

Cleveland Bay Sediment Origin and Dynamics

Cleveland Bay is a naturally sediment-rich coastal environment. Large quantities of sediment enter the region from natural sources, particularly the Burdekin River, and are continually redistributed by wind, waves and tides. Understanding these natural sediment processes helps explain why Cleveland Bay is naturally turbid, why shipping channels accumulate sediment over time and why maintenance dredging is required to maintain safe access to the Port of Townsville.

CLEVELAND BAY

Cleveland Bay is a sheltered, north-facing embayment. Unlike many open coastal areas, it tends to retain more sediment than it exports, making it a natural sediment sink.

What this means:

Cleveland Bay naturally accumulates sediment over time. This process has been occurring for thousands of years and helps explain why the bay contains large volumes of fine sediment and naturally experiences elevated turbidity.

As sea levels rose following the last ice age, Cleveland Bay was likely much deeper than it is today. Over thousands of years, river floods, waves and coastal currents have gradually deposited sediment throughout the bay, contributing to its present-day shape.

KEY FACT

Approximately 2 billion Cubic Metres of fine sediment is estimated to be stored on the seabed within Cleveland Bay.

BMT, (2018). Quantitative Sediment Budget Assessment. Lewis, S. and Bainbridge, Z. (2021). Much more than just sediments: The importance of sediment composition for Great Barrier Reef ecosystems. Report to the National Environmental Science Program. Reef Rainforest Research Centre Limited, Cairns (20pp.).

Cleveland Bay is influenced by newly delivered sediment and the large store of existing seabed sediment which both influence water quality and ecosystem health in Cleveland Bay.

While both newly delivered sediment and older seabed sediment influence water quality, newly delivered sediment from major floods often contains higher levels of nutrients. As a result, flood-derived sediments can have a greater influence on water quality and ecosystem health than older sediments already stored on the seabed.

Fine sediments transported from the Burdekin River during flood events are typically:

- much finer than many existing marine sediments;
- rich in nutrients and organic matter;
- capable of remaining suspended in the water column for extended periods;
- easily transported over large distances; and
- more readily resuspended following deposition.

Why sediment matters:

Cleveland Bay is a naturally dynamic coastal environment shaped by wind, waves, tides and sediment delivered from regional river systems. Sediment movement plays an important role in marine ecosystems, water quality and the safe operation of the Port of Townsville.

Studies have found that:

- Sediments have accumulated within the bay over thousands of years.
- More sediment enters and settles within the bay than leaves it under normal conditions.
- More recent sediments, particularly fine sediments from the Burdekin River can be transported into Cleveland Bay.
- Major floods and cyclones can temporarily export sediment from the bay.

Historical studies indicate elevated turbidity occurs on approximately 220 days each year due largely to natural resuspension processes.

As a result, understanding both the long-term accumulation of sediment within Cleveland Bay and the episodic delivery of new sediment from major flood events is essential for understanding water quality, light availability and ecosystem health in the region.



THE BURDEKIN RIVER: A MAJOR SOURCE OF SEDIMENT

The Burdekin River, located approximately 90 km south of Cleveland Bay, is the largest source of fine sediment entering coastal waters in the region.

While the Burdekin Falls Dam traps more than 95% of sand-sized material, fine sediment continues to be transported downstream during flood events. These fine particles originate primarily from soil and gully erosion throughout the catchment.

While the Burdekin exports an average of 3.3 million tonnes of fine sediment annually, large flood events can deliver substantially more.

These sediment inputs play a major role in influencing water quality, turbidity and sediment distribution across the region. Research has shown that some of this sediment reaches Cleveland Bay, where it can accumulate over time.



KEY FACT

During major flood events, the Burdekin River can deliver up to 15.74 million tonnes of fine sediment to coastal waters.

Kuhnert, P. Henderson, B. Lewis, S. Bainbridge, Z. Wilkinson, S. Brodie, J.E. (2012).

Quantifying total suspended sediment export from the Burdekin River catchment using the loads regression estimator tool. Water Resource. Res. 48 (4).

THE PORT OF TOWNSVILLE

Why this matters for the Port of Townsville:

The same natural processes that move sediment throughout Cleveland Bay also cause sediment to accumulate within the Port's navigation channels.

The Port operates within this naturally sediment-rich environment. The navigation channels and underwater infrastructure are deeper than surrounding waters and act as sediment traps, allowing naturally occurring sediments moving through the bay to settle within the channel.

To maintain safe shipping access, accumulated sediments are periodically removed through maintenance dredging and relocated to the approved Dredge Material Placement Area (DMPA) in deeper water offshore. Maintenance dredging does not introduce new sediment to Cleveland Bay. Rather,

it removes naturally accumulated sediments from Port infrastructure and returns them to the broader marine sediment system. This location reduces the likelihood of wave-driven resuspension and allows sediments to become incorporated into the natural seabed environment.

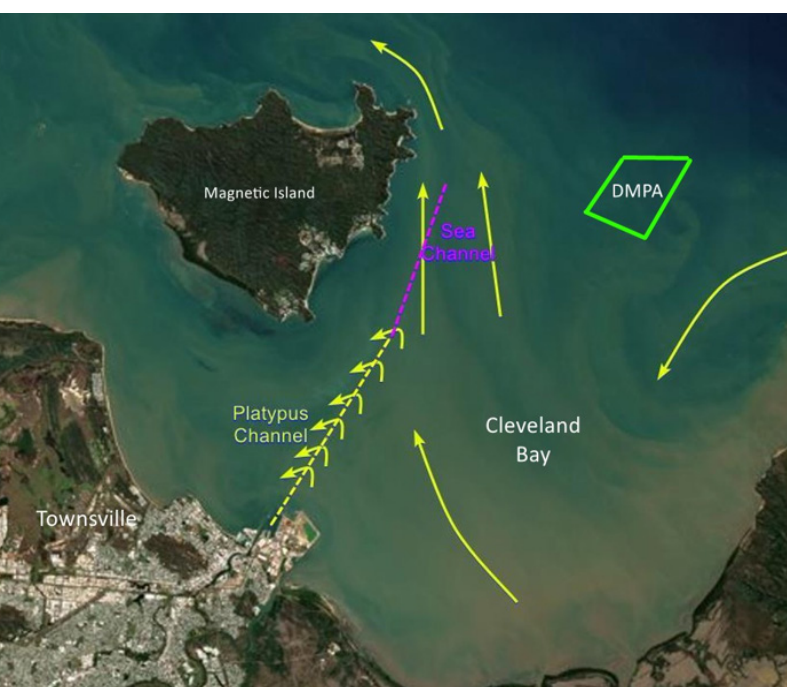
The location of the DMPA in deeper water is an important part of sediment management in Cleveland Bay.

Wave action is the main cause of sediment resuspension in Cleveland Bay. In shallow water, waves frequently reach the seabed and stir fine sediments back into the water column, increasing turbidity and allowing sediments to continue moving around the bay.

By contrast, the DMPA is in water depths of approximately 12–16 metres, where wave energy is significantly reduced before it reaches the seabed. As a result:

- Placed sediments are less likely to be resuspended by normal wind and wave conditions and turbidity generated by wave-driven resuspension is reduced.
- Sediments can settle more readily onto the seabed, and the dredge material becomes incorporated into the natural seabed sediments over time.
- Any gradual movement of sediment occurs through natural oceanographic processes rather than repeated wave resuspension.

This approach supports safe navigation at the Port while reducing the likelihood that placed material will be repeatedly stirred back into the water column by the everyday wind and wave conditions that commonly occur in Cleveland Bay.



Key Takeaways:

- The Burdekin River is a major source of sediment to coastal waters.
- Cleveland Bay naturally accumulates and stores sediment.
- Wind, waves and tides regularly resuspend sediment and influence water clarity.
- Cleveland Bay is naturally turbid for much of the year.
- Port shipping channels naturally trap sediment moving through the bay.
- Maintenance dredging removes naturally accumulated sediment and returns it to the broader marine sediment system.

RESEARCH SPOTLIGHT: BURDEKIN FLOODS AND WATER QUALITY

Recent research has shown that major Burdekin River flood events can influence water quality across a large area of the central Great Barrier Reef, including Cleveland Bay.

Monitoring following the 2019 flood found:

- Elevated sediment concentrations reduced underwater light available to corals and seagrass.
- Flood-derived sediments continued to affect water clarity for months after floodwaters receded.
- Strong winds and waves repeatedly resuspended newly deposited sediments.
- Nutrient-rich river sediments were associated with increased macroalgae growth on some inshore reefs.

(What's Really Damaging the Reef? Tracing the Origin and Fate of the Ecologically Detrimental Sediment and Associated Bioavailable Nutrients. Lewis et al. 2020)

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