

# Case study



## Event monitoring

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### Mackay Whitsundays Healthy Waterways integrated monitoring program

#### Background

This case study focuses on community-based event monitoring undertaken from 2004 to 2005 as part of the Mackay Whitsundays Healthy Waterways integrated monitoring program. The program is an initiative of the Mackay Whitsunday Natural Resource Management Group (MWNRMG). The event monitoring program is coordinated by the Department of Natural Resources and Water, on behalf of MWNRMG, and undertaken by community volunteers.

The Mackay Whitsundays region spans 300 km along the Central Queensland coast, comprising an area of approximately 9000 km<sup>2</sup>. The region consists of three major river systems, along with numerous smaller streams, that discharge into the Great Barrier Reef and western Coral Sea.

Over the last decade, a number of high-profile water quality issues have been reported across the region, including:

- fish kills
- low dissolved oxygen levels in lower catchment water bodies
- mangrove dieback in the Pioneer estuary, and in other tidal creeks
- blue-green algae (cyanobacteria) blooms, at times, in storages
- relatively high rate of use of chemicals (particularly herbicides) in the region
- extensively modified estuaries
- relatively high concentrations of herbicides in estuarine sediments and storm flows
- declining coral reef health, which has been linked to river pollutant discharge and sewage treatment plant effluent discharge.

#### Project objectives

Based on these water quality concerns, the objectives of this study were to:

- quantify pollutants generated by the major land uses in rainfall run-off events in the Mackay–Whitsunday region
- quantify pollutants discharging to the inshore areas of the Great Barrier Reef lagoon
- obtain baseline data to support regional and local target-setting, and water quality improvement plans
- increase awareness of water quality and aquatic ecosystem issues in the Mackay–Whitsunday region by involving the community in event sampling.

## Study design

The study was conducted in the Mackay Whitsunday Natural Resource Management region in Queensland, which consists of four major hydrological basins: the Plane, the Pioneer, the Proserpine and the O'Connell. A total of 21 sites were monitored across the region.

Sites were selected on streams that drained subcatchments dominated by a single land use. These included forest (rainforest), sugar cane, grazing (sclerophyll and cleared grassland) and urban (existing and developing). Catchments of mixed land use were also monitored.

Two major rainfall events, in early and late January 2005, generated run-off. Sampling was completed during the major flow events—including the rising, peaking and falling stages—at each site. Another smaller rainfall event occurred in April, producing some minor flows in the Pioneer and Proserpine basins.

## Monitoring methods

This event monitoring project had an emphasis on community involvement. Sampling was conducted with the assistance of landholders, local and state government staff, students and other interested individuals.

Volunteers were trained in the correct sampling and quality procedures, and each volunteer received a sampling kit with all necessary sampling equipment. Volunteers were visited whilst sampling to provide them with assistance and to ensure that correct procedures were followed. Freshwater sampling was conducted by volunteers, while marine sampling was only conducted by project staff.



Samples were collected from flowing water, where possible. This was done using a triple-rinsed bucket (with water from the site). Subsamples from the bucket were analysed for total suspended solids (TSS), total nutrients (unfiltered), dissolved nutrients (filtered on-site through 0.45  $\mu\text{m}$  filters) and pesticides.

Samples from urban sites were also sampled for total organic carbon (TOC), total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH). Chlorophyll *a* and phaeophytin samples were collected from flood plumes. These were filtered within 12 hours and frozen, while TSS, pesticides, TOC, TPH and PAH samples were kept dark and chilled until analysis.

Nutrient samples were frozen as soon as possible. The report, *Fresh and marine water quality in the Mackay Whitsunday Region 2004/2005*, published by the Mackay Whitsunday Natural Resource Management Group gives further details of laboratory methodologies for TSS, electrical conductivity, nutrients, chlorophyll *a*, phaeophytin, TOC, pesticides and hydrocarbons, as well as quality assurance procedures used.

Marine samples were collected in a dispersed pattern within and outside the visible plume area on 27 and 28 January. The plume area was mapped using an aerial survey, observations from sampling vessels and satellite imagery. Surface samples only were collected from the top 0.5 metre of the water column.

A sample within a *Trichodesmium* spp. bloom was taken, as were duplicate pesticide samples (for photosynthetic inhibition assay and chemical quantification of herbicide concentrations). Salinity of samples was measured using a hand-held refractometer in the field, although samples were collected for electrical conductivity measurements in the laboratory.

Samples for TSS, electrical conductivity, nutrients, chlorophyll *a*, phaeophytin and TOC were analysed at the Australian Centre for Tropical Freshwater Research (ACTFR) Water Quality Laboratory, James Cook University, Townsville.

Samples for pesticide and hydrocarbon analyses were analysed at the Queensland Health Scientific Services laboratory, Brisbane. Methodologies for each parameter are listed in the report.

To ensure data confidence, the following quality control checks were undertaken:

- in the field
  - Triplicate samples were taken at one site on one sampling occasion. The results of these were compared, to ensure that the results were within the pre-determined tolerable error range
  - Distilled and deionised water ('field blanks') were sampled using the same sampling technique to that used in the field. This was to ensure that no contamination was involved in the sampling process
- in the laboratory
  - Annual national low-level nutrient compliance testing was conducted
  - Routine shadow testing was conducted with other laboratories.



In addition, steps were taken to further validate the TSS monitoring protocol of taking a single sample at one point (middle or edge) in the stream. On one sampling occasion, additional water samples were collected at one of the monitoring sites. Three samples were taken from the edge and three from the middle. These samples were compared to one another to prove that the variation within the stream was not significant enough to warrant sampling at more than one point in the stream.

## Data interpretation

Data interpretation was carried out with the aid of resources such as:

- maps of the Mackay–Whitsunday region showing
  - major basins, towns and streams
  - event rainfall
  - waterway monitoring sites in each basin
  - plume sampling sites
  - Landsat image of regional flood plume
  - MODIS satellite image of visible brown suspended sediment plume and phytoplankton plume
- photographs showing
  - contents of a sampling kit
  - distinct edge of the flood plume in the coastal Great Barrier Reef lagoon (aerial photograph)
  - commencement of turbid run-off water
- line graphs of comparisons—between land-use subcatchments (forest, sugar cane and grazing)—of flow rate ( $\text{m}^3/\text{s}$ ) and
  - total suspended solids concentration ( $\text{mg}/\text{L}$ )
  - nitrogen concentrations ( $\mu\text{g}/\text{L}$ )
  - phosphorus concentrations ( $\mu\text{g}/\text{L}$ )
  - herbicide residue concentrations ( $\mu\text{g}/\text{L}$ )
- box and whisker plots of the distribution of water quality parameters in the event run-off from various land-use subcatchments (forest, grazing, sugar cane, urban development and urban drainage, and some mixed land-use catchments). The water quality parameters include

- filterable reactive phosphorus (FRP) concentrations ( $\mu\text{g/L}$ )
  - ammonia concentrations ( $\mu\text{g N/L}$ )
  - NO<sub>x</sub> (nitrate+nitrite) concentration ( $\mu\text{g N/L}$ )
  - Diuron residue concentrations ( $\mu\text{g/L}$ )
  - particulate phosphorus (PP) concentrations ( $\mu\text{g P/L}$ )
  - total suspended solids concentration (mg/L)
  - Tebuthiuron residue concentrations ( $\mu\text{g/L}$ )
- scatterplots (mixing curves) of plumes of
    - filterable reactive phosphorus
    - Diuron
  - histograms of rainfall (mm), run-off (mm) and sediment loss (t/ha) for an event for forest, sugar cane and grazing subcatchments.

Continuous times series flow data from the hydrographic gauging stations and point source water quality data was entered into the Brolga database of the Department of Natural Resources and Mines. Loads were calculated using linear interpolation.

To calculate loads across the entire hydrograph, point concentrations were extrapolated to the start and end of the hydrograph. For those sites and events where data gaps existed (for example, where the second peak was not sampled), point concentrations were estimated to improve the load calculation.

## Reporting

Results were presented in the report *Fresh and marine water quality in the Mackay Whitsunday Region 2004/2005*. In addition, key findings were communicated through public forums, press releases, presentations at scientific and land management meetings and scientific publications.

For further information, including the discussion, conclusions and recommendations of the study, download the full report from the Mackay Whitsunday Natural Resource Management Group publications web page <<http://www.mwnrm.org.au/publications/>>.

## References

Rohde, K, Masters, B, Brodie, J, Faithful, J, Noble, R & Carroll C 2006, *Fresh and marine water quality in the Mackay Whitsunday Region 2004/2005*, Mackay Whitsunday Natural Resource Management Group, Mackay, Queensland, viewed 21 November 2006, <[http://www.mwnrm.org.au/Documents/Fresh%20&%20Marine%20WQ%20Report\\_Volume%201%20Main%20Report.pdf](http://www.mwnrm.org.au/Documents/Fresh%20&%20Marine%20WQ%20Report_Volume%201%20Main%20Report.pdf)>.