HEALTHY WATERS PARTNERSHIP dry tropics

Townsville Dry Tropics
Waterways Report Card 2024

TECHNICAL REPORT

PART 5: Inshore Marine

Reporting on data collected 2022 - 2023

12 Inshore Marine Environment

Within the inshore environment, water quality and habitat are the two indices scored. Each of these indices are made up of indicator categories and indicators which are updated annually. All indicator categories use data provided by multiple partners of the Partnership team.

Index scores are calculated for the Cleveland Bay Inshore Marine Zone, and the Halifax Bay Inshore Marine Zone.

12.1 Water Quality

The water quality index for the Inshore Marine Environment of the Townsville Dry Tropics regions consists of three indicator categories: Nutrients, Physical-Chemical Properties, and Chlorophyll *a*. These are divided into eight indicators and for each indicator the parameters used to calculate scores are the:

- Water Quality Objectives (WQOs), and
- Annual means or medians (depending on the indicator), calculated from the monthly medians or means.

The Townsville Dry Tropics Methods Document (2024) provides definitions of the WQOs and guidelines for using mean or median values. Values can also be found in Appendix VV and Appendix XX.

The nutrients indicator category is comprised of four indicators, Nitrogen Oxides (NOx), Particulate Nitrogen (PN), Particulate Phosphorus (PP), and Total Phosphorus (TP). The scores for nutrients are averaged from the scores of the four indicators. The physical-chemical properties indicator category is comprised of three indicators, Turbidity, Total Suspended Solids (TSS), and Secchi Depth, and the score is calculated as the average from the scores of the three indicators. Finally, the Chlorophyll *a* indicator category is comprised of only one indicator, the Chlorophyll *a* indicator.

12.1.1 Monitoring Sites

In the 2022–2023 technical report, water quality data was collected from 20 sites (codes). Sites were grouped into eight geographic areas, six sub zones, and two zones as detailed in Table 57, with locations presented in Figure 21.

Table 57. Townsville Dry Tropics Inshore Marine water quality site summary.

Zone	Sub Zone	Geographic Area	Number of Sites
Cleveland Bay	Enclosed Coastal	Enclosed Coastal: Inside Port Zone	3
		Enclosed Coastal: Outside Port Zone	4
	Open Coastal	Open Coastal: Inside Port Zone	1
		Open Coastal: Outside Port Zone	3
	Magnetic Island	Magnetic Island	3
Halifax Bay	Enclosed Coastal	Enclosed Coastal	2
	Open Coastal	Open Coastal	2
	Midshelf	Midshelf	2

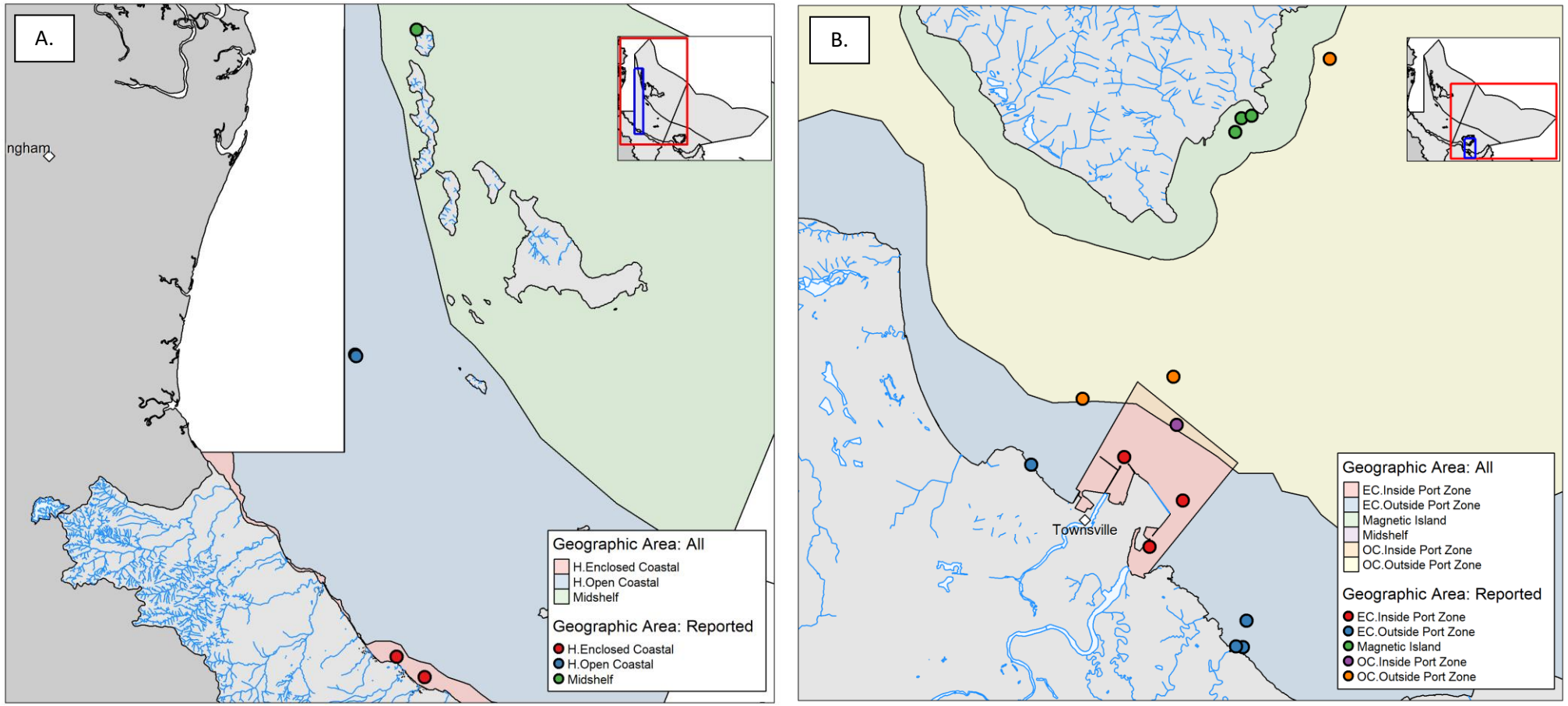

Figure 19. Inshore Marine Zones (A. = Halifax Bay, B. = Cleveland Bay), and Geographic Areas (see legend).

12.1.2 Overall Summary: Inshore Water Quality

The water quality index was graded as "good" in both Cleveland and Halifax Bay. This marks a decrease in score in Cleveland Bay (78 to 73), and an increase in score in Halifax Bay (69 to 73) (Table 58). The change in both bays was driven predominantly by a change in the physical-chemical properties indicator category.

Table 58. Current and previous water quality scores and grades for the Townsville Dry Tropics Inshore Marine Environment.

Zone	Nutrients	Phys-Chem Properties	Chlorophyll *a*	Water Quality				
				22-23	21–22	20–21	19–20	18–19
CB	84	48	87	73	78	73	79	36
HB	77	76	68	73	69	73	54	45

Standardised scoring range: ■ Very Poor (E) = 0 to <21 | ■ Poor (D) = 21 to <41 | ■ Moderate (C) = 41 to <61 | ■ Good (B) = 61 to <81 | ■ Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.1.2.1 *Key Messages*

- The Cleveland Bay inshore marine zone grade remained "good" although the score declined slightly from 78 to 73.
    - Most influential was a combination of the Turbidity and Secchi indicators in the Enclosed Coastal and Open Coastal sub zones.
- The Halifax Bay inshore marine zone grade remained "good" although the score increased slightly from 69 to 73.
    - Most influential was a combination of the Nitrogen Oxides (NOx) indicator category in the Enclosed Coastal sub zone, and the Turbidity and Total Suspended Solids (TSS) indicators in all sub zones.

12.1.3 Updated Methodology

Following a review of EPP water quality objectives (WQOs) the methodology used to calculate the inshore marine water quality scores and grades has been updated. In previous methods, the mean value of the NOx indicator was compared against the WQO values, this has been changed so that the median value of the NOx indicator is now compared. All prior results have been back calculated and are presented in Table 58.

12.1.4 Nutrients

For the 2022–2023 technical report the nutrients indicator category is comprised of four indicators, Nitrogen Oxides (NOx), Particulate Nitrogen (PN), Particulate Phosphorus (PP), and Total Phosphorus (TP), however not all indicators are measured at each site (determined by data provider). The scores and grades for Cleveland and Halifax Bay, and their associated sub zones are presented in Table 59. Annual mean or median values (depending on the indicator), samples collected, months sampled, and WQOs are presented in Appendix VV. Historical scores are presented in Appendix WW.

12.1.4.1 *Results: Inshore Nutrients*

Cleveland Bay received a nutrient indicator category score of 84 (very good). Within the zone, the enclosed coastal and open coastal sub zones received nutrient indicator category grades of "very good" (100), however the Open Coastal Outside Port Zone did not receive NOx scores due to the LOR

for the laboratory being unable to detect concentrations lower than the WQO[6] (despite data being available). The Magnetic Island Sub Zone received a grade of “poor” (22). All three indicators in this sub zone (NOx, PN, and PP) were graded as “poor” or “very poor” with scores of 19, 8, and 40 respectively (Table 59).

A low nutrients indicator category score in the Magnetic Island Sub Zone relative to other sub zones could be attributed to several factors. Considerations includes the use of different indicators and water quality objectives (WQOs), different sampling times and frequency, or differences in sampling programs and analysis methods (for example, LORs) (Appendix VV). It is also important to note that Magnetic Island Sub Zone is considered a world heritage area and such the WQOs must meet these strict standards. Equally, nutrient sources such as septic systems, large infrastructure projects in close proximity, and a greater exposure to large southern influences such as the Burdekin River may contribute to a low grade and score. A comparison of median values indicate that NOx concentrations were roughly equal to, or in some cases less than, the median values in other geographic areas (Appendix VV). Thus, it is possible to attribute differences in WQOs as the main driver of a low NOx score in the Magnetic Island Sub Zone for the 2022-2023 report. However, it is important to note that over several reports, the Magnetic Island Sub Zone has consistently received low scores and grades, and not always due to more stringent WQOs. It is likely that the multitude of unique geographic and regulatory characteristics of the Magnetic Island Sub Zone, in combination, continue to result in a low NOx score.

The poor grade for NOx in the Enclosed Coastal Outside Port Zone is likely influenced by similar factors as discussed above. However, the majority of the sampling sites in this geographic area are located in close proximity to the mouth of Sandfly Creek where the bay is very shallow and muddy, and can be affected by the tide and wind in addition to discharge from the Cleveland Bay Wastewater Treatment plant (Figure 21).

Halifax Bay Inshore received a nutrient indicator category score of 77 (good). Within the zone, the open coastal and midshelf sub zones received a nutrient indicator category grade of “good”, and the enclosed coastal sub zone received a grade of “very good” (Table 59). Across all indicators in all geographic areas, only the PN indicator did not receive a grade of “good” or “very good”. Instead, the PN indicator received a grade of “poor” in both the Open Coastal and Midshelf locations, which remain consistent with previous reporting years. Interestingly the NOx indicator shows signs of improvement from previous reporting years and should be carefully monitored to determine drivers.

[6] Data removed as the LOR was >= the WQO, and more than half of the concentration values were <= the WQO.

Table 59. Standardised scores and grades for the nutrient indicator category and indicators comprising the nutrient indicator category in the Townsville Dry Tropics Inshore Marine Environment.

Zone	Sub Zone	Area	NOx	PN	PP	TP	Nutrients	Zone Nutrients
Cleveland Bay	Enclosed Coastal	Inside Port Zone	100	ND	ND	100	100	84
		Outside Port Zone	100	ND	ND	100	100	
			100	ND	ND	100	100	
	Open Coastal	Inside Port Zone	100	ND	ND	100	100	
		Outside Port Zone	NA[7]	ND	ND	100	100	
			100	ND	ND	100	100	
	Magnetic Island	Magnetic Island	19	8	40	ND	22	
			79	8	40	100	84	
Halifax Bay	Enclosed Coastal	Enclosed Coastal	100	ND	ND	100	100	77
	Open Coastal	Open Coastal	100	32	63	ND	65	
	Midshelf	Midshelf	100	25	71	ND	65	
			100	29	67	100	77	

Standardised scoring range: ■ Very Poor (E) = 0 to <21 | ■ Poor (D) = 21 to <41 | ■ Moderate (C) = 41 to <61 | ■ Good (B) = 61 to <81 | ■ Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

[7] Data removed as the LOR was >= the WQO, and more than half (8 of 8) of the concentration values were <= the WQO.

12.1.5 Physical-Chemical Properties

For the 2022–2023 technical report the physical-chemical properties indicator category is comprised of three indicators, Turbidity (NTU), Total Suspended Solids (TSS), and (Secchi) Depth. The scores and grades for Cleveland and Halifax Bay, and their associated sub zones are presented in Table 60. Annual mean or median values (depending on the indicator and WQO), samples collected, months sampled, and WQOs are presented in Appendix XX. Historical scores are presented in Table 95.

12.1.5.1 *Results: Inshore Physical-Chemical Properties*

Cleveland Bay received a physical-chemical properties indicator category score of 48 (moderate). Within the zone, the enclosed coastal and open coastal sub zones received a grade of “poor” (36, 39) and the magnetic island sub zone received a grade of “very good” (91). Grades for indicators ranged from 0 to 89 for Turbidity, 0 to 100 for TSS, and 0 to 85 for Secchi (Table 60).

The wide range of scores and grades received for all indicators could be attributed to several factors, including the use of different water quality objectives (WQOs), different sampling times and frequency, or differences in sampling programs and analysis methods (Appendix XX). Equally, spatial variations such as proximity to large river outflows, distance offshore, and proximity to the Cleveland Bay shipping channel may contribute to a low grade and score. Some variation in indicators scores between geographic areas can be explained by differences in WQOs. For example, mean values for Secchi were similar in the Open Coastal Inside Port Zone and Open Coastal Outside Port Zone areas (1.2 and 1.1), but differences in WQOs resulted in significantly different standardised scores (72 and 0) (Table 60, Appendix XX). However, in the 2022-2023 the majority of scores and grades were driven predominantly by the concentrations measured for each indicator, rather than differences in WQOs. In the Enclosed Coastal Outside Port Sub Zone, the Secchi indicator did not record the same very low scores and grades as the Turbidity and TSS indicators as there is only one location where Secchi depth is monitored. The additional Turbidity and TSS sample sites are in close proximity to the mouth of Sandfly Creek where the bay is very shallow and muddy and can be affected by the tide and wind in addition to discharge from the Cleveland Bay Wastewater Treatment plant (Figure 21).

In the Enclosed Coastal Inside Port Sub Zone the Turbidity indicator score dropped from 100 in 2021-2022 to 28 in the current year. Investigation of the data found that the highest 50 percent of the readings were associated with higher turbidity readings further up the Ross River estuary than in the enclosed coastal zone with decreasing readings with distance from the river mouth. At the time of sampling strong ESE winds had prevailed for the preceding weeks, and the occasion of the highest results coincided with release of water from Ross Dam resulting in visible weeds in the water column. It is well known that plant material in the water column will contribute to high turbidity readings. Further factors occurring during this time included the Port of Townsville Channel Upgrade project, as well as standard port operations.

Halifax Bay received a physical-chemical properties indicator category score of 76 (good). Within the zone, both the Enclosed Coastal and Midshelf sub zone received a physical-chemical indicator category grade of “very good”, with the Open Coastal sub zone receiving a grade of “good”, and one received a grade of “moderate”. Across all indicators the “poor” grade for Secchi, driven largely by a “very poor” grade in the Open Coastal sub zone, contrasted the “very good” grade for TSS and Turbidity (Table 60). In the previous report it was noted that a spatial trend of improved water quality further offshore was apparent. Although this is not clearly evident in the grades and scores, a comparison of concentrations at each site once again supports this observation (Appendix XX).

Table 60. Standardised scores and grades for the physical-chemical properties indicator category and indicators comprising the physical-chemical properties indicator category in the Townsville Dry Tropics Inshore Marine Environment.

Zone	Sub Zone	Area	Turbidity	TSS	Secchi	Phys Chem	Zone Phys Chem
Cleveland Bay	Enclosed Coastal	Inside Port Zone	28	85	60	58	48
		Outside Port Zone	0	0	63	21	
			14	43	61	39	
	Open Coastal	Inside Port Zone	66	44	72	61	
		Outside Port Zone	30	3	0	11	
			48	24	36	36	
	Magnetic Island	Magnetic Island	89	100	85	91	
			42	46	56	48	
Halifax Bay	Enclosed Coastal	Enclosed Coastal	88	88	ND	88	76
	Open Coastal	Open Coastal	82	86	11	60	
	Midshelf	Midshelf	100	100	41	80	
			90	91	26	76	

Standardised scoring range: Very Poor (E) = 0 to <21 | Poor (D) = 21 to <41 | Moderate (C) = 41 to <61 | Good (B) = 61 to <81 | Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.1.6 Chlorophyll *a*

For the 2022–2023 technical report the Chlorophyll *a* indicator category is comprised of only one indicator, Chlorophyll *a*. The scores and grades for Cleveland and Halifax Bays, and their associated sub zones are presented in Table 61. Annual mean values, samples collected, months sampled, and WQOs are presented in Appendix XX. Historical scores are presented in Table 95.

12.1.6.1 *Results: Inshore Chlorophyll a*

Cleveland Bay received a Chlorophyll *a* indicator category score of 87 (very good). The Magnetic Island and Enclosed Coastal sub zones received grades of "very good" (84 and 90) and the Open Coastal Sub Zone was not graded (Table 61). Mean values were below objectives in all locations (Appendix XX).

Halifax Bay received chlorophyll *a* score of 68 (good). The Enclosed Coastal Water Sub Zone received a score of 100 (very good), the Open Coastal Waters Sub Zone received a score of 61 (good), and the Midshelf Sub Zone received a score of 43 (moderate). At each sub zone the grade decreases, from very good in the Enclosed Coastal Sub Zone to moderate in the Midshelf Sub Zone (Table 61). However, this result needs to be considered along with the differing WQO's with the WQO in the Enclosed Coastal more than four times higher than in the other sub zones (Appendix XX, Table 95).

Table 61. Standardised scores and grades for the Chlorophyll a indicator in the Townsville Dry Tropics Inshore Marine Environment.

Zone	Sub Zone	Area	Chl *a*	Zone Chl *a*
Cleveland Bay	Enclosed Coastal	Inside Port Zone	ND	87
		Outside Port Zone	90	
			90	
	Open Coastal	Inside Port Zone	ND	
		Outside Port Zone	ND	
			ND	
	Magnetic Island	Magnetic Island	84	
			87	
Halifax Bay	Enclosed Coastal	Enclosed Coastal	100	68
	Open Coastal	Open Coastal	61	
	Midshelf	Midshelf	43	
			68	

Standardised scoring range: Very Poor (E) = 0 to <21 | Poor (D) = 21 to <41 | Moderate (C) = 41 to <61 | Good (B) = 61 to <81 | Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.1.7 Overlap with the Wet Tropics Technical Report

The Townsville Dry Tropics reporting region shares four sites (BUR1, BUR2, Pandora, Pelorus) with the Wet Tropics reporting region (Appendix CCC). Underlying data is identical, however differences in aggregation and reporting style may result in minor discrepancies in the presentation of results.

12.1.8 Confidence Scores

Overall, there was low confidence in the results due to limited spatial and temporal sampling for some indicators in both bays (Table 62). For example, within Cleveland Bay almost all sites are within an 11km section of water near the coastline, despite the Enclosed Coastal Waters stretching more than 58km. It is noted that there is less development in these other areas and thus current monitoring may capture most of the areas impacted by human activities. More sampling, both along the coast and further offshore, would enable a more accurate understanding of the water quality within the inshore area.

Table 62. Confidence scores for the nutrients, physical-chemical properties, and Chlorophyll a indicator categories.

Indicator Category	Maturity (x0.36)	Validation (x0.71)	Representativeness (x2)	Directness (x0.71)	Measured error (x0.71)	Score (Rank)
Nutrients	2	3	1	3	1	7.6 (2)
Phys-Chem	2	3	1	3	1	7.6 (2)
Chlorophyll *a*	2	3	1	3	1	7.6 (2)

Rank based on score: 1 (very low) = 4.5 to 6.3; | 2 (low) = >6.3 to 8.1; | 3 (moderate) = >8.1 to 9.9; | 4 (high) = >9.9 to 11.7; | 5 (very high) = >11.7 to 13.5.

12.2 Habitat

The habitat index is comprised of two indicator categories: coral and seagrass, and both indicator categories source their results and discussion from reports published by partner organisations (Mckenna 2023, Thompson 2024).

12.2.1 Overall Summary: Inshore Habitat

Habitat scores where "moderate" in both Cleveland Bay (53) and Halifax Bay (47). Grades did not change in either bay, however scores decreased slightly in Cleveland Bay, and increased slightly in Halifax Bay. Neither bay received their highest or lowest scores since this technical report began, and once again these results provide insight into the mixed habitat health of the Inshore Marine Environment. This highlights that several intertwined factors play a role in the grades and scores of this indicator (Table 63).

Table 63. Standardised score for the Inshore Marine Environment habitat index.

Zone	Coral	Seagrass	Habitat Index				
			22-23	21-22	20-21	19-20	18-19
Cleveland Bay	39	68	53	57	54	48	56
Halifax Bay	47	ND	47	45	49	52	52

Coral Standardised scoring range: ■ = Very Poor: 0 to <21 | ■ = Poor: 21 to <41 | ■ = Moderate: 41 to <61 | ■ = Good: 61 to <81 | ■ = Very Good: 81 to 100.

Seagrass Standardised scoring range: ■ = Very Poor: 0 to <25 | ■ = Poor: 25 to <50 | ■ = Moderate: 50 to <65 | ■ = Good: 65 to <85 | ■ = Very Good: 85 to 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.2.1.1 *Key Messages*

- The Cleveland Bay inshore marine zone grade remained "moderate" although the score declined slightly from 57 to 53.
    - The seagrass grade within Cleveland Bay remained "good". The score declined slightly from 73 to 68, however can be explained by local environmental conditions.
        - Declines were region wide and not confined to areas closest to dredging activity, pointing to wider/regional drivers of change.
        - Unfavourable growing conditions for seagrass included a heatwave, above average out of season rainfall, sustained periods of high wind and multiple periods of low light conditions across many areas of the Bay.
        - As individual one-off events these unfavourable conditions were not likely to impact seagrass but the cumulative impact of them throughout the year were likely to have been behind the relatively small declines recorded in October 2022.
    - The total area of seagrass remained above the long-term average.
    - The coral grade with Cleveland Bay declined from "moderate" (41) to "poor" (39), however has fluctuated within this range for the past four years.
- The Halifax Bay inshore marine zone grade remained "moderate" although the score increased slightly from 45 to 47, neither its highest nor lowest in the past five years.
    - There remains a significant amount of macroalgae recorded at five of seven sites.

12.2.2 Coral

Coral data was primarily collected by the Great Barrier Reef Marine Monitoring Program (MMP)[8], and the Australian Institute of Marine Science's Long-term Monitoring Program (LTMP)[8]. Data was also collected by the citizen science group, Reef Check Australia (RCA)[8].

12.2.2.1 *Monitoring Sites*

Within Cleveland Bay six sites were sampled, with one site sampled twice by different monitoring programs (Geoffrey Bay). In Halifax Bay six sites were sampled, (Table 64). Reef locations are shown in Figure 22 and Figure 23, noting that the Palms West Reef consists of two sites.

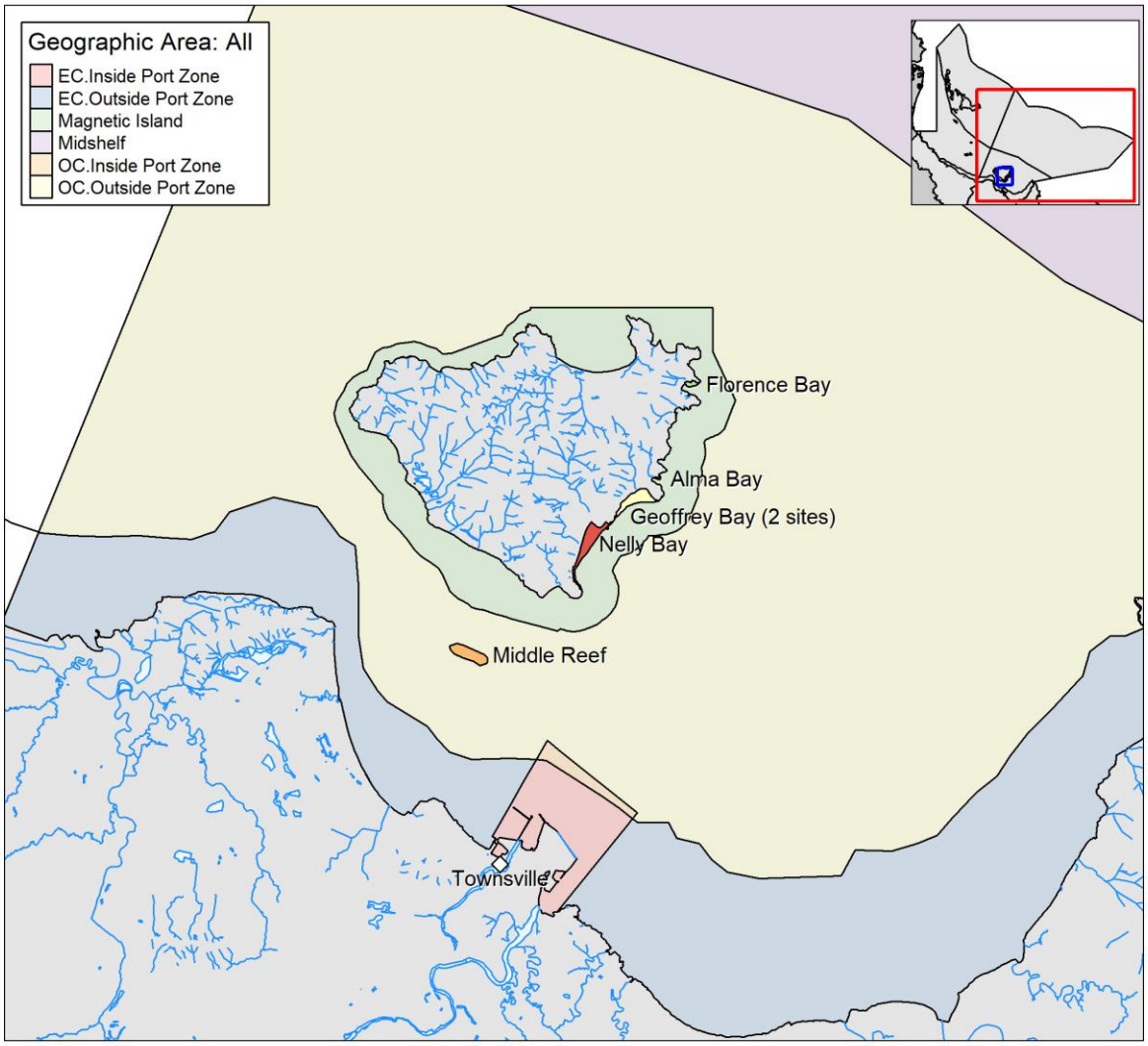

Figure 20. Coral reef sampling locations in the Cleveland Bay Inshore marine zone.

[8] MMP, LTMP, RCA

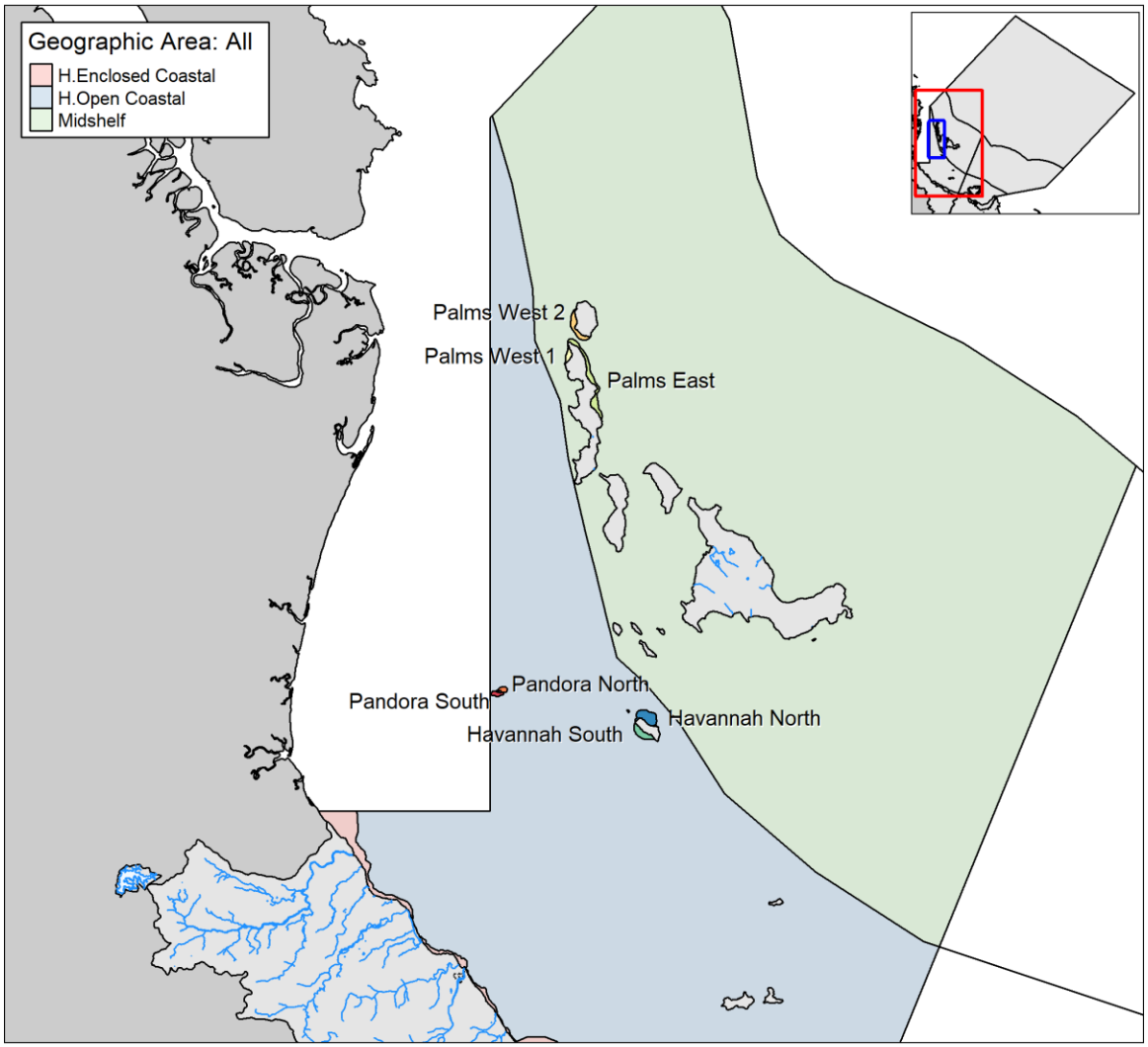

Figure 21. Coral reef sampling locations in the Halifax Bay Inshore marine zone.

Table 64. Inshore Marine coral sampling locations and sampling programs.

Zone	Sampling Program	Sampling Site	ID
Cleveland Bay	MMP & RCA	Geoffrey Bay	1
	RCA	Alma Bay	2
		Florence Bay	3
		Middle Reef	4
		Nelly Bay	5
Halifax Bay	MMP	Palms East	6
		Palms West	7
		Pandora South	8
		Havannah South	9
	LTMP	Pandora North	10
		Havannah North	11

12.2.2.2 *Results: Inshore Coral*

In Cleveland Bay, the grade for the coral indicator category was "poor", with a score of 39. In Halifax Bay, the grade for the coral indicator category improved from the previous reporting period with a score of 47 (moderate). These results show a mixed trend of overall coral health and recovery as reefs have been exposed to pressures, such as increased water temperatures that contributed to coral bleaching in 2020 (Table 65).

Table 65. Inshore Marine Environment coral indicator category scores for current and previous technical reports.

Zone	Coral Standardised Score				
	22-23	21–22	20–21	19–20	18–19
Cleveland Bay	39	41	36	44	38
Halifax Bay	47	45	48	50	52

Standardised scoring range: ■ Very Poor (E) = 0 to <21 | ■ Poor (D) = 21 to <41 | ■ Moderate (C) = 41 to <61 | ■ Good (B) = 61 to <81 | ■ Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

Discussion has been paraphrased from the Marine Monitoring Program Annual Report for inshore coral reef monitoring 2022-23 report and applies to the Cleveland Bay and Halifax Bay sites collectively. Reference: (Thompson 2024).

"Coral Composition received a score of 'good' and has remained stable on the boundary of 'good' and 'moderate' since 2021. The Coral cover indicator score remained categorised as 'moderate' having continued to increase since 2013. In 2023 hard coral cover had increased at Geoffrey Bay, Palms East, Havannah South, Pandora North, and Havannah North. Increases were attributed to recovery of *Acropora, Montipora, Goniopora* and *Alveopora*, and Merulinidae. The regional rate of increase in hard coral cover over the last four years remained within modelled expectations as reflected by the 'moderate' score for the Cover change indicator score, however, the rate of hard coral recovery was 'poor' at Pandora South and Havannah North.

The Macroalgae indicator score has continued to decline and remains 'very poor'. Very poor scores were recorded at Geoffrey Bay, Pandora South, Havannah South, Pandora North, and Havannah North. Where the cover of macroalgae was high, the macroalgal communities were dominated by large brown species of the genus *Lobophora* and/or Family Sargassaceae.

The Juvenile coral indicator remained categorised as 'poor', although has increased at Geoffrey Bay, Palms East, Palms West, Pandora South, and Havannah South. Decreases were recorded at Pandora North and were greatest at Havannah North. Influential in the regional decline in juvenile densities in recent years have been declines in genus *Turbinaria* as strong cohorts that settled on some reefs following cyclone Yasi have died or grown beyond the juvenile size classes" (Thompson 2024).

Table 66. Inshore Marine coral indicator and indicator category scores for all sites and zones.

Zone	ID	Hard Coral Composition	% Coral Cover	% Change Hard Coral	Juvenile Density	Macroalgae	Indicator Category
Cleveland Bay	1	50	51	65	29	0	39
	2	ND	63	ND	ND	ND	ND
	3	ND	65	ND	ND	ND	ND
	4	ND	70	ND	ND	ND	ND
	5	ND	25	ND	ND	ND	ND
Cleveland Bay		50	53	65	29	0	39
Halifax Bay	6	100	67	29	27	100	65
	7	0	51	49	52	100	50
	8	75	25	34	31	20	37
	9	100	53	44	30	0	45
	10	0	85	44	40	11	36
	11	100	29	50	62	0	48
Halifax Bay		62	52	42	40	38	47

Standardised scoring range: Very Poor (E) = 0 to <21 | Poor (D) = 21 to <41 | Moderate (C) = 41 to <61 | Good (B) = 61 to <81 | Very Good (A) = 81 – 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.2.3 Seagrass

Data for the seagrass indicator category was sourced from the Port of Townsville Long-Term Seagrass Monitoring Program (LTSMP), with monitoring conducted by James Cook University (JCU) (Mckenna 2023). The 2022–2023 technical report uses data collected during September to October in 2022.

12.2.3.1 *Monitoring Sites*

Seagrass was only monitored in Cleveland Bay in 2022-2023. Across Cleveland Bay ten seagrass meadows are monitored in the LTSMP and divided into three spatially distinct groups: Magnetic Island, Cape Pallarenda/Strand, and Cleveland Bay (Table 67). Meadow locations are provided in Figure 24.

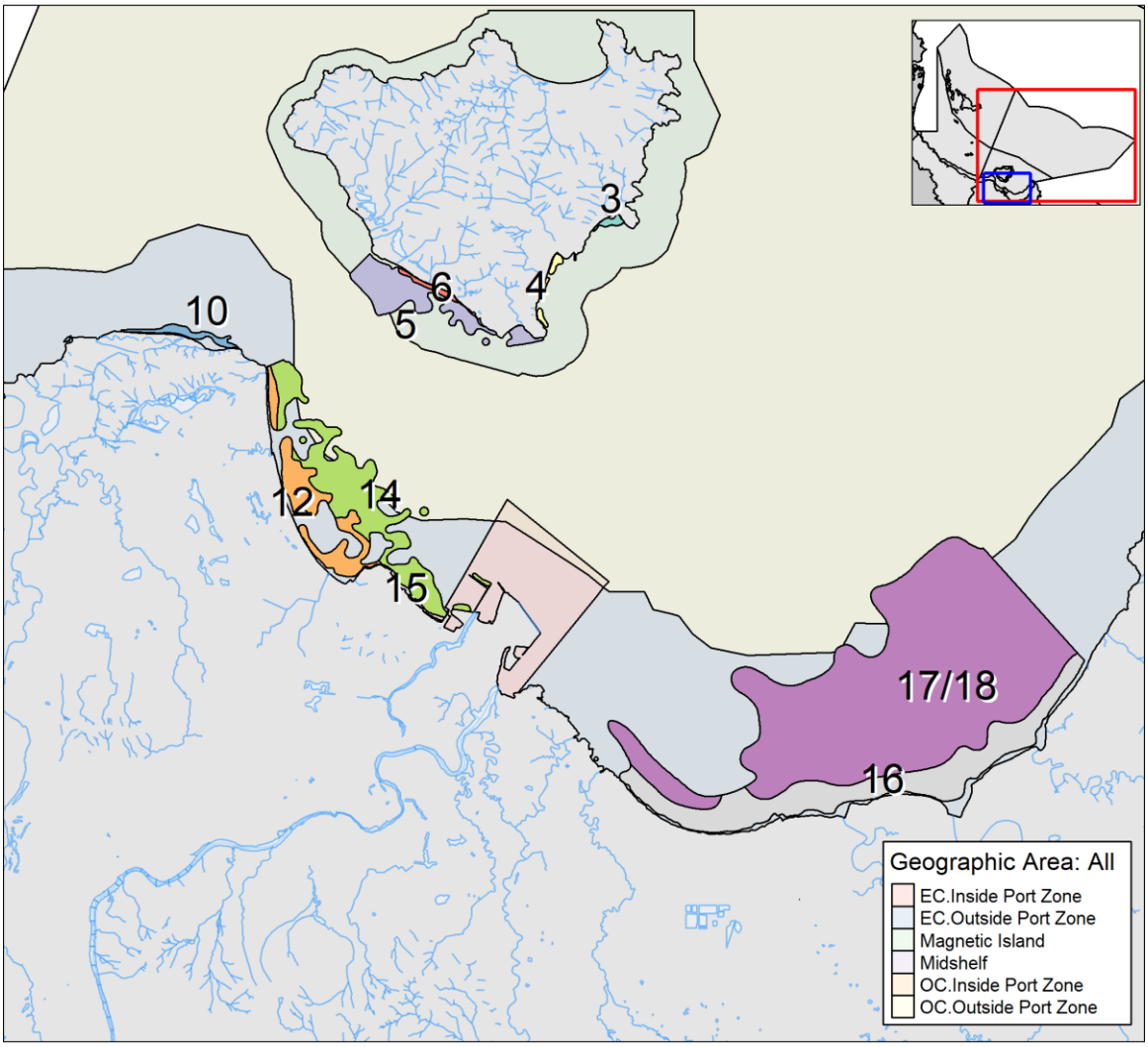

Figure 22. Seagrass meadow monitored for the LTSMP 2022 assessment.

Table 67. Overview of the Long-term Seagrass Monitoring Program (LTSMP) meadows. Adapted from (Mckenna 2023).

Region	Meadow	ID	History
Magnetic Island	Geoffrey Bay	3	Detailed Annual >10 years
	Nelly Bay	4	Detailed Annual >10 years
	Cockle/Picnic Bay	5	Detailed Annual >10 years
	Cockle Bay	6	Detailed Annual >10 years
Cape Pallarenda – Strand	Shelly Beach	10	Detailed Annual >10 years
	Rowes Bay	12	Detailed Annual >10 years
	Pallarenda inc. Virago Shoal	14	Detailed Annual >10 years
	Strand	15	Detailed Annual >10 years
Cleveland Bay	Cleveland Bay	16	Detailed Annual >10 years
	Cleveland Bay	17/18	Detailed Annual >10 years

12.2.3.2 *Results: Inshore Seagrass*

In Cleveland Bay, the grade for seagrass monitoring meadows was good, with a score of 68. This is a slight decrease on the score from the previous two reporting periods. These results show a recovery for overall seagrass health in comparison to the 19-20 report period (Table 68) where the seagrass had been impacted by the February 2019 flood.

Table 68. Standardised score for the seagrass indicator category.

Zone	Seagrass Standardised Score				
	22-23	21-22	20-21	19-20	18-19
Cleveland Bay Inshore Marine Zone	68	73	71	52	74

Standardised scoring range: ■ = Very Poor: 0 to <25 | ■ = Poor: 25 to <50 | ■ = Moderate: 50 to <65 | ■ = Good: 65 to <85 | ■ = Very Good: 85 to 100| ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

Discussion has been paraphrased from the Port of Townsville Seagrass Monitoring Program 2022 report. Reference: (Mckenna 2023).

"The seagrass condition category is comprised of three indicators: biomass, area, and species composition. Meadow scores are calculated as the lowest individual score of the three indicators, except when species composition is the lowest. When species composition is the lowest score the final meadow score is calculated as the average of the two lowest indicator scores (McKenna S 2022) (Carter 2023).

There are four monitoring meadows around Magnetic Island (3, 4, 5, 6). Three of the four meadows were of satisfactory or better condition in 2022, however, Meadow 6 was in poor condition due to a decrease in area from 50 ha in October 2021 to 22 ha in October 2022. This meadow, however, is highly variable in extent from year to year. Meadow 4 had expanded deeper and connected multiple patches along the shore, and its area was the largest it has been in the history of program (16 years, 21 ha). The species composition of all Magnetic Island meadows was above baseline conditions, with a species mix that reflected a good or very good condition in all meadows (Table 69).

There are four monitoring meadows that make up the Cape Pallarenda - Strand region (Meadows 10, 12, 14, 15). Three of the four meadows were in good or very good condition in October 2022; however, Meadow 10 was in a poor condition due to a decrease in area. The spatial footprint of Meadow 10 has been on a downward trajectory since 2014 with seagrass loss occurring on all sides of the meadow, although biomass and species composition remain in good condition. Interestingly, Meadow 12, that bounds and is on the seaward side of Meadow 10, has continued to expand shoreward as Meadow 10 retracts. For the meadows closest to the Channel Upgrade (CU) Project works (12, 14 and 15), area, biomass and species composition all remain in good or very good condition in 2022. Meadows 12 and 14 were slightly patchier in 2022 compared to 2021 but similar to previous years. Seagrass was present to 5.2m below MSL in October 2022 similar to previous surveys.

There are two monitoring meadows in Cleveland Bay, Meadow 16, and Meadow 17/18. These meadows are the largest coastal meadows in Townsville and were both in a satisfactory or better condition in 2022. In Meadow 16 species composition and biomass were both in good condition with density 'hotspots' increasing from 60 gDW m^{-2} in 2021 to 100 gDW m^{-2} in 2022. However, this is the first time since 2011 the area of the meadow has been below good condition. Coincidingly the

seaward Meadow 17/18 that bounds Meadow 16 has expanded shallower and meadow biomass rebounded from a low in 2019 to be in good condition for the last three years" (Mckenna 2023).

Table 69. Seagrass indicator scores for all meadows in the Cleveland Bay Inshore Marine Environment.

Region	ID	Biomass	Area	Species Comp.	Meadow Score
Magnetic Island	3	59	93	84	59
	4	87	100	99	87
	5	61	69	97	61
	6	80	47	89	47
Cape Pallarenda – Strand	10	73	49	75	49
	12	90	100	81	86
	14	70	67	99	67
	15	90	89	81	85
Cleveland Bay	16	83	63	97	63
	17/18	76	90	98	76
Overall					68

Standardised scoring range: ■ = Very Poor: 0 to <25 | ■ = Poor: 25 to <50 | ■ = Moderate: 50 to <65 | ■ = Good: 65 to <85 | ■ = Very Good: 85 to 100 | ND = No Data | NA = Not Applicable (data available but not usable) | X = Data was not updated this year.

12.2.4 Confidence Scores

There is very high confidence in the seagrass and coral indicator categories due to the efficacy and maturity of the habitat monitoring programs. Seagrass received a rank of 5 out of 5, and coral received a rank of 3, and 4 (Cleveland Bay was not as well represented as Halifax Bay) (Table 70).

Table 70. Confidence scores for the coral and seagrass indicator categories.

Indicator Category	Maturity (x0.36)	Validation (x0.71)	Representativeness (x2)	Directness (x0.71)	Measured error (x0.71)	Score (Rank)
Coral (CB)	3	3	1.5	3	2	9.8 (3)
Coral (HB)	3	3	2	3	2	10.8 (4)
Seagrass	3	3	3	3	3	13.5 (5)

Rank based on score: 1 (very low) = 4.5 to 6.3; | 2 (low) = >6.3 to 8.1; | 3 (moderate) = >8.1 to 9.9; | 4 (high) = >9.9 to 11.7; | 5 (very high) = >11.7 to 13.5.