.7 ***Abacus plot of detections of acoustically tagged white-throated snapping turtle (n = 95 tags) detected downstream or upstream of the new weir site at Rookwood, or at receivers positioned within the turtle passage***

3.3.1.2 Fitzroy River turtle detections in the broader array

Of the 76 Fitzroy River turtle fitted with acoustic tags between 1 April 2017 and 2 November 2024, 72 Fitzroy River turtle were detected on the acoustic array. The number of detections per turtle ranged between 248 (ID 1088) and 1,066,330 detections (ID 14279) (mean ± SE = 123,875 ± 17,456 detections) (Table 3.9).

The four acoustic-tagged Fitzroy River turtle that were not detected on the array were ID 15790, ID 15800, ID 15808, and ID 16034. These tagged Fitzroy River turtles were captured in the pool immediately upstream from the Rookwood Crossing in September 2017 (n = 3), October 2018 (n = 1). Active tracking using a portable acoustic receiver unit (VR100-200, Innovasea.com) and omnidirectional hydrophone via kayak confirmed the presence of three of the missing tags (ID 15790, 15800, and 16034) on 8 September 2017 in a 50 m pool section, between the detections fields of receivers positioned at Rookwood upstream and Rookwood midstream. Active tracking on 18 December 2018 again detected ID 15800 in the same 50 m pool immediately upstream of the crossing at Rookwood and ID 16034 was now located below the crossing at Rookwood.

During fieldwork in June 2019, one Fitzroy River turtle was recaptured where the acoustic tag had become detached from the shell and was missing. This female Fitzroy River turtle was initially captured in October 2018 and was fitted with transmitter ID 15818. Upon recapture, a new acoustic tag (ID 14285) was subsequently fitted to the turtle's shell and the animal released. Upon checking the tracking database, both movement data for this animal revealed that the tag did not move from the hydrophone placed at Rookwood riffle between 23 October 2018 and 18 December 2019. Pressure information transmitted by the transmitter suggests that the tag remained at ~1.5 m depth from July 2019 onwards. From comparing the detections, movements along the course of the river, and dive profiles of other tagged turtles, it is possible that the following tagged Fitzroy River turtles also disappeared due to attachment failure or predation: ID 8322,11709, 11727,12832, 12838, 16018.

Based on all the data collected between 22 April 2017 and 5 March 2025, the greatest number of tagged Fitzroy River turtle were detected at Rookwood far downstream (43 transmitters), Rookwood downstream (44 transmitters) and Rookwood Weir site (40 transmitters) (Table 3.9, Figure 3.8). This contrasts with previous years where the greatest number were detected at Rookwood mid (33 transmitters). High numbers of tagged Fitzroy River turtle were also detected between Rookwood mid and Rookwood upstream riffle (16-33 transmitters) and upstream of the Riverslea Crossing between Riverslea upstream and Riverslea riffle upstream (15-18 transmitters). Of the 97 tagged Fitzroy River turtle with acoustic detection data, 18 tags were detected in 2024-25 (one male; 17 females). Of these, 13 were last detected in the vicinity of Rookwood (Rookwood downstream: five; Rookwood far downstream: two; Rookwood mid: one; Rookwood riffle: one; Rookwood Weir site: three; Rookwood riffle upstream: one).

Tagged Fitzroy River turtle were detected for periods ranging between one day and 1,614 days (mean = 729 days; Table 3.11). Twenty-eight tagged Fitzroy River turtle have been detected for more than 900 days: 21 adult females and seven adult males. Forty-eight tagged Fitzroy River turtle have been detected for more than 600 days: 33 adult females, 12 adult males, and three unknown sex.

Of the 76 tags deployed on Fitzroy River turtle before March 2025, 18 were detected in 2024-25. During this time (2024-25), 14 turtle detections were recorded downstream from Rookwood Weir (<=19.45 km AMTD 0) and five turtle detections were upstream between the weir and The Pocket (Figure 3.9). One tagged Fitzroy River turtle (ID 16350) was detected on both sides of the weir. This turtle was detected at the Rookwood crossing on 28 February 2024 (upstream of Rookwood Weir) and Rookwood Weir site receiver station (downstream of Rookwood Weir) on 01 March 2024. For the purpose of this report, it is assumed this turtle moved downstream via the spillway as the turtle was not detected in the turtle passage or fishway, and the weir was overtopping on 28 February 2024.

Figure 3.8 ***Abacus plot of detections of acoustically tagged Fitzroy River turtle (n = 72 tags) detected at fixed receiver stations. Colour and size of the points represents the number of tagged turtles detected per day***

Table 3.11 Summary table of 72 Fitzroy River turtles (Fitzroy River turtle) tracked via acoustic telemetry

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
F	279	10252	5,006	2024-11-02	2025-03-04	Rookwood Weir site	Lawries bend upstream	122
F	269	11570	14,553	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood Weir site	122
F	261	10236	11,027	2024-11-02	2025-03-05	Rookwood Weir site	Rookwood Weir site	123
F	255	10244	11,791	2024-11-02	2025-03-05	Rookwood Weir site	Lawries bend upstream	123
F	274	16014	51,636	2017-05-01	2017-11-18	Lawries bend downstream	Hanrahan upstream	201
F	273	12852	2,987	2020-03-31	2020-10-24	Rookwood crossing	Lawries bend downstream	207
F	226	1082	45,004	2019-06-17	2020-01-19	Rookwood riffle	Rookwood downstream	216
F	262	14285	33,447	2019-06-15	2020-01-29	Rookwood riffle	Rookwood crossing	228
F	260	14297	73,207	2019-06-17	2020-03-28	Rookwood riffle	Rookwood upstream riffle	285
F	254	1088	248	2019-06-17	2020-04-29	Rookwood mid	Lawries bend upstream	317
F	247	16344	21,277	2022-02-28	2023-01-31	Rookwood Weir site	The Pocket upstream	337
F	187	1086	13,048	2019-06-17	2020-10-01	Rookwood mid	Riverslea downstream	472
F	246	11302	65,505	2023-03-01	2024-09-20	Rookwood downstream	Hanrahan far downstream	569
F	254	11715	131,632	2020-06-12	2022-04-01	Riverslea upstream	Riverslea riffle downstream	658
F	272	14273	92,650	2019-06-16	2021-05-08	Rookwood mid	Rookwood riffle	692
F	265	11318	13,525	2023-03-04	2025-03-03	Rookwood downstream	Rookwood far downstream	730
F	270	11314	42,614	2023-03-04	2025-03-05	Rookwood downstream	Rookwood downstream	732
F	264	11300	22,451	2023-02-28	2025-03-02	Rookwood downstream	Rookwood far downstream	733
F	235	11312	191,671	2023-03-02	2025-03-05	Rookwood downstream	Hanrahan pool	734
F	266	11298	154,360	2023-03-01	2025-03-05	Rookwood downstream	Rookwood downstream	735
F	257	11306	284,698	2023-03-01	2025-03-05	Rookwood downstream	Rookwood downstream	735
F	254	11727	25,533	2020-06-11	2022-07-06	Riverslea upstream	Riverslea upstream	755
F	271	14283	36458	2019-06-15	2021-09-11	Rookwood mid	Rookwood downstream	819
F	261	14267	77,963	2019-06-17	2021-11-14	Rookwood mid	Rookwood upstream riffle	881

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
F	273	14279	285,710	2019-06-17	2021-12-04	Rookwood downstream	Rookwood mid	901
F	265	14263	175,142	2019-08-28	2022-02-25	Rookwood mid	Rookwood mid	912
F	271	15804	51,665	2019-06-15	2022-01-07	Rookwood riffle	Rookwood riffle	937
F	261	11292	106,6330	2022-07-20	2025-03-04	Rookwood crossing	Rookwood mid	958
F	279	14269	180,435	2019-06-16	2022-02-08	Rookwood downstream	Riverslea riffle upstream	968
F	282	14277	238,098	2019-06-17	2022-02-16	Rookwood downstream	Rookwood crossing	975
F	262	14261	19,487	2019-06-17	2022-02-25	Rookwood riffle	Rookwood upstream riffle	984
F	268	12846	125,602	2020-03-31	2022-12-11	Rookwood crossing	Rookwood upstream riffle	985
F	236	11737	46,904	2020-06-12	2023-06-06	Riverslea upstream	Gogango creek upstream	1089
F	253	16352	222,258	2021-07-24	2024-07-23	Rookwood crossing	Rookwood riffle	1095
F	249	16354	307,640	2021-07-24	2024-07-23	Rookwood crossing	Rookwood Weir site	1095
F	260	15818	283,520	2018-10-23	2021-11-10	Rookwood riffle	Rookwood riffle	1114
F	294	15806	220,414	2019-06-15	2022-07-24	Rookwood riffle	Rookwood crossing	1135
F	262	11713	437,39	2020-06-12	2023-10-01	Riverslea upstream	Riverslea downstream	1206
F	267	11743	63,621	2020-06-13	2023-10-30	Riverslea upstream	Riverslea downstream	1234
F	262	16350	166,346	2021-07-24	2024-12-10	Rookwood crossing	Rookwood downstream	1235
F	270	11735	215,372	2020-06-12	2023-11-08	Riverslea upstream	Riverslea upstream	1244
F	241	11739	301,356	2020-06-12	2023-11-10	Riverslea upstream	Riverslea upstream	1246
F	250	11723	270,114	2020-06-11	2023-11-10	Riverslea upstream	Riverslea upstream	1247
F	283	11731	312,395	2020-06-11	2024-02-01	Riverslea upstream	Riverslea riffle upstream	1330
F	274	11733	187,843	2020-06-15	2024-11-15	Riverslea upstream	Riverslea upstream	1614
M	267	15792	645	2017-09-26	2017-09-27	Hanrahan downstream	Hanrahan downstream	1
M	271	12840	1,829	2020-03-31	2020-04-04	Rookwood crossing	Rookwood far downstream	4
M	277	1090	11,695	2019-06-17	2019-08-01	Rookwood riffle	Rookwood riffle	45

Sex	SCL (mm)	Acoustic tag code	No. detections	First detection	Last detection	First receiver	Last receiver	Duration (days)
M	252	10250	28,724	2024-11-03	2025-03-05	Rookwood Weir site	Rookwood downstream	122
M	252	12848	45,466	2020-03-31	2020-09-02	Rookwood crossing	Lawries bend upstream	155
M	243	14287	93,862	2019-06-15	2020-02-01	Rookwood riffle	Rookwood upstream	231
M	287	15788	109,103	2019-06-15	2020-02-26	Rookwood riffle	Rookwood riffle	256
M	270	14265	19,828	2019-06-16	2020-03-17	Rookwood riffle	Rookwood upstream riffle	275
M	274	14299	55,899	2019-06-22	2020-04-03	Rookwood upstream	Rookwood upstream riffle	286
M	262	12842	8,516	2020-04-01	2021-01-27	Rookwood crossing	Lawries bend upstream	301
M	256	12832	68,196	2020-04-01	2021-03-22	Rookwood mid	Rookwood mid	355
M	266	14281	109,015	2019-06-16	2020-11-14	Rookwood downstream	Rookwood downstream	517
M	259	16362	42,701	2021-07-24	2023-01-06	Rookwood crossing	Gogango creek mouth	531
M	250	15794	98,527	2019-09-14	2021-08-07	Rookwood Weir site	Rookwood Weir site	693
M	260	12838	1,159	2020-03-31	2022-03-17	Rookwood crossing	Lawries bend upstream	716
M	274	16018	260,277	2018-04-16	2020-07-30	Rookwood riffle	Rookwood riffle	836
M	271	14275	141,436	2019-06-16	2021-11-25	Rookwood downstream	Rookwood downstream	893
M	265	12844	194,987	2020-04-01	2022-09-14	Rookwood mid	Rookwood far downstream	896
M	270	14271	231,588	2019-06-17	2022-02-25	Rookwood downstream	Rookwood downstream	984
M	251	12836	44,660	2020-04-01	2022-12-12	Rookwood mid	Lawries bend upstream	985
M	259	12850	33,667	2020-03-31	2022-12-11	Rookwood mid	Rookwood far downstream	985
M	271	11709	243,201	2020-06-11	2023-11-02	Riverslea upstream	Gogango creek upstream	1239
M	247	11745	119,150	2020-06-17	2023-11-10	Riverslea upstream	Riverslea upstream	1241
M	268	11741	258,908	2020-06-13	2023-11-10	Riverslea upstream	Riverslea upstream	1245
M	261	11719	168,447	2020-06-11	2023-11-10	Riverslea upstream	Riverslea upstream	1247
J	177	8322	170,739	2020-04-01	2021-11-10	Rookwood mid	Rookwood Weir site	588
J	216	8320	150,522	2020-04-01	2022-04-01	Rookwood crossing	Rookwood crossing	730

Blue shading indicates turtles active on the array from January 2024 to May 2025

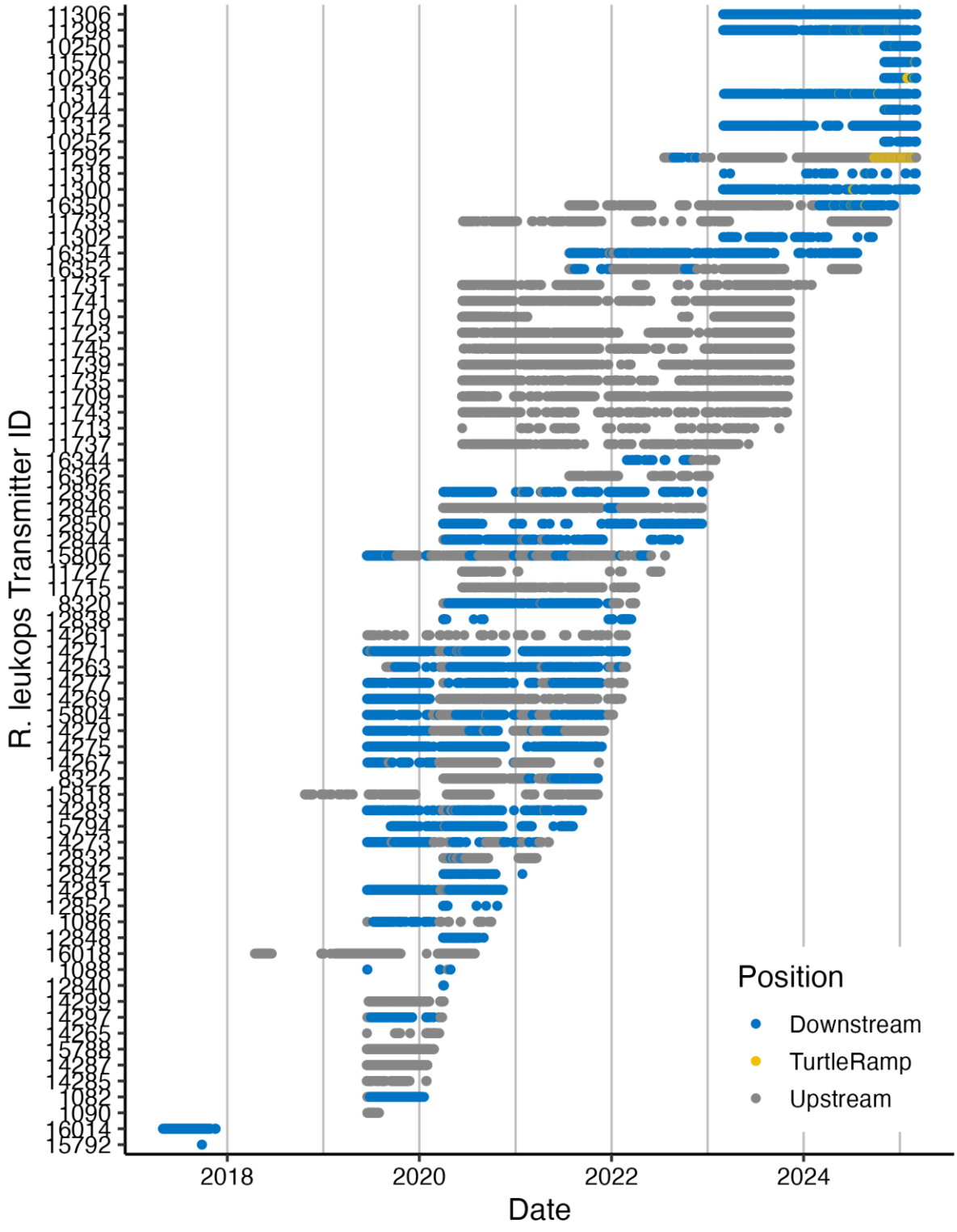

Figure 3.9 ***Abacus plot of detections of acoustically tagged Fitzroy River turtle (n = 72 tags) detected downstream or upstream of the new weir site at Rookwood, or at receivers positioned within the turtle passage***

3.3.2 Turtle passage

3.3.2.1 Movement of white-throated snapping turtles through the turtle passage

Of the 35 tagged white-throated snapping turtle detected between 1 January 2024 and 10 March 2025, 26 were detected by at least one receiver in/adjacent to the turtle passage (e.g. Approach channel upstream, Lower resting pool upstream (USRP5), Upper resting pool upstream (USRP1), Upper resting pool downstream (DSRP1), Mid resting pool downstream (DSRP6), Lower resting pool downstream (DSRP8) or Ramp entrance downstream) (Figure 3.12a).

A total of 18 white-throated snapping turtle appeared to be attracted to the downstream entrance of the turtle passage at Ramp entrance downstream (ID 10238, 10240, 10246 (Figure 3.10b), 10248, 10254, 10256, 10258, 10262, 10264 (Figure 3.10d), 10266, 11304, 11316, 11320, 11322, 11566, 11568 (Figure 3.10c), 16338 (Figure 3.10a), 16342). The majority of these detections occurred in November 2024, following the capture and tagging of 26 white-throated snapping turtles in this region of river at this time (Figure 3.12a, Table 3.9).

Three of these white-throated snapping turtles (ID 10246, 11568, 16338) were detected at the receiver station placed at Lower resting pool downstream (DSRP8) in November 2024 (Figure 3.10a-c) indicating that the turtles successfully found the ramp entrance and ascended to the first resting pool. These three white-throated snapping turtle were detected 2, 637 and 21 times respectively, over a period of 1, 2 and 1 days.

One tagged white-throated snapping turtle (ID 11326) was detected at Lower resting pool upstream (USRP5; Figure 3.11b). This animal was detected 10 times at this receiver over a 20-minute period on 21 February 2025. Rookwood Weir was overtopping at this time with the Lower resting pool upstream (USRP5) submerged underwater. As such, this detection represents the confirmed presence of a white-throated snapping turtle within the weir pool rather than directly within the turtle passage.

No white-throated snapping turtle were detected at the receivers placed at Upper resting pool upstream (USRP1), Upper resting pool downstream (DSRP1), or Mid resting pool downstream (DSRP6).

Ten tagged white-throated snapping turtle were detected immediately above the weir at Left bank weir pool between January 2024 and March 2025 (ID 10254 (Figure 3.11d), 10260 (Figure 3.11a), 10268 (Figure 3.11c), 10270, 10272, 11308, 11310, 11326 (Figure 3.11b), 11328, 11566 (Figure 3.11e)) and 11 found adjacent to the turtle passage on the right bank at Approach channel upstream (ID 10254, 10260, 10268, 10270, 10272, 11308, 11310, 11322 (Figure 3.11f), 11326, 11328, 11566).

Five white-throated snapping turtle were detected making a complete movement past the turtle passage between 1 January 2024 and 10 March 2025. This included two male white-throated snapping turtle ID 10254 and 11566 which moved in an upstream direction from Lawries bend upstream to Rookwood far upstream, passing Rookwood Weir in December 2024 and January 2025, respectively (Figure 3.11d and e). These turtles were not detected by the hydrophones within the turtle passage. However, it is assumed these turtles moved upstream via the turtle passage as the turtles were not detected by the PIT tag readers within the fishway. Three white-throated snapping turtle (ID 11322 (Figure 3.11f), 11316 and 11324), were recorded moving in a downstream direction from past Rookwood Weir in 2024. These turtles were not detected by the hydrophones within the turtle passage. As Rookwood Weir was overtopping at the time this turtle moved past the weir, it is assumed that the turtle moved downstream over the spillway.

Drafting note: This statement "However, it is assumed these turtles moved upstream via the turtle passage as the turtles were not detected by the PIT tag readers within the fishway." is to be confirmed when fishway PIT tag results are received.

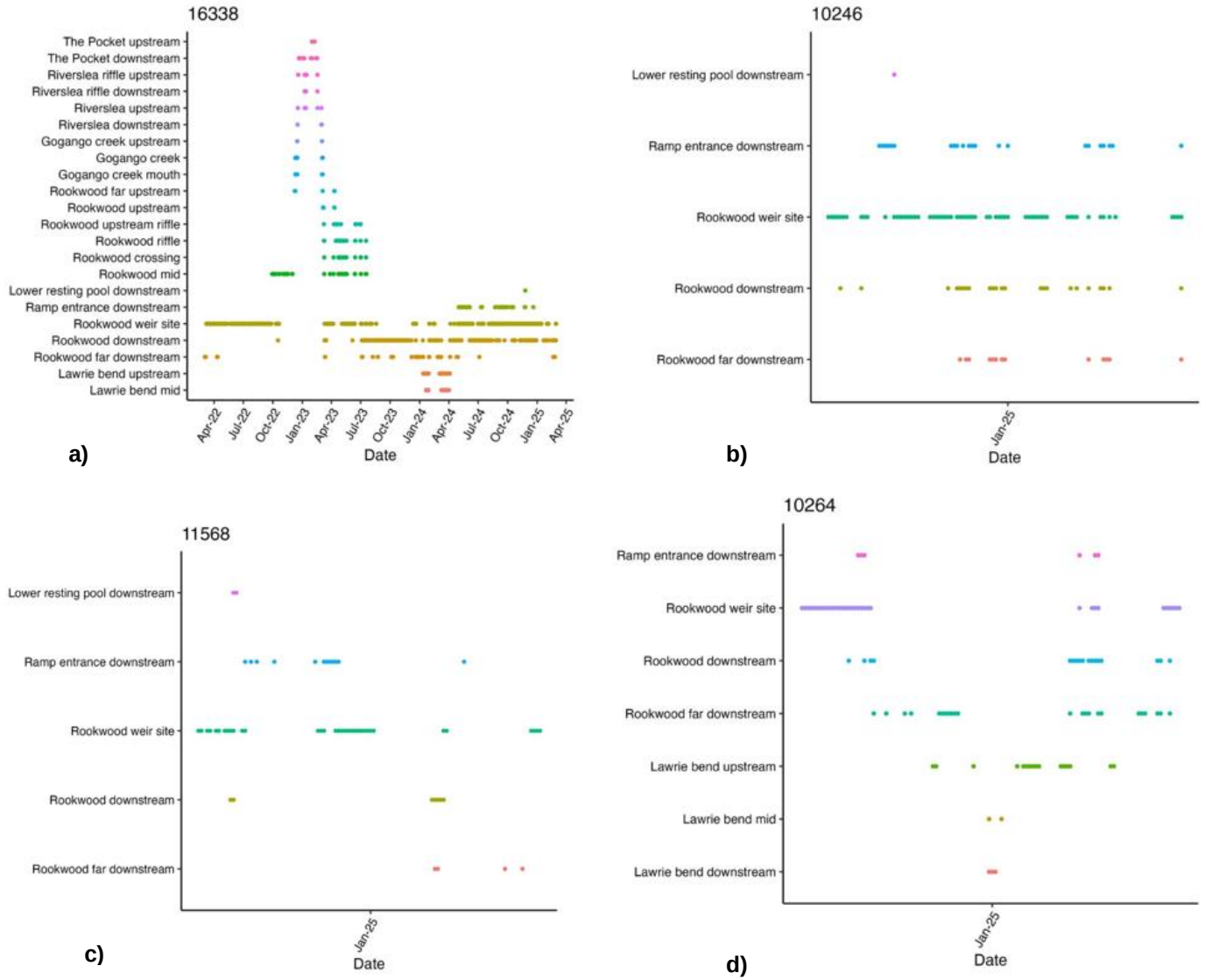

Figure 3.10 Abacus plot of detections of acoustically tagged white-throated snapping turtles (a-d) detected at fixed receiver stations positioned below the turtle ramp

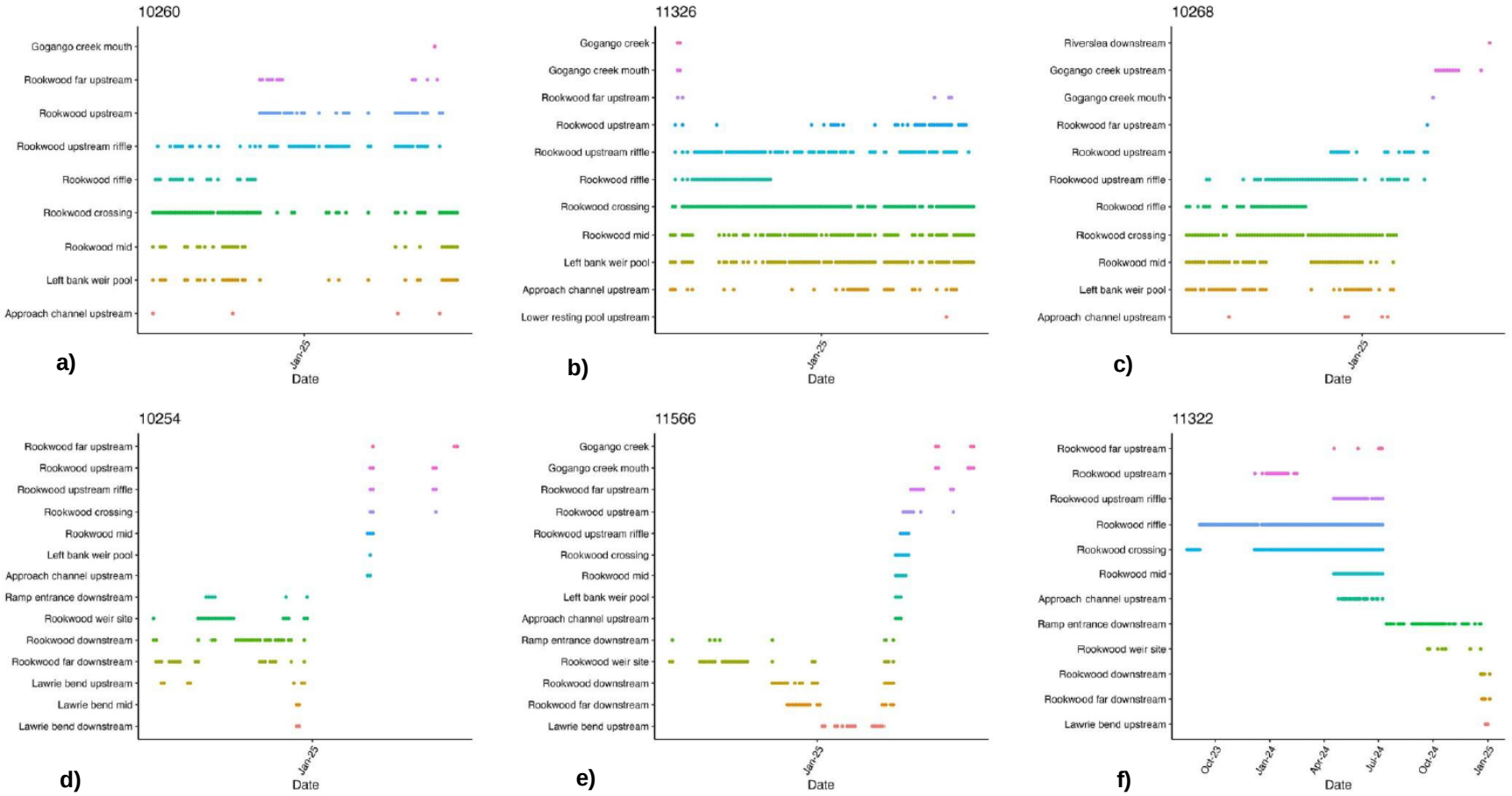

Figure 3.11 ***Abacus plot of detections of acoustically tagged white-throated snapping turtle detected at fixed receiver stations positioned above the turtle ramp (a-c) and those individuals that moved across the weir site while the turtle passage was in place (d-f)***

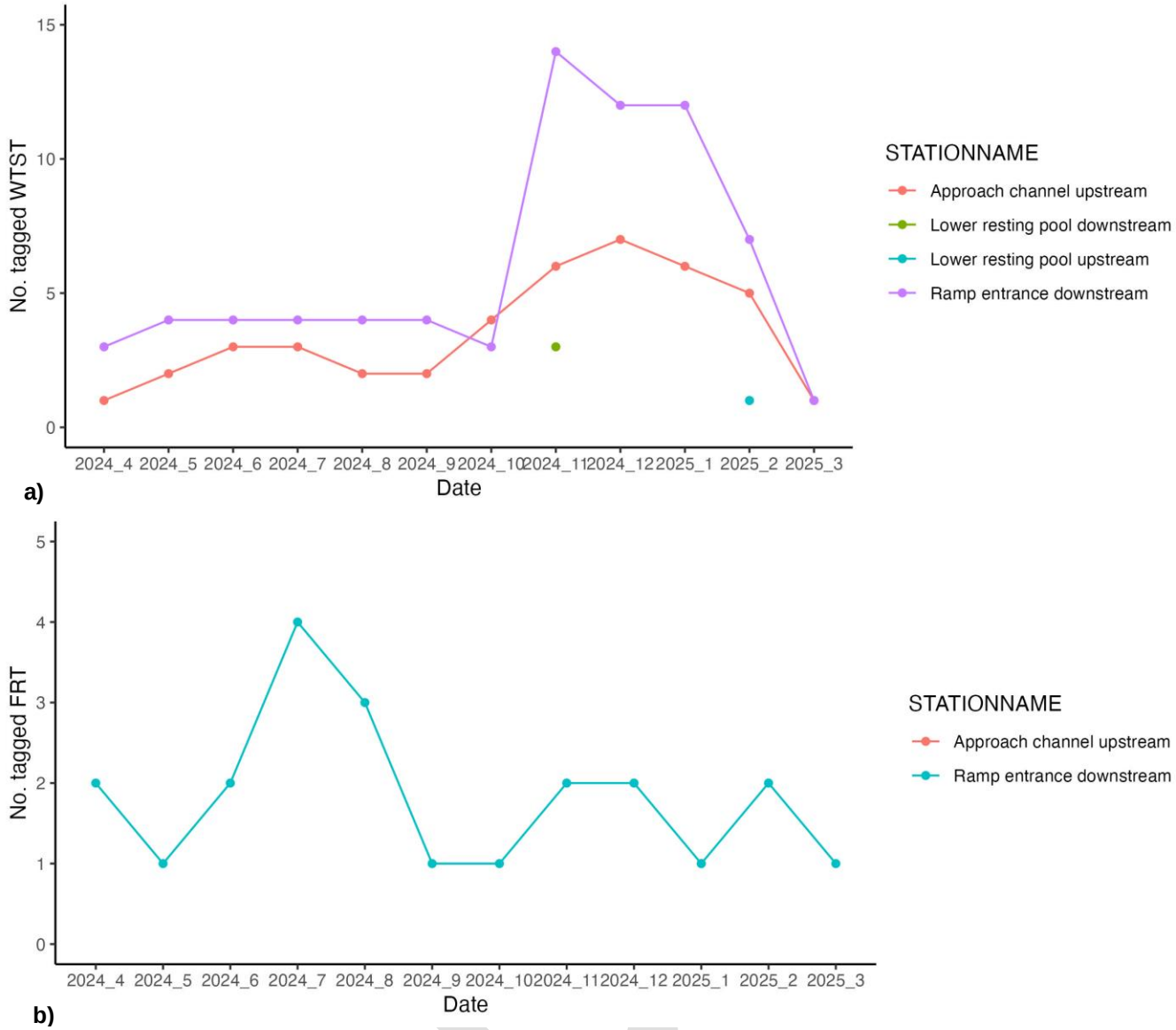

Figure 3.12 ***Number of tagged white-throated snapping turtle (a) and Fitzroy River turtle (b) detected on acoustic receivers located within/adjacent to the turtle passage between April 2024 and March 2025***

3.3.2.2 Movement of Fitzroy River turtles through the turtle passage

Of the 18 Fitzroy River turtle detected between 1 January 2024 and 10 March 2025, 10 were detected by at least one receiver within/adjacent to the turtle passage. These were Fitzroy River turtle ID 10236, 10244, 10250, 11292, 11298, 11300, 11314, 11318, 11570, 16350.

Nine of these Fitzroy River turtle appeared to be attracted to the downstream entrance of the turtle ramp at Ramp entrance downstream (Figure 3.12b). These were Fitzroy River turtle ID 10236, 10244, 10250, 11298 (Figure 3.13a), 11300 (Figure 3.13b), 11314 (Figure 3.13c), 11318 (Figure 3.13d), 11570, 16350 (Figure 3.13e). Although these turtles were detected in the vicinity of the downstream entrance of turtle passage, no Fitzroy River turtle were detected at any of the receivers positioned within the turtle passage.

The Fitzroy River turtle detected below the weir held home ranges downstream of Rookwood Weir extending between the receiver placed at the weir site, and Rookwood far downstream.

One tagged Fitzroy River turtle (ID 11292) was detected immediately upstream of Rookwood Weir being detected at the receivers placed at Left bank weir pool upstream and at the Approach channel upstream (Figure 3.13f). This animal was first tagged in 2022 prior to weir inundation. The recent hydrophone data indicates that this turtle remains within the weir pool and occupies a home range that falls between the Rookwood upstream riffle receiver station and the Rookwood Weir site (Figure 3.13f). This turtle was detected at the Left bank weir pool between September 2024 and March 2025, and in the Approach channel upstream in January 2025 (Figure 3.13f).

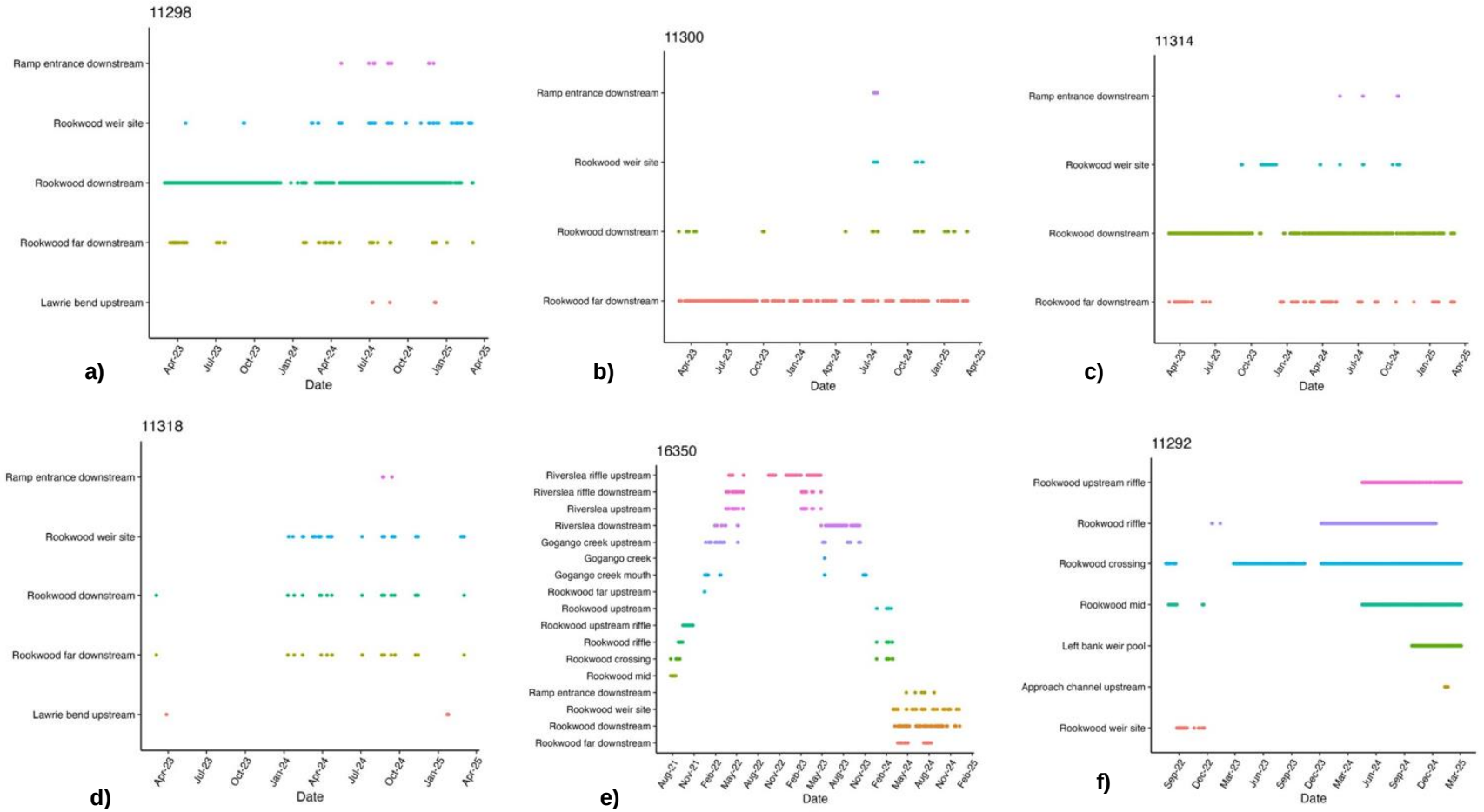

Figure 3.13 Abacus plot of detections of acoustically tagged Fitzroy River turtle detected at fixed receiver stations below the turtle passage (a-e), and above the turtle passage (e-f)

3.3.3 Broad-scale turtle population

3.3.3.1 Important areas

On average, 28 white-throated snapping turtles were detected per year (SE = 2.04), with 20 white-throated snapping turtles tracked in 2017, 21 in 2018, 26 in 2019, 36 in 2020, 32 in 2021, 25 in 2022, 22 in 2023, 35 in 2024, and 32 in 2025. On average, 23 Fitzroy River turtle were detected per year (SE = 5.59), with two Fitzroy River turtle tracked in 2017, two in 2018, 26 in 2019, 51 in 2020, 41 in 2021, 33 in 2022, 25 in 2023, 18 in 2024, and 12 in 2025.

Tagged white-throated snapping turtle used the full extent of the acoustic array, with high numbers of white-throated snapping turtle detected downstream of Riverslea downstream, at Rookwood, Gogango Creek, Lawries bend and Hanrahan pool (Table 3.9, Figure 3.14a). The greatest number of tagged white-throated snapping turtle were detected at Rookwood downstream (n = 59 turtles) and Rookwood far downstream (n= 58 turtles), with high numbers of white-throated snapping turtle detected between the Ramp entrance downstream and Rookwood far downstream in 2024 and early 2025. This increase in turtle numbers in these regions were likely due to increased tagging effort in these regions in late 2024. Indeed, Rookwood Weir site shifted from being 10th in the list of the last site where a tagged white-throated snapping turtle was detected in 2023 (four turtles), to first in the list in 2024 (15 turtles). This is likely due to the high number of turtles being tagged at this location at the end of 2024 and the potential aggregation of turtles below Rookwood Weir.

The stretch of river upstream of Rookwood from Rookwood upstream to Riverslea downstream had been visited by between 27-42 tagged white-throated snapping turtle during the study (Table 3.9). The section upstream from Rookwood Weir site to Gogango Creek mouth upstream has held relatively low numbers of acoustic tagged white-throated snapping turtle since 2023, with greater numbers of tagged turtles detected at the receiver positioned in immediately upstream and downstream of the weir site (Figure 3.14a). No tagged white-throated snapping turtle were detected at receivers positioned between Riverslea upstream to The Pocket upstream in 2024 or 2025. Turtles were commonly detected in this stretch of river prior to weir inundation (Figure 3.14a).

Receivers deployed downstream of Rookwood around Lawries bend (Lawries bend upstream – Lawries bend far downstream) historically detected a large number of acoustic tagged white-throated snapping turtle (min = 29, max = 41) (Table 3.9, Figure 3.6). Hanrahan far upstream (n = 27 turtles) and Hanrahan pool (n = 24 turtles), with fewer turtles detected downstream of Hanrahan Crossing (8–12 tags). These sites (from Lawries bend mid to Hanrahan far downstream) have held fewer white-throated snapping turtle from 2023 onwards (Figure 3.14a).

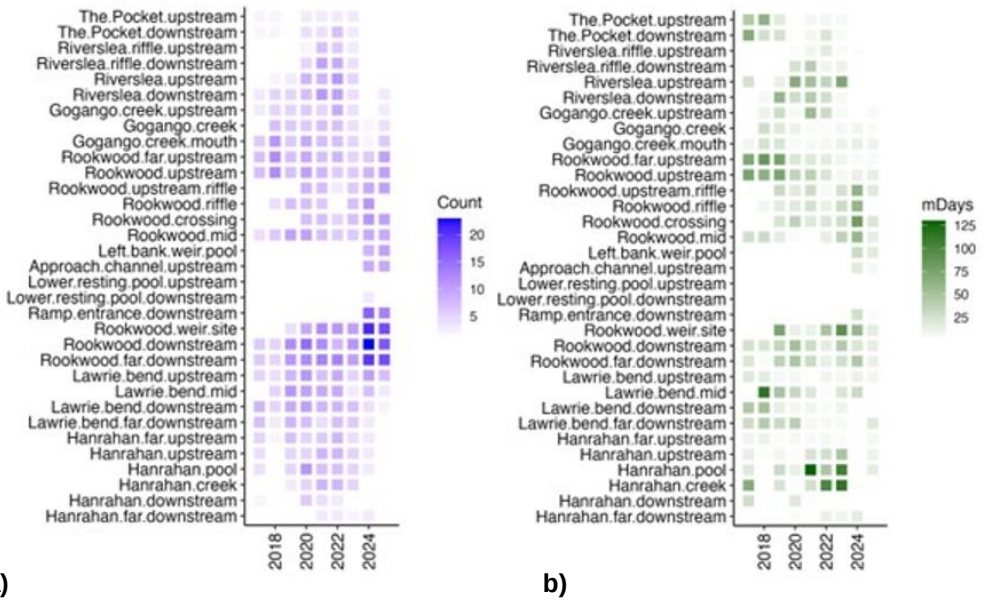

Figure 3.14 ***a) Number of acoustic tagged white-throated snapping turtles detected at each receiver station in the acoustic array each year between 22 April 2017 and 01 March 2025. b) the mean number of days that acoustic tagged white-throated snapping turtles were detected at each receiver station in the acoustic array each year between 22 April 2017 and 01 March 2025***

In contrast to tagged white-throated snapping turtle which were detected throughout the broad-scale survey area, Fitzroy River turtles were detected in clusters of acoustic receivers throughout the study region. The most upstream cluster is in the Riverslea pool-riffle sequence including Riverslea upstream (n = 18 tags), Riverslea riffle downstream (n= 17 tags), and Riverslea riffle upstream (n = 15 tags) (Table 3.9, Figure 3.15a). In this stretch of river, Fitzroy River turtles spent the greatest number of days at the Riverslea upstream receiver with this high use extending into 2024 (Figure 3.15b).

High numbers of Fitzroy River turtle were also detected at the stretch of river between Rookwood far downstream (n= 43 tags) and Rookwood riffle (n = 24 tags). The high connectivity within this stretch of river suggests that this area of river was once a continuous stretch of habitat for Fitzroy River turtle. In contrast, the region of river downstream from Rookwood far downstream was rarely visited by tagged Fitzroy River turtle. Prior to 2024, the greatest number of tagged Fitzroy River turtle were detected at the receiver positioned at Rookwood mid (n = 33) (Figure 3.15a). From 2024 onwards, greater numbers of tagged Fitzroy River turtle were detected downstream of the weir between Rookwood Weir site and Rookwood far downstream (Figure 3.15a). Only five tagged Fitzroy River turtle were detected upstream of the weir site from 2024 onwards (Rookwood crossing, Rookwood mid, Rookwood riffle, Rookwood upstream riffle), though the animals that remained here showed high residency in terms of number of days detected (Figure 3.15a).

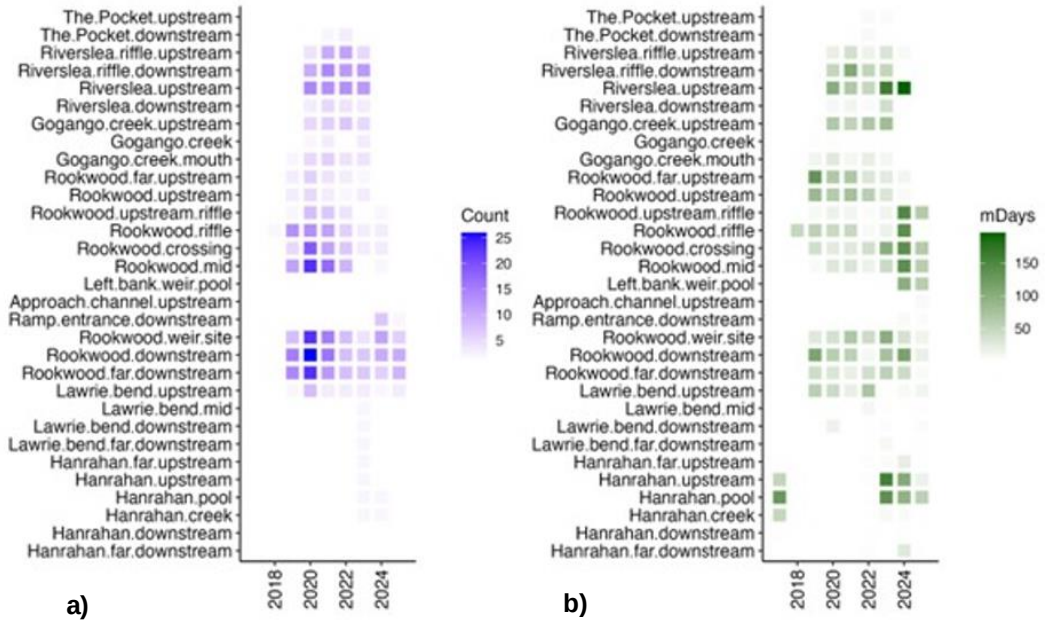

Figure 3.15 ***a) Number of acoustic tagged Fitzroy River turtles detected at each receiver station in the acoustic array each year between 22 April 2017 and 01 March 2025. b) the mean number of days that acoustic tagged Fitzroy River turtles were detected at each receiver station in the acoustic array each year between 22 April 2017 and 01 March 2025***

3.3.3.2 Variation in home range and distance travelled

Acoustic tagged white-throated snapping turtle (n = 95) were detected on between 1–28 receivers and occupied extents of the river (linear home range) of between 0 km (i.e. those turtles detected on only one receiver) and 36.4 km of river (i.e. the full extent of our acoustic array: ID 16368) (Table 3.12). The average extent of river occupied by a tagged white-throated snapping turtle for the whole tracking duration was 11.0 km (SE = 0.97 km). Mean extent of river occupied by acoustically tagged white-throated snapping turtle was lowest in July (mean = 1.33 km, SE = 0.40, n = 110 replicates) and August (mean = 1.29 km, SE = 0.17, n = 110 replicates) and greatest during March (mean = 4.02 km, SE = 0.56, n = 118 replicates) (Figure 3.16b).

After converting raw detections to 12-hour centres of activity, estimates of cumulative distance travelled by a tagged white-throated snapping turtle for the period April 2017 to March 2025 ranged between 0 and 282 km for the entire tracking period (mean = 69.90 km, SE = 7.24 km), or between 0 (min) – 63.6 km (max) per month (Table 3.12). On average, tagged white-throated snapping turtle were most active within their home range during March (mean = 7.13 km per month, SE = 0.87, n = 102 replicates) and least active within their home range during November (mean = 3.16 km per month, SE = 0.55 km, n = 146 replicates) (Figure 3.16a).

Acoustic tagged Fitzroy River turtle were detected between one and 22 receivers and occupied extents of the river (i.e. linear home range) of between 0 km (i.e. those turtles detected on only one receiver) and 36.40 km of river (i.e. the full extent of our acoustic array: ID 16344) (Table 3.12). The average extent of river occupied by a tagged Fitzroy River turtle for the entire tracking duration was 5.03 km (SE = 0.76 km). The extent of river occupied by acoustically tagged Fitzroy River turtle was greatest in April (mean = 1.49 km, SE = 0.18 km, n = 104 replicates) and lowest during November (mean = 0.52 km, SE = 0.09, n = 109 replicates) (Figure 3.16b).

After converting raw detections to 12-hour centres of activity, estimates of cumulative distance travelled by a tagged Fitzroy River turtle ranged between 0 and 275.10 km (female ID 12846) throughout the tracking period (mean = 28.6 km; SE = 5.03 km), or 0 (min) – 31.3 km (max) per month (Table 3.12). Mean monthly distance travelled by acoustically tagged Fitzroy River turtle was lowest during August (mean = 1.13 km, SE= 0.20, n = 138 replicates) and November (mean = 1.10 km, SE= 0.19, n = 128 replicates), and greatest during April (mean = 2.12 km, SE = 0.28, n = 96 replicates) (Figure 3.16a).

Table 3.12 Summary table of white-throated snapping turtle and Fitzroy River turtle movements and range use between April 2017 and March 2025

Species	Sex	Acoustic tag code	Duration (days)	No. unique receiver stations	Total distance moved (km)	Distance travelled/ day (km)	Linear home range (km)
White-throated snapping turtle	M	10238	121.64	4	30.37	0.250	2.02
White-throated snapping turtle	F	10240	121.67	4	24.56	0.202	2.02
White-throated snapping turtle	M	10242	121.80	3	6.82	0.056	1.85
White-throated snapping turtle	M	10246	118.27	5	28.65	0.242	2.02
White-throated snapping turtle	M	10248	95.70	5	43.56	0.455	4.95
White-throated snapping turtle	M	10254	114.71	14	41.81	0.364	11.26
White-throated snapping turtle	M	10256	120.57	6	32.03	0.266	7.40
White-throated snapping turtle	M	10258	123.00	4	27.58	0.224	2.02
White-throated snapping turtle	F	10260	123.22	9	39.19	0.318	4.48
White-throated snapping turtle	F	10262	118.96	4	19.43	0.163	2.02
White-throated snapping turtle	M	10264	121.09	7	40.90	0.338	8.24
White-throated snapping turtle	F	10266	123.85	4	16.31	0.132	2.02
White-throated snapping turtle	M	10268	106.89	11	27.45	0.257	9.28
White-throated snapping turtle	F	10270	123.75	8	31.69	0.256	2.59
White-throated snapping turtle	F	10272	123.62	12	43.50	0.352	9.28
White-throated snapping turtle	J	10274	481.87	2	23.71	0.049	0.95
White-throated snapping turtle	M	1084	290.21	22	85.23	0.294	34.35
White-throated snapping turtle	F	11290	735.85	2	59.67	0.081	0.95
White-throated snapping turtle	F	11294	404.92	5	38.86	0.096	3.34
White-throated snapping turtle	M	11296	6.73	10	13.10	1.947	17.55
White-throated snapping turtle	F	11304	733.57	5	17.11	0.023	3.06
White-throated snapping turtle	M	11308	721.74	14	49.00	0.068	10.43
White-throated snapping turtle	F	11310	722.12	15	130.71	0.181	11.74
White-throated snapping turtle	M	11316	1294.63	20	67.62	0.052	25.83
White-throated snapping turtle	M	11320	732.53	11	148.13	0.202	16.11
White-throated snapping turtle	M	11322	508.01	12	49.25	0.097	7.97
White-throated snapping turtle	M	11324	45.74	12	18.35	0.401	18.04

Species	Sex	Acoustic tag code	Duration (days)	No. unique receiver stations	Total distance moved (km)	Distance travelled/ day (km)	Linear home range (km)
White-throated snapping turtle	F	11326	124.09	11	48.38	0.390	5.04
White-throated snapping turtle	F	11328	123.76	8	37.85	0.306	2.59
White-throated snapping turtle	F	11562	121.96	3	51.34	0.421	1.85
White-throated snapping turtle	F	11564	122.05	4	25.02	0.205	4.78
White-throated snapping turtle	M	11566	120.80	14	28.27	0.234	10.43
White-throated snapping turtle	M	11568	117.07	5	10.95	0.094	2.02
White-throated snapping turtle	F	11711	518.52	2	33.57	0.065	0.36
White-throated snapping turtle	F	11717	1242.01	3	50.92	0.041	3.10
White-throated snapping turtle	M	11721	1306.54	22	112.10	0.086	28.01
White-throated snapping turtle	M	11725	1246.77	6	32.36	0.026	8.09
White-throated snapping turtle	M	11729	438.64	4	23.97	0.055	3.67
White-throated snapping turtle	M	11747	310.09	3	5.94	0.019	0.92
White-throated snapping turtle	M	12834	984.93	24	122.21	0.124	32.39
White-throated snapping turtle	M	12854	966.65	22	192.61	0.199	28.53
White-throated snapping turtle	F	12856	791.03	13	168.11	0.213	17.54
White-throated snapping turtle	F	12858	984.98	13	132.50	0.135	18.75
White-throated snapping turtle	M	12860	148.02	7	13.82	0.093	11.16
White-throated snapping turtle	F	12862	980.56	6	48.46	0.049	3.53
White-throated snapping turtle	M	12864	481.70	10	30.00	0.062	13.67
White-throated snapping turtle	F	14289	740.76	23	108.39	0.146	29.90
White-throated snapping turtle	F	14291	930.55	14	114.42	0.123	13.72
White-throated snapping turtle	M	14293	979.43	17	232.16	0.237	23.99
White-throated snapping turtle	M	14295	671.45	18	34.62	0.052	23.19
White-throated snapping turtle	F	15786	67.82	1	0.00	0.000	0.00
White-throated snapping turtle	F	15796	1122.09	5	172.87	0.154	5.99
White-throated snapping turtle	F	15798	72.33	4	10.22	0.141	5.91
White-throated snapping turtle	F	15802	470.32	2	11.23	0.024	2.75
White-throated snapping turtle	F	15810	1078.27	9	37.13	0.034	6.55
White-throated snapping turtle	M	15812	1120.64	3	19.06	0.017	5.02
White-throated snapping turtle	M	15814	862.12	9	136.54	0.158	9.47
White-throated snapping turtle	M	15816	1122.32	9	67.07	0.060	15.56
White-throated snapping turtle	F	15820	1646.38	15	264.67	0.161	19.86
White-throated snapping turtle	M	15822	1116.57	21	151.60	0.136	26.26
White-throated snapping turtle	M	15824	245.48	6	57.87	0.236	7.47
White-throated snapping turtle	M	16004	591.32	3	24.60	0.042	3.06
White-throated snapping turtle	M	16006	374.47	9	29.60	0.079	15.69
White-throated snapping turtle	F	16008	883.62	14	281.98	0.319	19.54
White-throated snapping turtle	F	16010	172.41	5	91.15	0.529	5.20
White-throated snapping turtle	M	16012	152.16	7	52.94	0.348	11.59

Species	Sex	Acoustic tag code	Duration (days)	No. unique receiver stations	Total distance moved (km)	Distance travelled/ day (km)	Linear home range (km)
White-throated snapping turtle	F	16016	523.94	2	15.10	0.029	0.84
White-throated snapping turtle	M	16020	600.79	9	105.76	0.176	15.62
White-throated snapping turtle	M	16022	173.20	3	15.21	0.088	3.88
White-throated snapping turtle	F	16024	334.22	3	78.75	0.236	2.66
White-throated snapping turtle	F	16026	932.76	6	207.48	0.222	7.47
White-throated snapping turtle	M	16028	188.58	6	8.32	0.044	9.47
White-throated snapping turtle	F	16030	69.36	10	30.23	0.436	18.75
White-throated snapping turtle	M	16032	400.75	6	212.70	0.531	7.47
White-throated snapping turtle	M	16036	200.87	2	11.52	0.057	1.37
White-throated snapping turtle	M	16038	76.03	2	7.61	0.100	0.95
White-throated snapping turtle	F	16040	1127.73	6	80.47	0.071	9.12
White-throated snapping turtle	M	16042	483.14	4	41.91	0.087	8.09
White-throated snapping turtle	M	16334	571.63	10	108.60	0.190	14.19
White-throated snapping turtle	F	16336	1087.71	3	1.83	0.002	2.08
White-throated snapping turtle	M	16338	1093.40	22	209.62	0.192	25.21
White-throated snapping turtle	M	16340	719.58	18	104.93	0.146	21.65
White-throated snapping turtle	F	16342	1094.96	4	25.27	0.023	2.02
White-throated snapping turtle	M	16346	716.63	11	59.91	0.084	18.45
White-throated snapping turtle	M	16356	247.85	12	20.46	0.083	16.49
White-throated snapping turtle	F	16358	580.73	4	21.33	0.037	28.93
White-throated snapping turtle	F	16360	591.33	5	30.25	0.051	25.83
White-throated snapping turtle	M	16364	645.82	17	69.01	0.107	28.01
White-throated snapping turtle	F	16366	1094.23	10	261.81	0.239	16.64
White-throated snapping turtle	M	16368	1012.18	28	179.20	0.177	36.43
White-throated snapping turtle	M	16370	1093.97	9	214.51	0.196	16.64
White-throated snapping turtle	M	16372	1094.19	21	253.17	0.231	27.43
White-throated snapping turtle	J	465	541.16	2	12.70	0.023	0.77
White-throated snapping turtle	J	469	584.26	3	24.23	0.041	2.66
White-throated snapping turtle	F	473	169.11	10	10.35	0.061	7.50
Fitzroy River turtle	F	10236	122.90	4	6.10	0.050	2.02
Fitzroy River turtle	F	10244	122.83	5	4.51	0.037	4.95
Fitzroy River turtle	M	10250	122.05	4	8.56	0.070	2.02
Fitzroy River turtle	F	10252	122.26	8	29.33	0.240	11.91
Fitzroy River turtle	F	1082	215.56	3	1.92	0.009	2.58
Fitzroy River turtle	J	1086	471.72	7	16.94	0.036	11.74
Fitzroy River turtle	F	1088	317.05	8	14.55	0.046	6.59
Fitzroy River turtle	M	1090	44.69	1	0.00	0.000	0.00
Fitzroy River turtle	F	11292	958.24	7	19.49	0.020	0.00
Fitzroy River turtle	F	11298	735.16	5	71.27	0.097	4.95

Species	Sex	Acoustic tag code	Duration (days)	No. unique receiver stations	Total distance moved (km)	Distance travelled/ day (km)	Linear home range (km)
Fitzroy River turtle	F	11300	732.45	4	19.07	0.026	2.02
Fitzroy River turtle	F	11302	568.67	12	61.84	0.109	17.55
Fitzroy River turtle	J	11306	735.10	3	15.65	0.021	1.85
Fitzroy River turtle	F	11312	733.84	10	153.20	0.209	15.47
Fitzroy River turtle	F	11314	732.07	4	58.33	0.080	2.02
Fitzroy River turtle	F	11318	730.55	5	36.73	0.050	4.95
Fitzroy River turtle	F	11570	121.77	4	10.91	0.090	2.02
Fitzroy River turtle	M	11709	1238.58	7	43.06	0.035	8.48
Fitzroy River turtle	F	11713	1205.74	4	40.78	0.034	3.67
Fitzroy River turtle	F	11715	658.43	3	6.49	0.010	0.92
Fitzroy River turtle	M	11719	1246.77	2	2.24	0.002	0.36
Fitzroy River turtle	F	11723	1246.76	3	14.23	0.011	0.92
Fitzroy River turtle	F	11727	754.57	4	7.47	0.010	3.98
Fitzroy River turtle	F	11731	1330.12	3	36.76	0.028	0.92
Fitzroy River turtle	F	11733	1614.40	3	10.85	0.007	0.92
Fitzroy River turtle	F	11735	1243.43	3	33.63	0.027	0.92
Fitzroy River turtle	F	11737	1088.89	4	14.68	0.013	7.55
Fitzroy River turtle	F	11739	1245.49	4	30.17	0.024	3.98
Fitzroy River turtle	M	11741	1244.73	3	43.94	0.035	0.92
Fitzroy River turtle	F	11743	1233.47	9	62.22	0.050	11.14
Fitzroy River turtle	M	11745	1240.30	2	16.87	0.014	0.36
Fitzroy River turtle	M	12832	355.41	6	25.14	0.071	3.53
Fitzroy River turtle	M	12836	984.74	5	32.44	0.033	5.99
Fitzroy River turtle	M	12838	715.76	6	5.37	0.007	6.27
Fitzroy River turtle	M	12840	4.42	5	1.91	0.432	3.34
Fitzroy River turtle	M	12842	301.22	6	5.38	0.018	6.27
Fitzroy River turtle	M	12844	896.06	4	13.70	0.015	3.06
Fitzroy River turtle	F	12846	984.89	12	275.10	0.279	9.47
Fitzroy River turtle	M	12848	154.54	6	5.32	0.034	6.27
Fitzroy River turtle	M	12850	984.82	4	34.82	0.035	3.06
Fitzroy River turtle	F	12852	206.45	8	8.31	0.040	9.56
Fitzroy River turtle	F	14261	984.25	6	63.86	0.065	3.97
Fitzroy River turtle	F	14263	912.18	7	18.21	0.020	3.66
Fitzroy River turtle	M	14265	274.77	2	0.13	0.000	0.13
Fitzroy River turtle	F	14267	880.71	7	31.21	0.035	3.66
Fitzroy River turtle	F	14269	967.59	11	72.71	0.075	18.47
Fitzroy River turtle	M	14271	983.83	4	41.91	0.043	3.06
Fitzroy River turtle	F	14273	691.84	8	41.63	0.060	6.59
Fitzroy River turtle	M	14275	892.32	3	10.22	0.011	1.85

Species	Sex	Acoustic tag code	Duration (days)	No. unique receiver stations	Total distance moved (km)	Distance travelled/ day (km)	Linear home range (km)
Fitzroy River turtle	F	14277	974.49	6	29.87	0.031	3.53
Fitzroy River turtle	F	14279	900.65	5	42.73	0.047	3.34
Fitzroy River turtle	M	14281	516.57	5	14.90	0.029	3.34
Fitzroy River turtle	F	14283	819.06	4	41.81	0.051	3.06
Fitzroy River turtle	F	14285	227.92	2	0.56	0.002	0.19
Fitzroy River turtle	M	14287	230.56	3	35.16	0.153	1.52
Fitzroy River turtle	F	14297	285.35	6	22.55	0.079	6.59
Fitzroy River turtle	M	14299	286.71	4	56.11	0.196	3.28
Fitzroy River turtle	M	15788	256.20	3	1.01	0.004	0.32
Fitzroy River turtle	M	15792	1.00	1	0.00	0.000	0.00
Fitzroy River turtle	M	15794	692.96	4	10.78	0.016	3.06
Fitzroy River turtle	F	15804	936.58	6	92.44	0.099	3.53
Fitzroy River turtle	F	15806	1134.76	7	60.32	0.053	3.66
Fitzroy River turtle	F	15818	1113.59	1	0.00	0.000	0.00
Fitzroy River turtle	F	16014	200.97	6	53.66	0.267	8.30
Fitzroy River turtle	M	16018	836.41	1	0.00	0.000	0.00
Fitzroy River turtle	F	16344	336.85	23	57.46	0.171	36.43
Fitzroy River turtle	F	16350	1235.33	17	133.03	0.108	15.41
Fitzroy River turtle	F	16352	1094.94	12	65.76	0.060	9.47
Fitzroy River turtle	F	16354	1094.97	5	22.10	0.020	3.34
Fitzroy River turtle	M	16362	530.60	15	62.48	0.118	16.77
Fitzroy River turtle	J	8320	730.05	6	13.02	0.018	3.53
Fitzroy River turtle	J	8322	588.17	2	5.78	0.010	1.21

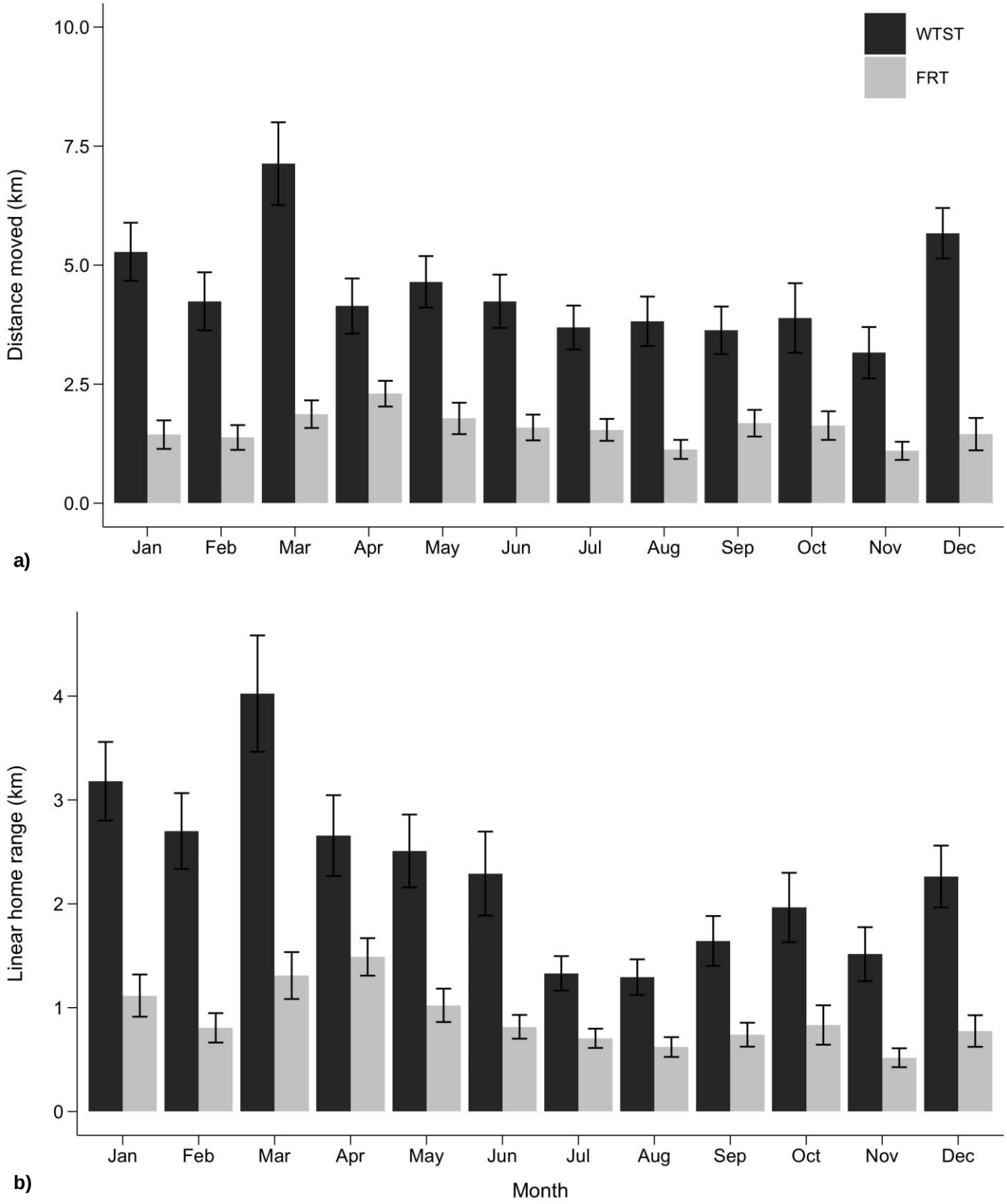

Figure 3.16 ***Distance moved (mean monthly ± standard error) and linear home range size (mean monthly ± standard error) of acoustic tagged white-throated snapping turtles (WTST) and Fitzroy River turtles (FRT) between 22 April 2017 and 01 March 2025***

3.3.3.3 Sex-related difference in space use

When comparing river extent occupied for the entire tracking period between the 52 tagged adult male and 40 female white-throated snapping turtles, the average linear home range for adult males was found to be 13.7 km (SE = 1.35 km) and the average linear home range for adult females was 8.48 km (SE = 1.32 km).

On average, female home ranges were larger than male home ranges between May – August, the nesting season for this species (Figure 3.17a). The greatest difference between male and female home ranges was in June, and this month was also when female home ranges were the largest overall. The extent of river occupied by male white-throated snapping turtle were generally larger than female white-throated snapping turtle between October – April, with males having the largest home ranges between December and March (Figure 3.17a)

Overall, female white-throated snapping turtle travelled similar distances per month as males (female: mean = 4.33 km/month, SE = 0.25 km, n = 625 replicates; male = 4.63 km/month, SE = 0.25 km, n = 757 replicates), while juveniles travelled much smaller distances (1.48 km/month, SE = 0.33 km, n = 41 replicates).

As with the linear home range comparisons, females travelled greater distances than male turtles between May – September, whereas males travelled greater distance than female white-throated snapping turtle between November – March (Figure 3.18a). Tagged male white-throated snapping turtle travelled ~2x further during March than in May – November, and the extent of river occupied was also ~2x larger during this month.

For the 22 male and 41 female Fitzroy River turtles which were detected on more than one acoustic hydrophone station, we found that the total extent of river occupied by adult females were generally larger than that of male Fitzroy River turtle (females: mean = 6.44 km, SE = 1.05 km; males: mean = 3.78 km, SE = 0.79 km).

For male Fitzroy River turtle, the extent of river occupied (i.e. their linear home range) peaked during April (mean = 1.88 km, SE = 0.39 km, n = 27 replicates), with individuals maintaining highly confined home ranges (mean <0.4 km) between the months of July – November (Figure 3.17b). In contrast, female Fitzroy River turtle occupied large (mean >1.0 km) monthly home ranges in September and October (coinciding with the Fitzroy River turtle nesting season (Cann and Sadler, 2017), with another peak in home range size between March and May.

Estimates of monthly distances travelled (calculated from COA estimates) was greater in female Fitzroy River turtle (mean = 1.86 km, SE = 0.34 km, n = 826 replicates) compared to males (mean = 1.17 km, SE = 0.29 km, n = 429 replicates).

As in the monthly linear home range estimates, the distances moved by tagged male Fitzroy River turtle peaked in April (mean = 2.68 km/month, SE = 0.61 km, n = 32 replicates) with the mean distance travelled per month remaining ≤0.8 km/month for July, August, September, November and February (Figure 3.18b). In contrast, the monthly distance travelled by female Fitzroy River turtle was greatest during May (mean = 2.23 km/month, SE = 0.48 km, n = 67 replicates) and during September (mean = 2.26 km/month, SE = 0.39 km, n = 94 replicates).

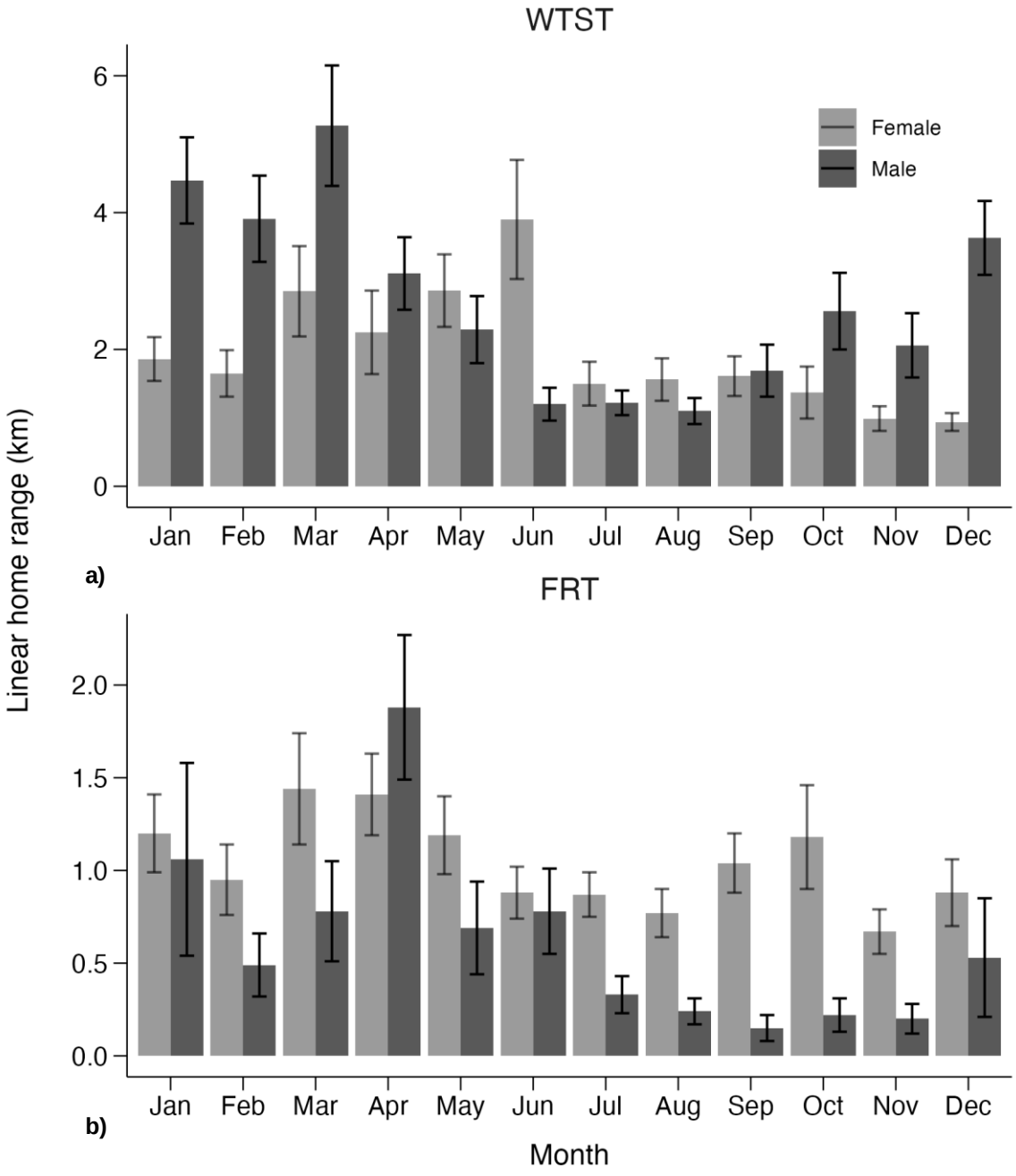

Figure 3.17 ***Linear home range size (mean monthly ± standard error) by male and female acoustic tagged white-throated snapping turtles (WTST) (a) and Fitzroy River turtles (FRT) (b) detected on the acoustic array between 22 April 2017 and 01 March 2025***

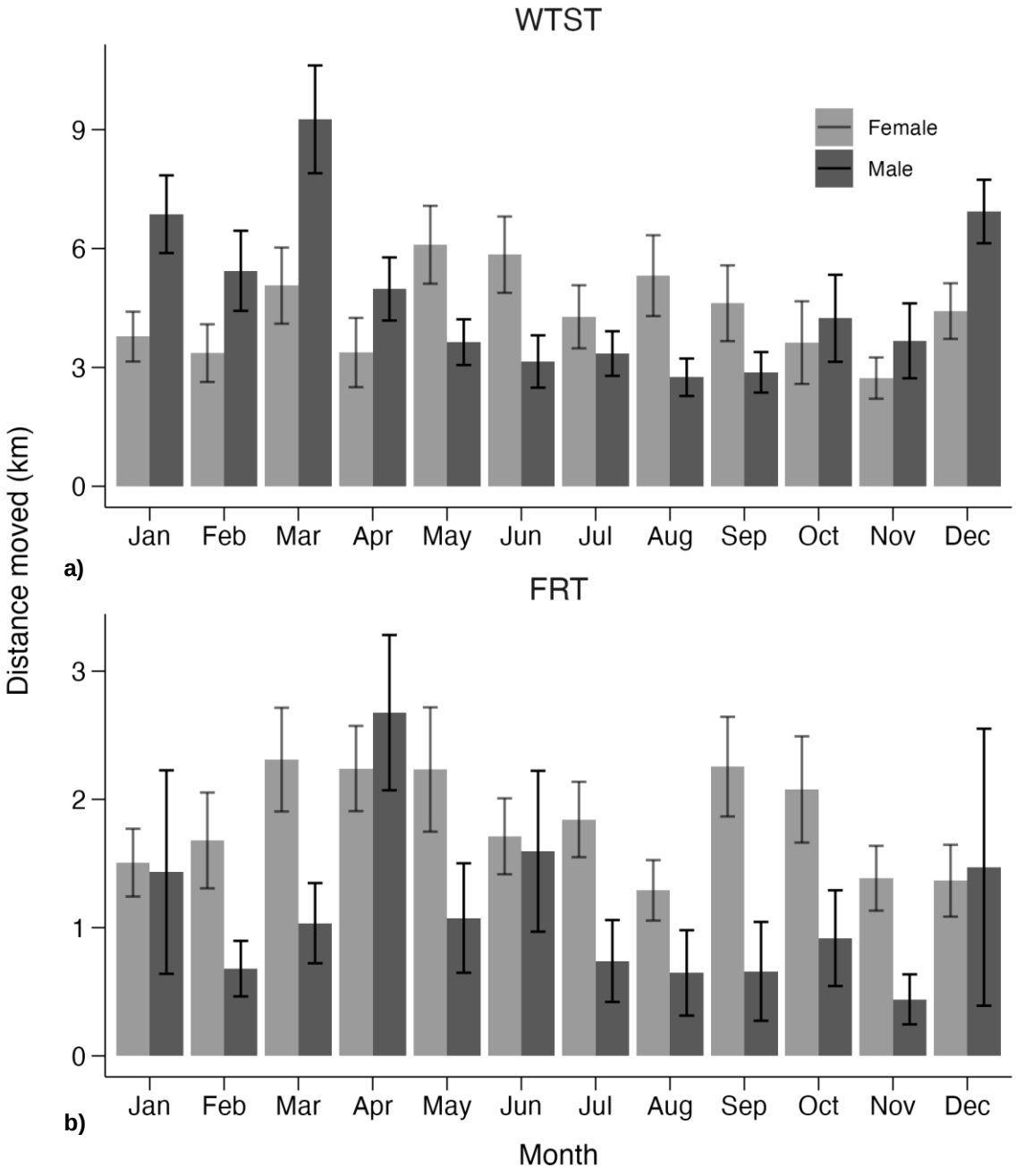

Figure 3.18 ***Distance moved (mean monthly ± standard error) by male and female acoustic tagged white-throated snapping turtles (WTST) (a) and Fitzroy River turtles (FRT) (b) detected on the acoustic array between 22 April 2017 and 01 March 2025***

3.3.3.4 Comparison between pre-construction and operation

Mean monthly home ranges (max river extent) of female white-throated snapping turtle were greatest between 2017– 2019, then gradually decreased in size from 2020 onwards to the smallest home range size in 2024 (mean = 1.13 km, SE = 0.15 km) (Figure 3.19). In male white-throated snapping turtle, mean monthly home ranges were similar between years.

Similar to mean monthly home range size, the monthly distances travelled by female white-throated snapping turtle were greatest between 2017– 2019 and the monthly distances travelled by female white-throated snapping turtle decreased in size from 2020 onwards and were most site attached in 2024 (Figure 3.20). Mean monthly distances travelled in male white-throated snapping turtle were similar across years (Figure 3.20).

Mean monthly home range size and mean monthly distances travelled of female Fitzroy River turtle were over 2.5x greater in 2017 than in later years (Figure 3.19, Figure 3.20). These high movements of female Fitzroy River turtle in 2017 was largely due to the behaviours of one individual (ID 16014) which was highly active following release at Lawries bend on 01 May 2017 with movements around the Hanrahan pool region before the tag disappeared from the acoustic array on the 18 November 2017 (Table 3.11, Figure 3.9). Mean monthly home range size of females since weir operations commenced is similar to pre-development and construction phases. Mean monthly home range size of male Fitzroy River turtles was higher in 2024 than previous years.

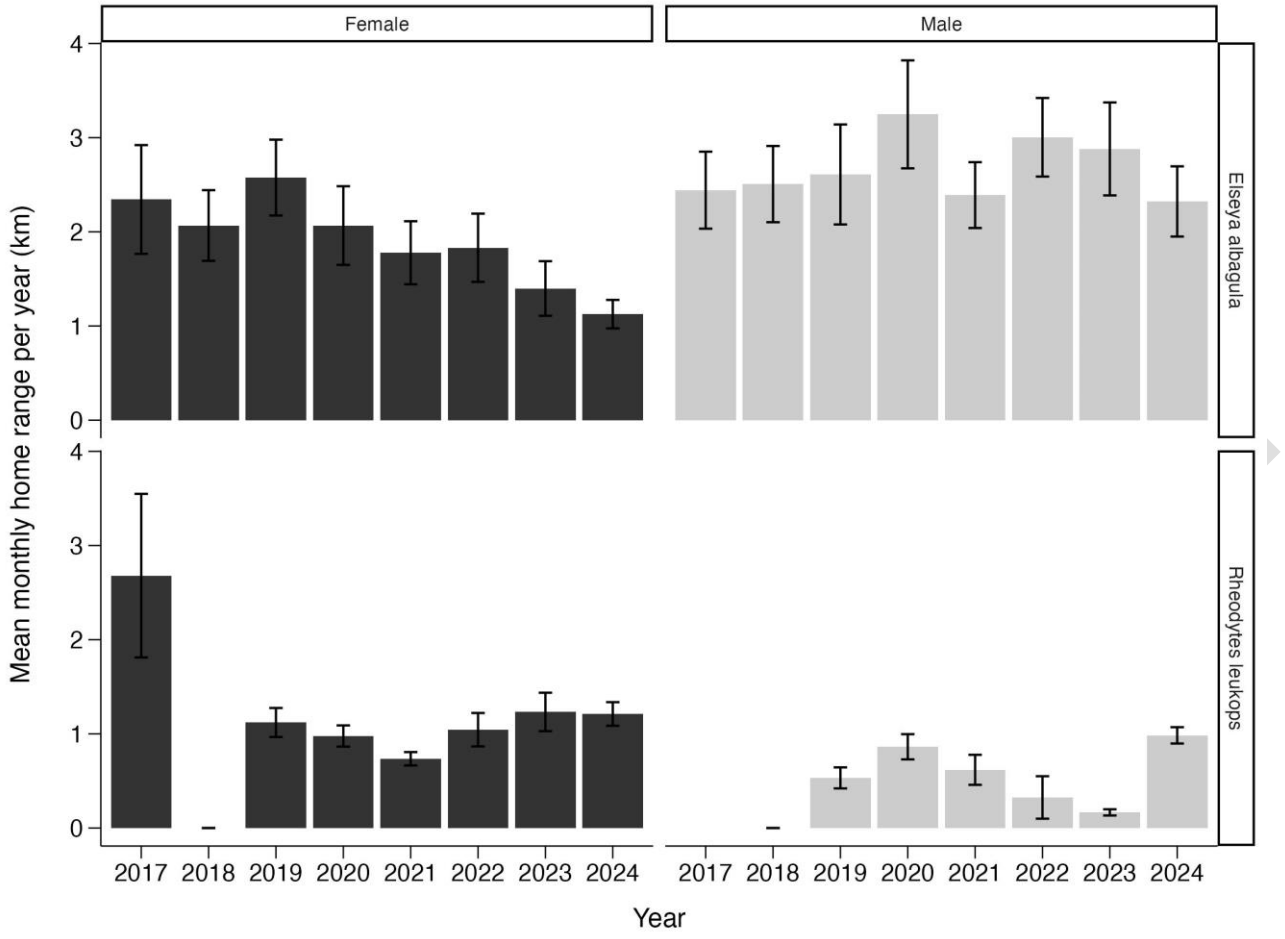

Figure 3.19 ***Annual variation in home range size (mean monthly ± standard error) by female and male acoustic white-throated snapping turtles (top) and Fitzroy River turtles (bottom) detected on the acoustic array between 22 April 2017 and 31 December 2024***

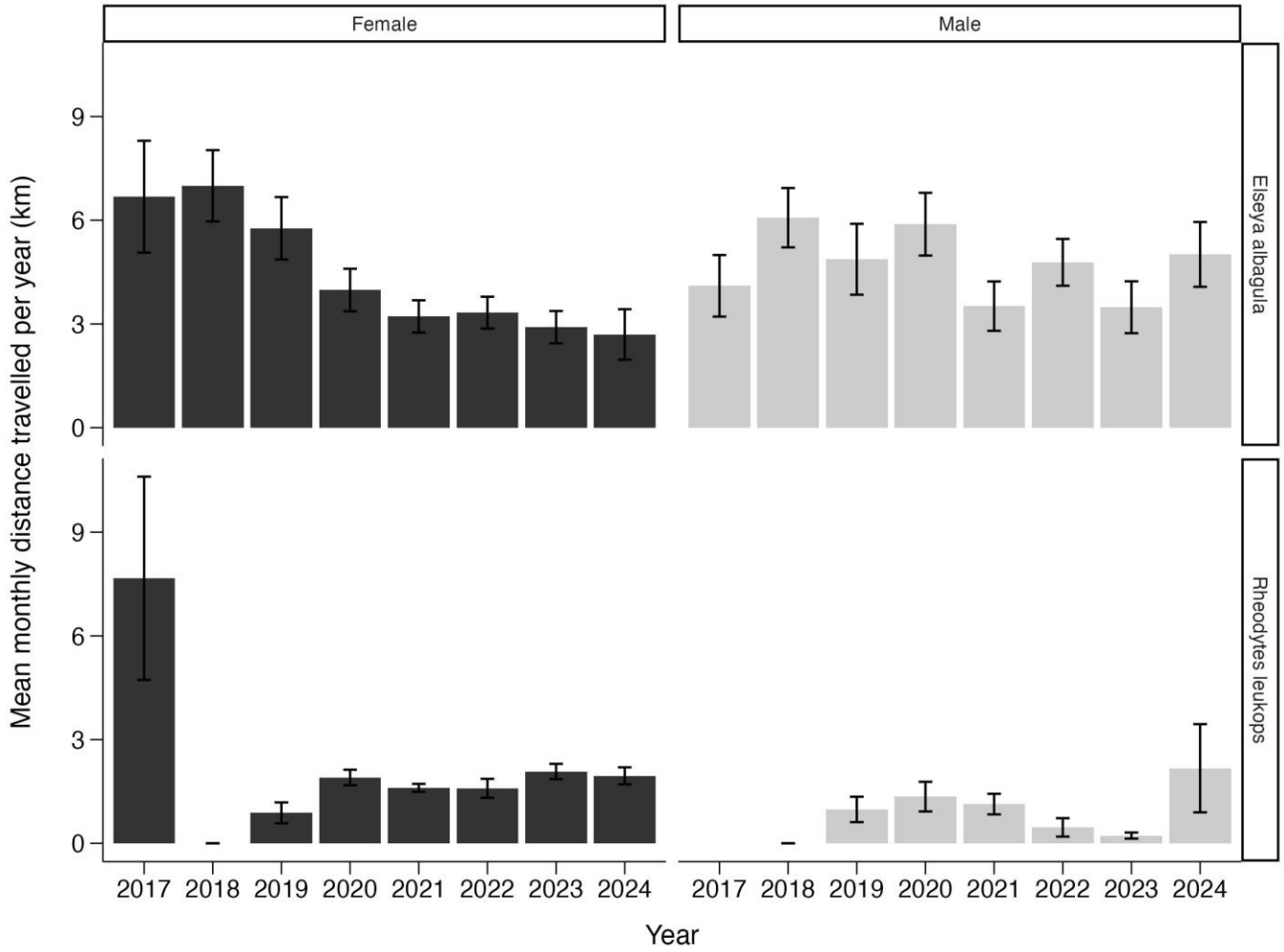

Figure 3.20 ***Annual variation in distance travelled (mean monthly ± standard error) by female and male acoustic tagged white-throated snapping turtles (top) and Fitzroy River turtles (bottom) detected on the acoustic array between 22 April 2017 and 31 December 2024***

Between 2017 and March 2025, there were 116 detected movements by 32 tagged white-throated snapping turtle (19 males, 13 females) across the new weir site at Rookwood (i.e. between the receiver named “Rookwood mid” and the receivers positioned downstream of this location). This included 59 movements upstream and 57 movements downstream.

Of the 57 recorded movements downstream by tagged white-throated snapping turtle, five were in 2017, four were in 2018, 13 were in 2019, nine were in 2020, six were in 2021, seven were in 2022, 10 were in 2023, three were in 2024 and zero were in 2025. In 2024, movements occurred in January (male ID 11324), April (male ID 11316) and July (male ID 11322). Of the 59 recorded movements upstream by tagged white-throated snapping turtle, seven were in 2017, four were in 2018, 11 were in 2019, nine were in 2020, 10 were in 2021, four were in 2022, 12 were in 2023, one was in 2024 and one was in 2025. In 2024-25, the movement occurred in December 2024 (male ID 10254) and January 2025 (male ID 11566).

Movements upstream and downstream across the weir site occurred in all months, peaking in June: January (9), February (4), March (13), April (7), May (10), June (14), July (1), August (3), September (9), October (10) November (5), and December (4).

Between 2017 and March 2025, there were 202 detected movements of 31 tagged Fitzroy River turtle (11 males, 17 females, three juveniles) between the receiver placed upstream of the weir (Rookwood mid) past the hydrophone placed at Rookwood Weir site (and downstream to the receiver placed at Rookwood downstream and beyond). Of these 202 movements, 94 were in an upstream direction and 108 were in a downstream direction).

Of the 108 recorded movements downstream by tagged Fitzroy River turtle, zero were in 2017, zero were in 2018, 16 were in 2019, 59 were in 2020, 26 were in 2021, 6 were in 2022, zero were in 2023, one was in 2024 and zero

were in 2025. In 2024, the downstream movement of the female Fitzroy River turtle (ID 16350) downstream across the weir site occurred in January. Of the 94 recorded movements upstream by tagged Fitzroy River turtle, zero were in 2017, zero were in 2018, 7 were in 2019, 50 were in 2020, 27 were in 2021, 10 were in 2022, zero were in 2023, zero were in 2024 and zero were in 2025.

Movements upstream and downstream across the weir site occurred in all months, peaking in April: January (14), February (13), March (20), April (46), May (18), June (50), July (10), August (6), September (9), October (3) November (5), and December (8).

The recorded transmitter depth for both white-throated snapping turtle and Fitzroy River turtle were significantly deeper in 2024 and 2025 than in previous years of monitoring (2017-2023). For white-throated snapping turtle, the depths recorded by the tags increased beyond previous levels in October 2024 and remained high throughout January-March 2025.

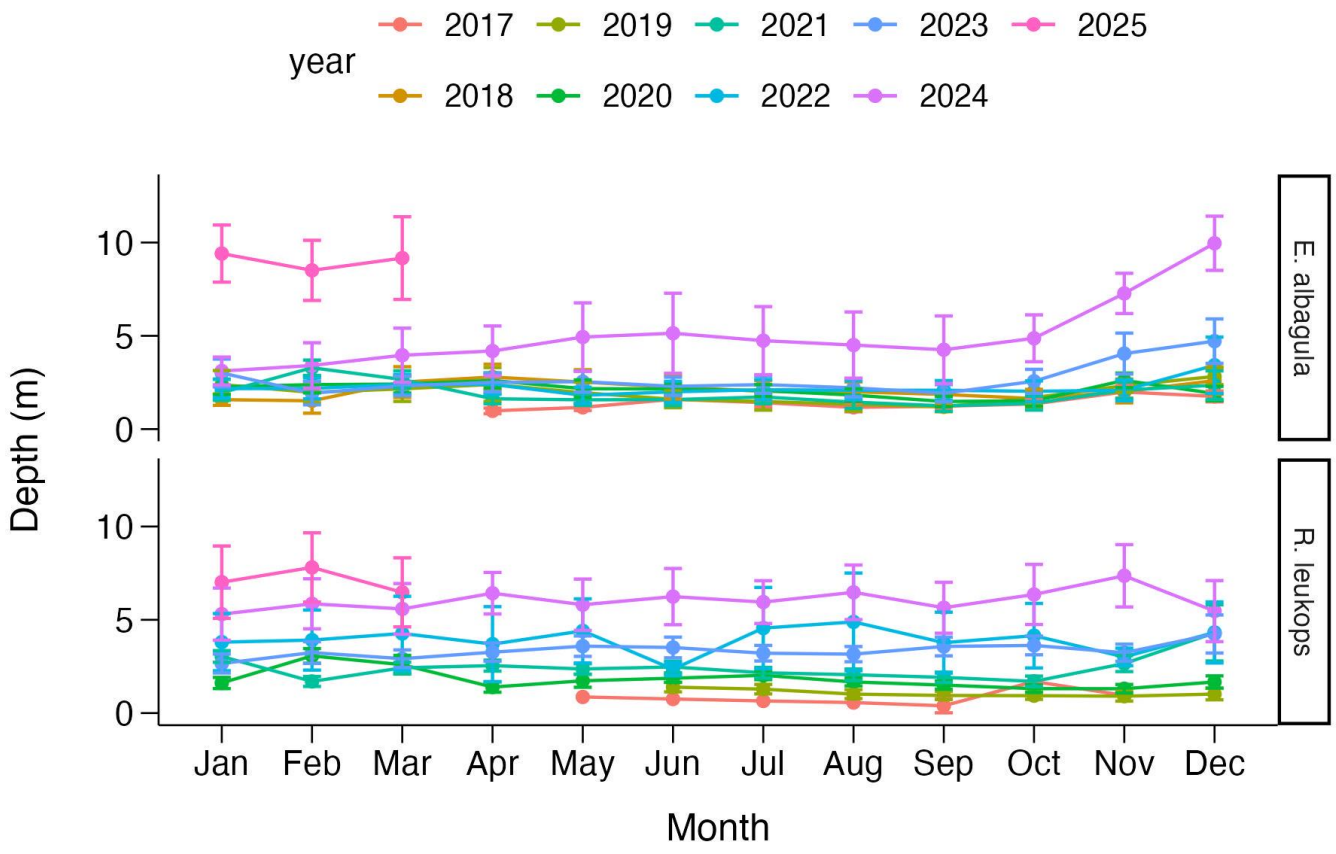

Figure 3.21 ***Annual variation in transmitter depth in meters (mean monthly ± standard error) by acoustic tagged white-throated snapping turtles (top) and Fitzroy River turtles (bottom) detected on the acoustic array between 22 April 2017 and 01 March 2025***

3.3.3.5 Timing of turtle movement

Environmental flows in 2024 were characterised by a large flows associated with heavy rainfall throughout January, and February 2024, followed by smaller flows between March–May 2024 and in July–August 2024 (refer to Section 3.1). The remainder of 2024 experienced little to no natural flows until very heavy rainfall in January and February 2025 created moderate flows.

Heavy rainfall and high river flows in January – February 2024 associated with the large movements of two male white-throated snapping turtle (ID 11320, 16346). ID 11320 moved from Lawries bend downstream to Rookwood Weir site and male ID 16346 moved from Lawries bend upstream to Hanrahan far downstream (Figure 3.22).

Smaller flows in March 2024 – May 2024 were associated with the downstream movements of male white-throated snapping turtle ID 11320 from Rookwood Weir site to Hanrahan pool, male white-throated snapping turtle ID 11316 from Rookwood riffle to Lawries bend upstream, and the upstream movement of female white-throated snapping turtle 11310 from Rookwood Crossing to Gogango Creek (Figure 3.22a-d).

Small flows in July 2024 – August 2024 were associated with the downstream movements of female white-throated snapping turtle ID 11310 from Gogango Creek to Approach channel upstream and ID 16352 from Rookwood far upstream to Rookwood mid (Figure 3.22c and d).

Moderate flows in January 2025 associated with the movements of several white-throated snapping turtle captured and tagged during the November 2024 capture event around Rookwood. These movements included male IDs 10254, 10256, 11566, 10264, and female white-throated snapping turtle ID 10268, 10260, and 10272 (Figure 3.22b and c). Several other white-throated snapping turtle tagged prior to the November 2024 capture event also undertook movements at this time, including five male white-throated snapping turtle (ID 11308, 11316, 11320, 11324, 16346) and one female white-throated snapping turtle (ID 11310) (Figure 3.22a and c).

Three female Fitzroy River turtle moved during the moderate flows in January 2025 (Figure 3.23a-d). These movements included: female Fitzroy River turtle ID 10236 which moved from the station positioned at the Ramp entrance downstream to Rookwood far downstream; female Fitzroy River turtle ID 10244 which moved from Rookwood Weir site to Lawries bend upstream; and female Fitzroy River turtle ID 10252 from Lawries bend downstream to Hanrahan far upstream before moving back upstream to Rookwood Weir site.

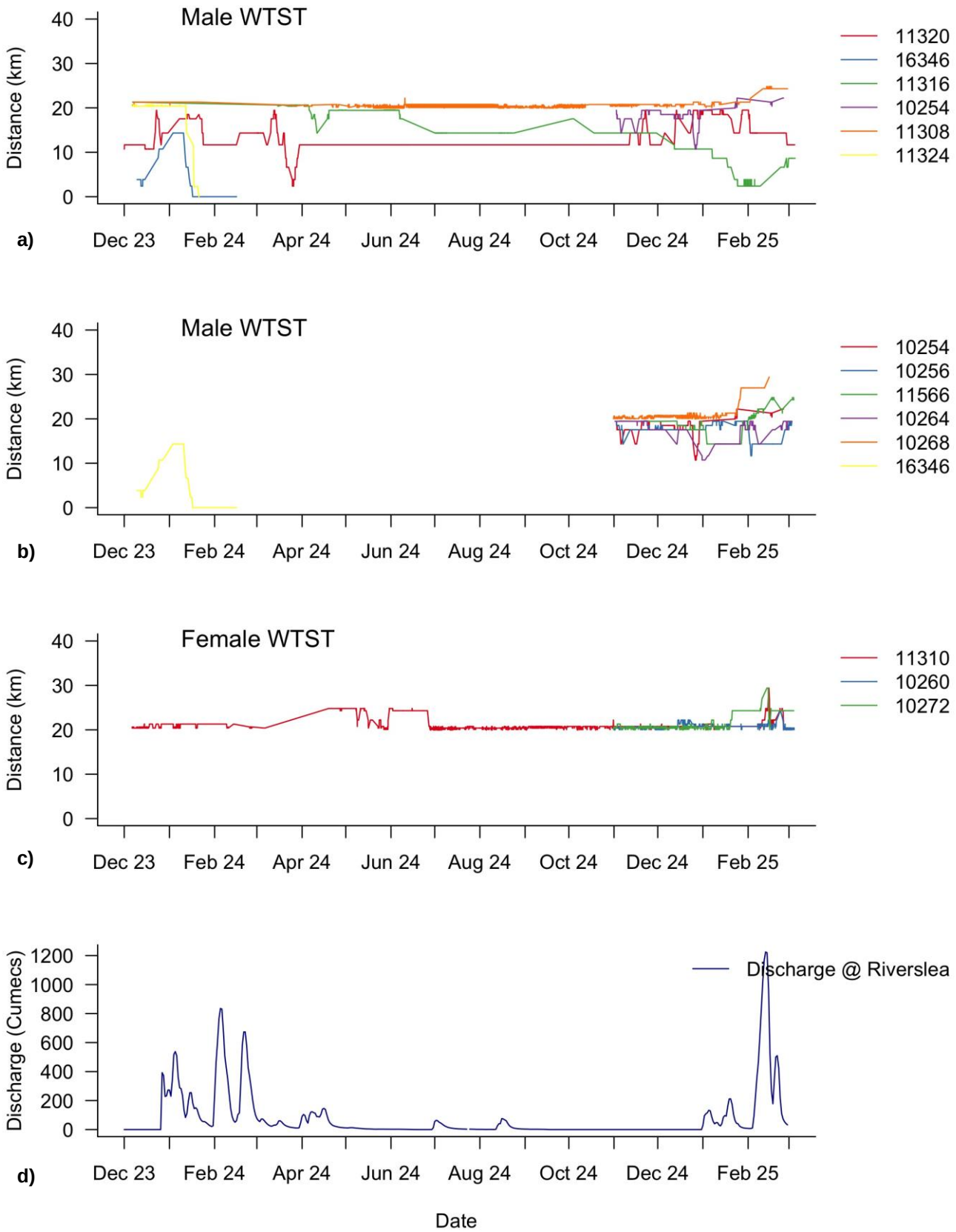

Figure 3.22 ***Location of an acoustically tagged white-throated snapping turtles (a-c) in 2024 and 2025 relative to the most downstream receiver at Hanrahan far downstream and flow (discharge) at Riverslea (d)***

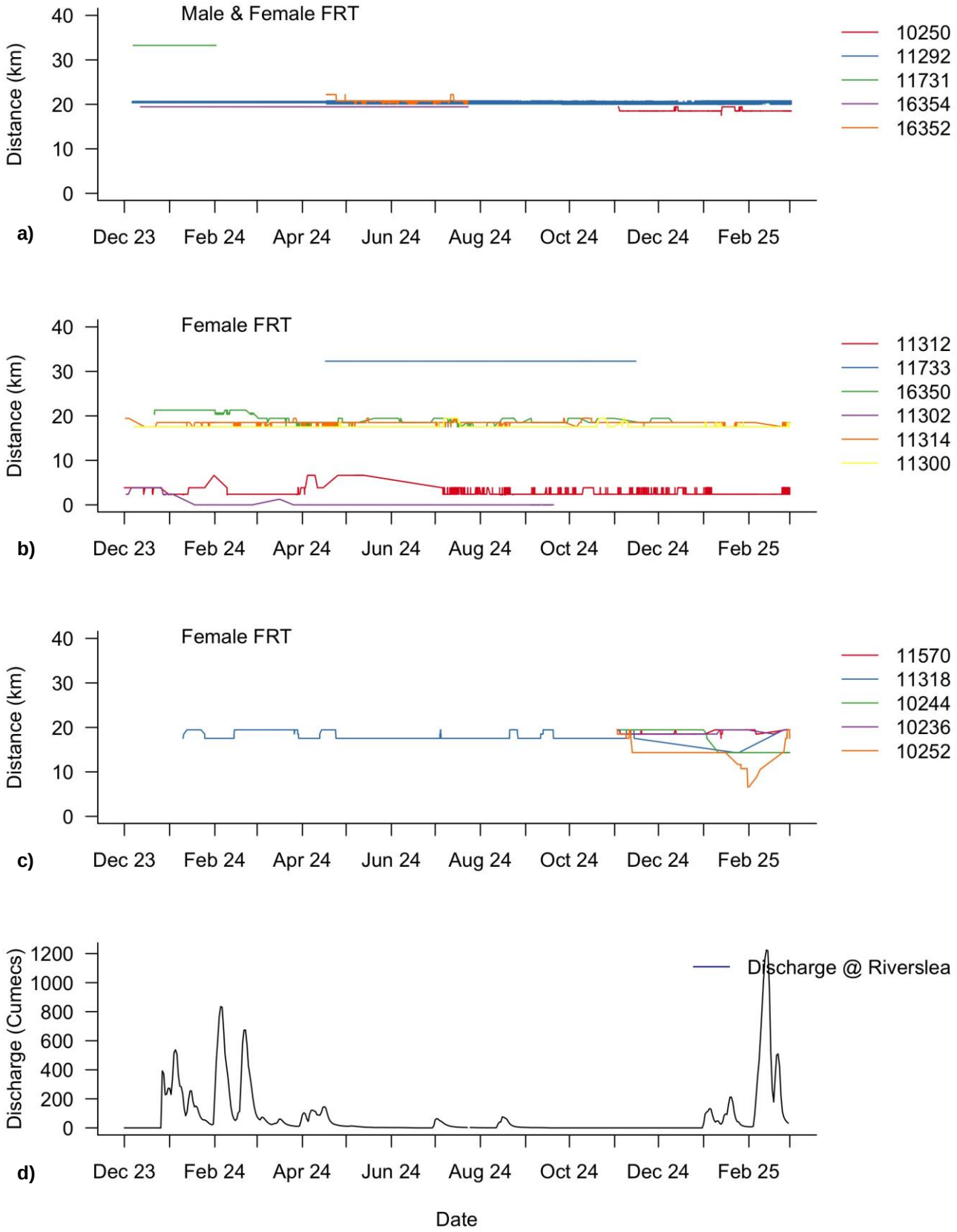

Figure 3.23 ***Location of an acoustically tagged Fitzroy River turtles (a-c) in 2024 and 2025 relative to the most downstream receiver at Hanrahan far downstream and flow (discharge) at Riverslea (d)***

3.4 PIT tag readers

PIT tag data from the three PIT tag readers installed in the turtle passage are presented in Table 3.13.

Drafting note: fishway PIT tag data to be included when received.

PIT tag detections occurred when resting pools DSRP7 and USRP5 were submerged during the flooding event in early April 2025. None of the detections were of turtles tagged during the previous Turtle Movement Study or Year 1 2024-25 of operations phase monitoring so are all likely to be fish tagged as part of the fishway monitoring program.

It is suspected that the PIT tag readers are not detecting the PIT tags that have been inserted into the turtles as turtles tagged with PIT tags have been confirmed present on the turtle passage by the acoustic hydrophones but have not registered on the PIT tag readers.

Table 3.13 Pit tag reader data along turtle passage

Pit tag reader	Date	Number of detections	Species	Pit tag numbers
D1 (DSRP7)	6 April 2025	1	Leathery grunter (fish)	989001040550334
	6 April 2025	1	Unknown	989001040553153
	7 April 2025	2	Unknown	989001040549485 989001040551344
	7 April 2025	4	Blue catfish (fish)	989001040549656 989001040549704 989001040550150 989001040550183
	8 April 2025	3	Unknown	989001040551787 989001040551793 989001040553183
	9 April 2025	5	Unknown	989001040551777 989001040551782 989001040551787 989001040553194 989001040553203
	10 April 2025	3	Unknown	989001040551406 989001040551787 989001040551818
	11 April 2025	1	Unknown	989001040551818
D2 (DSRP1)	No detections			
D3 (USRP5)	12 February	1	Unknown	989001040553180
	4 April 2025	1	Unknown	989001040553180
	5 April 2025	1	Unknown	989001040553180
	6 April 2025	1	Unknown	989001040553180

3.5 Remote cameras

Individual turtles were recorded ten times on the remote cameras (Plate 3.7 and Plate 3.8), spanning between 11 November 2024 and 8 March 2025. Majority of captured images include only a small portion of the head of each turtle from a distance (>1 m), likely when the turtle is surfacing to breathe. Subsequently, nine of these ten individuals could not be confidently identified from remote camera imagery, however one adult female white-throated snapping turtle was confirmed present on 4 March 2025 in USRP1 (Plate 3.8). Timing of recorded turtle movement in the turtle passage varied, however typically images were recorded early to mid morning (~4am to 9:30am) or early to late evening (~4pm to 9pm).

Captured imagery indicates that turtles are utilising both the resting pools and shallow ramp sections between them (Plate 3.7 and Plate 3.8). It is suspected that individuals may remain in resting pools for several hours to multiple days. For example, on 3 and 8 November 2024, an unidentified turtle was recorded surfacing in resting pool DSRP5 (CAM02) in the evening. While it is possible the same individual was recorded on both occasions, this cannot be confirmed. Similarly, the female adult white-throated snapping turtle was observed basking on the shallow traverse section adjacent to resting pool USRP1. Two hours later, another turtle was recorded in the same area and may have been the same individual, though this too can not be verified. It is unknown whether this white-throated snapping turtle successfully travelled through the entirety of the turtle passage.

Overall, the captured remote camera imagery was insufficient to confirm whether any turtles moved through the entire length of the turtle passage infrastructure. This may be due to suboptimal camera positioning, with some units mounted too high or angled too broadly to detect turtle movement effectively. For example, CAM01 which was positioned at the most downstream resting pool (DSRP8) did not record any turtles or other fauna, suggesting it may be either malfunctioning or poorly positioned. CAM05, which overlooks the ramp and the most upstream pool (USRP5), also captured minimal imagery, possibly due to an overly broad field of view that limits its ability to detect fauna at closer range. Repositioning may improve its' effectiveness. There was frequent triggering of remote cameras by birds (Plate 3.9) further suggest misalignment or an overly wide field of view. However, this setup does provide information about the presence of potential turtle predators.

Other recorded fauna observations were almost exclusively avifauna, primarily observed wading and foraging in shallow sections across the uppermost resting pools on the upstream side of the turtle passage (CAM04 – USRP1-3; Plate 3.9). The most frequently recorded species was the white-faced heron (*Egretta novaehollandiae*); with multiple individuals captured several times. Similar to turtles, the white-face heron frequented the turtle passage during the early mornings and late afternoons, and did not appear to disturb the turtles. For example, during the 3 November observation, the turtle appeared alongside a white-faced heron perched on the cement edge of the passage and did not appear disturbed (Plate 3.9). Other avifauna species captured on remote cameras included the magiepie-lark (*Grallina cyanoleuca*), Pacific black duck (*Anas superciliosa*), common crow (*Euploea corinna*), and nankeen night-heron (*Nycticorax caledonicus*). The crow and nankeen night-heron were recorded preying on an unidentified amphibian and rodent, respectively (Plate 3.9).

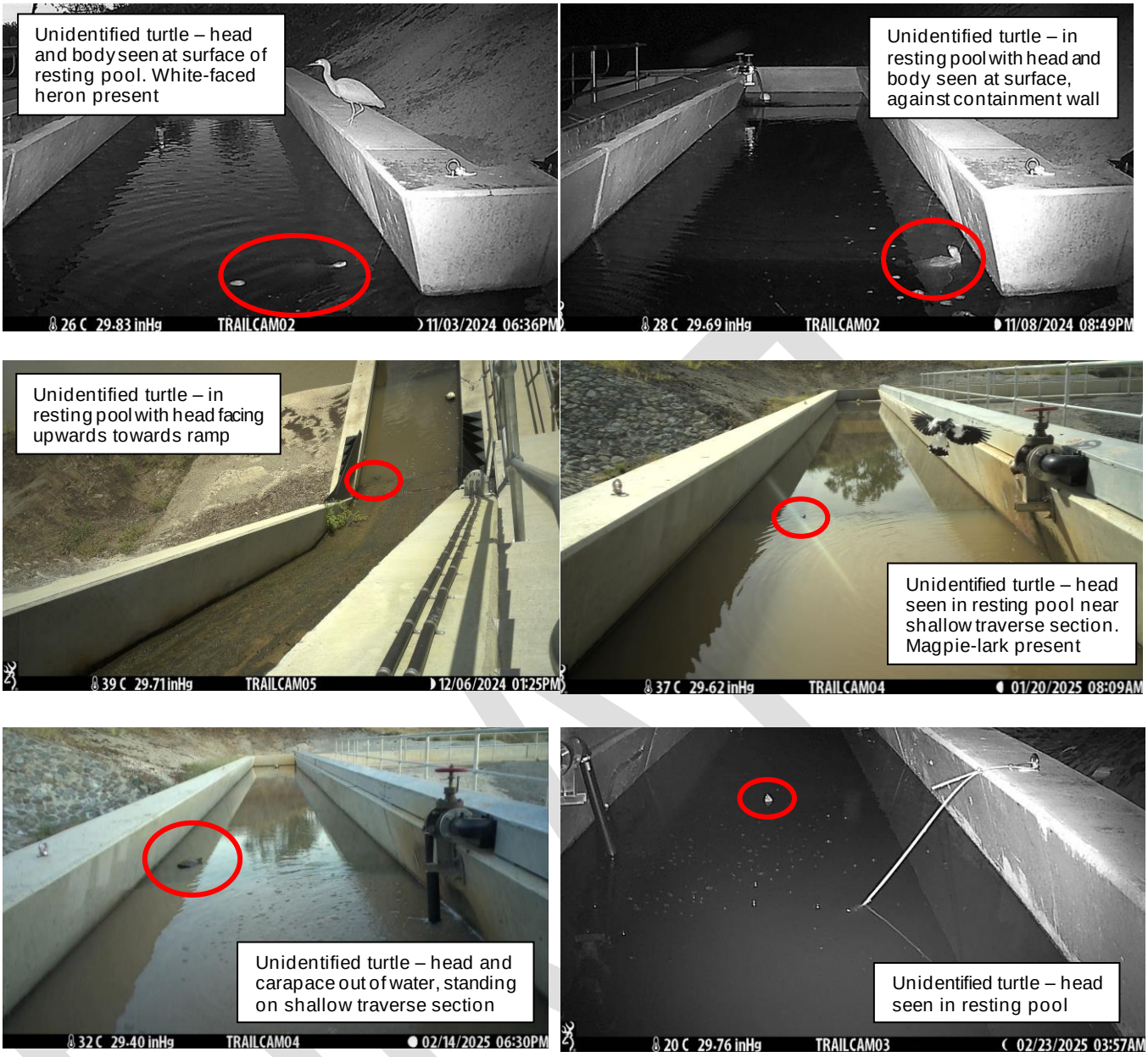

Plate 3.7 Turtles recorded via remote cameras (in chronological order)

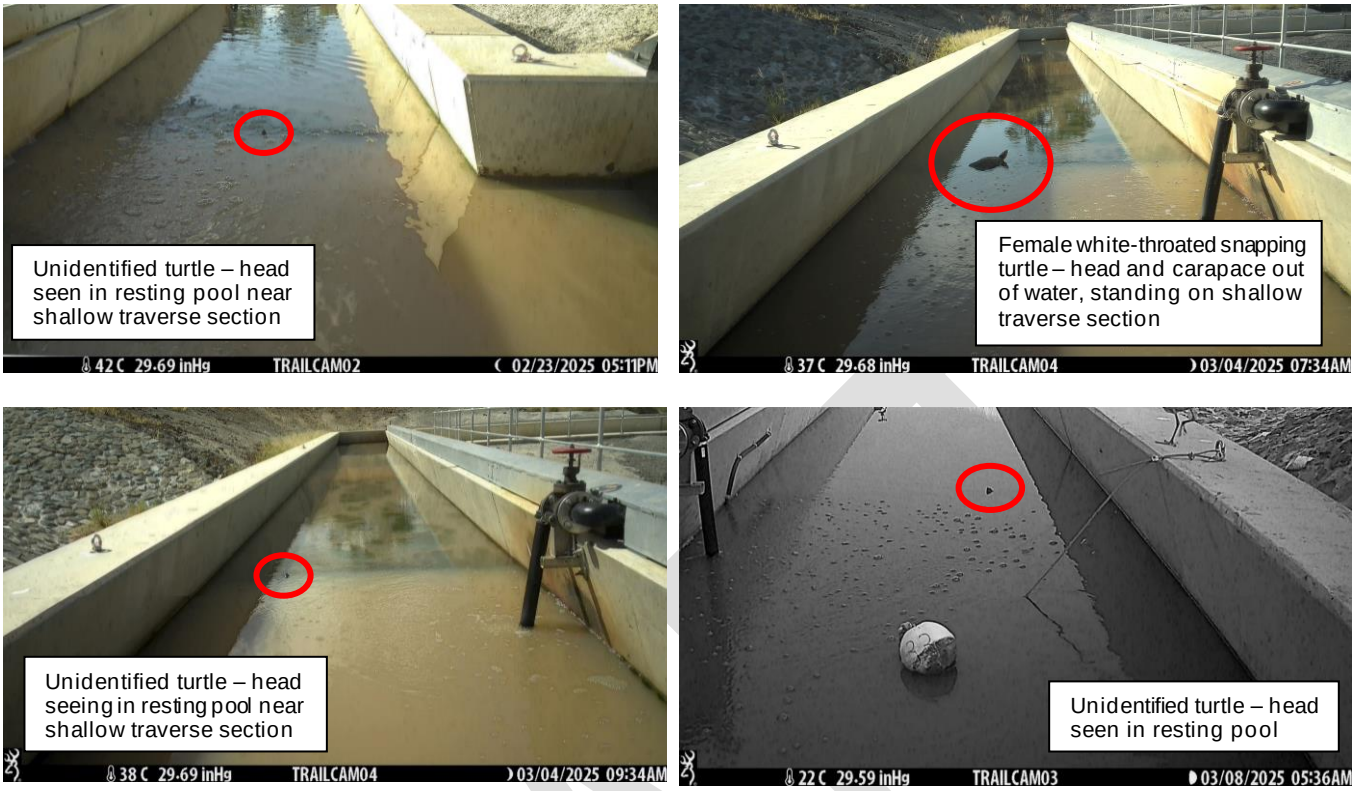

Plate 3.8 ***Turtles recorded via remote cameras (in chronological order, continued)***

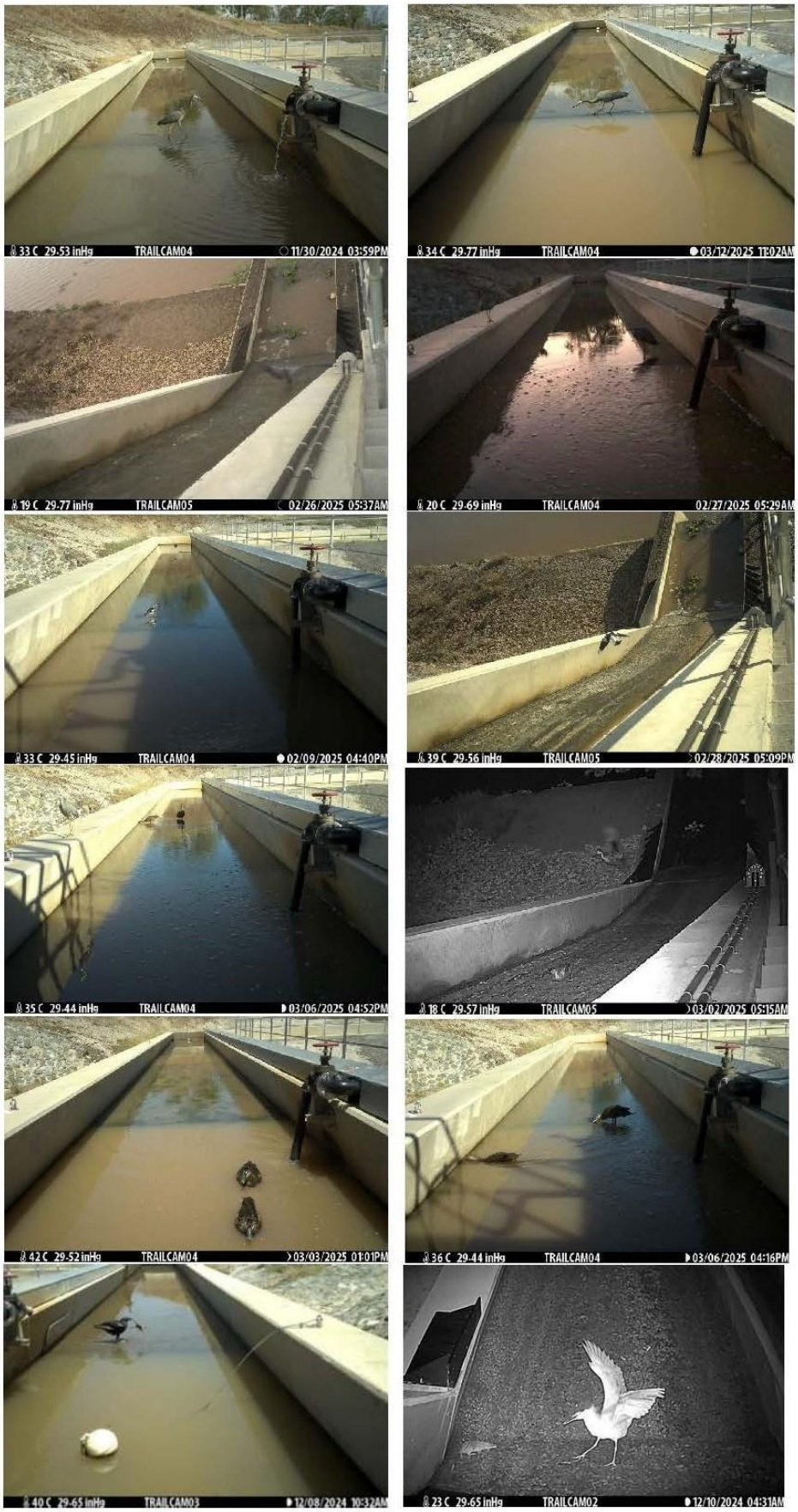

Plate 3.9 ***Additional fauna recorded on remote cameras – white-faced heron (top and second row), magpie lark (third row), Pacific black duck (fourth and fifth row), common crow (bottom left) and nankeen night-heron (bottom right)***

3.6 Operational inspections and observations

Completed turtle passage inspection, turtle observation, and turtle injury/mortality forms up to 15 May, 2025, are provided in Appendix C, Appendix D, and Appendix E, respectively. These were completed by a combination of Sunwater and GHD during operational inspections and field survey events. In Year 1 2024-25 of Rookwood Weir operations, these various forms were completed primarily by Sunwater, with GHD completing additional forms during turtle capture surveys.

3.6.1 Turtle passage inspections

A total of 12 turtle passage inspection forms were completed during Year 1 2024-25 of operational phase monitoring (Appendix C). Forms were completed between August 6, 2024 to May 9, 2025. Of these, 10 were completed by Sunwater monthly from August 2024 to May 2025, and two completed by GHD; once during each turtle capture survey (i.e. October/November 2024 and May 2025).

Draft note: Additional information required from operating conditions recorded monthly (?) by Sunwater, including:

- *Water levels and water quality within resting pools (currently only have data for two months, Jan and March 2025)*
- *Any noted presence of fish in turtle passage*
- *Presence/evidence of predatory birds or other predators (wild dogs)*
- *Build up of sediment and debris, and any maintenance undertaken to rectify this*
- *Condition of turtle monitoring equipment*

3.6.1.1 Flow depth and velocity

Flow depth and velocity were recorded for both ramp and resting pool sections of the upstream and downstream sides of the turtle passage infrastructure. After standardising units and averaging across all valid entries:

- Ramp sections were recorded with an average depth of ~0.022 m and an average flow velocity of ~1.26 m/s.
- Resting pool were sections were recorded with an average depth of ~0.39 m and an average flow velocity of ~0.045 m/s.

These values suggest the ramps consistently maintained sufficient flow velocities to stimulate directional movement, while the resting pools provide relatively low-flow environments appropriate for turtle resting behaviour. However, flow modifications have been made since the beginning of Year 1 2024-25.

Following October/November 2024 turtle capture survey and inspection of the turtle passage, the ramp's flow conditions were modified in line with recommendations by Dr Natalie Clark. While the design and operation of the ramp, as outlined in the approved Operations SMP, includes provision for a continuous small attraction flow, Dr Clark noted that flow levels were higher than necessary—particularly in the downstream ramps closer to the top of the turtle passage (i.e. near DSRP3 and DSRP4) and in all upstream ramps, and flows were too low on the first ramp leading to resting pool DSRP8. Modifications were made to reduce flow rates in these higher flow areas and improve flow at the ramp entrance to enhance turtle attraction. Additional adjustments were also made to submerge flow outlets in resting pools below the water surface to improve water quality and reduce surface splashing, which was suspected to be potentially deterring turtles based on operator observations. These changes reflect the experimental nature of the design and the need for ongoing adaptive management to meet monitoring success criteria.

From March 2025 onwards, flow velocity and depth were not recorded for the upstream passage in lower and middle sections (i.e. USRP4 to USRP5). This is likely due to inundation caused by overtopping of the weir during this period, which would have submerged these resting pools. The absence of readings and limited access noted in field forms suggests that standard survey points were either inaccessible or underwater during these inspections.

3.6.1.2 Condition of turtle passage infrastructure

Within resting pools, algal growth was a recurring feature across most inspections, typically described as moderate, filamentous, or clumpy (Plate 3.10). At the upstream approach channel, woody debris was present

intermittently, particularly in earlier inspections (August-December 2024), with water lettuce noted on several occasions (notably in September 2024, March 2025, April 2025, and May 2025). Silt accumulation at the bottom of resting pools was observed in multiple instances, including in USRP3 (October/November 2024; Plate 3.10) and USRP4 (May 2025). Turtle presence was confirmed during the May 2025 GHD inspection, with individuals observed in DSRP3 (see Section 3.2.1.2).

Ramp sections similarly had frequently observed algal buildup, particularly in April and May 2025, with growth up to 20 mm thick reported. Structural conditions were generally sound, though one inspection (GHD October/November 2024) noted ramp lips protruding into the flow and plant growth along the upstream side near USRP5 (Plate 3.10).

The abutment tunnel, which connects the upstream and downstream sections of the passage, consistently exhibited debris accumulation attributed to vehicle traffic crossing the surface grating above (Plate 3.10). While often deemed not obstructive to turtle movement, it was a regular observation. Algal growth and occasional plant presence were also recorded in the tunnel.

3.6.1.3 Maintenance requirements

Most inspections concluded that no immediate maintenance was required, although three forms recommended specific actions:

– October 2024 (GHD): Noted potential issues with ramp lips which impact flow and have the potential to cause injury to turtles (e.g. plastron scraping or impact damage to carapace) and vegetation overgrowth requiring attention
– March 2025 (Sunwater): Removal of water lettuce
– May 2025 (Sunwater): Suggested a “good flush out” due to observed debris and algal buildup.

Drafting note: Sunwater to provide information whether these have been completed.

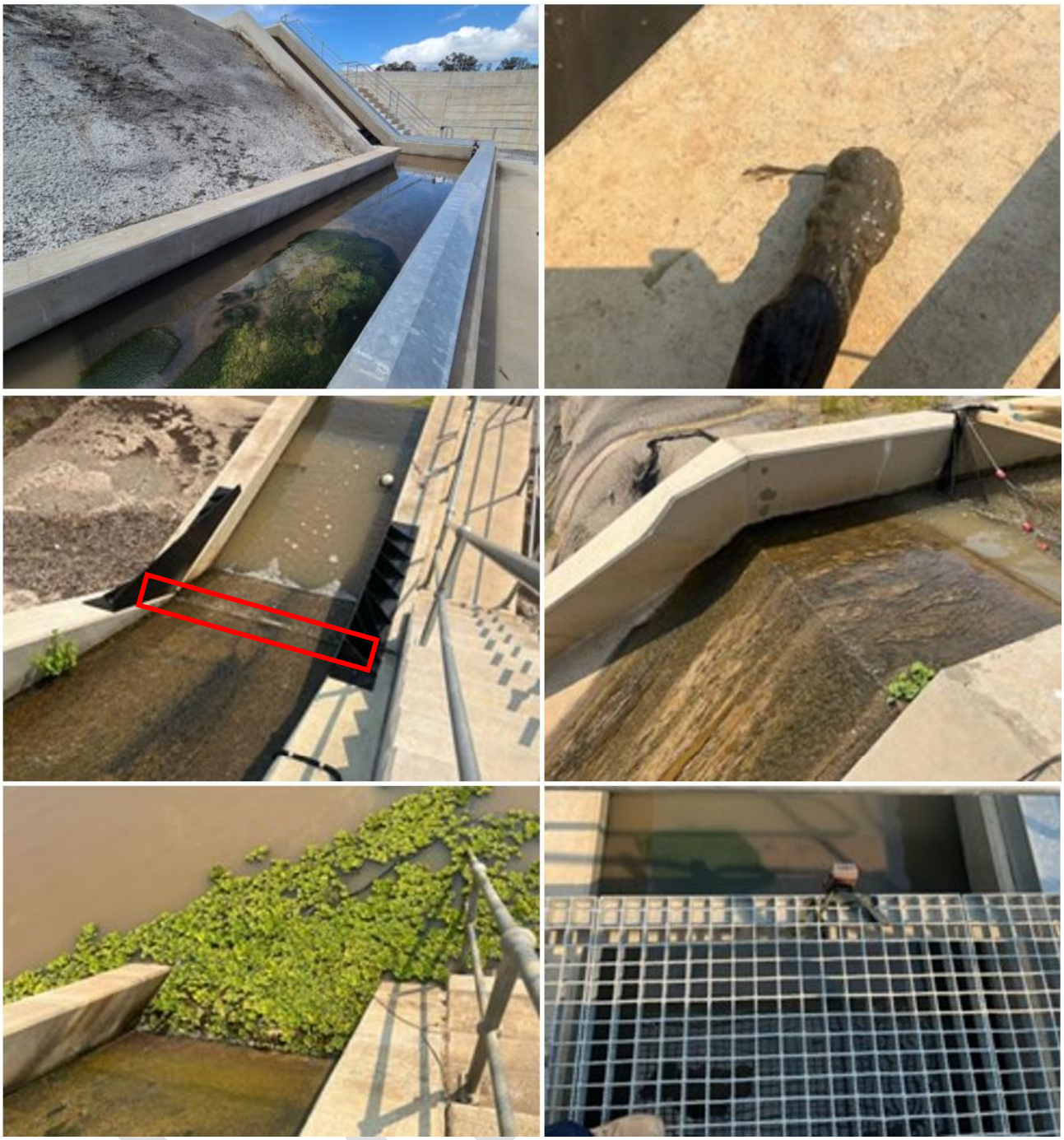

Plate 3.10 ***Algae adjacent to DSRP5 (top left); silt/algae found at the bottom of resting pool USRP3 (top right); lip protruding from the join on the ramp which may pose a risk to turtles (middle left), water lettuce and algae on ramp near DSRP8 (middle right), and at approach channel upstream (bottom left), accumulation of gravel/debris along abutment tunnel (bottom right)***

3.6.2 Turtle observations

A total of eight turtle observation forms were completed (Appendix D). Of these, three forms recorded between one and six turtles basking along the concreted left bank erosion protection downstream of Rookwood Weir (Plate 3.11). The remaining five forms recorded observations of turtles within the turtle passage (Plate 3.11). Of those observations within the turtle passage, a total of six turtles were observed using the turtle passage:

– Four turtles on the downstream side
– Two turtles on the upstream side.

Three of these turtles were recorded as possibly identified as Fitzroy River turtles, however, only one could be confidently identified. The one confirmed Fitzroy River turtle was observed by Sunwater on April 16, 2025, using the turtle passage, sheltering in a resting pool adjacent to the abutment tunnel on the upstream side of the passage (resting pools USRP1-3). Distinctive claw marks and trail was observed on the downstream side of the abutment suggesting this turtle was moving in an upstream direction and passed through the abutment tunnel. Observations were recorded between 3 July 2024 to 16 April 2025. No predation of turtles or falls were observed using these observation forms.

Draft note: Sunwater to provide an image of the observed Fitzroy River turtle for inclusion

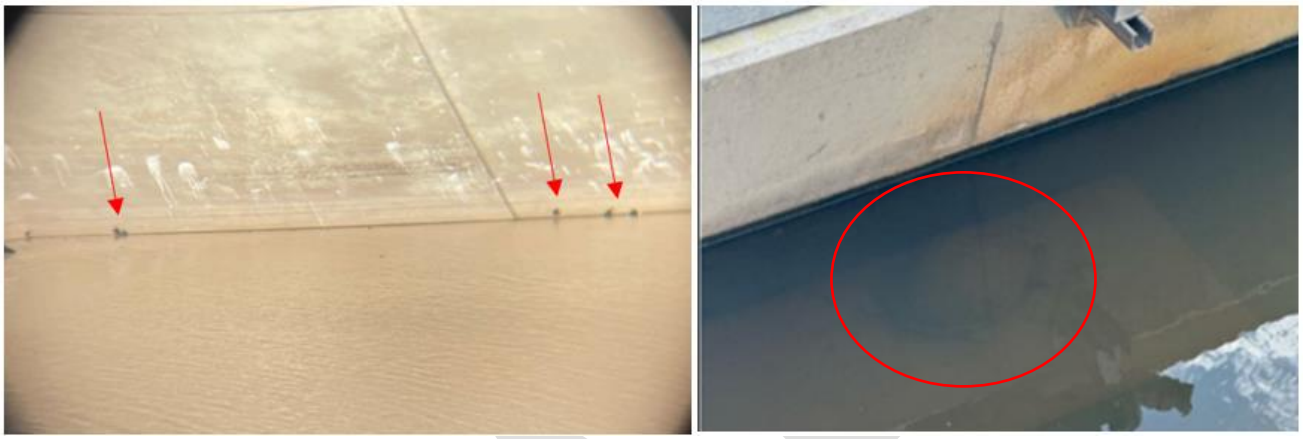

Plate 3.11 Reported turtle observations on left bank (left), turtle passage (right)

3.6.3 Turtle injury/mortality

One turtle injury/mortality form was completed by Sunwater on 14 November 2024 detailing the discovery of a deceased adult Fitzroy River turtle on the right bank downstream side of Rookwood Weir. The turtle was found in the advanced stages of decay, and the carcass was left i*n-situ* (Plate 3.12). Upon review of the submitted form by a suitably qualified person, it was identified that the turtle's carapace had sustained severe damage indicative of forceful contact with a hard structure. This, combined with the left arm and leg missing suggested predation of the turtle had occurred either before or after death. It is suspected that this Fitzroy River turtle was also left in the identified location by a predator.

Plate 3.12 Reported Fitzroy River turtle mortality

4. Compliance with success criteria

In accordance with Project approval conditions, the turtle passage infrastructure and turtle protection design features were monitored to assess effectiveness against the approved performance criteria (Section 1.2.2). This monitoring has formed part of the operations phase turtle monitoring program. Table 4.1 assesses whether the success criteria have been achieved through evidence (provided in Section 3) and whether the contingency program threshold has been triggered requiring corrective actions.

Table 4.1 Assessment of turtle movement information against the success criteria

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
Management strategy 1 – Turtle movement **Management strategy 2 – Turtle protection**			
1	75% of white-throated snapping turtles and Fitzroy River turtles that attempt to use the turtle passage each year for upstream passage will do so successfully.	**Success criteria partially achieved** – Six white-throated snapping turtles and two Fitzroy River turtle attempted to use the turtle passage between January 2024 and May 2025 – Of these, two white-throated snapping turtles and two Fitzroy River turtle were confirmed moving upstream through the turtle passage – This equates to 33% of white-throated snapping turtles and 100% of Fitzroy River turtles successfully using the turtle passage to move upstream of Rookwood Weir – The Fitzroy River turtles did not trigger the contingency program threshold, whereas, the white-throated snapping turtles did trigger corrective actions	**Yes** < 50% of white-throated snapping turtles that attempted to use the turtle passage successfully did so
2	Turtle monitoring downstream of the weir demonstrates no turtle injury/mortality during downstream turtle passage over the spillway, as evidenced by impact damage to turtles.	**Success criteria partially achieved** – One potential mortality associated with downstream movement of turtles over Rookwood Weir was recorded between January 2024 to March 2025. One deceased Fitzroy River turtle was recorded on the downstream side of the weir structure. It had sustained severe damage to the carapace which suggests contact with a hard structure – Minor damage including grazes to the carapace and/or the plastron, and small chips to the external margins of scutes were recorded on 13 of the 49 white-throated snapping turtles and four of the 16 Fitzroy River turtles which were captured within 500 m downstream of the weir – Major damage to the carapace was recorded for four of the 49 white-throated snapping turtles – Overall, during 2024-25, 35% of white-throated snapping turtles and 25% of Fitzroy River turtles showed signs of fresh or healed injuries. Compared to pre-construction levels, injury rates during operations were slightly higher for white-throated snapping turtles (28%) and slightly lower for Fitzroy River turtles (34%) – Of the major injuries 8% of the white-throated snapping turtles potentially had injuries indicative of impacts from the weir/turtle passage – None (0%) of the Fitzroy River turtle injuries were considered to be a result from impacts to the weir/turtle passage – As there were more than 5% of white-throated snapping turtles which were recorded with evidence of impact damage within 500 m downstream of the weir, corrective actions are triggered	**Yes** > 5% of turtles recorded within 500 m downstream of the weir within a 12-month period show evidence of impact damage (i.e. serious shell fractures)

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
3	The turtle passage remains operational (attraction flow is provided and passage unobstructed) continuously when the storage is above 8,000 ML up to a 1 in 5-year spilling event.	This success criterion is out of scope for the turtle movement study so is to be assessed by Sunwater	To be assessed by Sunwater
4	The turtle passage operates for one week after each four weeks of non-operation when the storage is below 8,000 ML.	This success criterion is out of scope for the turtle movement study so is to be assessed by Sunwater	To be assessed by Sunwater
5	75% of adult white-throated snapping turtles and Fitzroy River turtles recorded within 50 m of the turtle ramp and fishway entrances within a 12-month period are attracted to and can successfully locate the turtle passage entrance (as defined as entering the funnel-shaped ramp).	**Success criteria not achieved** – Six out of 18 white-throated snapping turtles and two out of 10 Fitzroy River turtles were recorded, captured or observed within or beyond the DSRP8 between January 2024 and May 2025 – This equates to 33% of white-throated snapping turtles and 20% of Fitzroy River turtles which were successfully attracted to and located the turtle passage entrance – However, data is currently limited to the hydrophone results as the remote cameras do not adequately capture turtle movements at the turtle passage entrance – A further eight unidentified turtle species were observed or photographed on the turtle passage	**Yes** < 50% of adult white-throated snapping turtles and Fitzroy River turtles recorded within 50 m of the turtle ramp and fishway entrances within a 12-month period, were attracted to and successfully located the turtle passage entrance
6	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can successfully ascend the ramp and pool arrangement to reach the abutment throughfare.	**Success criteria partially achieved** – Two out of six white-throated snapping turtles and two out of two Fitzroy River turtles were acoustically recorded and/or observed in the downstream upper resting pools (DSRP1-3) before the abutment thoroughfare between January 2024 and May 2025 – This equates to 33% of white-throated snapping turtles and 100% of Fitzroy River turtles which successfully ascended the ramp and resting pools to reach the abutment thoroughfare – The Fitzroy River turtles did not trigger the contingency program threshold, whereas, the white-throated snapping turtles did trigger corrective actions – Two other species of turtle, Krefft's River turtle and saw-shelled turtle, were captured within the downstream upper resting pools (DSRP1-3)	**Yes** < 50% of adult white-throated snapping turtles that attempted to use the turtle passage within a 12-month period, successfully ascended the ramp and pool arrangement to reach the abutment thoroughfare
7	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp within a 12-month period can	**Success criteria partially achieved** – Two out of six white-throated snapping turtles and two out of two Fitzroy River turtles were acoustically recorded and/or observed on both the downstream	**Yes** < 50% of adult white-throated snapping turtles that attempted to use the turtle passage within a 12-month

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
	successfully move through the abutment throughfare.	and the upstream side of the abutment thoroughfare between January 2024 and May 2025 indicating movement through the abutment tunnel – This equates to 33% of white-throated snapping turtles and 100% of Fitzroy River turtles which were successfully moved through the abutment thoroughfare – The Fitzroy River turtles did not trigger the contingency program threshold, whereas the white-throated snapping turtles did trigger corrective actions	period, successfully moved through the abutment thoroughfare
8	75% of adult white-throated snapping turtles and Fitzroy River turtles that attempt to use the ramp can successfully descend the turtle ramp from the abutment throughfare into the impoundment to complete passage past the weir.	**Success criteria partially achieved** – Two out of six white-throated snapping turtles and two out of two Fitzroy River turtles were acoustically recorded and/or observed moving in an upstream direction (Fitzroy River turtle) on the upstream side of the abutment thoroughfare between January 2024 and May 2025 – This equates to 33% of white-throated snapping turtles and 100% of Fitzroy River turtles which were successfully moved through the abutment thoroughfare – The Fitzroy River turtles did not trigger the contingency program threshold, whereas the white-throated snapping turtles did trigger corrective actions	**Yes** < 50% of adult white-throated snapping turtles that attempted to use the turtle passage within a 12-month period, successfully descend the turtle ramp from the abutment thoroughfare into the impoundment to complete passage past the weir
9	Turtle monitoring demonstrates no predation of turtles from within the turtle passage infrastructure.	**Success criteria achieved** – There was no predation or attempted predation of turtles observed/recorded on the turtle passage between January 2024 and May 2025. However, the dead Fitzroy River turtle found immediately downstream of the weir structure showed evidence of predation. Despite this, there is no available evidence for whether the predation occurred before or after death and if it occurred on the ramp	**No** < 5% of turtles recorded within the turtle ramp within a 12-month period are subject to predation or attempted predation
10	Turtle monitoring demonstrates no turtle injury and/or mortality from within the turtle passage as a result of falls.	**Success criteria achieved** – There was no mortality of turtles on the turtle passage as a result of falls observed or photographed between January 2024 and May 2025 – There was one Fitzroy River turtle which had fresh and healed grazes on the plastron. While it was not observed, this could indicate that this turtle had a fall down the ramp section – One Fitzroy River turtle was found deceased on the downstream side of the weir but external to the turtle passage. This turtle did not have evidence of fall injuries and is likely to have died from other (unknown) causes	**No** < 5% of turtles recorded within the turtle ramp within a 12-month period are observed falling within or from the turtle ramp resulting in serious turtle injury/mortality
11	The ratio of adult male and female white-throated snapping turtles and Fitzroy River turtles successfully moving upstream through the turtle ramp within a 12-month period is	**Success criteria partially achieved** – During pre-development a mean of four male and four female white-throated snapping turtles moved between hydrophones at the Rookwood Weir site – During operations, two male and zero female white-throated snapping turtles successfully moved upstream through the turtle passage	**Yes** The ratio of adult male to female turtles successfully utilising the turtle ramp from the entrance channel to the impoundment within a 12-month period is substantially different to pre-

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
	equivalent to pre-development ratios.	– Therefore, the male:female ratio is 1:1 (pre-construction) and 2:1 (operations) for the white-throated snapping turtles. This result suggests male white-throated snapping turtles are utilising the turtle passage more than females however the total number of turtles recorded using the turtle passage is too low to infer impacts at this stage – During pre-development a mean of nine male and five female Fitzroy River turtles moved between hydrophones at the Rookwood Weir site – During operations, zero male and one female Fitzroy River turtles successfully moved upstream through the turtle passage – Therefore, the male:female ratio is 9:5 (pre-construction) and 0:1 (operations) for the Fitzroy River turtles. However, the total number of turtles recorded using the turtle passage is too low to infer impacts at this stage – White-throated snapping turtles achieved the success criteria, whereas Fitzroy River turtles triggered the contingency program. However, it should be noted that there is still limited data availability from the operations phase so further monitoring will be required to confirm seasonal movements – This assessment has been based on limited data and therefore the ecological relevance of the results should be interpreted with caution	development ratios within a 12-month period
12	Seasonal variation in use of the turtle ramp by adult male and female white-throated snapping turtles and Fitzroy River turtles is equivalent to pre-development seasonal trends over a 12-month period	**Success criteria not achieved** – During pre-development, male white-throated snapping turtles predominantly moved upstream during September and October. During operations, two male white-throated snapping turtles moved upstream past Rookwood Weir in December 2024 and January 2025 – Seasonal movements upstream past Rookwood Weir for male white-throated snapping turtles during operations were slightly later, by approximately two months than during pre-construction – During pre-development, female white-throated snapping turtles typically moved upstream during January, March, May and June. During operations, there were no female white-throated snapping turtles recorded moving upstream through the turtle passage – During pre-development, male Fitzroy River turtles predominantly moved during June. During operations, there were no male Fitzroy River turtles recorded moving through the turtle passage – During pre-development, female Fitzroy River turtles typically moved upstream during September. During operations, one female Fitzroy River turtle moved through the turtle passage in May 2025 – Seasonal movements upstream past Rookwood Weir for female Fitzroy River turtles appeared to happen earlier (by approximately four months) during the operations phase than during pre-construction	**Yes** The seasonal use of the turtle ramp (measured by attempted use and successfully passage per month) by adult white-throated snapping turtles and Fitzroy River turtles is substantially different to pre-development seasonal trends in movement behaviour over a 12-month period

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
		– Both species triggered the contingency program threshold so corrective actions are required. However, it should be noted that there is still limited data availability from the operations phase so further monitoring will be required to confirm seasonal movements – This assessment has been based on limited data and therefore the ecological relevance of the results should be interpreted with caution	
13	Measurement of the turtle ramp attraction flow during inspections and turtle capture monitoring events indicates that the depth of water flow on the upstream ramp remains suitable for turtles to climb as per annual depth criteria	**Success criteria not achieved** – The mean water flow on the ramp turtle passage sections during inspections was 2.2 cm which is 2.8 cm less than the defined 5 cm of flow – The difference in flow depth is more than 25% which triggers corrective action – During the inspection in October/November 2024 it was note that the flow rate at the attraction funnel (Panel P1) may be too low and should be increased to increase attraction. Whereas the flow on the ramp sections (Panel P2 and Panel P3), was assessed to be possibly too high, however, more data is needed – The annual depth criterion of 5 cm of flow is not achievable based on the flow rates required to increase the flow depth to 5 cm. The high rate of flow would not be suitable for turtles to climb the ramps. An annual depth criterion of 2.5 cm would be more suitable	**Yes** Average water flow on the upstream ramp (as measured at three locations) is > 25% different to the annual depth criteria (initially defined as 5 cm of flow)
14	Over a 12-month period, habitat conditions within the resting pools remain suitable for adult white-throated snapping turtles and Fitzroy River turtles, as evidenced by achievement of suitable pool depth criteria, compliance with water quality objectives, and long-term availability of shelters	**Success criteria achieved** – The mean water depth in resting pools during inspections was 0.39 m which is 0.11 m less than the defined 0.5 m of water depth – However, the difference in water depth of the resting pools from the defined water depth is less than 25% – Water quality in the resting pools was similar to or better than the water quality of the Fitzroy River downstream and upstream of Rookwood Weir. – Whilst there was recorded algae on the surfaces of ramps and shallow section of the turtle passage, and sediment deposits in resting pools, overall conditions were considered suitable for turtles. It is unknown if algae buildup on ramps is beneficial or detrimental to turtle movement, and video footage would likely be required to discern any possible benefit/impact – Turbidity within the resting pools was marginally higher than the water quality guidelines but was lower than the pre-action baseline concentration – There was some silt deposition (<15 cm) in the lower resting pools (DSRP8 and USRP5) – There was also some build of algae within the resting pools and along the ramp	**No** Average habitat conditions within resting pools (as measured at three locations) is < 25% different to annual pool suitability criteria (initially defined as 0.50 m water depth, water quality equivalent to background levels (temperature, pH, dissolved oxygen, conductivity and turbidity compliant (±25%) with conditions within similar depth habitat upstream and/or downstream), and shelter is available/functioning)

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
		– Dissolved oxygen was marginally lower than the water quality guidelines. Overall, water quality conditions were still considered to be reasonable to support turtles – The shelters were available and in good condition for turtles to seek refuge – Overall, it is expected that habitat within the resting pools remain suitable for white-throated snapping turtles and Fitzroy River turtles	
15	Annual monitoring downstream of the weir trash screens and inlets indicates no entrapment or drowning of white-throated snapping turtles or Fitzroy River turtles.	**Success criteria achieved** – There has been no evidence of weir trash screens and inlets entrapping or drowning white-throated snapping turtles or Fitzroy River turtles – However, as the storage level of the weir pool was high (minimum of 60%), any evidence of turtle mortality (i.e. turtle shell remains) at the base of the intake/screens would not be visible – One deceased Fitzroy River turtle was recorded on the downstream side of the weir structure but the mortality was determined to not be the result of entrapment or drowning from the weir trash screens and inlets	**No** < 5% of turtles recorded within 500 m upstream and downstream of the weir within a 12-month period show evidence of entrapment/drowning on the weir trash screens or inlets
16	Monitoring of the fishway over a 12-month period indicates no injury/mortality of white-throated snapping turtles or Fitzroy River turtles occurred within the fishway complex.	**Success criteria achieved** – There has been no evidence of injury/mortality of white-throated snapping turtles or Fitzroy River turtles from the fishway complex – One deceased Fitzroy River turtle was recorded on the downstream side of the weir structure but the mortality was determined to not be the result of the fishway complex – There have been some injuries observed (see success criteria 2), however, these are unlikely to be the result of the fishway complex	**No** < 5% of the total number of turtles recorded within 500 m downstream of the fishway within a 12-month period show evidence of injury/mortality within the fishway or from fishway operation (as evidenced by entrapment/drowning within fishway and/or crushing injuries from gates)
17	At least 20 adult Fitzroy River turtles and white-throated snapping turtles recorded attempting to use the turtle passage within a 12-month period.	**Success criteria not achieved** – Six white-throated snapping turtles and one Fitzroy River turtle were recoded attempting to use the turtle passage which is less than the contingency threshold of 20 turtles	**Yes** Sampling sizes for the Fitzroy River turtles and white-throated snapping turtles are adequate to allow the success criteria to be assessed (i.e. < 20 turtles recorded using the turtle ramp within a 12-month period)
Management strategy 4 – Protection of habitat			
18	Suitable turtle habitat is present within, and/or upstream and/or downstream of Rookwood Weir.	**Success criteria achieved** – Suitable turtle habitat is present within the weir pool, and upstream and downstream of Rookwood Weir – Downstream, water quality was good, with exception of the downstream approach channel where dissolved oxygen was very low	**No** Turtles have been identified within the impoundment or within 1 km downstream. Turtles captured in these areas are not in a poorer health than those recorded during baseline

No.	Success Criteria	Outcome and evidence	Corrective action required & contingency program threshold
		– A suitable nesting bank is still present on the downstream left bank. The condition of this nesting bank improved following the flooding event in early April – Within the weir pool, water quality was typically good except for the slightly low dissolved oxygen concentration – Recruitment of white-throated snapping turtles and Krefft's river turtle was observed within the weir pool at Gogango Creek with the capture of one hatchling of each species – There were 11 white-throated snapping turtle and one Fitzroy River turtle acoustically recorded within the weir pool immediately upstream of the weir wall between January 2024 and May 2025 – 8 white-throated snapping turtles were captured within the weir pool immediately upstream of the weir wall during turtle capture field surveys. There are no suitable methods to capture Fitzroy River turtle – 29 white-throated snapping turtles and 15 Fitzroy River turtles were captured in Rookwood downstream pool and riffle during turtle capture field surveys – There was a slight increase (up by 7%) in the number of white-throated snapping turtles and slight decrease (down by 9%) of Fitzroy River turtles with minor grazes/chips to the carapace and plastron and eye damage compared with pre-construction – Overall, turtle health during operation is comparable to pre-construction levels	surveys (as measured by higher rates of injury/mortality/illness)

5. Corrective actions

If monitoring evidence indicates that the success criteria are not being met, as per the triggers and monitoring frequency outlined in the Rookwood Weir Operations SMP, corrective/contingency actions will be implemented. Table 5.1 discusses success criteria which were not achieved, the corrective action outlined in the Rookwood Weir Operations SMP, the recommended course of action and the timing of the response.

Table 5.1 Operations SMP corrective actions and recommendations to achieve success criteria

Success criteria no.	Operations SMP corrective action	Justification	Recommendation	Timeframe
Management strategy 1 – Turtle movement **Management strategy 2 – Turtle protection**				
1	If less than 50% of adult turtles that attempt to use the turtle passage in a 12-month period fails to successfully use the ramp, a catch and release program will be implemented as required until the criteria are met.	1. As this is Year 1 of implementing the operations phase monitoring, more data is required to assess this success criteria 2. Four species of turtle have been recorded using the turtle passage, including the upper pools 3. The placement, type and number of remote cameras have not allowed for detailed assessment of the species of turtles or behaviour of turtles on the turtle passage 4. The PIT tag readers have had technical difficulties throughout the year, so no turtle data has been captured from this method 5. While there has been an increase in the number of turtles acoustically detected downstream of the weir, this is likely correlated with the increase in deployment of acoustic tags in this area. The number of turtles captured and acoustically recorded downstream of Rookwood Weir does not indicate very larger numbers of turtles are aggregating below the weir and therefore a catch and release program is not considered to be required at this time	1. Sunwater to reassess the type, number and placement of remote cameras 2. Sunwater to confirm PIT tag readers are operating as expected 3. Continue to monitor turtle passage flows 4. Continue to monitor turtle behaviour through turtle capture, remote cameras, PIT tag readers and observations	As soon as practicable
2	If greater than 5% of turtles recorded within 500 m downstream of the weir within a 12-month period show evidence of impact damage (i.e., serious shell fractures), corrective actions will be developed based on identified cause of injury/mortality. Design options may include: – Install barrier arm/boom in front of trash/intake screens as adaptive management if monitoring indicates velocities cause risk of turtle injury/mortality – Add smooth surface finish (anti-graffiti paint) to prevent turtles climbing unsafe locations	– As per justification 1 above	– As per recommendations 1, 3 and 4 above	As soon as practicable

Success criteria no.	Operations SMP corrective action	Justification	Recommendation	Timeframe
	– Increase frequency of inspections and maintenance to clear debris			
5	If less than 50% adult white-throated snapping turtles and Fitzroy River turtles recorded within 50 m of the turtle ramp and fishway entrances within a 12-month period, are attracted to and can successfully locate the turtle passage entrance (as defined as entering the funnel shaped ramp), corrective actions will be developed and implemented. Options may include: – Add additional attraction in the form of a solar power water sprinkler (to provide auditory cue) and/or increase water volume/velocity attraction flow – Modify attraction channel (where possible in compliance with fishway requirements) to improve pathway/connectivity between downstream river channel and turtle passage infrastructure.	– As per justification 1, 3 and 5 above 6. Attraction flows have been modified throughout the year as the ramp funnel water flow was observed to be low, and the downstream upper ramps had flows which were too high. However, there is no camera footage to confirm the outcome of the adjustments 7. Pipes were attached to the outlets in the resting pools after observations from operators that turtles were observed to move out of pools when the pumps were turned off. The pipes were also added to improve flow circulation within the pools	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable
6	If less than 50% of adult turtles that attempt to use the turtle passage in a 12-month period fails to successfully ascend the ramp and pool arrangement to reach the abutment throughfare, corrective actions will be developed and implemented. Options may include: – Provide additional roughness to the turtle ramp to increase grip – Adjust volume/velocity of attraction flow and/or water depth/quality within resting pools – Add additional attraction in the form of a solar power water sprinkler to provide auditory cue – Provide additional shelters and/or other habitat features – Alternative solutions, such as the addition of intermittent resting pools and/or alteration of the concrete surface will be developed and implemented as required	– As per justification 1, 2, 3, 4 and 5 above 8. Suggested structural modifications to the turtle passage are not considered necessary at this time as the water depth and quality, and shelter in pools is considered sufficient 9. However, it is unknown if algae or flow on ramp is a benefit or impact to turtle passage as there is suitable camera footage of turtles on the ramp	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable
7	If less than 50% of adult turtles that attempt to use the turtle passage in a 12-month period fails to	– As per justification 1, 3, 4, 5, 8 and 9 above	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable

Success criteria no.	Operations SMP corrective action	Justification	Recommendation	Timeframe
	successfully move through the abutment throughfare, corrective actions will be developed and implemented. Options may include: – Modify design of mesh grid to increase natural light – Adjust volume/velocity of attraction flow and/or water depth/quality within resting pools – Add additional attraction in the form of a solar power water sprinkler to provide auditory cue – Provide additional shelters and/or another habitat features within abutment throughfare – Alternative solutions, such as the addition of intermittent resting pools and/or alteration of the concrete surface will be developed and implemented as required.	10. Three turtles (two white-throated snapping turtles and one Fitzroy River turtle) have been recorded moving in an upstream direction through the abutment tunnel		
8	If less than 50% of adult turtles that attempt to use the turtle passage in a 12-month period fails to successfully descend the turtle ramp from the abutment throughfare into the impoundment to complete passage past the weir, corrective actions will be developed and implemented. Options may include: – Adjust volume/velocity of attraction flow and/or water depth/quality within resting pools. – Add additional attraction in the form of a solar power water sprinkler to provide auditory cue. – Modify ramp substrate to improve grip. – Alternative solutions, such as the addition of intermittent resting pools and/or alteration of the concrete surface will be developed and implemented as required. – Provide additional shelters and/or other habitat features.	– As per justification 1, 3, 4, 5, 8 and 9 above 11. Three turtles (two white-throated snapping turtles and one Fitzroy River turtle) have been recorded moving in an upstream direction past Rookwood Weir, traveling through the abutment tunnel and successfully descending the ramp into the weir pool	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable
11	If the ratio of adult male to female turtles successfully utilising the turtle ramp from the entrance channel to the impoundment within a 12-month period is statistically significantly different to predevelopment ratios of turtles moving outside their home range within a 12-month period,	– As per justification 1, 3, 4 and 5 above 12. There is currently not enough data to conduct a statistical analysis	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable

Success criteria no.	Operations SMP corrective action	Justification	Recommendation	Timeframe
	corrective actions will be developed and implemented. Options will be based on the potential cause of noncompliance for each species (e.g., attraction to ramp, ascend ramp pool sequences, abutment throughfare, descend into impoundment).			
12	If seasonal use of the turtle ramp (measured by attempted use and successfully passage per month) by adult white-throated snapping turtles and Fitzroy River turtles is statistically different to predevelopment seasonal trends in movement behaviour over a 12-month period, corrective actions will be developed and implemented. Options may include: – Adjust volume/velocity of attraction flow during varying headwater and tailwater conditions. – Add additional attraction in the form of a solar power water sprinkler to provide auditory cue for ramp entrance at varying headwater and tailwater levels. – Adjust water supply and modify shelters and/or other habitat features to control environmental conditions within turtle passage infrastructure.	– As per justification 1, 3, 4, 5, 8 and 12 above	– As per recommendations 1, 2, 3 and 4 above	As soon as practicable
13	If average water flow on the upstream ramp (as measured at three locations) is greater than 25% different to the annual depth criteria (initially defined as 5 cm of flow) to be refined and set after each 12 months of monitoring), corrective actions will be developed and implemented. Options may include: – Adjust volume/velocity of attraction flow: Globe values and SCADA to be adjusted as per Rookwood Weir Operation and Maintenance Plan, to maintain required discharge and height of flow over the ramps and pools. Discharge to be initially set to achieve 5-15 mm of flow over the ramps and pools. Target discharge and height to be informed by results of the turtle passage infrastructure monitoring. – Modify ramp substrate to improve grip.	– As per justification 1, 3, 6, 7 and 8 above	– As per recommendations 1, 3 and 4 above	As soon as practicable

Success criteria no.	Operations SMP corrective action	Justification	Recommendation	Timeframe
	– Completion of maintenance/repair actions to restore operation as soon as possible.			
17	If sampling sizes for the Fitzroy River turtles and white-throated snapping turtles are too low to allow the success criteria to be assessed (less than 20 turtles recorded using the turtle ramp within a 12-month period), corrective actions will be implemented and may include: – Expansion of the Turtle Movement Study to include monitoring of the common Krefft's River turtle (*Emydura macquarii krefftii*). Data from the Krefft's river turtle would then be used to infer suitability of ramp for the threatened species. Initially, monitoring via PIT tags readers, cameras, turtle capture surveys, observations and inspections to occur following the first year of non-compliance. Inclusion of acoustic tags to be considered following the second consecutive year of non-compliance. – Artificial experimentation involving the relocation of tagged turtles from upstream of the Weir to the downstream entrance of the turtle passage and/or to within the turtle passage to obtain results on the physical suitability of the turtle passage for the Fitzroy River turtles and white-throated snapping turtles.	– As per justification 1 above 13. The catch rates of white-throated snapping turtles has been relatively high since operations began (51 white-throated snapping turtles added to the array in Year 1), meaning the number of this target species on the array has substantially increased recently. It is expected that there will be an increase in number of recorded turtles using the turtle passage in Year 2 14. The catch rates of Fitzroy River turtles has remained consistent throughout the turtle monitoring study with higher catch rates expected in the future as flow conditions become more predictable to allow efficient trapping 15. Expansion of the turtle movement study to include Krefft's river turtle or artificial experimentation is not recommended at this time	5. Continue with the turtle capture program and re-assess at the conclusion of Year 2	As soon as practicable

6. Conclusions and recommendations

As required by Project approval conditions, the results of the operations phase monitoring were assessed against 18 success criteria developed for the protection of turtles, turtle movement and habitat. Of the success criteria assessed, six were achieved, six were partially achieved and four were not achieved in Year 1 2024-25 of Rookwood Weir operations. The success criteria which were not achieved were primarily related to percentage and/or number of turtles successfully using the turtle passage. Corrective actions were recommended for ten success criteria; those that were either not achieved or partially achieved. The key assessment findings included:

- Both the white-throated snapping turtle and Fitzroy River turtles were confirmed successfully ascending the turtle passage ramp and pools sections, moving through the abutment tunnel and descending into the weir pool to successfully move upstream pass Rookwood Weir. However, the number of turtles that successfully moved upstream past the weir was low in relation to those recorded partially utilising the turtle ramp. The number of turtles attracted to the turtle passage entrance was also higher than the number of turtles locating and ascending the turtle passage. Overall, the number of turtles utilising the turtle passage was too low to assess seasonal and sex-related differences in movements.
- There was no evidence of predation of turtles within the turtle passage however, monitoring indicates the weir and/or turtle passage has increased the rate of minor and major injuries in the white-throated snapping turtle and there was one mortality of a Fitzroy River turtle as a result of major shell damage (and potentially predation following death). There was no evidence of turtle injury/mortality associated with the weir trash screens, inlets or fishway.
- Overall, habitat conditions within the turtle passage were suitable for turtles however, the small attraction flow at the funnel shaped entrance, high velocity flow on the ramp sections, algae growth, and sediment build up within resting pools were identified as having potential to impact turtle movement and/or habitat suitability.
- Suitable habitat for white-throated snapping turtle and Fitzroy River turtles remains present within, upstream and downstream of Rookwood Weir. Both species were confirmed present with the Rookwood Weir impoundment although, number of turtles captured and detected by the acoustic hydrophones was lower upstream of the weir than downstream. The distribution of turtles recorded by the acoustic hydrophones has constricted since the start of weir operations with the majority of turtles now located immediately upstream and downstream of Rookwood Weir. The mean monthly home range size of female white-throated snapping turtles has reduced since weir operations. Suitable nesting habitat with confirmed evidence of nesting was observed on the left bank immediately downstream of Rookwood Weir and at Hanrahan Crossing. The capture of two hatchling turtles (one white-throated snapping turtle and one Krefft's river turtle) at Gogango Creek indicates nesting of these species may have occurred within the Rookwood Weir pool since initial impoundment.

Ten success criteria were not achieved or only partially achieved in Year 1 2024-25, with all meeting the threshold for corrective action. However, practical and technical difficulties with monitoring equipment limited the information available for assessment and as such, it is recommended that more data is obtained to accurately access compliance with success criteria before corrective actions are initiated. Recommendations for improvement are proposed below for implementation in Year 2 2025-26.

To adequately assess the success criteria for the turtle passage the following recommendations should be implemented:

- The placement, type and number of remote cameras are to be reviewed and modified to allow continuous monitoring of turtle behaviour along the full length of the turtle passage
- The PIT tag readers within the turtle passage are to be reviewed to confirm they are operating as intended and repaired if required
- Continue to monitor turtle passage conditions and conduct maintenance / repairs as required
- Identify additional suitable capture locations within the weir pool to improve upstream turtle monitoring
- Standardisation of *in-situ* water quality measurements and assessments as results differed between Sunwater and GHD.

7. References

Bureau of Meteorology (BOM) (2024). Service Level Specification for Flood Forecasting and Warning Services for Queensland – Version 3.6. Available at http://www.bom.gov.au/qld/flood/brochures/QLD_SLS_current.pdf

Bureau of Meteorology (BOM) (2025). Long-range weather and climate. www.bom.gov.au/climate/. Accessed May 2025.

Campbell, H.A., Watts, M.E., Dwyer, R.G., and Franklin, C.E. (2012). V-Track: software for analysing and visualising animal movement from acoustic telemetry detections. *Marine and Freshwater Research*, 63: 815-820.

Cann, J., and Sadler, R. (2017). *Freshwater turtles of Australia*. CSIRO Publishing.

Clark, N.J., Gordos, M.A. and Franklin, C.E. (2008). Diving behaviour, aquatic respiration and blood respiratory properties: a comparison of hatchling and juvenile Australian turtles. *Journal of Zoology*, 275: 399-406.

Commonwealth of Australia (CoA) (2020) The National Recovery Plan for the White-throated Snapping Turtle (*Elseya albagula*), Commonwealth of Australia 2020.

Department of Environment and Science (2018). *Monitoring and Sampling Manual*: *Environmental Protection (Water) Policy 2009*. Available at https://environment.desi.qld.gov.au/__data/assets/pdf_file/0031/89914/monitoring-sampling-manual-2018.pdf

Department of Regional Development, Manufacturing and Water – Queensland Government (DRDMW) (2025). Water Monitoring Information Portal. https://water-monitoring.information.qld.gov.au/ . Accessed May 2025.

GHD (2017). Lower Fitzroy River Infrastructure Project: Turtle Movement Study Project Planning and Design Phase. Report prepared for Gladstone Area Water Board.

GHD (2022). Rookwood Weir – Turtle Movement Study – Annual Report 2021 – RWW-GHD-ENV-RP-0022. Prepared for Sunwater Limited.

GHD (2023). Rookwood Weir – Operations Species Management Plan RWW-GHD-ENV-MP-003. Prepared for Sunwater Limited.

GHD (2024). Rookwood Weir – 2023 Turtle Movement Study – Annual Report. Prepared for Sunwater Limited.

Gordos, M.A., Franklin, C.E. and Limpus, C.J. (2003). Seasonal changes in the diving performance of the bimodally respiring freshwater turtle *Rheodytes leukops* in a natural setting. *Canadian Journal of Zoology*, 81: 617-625.

Gordos, M.A., Hamann, M., Schauble, C.S., Limpus, C.J. and Franklin, C.E. (2007). Diving behaviour of *Elseya albagula* from a naturally flowing and hydrologically altered habitat. *Journal of Zoology*, 272: 458-469.

Hamann, M., Schauble, C.S., Limpus, D.J., Emerick, S.P. and Limpus, C.J. (2007). Management plan for the conservation of *Elseya* sp. (Burnett River) in the Burnett River Catchment. Report prepared for the Queensland Environmental Protection Agency.

Hollier, C (2010). The effect of different water release volumes on the survival of incubating eggs of *Elseya albagula*, Central Queensland, Australia, Honours thesis, University of Melbourne.

Horne, J.S., Garton, E.O., Krone, S.M. and Lewis, J.S. (2007). Analyzing animal movements using brownian bridge. *Ecology*, 88(9): 2354-63.

Limpus, C.J., Limpus, D.J., Parmenter, C.J., Hodge, J., Forrest, M.J. and McLachlan, J. (2007). Proposal for raising Eden Bann Weir and construction of Rookwood Weir – an assessment of the potential implications and mitigation measures for Fitzroy Turtles. Commercial in confidence report prepared for Department of Infrastructure, Queensland.

Limpus, C.J., Limpus, D.J., Parmenter, C.J., Hodge, J., Forrest, M.J., and McLachlan, J. (2011a). The biology and management strategies for freshwater turtles in the Fitzroy Catchment, with particular emphasis on *Elseya albagula* and *Rheodytes leukops* – a study initiated in response to the proposed construction of Rookwood Weir and the raising of Eden Bann Weir. Department of Environment and Resource Management, Queensland Government.

Limpus, C.J., Limpus, D.J., Hollier, C., Savige, M., McAllister, D. (2011b). Survey of Freshwater turtle populations and nesting habitat, Tartrus Weir Turtleway Project. September – December 2011. Brisbane Department of Environment and Heritage Protection, Queensland Government.

Mathie, N.J. and Franklin, C.E. (2006). The influence of body size on the diving behaviour and physiology of the bimodally respiring turtle *Elseya albagula*, *Journal of Comparative Physiology B*, 176: 739-747.

McDougall, A.J., Espinoza, T., Hollier, C., Limpus, D.J. and Limpus, C.J. (2015). A risk assessment approach to manage inundation of *Elseya albagula* nests in impounded waters: a win-win-situation? *Environmental Management*, 55: 715-724.

Micheli-Campbell, M.A., Connell, M.J., Dwyer, R. and Franklin, C.E., Fry, B., Kennard, M., Tao, J. and Campbell, H.A. (2017). Identifying critical habitat for freshwater turtles: integrating long-term monitoring tools to enhance conservation and management. *Biodiversity Conservation*, 26(3): 1675-1688.

Priest, T. (1997). Bimodal respiration and diving behaviour of the Fitzroy River turtle *Rheodytes leukops*. BSc Honours Thesis. The University of Queensland. Brisbane.

Priest, T.E. and Franklin, C.E. (2002). Effects of water temperature and oxygen levels on the diving behaviour of two freshwater turtles: *Rheodytes leukops* and *Emydura macquarii*. *Journal of Herpetology*, 36: 55-561.

R Core Team (2025). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/.

Rogers, V.M. (2001). Dietary ecology including dietary resource partitioning of four sympatric species of chelid turtle in a tributary of the Fitzroy River, central Queensland. BSc. (Honours) thesis, Central Queensland University, Rockhampton, Queensland.

State of Queensland 2013. Environmental Protection (Water) Policy – scheduled Environmental Values and Water Quality Objectives for Fitzroy Basin waters. Queensland Government, Brisbane QLD, Australia. Available at https://environment.des.qld.gov.au/water/policy/fitzroy-basin.html

Sunwater Limited (2024). Lower Fitzroy Water Quality Monitoring and Reporting Program. Available at https://www.sunwater.com.au/wp-content/uploads/Home/Projects/Rookwood/Water_Quality_Monitoring_and_Reporting_Program.pdf

Thomson, S., Georges, A. and Limpus, C.J. (2006). A new species of freshwater turtle in the genus *Elseya* (Testudines: Chelidae) from Central Coastal Queensland, Australia. *Chelonian Conservation and Biology*, 5: 74-86.

Tucker, A.D., Limpus, C.A., Priest, T.E., Cay, J., Glen, C. and Guarino, E. (2001). Home ranges of Fitzroy River turtles (*Rheodytes leukops*) overlap riffle zones: potential concerns related to river regulation. *Biological Conservation*, 102: 171-181.

Tunuba (2025). 2025 Annual Nest Protection Plan. Prepared for Sunwater Limited.

Udyawer, V., Dwyer, R.G., Hoenner, X., Babcock, R.C., Brodie, S., Campbell, H.A., Harcourt, R.G., Huveneers, C., Jaine, F.R.A., Simpfendorfer, C.A., Taylor, M.D. and Heupel, M.R. (2018). A standardised framework for analysing animal detections from automated tracking arrays. *Animal Biotelemetry*, 6: 17.

Appendices

Appendix A

Curricula Vitae

Appendix B

In-situ water quality results

Table 7.1 Raw in-situ water quality results from Year 1 2024-25

Event	Site	Date	Depth (m)	Temperature (°C)	Electrical conductivity (µS/cm)	pH	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU) (FNU for Sunwater samples)
Pre-Action Baseline for Fitzroy River catchment – Sunwater Water Quality Monitoring and Reporting Program (Sunwater Limited 2024) (75th%ile unless indicated as a range)					269	7.3-8.4	89-101%	-	190.5
EPP Water Quality Objectives for Fitzroy River Sub-basin – fresh waters[1]					<445 µS/cm (base flow) <250 µS/cm (high flow)	6.5-8.5	85-110%	-	<50 NTU
EPP Water Quality Objectives for Fitzroy Sub-basin – freshwater lakes/reservoirs[2]					<250 µS/cm (no flow/base flow)	6.5-8.0	90-110%	-	1-20 NTU
Hydrophone survey Sep 2024	Hanrahan pool[1]	24/09/2024	0.1	22.2	191	7.9	87.6	7.6	96
	Downstream approach channel[1]	24/09/2024	0.1	20.8	218	7.7	68.4	6.2	90
	The Pocket upstream[2]	25/09/2024	0.1	22.4	152	7.1	61.0	5.3	97
	Upstream approach channel[2]	26/09/2024	0.1	20.6	147	7.3	79.0	7.1	147
Turtle capture survey Oct/Nov 2024	DSRP8	30/10/2024	0.1	19.9	167	8.1	96.1	8.8	55.1
	Downstream approach channel[1]	30/10/2024	0.1	20.4	163	7.3	74.1	6.7	62.0
	Weir discharge pool[1]	30/10/2024	0.1	20.5	163	7.1	22.1	2.0	-
	Rookwood Weir pool – at Rookwood Camping Reserve[2]	31/10/2024	0.1	24.2	160	7.4	64.3	5.4	79.3
	Rookwood Weir pool – at Rookwood Camping Reserve[2]	31/10/2024	3.0	22.7	155	7.0	27.1	2.4	-
	Rookwood downstream pool[1]	01/11/2024	0.1	21.5	166	7.3	76.2	6.7	63.3
	Downstream approach channel[1]	04/11/2024	0.1	19.0	165	7.3	93.2	8.7	44.0
	Rookwood downstream pool[1]	04/11/2024	0.1	19.3	165	7.2	92.8	8.6	45.6
	Rookwood riffle[1]	04/11/2024	0.1	19.3	165	7.2	88.0	8.1	46.9
	Foleyvale crossing[1]	05/11/2024	0.1	30.4	253	9.7	145.5	10.5	24.2

Event	Site	Date	Depth (m)	Temperature (°C)	Electrical conductivity (µS/cm)	pH	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU) (FNU for Sunwater samples)
Pre-Action Baseline for Fitzroy River catchment – Sunwater Water Quality Monitoring and Reporting Program (Sunwater Limited 2024) (75th%ile unless indicated as a range)					269	7.3-8.4	89-101%	-	190.5
EPP Water Quality Objectives for Fitzroy River Sub-basin – fresh waters[1]					<445 µS/cm (base flow) <250 µS/cm (high flow)	6.5-8.5	85-110%	-	<50 NTU
EPP Water Quality Objectives for Fitzroy Sub-basin – freshwater lakes/reservoirs[2]					<250 µS/cm (no flow/base flow)	6.5-8.0	90-110%	-	1-20 NTU
Hydrophone survey Dec 2024	Hanrahan pool[1]	10/12/2024	0.1	29.4	203	7.5	81.0	6.2	30.8
	Lawries bend upstream[1]	10/12/2024	0.1	27.2	192	7.2	77.1	6.1	36.0
	Stilling basin[2]	11/12/2024	0.1	27.0	186	7.2	60.6	4.7	48.7
	The Pocket upstream[2]	11/12/2024	0.1	29.9	196	7.6	90.6	6.8	55.5
	Rookwood Weir (hydrophone)[2]	12/12/2024	0.1	23.9	180	7.1	71.0	6.0	38.4
	Downstream approach channel[1]	12/12/2024	0.1	24.0	182	7.1	79.9	6.7	36.2
	DSRP8[1]	12/12/2024	0.1	22.6	179	7.7	105.6	9.0	29.8
	Upstream approach channel[2]	12/12/2024	0.1	29.6	198	7.5	91.3	6.8	52.1
Hydrophone survey Mar 2025	Hanrahan pool[1]	5/03/2025	0.3	28.7	211	7.4	83.4	6.4	103
	Downstream approach channel[1]	4/03/2025	0.3	27.6	209	7.4	80.6	6.3	104
	DSRP8[1]	4/03/2025	0.3	27.2	203	8	83.4	6.7	100
	Upstream approach channel[2]	4/03/2025	0.3	27.9	206	7.1	39.1	3	104
	USRP5[1]	4/03/2025	0.3	27.7	205	7.7	94.2	7.4	105
	Gogango creek[2]	4/03/2025	0.3	29.3	212	7.3	77.4	5.9	102
Turtle capture survey May 2025	Hanrahan crossing[1]	05/05/2025	0.1	23.0	242	7.4	105.6	9.1	90.9
	Hanrahan crossing[1]	06/05/2025	0.1	22.8	229	7.5	85.8	7.5	90.7
	Downstream approach channel[1]	08/05/2025	0.1	22.7	219	7.5	99.4	8.6	88.3

Event	Site	Date	Depth (m)	Temperature (°C)	Electrical conductivity (µS/cm)	pH	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU) (FNU for Sunwater samples)
Pre-Action Baseline for Fitzroy River catchment – Sunwater Water Quality Monitoring and Reporting Program (Sunwater Limited 2024) (75th%ile unless indicated as a range)					269	7.3-8.4	89-101%	-	190.5
EPP Water Quality Objectives for Fitzroy River Sub-basin – fresh waters[1]					<445 µS/cm (base flow) <250 µS/cm (high flow)	6.5-8.5	85-110%	-	<50 NTU
EPP Water Quality Objectives for Fitzroy Sub-basin – freshwater lakes/reservoirs[2]					<250 µS/cm (no flow/base flow)	6.5-8.0	90-110%	-	1-20 NTU
	Riffle directly downstream of weir	08/05/2025	0.1	22.7	219	7.5	101.0	8.7	85.5
	Downstream approach channel[1]	08/05/2025	0.1	23.7	227	7.5	100.5	8.5	87.0
	Rookwood Weir pool – at Rookwood Camping Reserve[2]	11/05/2025	0.1	22.4	224	7.1	44.1	3.8	86.6
	Rookwood riffle[1]	11/05/2025	0.1	22.4	223	7.5	99.9	8.7	85.3
	Rookwood Weir pool – at Rookwood Camping Reserve[2]	13/05/2025	0.1	22.5	227	7.0	61.8	5.4	92.4
	Downstream approach channel[1]	13/05/2025	0.1	24.4	254	7.8	101.3	8.5	81.1
	DSRP8[2]	13/05/2025	0.1	24.5	226	8.4	100.9	8.4	78.4
	DSRP7[2]	13/05/2025	0.1	24.3	232	8.1	102.4	8.6	78.7
	DSRP2[2]	13/05/2025	0.1	23.1	228	7.1	49.0	4.2	72.2
	USRP2[2]	13/05/2025	0.1	23.5	230	7.2	67.2	5.7	78.5
	USRP5[2]	13/05/2025	0.1	24.3	232	8.2	100.7	8.4	73.8
	Upstream approach channel[2]	13/05/2025	0.1	25.4	240	7.2	70.2	5.7	76.5
Sunwater sampling January 2025	DSRP8[2]	15/01/2025	0.385	22.39	192	7.31	95.8	8.31	84.07
	DSRP7[2]	15/01/2025	0.193	21.734	190.6	7.3	53.2	4.67	49.62
	DSRP6[2]	15/01/2025	0.135	24.515	195.7	7.21	49.8	4.15	340.23
	DSRP5[2]	15/01/2025	0.426	28.088	169.1	6.98	3.5	0.27	570.23
	DSRP4[2]	15/01/2025	0.441	28.05	166.4	7.43	18.9	1.48	92.67

Event	Site	Date	Depth (m)	Temperature (°C)	Electrical conductivity (µS/cm)	pH	Dissolved oxygen (% saturation)	Dissolved oxygen (mg/L)	Turbidity (NTU) (FNU for Sunwater samples)
Pre-Action Baseline for Fitzroy River catchment – Sunwater Water Quality Monitoring and Reporting Program (Sunwater Limited 2024) (75th%ile unless indicated as a range)					269	7.3-8.4	89-101%	-	190.5
EPP Water Quality Objectives for Fitzroy River Sub-basin – fresh waters[1]					<445 µS/cm (base flow) <250 µS/cm (high flow)	6.5-8.5	85-110%	-	<50 NTU
EPP Water Quality Objectives for Fitzroy Sub-basin – freshwater lakes/reservoirs[2]					<250 µS/cm (no flow/base flow)	6.5-8.0	90-110%	-	1-20 NTU
	DSRP3[2]	15/01/2025	0.125	27.843	207.6	7.67	12.5	0.98	1205.31
	DSRP2[2]	15/01/2025	0.298	25.804	206.8	7.64	61.2	4.98	978.72
	DSRP1[2]	15/01/2025	0.159	25.614	207.3	7.28	60.5	4.94	161.3
	USRP5[2]	15/01/2025	0.172	24.959	202.1	7.44	8.7	0.72	432.29
	USRP4[2]	15/01/2025	0.247	23.688	200.4	6.97	21.6	1.83	340.9
	USRP3[2]	15/01/2025	0.173	23.782	194.4	6.89	61.3	5.18	89.33
	USRP2[2]	15/01/2025	0.211	26.254	216.3	7.12	18.2	1.47	149.12
	USRP1[2]	15/01/2025	0.176	26.433	212.7	7.34	72.9	5.86	249.95
Sunwater sampling March 2025	DSRP8[2]	12/03/2025	0.396	26.337	201.8	7.43	97.8	7.88	94.73
	DSRP7[2]	12/03/2025	0.143	26.522	201.3	7.44	97.1	7.8	98.26
	DSRP6[2]	12/03/2025	0.206	26.768	208.1	7.04	59.2	4.73	100.25
	DSRP5[2]	12/03/2025	0.206	26.77	208.1	7.04	59	4.72	100.31
	DSRP4[2]	12/03/2025	0.367	26.76	208.4	7.03	56.1	4.48	96.96
	DSRP3[2]	12/03/2025	0.298	25.953	206.3	6.97	27.5	2.23	97.37
	DSRP2[2]	12/03/2025	0.28	26.667	207.6	6.84	54.8	4.39	98.99
	DSRP1[2]	12/03/2025	0.214	26.52	207.3	6.85	57.2	4.59	206.55
	USRP5[2]	12/03/2025	0.317	26.541	207.1	6.95	54.4	4.37	134.05
	USRP4[2]	12/03/2025	0.379	26.632	207.4	6.93	30.9	2.48	527.78
	USRP3[2]	12/03/2025	0.452	26.838	211.5	6.49	54.4	4.34	133.29
	USRP2[2]	12/03/2025	0.475	26.96	219.9	6.5	24.3	1.94	500.37
	USRP1[2]	12/03/2025	0.339	26.603	198.4	6.3	83.5	6.7	843.78

Cells shaded blue denote values outside of both the baseline conditions and relevant EPP WQO
Cells shaded orange denote values within baseline conditions but outside of the relevant EPP WQO
Cells shaded yellow denote values outside of the baseline conditions, but within the relevant EPP WQO

Appendix C

Turtle passage inspection forms

Appendix D

Turtle observation forms

Appendix E

Turtle injury/mortality forms

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