Noosa Main Beach Algae Mitigation Trial

Author

Corbett, BB, Jackson, LA, Tomlinson, R, Hagan, M, Schalcher, T, Lloyd, S, Hughes, L

Published

2009

Conference Title

19th Australasian Coastal and Ocean Engineering Conference 2009 and the 12th Australasian Port and Harbour Conference 2009, COASTS and PORTS 2009

Noosa Main Beach Algae Mitigation Trial

Bobbie B. Corbett[1], L. Angus Jackson[1], Rodger Tomlinson[2], Michael Hagan[4], Thomas Schalcher[3] and Lawrence Hughes[2]

[1]International Coastal Management, Gold Coast, Australia
[2]Griffith Centre for Coastal Management, Gold Coast, Australia
[3]University of Sunshine Coast, Maroochydore, Australia
[4]Sunshine Coast Regional Council, Noosa, Australia

Abstract

Noosa Main Beach (Sunshine Coast, Australia) experienced large volumes of filamentous algae Hincksia sordid during the summer months for three consecutive years. Visually unappealing and producing an obnoxious odour, it has a significant negative impact on the local tourist-based economy. Traditional methods of dealing with the algae were unsuccessful and alternative options were generated, culminating in the trial of a seabed based curtain in 2009.

1 Introduction

The Noosa Main Beach Algae Mitigation Project was initiated in 2005 in response to the repeated presence of algae during the summer months at Noosa (Sunshine Coast, Queensland, Australia). While the source of the algae bloom was investigated, the aim of this project was to investigate ways to exclude the algae from Noosa Main Beach between First Point and the middle groyne (Figure 1).

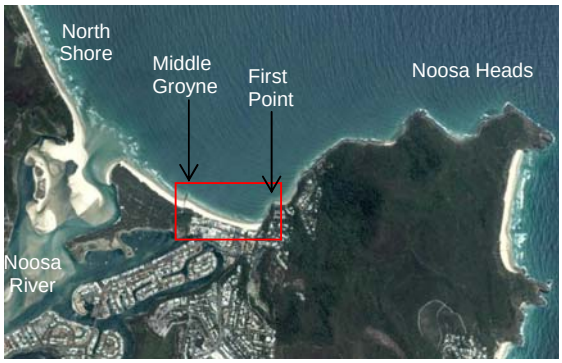

Figure 1: Area of Exclusion on Noosa Main Beach (Image Source: Google)

The project was split into four main stages:

1. Option Overview and Proposed Trials
2. September Data Collection
3. Design and approvals
4. Summer trial

2 Background

Noosa Main Beach is sheltered from the predominant SE swells by Noosa Heads. As a result, Laguna Bay typically experiences relatively calm conditions (average wave height of 0.3m).

Hincksia sordida is a finely filamentous brown algae that can range in size from 20cm down to 0.03mm, depending on the stage in its lifecycle. At Noosa, the Hincksia was typically fragmented and generally <10mm in size.

Hincksia sordida was first observed at Noosa Main Beach in 2002. For three years (2002/03 – 2005/06) the algae was evident in increasing quantities during the summer months (typically between September and February). The alga appeared in patches within the surf zone where it was dispersed throughout the water column, turning the nearshore area a dark brown.

Quantities of algae would remain on the beach on the outgoing tide (Figure 2). While wet, it retained a soup-like consistency that made it difficult to remove. When allowed to dry, the decomposition would release Hydrogen Sulphide, but allowed the algae to be removed from the beach and placed as landfill. Between 20 and 700 tonnes of algae and sand were removed from the beach per day.

Figure 2: Hincksia sordida dispersed through the water column and drying on the beach

The presence of alga on the beach and within the nearshore zone was visually unappealing and produced obnoxious odours. Due to the nature of the development along Hastings Street and the popularity of the beach itself, this was detrimental to the local tourism industry and economy.

3 Stage 1: Option Overview (GCCM, 2005a)

The shape of Laguna Bay and typically calm conditions lends itself to the formation of circulation cells that could easily allow the accumulation of algae in the nearshore zone, gradual migration along the beach and trapping of alga adjacent to middle groyne.

Anecdotal evidence suggested that the presence of the alga was typically associated with northerly conditions and natural flushing of the system was often associated with a southerly change or larger wave conditions.

Local and regional modelling was undertaken using Delft3D allowed a conceptual model of current patterns to be generated (Figure 3 and Figure 4). Current measurements taken during stage 2 generally validated the direction and magnitude of the modelled currents. For further details, see GCCM report (2005d).

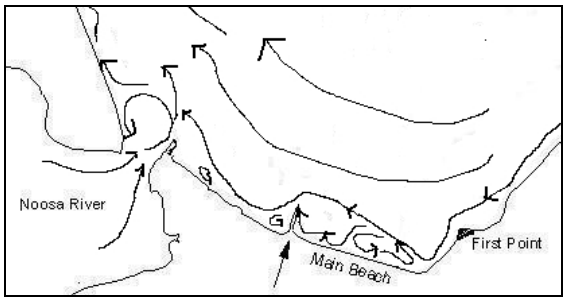

Figure 3: Circulation Cells developing as a result of calm (H=0.5m) north-easterly conditions

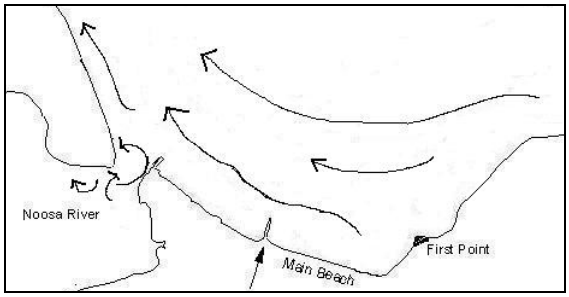

Figure 4: Current patterns developing as a result of large (H=1m) south-easterly conditions

A number of options were considered. These included:

1. Do Nothing
2. Treat at source
3. Change dynamics
4. Collection
5. Exclusion

Do nothing was generally considered to be undesirable and dealing with the alga at the source was not viable as the source is yet to be located. Trials incorporating changing the dynamics, collecting the algae and excluding the algae were to be trialled, although exclusion appeared to be the more desirable option as it would keep algae out of the nearshore zone and off the beach.

For further details, see GCCM report (2005a).

4 Stage 2: Data Collection

Preliminary observations indicated that pockets of algae were distinct, restricted to the width of the surf zone (Figure 5) and to defined areas alongshore which appeared to correlate with rip cells. Within this region, the alga was well distributed through the water column by turbulence generated by wave action.

Figure 5: Algae present over the width of the surf zone

Directly seaward of the surf zone, while the water appeared clear, further inspection revealed that algae was evident in very low concentrations throughout the water column, with very high concentrations within ~10-20cm of the seabed (Figure 6). Further seaward, the layer close to the seabed remained evident, with variations in concentration becoming more distinct so that 'patches' of algae became more defined (Figure 7).

Figure 6: Very high concentrations of algae at the seabed directly seaward of the surf zone.

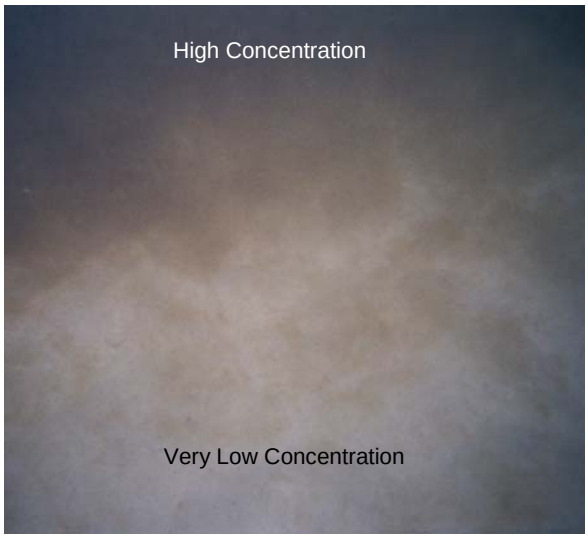

Figure 7: Patches of higher and lower concentration of algae slightly further seaward

Spot observations were undertaken using an underwater camera in locations up to 1km offshore in water up to 10m deep. While patches of algae became smaller, thinner and better defined, no large clear areas were observed. This represents a significant volume of algae which can be drawn into the nearshore zone and onto the beach during certain conditions.

Figure 8: Sparse algae

For further details, see GCCM report (2005b).

5 Stage 3: Design & Approvals

Approvals for the collection of algae off the beach were already in place prior to the start of the project. Due to the critical nature of the timing and the late arrival of the algae during the 05/06 summer, stage 3 was initiated prior to arrival of the algae. These approvals were amended to incorporate a range of trial options, including:

- fine-meshed net or silt curtain (Figure 9)
  - floating
  - seabed based
- air bubble curtain (Figure 10)
- combination

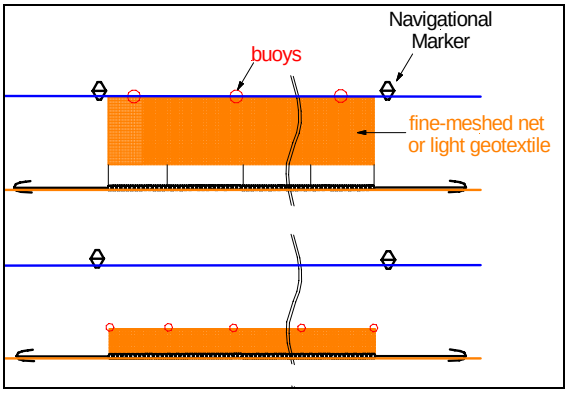

Figure 9: Sketch of fine meshed net or silt curtain (floating or seabed based)

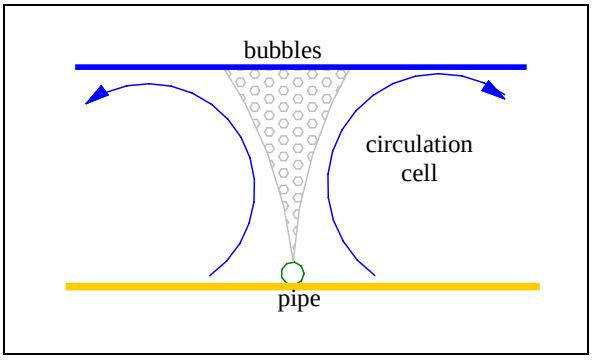

Figure 10: Sketch of air bubble curtain

For further details, see GCCM report (2005c)

6 Stage 4: Trial

6.1 Drag Netting

A 40m long x 1m wide 20mm mesh fishing net was handled by two people in the surf zone and removed from the water using a 4WD (Figure 11). The 20m length appeared noticeably clearer, but the volume of algae removed and successfully cleaned from the net was only ~0.25m^3. Standard procedures for net cleaning proved ineffective and a significant amount of algae was unable to be removed effectively from the net (Figure 12). Subsequent attempts were less effective as the net was already clogged with algae.

Figure 11: Algae removed from water using 20mm mesh fishing net.

Figure 12: Mesh was clogged with algae and could not be easily cleaned.

A 3m length of shade cloth was also trialled. A similar volume was removed (per metre of net), but unlike the mesh, the cloth was easily cleaned as the algae rolled off the fabric (Figure 13).

Figure 13: Algae rolling off the shade cloth

While this was more feasible, further trials were not undertaken as the volumes that could be effectively removed from the surf zone with a single "net" of a manageable size was much lower than the volumes of algae that were typically present within the surf zone and on the beach.

6.2 Sand Shifter

The operation of the local sand backpassing operation (Sand Shifter) provided the only real low-impact mechanism for influencing current patterns that may disperse the algae. While there was a patch of clear water directly seaward of the Sand Shifter (Figure 14), a dense patch of algae was evident within 30m of the discharge point. As such, it was concluded that the effect was relatively localised and the lack of people utilising this section of beach made it clear that the discharge was not successfully creating a desirable swimming location.

Figure 14: Clear water directly seaward of the Sand Shifter discharge point

6.3 Seabed Based Algae Curtain

6.3.1 Concept & Design

As the algae is predominantly located in a relatively thin band close to the seabed further offshore, it would be most effective to target it while it was within this zone (before it is dispersed within the surf zone). A seabed based approach provided additional benefits in the form of reducing the impact on visual and recreational amenity of the location as well as minimising potential for safety risks to swimmers.

It was decided to trial a 100m long seabed barrier in the form of a woven geotextile "curtain" with suitable weights and buoys to ensure it remained essentially vertical within the water column despite wave action. This would be securely anchored in place along its length.

This was undertaken as a full-scale trial with monitoring to establish how the algae responded to the curtain (i.e. if it effectively prevented migration of algae shoreward); if design revisions or altered layouts could improve its effectiveness;

and if periodic removal of algae from behind the barrier would be necessary.

It was recognised that while the curtain could potentially reduce the volume of algae reaching the beach, it was unlikely that it would completely eliminate algae from within the protected area. As this type of algae has not been dealt with in the past, it was acknowledged that the proposed trial was experimental and further evolution of the concept (or development of alternate concepts) may be necessary.

For further details, see GCCM report (2005c).

6.3.2 Installation

The seabed based curtain was fabricated by ELCO Solutions in 2005 (Figure 15), however the algae season finished early and did not appear in subsequent seasons, so the installation of the curtain was delayed. In 2009, the newly formed Sunshine Coast Regional Council decided to deploy the curtain as a proactive measure to ensure that installation could be undertaken smoothly when required. The curtain was successfully deployed by Marine Civil Contractors in March 2009 (Figure 16).

Figure 15: Seabed based algae curtain prior to installation

Figure 16: Final assembly and deployment of algae curtain

The curtain was deployed in water depths between 3.8 – 4.5m LAT, giving ~3m clearance above the curtain at all times. Once deployed and pulled into position, the curtain sat vertically in the water column with the centre of the chain at the seabed level (Figure 17) and the top of the curtain moving horizontally by up to ~0.5m during the sets (H_{max} = 1.3m). These observations suggested that preliminary design was reasonably accurate.

Figure 17: Seabed based algae curtain resting on seafloor

Monitoring was undertaken by both International Coastal Management and the University of Sunshine Coast. During deployment and subsequent inspections, both fine algaes and larger seagrasses were present in the waters surrounding the curtain. The finer alga was not the Hincksia-type and was dispersed over a larger depth of water column (~1m). As a result, it would be anticipated that the curtain would not be as effective for this algae type. While the alga was present on both sides of the curtain during all inspections, it was noticeably denser on the seaward side of the curtain.

During this time there were a number of storm events, the largest of which was associated with Tropical Cyclone Hamish, which produced 30-40knot winds and 3-4m swell at Noosa (Figure 18). This meant that the breaking zone extended out to approximately the location of the curtain.

Inspections subsequent to TC Hamish revealed that the curtain had remained in location, had not become buried in sand and, while four tears were identified in the geotextile fabric (Figure 19), the majority of the curtain was in good repair considering the conditions to which it was exposed.

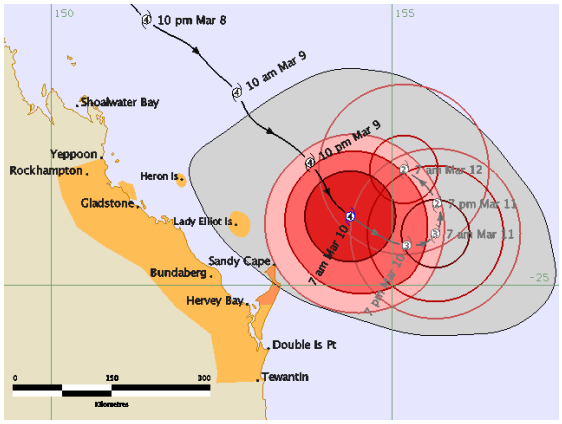

Figure 18: Tropical Cyclone Hamish

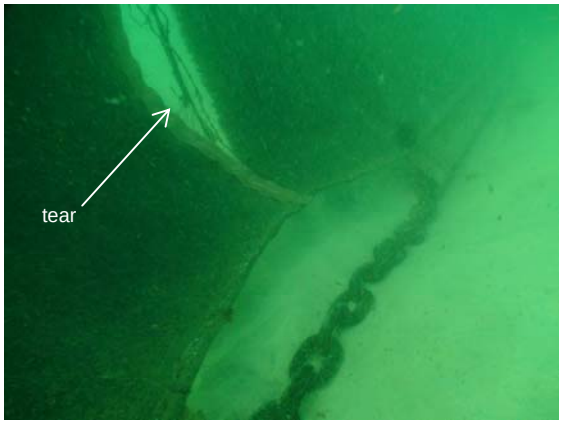

Figure 19: One of four tears in the geotextile fabric as a result of Tropical Cyclone Hamish

The curtain was left in place for approximately 4 months before it was retrieved in late July. Marine growth on the woven geotextile was reasonably limited during this time and could easily be removed with light brushing. It is likely that growth would be higher during the more typical deployment period (i.e. during the summer months).

For further details, see ICM report (2009).

7 Future Works

The final trial of the algae mitigation curtain is to be undertaken when the Hincksia sordida algae returns to Noosa Main Beach.

8 References

Griffith Centre for Coastal Management. (2005a) Noosa Main Beach Algae Mitigation Project: Option Review and Proposal for Trials. Research Report 46/1

Griffith Centre for Coastal Management. (2005b) Noosa Main Beach Algae Mitigation Project: Final Data Collection. Research Report 46/2

Griffith Centre for Coastal Management. (2005c) Noosa Main Beach Algae Mitigation Project: Trial Design. Research Report 46/3

Griffith Centre for Coastal Management. (2005d) Noosa Main Beach Algae Mitigation Project: Delft 3D Numerical Modelling of Laguna Bay. Research Report 46/4

International Coastal Management. (2009) Noosa Main Beach Algae Mitigation Project: Stage 4B Report.