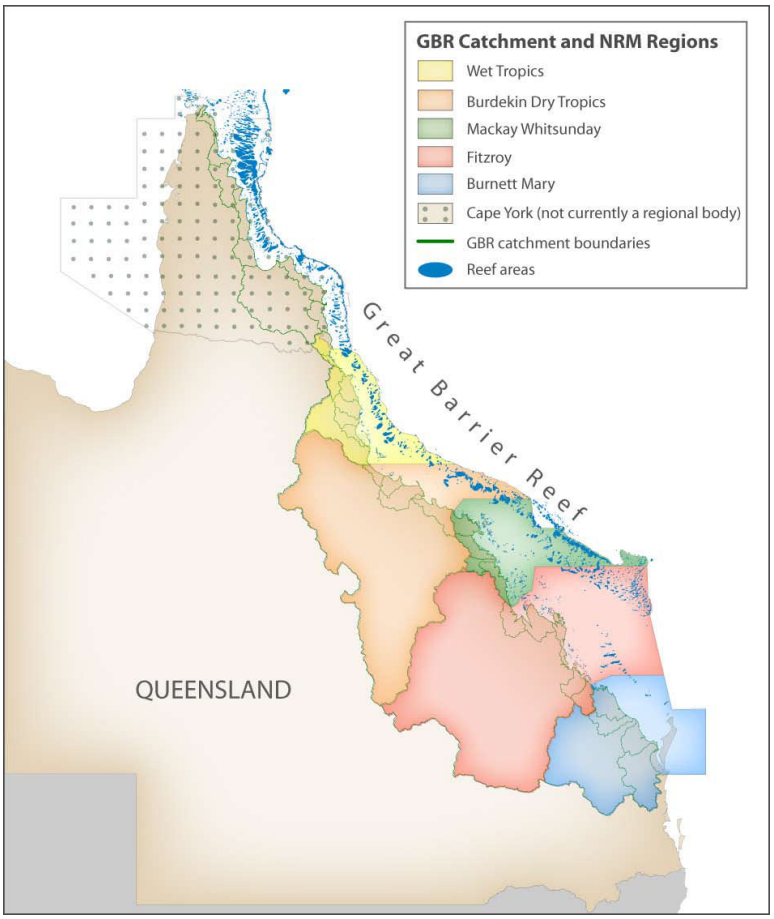
REEF PLAN MONITORING: MARINE WATER QUALITY IMPACTS

The Marine Monitoring Program is a long-term water quality and ecosystem heath monitoring program carried out in the inshore region of the Great Barrier Reef Lagoon. The program is an integral component of the Reef Water Quality Protection Plan, that will help to assess the long-term effectiveness of Reef Plan in reversing decline in the quality of water entering the Great Barrier Reef Marine Park. The Great Barrier Reef Marine Park Authority is responsible for the design, implementation and reporting of the monitoring program.

Reef Water Quality Protection Plan Marine Monitoring Program Integration Workshop



The Great Barrier Reef catchment is comprised of ten priority rivers and six Natural Resource Management regions within the Reef catchment.

The Marine Monitoring Program was established in late 2004. In September 2007, the Great Barrier Reef Marine Park Authority (GBRMPA) in partnership with the Integration and Application Network (IAN) and the Reef Water Quality Partnership (RWQP) held a workshop to facilitate the integration of indicators and available data collected as part of the monitoring program. Key participants of the workshop included, current water quality and ecosystem health monitoring providers, leading marine research experts, State and Federal government representatives and members from the RWQP Scientific Advisory Panel.

The objective of the workshop was to consider how the data collected through the Marine Monitoring Program could be integrated to facilitate the assessment of marine ecosystem health in relation to water quality. The desired outcome was a reporting framework for the integration of inshore marine water quality and ecosystem health information. The marine data integration framework will facilitate and assist with the development of regional and local water quality report cards.

The RWQP is currently in the initial stages of developing a Reef and Catchment Water Quality Report Card to report on catchment to reef water quality and marine ecosystem health. The ultimate goal of which, is to relate inshore marine water quality and ecosystem health to catchment water quality indicators and changes in land management activities.

A summary of the outcomes from the workshop were presented to the RWQP Scientific Advisory Panel following the workshop.

The 3 day workshop included:

- Presentations on the outcomes from the RWQPP Marine Monitoring Program, the current status of marine water quality and ecosystem health research activities, updates on State and Regional catchment water quality monitoring programs and overviews of current reporting activities undertaken by the RWQP and MTSRF
- Discussions about appropriate indicators for marine water quality and inshore marine ecosystem health
- Discussion on mechanisms for the assessment of data including approaches for developing spatially appropriate indicator benchmark values
- Potential mechanisms for ranking and reporting regional marine condition.

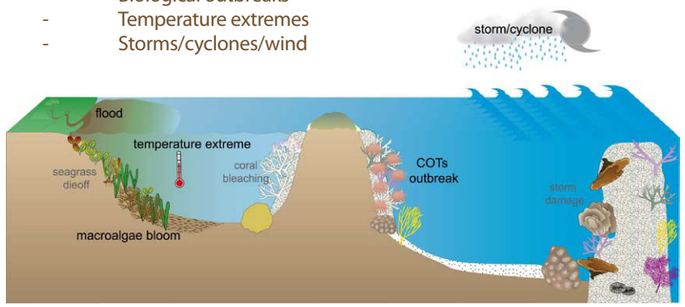
The ultimate goal is to relate inshore marine water quality and ecosystem health to improvements in catchment and on-farm management.

DRIVERS

The focus of the workshop, was the assessment of marine ecosystem health in relation to inshore marine water quality. However, the ultimate goal of the Reef Plan and the RWQP Reef and Catchment Water Quality Report Card is to assess inshore marine ecosystem health in relation to catchment status and future improvements in land management. Inshore marine ecosystems are at risk from declining water quality, as well as from numerous acute disturbances that can potentially over-ride, or confound the effects of water quality. Thus, in order to interprete ecological condition, (particularly in the context of a Report Card) it is important to understand the influence of other key drivers/explainatory variables. These drivers will be reported as part of the marine component of a Report Card.

Critical drivers of ecological health of inshore marine environments include:

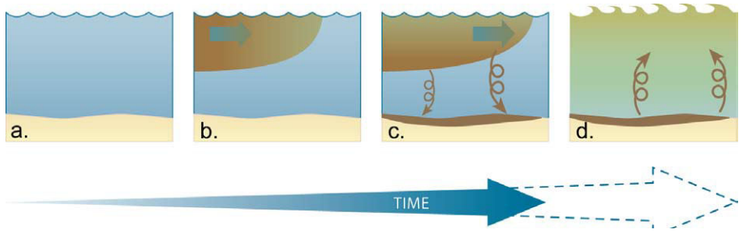
- River flow
- Flood events
- Biological outbreaks
- Temperature extremes
- Storms/cyclones/wind



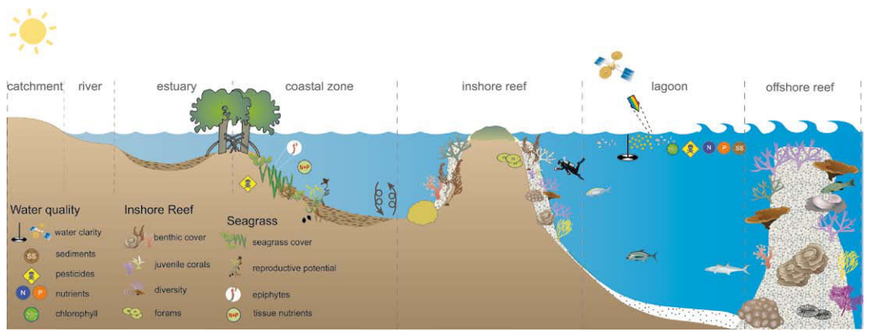
WATER QUALITY

The quality of water entering the Great Barrier Reef lagoon has declined since European settlement and is impacting on the condition of Great Barrier Reef ecosystems. Human activitiy in the GBR catchments, particularly land clearing for agriculture and urban development, has resulted in the increased loads of pollutants to the Reef. The pollutants of primary concern include sediments, nutrients and pesticides. Within the near-shore marine environment, temporal changes in water quality have been observed. During periods of no/low river flow and calm weather the inshore waters of the GBR are relatively clear (a). During flood events (b) terrestrial based sediments, nutrients and pesticides are transported via rivers into the near shore environment, as the plume disperses (c) these materials are deposited to bottom sediment. Over time, particularly during periods of high wind and waves, deposited materials can be resuspended and continue to influence water quality (d).

DEPOSITION AND RESUSPENSION



Marine Monitoring Program Indicators



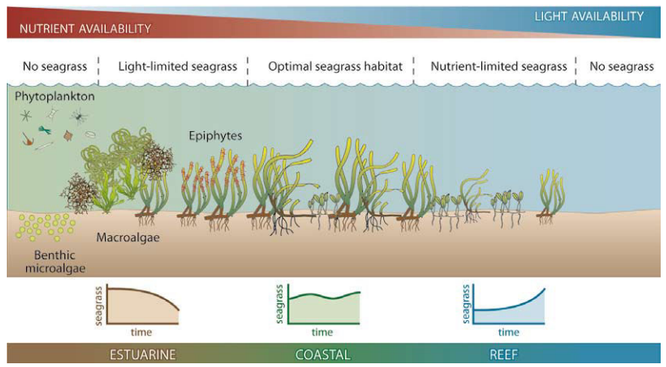
Ecosystem health and water quality indicators are monitored at inshore coral reefs and intertidal seagrass meadows

The Marine Monitoring Program assesses the health of key marine ecosystems (inshore coral reefs and intertidal seagrasses) and the condition of water quality in the inshore GBR lagoon. The monitoring program has been developed using best available science and is continuously improved with the advancement in scientific understanding. Conceptual diagrams have been used to help establish fundamental processes and relationships between marine water quality and ecosystem health, which formed the basis for the identification of indicators for use in the reporting framework. Inshore coral reef water quality indicators include; benthic cover, coral demographics, genus diversity, coral recruitment and a foraminifora index. Intertidal seagrass water quality indicators include; seagrass cover, reproductive potential (seed bank and flowering), epiphyte cover and tissue nutrient content. The key water quality pollutants of concern (sediments, nutrients and pesticides) are monitored (during ambient and event conditions) through traditional grab sampling, passive samplers, datalogger and remote sensing technologies.

INTERTIDAL SEAGRASS

Intertidal seagrasses are influenced primarily by the availability of light and nutrients for primary production. These factors influence the species of seagrass that can grow, and the trends in seagrass meadow cover observed over time.

In the GBR there are three generic types of intertidal seagrass meadows monitored; estuarine, coastal and reef top seagrass meadows. Estuarine seagrasses have high nutrient availability (due to their close proximity to rivers), but due to their location these meadows are often limited by low light regimes (due to highly turbid waters and overgrowth by macroalgae). In general estuarine seagrasses in the GBR are showing signs of decline, primarily due to the lack of light available for growth.



Nutrient and light availability are the primary factors that influence long-term trends of intertidal seagrass meadows in the inshore GBR .

Coastal seagrass meadows generally have adequate light and nutrients available for growth. These meadows are, however subject to periods of disturbance from winds generated turbidity, waves and floods. GBR coastal seagrasses are showing short term declines and increases but are generally showing no trend over time. Reef top seagrass meadows, on the other hand, have high light availability and low nutrients, thus the smaller ephemeral species are usually present. GBR reef top seagrass meadows are showing signs of increasing cover, which may be attributable to localised nutrient inputs and increased loads of nutrients reaching the inshore GBR.

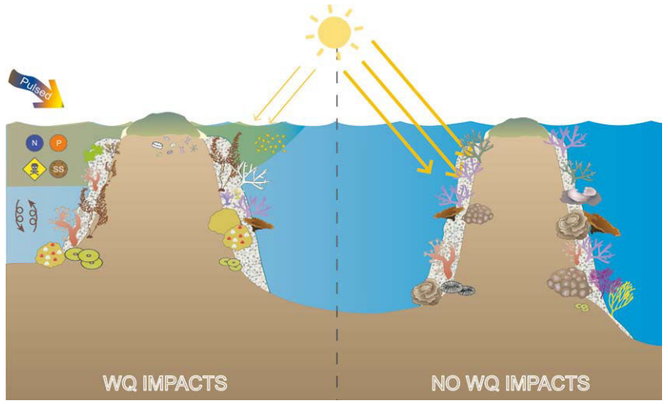
Land use changes in the GBR catchment, particularly for intensive agriculture and grazing, has resulted in increased sediment, nutrient and pesticide runoff to the GBR, the majority of which, are transported during the wet season.

INSHORE CORAL REEFS

Inshore coral reef communities are at risk from impacts caused by disturbances such as storms and cyclones, crown-of-thorn starfish outbreaks, climate change and coral bleaching as well as being exposed to sediment, nutrients and pesticides from land runoff.

Reduced water quality can impact inshore reefs directly and indirectly. High levels of nutrients favour the growth of macroalgae which can outcompete and reduce light available for coral growth. Nutrients can also cause a decline in crustose corraline algae and an increase in bioeroders, both of which can weaken reef structure. Sediment has variable impacts of coral reefs depending on the time of exposure, sediment type and corals present. In general, sedimentation and reduced light availability (due to turbid water) can reduce coral photosynthesis and recruitment often resulting in a shift to more tolerant species. Pesticides have been shown to affect corals in a number of different ways, although the effects remain poorly understood. Low levels of herbicides can cause photophysiological stress, insecticides and fungicides have been shown to affect coral early life-history stages.

Adult corals can tolerate poorer water quality than new recruites, thus one way in which water quality is initially likely to impact inshore reefs is through an effect on juvenile corals and coral recruitment.



Terrestrial runoff (sediments, nutrients and pesticides) impact inshore coral reef communities.

Tourism operators, community groups and researchers are assisting the GBRMPA to monitor water quality and ecosystem health of key inshore ecosystems to assess the long-term effectiveness of improved land management..

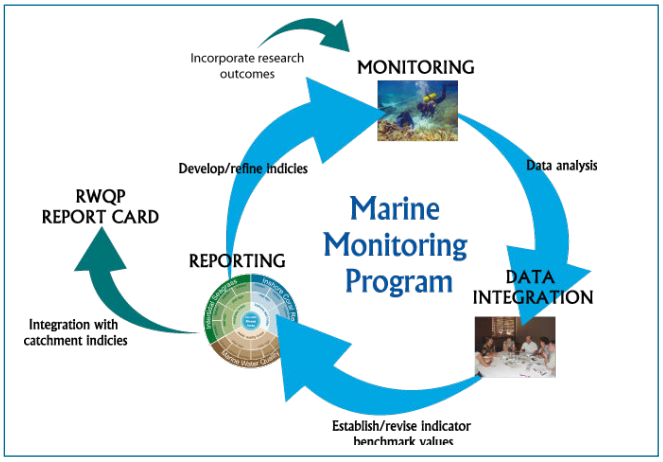
EFFECTIVE COMMUNICATION

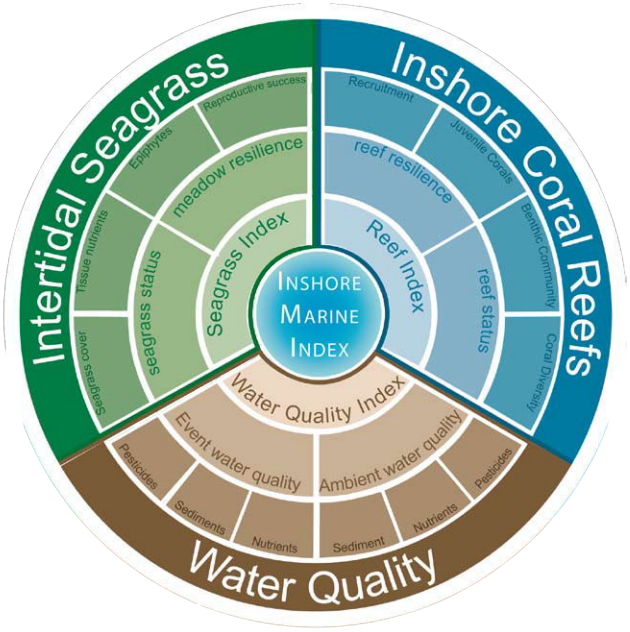
MANAGEMENT, MONITORING, RESEARCH AND REPORTING

The management framework for the Marine Monitoring Program involves ongoing knowledge acquisition, monitoring and evaluation. This will lead to continuous improvement in the identification of water quality and ecosystem health indicators and influence the development and implementation of catchment management actions. This approach recognises that fact that although we do not fully understand the impacts of water quality on inshore marine ecosystem health, action needs to be undertaken immediately and future research will improve understanding.

There is a strong emphasis within the Marine Monitoring Program to effectively communicate the conceptual basis of the monitoring program, the outcomes of the program and the development of monitoring, research and planning for natural resource management in the GBR catchments.

The RWQP Reef and Catchment Water Quality Report Card is one mechanism for communicating the linkages between changes in land management, water quality and inshore marine ecosystem health. The Marine Monitoring Program provides fundamental marine information to feed into the RWQP Water Quality Report Card.





An initial visualisation for the integration of indicators for the three marine water quality indicies.

During the integration workshop, water quality indicators appropriate for a Report Card were proposed, and approaches for assessment and visualisation were discussed. The framework for integration involves the assessment of indicators within three indicies; inshore marine water quality (event and ambient), inshore coral reef and intertidal seagrass.

The approach for the assessment of indicators was based on the compliance of an indicator to a benchmark value (or range in values) within a GBR NRM region. Significant investment is now required to statistically analyse data to define appropriate benchmark values and develop indicies for the inshore water quality , inshore coral reef and intertidal seagrass health in the GBR for contribution to the RWQP Report Card and other reporting mechanisms.

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