AUSMAP

AUSTRALIAN MICROPLASTIC ASSESSMENT PROJECT

Final Overview of Microplastics across GBR Catchments: 2019-2023

Australian Microplastic Assessment Project

June 2023

Contents

MICROPLASTIC IDENTIFICATION IN GBR CATCHMENTS 3

FIVE YEAR TRENDS IN REEFCLEAN DATA 4

2023 MICROPLASTIC OVERVIEW 7

REGIONAL BREAKDOWN 11

REGION 1- CAPE YORK 11

REGION 2 - WET TROPICS 14

16

REGION 3 - BURDEKIN 17

REGION 4 - MACKAY WHITSUNDAY 20

22

REGION 5 - FITZROY 23

REGION 6 - BURNETT MARY 26

POTENTIAL SOURCES OF MICROPLASTICS 29

FINAL CONCLUSIONS AND RECOMMENDATIONS 30

ReefClean is funded by the Australian Government's Reef Trust

We acknowledge the Traditional Custodians of the land and waterways on which we live, work and learn.

Microplastic Identification in GBR Catchments

The ReefClean project was designed to implement a cost-effective program of targeted and integrated marine debris activities to:

- Reduce the volume of debris generated in, or entering the Great Barrier Reef (GBR) that may impact listed threatened and migratory species, such as dugongs and turtles, as well as vital ecosystems of the GBR, and;
- Increase awareness in Reef catchment communities about the issue of marine debris, including microplastics, and actions they can undertake to prevent litter from entering Reef waterways.

Microplastic (1-5mm size class) surveys formed part of ReefClean clean-up activities at coastal sites around the GBR over the duration of the project, to improve awareness of the impacts of microplastics on the environment and contribute to mapping the extent of microplastic accumulation around waterways and beaches nationwide.

Microplastics or 'microlitter' are reported as microplastics per metre squared (mp/m^2) as the standard metric. Data on typology (resin pellets, hard plastic fragments, foam, fibre, film or rubber), colour and size are also collated. These metrics enable a comparison between locations and at sites over time to document changes and effectiveness of any management strategies.

The AUSMAP sampling methodology was used to collect rigorous and scientifically reliable data on microplastic particles (1-5 mm), which involves replicate sediment sampling along the most recent high tide of each shoreline. This sampling regime has been the most comprehensive and broadscale analysis of microplastic trends with the GBR catchment. Samples are sieved in the field for microplastics across each GBR catchment and then further verified by the AUSMAP Scientific Officer. AUSMAP rates sites based on identified microplastic loads which are then translated into colour-coded points on a national map that represent specific load ranges.

The AUSMAP microplastic load colour key is as follows:

Microplastic levels (mp/m^2)	Grading	Status
0-10	Very Low	GOOD
11-50	Low	WATCH & ACT
51-250	Moderate	WATCH & ACT
251-1000	High	HOTSPOT
1001-10,000	Very High	HOTSPOT
>10,000	Extreme	HOTSPOT

The number of mp/m^2 can be applied to determine if the site is considered a pollution hotspot. Levels above 250 mp/m^2 are considered a 'microplastic hotspot', although moderate levels warrant further investigation on a 'Watch and Act' premise. That is, continue to monitor the sites and if levels increase, hotspot grading may be prematurely applied within areas of significance based on the precautionary principle.

Five Year Trends in ReefClean Data

Over the course of this five-year project from 2019 to 2023, 126 microplastic samples were collected from 44 sites (**Figure 1a**). Samples from March 2023 are the final addition to the ReefClean microplastic dataset. The project has highlighted hotspots of concern and regions more at risk from microplastic pollution. The study has also demonstrated the seasonal and varying nature of microplastic loads. For the most part, microplastic loads across the GBR are low, relative to the more densely populated regions of the country. Despite this positive result, the resounding outcome of the project is that continued monitoring is required into the future to enable further data analysis of the effects of larger climatic variances (e.g., ENSO) on microplastic loads in the GBR.

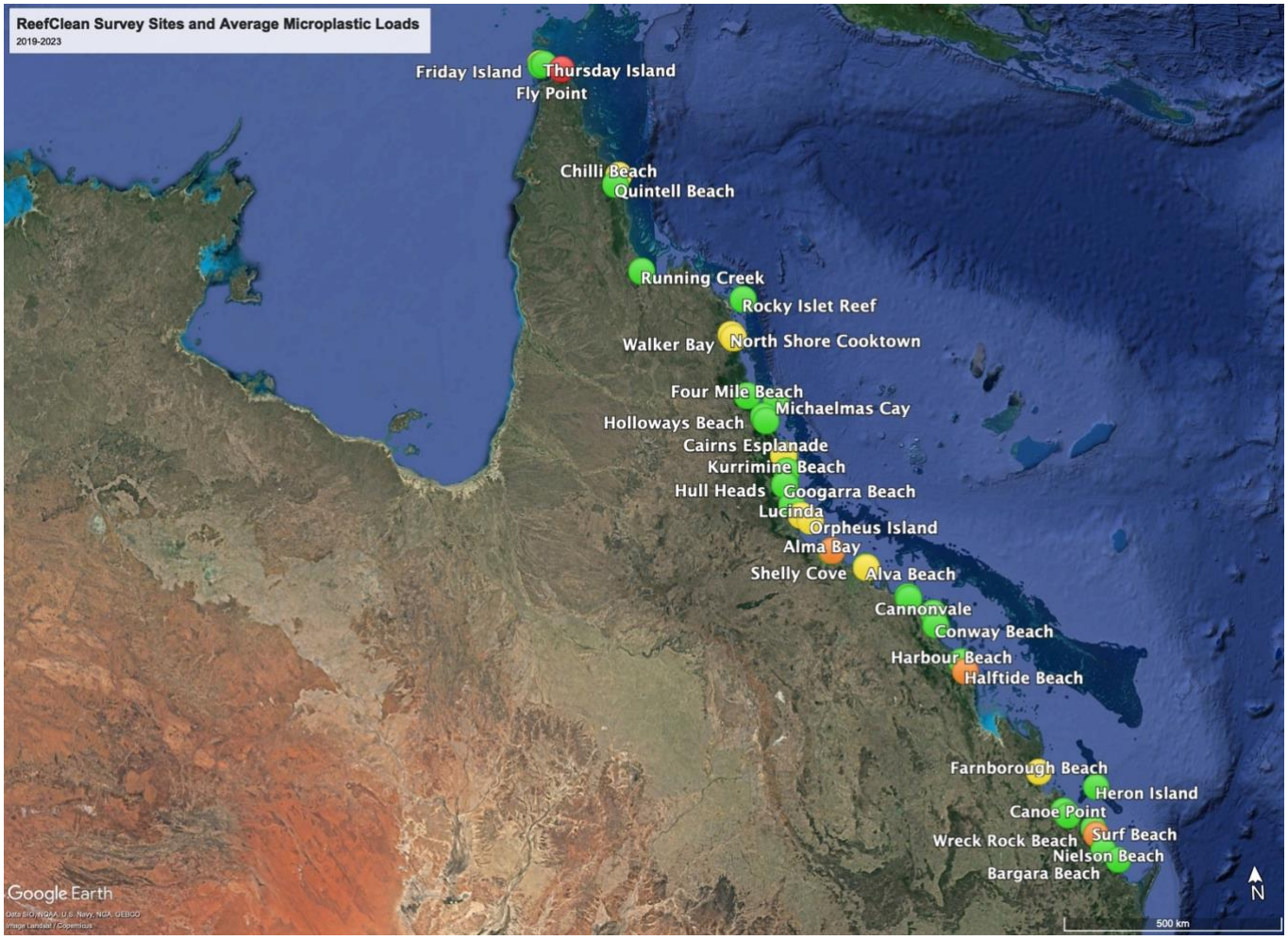

Figure 1a. *Summary of ReefClean sample locations and average microplastic loads from ReefClean 2019-2023. (Green = Very Low; Yellow = Low, Orange = Moderate, Red = High).*

Determining trends on a regional basis remains a challenge, when considering that changes to sampling sites and efforts each year can impact regional averages. However, this dataset provides indispensable insight into the ways in which microplastic concentrations vary temporally and spatially across the GBR.

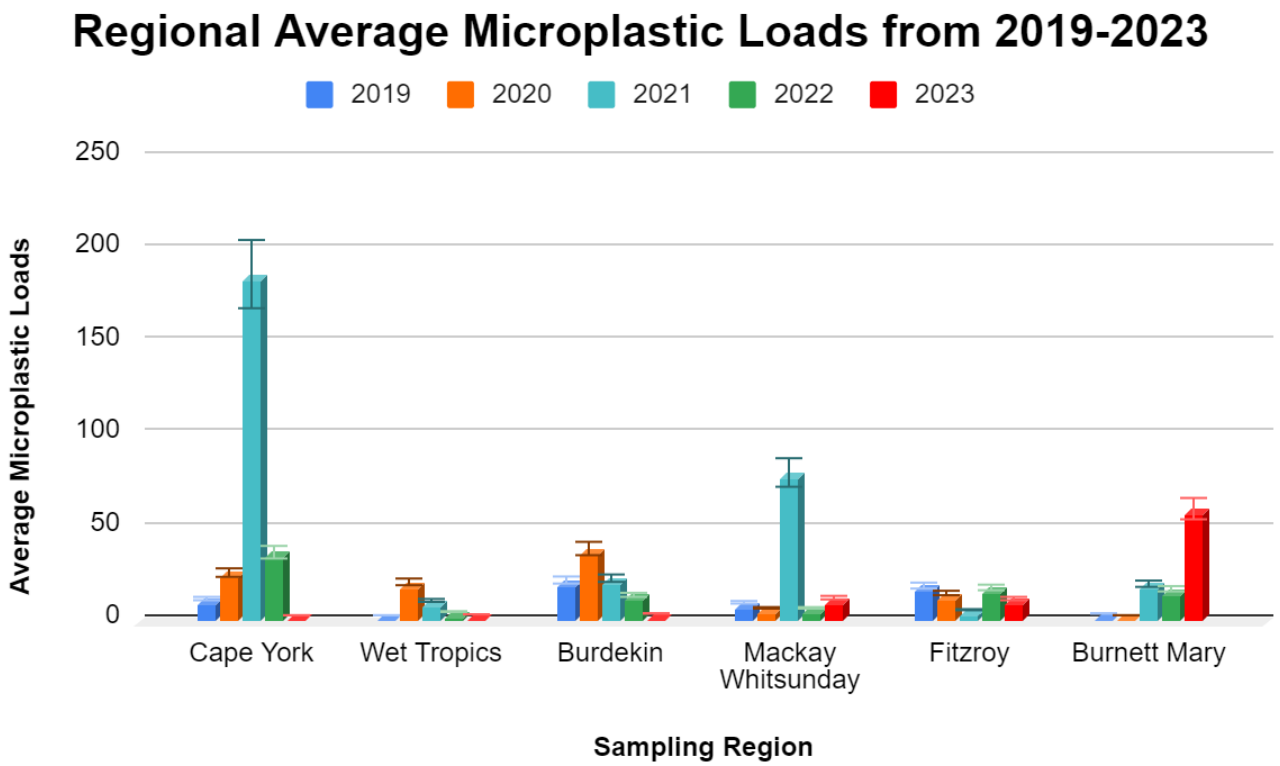

Figure 1b. *Regional Average Microplastic Loads from ReefClean samples between 2019-2023. Averages include opportunistic samples and are influenced by the volume of surveys taken in each region. Error bars reflect variance during each sampling year. Microplastics measured in mp/m^2.*

Figure 1b demonstrates general regional trends, whilst acknowledging regional variance between sites. Major trends that can be observed from this graph, include:

- A general decrease in microplastics across all NRMs in March 2023, except for the Burnett Mary region which was influenced by the opportunistic sample at Wreck Rock Beach;
- A substantial spike in 2021 in the Cape York and Mackay Whitsunday regions (primarily driven by considerable increases at individual sites), driven mostly by localised weather events;
- A downward trend over time in both the Wet Tropics and Burdekin regions since 2020;
- A relatively stable condition in the Fitzroy region over the length of the project; and
- An upward trend in the Burnett Mary region between 2019 and 2022, although this is driven primarily by changes at one site.

Future monitoring should consider these regional trends in order to capture the full picture of microplastic pollution in the GBR.

Excluding Wreck Rock Beach, the March 2023 samples continued the trend of decreasing site averages since they first peaked in 2021. As was reported in 2022, the greatest differences in microplastic loads remains at Fly Point which recorded 1,191 mp/m^2 in September of 2021, and 136 mp/m^2 in September of 2022. In spite of this, general decreases were evident at most sites across the GBR with all surveys yielding **Very Low**, or **Low** results - some of the lowest results seen throughout the ReefClean project.

Potential explanations for this broadscale decrease in microplastics may include the conclusion of the La Nina event that occurred from 2020 to early 2023. This weather event is typically characterised by above average rainfall during Winter and Spring[1], which may account for the elevated September loads observed in the Cape York and Mackay Whitsunday regions during 2021. The recent declaration that Australia has a 70% chance of an El Nino, which typically reduces rainfall across Northern and Eastern Australia[2], may additionally explain why microplastic loads declined in the 2023 samples. It is important to note that only one sample round and reduced sample sites are also likely to have impacted this trend, which reiterates the importance of undertaking further monitoring.

Moreover, the 2022 ReefClean report noted that seasonal affect has the greatest influence on changing microplastic loads in 2022. This is the consequence of seasonal oscillations, including changes to rainfall, wind direction and ocean currents which can impact microplastic inputs from land-based and aquatic sources. It is interesting to note that 2023 samples marked a sharp decline across all NRM regions, despite March 2022 samples being typically higher than loads recorded in September 2022. This was most obvious at Surf Beach, which marked a decrease from 86 mp/m^2 to 6 mp/m^2 between March 2022 and March 2023.

[1] http://www.bom.gov.au/climate/updates/articles/a020.shtml
[2] https://www.csiro.au/en/news/all/news/2023/june/expert-commentary-el-nino

2023 Microplastic Overview

In March 2023, the Tangaroa Blue Foundation field team conducted the final 13 AUSMAP microplastic surveys across the six Natural Resource Management (NRM) areas within the GBR monitoring region as part of the ReefClean Project **(Figure 1C).** The 13 surveys included:

- 12 surveys at ReefClean monitoring sites (note: some standard ReefClean monitoring sites were not sampled in March 2023, including Fly Point, Four Mile Beach, Shelly Cove, Alva Beach, Half Tide Beach and Walker Bay); and
- One additional survey was conducted at Wreck Rock Beach in Deepwater National Park.

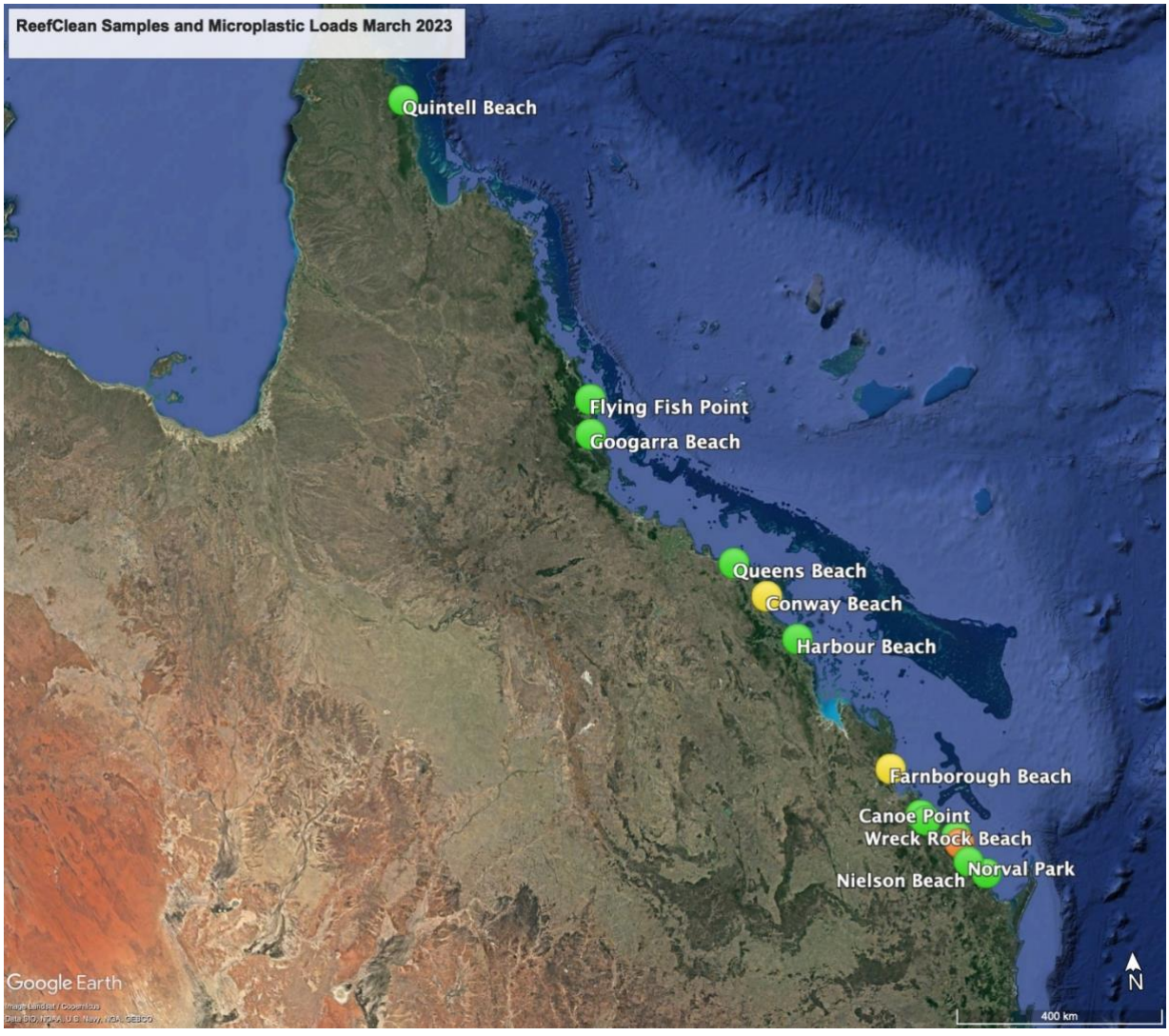

Figure1C. *Summary of ReefClean sample locations and microplastic loads from March 2023. (Green = Very Low; Yellow = Low, Orange = Moderate).*

Out of the 13 surveys undertaken, 10 yielded microplastics. ReefClean samples in 2023 exhibited minimal variation from **Very Low** to **Moderate** with microplastic loads ranging from 0 to 224 mp/m^2. The highest levels were recorded at Wreck Rock Beach in the Burnett Mary region with 224 mp/m^2. Excluding this opportunistic sample, Farnborough Beach in the Fitzroy region recorded the highest value amongst standard ReefClean sample sites with 19 mp/m^2 which is **Low** on AUSMAP's grading scale (**Table 1**). This value is in line with prior results at this site, with 23 mp/m^2 recorded in March of 2022 **(Table 6)**.

Conway Beach in the Mackay Whitsunday region was also shown to have **Low** microplastic loads with 15 mp/m^2 (**Table 1**). This correlates with the sample from March 2022, where a value of 11 mp/m^2 was observed but is higher than previous sample years where results were <5 mp/m^2 **(Table 5)**. September values in 2020, 2021 and 2022 have additionally been **Very Low**.

All other sites investigated in the March 2023 ReefClean sampling resulted in **Very Low** microplastic loads between 0 and 6 mp/m^2 **(Table 1).** The continuation of sampling across all sites is vital in understanding microplastic hotspot developments across the ecologically significant GBR Region.

Table 1. *Summary of ReefClean microplastic sampling activities in March 2023 and regional averages measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate).*

Region and Regional Average (mp/m^2)	Site and Microplastic Level (mp/m^2)		Region and Regional Average (mp/m^2)	Site and Microplastic Level (mp/m^2)	
Cape York: 1 survey, 1 site NRM average all surveys = 0 mp/m^2	Quintell Beach (Mar)	0	**Mackay Whitsunday:** 2 surveys 2 sites NRM average all surveys = 9.5 mp/m^2	Conway Beach (Mar)	15
				Harbour Beach (Mar)	4
Wet Tropics: 2 surveys 2 sites NRM average all surveys = 0.5 mp/m^2 Adjusted average from surveys where plastic was found = 1 mp/m^2	Flying Fish Point (Mar)	0	**Fitzroy:** 3 surveys 3 sites NRM average all surveys = 9 mp/m^2	Farnborough Beach (Mar)	19
	Googarra Beach (Mar)	1		Barney Point (Mar)	2
				Canoe Point (Mar)	6
Burdekin: 1 survey 1 site NRM average all surveys = 1 mp/m^2	Queens Beach (Mar)	1	**Burnett Mary:** 4 surveys 4 sites NRM average all surveys = 57.5 mp/m^2 Adjusted average from surveys where microplastic was found = 77 mp/m^2	Surf Beach (Mar)	6
				Norval Park Beach (Mar)	0
				Nielson Beach (Mar)	1
				Wreck Rock Beach, Deepwater National Park (Mar)	224

The Mackay Whitsunday region had the highest average microplastic load in March 2023, with 9.5 mp/m^2. This result remains within the **Very Low,** category on the AUSMAP grading scale, and was primarily driven by a **Low** result of 15 mp/m^2 at Conway Beach **(Table 1)**. Similarly, the Fitzroy region had the second highest average microplastic load, which was influenced by a **Low** result of 19 mp/m^2 at Farnborough Beach **(Table 1)**.

The lowest regional microplastic average was observed in the Cape York region where no microplastics were found **(Table 1**). This is most likely due to the reduced sampling efforts in the region with only Quintell Beach being sampled in March 2023.

Overall, all regions reported consistently low microplastic volumes with regional averages being typically influenced by changes at one site rather than broad regional changes. Loads of 0 mp/m^2 were recorded at three sites, alongside nine additional **Very Low** results. It is important to note that the surveys from March 2023 do not provide a full annual dataset, and therefore limit analysis of seasonal trends in this sample year.

Regional Breakdown

Region 1- Cape York

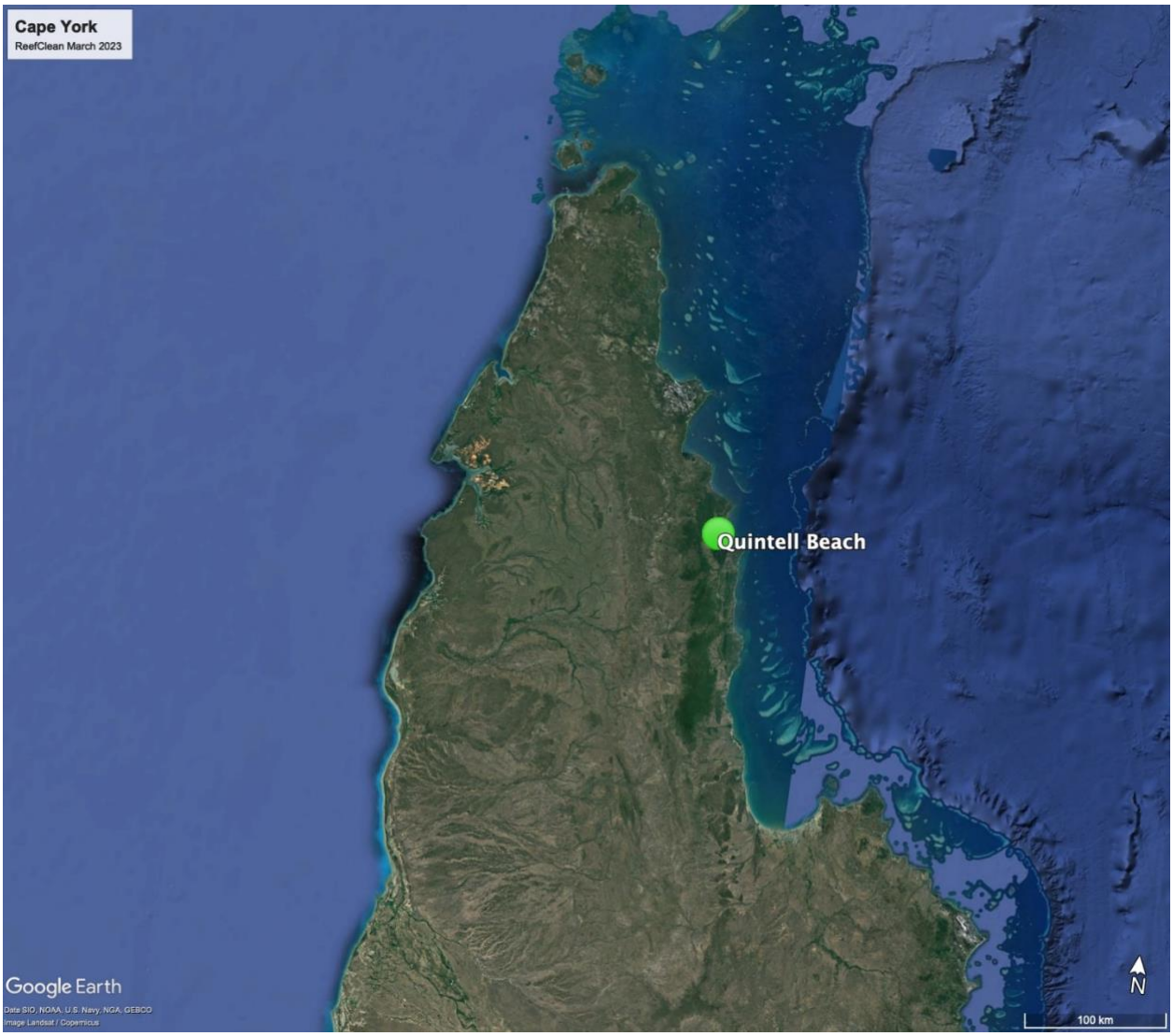

Figure 2. Cape York sample locations and microplastic loads March 2023 (Green = Very Low)

The Cape York Region was sampled on one occasion in March 2023 at Quintell Beach which is a standard ReefClean sampling site with well documented trends **(Figure 2**).

The exclusion of Fly Point from ReefClean sampling efforts in the Cape York region has contributed to a reduced regional average in 2023. Previously, Fly Point was found to have the highest regional result, with 1,191 mp/m^2 and 136 mp/m^2 found in September of 2021 and 2022 respectively **(Table 2).**

Table 2. *Summary of previous ReefClean microplastic sampling activities in the Cape York Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate; Red = High; Black = Very High).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
Quintell Beach	0	Quintell Beach	1	Quintell Beach (Mar)	12	Quintell Beach (Mar)	0	Quintell Beach (Mar)	0
				Quintell Beach (Sept)	17	Quintell Beach (Sept)	0		
		Fly Point	44	Fly Point (Mar)	7	Fly Point (Mar)	0		
				Fly Point (Sept)	**1,191**	Fly Point (Sept)	136		
Walker Bay	7			Walker Bay	34				
Friday Island	5			Running Creek	3				
Goods Island	21			Chili Beach	26				
Rocky Islet Reef	0								
North Shore Cooktown	23								
Thursday Island	4								

Seven surveys have been undertaken at Quintell Beach since 2019, which provides valuable insight into microplastic loads at this site **(Table 2).** The results have varied from zero microplastics found in 2019, 2022, and 2023, to 17 mp/m^2 in 2021 (**Low** microplastic load) **(Figure 3).** This places the result from March 2023 within the context of prior samples from Quintell Beach, highlighting that **Very Low** values are typical for this time of year. It is likely that the higher values recorded during March and September of 2021 were influenced by seasonal weather conditions on the South-East coast.

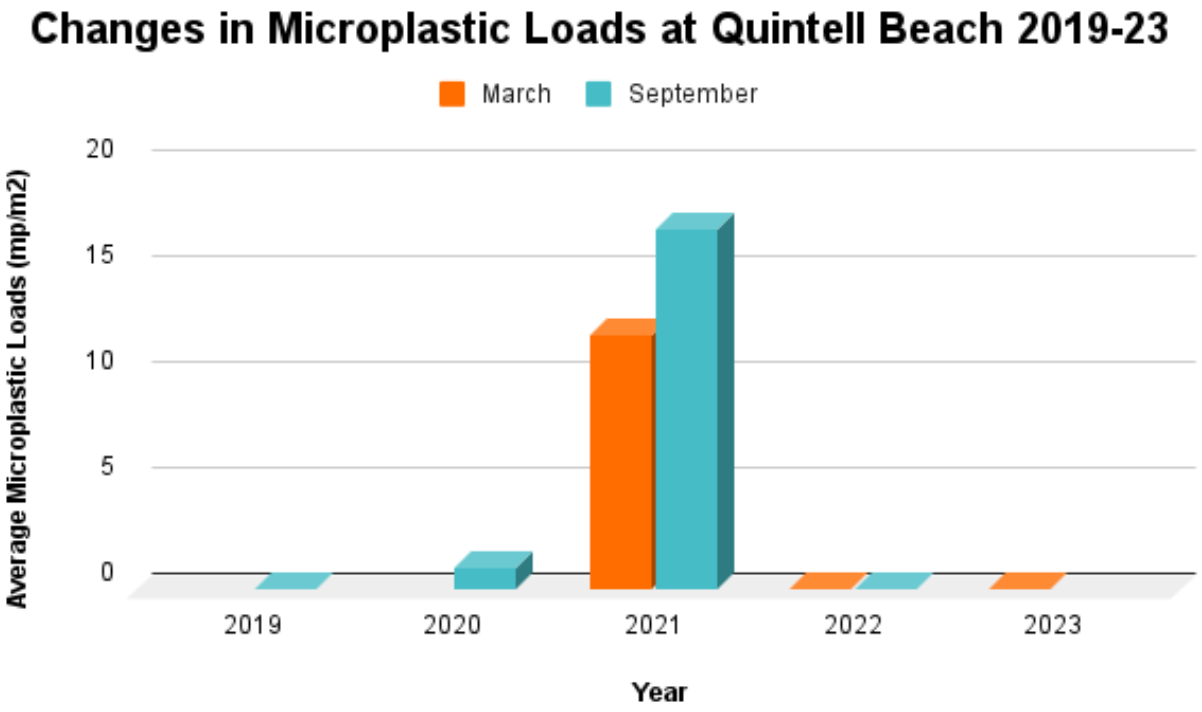

Figure 3. Changes in Microplastic Loads at Quintell from 2019-2023, including biannual samples where possible.

Region 2 - Wet Tropics

Figure 4. Wet Tropics sample locations and microplastic loads March 2023 (Green = Very Low).

Two surveys were undertaken at standard ReefClean sites in the Wet Tropics in March 2023 **(Figure 6)**. Both Flying Fish Point and Googarra Beach reported **Very Low** loads of microplastic debris, ranging from 0 to 2 mp/m^2 **(Table 3).** This is consistent with prior results which have typically observed **Very Low** to **Low** concentrations in this region.

Table 3. *Summary of previous ReefClean microplastic sampling activities in the Wet Tropics Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
		Four Mile Beach (Feb)	0	Four Mile Beach (Mar)	3	Four Mile Beach (Mar)	2		
		Four Mile Beach (Sept)	1	Four Mile Beach (Sept)	5	Four Mile Beach (Sept)	0		
				Flying Fish Point (Sept)	5	Flying Fish Point (Mar)	0	Flying Fish Point (Mar)	0
						Flying Fish Point (Sept)	1		
				Googarra Beach (Mar)	15	Googarra Beach (Mar)	0	Googarra Beach (Mar)	1
				Googarra Beach (Sept)	0	Googarra Beach (Sept)	2		
Michaelmas Cay	0	Lucinda (Feb)	81	Coconuts (Sept)	32				
Holloways Beach	8	Lucinda (Sept)	7	Hull Heads (Sept)	0				
Cairns Esplanade	0	Hinchinbrook Island	1						
Kurrimine Beach	0								

Both Flying Fish Point and Googarra Beach have been sampled consistently since 2021. Loads at these sites have remained **Very Low** according to AUSMAP's rating scale, with the exception of Googarra Beach which recorded a **Low** result of 15 mp/m^2 in March 2021 **(Table 3).** It was posited in prior ReefClean reports that this result remains within normal variation for Googarra Beach, with repeated **Low** values in 2022 and March 2023 reinforcing this. These trends are presented below in **Figure 5**. This year's sample was composed of only one hard fragment that was blue in colour and within the 2-3 mm size category.

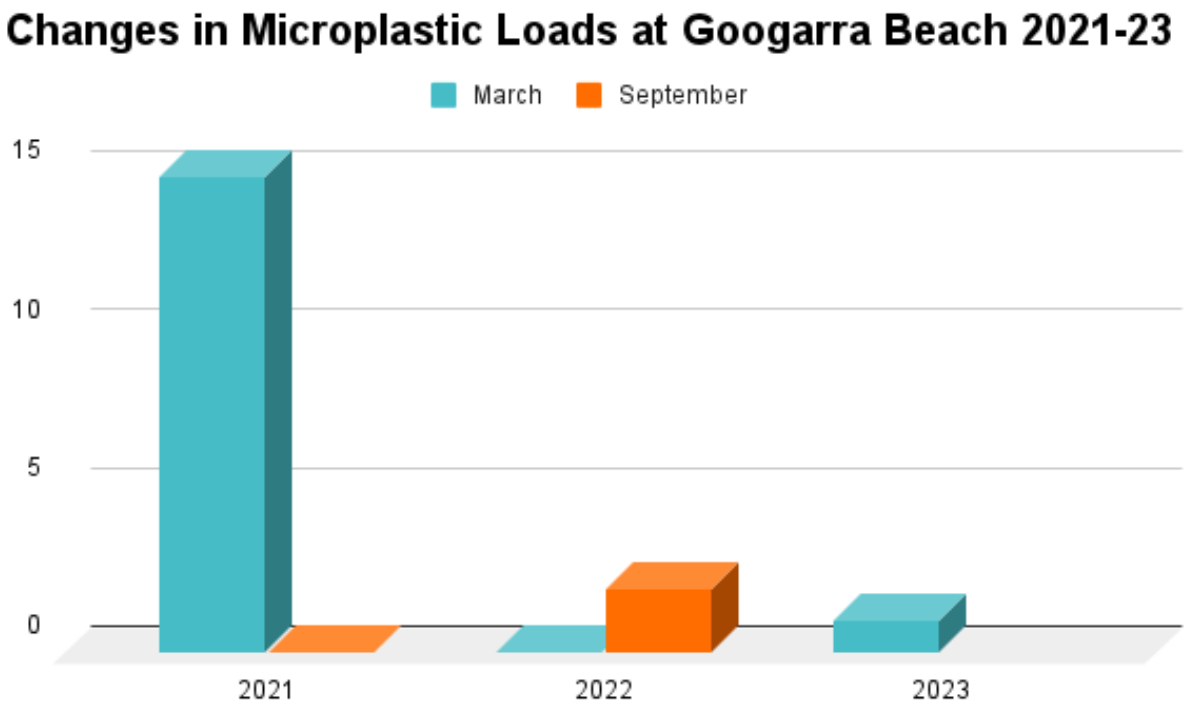

Figure 5. Changes in Microplastic Loads at Googarra Beach from 2021-2023, including biannual samples where possible.

Region 3 - Burdekin

Figure 6. *Burdekin sample locations and microplastic loads March 2023 (Green = Very Low).*

One survey was conducted at Queens Beach during March 2023 **(Figure 6)**. This site has been sampled 6 times since 2020 which provides an ideal reference point to observe trends **(Table 4; Figure 6)**.

Table 4. *Summary of previous ReefClean microplastic sampling activities in the Burdekin Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
Shelly Cove	11	Shelly Cove	0	Shelly Cove (Mar)	1	Shelly Cove (Mar)	2		
				Shelly Cove (Sept)	0	Shelly Cove (Sept)	0		
		Alva Beach	0	Alva Beach (Mar)	111	Alva Beach (Mar)	7		
				Alva Beach (Sept)	4	Alva Beach (Sept)	0		
		Queens Beach	0	Queens Beach (Mar)	14	Queens Beach (Mar)	5	Queens Beach (Mar)	1
				Queens Beach (Sept)	4	Queens Beach (Sept)	0		
Alma Bay	27	Alma Bay	209						
Orpheus Island	20	Nelly Bay	5	Bowen Water Park Beach	3				
		Geoffrey Bay	0						

The survey result from March 2021 of 14 mp/m^2 remains the highest value at this site, with all other results remaining within the **Very Low** category on AUSMAP's grading scale. This year's result of 1 mp/m^2 is consistent with this decreasing trend **(Figure 7),** having contained a single particle in the category 'Other,' that was black in colour and > 5 mm in length. It is worth noting that all September samples in prior sample years in the Burdekin region demonstrated lower microplastic presence compared to March, which may suggest a seasonal influence and goes against data from the other regions.

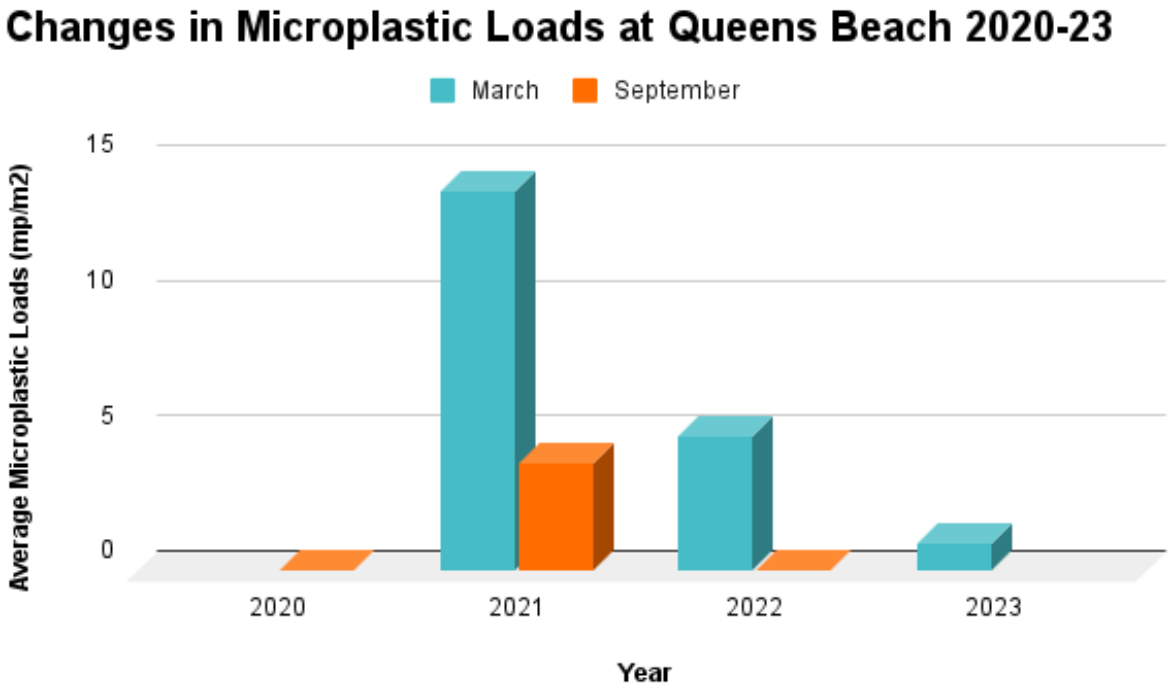

Figure 7. Changes in Microplastic Loads at Queens Beach from 2021-2023, including biannual samples where possible.

Region 4 - Mackay Whitsunday

Figure 8. *Mackay Whitsunday sample locations and microplastic loads March 2023 (Green = Very Low, Yellow = Low)*

Two sites were surveyed in the Mackay Whitsunday region in March 2023 **(Figure 8; Table 5)**. This is comparable to the volume of surveys completed in 2021, with Conway Beach and Harbour Beach being assessed in prior years **(Table 5)**. The highest microplastic load was observed at Conway Beach, with 15 mp/m^2 found in March 2023, signifying a **Low** load according to AUSMAP's grading scale. Conway Beach was also found to have the highest regional microplastic loads in 2022, where a result of 11 mp/m^2 was recorded in March **(Table 5).**

Table 5. *Summary of previous ReefClean microplastic sampling activities in the Mackay Whitsunday Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate; Red = High).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
		Conway Beach	3	Conway Beach (Mar)	1	Conway Beach (Mar)	11	Conway Beach (Mar)	15
				Conway Beach (Sept)	2	Conway Beach (Sept)	2		
				Conway Beach (Dec)	14				
		Harbour Beach	8	Harbour Beach (Mar)	1	Harbour Beach (Mar)	1	Harbour Beach (Mar)	4
				Harbour Beach (Sept)	11	Harbour Beach (Sept)	7		
		Half Tide Beach	1	Half Tide Beach (Mar)	140	Half Tide Beach (Mar)	0		
				Half Tide Beach (Sept)	311				
Cannonvale	7								

Harbour Beach maintained a **Very Low** result from March 2022 to March 2023 **(Table 5)**, which is in line with additional **Very Low** results from March and September of 2020. These figures help to place the **Low** microplastic load of 11 mp/m^2 obtained in September 2021, within the context of broader trends. Given that additional sites in the Mackay Whitsunday region also recorded higher than average results in 2021, including **High** microplastic loads of 140 and 311 mp/m^2 at Half Tide Beach **(Table 5),** this elevated result was likely influenced by abnormal weather conditions.

Additional analysis on this year's March sample from Conway Beach indicated that it was composed mainly of hard fragments (93%) and pellets (7%). Hard fragments were additionally dominant in samples from March 2022, highlighting a consistent trend in plastic types. The presence of pellets is concerning as it implies an industrial land-based source. Pellets or nurdles, are a primary microplastic which can be derived from virgin or recycled plastic and are moulded into a wide variety of products. This microplastic type is currently the source of major concern due to their mismanagement during storage and transport, and propensity to enter waterways via nearby stormwater networks. Microplastic colours at Conway Beach varied with a combination of blue (60%), white (33%) and clear (7%) particles found. Size also varied greatly from 1 to >5 mm in diameter. This result remains within AUSMAP's **Low** category and is within expected normal variation at Conway Beach, which has fluctuated within this category since it was first sampled in 2020 **(Figure 8).**

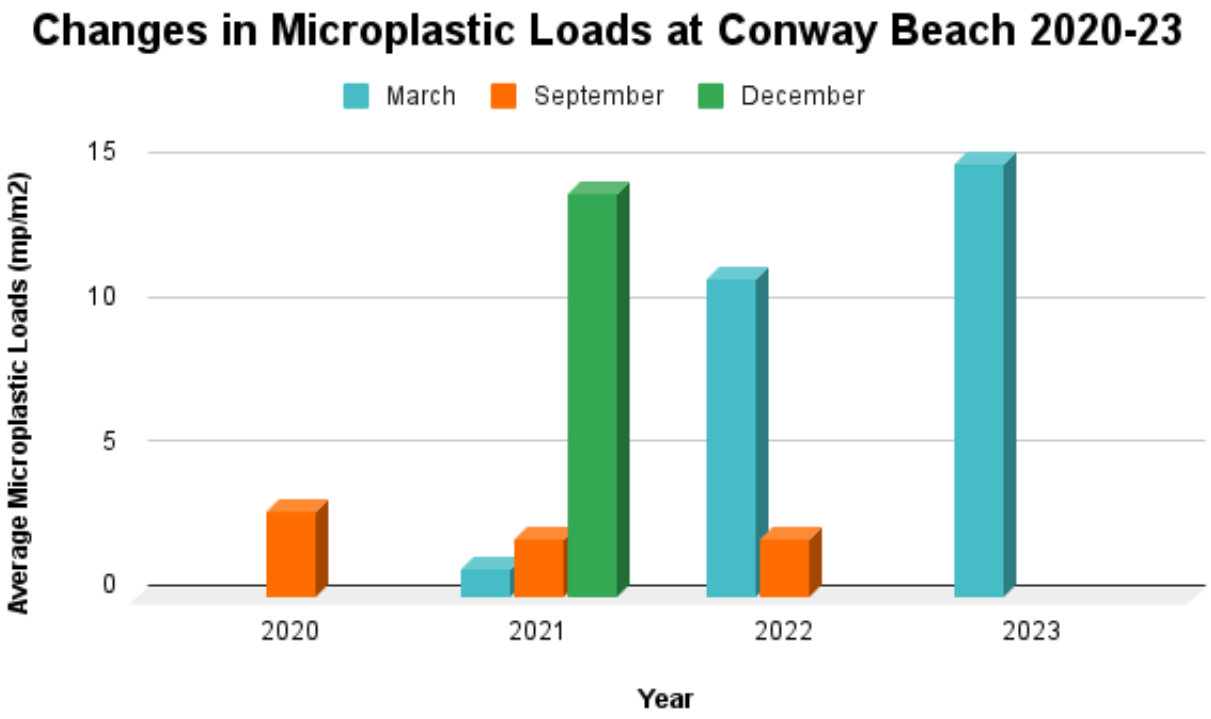

Figure 8. Changes in Microplastic Loads at Conway Beach from 2021-2023, including biannual samples where possible.

Region 5 - Fitzroy

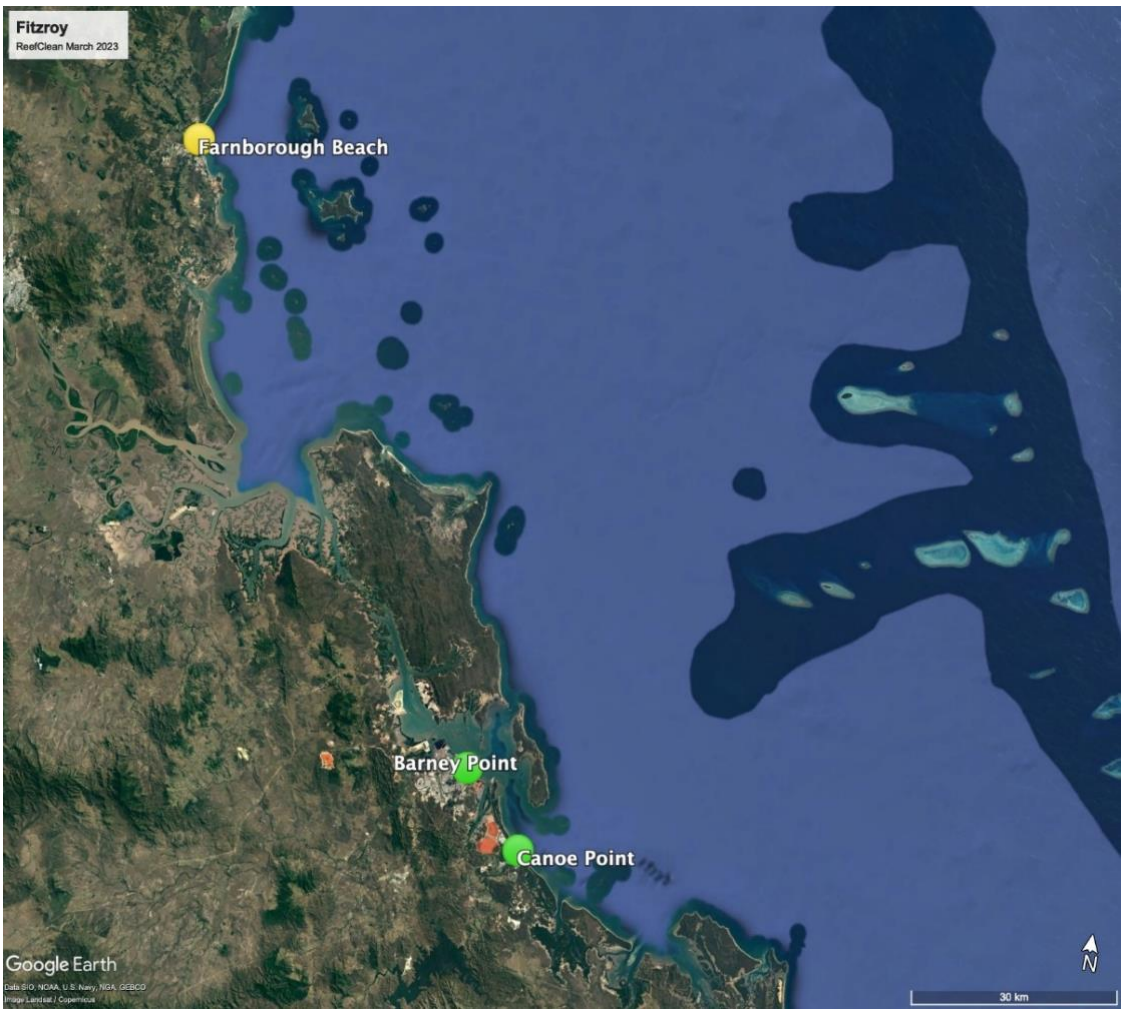

Figure 9. *Fitzroy sample locations and microplastic loads March 2023. (Green = Very Low, Yellow = Low)*

The Fitzroy region was surveyed at three standard ReefClean sites in March 2023, including Canoe Point, Farnborough Beach and Barney Point **(Figure 9)**. Each of these sites have been sampled in at least three prior sample years, providing a valuable baseline to identify trends **(Table 6).** Microplastic loads within this region ranged from **Very Low** to **Low**, with the highest load recorded at Farnborough Beach with 19 mp/m^2 **(Table 6)**.

Table 6. *Summary of previous ReefClean microplastic sampling activities in the Fitzroy Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
Canoe Point	16	Canoe Point	0	Canoe Point (Mar)	0	Canoe Point (Mar)	11	Canoe Point (Mar)	6
				Canoe Point (Sept)	2	Canoe Point (Sept)	0		
		Farnborough Beach	23	Farnborough Beach (Mar)	5	Farnborough Beach (Mar)	23	Farnborough Beach (Mar)	19
						Farnborough Beach (Dec)	0		
				Barney Point (Mar)	1	Barney Point (Mar)	24	Barney Point (Mar)	2
				Barney Point (Sept)	4	Barney Point (Sept)	0		
						Heron Island (Dec)	0		

Farnborough Beach has been a recurring survey site and has fluctuated from **Very Low** to **Low** loads since it was initially surveyed in 2020 **(Table 6).** As it recorded the highest loads for the Fitzroy region in March 2023 with 19 mp/m^2, further analysis of the sample was undertaken. This showed that it was dominated by hard fragments (100%) which were described as 'weathered' in some cases, likely due to the length of time that they had been in the environment. These were mainly white in colour (47%) or opaque (32%) and were between 3-5mm in size. This survey result is consistent with prior ReefClean years.

Both Canoe Point and Barney Point showed decreasing trends from March 2022 to 2023, with loads of 6 mp/m^2 and 2 mp/m^2, respectively **(Table 6)**. The greatest reduction was at Barney Point which recorded 24 mp/m^2 in 2022, a record high for this site **(Table 6)**. Canoe Point has also demonstrated decreasing loads since 2019 and holds the longest sample dataset within the Fitzroy Region which provides an excellent baseline dataset **(Figure 10).**

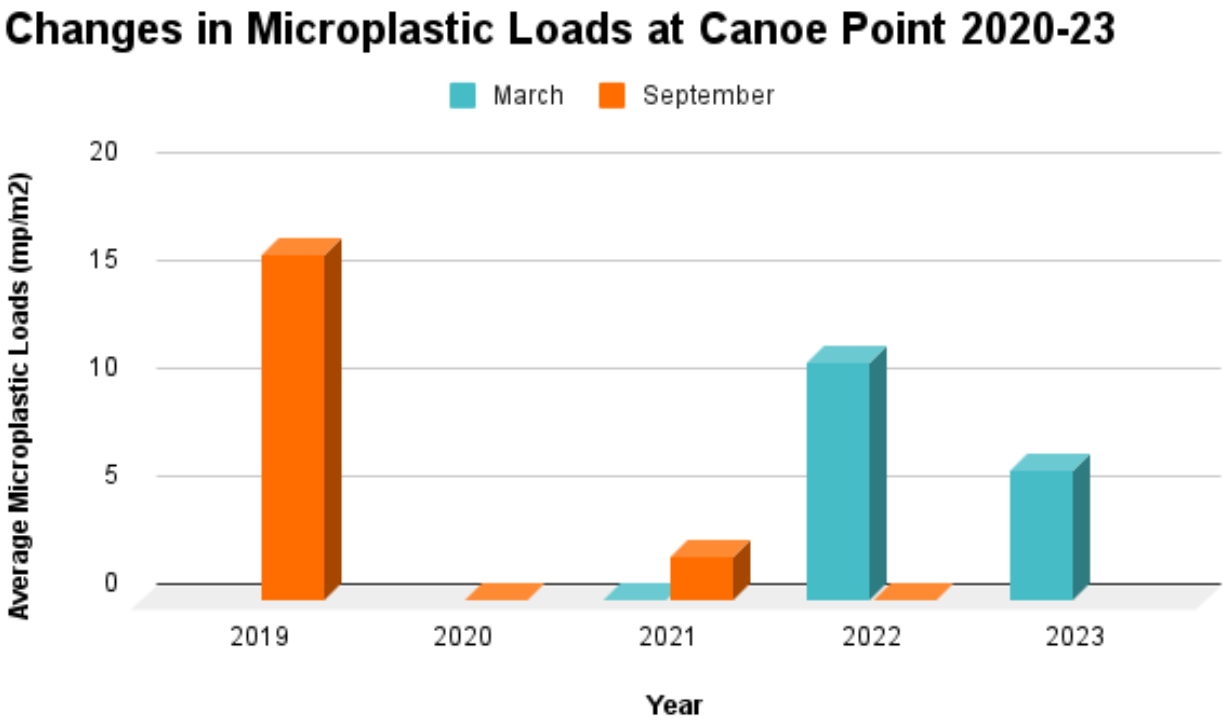

Figure 10. Changes in Microplastic Loads at Canoe Point from 2021-2023, including biannual samples where possible.

Region 6 - Burnett Mary

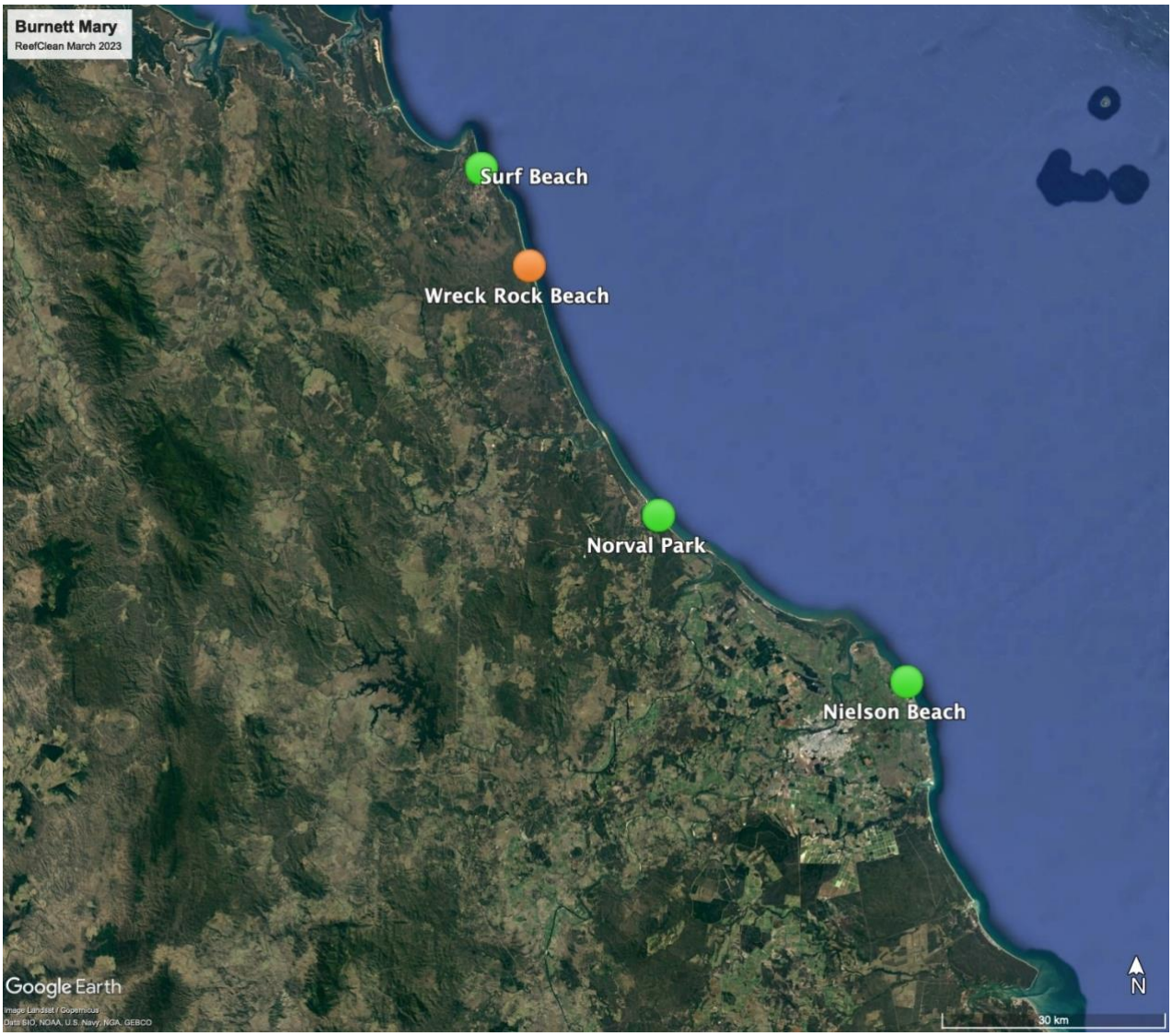

Figure 11. *Burnett Mary sample locations and microplastic loads March 2023 (Green = Very Low; Orange = Moderate)*

Three surveys were undertaken at the regular ReefClean sites within the Burnett Mary Region in March 2023, including at repeat ReefClean sites: Surf Beach, Norval Park Beach and Nielson Beach **(Figure 11)**. Of these samples, the highest microplastic sample was recorded at Surf Beach with 6 mp/m^2, which remains within the **Very Low** category. There was an additional opportunistic survey undertaken at Wreck Rock Beach which recorded 224 mp/m^2 - the highest value ever found within the Burnett Mary Region, considered as a **Moderate** level of microplastics that should be monitored to ensure no further increases.

Table 7. *Summary of previous ReefClean microplastic sampling activities in the Burnett Mary Region from 2019, 2020, 2021, 2022 and 2023. All samples are included from each sample year. Where no repeat sample was collected, cells have been omitted. Microplastics measured in mp/m^2 (Green = Very Low; Yellow = Low; Orange = Moderate).*

Site and Microplastic Level (2019) (mp/m^2)		Site and Microplastic Level (2020) (mp/m^2)		Site and Microplastic Level (2021) (mp/m^2)		Site and Microplastic Level (2022) (mp/m^2)		Site and Microplastic Level (2023) (mp/m^2)	
Surf Beach	2	Surf Beach	0	Surf Beach (Mar)	6	Surf Beach (Mar)	86	Surf Beach (Mar)	6
				Surf Beach (Sept)	68	Surf Beach (Sept)`	0		
		Norval Park Beach	0	Norval Park Beach (Mar)	3	Norval Park Beach (Mar)	0	Norval Park Beach (Mar)	0
				Norval Park Beach (Sept)	5	Norval Park Beach (Dec)	0		
				Nielson Beach (March)	8	Nielson Beach (Mar)	0	Nielson Beach (Mar)	1
				Nielson Beach (Sept)	11	Nielson Beach (Dec)	0		
Bargara	1	Bargara	0						
Miara	0								
								Wreck Rock Beach (Mar)	224

Both Norval Park and Nielson Beach continued to record **Very Low** microplastic loads in March 2023 with results of 0 mp/m^2 and 1 mp/m^2 respectively. This supports the understanding that higher than average loads in 2021, where Norval Park Beach recorded 3 mp/m^2, and 5 mp/m^2 and Nielson Beach had 8 mp/m^2 and 11 mp/m^2, were the product of weather conditions rather than representing an upwards trend **(Table 7)**.

An opportunistic sample collected from Wreck Rock Beach, not previously surveyed, had a **Moderate** result of 224 mp/m^2, which was composed of hard fragments (84%), pellets (15%) and film (1%)**.** These microplastics varied in colour ranging from 2 to 5 mm in size**.** The presence of hard fragments is consistent with surveys in the Burnett Mary region, however as mentioned above, pellets are a cause for concern. The relatively close proximity of Surf Beach, where pellets were found in 2022, to Wreck Rock Beach may indicate a local industrial source nearby**.**

Moreover, Surf Beach recorded 6 mp/m^2 during this year's sampling session, a sharp decline from **Moderate** results in September of 2021 and March of 2022, with 68 mp/m^2 and 86 mp/m^2, respectively. The return to **'Very Low'** microplastic loads in September of 2022 and March 2023 is encouraging. Concern was expressed in the 2022 ReefClean report regarding the presence of primary pellets or 'nurdles', however they were absent in this March sample. Together these surveys comprise the longest sample effort in the Burdekin region, having been sampled 7 times since 2019 **(Figure 12).**

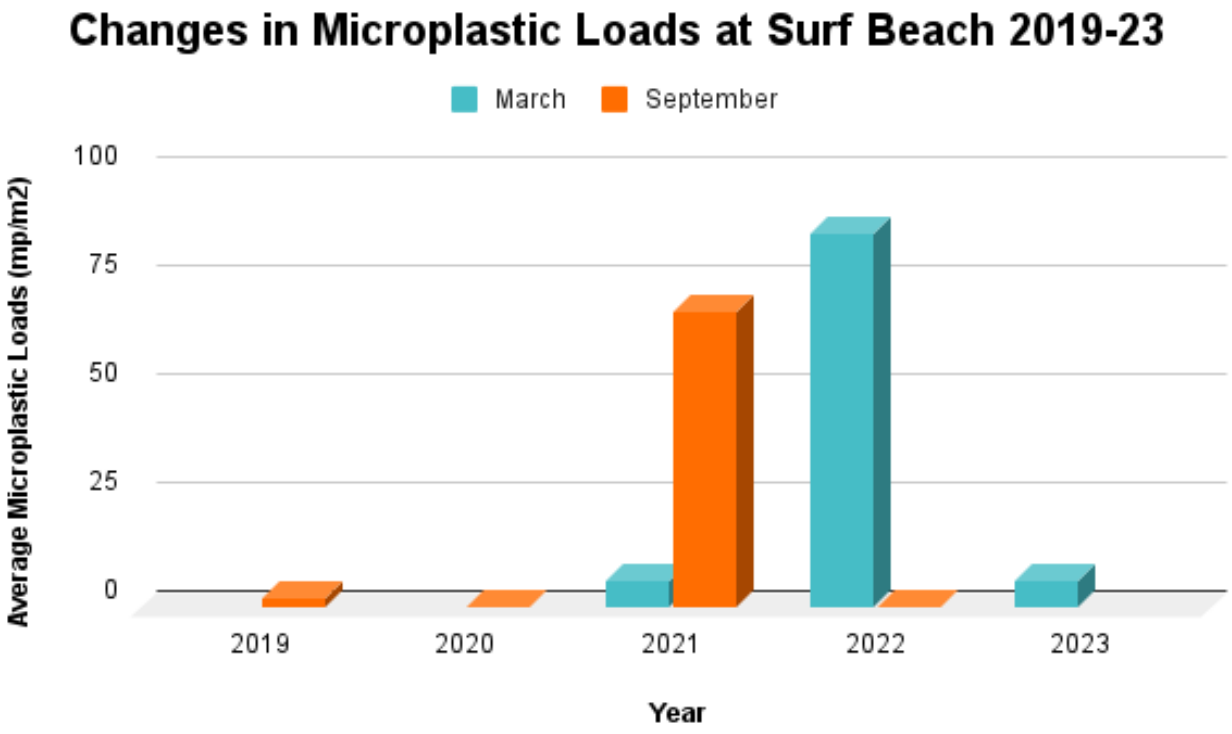

Figure 10. Changes in Microplastic Loads at Canoe Point from 2021-2023, including biannual samples where possible.

Potential Sources of Microplastics

As with prior years, ReefClean sampling during March 2023 identified hard plastic fragments as the dominant microplastic type, which were mainly blue, opaque or white. This trend has been evident since microplastic sampling commenced in 2019, highlighting that there are consistent inputs of hard fragments into the GBR catchments. Previous reports have noted that these are categorised as *secondary microplastics,* as they typically break off from larger plastic items due to ultraviolet photodegradation, aeolian action and wave force. The colours are also reflective of that used in common plastic products.

It is challenging to understand the source of these hard fragments due to their widespread nature, and potential to have travelled via ocean currents from South-East Asia. AUSMAP's method of classifying plastics according to their colour, shape and relative age provides a tentative step towards potential source identification though is largely limited to local source tracking at a specific site rather than across a specific catchment. For example, some hard fragments found at Farnborough Beach in March 2023, were described as 'weathered' which suggests that they had been in the marine environment for extended periods and had potentially originated from distant sources. Similarly, the very high levels found previously in the Cape York Region are likely to be sourced from offshore rather than nearshore. However, for the most part the microplastics found would more than likely be sourced nearby (e.g., within the locality or region). Inferences regarding their origin point can be made based on the condition of the microplastics which typically show signs of degradation and biofouling when they have been in the environment for a prolonged period of time.

Moreover, there were fewer nurdles found in March 2023, than found in 2022 ReefClean samples. Their presence is typically an indication of a local industrial source, as these primary microplastics are easily spilled in storage and transportation. In 2022, nurdle concentrations were flagged at Harbour Beach (~14%), and Surf Beach (18%). No nurdles were identified in samples from March 2023 at either of these sites, however further sampling would confirm this by accounting for seasonal depositional differences. Instead, nurdles were only found at Conway Beach (7% pellets) and Wreck Rock Beach (15% nurdles). As with above, only through ongoing sampling can we determine a consistent litter input and attempt to implement source tracking methods.

With close to five complete years of ReefClean survey data, it is evident that microplastic loads and types are subject to temporal and spatial variability. This dataset now comprises the baseline through which further surveys at each site and across NRMs can be compared, which is crucial to conserving the health of the iconic GBR.

Ongoing biannual monitoring is recommended to ensure that intervention can occur according to AUSMAP's hotspot scale, and relevant councils, communities and government agencies can work collaboratively to address the sources of microlitter.

Final Conclusions and Recommendations

As has been mentioned throughout this report, ongoing sampling is imperative to better understand the trends observed throughout this monitoring and assessment program and build our knowledge on what factors contribute to their variability. Therefore, it is recommended that bi-annual sampling continue across the standard ReefClean monitoring sites. It would also be beneficial for future sampling to consider sites that are yet to be catalogued, including those with higher urban density, proximity to industrial areas, or potential to receive waste from South-East Asia via ocean currents. This would help to construct a more widespread understanding of microplastic trends throughout the GBR and each NRM and allow for more targeted action to take place.

AUSMAP's grading scale should be utilised as a guide for when further intervention may be warranted at a given site, with source tracking generally being recommended for sites recording consistent **High** values (251-1,000 mp/m^2). For sites where **Moderate** levels (51-250 mp/m^2) are recorded, intervention may be warranted earlier to address a potential new local litter input.

Source tracking typically utilises a combination of catchment-specific sampling techniques, such as end-of-stormwater-pipe netting and street-level drain trap analysis to determine single or multiple microplastic sources. From this, targeted intervention can occur in partnership with relevant stakeholders to reduce their volumes in the GBR. Successful trials of this framework have been conducted in NSW and SA, with measurable action and positive outcomes being yielded from both projects. Ultimately, everyone stands to benefit from clean and healthy waterways, with the protection of the iconic GBR remaining a pivotal priority beyond the conclusion of the ReefClean Project.

AUSMAP would like to thank all of the ReefClean partnering organisations and volunteers for their support and efforts in conducting microplastic surveys during the ReefClean project.

Reef Check Australia
Capricornia Catchments
Eco Barge Clean Seas
OceanWatch Australia
South Cape York Catchments
Whitsunday Catchment Landcare
Pioneer Catchment Landcare Group
Australian Government Reef Trust

Australian Microplastic Assessment Project (AUSMAP)
Total Environment Centre
ABN 54 152 721 302

PO Box K61
Haymarket, NSW, 1240
Australia

+61 2 9211 5022
info@ausmap.org www.ausmap.org