Australian Government
Great Barrier Reef Marine Park Authority

Site Assessment Report

Douglas Shoal Remediation Project

Great Barrier Reef Marine Park Authority

8 November 2019

Level 25, 12 Creek Street
Brisbane. QLD. 4000

Advisian
Worley Group

advisian.com

Published by the Great Barrier Reef Marine Park Authority

ISBN 9780648589242

A catalogue record for this publication is available from the National Library of Australia

This publication should be cited as:

Neale, S.J. and Boylson, B.D. 2019, *Douglas Shoal remediation project: Site assessment report*, Prepared by Advisian Pty Ltd for the Great Barrier Reef Marine Park Authority, Townsville, Queensland, Australia.

Disclaimer

This report has been prepared by Advisian Pty Ltd on behalf of and for the exclusive use of Great Barrier Reef Marine Park Authority, and is subject to and issued in accordance with the agreement between Great Barrier Reef Marine Park Authority and Advisian. Advisian accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

While all efforts have been made to verify facts, the Great Barrier Reef Marine Park Authority takes no responsibility for the accuracy of information supplied in this publication.

Aboriginal and Torres Strait Islander readers are advised this publication may contain names and images of deceased persons.

Comments and questions regarding this document are welcome and should be addressed to:

Australian Government
Great Barrier Reef
Marine Park Authority

Great Barrier Reef Marine Park Authority
2–68 Flinders Street
(PO Box 1379)
Townsville QLD 4810, Australia

Phone: (07) 4750 0700
Fax: (07) 4772 6093
Email: info@gbrmpa.gov.au
www.gbrmpa.gov.au

Advisian
Worley Group

Table of contents

Table list

Figure list

Appendix list

1 Executive summary

The bulk carrier *Shen Neng 1* ran aground on Douglas Shoal in April 2010 and remained on the shoal for ten days before being re-floated. The vessel suffered significant damage and loss of antifouling paint (AFP) through contact with the shoal over an area of approximately 42 hectares.

The Great Barrier Reef Marine Park Authority (the Authority) established the Douglas Shoal Remediation Project (the Project) in late 2016 with funds from a court settlement associated with the grounding. The primary desired outcome of the Project is that remediation supports natural recovery of the shoal. Key concerns for natural recovery were identified as AFP-related contamination and physical damage associated with grounding-related rubble and flattening of the shoal's topography. A preliminary site assessment commissioned by the Authority identified potential priority areas for remediation (Areas A, C, E and F) which covered approximately 42 hectares.

Advisian is providing planning and project management services to the Authority including remediation planning, stages of which include targeted fieldwork, site assessment and options analysis (Figure 1-1). Remediation planning is focused on the previously identified priority areas and key concerns for natural recovery of the shoal. An expectation for remediation planning is that it promotes best 'value for money' solutions that address the most significant impediments to natural recovery of the shoal.

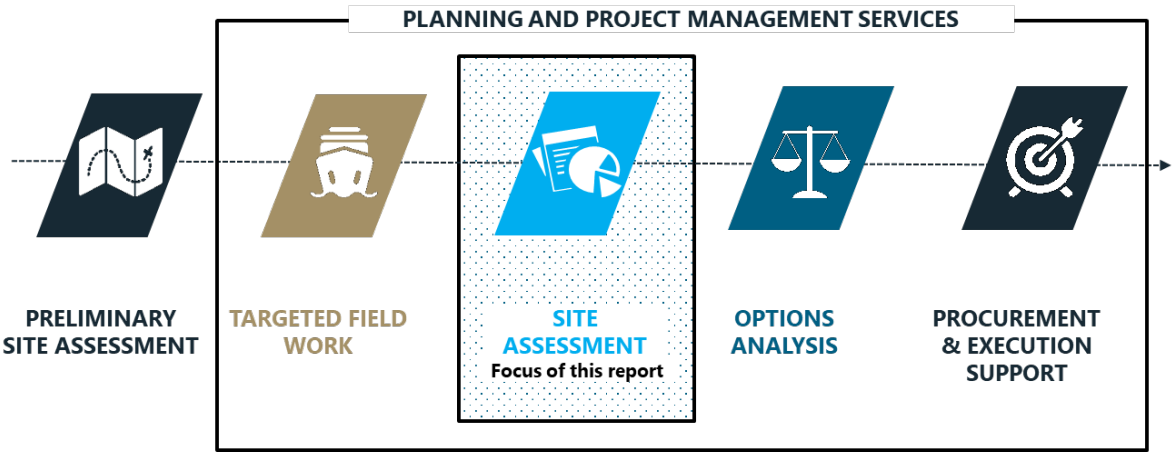

Figure 1-1 Planning and project management services

Targeted fieldwork was executed to provide information on physical damage and contamination:

- Diver-assisted sediment sampling at 237 georeferenced sampling locations conducted over a 17-day period in March 2019
- Visual survey including multibeam sonar and acoustic sub-bottom profiling, drop camera and towed underwater video survey conducted within a 15-day period in May and June 2019.

Fieldwork data was considered in the context of sediment and water quality guidelines, along with information relating to the background environment and previous investigations (Figure 1-2), albeit that significant gaps with respect this information are evident:

- There are no data relating to the pre-grounding incident condition of the shoal to provide information on habitat and how this may change seasonally and in response to natural events
- There is not a consistent or comparable set of information regarding contamination or physical damage to enable detailed quantitative analysis of change over time including natural recovery.

Given these information gaps the site assessment focuses on the current state of the shoal. Evidence regarding physical damage and contamination is used to delineate areas of 'high' and 'moderate' priority for consideration as part of the options analysis.

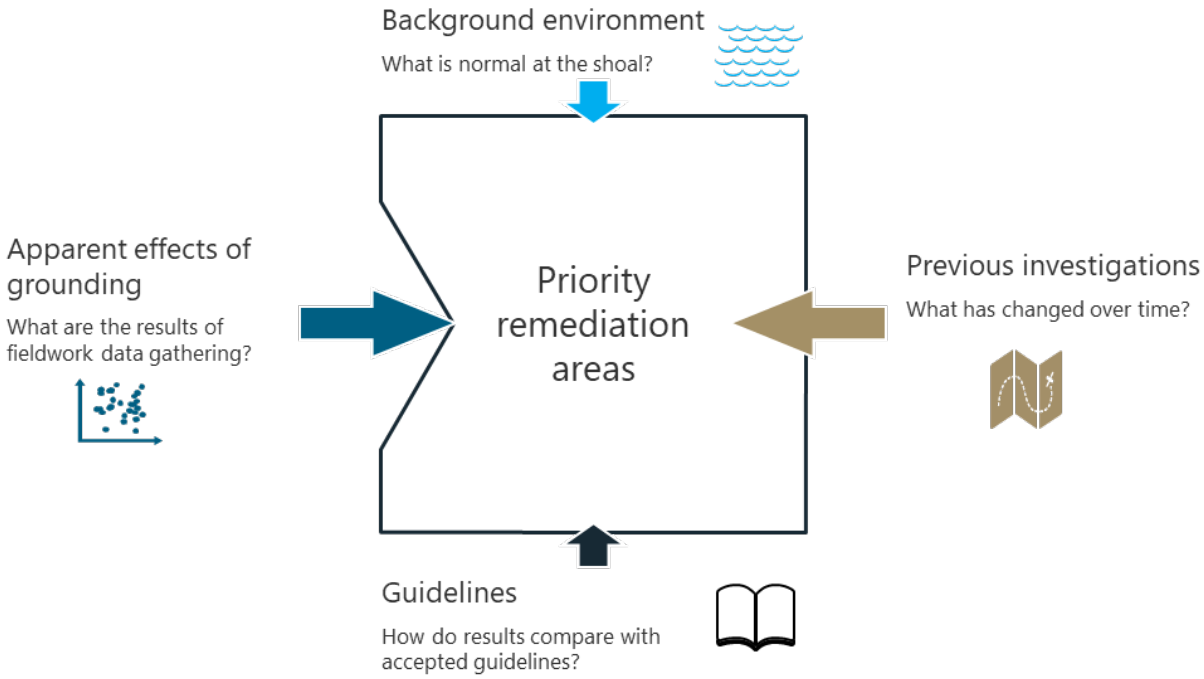

Figure 1-2 Priority remediation area delineation

While Douglas Shoal does not have a complex range of features, some habitat diversity is evident. Habitat areas of the Low Relief Terrace of the shoal include (Figure 1-3):

- Undulating expanses of densely covered (predominately macroalgae) hard reef substrate with occasional sandy patches
- Channels or gutters containing large pieces of dead coral or coarse sand with gently sloping sides
- Flat expanses of low relief corals with minimal sediment
- Holes containing sand or dead coral fragments with densely inhabited steep walls.

The High Relief Terrace to the north and north-west of the shoal contains more complex features:

- Spur and groove outcrops with moderate coral cover rising several metres from the sea floor
- Deep channels with large fragments of broken coral and coarse sand with sparse tufts of macroalgae growing within the sediment.

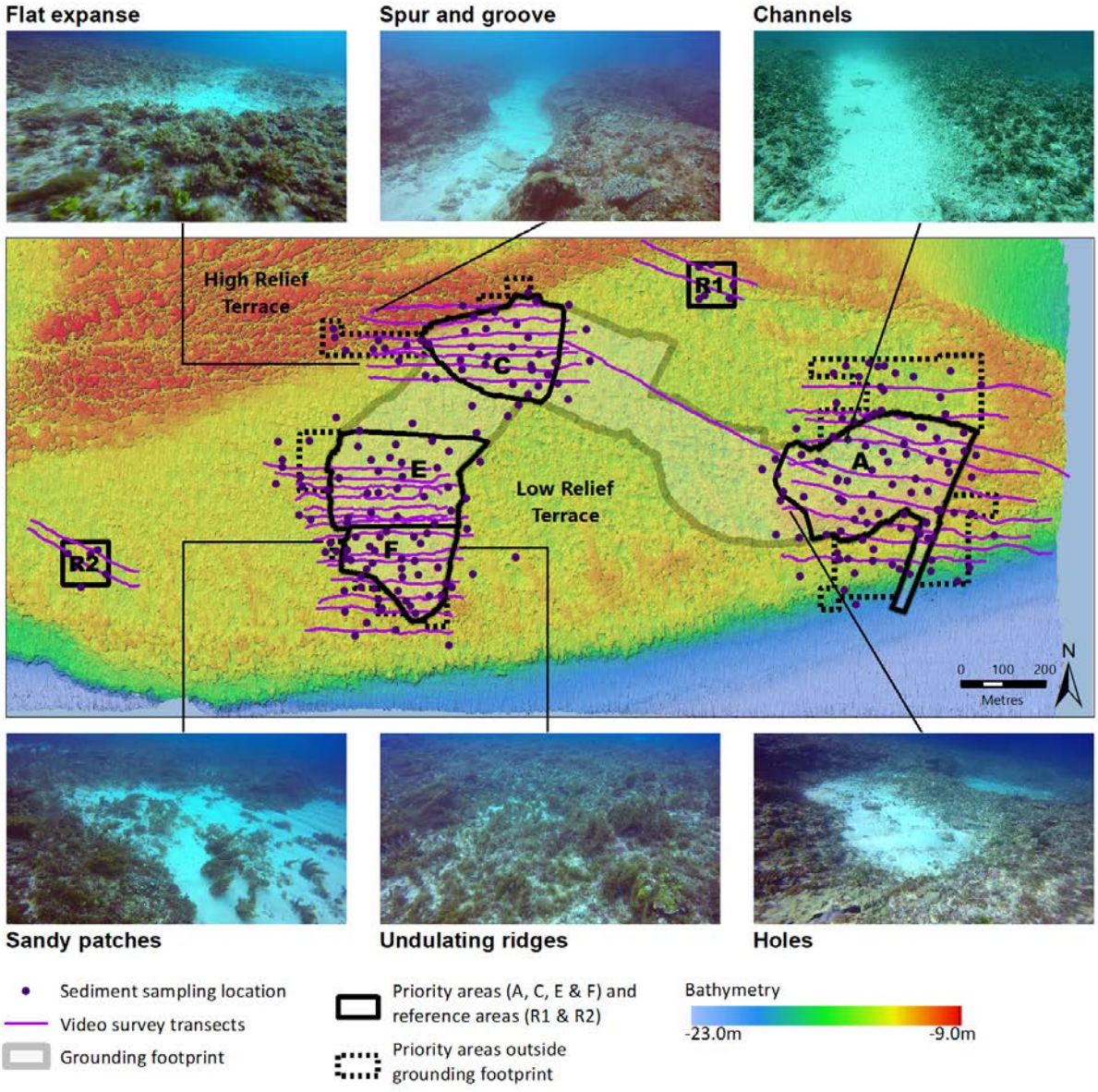

Figure 1-3 Field survey and habitat types at Douglas Shoal

The surveyed area of the Low Relief Terrace consists of large expanses of turf algae on rock (32.6%), macroalgae growing predominately on rock (38.5%) and hard (3.8%) and soft coral (2.0%) growing on rock, areas of grounding related rubble (10.2%), dead coral fragments (~1%) and sand (9.3%).

Sediment is not a dominant component of the substrate, nor is it uniformly distributed across the surveyed area of Douglas Shoal. It is typically located in depressions as patches in undulating areas and in channels, gutters and holes. The depth of sediment is limited across the surveyed area of the shoal, ranging from 5mm to 400mm, and averaging 73mm.

1.1 Contamination

Analysis of sediment samples taken during the site assessment focused on the constituents of AFP and particularly copper and tributyltin (TBT). A staged assessment process was applied like that set out in the National Assessment Guidelines for Dredging (NAGD, Commonwealth of Australia (2009)) with laboratory analysis results compared to both NAGD screening levels and the 95th and 99th % species protection default guideline values outlined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018).

Analysis supported delineation of high and moderate priority areas for remediation with respect to contamination. Contamination of sediments exists primarily within part of the previously identified Priority Area A and is principally associated with TBT (Figure 1-4).

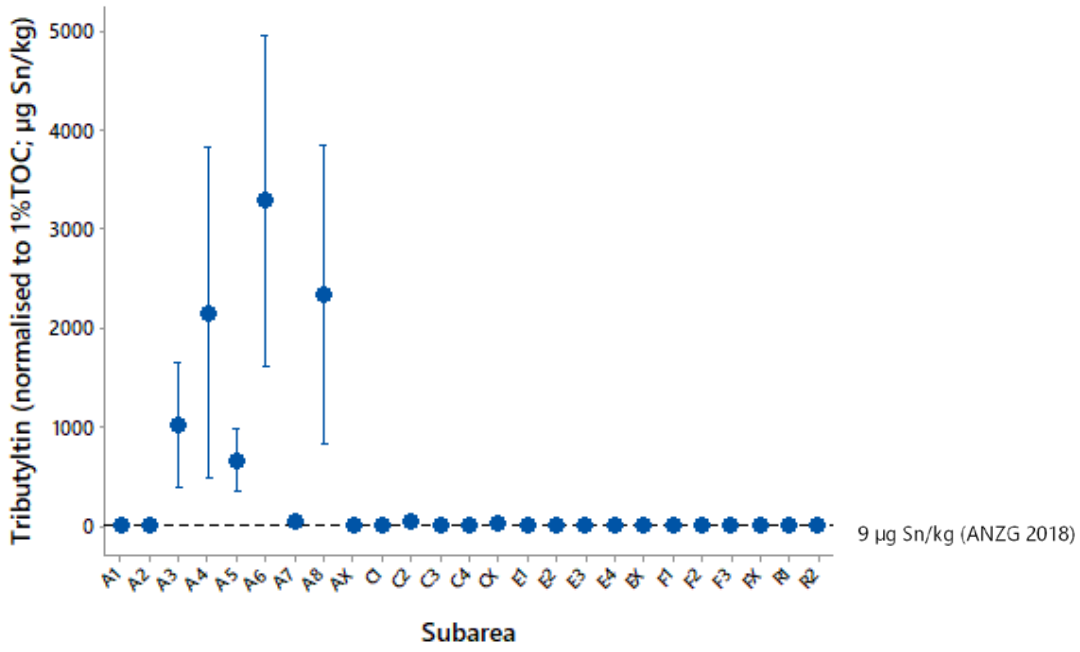

Figure 1-4 Mean concentrations of tributyltin (±standard error) by sub-area (ANZG (2018) default guideline value of 9µg Sn/kg is displayed as a dashed line)

No visible evidence of AFP smears, flakes or chips was identified during the survey. It is likely that the extent and level of contamination has reduced at the grounding site over time, with contributing factors to reduction including exposure to erosive forces (e.g. ocean currents and waves) through normal conditions and extreme events. Notwithstanding this, investigation of TBT persistence show it may be another decade before TBT ceases to be a contaminant of concern in Priority Area A. As such, it is considered that addressing AFP-related contamination should remain a priority for remediation.

Remediation planning and monitoring should recognise that sediments are not well mixed, with contamination typically associated with remnants of AFP flakes in fine sediment. Contamination of sediments may occur outside of the priority remediation areas; however, such areas are likely to be small, isolated and with lower levels of contamination.

1.2 Physical damage

Physical contact between the vessel and the shoal created rubble. The rubble is different from naturally occurring sediments (including dead coral fragments) as it is coarser, more angular, and typically without encrusting organisms (coralline algae or turf algae, encrusting sponges or coral). The rubble is commonly unconsolidated and its movement over time appears to impede natural recovery.

Fieldwork and analysis focussed on identification and delineation of areas of rubble. Data derived from sonar survey (including Angle-Range Analysis (ARA)) was correlated with sediment particle size distribution data and habitat characterisation data from underwater video survey to delineate areas of rubble (Figure 1-5). This analysis also shows that unconsolidated rubble has moved over time, generally in a westerly direction, and affected habitat on the shoal beyond the grounding footprint. Further analysis indicates in some locations the rubble has filled (partially or completely) natural depressions and therefore altered habitat complexity on the shoal.

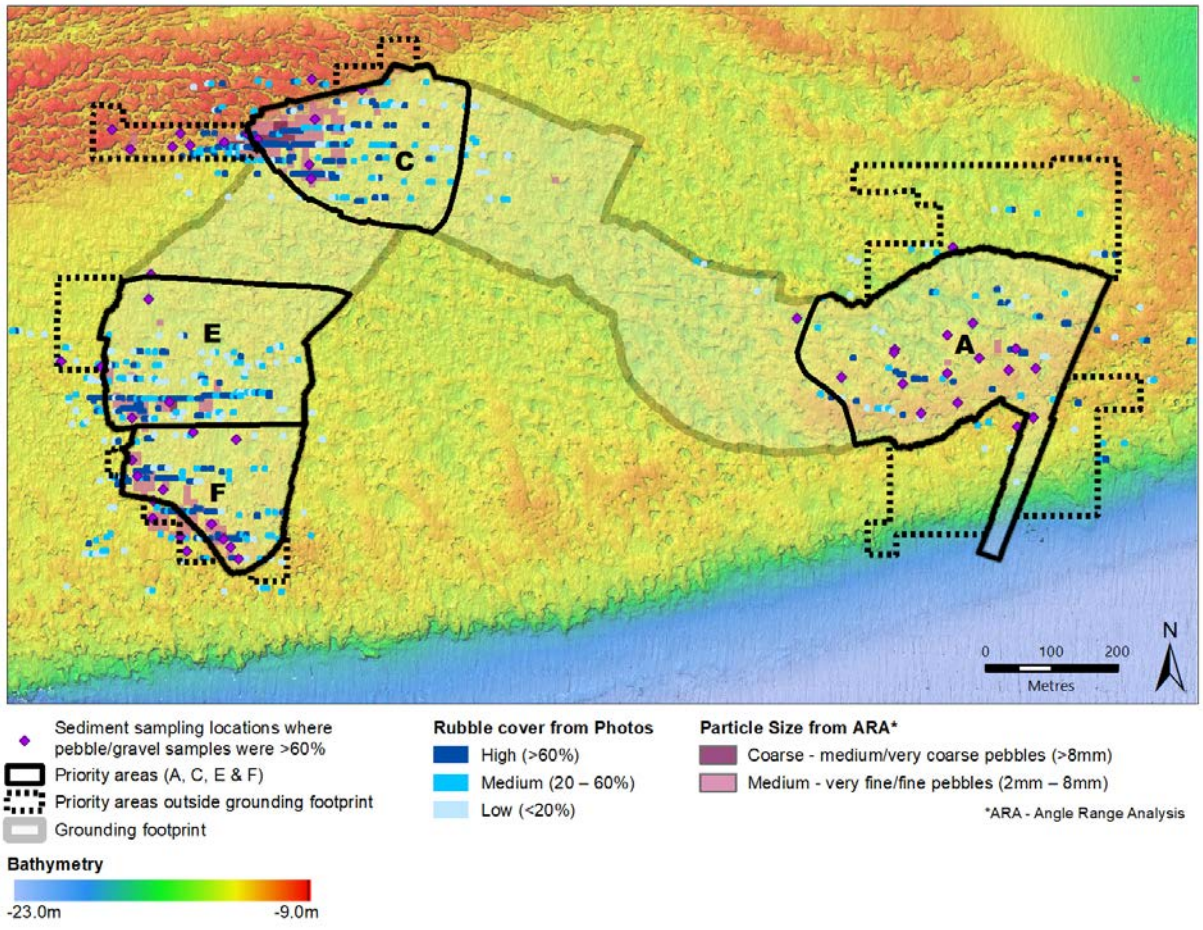

Figure 1-5 Rubble distribution across the priority areas

Physical damage associated with rubble is more obvious than areas affected by abrasive flattening and compaction as these areas are commonly obscured by the rubble. Analysis of changes over time (between 2010 and 2019 survey) in flattened extent suggests that grounding-related flattened areas are at least in part associated with rubble filling in depressions and 'flattening' the profile of the shoal.

1.3 Habitat changes

Data collected from underwater video survey was qualitatively compared with data from surveys immediately after the grounding in 2010. Both surveys found low cover of hard coral (<8%) and high abundance of macroalgae and 'bare' reef pavement outside the grounding footprint on the Low Relief Terrace of the shoal.

Comparison of 2019 survey benthic habitat and benthos data from inside and outside the area assumed to be impacted by the grounding is shown in Figure 1-6. Outside the impacted areas, hard and soft coral, macroalgae, turf algae on rock, sand and other benthos were more abundant. The impacted areas were characterised by having very high cover of rubble. Closer examination of the benthic groups shows the cover of rubble is highest inside the impacted area in Priority Area F (47.9%), followed by Priority Area C (23.5%), Area E (31.4%) then Area A (10.4%). It is considered likely that the grounding caused habitat changes on the shoal including the replacement of areas of 'turf algae on rock' and areas of 'sand' with 'rubble'.

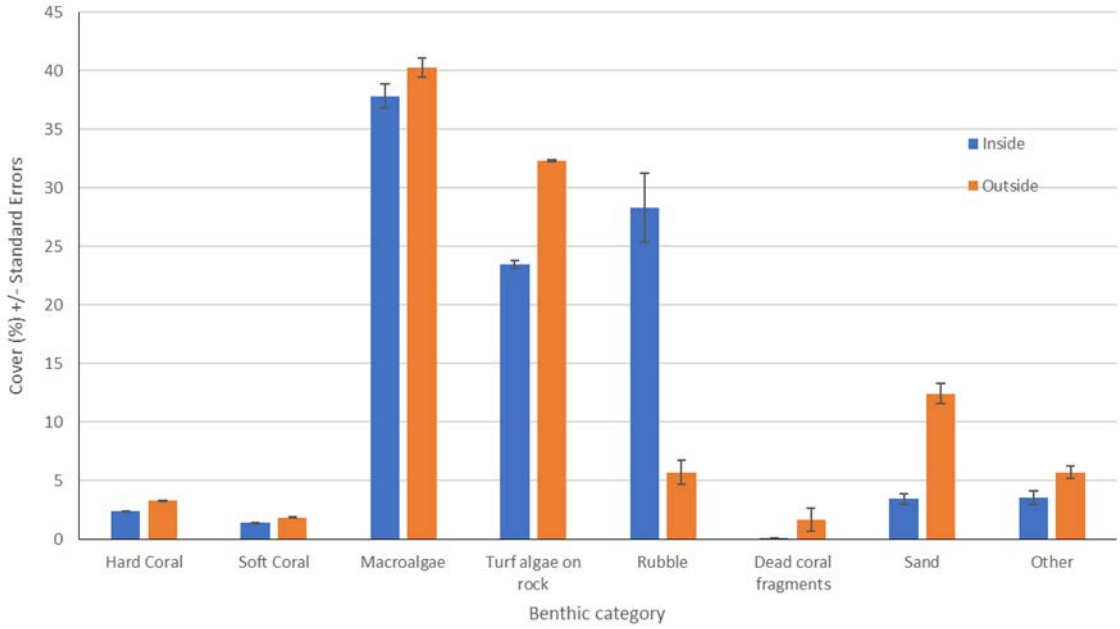

Figure 1-6 Percentage covers (+/- standard error) of benthic groups inside and outside the assumed impacted areas

The appearance of the rubble does not appear to have changed significantly since the grounding and remains obviously different to the natural sediments found in the reference or unaffected areas; however, some areas of rubble do support benthic organisms and have consolidated over time. It appears that some areas of substrate smothered by rubble following the grounding have been exposed with westward movement of rubble over time. Undulating substrate was found in these areas to be devoid of algal growth; however, now exposed these areas may support the settlement and growth of coral recruits and other benthos.

1.4 Priority remediation areas

The site assessment investigations show that almost ten years after the grounding incident contamination and physical damage remain as potential impediments to natural recovery, albeit their significance within the survey area may have diminished over time. The investigations support delineation of priority areas for remediation as follows (Figure 1-7):

- Remediation priority for contamination in part of Priority Area A:
  - Moderate priority assigned where analysis shows concentrations of TBT, copper or zinc in sediment are predominantly above default guideline values for ecosystem protection, with contaminant levels in sediment likely to remain above the guideline values for about ten years
  - High priority assigned where, in addition to the above, analysis shows that disturbance of the sediment is likely to release water with concentrations of TBT, copper or zinc above default guideline values for the protection of a high ecological or conservation value system.
- Remediation priority for persistence of rubble in part of priority areas C, E and F:
  - High priority assigned where analysis shows most substrate is rubble
  - Moderate priority assigned where analysis shows rubble is a significant part of the substrate.

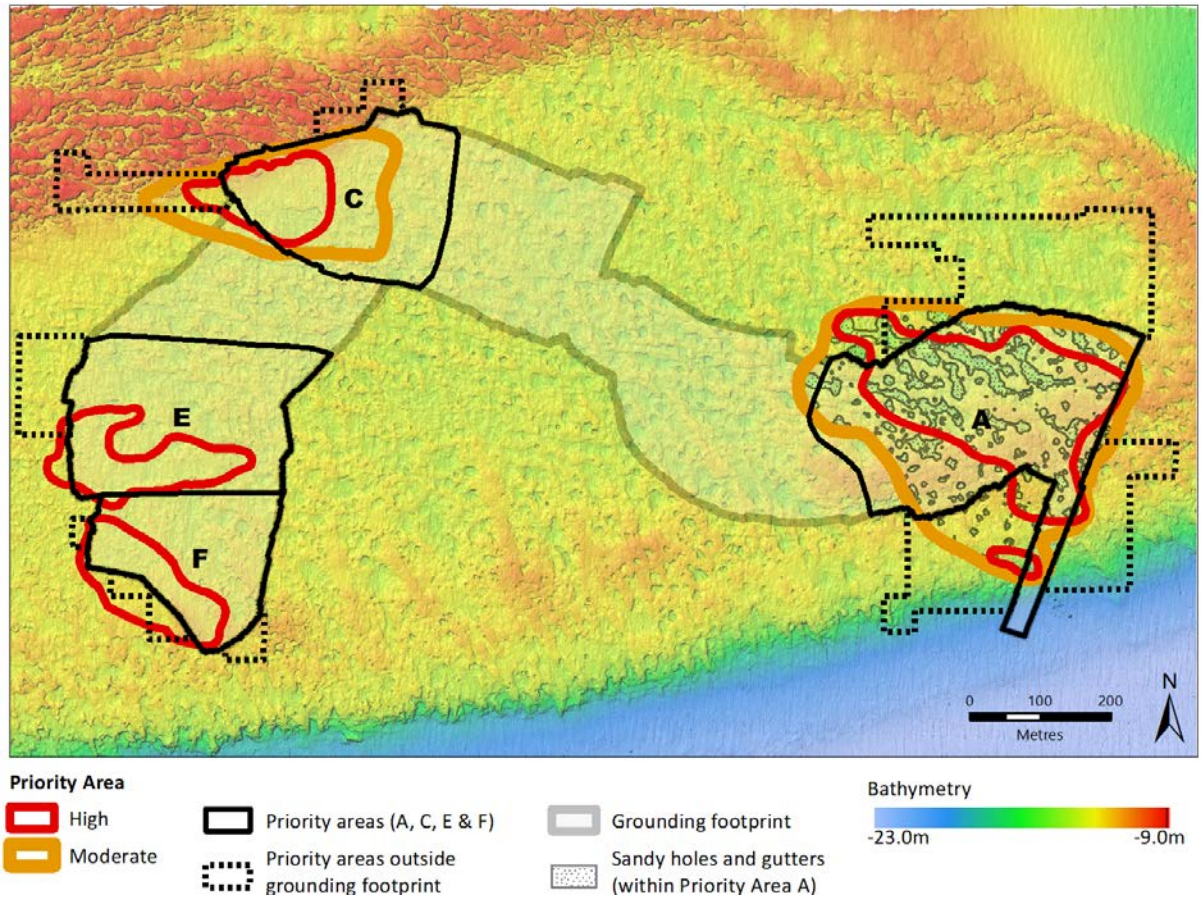

Figure 1-7 Delineation of high and moderate priority areas

The persistence of rubble obscures the extent of abrasive flattening and compaction damage on the shoal; however, these areas of abrasive flattening and compaction are considered to be of lower importance with respect to remediation, given that the areas are small, within identified areas of rubble and that 'natural' areas adjacent to the grounding footprint are likely to offer habitat of similar value to these abraded flattened areas. Areas of abrasive flattening and compaction damage are not mapped and are not considered to be a priority for remediation. It is considered that other areas within the grounding footprint, including the remainder of areas A, C, E and F (Figure 1-7) do not represent a priority for remediation as there is insufficient evidence to show that natural recovery of the shoal is impeded by any ongoing influence of the grounding in these areas.

The total area of high and moderate remediation priority (contamination and physical damage) is 9.8 hectares (Table 1-1). This includes 2.3 hectares considered to be of high and moderate remediation priority for contamination and 7.5 hectares considered to be of high and moderate remediation priority for physical damage. Using the average measured sediment depth for each area the volume of sediment within the high and moderate remediation priority areas (contamination and physical damage) is estimated to be 7,065m^3 (Table 1-1). This includes 1,386m^3 of sediment considered to be of high and moderate remediation priority for contamination within part of Priority Area A, and 5,679m^3 of rubble considered to be of high and moderate remediation priority for physical damage across part of priority areas C, E and F.

Table 1-1 Area and sediment volume estimates

Priority area	Impediment to natural recovery	Estimated area (ha)			Estimated volume of sediment (m^3)		
		High	Moderate	Total	High	Moderate	Total
A	Contamination	1.5	0.8	2.3	880	506	1,386
C	Physical damage	1.5	2.3	3.8	1,158	1,761	2,919
E	Physical damage	1.8	-	1.8	1,196	-	1,196
F	Physical damage	1.8	-	1.8	1,564	-	1,564
Totals	**Contamination and physical damage**	**6.6**	**3.2**	**9.8**	**4,798**	**2,267**	**7,065**

The site assessment has delineated the remediation priority areas based on detailed studies designed to reduce uncertainty with respect to the spatial distribution of physical damage and contamination. The total area identified through the site assessment as being of high and moderate remediation priority for physical damage and contamination (9.8 hectares) is significantly less than the area identified as a being of potential remediation priority for both contamination and physical damage in the preliminary site assessment (42 hectares).