To:	Neil McCabe & Geoff Sharp	**From:**	Ben Cook & Andrew Bently
Company:	Sunwater		**SLR Consulting Australia Pty Ltd**
cc:		**Date:**	8 May 2026
		Project No.	635.000125.00001

RE: Lower Fitzroy Water Quality Monitoring Reporting Program and Water Quality (Nitrogen) Offsets Management Plan: Nitrogen Assessment Report, December 2023 to November 2025

1.0 Introduction

SLR Consulting was engaged by Sunwater to prepare the Nitrogen Assessment Report (NAR) for Rookwood Weir, located on the Fitzroy River.

The Fitzroy River is part of the Great Barrier Reef (GBR) catchment and thus any works impacting the water quality of the river is regulated by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A weir has the potential to impact water quality, specifically concentrations and loads of nitrogen, due to accumulation and decomposition of organic material in the impoundment, with downstream release of water of impacted quality presenting potential risks to the GBR.

The EPBC 2009/5173 approval presents a range of conditions for the construction and operation of Rookwood Weir. Sunwater have developed a Lower Fitzroy Water Quality Monitoring and Reporting Program (LFWQMRP) and Water Quality (Nitrogen) Offsets Management Plan (WQNOMP) to address EPBC 2009/5173 conditions 1a) and 5a), respectively.

Additionally, EPBC approval requires:

> a) the monitoring of changes in **nutrient concentrations** under Condition 1b i)
>
> b) Under condition 4 b vii), any increase in nitrogen due to decaying vegetation in the inundation area needs to be offset unless monitoring conclusively determines that the impact is less than predicted. The approved WQNOMP states that 2 years of monitoring post inundation will be used as the period to determine if offsets are required.

The WQNOMP has been developed to quantify potential nitrogen loads generated due to inundation caused by the construction and operation of the weir, and identify strategies to offset nitrogen loads. The nitrogen offset requirement of 194 tonnes has been generated through a modelled scenario; however, requires validation through analyses of empirical nitrogen monitoring data to confirm nitrogen loads. Subsequently, a Nitrogen Assessment Report (NAR) is required to be completed following the first two years of weir operation (i.e. December 2023 to November 2025; Reporting Period) to assess nitrogen loads using water quality monitoring and flow data.

This NAR has been completed to provide an analysis and assessment of the following particulars:

- Analysis of total nitrogen concentrations during the Reporting Period (i.e. December 2023 to November 2025) in comparison to baseline pre-operations period (i.e. July 2020 to June 2023; Baseline Period) to provide an indication of nutrient trending over time; and
- Assessment of total nitrogen quantities (i.e. loads) released during the Reporting Period in comparison to the Baseline pre-operations period to provide an estimated change in nitrogen quantities (+ or -).

2.0 Methods

2.1 Study Design

Raw water quality data collected during implementation of the LFWQMRP was provided to SLR Consulting by Sunwater. Only monitoring sites with data collected in both the pre-operations and operations phase were used for comparison between phases.

Monitoring sites used in the program included upstream reference sites (upstream of predicted maximum Full Supply Level), the weir (within impoundment) locations, and sites downstream of the weir location. Monitoring data collected at relevant State Government gauging stations was also used as required. Monitoring site and gauging station locations are presented in Table 1 and Figure 1.

The Baseline Period was July 2020 - June 2023. While construction commenced in January 2020 there were no hydrological influences on the Fitzroy River associated with the Project prior to June 2023.

The operations monitoring phase commenced in December 2023 when the weir first filled, with the Reporting Period being December 2023 to November 2025.

Pre-action 75th percentile baselines were sourced from (Flint & Jones, 2024), Table 13.

Table 1: Descriptions and locations of water quality monitoring stations and flow gauges

Water Quality Monitoring Station	Flow Gauge	Flow Gauge Owner	Location	Period	Substitutions (if regular water quality station not available)
Weir DS	Rookwood Weir Tailwater	Sunwater	Downstream	Reporting	
Weir US	Rockwood Weir Headwater	Sunwater	Within Impoundment	Reporting	
Riverslea	Riverslea	Sunwater	Downstream (pre-operations), Within Impoundment (operations)	Baseline, Reporting	
Coolmaringa at Mackenzie	130105B	Queensland Government	Upstream	Baseline, Reporting	ALT3
Beckers at Dawson	130322A	Queensland Government	Upstream	Baseline, Reporting	ALT6
Rannes at Callide	130306B	Queensland Government	Upstream	Baseline, Reporting	
The Gap	130005A	Queensland Government	Downstream	Baseline, Reporting	

200,000

7,400,000

Forest
Marlborough Creek
Lake Learmouth State Forest
Fitzroy River
The Gap (130005A)
Alligator Creek
Yaamba
Mackenzie River
Goodedulla National Park
Fitzroy River
Fitzroy River
Coolmaringa (130105B)
Rockhar
Gracemere
Springton Creek
Stanwell
Mackenzie River
Weir DS
Weir US
Riverslea (13003B)
Fitzroy River
Duaringa State Forest
Westwood
Mount Morgan
Bone Creek
Duaringa
Charley Creek
Pearl Creek
Dawson River
Dee River
Wowan
Dee River
Centre Creek
Don River
Beckers (130322A)
Dawson Range State Forest
Dawson River
Don River
Rannes (130306B)
Woorabinda
Callide Creek
Gerard Creek
Bell Creek
Mimosa Creek
Baralaba
Callide Creek (Old Channel)
Redcliffe State Forest
Overdeen State Forest

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SLR

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0 3.5 7 14 km

Coordinate System:	GDA2020 MGA Zone 55
Scale:	1:400,000 at A3
Project Number:	635.000125
Date Drawn:	8/05/2026
Drawn by:	AB
Reviewed by:	BC

LEGEND

Monitoring Location

- Downstream
- Upstream
- Within Impoundment
- Watercourse
- Lake/Reservoir

ROCKWOOD WEIR

LOCATIONS OF WATER QUALITY AND FLOW MONITORING LOCATIONS.

FIGURE 1

Path: C:\Users\andrew.bentley\OneDrive - SLR Consulting\Documents - FRC Utility\Mapping\Projects\2025\635.000125_SW_Lower_Fitzroy_WQ\635.000125_SW_Lower_Fitzroy_WQ\635.000125_SW_Lower_Fitzroy_WQ.aprx\Fig1_Sites_NAR

2.2 Antecedent Flow

Hydrographs in daily time step for each gauging station were prepared to visually display flow patterns between July 2020 and November 2025 (i.e. Baseline and Reporting Periods). Any notable differences in flow patterns between the baseline and operation phases were noted.

2.3 Nitrogen Concentrations

Raw total nitrogen data was graphed for each site between July 2020 and November 2025 to visually display trends over time and compare total nitrogen concentrations with the applicable pre-action baseline 75th percentile.

2.4 Nitrogen Loads

To derive estimated daily total nitrogen concentration data, the difference between two consecutive data points was calculated, and this was divided by the number of days between the two data points, which yielded the 'daily change number'. Derived total nitrogen concentration data was then calculated for each day between the two data empirical points by either sequentially adding or subtracting the daily change number using a daily time step. This yielded a steady daily rate of change in derived total nitrogen concentration data between the two empirical monthly water quality values and is assumed to approximate a linear relationship in water quality patterns between empirical data points. Higher density of sampling events during flow events ensures that variability in water quality concentration data associated with flows is adequately represented in the underlying empirical data, and in the derived data. Any empirical data that was less than the limit of reporting was assumed to be half of the limit of reporting in all calculations.

The mass of each parameter in tonnes was then calculated by multiplying concentration data in milligrams per litre with flow volume in megalitres/day for each day of the Baseline[1] and Reporting Periods and then divided by 1,000. These results were graphed and any apparent trends noted, including noting any differences in nitrogen loads in the Reporting Period compared to the Baseline Period.

It is noted that total nitrogen loads are typically correlated with flow magnitude, and that higher magnitude flows were recorded during the Baseline Period compared to the Reporting Period. A second set of analyses was conducted to account for variability on flow magnitude between the Baseline Period and the Reporting Period. The above-described analyses of total nitrogen loads were repeated with data corresponding with days where flow magnitude was within the top 10% of flows recorded at Riverslea during the Baseline Period (i.e. 11,660 ML/day) excluded, thereby comparing data between the Baseline and Reporting Period where the maximum daily flow recorded was the same.

3.0 Results

3.1 Antecedent Flow

Mean daily flow volumes at each site were plotted for upstream sites (Coolmaringa, Beckers and Rannes), sites at the weir location (Riverslea and Weir US) and the downstream sites (Weir DS and The Gap). There were relatively more frequent large flow events (i.e. greater than 100,000 ML/day) during the Baseline Period (2021, 2022 and 2023) in comparison to

[1] Flow volume at Riverslea was used for load calculations for Weir_US and Weir_DS during the baseline period.

the Reporting Period (2023 and 2025), however the largest flow event was recorded during the Reporting Period (i.e. April 2025).

All sites had a similar flow pattern; however, the timing of peak (highest magnitude in the time series) flows varied between some of the upstream sites, indicating different tributaries were contributing more greatly to flow in the lower Fitzroy River at different times.

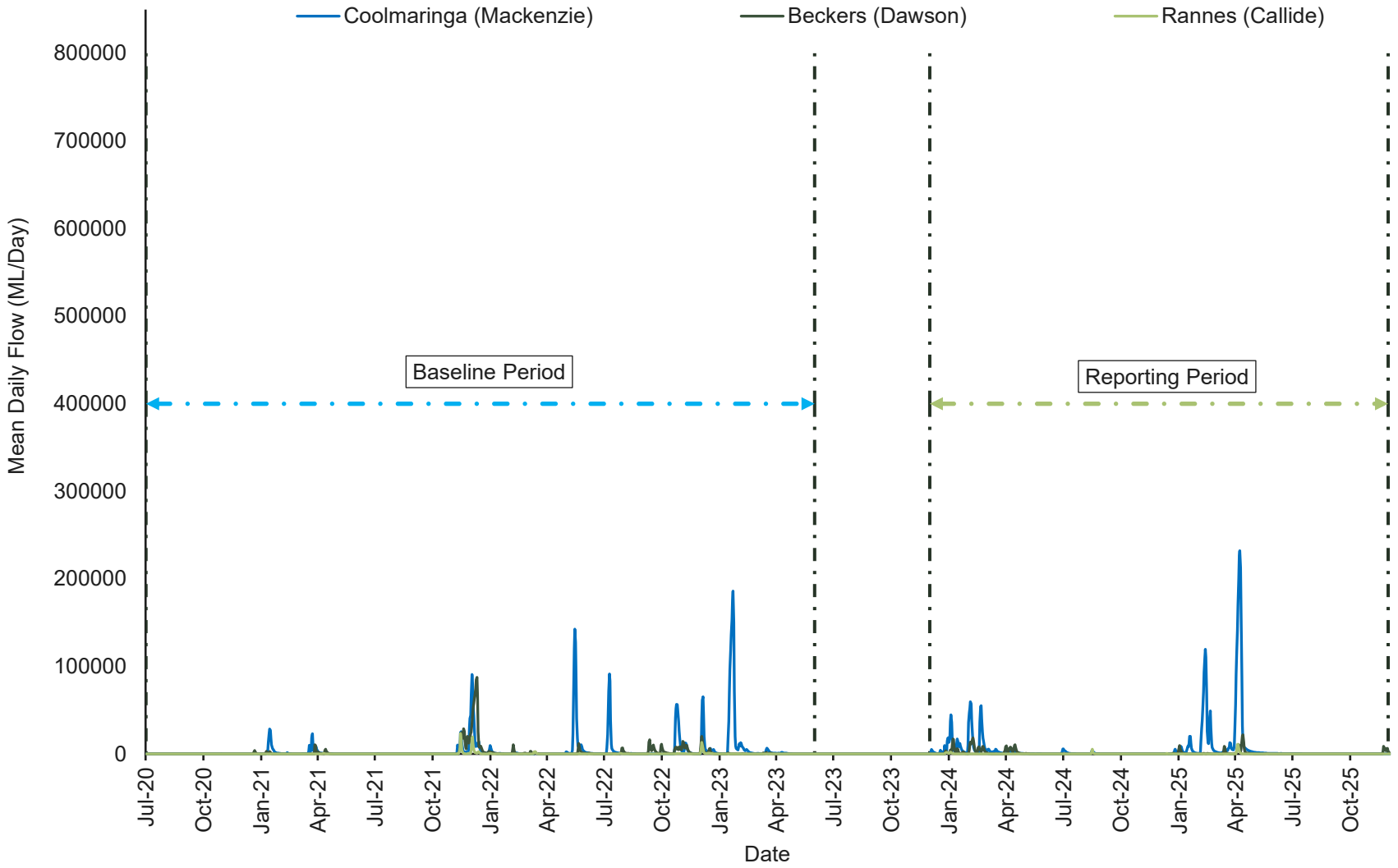

Figure 2: Daily flow volume at the upstream sites between July 2020 and November 2025.

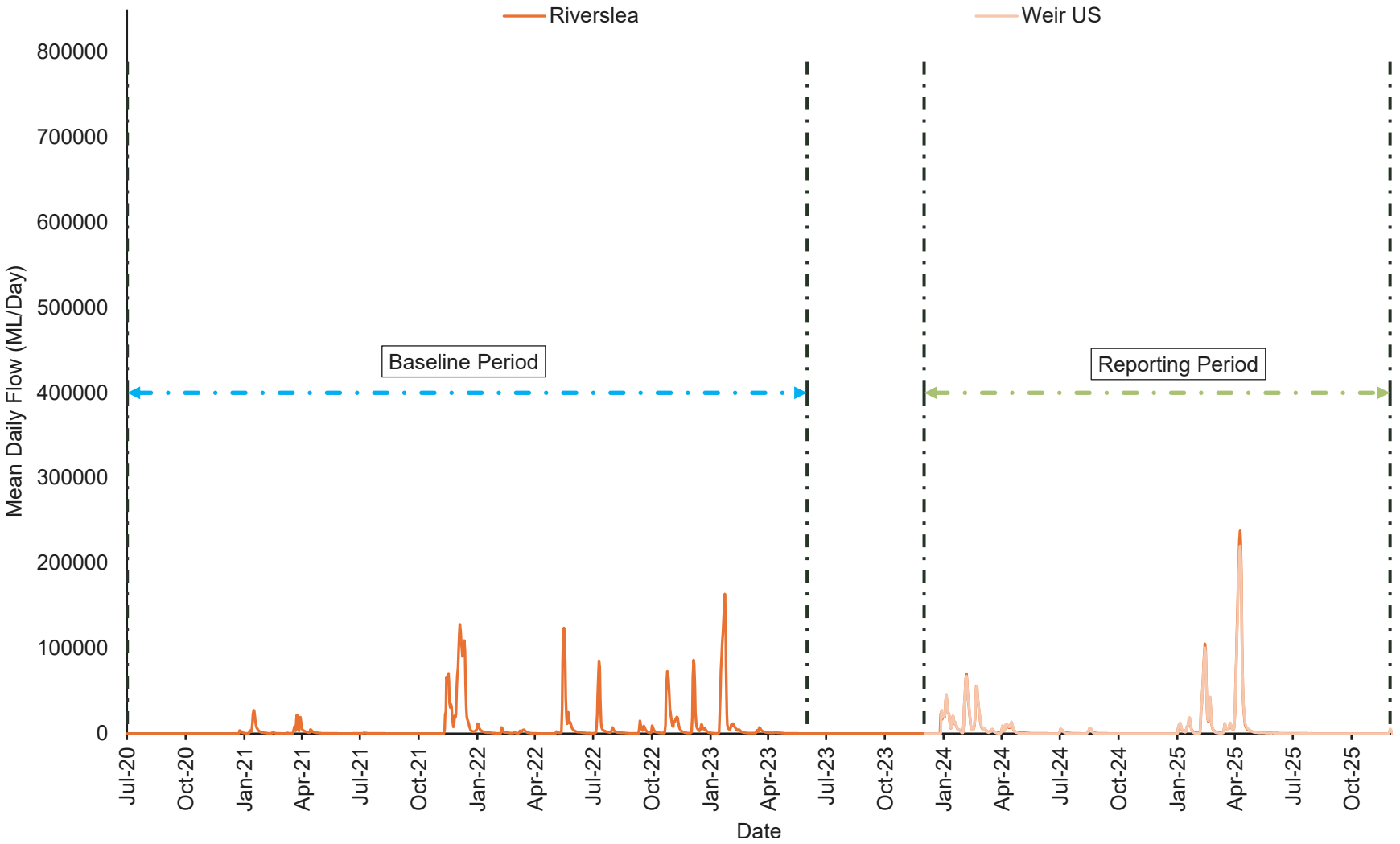

Figure 3: Daily flow volume at weir locations between July 2020 and November 2025.

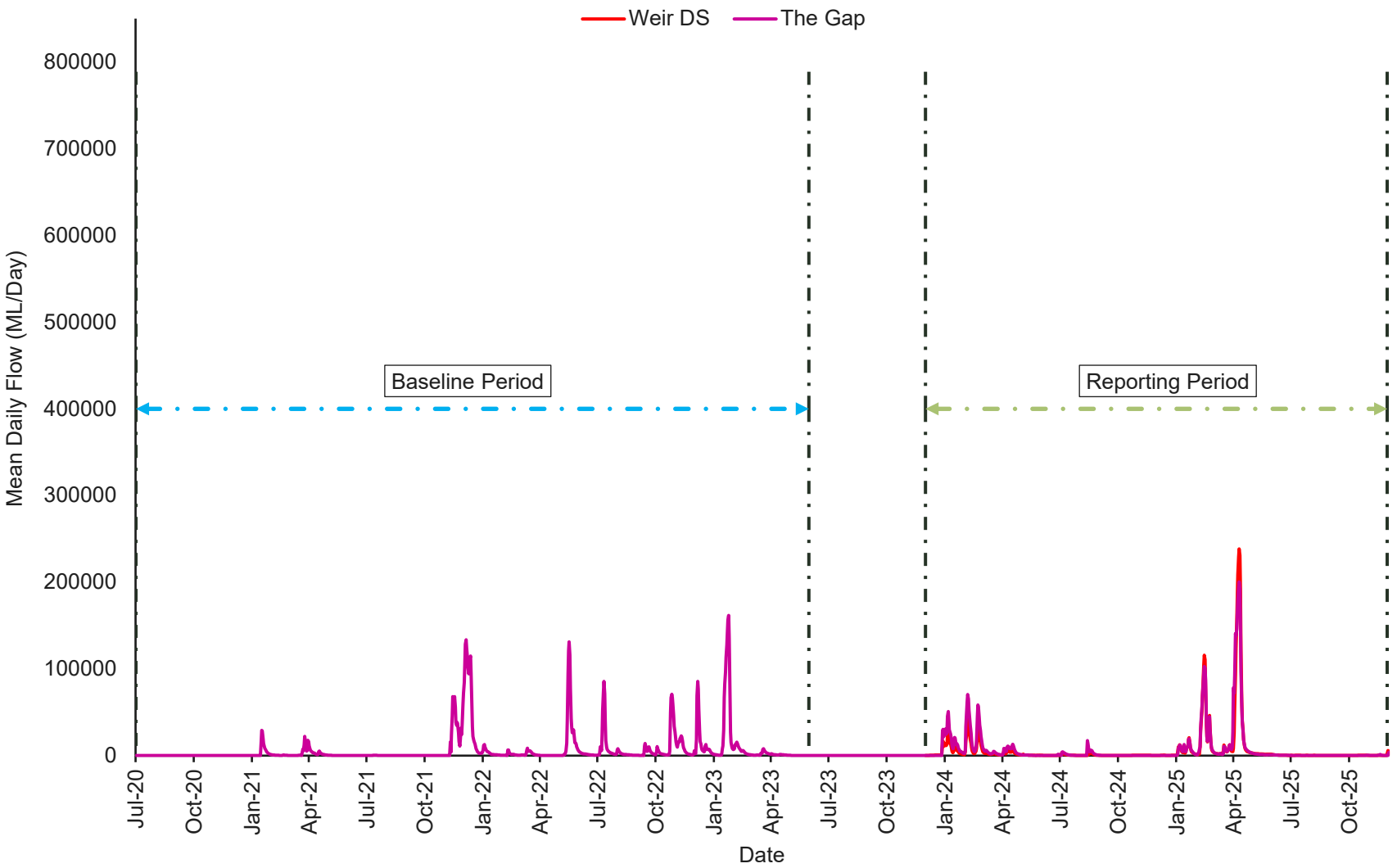

Figure 4: Daily flow volume at downstream sites between July 2020 and November 2025.

3.2 Nitrogen Concentrations

Nitrogen concentrations for the Baseline and Reporting Periods were plotted against the applicable 75th percentile pre-action baselines (Figure 5, Figure 6, Figure 7). The frequency and magnitude of exceedances of the applicable baseline 75th percentile were higher for the Baseline Period than the Reporting Period at all sites. Furthermore, at the weir location the concentration of total nitrogen only exceeded the baseline 75th percentile once at each location during the Reporting Period (Riverslea; April 2025 and Weir US; May 2025).

The concentration of nitrogen at the downstream sites were slightly higher but generally similar to the concentrations within the weir during the Reporting Period, indicating that the weir is having minimal impact on the nitrogen concentration downstream. In contrast, during the Baseline Period the weir locations recorded higher concentrations of nitrogen than at the downstream sites. This may suggest that nitrogen that would previously be discharged downstream is being deposited within the weir, or that denitrification is occurring within the weir, although further monitoring data (and specific assessment of denitrification) over a longer time period of operations is required to confirm this possibility.

At all sites, and most notably at the weir location, there was a trend of reduced peak nitrogen concentrations in the Reporting Period compared to the Baseline Period.

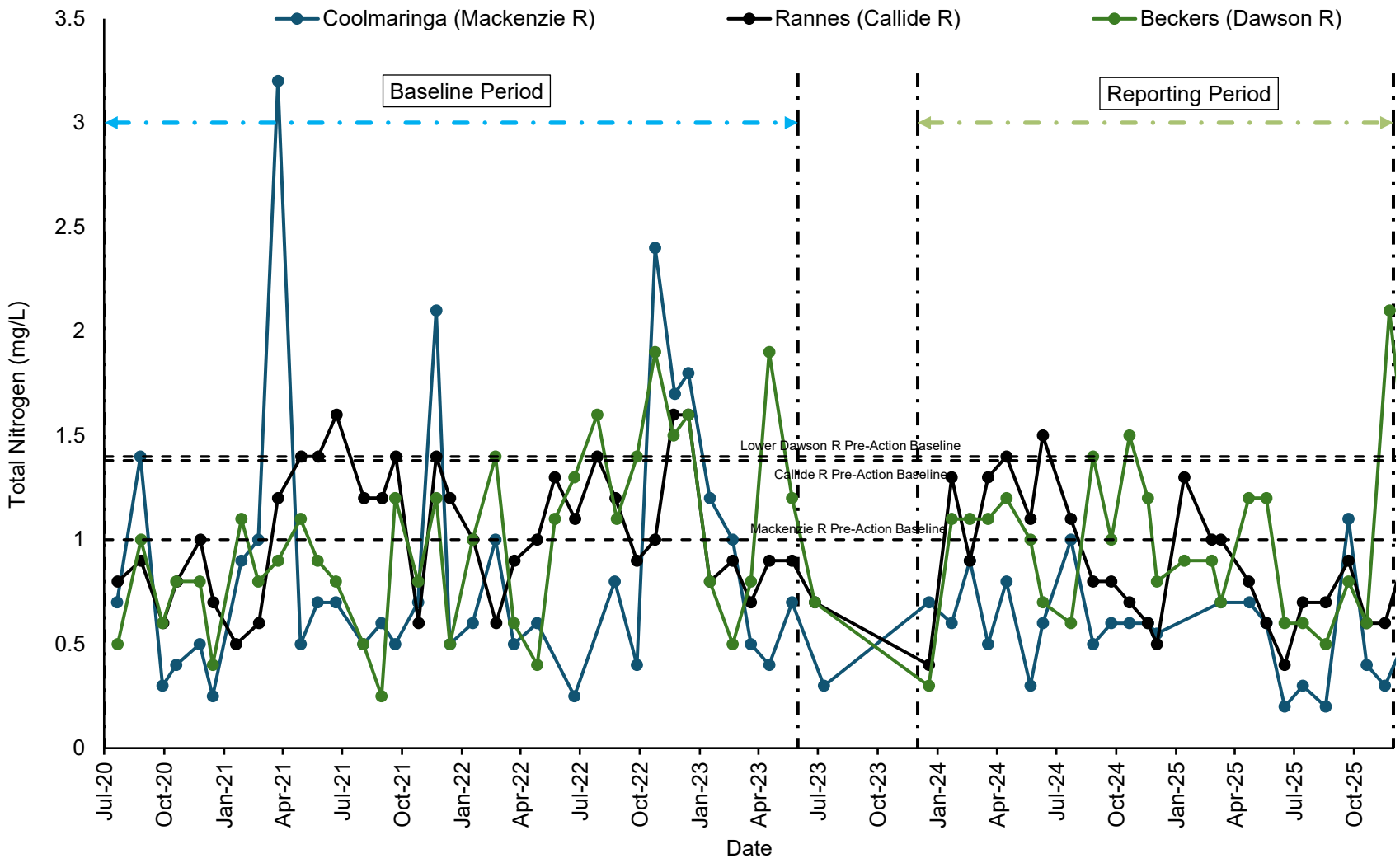

Figure 5: Nitrogen concentrations at the upstream sites between July 2020 and November 2025.

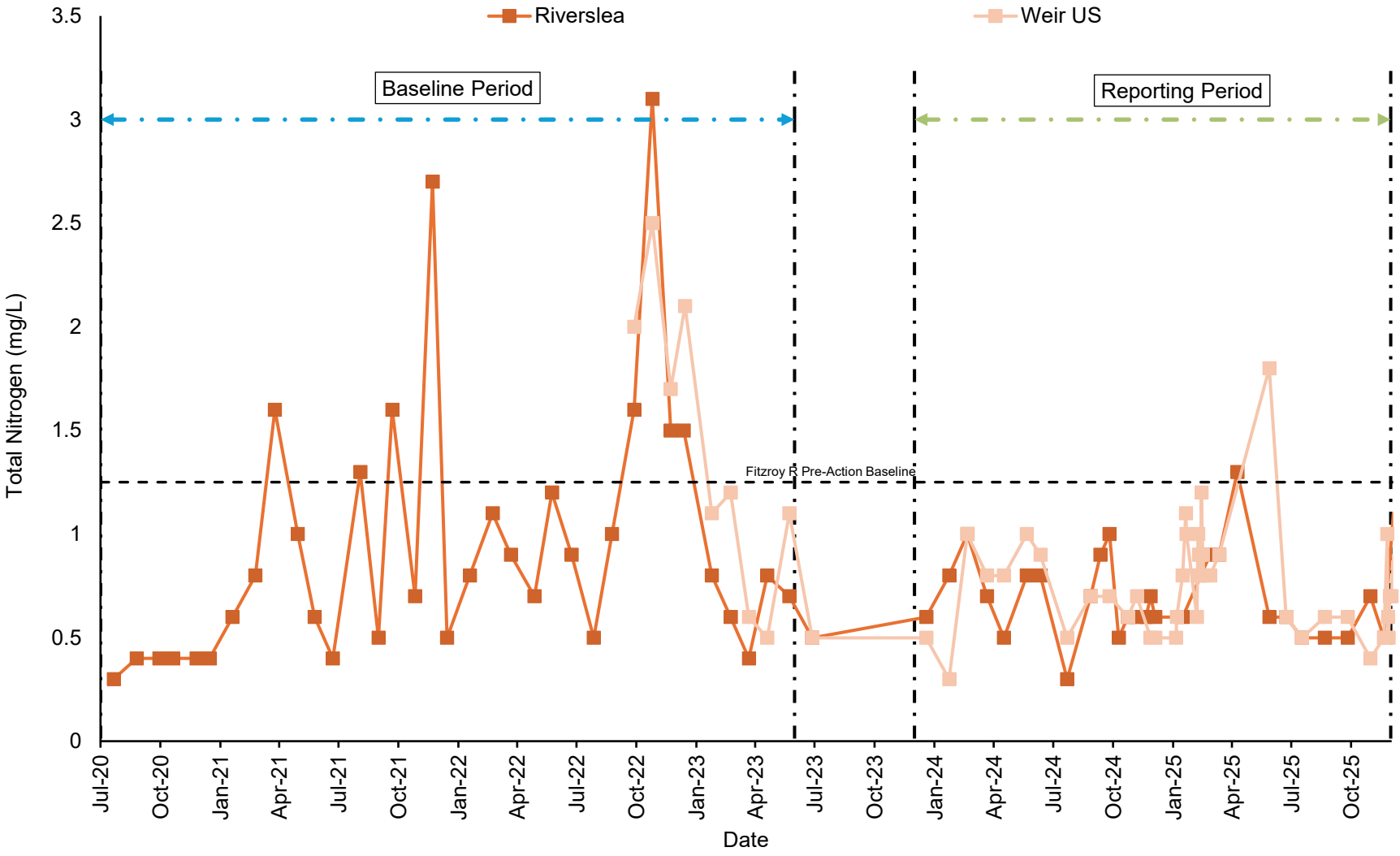

Figure 6: Nitrogen concentrations at weir locations between July 2020 and November 2025.

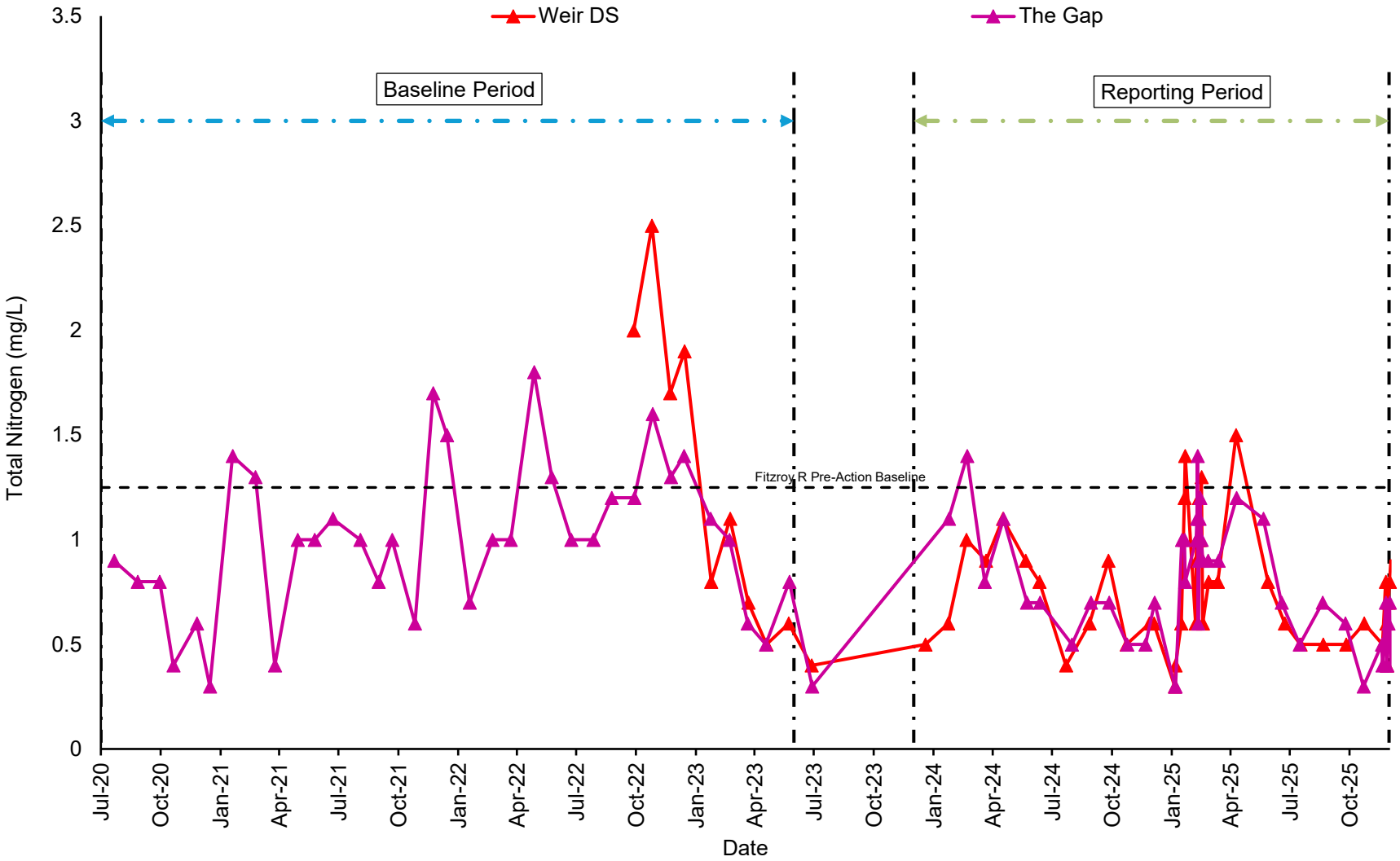

Figure 7: Nitrogen concentrations at downstream sites between July 2020 and November 2025.

3.3 Nitrogen Loads

Calculated nitrogen loads were plotted for upstream, weir and downstream sites (Figure 8, Figure 9, Figure 10). In general, the quantity of nitrogen exported fluctuated in conjunction with changing flow rates at all locations. The timing and concentration of peaks in nitrogen loads was generally similar across all locations, except for the April 2025 flow event, where nitrogen loads increased with distance downstream.

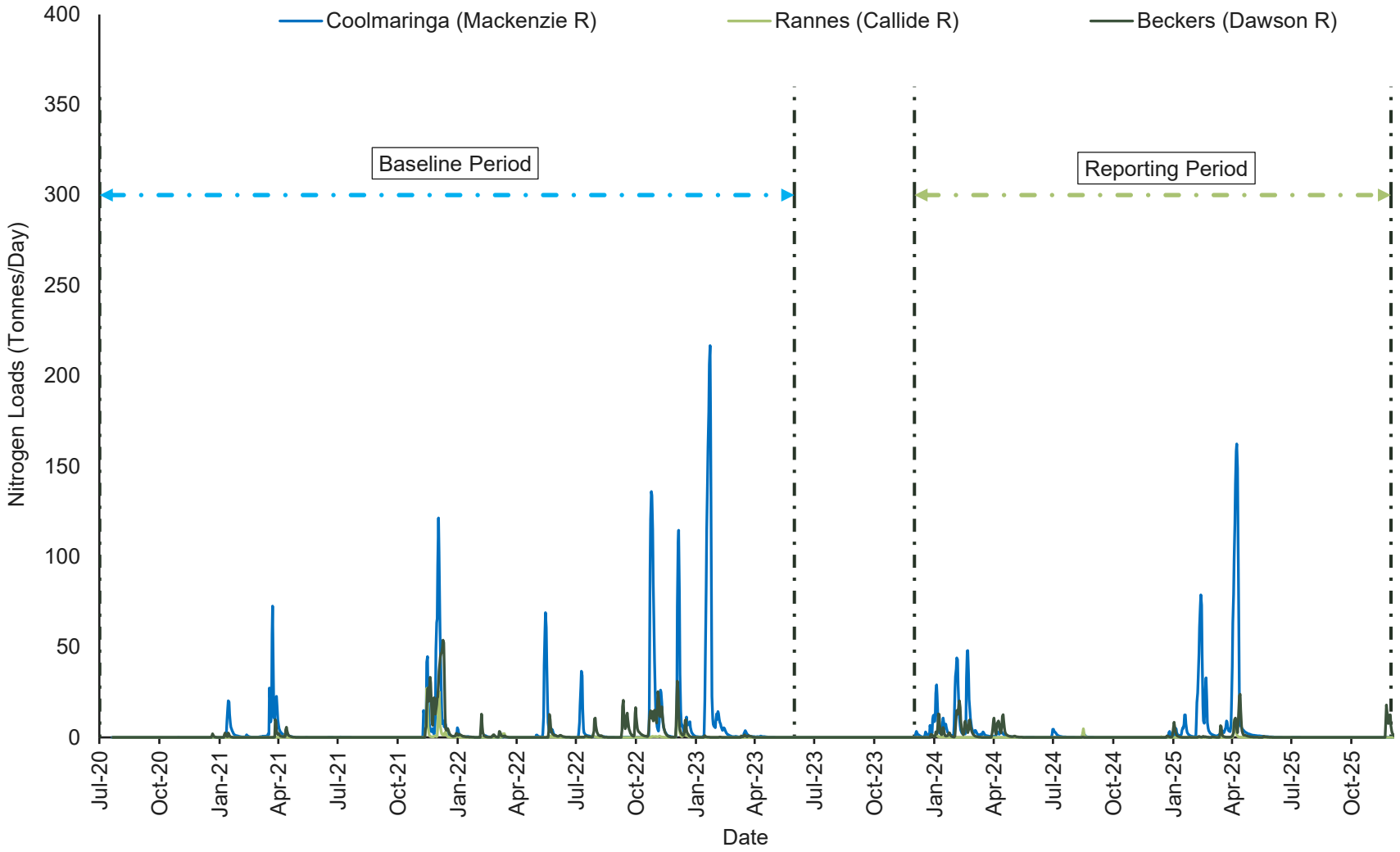

Figure 8: Nitrogen loads at upstream sites between July 2020 and November 2025.

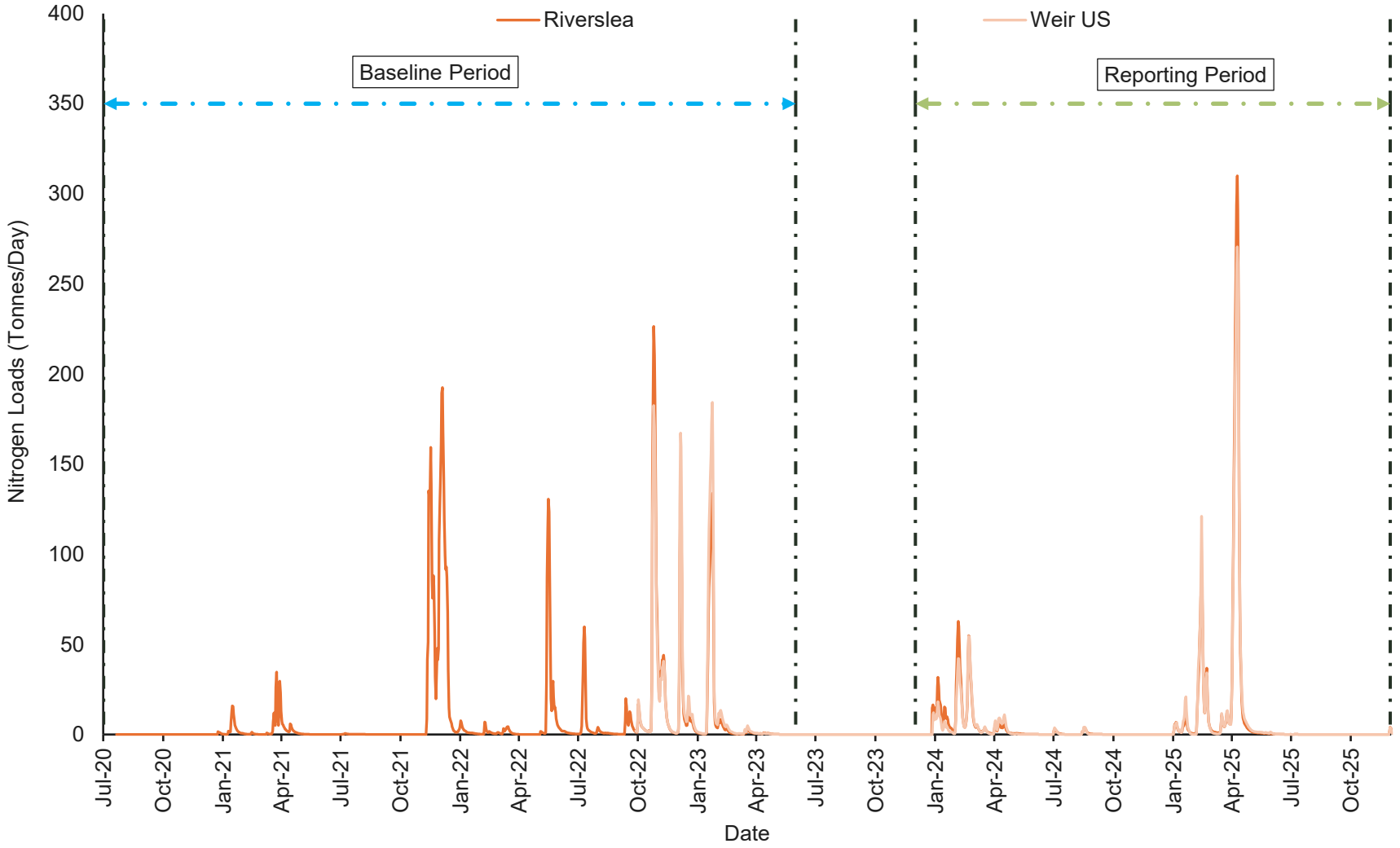

Figure 9: Nitrogen loads at the weir locations between July 2020 and November 2025.

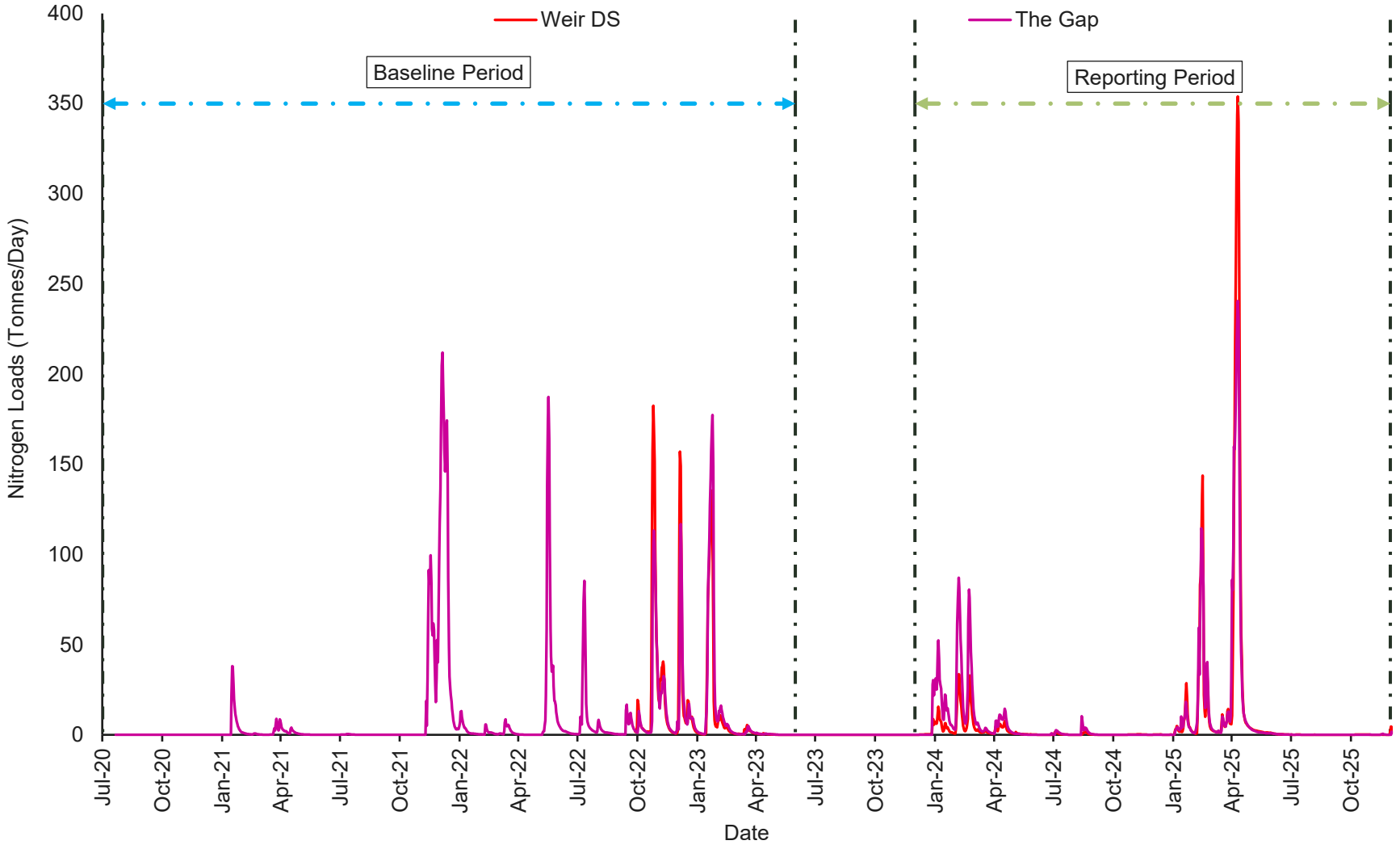

Figure 10: Nitrogen loads at downstream sites between July 2020 and November 2025.

On average, more nitrogen was exported during the Baseline Period than during the Reporting Period at all locations (Table 2). This means that the quantity of nitrogen exported through the Fitzroy River, in particularly at the weir and downstream, did not increase due to the operation of the weir during the Reporting Period in comparison to the Baseline Period.

The loads of nitrogen generally increased with distance downstream, with nitrogen loads highest at the downstream location (The Gap) during the Baseline[2] and Reporting Periods. However, the difference in nitrogen loads between the Baseline and Reporting Periods at the downstream location (The Gap) was generally lower than at the weir location (Riverslea), particularly when peak flows periods were excluded (Table 3), indicating that during very high flows, nitrogen loads downstream may be reduced due to the deposition of nutrients in the weir, or that denitrification is occurring within the weir. Further monitoring data (and specific assessment of denitrification) over a longer time period of operations would be required to confirm this possibility.

[2] While average nitrogen loads was highest at Weir_US and Weir_DS during the Baseline Period, results were not comparable as results were calculated from a subset of the Baseline Period.

Table 2 Summary of nitrogen loads at each monitoring site for the Baseline and Reporting Periods.

Location	Station	Daily Average Load (tonnes/day)		Comparison Between Periods	Annual Loads (tonnes/yr)		Difference in Annual Loads
		Baseline	Operations		Baseline	Operations	
Upstream	Coolmaringa	5.03 (± 0.62)	4.21 (± 0.59)	Not Significantly Different	1,836	1,535	-301
	Rannes	0.27 (± 0.06)	0.09 (± 0.02)	Lower During Operations	100	33	-67
	Beckers	1.75 (± 0.18)	1.09 (± 0.11)	Lower During Operations	640	397	-243
Within Impoundment	Riverslea	8.48 (± 0.85)	6.69 (± 1.04)	Not Significantly Different	3,096	2,443	-653
	Weir US	16.59 (± 2.44)*	6.27 (± 0.95)	Lower During Operations	6,054*	2,287	–
Downstream	Weir DS (outlet)	14.84 (± 2.16)*	7.09 (± 1.23)	Lower During Operations	5,418*	2,588	–
	The Gap	9.14 (± 0.88)	8.13 (± 0.98)	Not Significantly Different	3,336	2,968	-368

* Data was available for only part of the Baseline Period (September 2022 to June 2023) and therefore results are not directly comparable with other locations that utilised the full baseline range. – Not calculated as annual loads for the Baseline Period are not comparable with other results.

Table 3 Summary of nitrogen loads during the Baseline and Reporting Periods where peak flow periods were excluded.

Location	Station	Daily Average Load (tonnes/day)		Comparison Between Periods	Annual Loads (tonnes/yr)		Difference in Annual Loads
		Baseline	Operations		Baseline	Operations	
Upstream	Coolmaringa	0.97 (± 0.14)	0.88 (± 0.08)	Not Significantly Different	355	320	-35
	Rannes	0.05 (± 0.01)	0.03 (± 0.01)	Lower During Operations	19	11	-8
	Beckers	0.67 (± 0.08)	0.59 (± 0.08)	Not Significantly Different	243	214	-29
Within Impoundment	Riverslea	1.35 (± 0.09)	1.14 (± 0.08)	Lower During Operations	492	416	-76
	Weir US	3.38 (± 0.33)*	1.21 (± 0.09)	Lower During Operations	1,233*	440	–
Downstream	Weir DS (outlet)	3.13 (± 0.31)*	1.22 (± 0.09)	Lower During Operations	1,144*	445	–
	The Gap	1.9 (± 0.13)	1.78 (± 0.14)	Not Significantly Different	695	649	-46

* Data was available for only part of the Baseline Period (September 2022 to June 2023) and therefore results are not directly comparable with other locations that utilised the full baseline range. – Not calculated as annual loads for the Baseline Period are not comparable with other results.

4.0 Limitations

The following limitations are noted for the data used in this assessment:

- Monitoring locations are spread over a wide geographical range – upstream and downstream locations are approximately 100 km away from the weir. This means that any nitrogen inputs or amelioration between the upstream sites and the weir location are unknown.
- The frequency of large flow events recorded during the Reporting Period was lower in comparison to the Baseline Period. While this may under-estimate nitrogen loads discharged during the operational phase, the ancillary analyses identified similar results, indicating the results of the main analysis appear to be reasonable estimates of nitrogen loads for this assessment.
- Nitrogen load calculations for the Weir_US and Weir_DS locations during the Baseline Period were not comparable with other locations as data was only available for a subset of the Baseline Period (September 2022 to June 2023).

5.0 Conclusions

The available data suggest that the concentrations and loads of nitrogen in the lower Fitzroy River have not increased during the Reporting Period (i.e. first 24 months of operation of Rookwood Weir) compared to baseline condition. Therefore, there is no indication that the construction of Rookwood Weir, or the subsequent decomposition of vegetation from the impoundment of water, has increased nitrogen concentrations within or downstream of the impoundment during the Reporting Period. In fact, nitrogen results indicate that the impoundment may have reduced the loads of nitrogen in the lower Fitzroy River during very high flows.

Analysis of nitrogen loads estimated a reduction of 736 tonnes (368 tonnes of nitrogen per year) of nitrogen at the most downstream location (The Gap) during the Reporting Period compared to the Baseline Period. This suggests that the modelled nitrogen loads increase of 194 tonnes was not validated with the empirical nitrogen data collected, and that there is no apparent increased water quality risks for the GBR or requirement for a nitrogen offset for the first two years of inundation and operation.

6.0 References

Flint, N., & Jones, C. E. (2024). *Lower Fitzroy Water Quality Monitoring and Reporting Program.* Queensland: CQ University.