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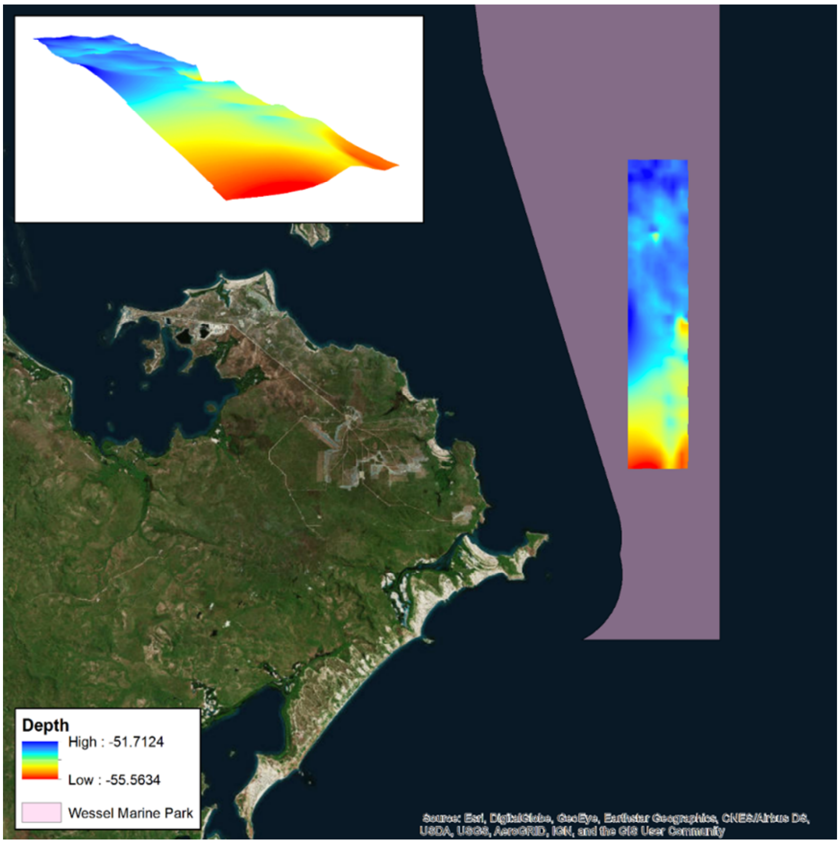
AUSTRALIAN INSTITUTE OF MARINE SCIENCE

Wessel Marine Park Multibeam Survey

REPORT PREPARED FOR PARKS AUSTRALIA

Mark Case, Simon Harries, Karen Miller



AIMS: Australia's tropical marine research agency

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Australian Institute of Marine Science
PMB No 3
Townsville MC Qld 4810
PO Box 41775
Casuarina NT 0811
Indian Ocean Marine Research Centre
University of Western Australia, M096
Crawley WA 6009

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1	Prepared by:	*Mark Case*	*12/06/2019*	
	Approved by:	*Michaela Dommisse*	*19/06/2019*	
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1 CONTEXT

1.1 Background

The Australian Institute of Marine Science (AIMS) was contracted by Parks Australia to undertake opportunistic multibeam bathymetry mapping of West Cape York Marine Park during a pre-existing transit voyage of the Research Vessel *Solander* from Thursday Island to Darwin, planned for January-February 2019.

Due to extreme weather conditions it was not feasible to survey within the West Cape York Marine Park, and instead an area within the more sheltered southern region of the Wessel Marine Park was surveyed. The Wessel Marine Park is located off the east coast of East Arnhem Land, Northern Territory. A general location diagram showing the Wessel Marine Park survey locations is provided as Figure 1.

The primary objective of the survey was to undertake approximately 24hrs of MBES surveying to quantitatively map parts of the seafloor within the Wessel Marine Park to build knowledge of the values of the park and to provide data that can inform future, targeted bathymetric and biological surveys.

This report details the operational aspects of the survey and provides a summary of the multibeam echo sounder (MBES) data that was acquired and processed.

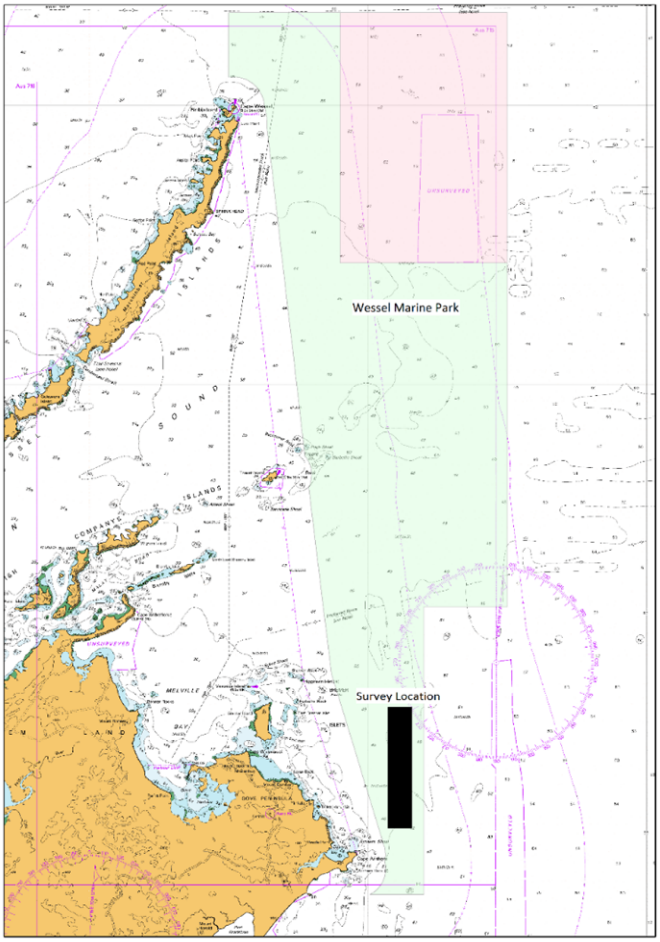

Figure 1: General location diagram for the multibeam echo sounder (MBES) survey and Wessel Marine Park

1.2 Survey Planning

Survey planning for the West Cape York Marine Park was undertaken in consultation with Parks Australia to optimise value of new data relative to marine park zones, habitats and depth gradients, existing multibeam data, and to prevent surveying where MBES data already existed.

The following websites and data portals were queried about multibeam and bathymetry data and its availability and quality.
AusSeabed Marine Data Discovery - Bathymetry and Backscatter Data Access
https://marine.ga.gov.au/#/
CSIRO - Data Access Portal
https://data.csiro.au/dap/search?kw=Bathymetry/Seafloor%20Topography
Australian Hydrographic Office
http://www.hydro.gov.au/business-publications/hydroscheme.ht

Several layers of information were download and assessed. Transit data from the CSIRO – Data Access Portal was of a poor quality and didn't affect planning. The RAN had recently completed multibeam surveys in the Northern region of the West Cape York Marine Park and data should be available late June 2019. On the basis of coverage of existing data and potential areas of biological interest, it was decided to survey in the central area of the marine park focusing on Carpentaria

Shoal and the poorly surveyed area 15km south of Carpentaria Shoal. These areas were not actually surveyed due to poor weather, this planning information will be valuable for future opportunities.

Due to weather conditions it was not feasible to survey within the West Cape York Marine Park. The final survey area within the Wessel Marine Park was determined based on a combination of an area of interest at the 50m contour bounded by the sheltered southern region of the Wessel Marine Park where normal multibeam surveying could be undertaken.

2 RESOURCES

2.1 Vessel

The AIMS vessel RV Solander was mobilised from Thursday Island, Queensland for the transit voyage to Darwin. The Solander is a 35m research and survey vessel (Figure 2), and is managed and operated by Riverside Marine.

Figure 2: AIMS Vessel RV Solander

2.2 Equipment

2.2.1 Multibeam

The AIMS R2Sonic 2026 multibeam echo sounder was mobilised to the carriage within the Solander's moon pool by AIMS staff prior to departure (Figure 3). The 2026 operates on a user-selectable frequency ranging from 100 to 450 kHz, with 256 equidistant- or equiangular-spaced beams across a variable swath (10° to 160°).

For the Wessel Marine Park Survey, the R2Sonic 2026 was operated between 300 kHz and 400 kHz and swath sectors ranging from 120° to 155° (depth dependent).

All installation offsets for the multibeam system (including POSMV), along with Operational parameters used on a line by line basis, are provided in the multibeam acquisition log (7084_Wessels_MBES_Line_Log.xlsx).

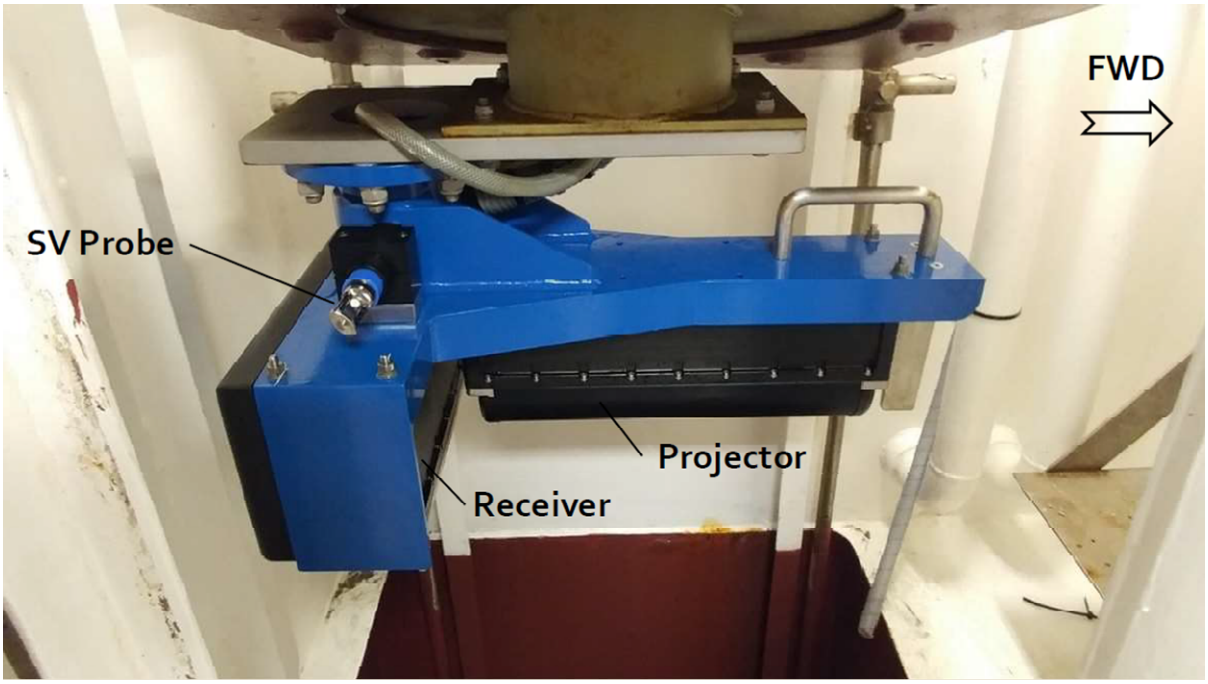

Figure 3: AIMS R2Sonic 2026 multibeam echo sounder mounted to the moonpool carriage on RV Solander

2.2.2 Position and Orientation System

Position, heading, and attitude were provided by the Solander's permanently installed POSMV Oceanmaster. The POSMV's antennae are permanently mounted on the awning support structure on the vessel's recreation deck. The POSMV IMU is located inside the computer office within proximity of the vessel's centre of rotation (COR).

2.2.3 Speed of Sound Sensors

An AML Minos X sound velocity profiler was used to acquire speed of sound profiles through the water column. Profiles were applied immediately in QINSy and used during multibeam acquisition and also by Qimera during data processing when necessary.

In addition, the R2Sonic 2026 frame held a speed of sound sensor (AML Micro) for measuring the speed of sound (SV) at the multibeam transducer/receiver location. This value was used by the R2Sonic 2026 for receive beam steering and in QINSy to real-time QC the difference between measured SV and the profile in use at the time.

2.3 Personnel

Lead multibeam operator Simon Harries acquired and processed multibeam and peripheral data with additional on-board acquisition support from Mark Case.

3 SURVEY OPERATIONS

3.1 Daily Operations

A total of 28.5 hours of multibeam surveys were completed for the project. These included multibeam operations for the Wessel Marine Park survey.
5th February 18:00 – 24:00 (approx.) MBES scoping lines
6th February 00:00 – 7:00 (approx.) MBES scoping lines
6th February 18:00 – 24:00 (approx.) MBES Infill.
7th February 00:00 – 07:00 (approx.) MBES Infill.
7th February 21:30 – 24:00 (approx.) MBES Infill.

3.2 Survey Line Plan

Survey lines for bathymetry acquisition were designed and supplied by AIMS on board the vessel in shapefile format for use by QINSy. Despite the considerations during planning for the project, the final survey area was restricted to a region east of Cape Arnhem headland that had protection from the adverse winds. Five survey scoping lines were planned and completed with 1000m line spacing. Infill planning and operation was conducted during normal survey operations.

3.3 Horizontal and vertical Control

Raw multibeam data was referenced to the 2014 realisation of the ITRF (ITRF2014) by the POSMV. QINSy then georeferenced the bathymetric DTMs to WGS84 (UTM Zone 53S) while further-reducing the ITRF2014 heights to approximate MSL using the geoid-ellipsoid separation model AUSGEOID09. AUSGEOID09 is the quasi-geoid model which is valid onshore, while offshore it is the earth gravity model EGM2008. (Information provided by Acoustic Imaging, 2017.) This method of sounding reduction does not require the measurement of the multibeam draft, therefore it was not recorded during this survey.

3.4 Speed of Survey

Vessel speed during the survey was variable between 5-7 knots due to sea state, which still allowed for maximum overall seabed coverage for the duration of the survey.

3.5 Equipment Calibrations

Immediately following installation and prior to the R2 Sonic 2026 performance testing, the POSMV was calibrated. The 2026 was calibrated as part of the performance testing and the results are presented below:

Pitch -0.620°
Roll - 1.353°
Yaw 0.036°

3.6 Data Acquisition

3.6.1 Multibeam

Multibeam operations for the main survey run lines were conducted during night-time hours (approximately 18:00 to 06:00). QINSy was configured to receive raw bathymetry and backscatter data from the R2 Sonic 2026, as well as time, position, and attitude data from the POSMV. It displayed the real-time quality of these data strings during acquisition, as well as a real-time map of multibeam bathymetry coverage. Raw multibeam data was logged in QPS database (.db) file format. All logged multibeam survey lines were recorded in the MBES log.

3.6.2 POSMV

POSMV (.000) data was logged directly by the PosView application. These files were not processed as part of this project but were logged per AIMS request for future use.

3.6.3 Speed of Sound

Speed of sound profiles through the water column were acquired throughout the survey operations. Locations of profiles were selected during the survey based on water depth and spatial distribution. QINSy was updated with the most current profile for the working location of the vessel throughout the survey. Information for each profile was recorded in the MBES log. The surface speed from the profile in use was continually compared by QINSy to the real-time values from the mini SV probe (mounted with the 2026).

3.7 Data Processing

POSPac MMS ver 8.3 SP3 was used to post-process the navigation data from the POSMV, and to generate smoothed best estimate of trajectory files (SBET). QPS Qimera (Ver 17.3.0) was used for processing the multibeam bathymetry data. Qimera was used to review the QINSy.db files, apply SBET files and for cleaning. A weak spline was applied to remove data spikes and noisy data was manually cleaned where necessary. Qimera was used to QC the bathymetry and create surfaces for export to geotiff and ASCII deliverables.

4 DATA PRODUCTS

4.1 Interpolated Bathymetry

Bathymetry surface gridded at 5m resolution and smoothed with a 5 cell weighted moving average. Horizontal datum is WGS84, Vertical Datum is depth below approximate MSL (based on Ausgeoid09).

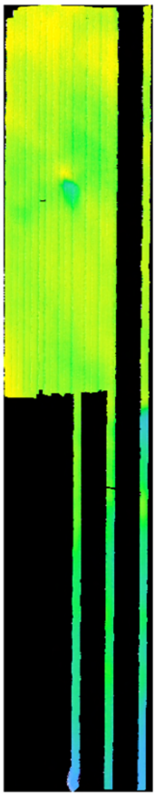

Figure 4: Bathymetry surface (at 5m gridded resolution) for the area surveyed within the Wessel Marine Park during RV Solander Trip 7084.

4.2 Backscatter

Backscatter data was collected and post processed and is available as either ASCII or Geotiff.

4.3 3D Visualisation Product

A Regular Minimum Interpolation Spline, using ArcGIS Spatial Analyst, was run across the data and bounded to the original survey extents thus infilling in-between the survey lines and the South West corner where no data was collected. This method is best used for generating gently varying surfaces in elevation (ArcGIS Pro, 2019). ArcScene was then used to produce the 3D visualization surface.

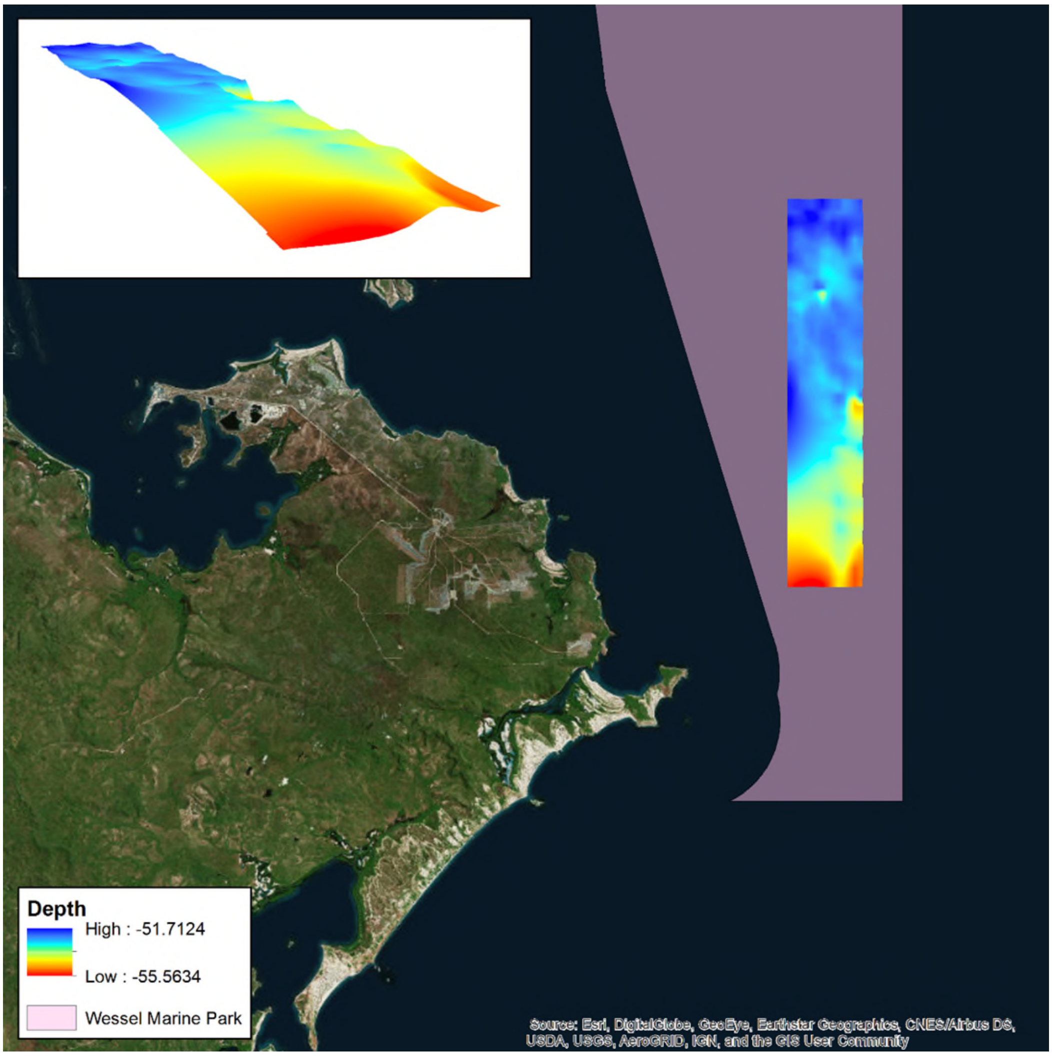

Figure 5: Output spline with 3D surface render of the areas surveyed in the Wessel Marine Park during RV Solander Trip 7084

4.4 Interesting Features

The multibeam survey area is a relatively flat homogeneous area spanning 50-55m depth, which is most likely comprised of sandy mud (Heap, et al., 2004). However groups of holes or depressions were seen scattered throughout the multibeam survey area. The deepest holes were up to 1.5m deep and they average about 5m wide.

The observed holes are likely to be pockmarks. Pockmarks are commonly seen in muddy areas in Australia's northwest continental shelf and were first observed in Australia in the Oceanic Shoals Marine Park. They are thought to be formed through turbulence and scouring associated with bottom currents, and may represent areas of different biodiversity compared with adjacent habitats (Picard K, et al., 2018). Visual surveys (e.g. by ROV or AUV) are likely to be the best method to better understand the nature of the pockmark features in the Wessel Marine Park.

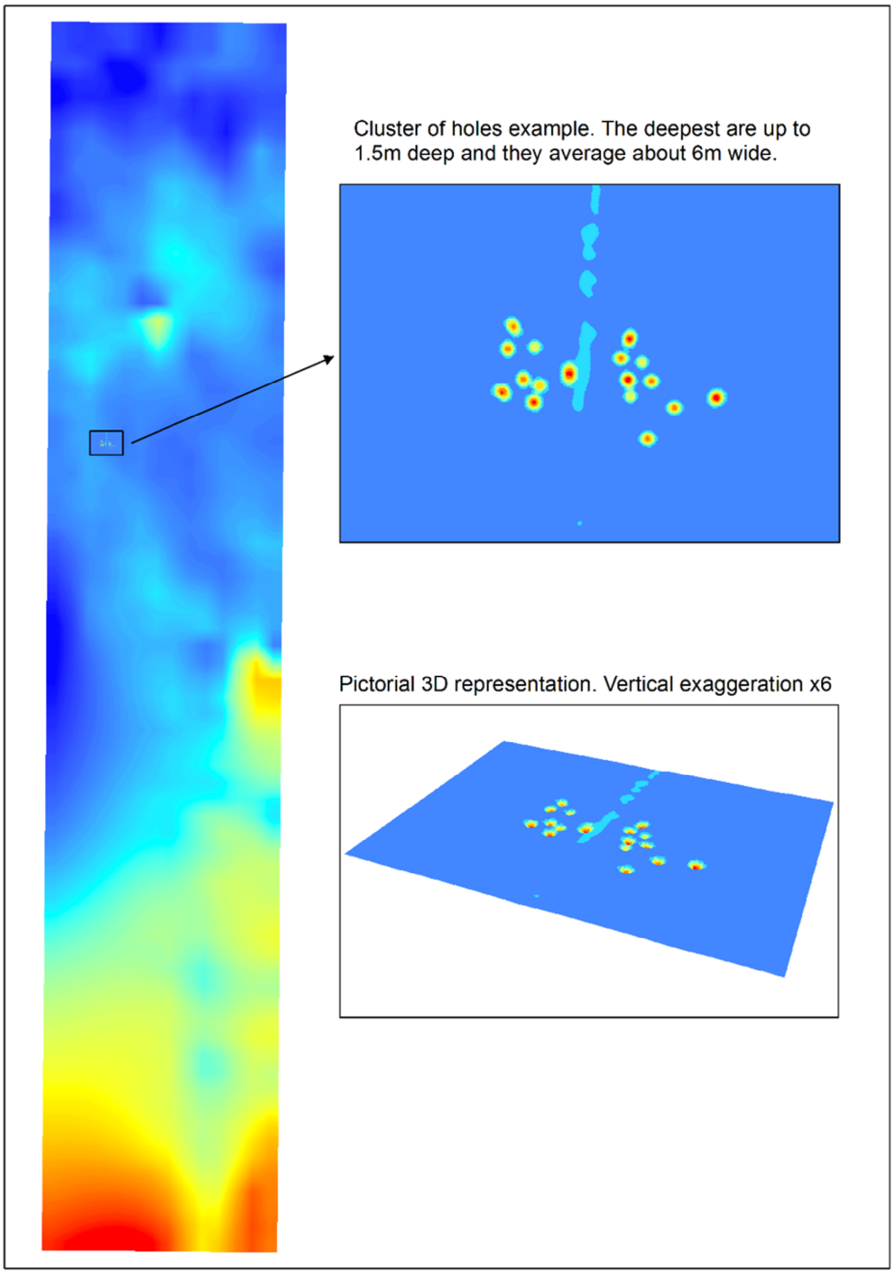

Figure 6: Details of one cluster of holes observed on the seabed in the Wessel Marine Park during Solander Trip 7084

4.5 Data Management and Storage

All data collected by AIMS during the Wessel Marine Park multibeam survey has been managed as per the AIMS WA data management strategy being:

- All field data has been copied to internal WA AIMS servers and appropriate backups made and stored off site. The AIMS WA server is also mirrored onto Townsville servers for archival and data protection purposes.
- A data storage and spatial index has been created on the AIMS WA server to manage all spatial information.

- MEST Metadata and locational ESRI Shape files has been created and published to our external geoserver. NOTE: the AODN website harvests from this server. https://apps.aims.gov.au/metadata/view/5a20d372-1400-494a-b593-9673e6207d0b
- Both the raw and post process multibeam data will be provided to Geoscience Australia to be made available through the AusSeabed data discovery portal. http://www.ausseabed.gov.au/surveys-data/data

5 REFERENCES

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