Sedimentation impacts in Moreton Bay: a priority knowledge synthesis

IMPACTS: Mangroves

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This impact statement is drawn from

Sedimentation Impacts in Moreton Bay, a priority knowledge-synthesis

The report was commissioned by The Moreton Bay Foundation in 2025 to summarise key evidence on how sedimentation affects Moreton Bay's coastal and marine ecosystems, and the ecological and cultural values they support. The report brings together published and grey literature, conceptual models, and expert review to provide a clear, high-level understanding of sedimentation pressures, their impacts, and remaining knowledge gaps.

This standalone document can be found in the full report. Where references are made to other sections, these are indicated by this symbol: †. A full list of external citations, data sources, and methods used in this document is included in the complete report, available at **moretonbayfoundation.org**

David Brewer Consulting (DBC) has prepared this report for The Moreton Bay Foundation under the contract titled 'TMBF Priority Knowledge Synthesis: Sedimentation Impacts in Moreton Bay'. Information about the Moreton Bay Foundation can be found at: https://moretonbayfoundation.org/

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Mangroves:
Sedimentation Impact Statement

Mangroves in Moreton Bay
Photo credit: V. Bennion

Status and trend summary

Table 1 provides a qualitative summary assessment of the mangrove communities in Moreton Bay, highlighting key aspects of their current condition, future trajectory and the impacts of sedimentation. Between 1955 and 2021 mangrove area in the Bay had a net gain of 10.9% due to sea level rise and sediment accretion. But there have also been losses due to subsiding soils and dieback. Most gains in mangrove area have been due to landward encroachment into saltmarsh and supratidal forest communities. The overall current condition of mangroves in the Bay is rated as 'Good, with 'High' confidence.

The condition trend for mangroves is noted as 'Stable' and with 'Medium' confidence. This reflects a combination of the moderate increases in mangrove area happening in the Bay, along with the limited scope for future mangrove encroachment over time due to 'coastal squeeze', where future landward mangrove migration is blocked by permanent urban and industrial development on the coastline. Other factors affecting mangroves include a range of anthropogenic inputs into the Bay, such as pollutants, the impacts of which are poorly understood. Given that sedimentation from Moreton Bay catchments is not decreasing and sea level rise may promote increased sediment deposition, the contribution of sedimentation to the condition trend for mangroves is considered 'Moderate' with 'Medium' confidence.

Table 1. Qualitative assessment of the overall status and trend in condition, and the likely severity and direction of sedimentation-specific impacts, on mangroves in Moreton Bay.

Value condition assessment	Assessment	Confidence
Current condition	Good	High
Contribution of sedimentation to the current condition	Moderate	Medium
Condition trend	Stable	Medium
Contribution of sedimentation to trend	Moderate	Medium

Overview

Moreton Bay's mangrove communities are significant subtropical wetlands in Southeast Queensland, covering 15,469 hectares in 2021 (Figure 1) (Queensland Government, 2024). They are dominated by salt-tolerant vegetation found within the intertidal zone, ranging from approximately mean sea level up to the highest neap tides (Lovelock *et al*., 2019). Their distribution ranges from upstream river systems and tidal creeks to low-energy fringing parts of the Bay, including smaller Bay islands (Lovelock *et al*., 2019) (Figure 2). They are regularly inundated by seawater in the intertidal zone (Choi *et al*., 2022) and are often distributed as parallel zones representative of an elevation gradient and tidal flushing frequency (Adame *et al.,* 2010).

Moreton Bay's mangroves support a moderate diversity of seven tree species, which is typical for subtropical Australian coastlines (Lovelock *et al*., 2019). Fringe mangroves occupy the lowest elevations and are diurnally flooded by neap and spring tides (Adame *et al.,* 2010). Scrub mangroves occupy mid-elevations, flooded only during spring tides. Saltmarshes and supratidal forest communities containing *Casuarina glauca* (Swamp she-oak) and *Melaleuca quinquenervia* (Broad-leaved paperbark) are found at the highest elevations, flooded during spring tides, and occupy higher elevations landward of mangrove stands (Adame *et al.,* 2010; New South Wales Government, 2008a) (see **† Section 5.4**).

Avicennia marina (Grey mangrove) is the most widely distributed species and the dominant species in most communities, particularly on the western side of Moreton Bay (Lovelock *et al*., 2019). *Rhizophora stylosa* (Red mangrove) is abundant on soft unconsolidated marine clays or sandy soils, particularly on the eastern islands and southern shores of the Bay (Lovelock *et al.,* 2014, 2019; Hill *et* al., 2021; Bennion *et al.,* 2024a). *Bruguiera gymnorhiza* (Orange mangrove) and *Ceriops australis* (Yellow mangrove) are found within the high intertidal zone, and *Aegiceras corniculatum* (River mangrove) is commonly found within riverine conditions (Lovelock *et al*., 2019).

Mangroves filter out and capture nutrients and sediments from the water column, depositing and storing carbon within their soils, forming significant 'blue carbon' repositories (Adame *et al.,* 2010; Lovelock *et al.,* 2014, 2022; Woodroffe *et al.,* 2016). Blue carbon sinks include the accumulation of organic matter, particularly root matter, in combinations with accumulated sediments. Their above-ground root systems and stems enhance sediment deposition, promoting mangrove growth and expansion (Adame *et al.,* 2010; Bennion *et al.,* 2024a). Higher sediment deposition occurs within the fringing zone of mangrove forests, with riverine mangroves showing more homogeneous sediment distribution (Adame *et al.,* 2010).

Sediment trapping efficiency varies among species due to differences in root structure, stem densities and forest structure (Bennion *et al.,* 2024a). For instance, *Rhizophora* species' prop roots have been associated with higher surface accretion rates compared to *Avicennia* pneumatophores (Bennion *et al.,* 2024a). The fringe (or lowest elevation) zone accounts for up to 72% of total sedimentation, largely due to greater vegetation cover, more extensive root systems, and a well-developed epiphytic algal community that enhances friction (Adame *et al.,* 2010).

Mangrove forests can adjust to rising sea levels by building substrate rapidly enough to keep pace with local rates of sea-level rise (Woodroffe *et al.,* 2016). A global synthesis of studies identified that mangroves should be able to withstand and maintain their elevation with maximum sea level increases of 7 mm year^{-1} (Saintilan *et al.,* 2020).

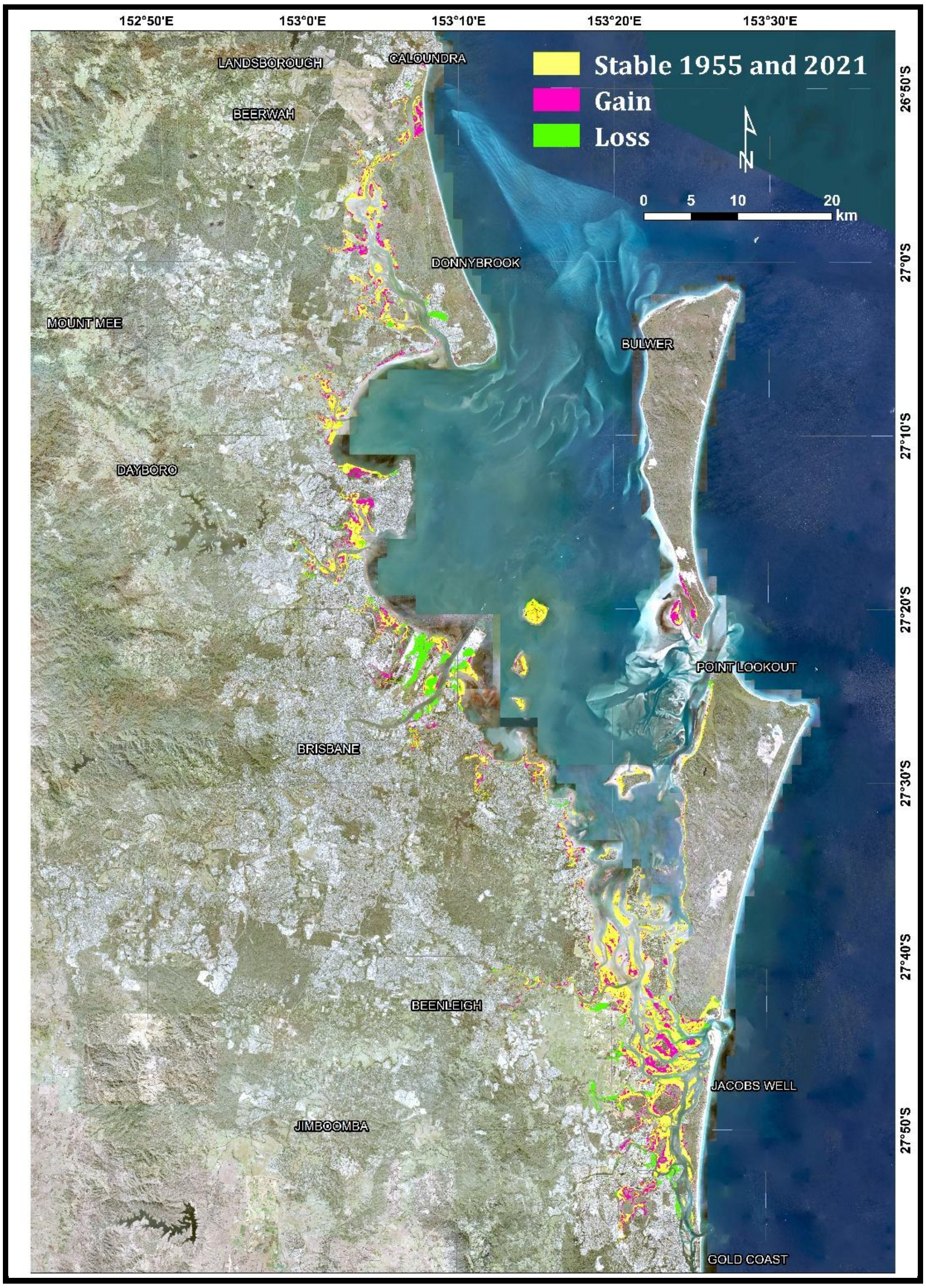


Figure 1. Changes in mangrove extent between 1955 and 2021 within Moreton Bay. Taken from Accad et al. (2023).

Population status

Moreton Bay's mangroves have shown a net gain of 1,519 hectares (10.9%) between 1955 and 2021 (Queensland Government, 2024), primarily through encroachment into adjacent saltmarsh areas communities (Lovelock *et al*., 2019; Queensland Government, 2024). Saltmarshes and supratidal forests have been reduced by 70.4% and 20.5%, respectively (Queensland Government, 2024). A total of 4,560 ha of mangrove has been gained by encroachment into other communities, while 3,041 ha were lost, either by transitioning to another community type or due to anthropogenic causes (Queensland Government, 2024). Despite the net gain, Moreton Bay has experienced significant mangrove dieback, primarily due to subsiding soils creating ponds (Twomey *et al.,* 2023) and extreme weather events (Bennion *et al.,* 2024b). Dieback events accounted for 12% of mangrove losses from 1955–2012 (Accad *et al*. 2016; Lovelock *et al*., 2019) (Figure 1).

The dominant species is *A. marina* (Lovelock *et al*., 2019), but *R. stylosa* is also abundant, particularly on the eastern and southern shores (including the sand islands of the Bay), and its increasing presence may enhance resilience to sea-level rise (Hill *et al*., 2021; Bennion *et al.,* 2024a).

An ongoing program to monitor the mangroves and associated communities within Moreton Bay was established in 2011 (Queensland Government, 2024).

Figure 2. Mangroves in Moreton Bay. Photo credit: V. Bennion.

Value

Ecological value

Mangroves play a crucial role in the region's coastal ecosystems (Adame *et al.,* 2010; Kovacs *et al.*, 2019). They serve as important habitats for a wide range of fauna, including species vital for commercial and recreational fisheries, and act as nursery habitats for many marine species, including fish and prawns (Lovelock *et al.*, 2019; Henderson *et al.*, 2021). They also support a diverse array of crustaceans, worms, and molluscs, which serve as prey for wading birds (Kovacs *et al.,* 2019). Crabs within mangroves process decomposing leaf litter, linking mangrove productivity to fisheries production (Lovelock *et al.*, 2019).

Mangroves act as natural barriers that filter pollutants, nutrients and sediment, and provide protection against extreme weather events, waves and storm surges (Barbier *et al.,* 2011; Lovelock *et al.*, 2019, Beeston *et al.*, 2023). Their roots enhance sediment deposition, which in turn promotes their growth and expansion, thereby protecting adjacent seagrass and coral reef ecosystems from excess sedimentation (Bennion *et al.,* 2024a).

Mangroves are effective at trapping sediments (Adame *et al.,* 2010) and play a crucial role in nutrient retention and cycling. Moreton Bay mangroves can retain significant percentages of nitrates (28%), soluble phosphorus (51%), and ammonium (83%) during tidal cycles, thereby enhancing water quality (Lovelock *et al.*, 2019; Choi *et al.*, 2022).

Cultural value

Moreton Bay's mangroves hold significant cultural value, particularly for the Quandamooka People, the Traditional Custodians of the region, who have nurtured the Bay’s lands and seas for over 25,000 years (Dean *et al.*, 2019; Fischer *et al.*, 2019). This cultural importance is rooted in a deep, multi-millennial connection to the land and sea, fostering a custodial ethic where environmental management is a customary responsibility (Fischer *et al.*, 2019; Nasplezes *et al.*, 2019).

Mangroves are integral to cultural identity, heritage and well-being. Places hold symbolic meanings, often reflected in Aboriginal place names or archaeological sites, such as middens and fish traps, which are tangible expressions of their connection to Country (Pinner *et al.*, 2019; Lovelock *et al.*, 2019; Beeston *et al.*, 2023).

Overall, mangroves provide important cultural benefits and contribute to the well-being of coastal people, extending beyond their commercial utility (Saeck *et al.*, 2019a; Lovelock *et al.*, 2019; Beeston *et al.*, 2023).

Economic value

Mangroves are crucial habitats and nursery grounds for commercially and recreationally important fish and crustacean species, with commercial catches correlated to mangrove area (Leigh *et al.*, 2013; Lovelock *et al.*, 2019; Henderson *et al.*, 2021). As part of the Bay's natural assets, mangroves contribute to nature-based tourism and various recreational activities (Lovelock *et al.,* 2019; Ross *et al.,* 2019a, b).

Mangroves act as natural barriers, reducing coastal erosion, waves and storm surges, thereby protecting land and infrastructure (Kovacs *et al.,* 2019; Lovelock *et al.*, 2019; Bennion *et al.*, 2024a). They also store substantial amounts of organic carbon (4.1 to 5.2 million Mg in Moreton Bay), contributing to climate change mitigation (Lovelock *et al.*, 2014, 2019; Woodroffe *et al.*, 2016; Choi *et al.*, 2022; Bennion *et al.*, 2024a) and offering potential for income through carbon markets (Lovelock *et al.,* 2019; Beeston *et al.*, 2023). They filter pollutants, nutrients, and sediments, benefiting the overall health of the Bay and supporting other valuable ecosystems (Kovacs *et al.,* 2019; Lovelock *et al.,* 2019; Beeston *et al.*, 2023).

History

The history of mangroves in Moreton Bay shows a dynamic landscape significantly influenced by both natural processes and human activities since European settlement. Since European colonisation, these habitats have been highly modified by land-use changes and urban development (Lovelock *et al.,* 2019).

Moreton Bay had extensive mangrove areas, covering around 14,273 hectares in 1955 (Accad *et al.*, 2023). Between 1955 and 2012 there was a net 10.9% increase in mangrove communities (see Population status section above) (Accad *et al.*, 2023; Lovelock *et al.,* 2019).

Extreme weather events, such as the major floods in 1974, 2011, and 2022, also increased mud deposition and fine particle suspension in the Bay, which impacted these habitats (see the Impacts of Sedimentation section below) (Kovacs *et al.,* 2019; Lockington *et al.,* 2017).

Mangroves are protected from development and destruction under Australian law (*Environment Protection and Biodiversity Conservation Act 1999*), state laws (*Fisheries Act 1994*) and international agreements (RAMSAR convention) (Lovelock *et al.*, 2019). They are vulnerable to anthropogenic impacts from adjacent onshore developments, as well as to siltation, runoff and climate change-induced effects (such as more severe droughts and sea level rise).

Despite ongoing protective legislation and international agreements, mangroves and saltmarshes continue to face pressures, highlighting the dynamic and contested nature of these valuable coastal ecosystems (Lovelock *et al.,* 2019).

Impacts of sedimentation

Human activities, like urban development, land clearing, freshwater extraction and the alteration of waterways with dams, have drastically increased fluxes of sediments, nutrient loads and contaminants in Moreton Bay and have led to a dramatic increase in mud distribution across the bay (Douglas *et al.*, 2003; Grinham *et al.*, 2024). Sediment loads are estimated to be 30 to 100 times greater than pre-European settlement rates (Leigh *et al.*, 2013). Muddy sediments now cover over 860 km^2 of Moreton Bay, more than doubling since 1970 and becoming the dominant sediment type (Lockington *et al.,* 2017; Saeck *et al.*, 2019a; Grinham *et al.*, 2024). This increased load of muddy sediments has compromised Moreton Bay's ecosystems by reducing water clarity and smothering other sensitive ecosystems (Kovacs *et al.,* 2019; Saeck *et al.,* 2019a; Grinham *et al*., 2024).

However, sedimentation in Moreton Bay has both positive and negative impacts on its mangrove ecosystems (Adame *et al.,* 2010; Lovelock *et al.,* 2019; Bennion *et al.,* 2024a). See Figure 3 for a conceptual model of sedimentation impacts on mangroves.

Positive Impacts

Mangrove forests rely on sediment accretion and organic matter accumulation (from root growth) to maintain their soil surface elevation and adapt to rising sea levels (Lovelock *et al.,* 2015; Woodroffe *et al.,* 2016; Bennion *et al.,* 2024a). Studies in Moreton Bay have shown that soil surface elevation increases with mean sea level and turbidity in areas with abundant fine sediment (Lovelock *et al.,* 2015). Mangrove structures, such as stems and above-ground roots, play a crucial role in reducing tidal flow velocity and enhancing the retention of sediment and organic material within the wetlands (Lovelock *et al.,* 2015; Bennion *et al.,* 2024a).

The increased sediment supply following European settlement in Moreton Bay has likely contributed to an expansion of mangrove areas and their encroachment into saltmarsh habitats (Kovacs *et al.,* 2019; Lovelock *et al.,* 2019). This aligns with the 10.9% net expansion of mangrove habitats observed in Moreton Bay between 1955 and 2012 (Accad *et al*., 2023; Lovelock *et al.,* 2019).

Mangroves are effective at trapping sediments and retaining nutrients, such as nitrates, soluble phosphorus, and ammonium, thereby contributing to the Bay's water quality (Lovelock *et al.,* 2019).

Negative impacts

High sediment loads, particularly fine muds, can alter mangrove species composition and ecosystem functioning, leading to a shift from predominantly sandy habitats to more mud-dominated ones, especially in the western Bay (Lovelock *et al.,* 2019; Saeck *et al*., 2019a). The shift in sediments creates a corresponding change in benthic species which are essential food organisms for shorebirds, fish and other groups. These fine sediments are easily resuspended by wind and tidal currents, leading to increased turbidity and reduced water clarity (Lockington *et al.,* 2017; Saeck *et al*., 2019a). This negatively impacts light-dependent benthic communities and the higher trophic groups that feed on them.

Mangrove encroachment, partly driven by sedimentation, poses a significant threat to saltmarsh and supratidal forest communities (see Positive impacts section above) (Kovacs *et al.,* 2019; Lovelock *et al.,* 2019; Queensland Government, 2024). The encroachment into saltmarshes also reduces critical feeding and roosting sites for migratory shorebirds (Lovelock *et al.,* 2019; Fuller *et al*., 2021), threatening over two-thirds of assessed roosting sites, although some species do roost within dense mangroves (Fuller *et al*., 2021).

Recommendations

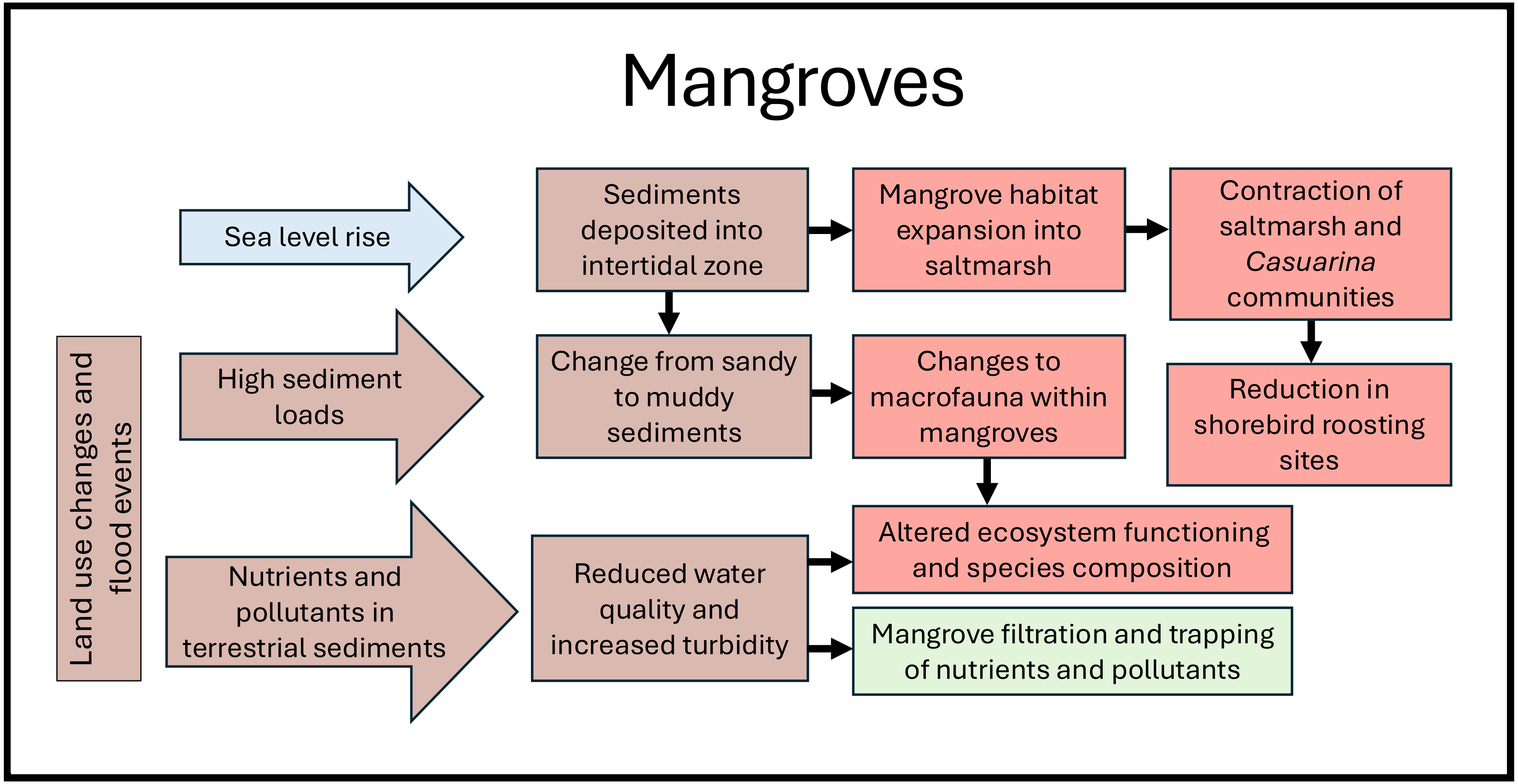
1. Implement active sediment management, which can include manually removing excess sediment where loads are too high, or trapping and adding sediment where rates are too low (Beeston *et al.,* 2023). Permeable structures can be constructed to enhance sediment trapping and reduce wave energy (Beeston *et al.,* 2023).
2. When planting, select native mangrove species that are more tolerant of specific sedimentation rates (Beeston *et al.,* 2023).
3. Address the root causes of erosion, such as unsustainable aquaculture practices, to promote natural mangrove regeneration (Beeston *et al.,* 2023).
4. Prioritise the conservation of the seaward fringe mangrove zone as it plays a crucial role in sediment retention and aim to preserve the entire coastal wetland for sustained sediment retention (Adame *et al.,* 2010).
5. In areas where mangroves encroach on saltmarsh, focus on mitigating the underlying causes or planning for the landward migration of saltmarsh habitats (New South Wales Government, 2008a).
6. Maintain heterogeneous estuarine seascapes that include a mosaic of natural habitats like seagrass meadows and instream rock, alongside mangroves, to support diverse ecosystems (Henderson *et al.,* 2021).

Expert review

Vicki Bennion (School of the Environment, University of Queensland) kindly provided expert review of the Mangroves: Sedimentation Impact Statement.

Conceptual model - impacts of sedimentation on mangroves

Figure 3. Conceptual model that qualitatively describes the major impacts of sedimentation on mangrove communities in Moreton Bay. Brown boxes signify sedimentation-related processes; blue boxes signify other relevant and interacting consequential inputs or impacts; red boxes signify adverse impacts/outcomes; green boxes indicate likely positive or neutral impacts/outcomes.



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This impact statement is drawn from

Sedimentation Impacts in Moreton Bay, a priority knowledge-synthesis

The report was commissioned by The Moreton Bay Foundation in 2025 to summarise key evidence on how sedimentation affects Moreton Bay's coastal and marine ecosystems, and the ecological and cultural values they support. The report brings together published and grey literature, conceptual models, and expert review to provide a clear, high-level understanding of sedimentation pressures, their impacts, and remaining knowledge gaps.

This standalone document corresponds to **Section 5.3** of the full report. A full list of external citations, data sources, and methods used in this document is included in the complete report, available at

moretonbayfoundation.org

Cover Images:
(Top) Mangroves in Moreton Bay. Photo credit: K. Walters
(Bottom) Mangroves in Moreton Bay. Photo credit: V. Bennion

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