MARINE WATER MONITORING PROGRAM

SUMMARY

The Port of Townsville has an established marine water quality monitoring program that has been in place for over 10 years at some monitoring locations providing a long-term dataset.

This monitoring program commenced in September 2014, with the program designed to understand the variations in water quality within the bays, particularly at locations in proximity to sensitive habitat receptors such as seagrass meadows and/or coral reef areas. The primary parameters of interest for the water quality monitoring program are turbidity and underwater light levels.

Most of the monitoring locations are in Cleveland Bay in proximity to Port operations and one is located in southern Halifax Bay as a comparison site.

The Port uses this information to understand water quality in proximity to sensitive habitat receptors and to inform adaptive management for project based dredging and routine maintenance dredging and dredge material placement in Cleveland Bay.

The data from this program contributes to a range of different organisations and broader monitoring datasets, including supporting the National Environmental Science Program (NESP) Tropical Water Quality Hub assessments of dredging water quality influences (lead by AIMS) and the Healthy Waters Partnership for the Dry Tropics.

With the recent capital dredging project, a significant enhancement to the water quality monitoring network was implemented providing near real time access to water quality data from multiple monitoring sites across Cleveland and Halifax Bay. The real time data enabled continuous information regarding environmental conditions across a range of weather and operating scenarios. The improved data availability supports more timely and informed environmental management and operational decision-making.

PARAMETERS

The marine water monitoring program has measured different parameters over time including:

- Turbidity (the amount of suspended particles in the water column)
- Multispectral light, including PAR - Photosynthetically Active Radiation (the amount and quality of light reaching the seabed)[1]
- Water Temperature
- Sedimentation (amount of sediment settling in a particular area)*
- Water depth
- Other quality parameters - Dissolved Oxygen, pH, Conductivity*

From 2014 – 2021 the data was collected continuously and periodically collected from data loggers located on marine frames deployed underwater. Since 2021, monitoring of the above parameters was by telemetered buoys providing near real time data via a data visualization platform. The addition of telemetry provides near real time data, improves the data retrieval and provides significantly improved access to data.

The monitoring equipment is located on the sea floor (benthic monitors) to measure these water quality parameters at the same position in the water column as the sensitive habitat receptors.

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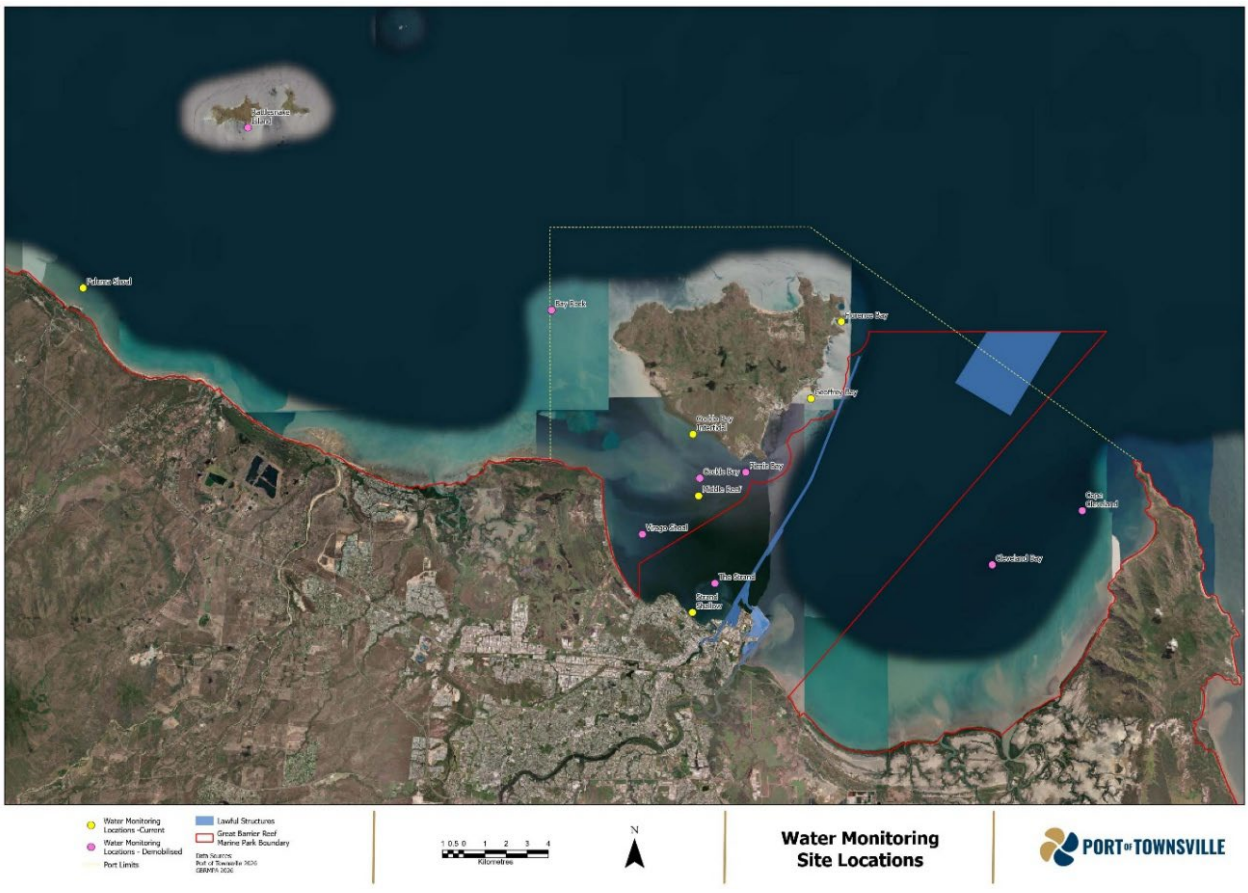
[1] *measured since 2019*

* *measured at different locations and sites across the historical program but no longer measured in the current iteration of the program.*

LOCATIONS

The marine water quality monitoring has been undertaken at various locations since 2014 , with a maximum program of 16 monitoring sites (12 subtidal, 4 intertidal sites) utilised across 2019-2024. Since 2024, this program has been rationalised to 6 key locations, with the below table providing a full list of locations that have informed this program and their period of deployment.

LOCATION	REASON FOR LOCATION	TIME PERIOD
Middle Reef	Sensitive receptor (Water, Coral & Seagrass)	2019 – current
Florence Bay	Sensitive receptor (Water, Coral & Seagrass)	2014- current
Geoffrey Bay	Sensitive receptor (Water, Coral & Seagrass)	2014 – current
Paluma Shoal	Reference (Water & Coral)	2020 – current
Cockle Bay (intertidal)	Sensitive receptor (Seagrass)	2021 – current
Picnic Bay	Sensitive receptor (Water, Coral & Seagrass)	2014 – 2024
Virago Shoal	Sensitive receptor (Water, Coral & Seagrass)	2014 – 2025
Cleveland Bay	Reference (Water & Seagrass)	2014 – 2025
The Strand (shallow)	Sensitive receptor (seagrass)	2021 – current
The Strand (deep)	Sensitive receptor (Water)	2019 – 2024
Cape Cleveland	Reference (Water & Seagrass)	2019 – 2024
Bay Rock	Reference (Water & Coral)	2019 – 2021
Rattlesnake Island	Reference (Water & Coral)	2019 – 2024
Geoffrey Bay (intertidal)	Sensitive receptor (Seagrass)	2019 – 2024
Cape Cleveland (intertidal)	Reference (Seagrass)	2019 – 2024
Shelly Beach (intertidal)	Reference (Seagrass)	2019 – 2024



Noting the variable climatic conditions that North Queensland is exposed to, the monitoring program has measured water quality through or immediately after significant climatic events since 2019 including:

- Extensive flooding and above average rainfalls:
  - January/February 2019 (Townsville Flood); and
  - a persistent low-pressure system and severe flooding in February 2025
- Tropical cyclones:
  - January 2021 (TC Kimi),
  - February/March 2021 (TC Niran),
  - December 2023 (TC Jasper),
  - January/February 2024 (TC Kirrily)
- Marine heat waves and associated mass coral bleaching events were reported for the GBR region in 2020, 2022, 2024 and 2025.

INSIGHTS FROM THE MARINE WATER QUALITY PROGRAM

As detailed in the Channel Upgrade Marine Water Monitoring Program reports, the marine water quality monitoring program has provided the following insights into water quality in Cleveland Bay:

- A substantial water quality dataset over many years, facilitating an understanding of relationships between water quality parameters, trends observed across monitoring locations, and the whole of system influence of climatic events.
- Underwater light quality and quantity have been highly influenced by elevated suspended sediments (turbidity) and has been frequently observed during monitoring. While these low light events varied between monitoring locations, they were often associated with periods of elevated wind conditions and wind driven waves or high cloud cover, which were particularly notable during large scale weather events.
- The water quality data recorded through the program identifies a high level of spatial and temporal variability in the turbidity and light levels, influencing the sediment depositional environment, with different sites behaving differently in the same weather pattern. Sites in deeper water and around Magnetic Island generally have a lower level of turbidity and higher light availability. Inshore shallower sites (e.g. the Strand) are highly mobilised in low to moderate winds and remain mobile for a period following the wind stopping resulting in much high level of turbidity and lower levels of measured light.
- Coupled with the information from the coral and seagrass monitoring programs, the ongoing presence and resilience of the sensitive receptors in Cleveland Bay indicate that they are likely adapted to the regular flux of natural conditions across varied turbidity concentrations and light availability.
- The program has monitored the stress on the natural environment through climatic events such as marine heat waves, flooding and cyclones. Coupled with the information from the coral and seagrass monitoring programs, this gives the Port and other parties insight into the condition and resilience of the sensitive receptor habitats.

Data from this program is available at the following link: Water Quality | Port of Townsville

MARINE WATER MONITORING AND PORT OPERATIONS

The marine water monitoring program is regularly used to inform Port Operations and activities in the marine environment. A key application is the assessment of potential water quality influences of maintenance dredging activities.

During the 2025 maintenance dredging campaign, near real time water quality data was reviewed regularly during the dredging works to identify any emerging trends and early warning indicators in the water quality that could inform operational decisions for dredging operations.

Further to this active monitoring, the Port has completed a review of the marine water quality conditions before, during and after the maintenance dredging campaign. The assessment found no evidence that maintenance dredging activities were driving changes in water quality during the monitoring period. Instead, variations in water quality during the campaign were found to be closely aligned with prevailing weather conditions, with similar trends

observed across all monitoring locations, including the far field reference sites. These findings indicate that regional level environmental conditions were the predominant influence on water quality.

The availability of near real-time and long-term monitoring data provides the Port with a strong evidence base to support environmental stewardship and adaptive management of marine operations.

OTHER WATER QUALITY MONITORING

The Port has a separate long-term marine water monitoring program that was established in 2004 which is primarily used to characterise marine water in the environment within and surrounding the port, including from the catchment areas (Ross River and Ross Creek). This program takes water samples on a quarterly basis with analysis by a NATA certified laboratory. As such the information from this program provides periodic information on the ambient marine water within and in the vicinity of the operational areas of the Port of Townsville.

The Port also has also implemented real time water quality monitoring via surface buoys in Geoffrey Bay and on the S2 channel marker since 2018. The primary parameters of interest for the water quality monitoring program are turbidity, conductivity and temperature. These buoys have monitoring equipment deployed approximately 1m below the surface of the water.

Data from this program is available publicly at the following link: [Monitoring in Cleveland Bay | Port of Townsville]

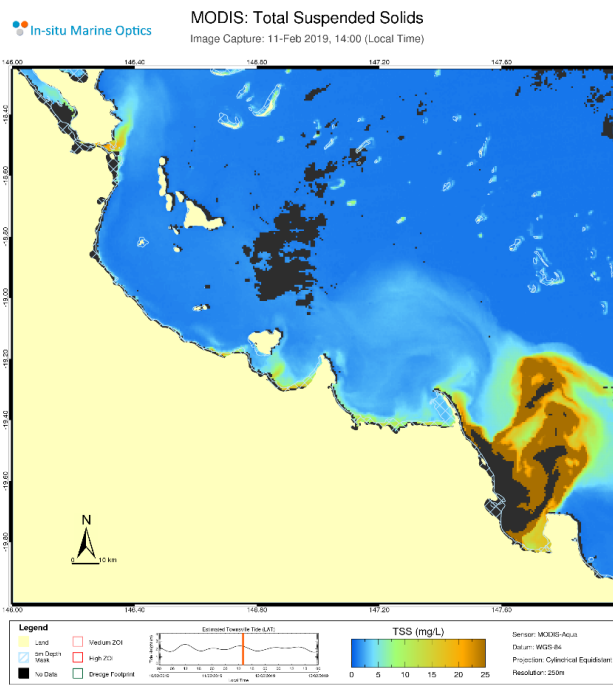
MODIS SUMMARY

The Port also uses satellite remote sensing as a cost-effective tool for mapping and monitoring the spatial extent of sediment plumes and associated water quality parameters. This uses the twice daily Moderate Resolution Imaging Spectroradiometer (MODIS) satellite-based images to both visually show the extent of suspended sediment in marine waters and to calculate an estimated suspended sediment concentration at defined locations. The calculated suspended sediment concentrations can also be compared to a baseline sediment level to indicate the relative monthly sediment concentrations across a broader regional area.

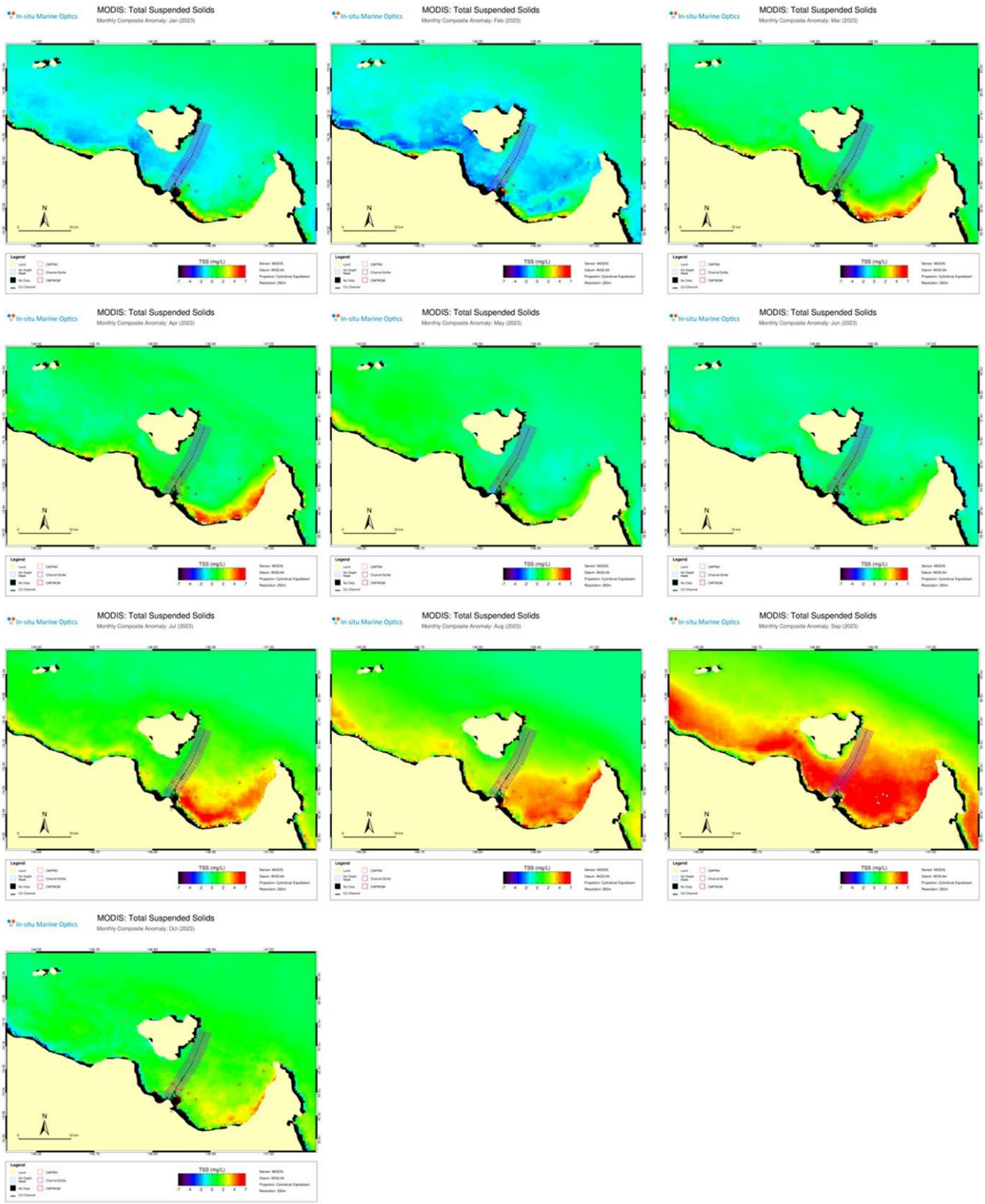
Recent projects have demonstrated an impressive accuracy of water quality information derived from remote sensing.

Examples of the remote sensing products and the information it provides are as follows:

Visual understanding of suspended sediments in the marine environment: 11/02/2019



Total suspended sediment concentration estimate – 11/02/2019



MODIS imagery showing a comparison of monthly TSS composites from 2023, mapped as an anomaly against monthly baseline (2009-2021) composites