Appendix F
Benthic Habitats Modelling Technical Report

Australian Government

Australian Institute of Marine Science

Towed video report for the Darwin Ship Lift EIS

Authors: Mark Case, Ronen Galaiduk, Simon Harries, Joshua Biggs, Ben Radford, Claire Streten

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AIMS: Australia's tropical marine research agency.
www.aims.gov.au

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	8/03/2021	Extracted from benthic community model report.
	Reviewed by:	Claire Streten	10/03/2021	
2				

Cover photo: RV Solander in Western Australia. Image: N. Thake

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1 SUMMARY

AECOM contracted AIMS to conduct a benthic habitat survey of the area designated for construction of Ship Lift in Darwin Harbour. Eleven transects of the total length of 10 km were executed in the study area using AIMS' slow towed video system deployed from AIMS' vessel Capricornus. Over 4000 digital stills were collected from the downward facing camera of which 3889 were scored using the 5-point intercept method. The collected imagery was classified to the Collaborative and Annotation Tools for Analysis of Marine Imagery and Video (CATAMI) classification scheme.

Bare substate was the dominant benthic class observed in most transects. Tows near South Shell Island (Tow 1) and Catalina Island (Tow 8) had the most diverse composition while rest of the tows had some benthic biota observed along the transects.

2 BACKGROUND

AECOM is involved in the construction of Ship Lift in Darwin Harbour, Northern Territory. To facilitate the environmental approvals process, an improved understanding of the key habitats, which could act as sensitive receptor environments during the construction of the Ship Lift, was sought out. The benthic communities in the vicinity of the Ship Lift footprint were surveyed using the towed video method.

3 METHODS

3.1 Sampling design

The benthic habitat classes mapped from the original predictive habitat model (Figure 10 in Galaiduk et al. 2019) were used as a priori features for the sampling design for towed video transects designed to cover the study area. A spatially balanced, unequal inclusion probability habitat survey design using GRTS (Generalized Random Tessellation; Stevens & Olsen 2004) was employed to allocate the starting points for towed video transects. A total of 11 transects of the total length of 10 km were allocated for the study area, however, due to limited visibility from low water clarity, changing depth profiles and geomorphic barriers, several transects were shortened and extra tows were included in the predicted zone of influence (Figure 1). An additional two slow video transects were completed (B1, B2) at the request of the client the data was not used in the updating the benthic habitat model.

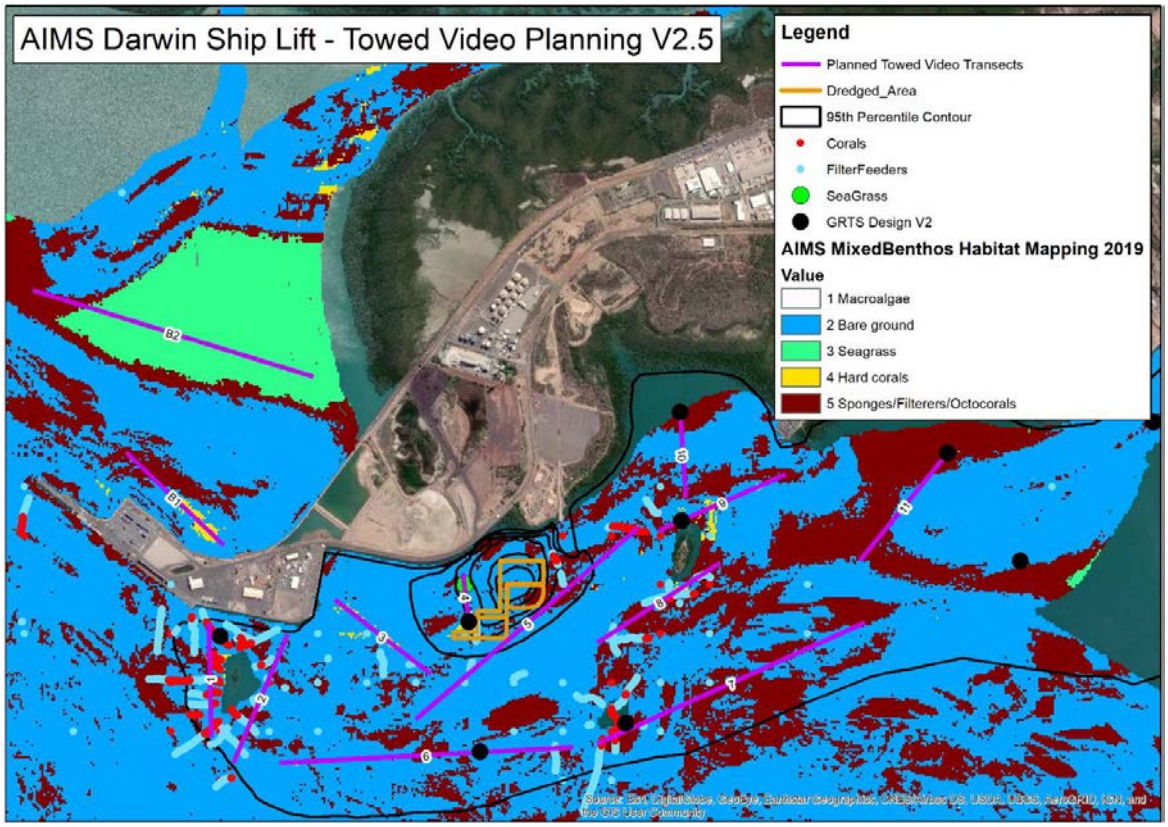


Figure 1. Slow video transects allocation based on the previously mapped habitat classes from the 2019 model.

3.2 Slow towed video

The Slow Towed Video (Slowvid) is a lightweight battery-powered system designed to be deployed and controlled by hand from a small vessel which records underwater video and stills imagery of the benthos. The video signal is delivered to and recorder on the surface video display/recorder. The video display is used to position the tow body at a height of approximately 0.5 – 0.3 m from the bottom to capture still images. Battery-powered underwater video lights are used to provide additional light for the forward-facing video camera and the down-facing still camera. The Slowvid system was towed at 0.5 - 1 knots behind the AIMS vessel Capricornus along the predefined transects shown in Figure **1**. Position (WGS84) was recorded every second by handheld GPS units. Navigational files (gpx) were imported into AIMS "TowedStills" database and the latitude and longitude linked by time with its corresponding still image (see Appendix 1 for full details on the standard operating procedures (SOPS) for the Slowvid system). All georeferenced images were loaded into AIMS online benthic image scoring platform ReefCloud (https://reefcloud.ai/). The still images were analysed by marine science technician using a 5-point intercept method (Heyward et al. 2012; Figure 2). The Collaborative and Annotation Tools for Analysis of Marine Imagery and Video (CATAMI) classification scheme (http://catami.org/classification) was used to assign benthic categories for still images.

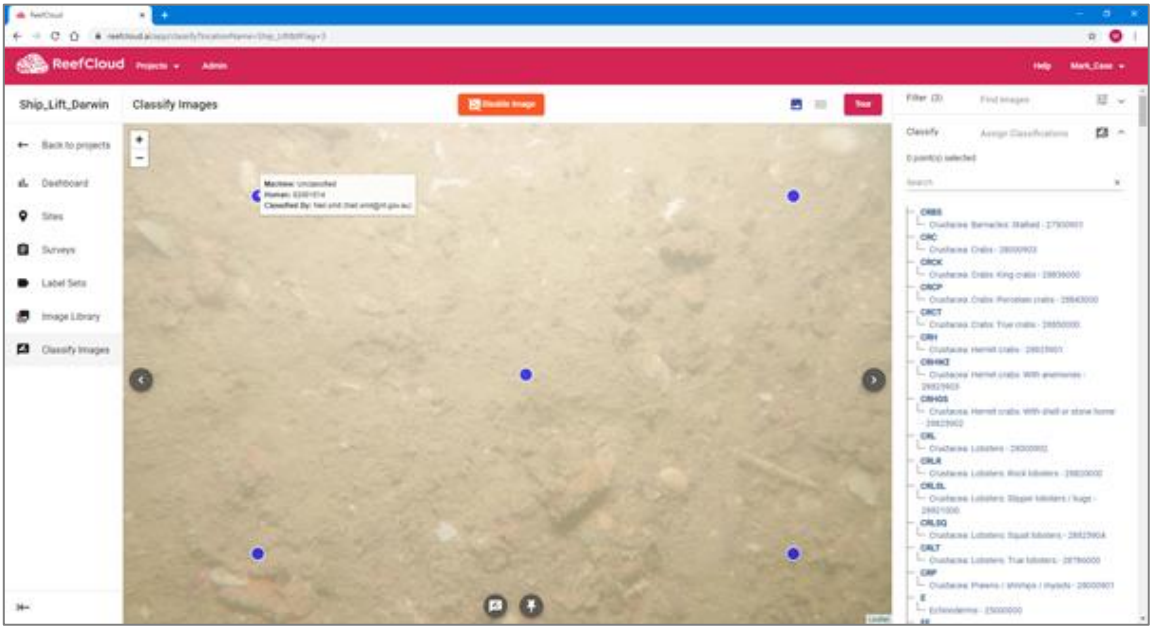


Figure 2. An example of slowvid imagery with overlayed 5 scoring points for benthic habitat analysis loaded into ReefCloud platform.

4 RESULTS

Slow Towed video surveys collected footage and incorporated a downward facing camera, which captured detailed images of the seabed. The images provided for habitat sampling, at much reduced scale but higher resolution than the forward facing video which typically is used for broad-scale habitat classification. The video was not scored due to high turbidity in the video footage. Over 4000 digital stills were collected from the downward facing camera of which 3889 were scored using the 5-point intercept method (Heyward et al. 2012; Table 1).

Table 1. Summary by transect of the images taken.

Survey	Transect	Date	Technique	Images taken
Trip7503	Darwin_ShipLift_Tow1	23/11/2020	Slow Video	189
Trip7503	Darwin_ShipLift_Tow2	23/11/2020	Slow Video	228
Trip7503	Darwin_ShipLift_Tow3	24/11/2020	Slow Video	134
Trip7503	Darwin_ShipLift_Tow4	24/11/2020	Slow Video	132
Trip7503	Darwin_ShipLift_Tow5	24/11/2020	Slow Video	639
Trip7503	Darwin_ShipLift_Tow6	23/11/2020	Slow Video	578
Trip7503	Darwin_ShipLift_Tow7	24/11/2020	Slow Video	452
Trip7503	Darwin_ShipLift_Tow8	24/11/2020	Slow Video	301
Trip7503	Darwin_ShipLift_Tow9	24/11/2020	Slow Video	164
Trip7503	Darwin_ShipLift_Tow10	24/11/2020	Slow Video	152
Trip7503	Darwin_ShipLift_Tow11	24/11/2020	Slow Video	232
Trip7503	Darwin_ShipLift_TowB1	24/11/2020	Slow Video	198
Trip7503	Darwin_ShipLift_TowB1	24/11/2020	Slow Video	490

Bare substate was the dominant benthic class observed in most transects (3 and 4). No biota was observed along tows 10, 11, B1 and B2 (Figures 3 – 4, Figures 14 - 17). Sponges were observed along tow lines 1 -9 (Figures 3 – 4, 5 - 12). While soft corals were observed along tow lines 1, 2, 7 and 8 (Figures 5, 6, 11 and 12). The benthic communities along tow line 1, which was located on the west side of South Shell Island, as well as tow line 8 (near Catalina Island) had the most diverse composition (Figures 5 and 12). Hard corals were sparse with most being observed along the tow line 1.

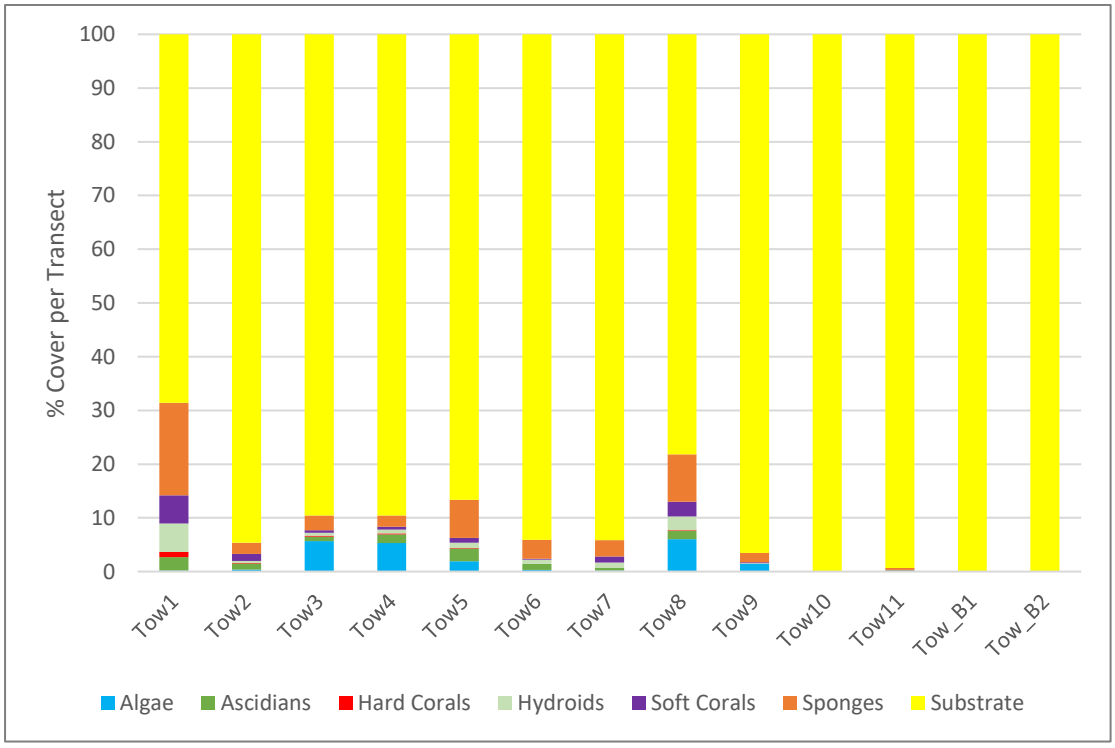


Figure 3. Summary of benthic data classifications obtained from high resolution still-images taken during Slowvid by % cover contribution of major categories.

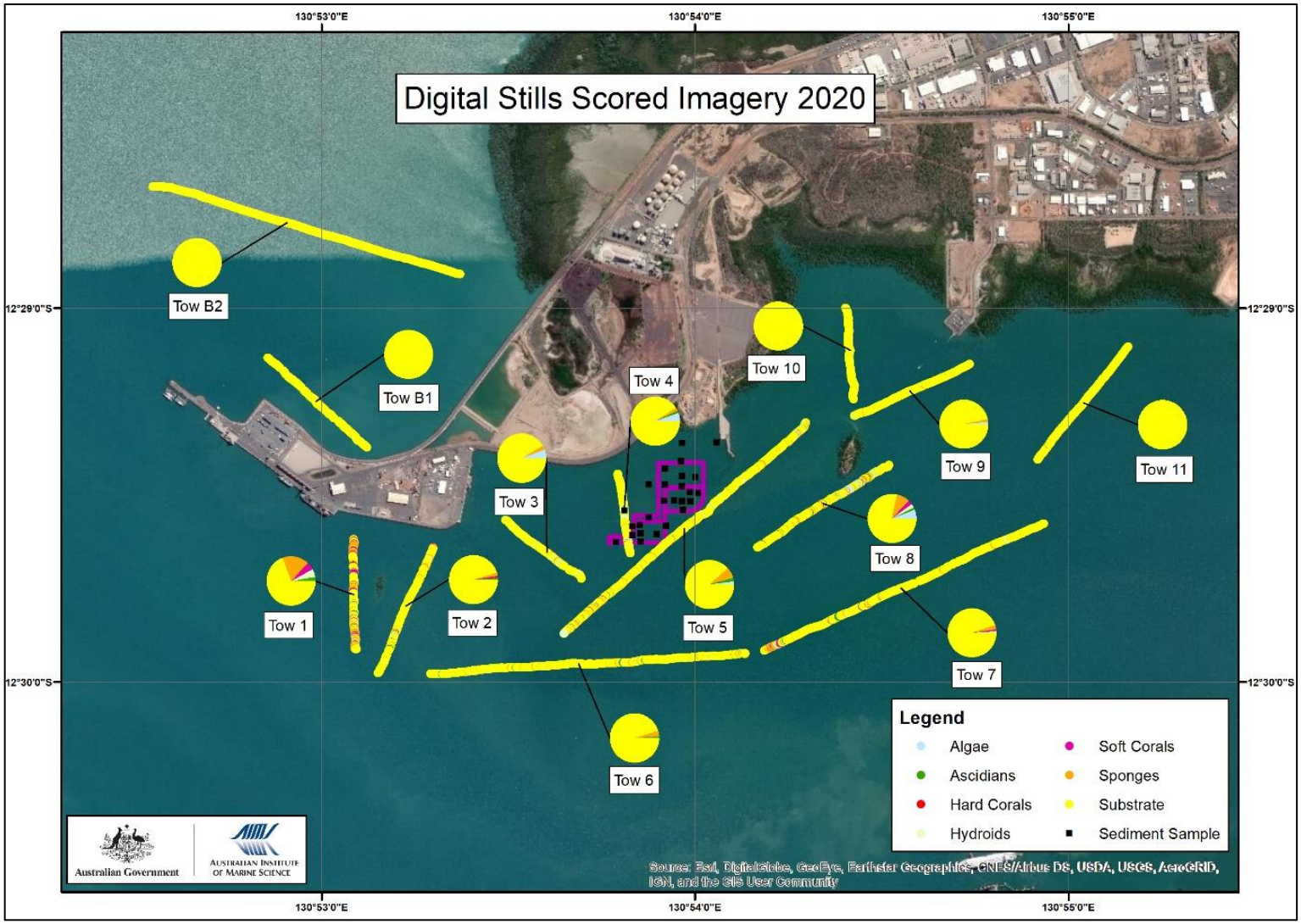


Figure 4. Overview of biota identified along all slow video transects with the proportion of benthic groups shown on the pie charts and locations of sediment cores. Area outlined in purple line is the Ship Lift area

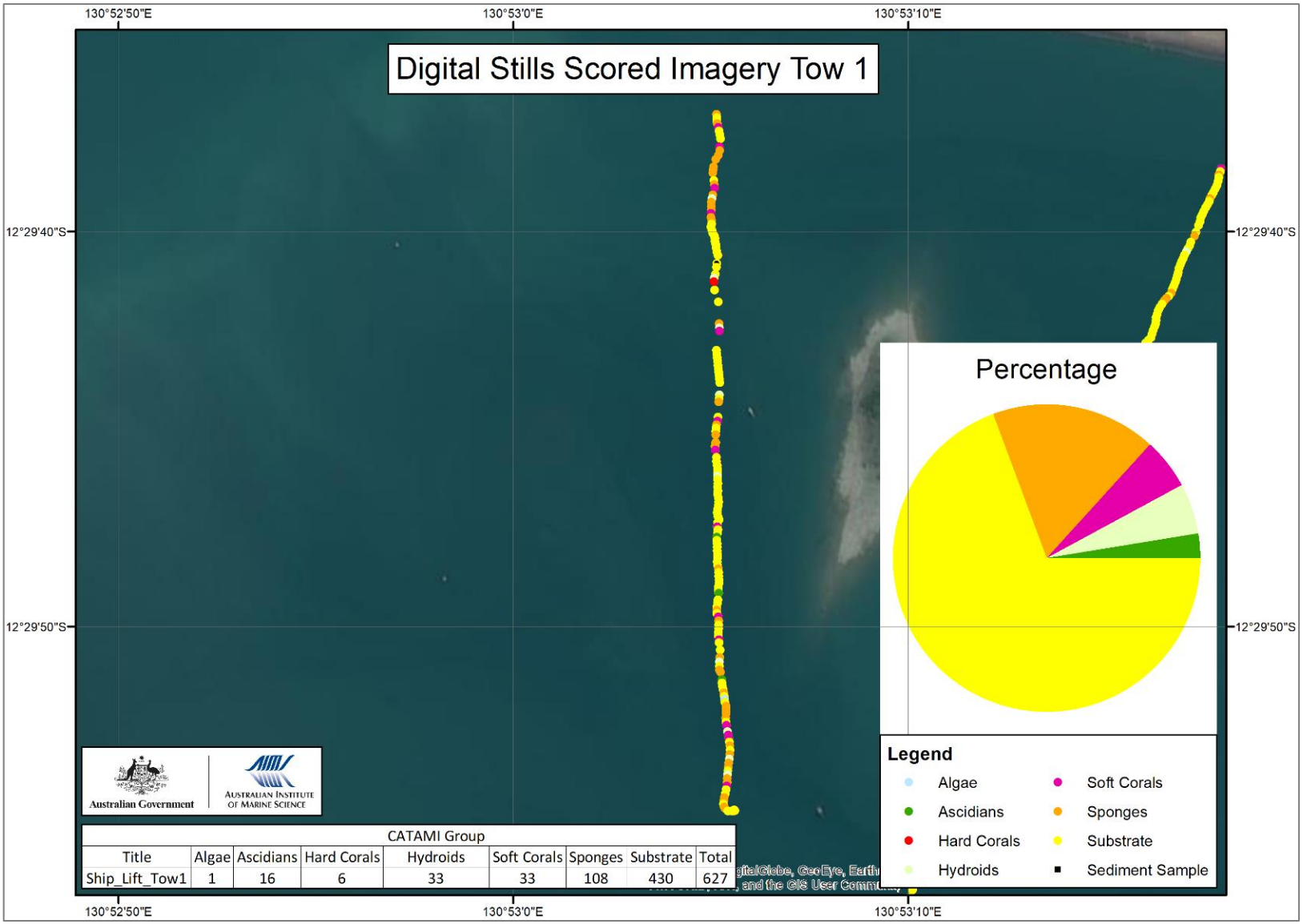


Figure 5. Benthic groups identified along towed video transect 1 (west of South Shell Island)

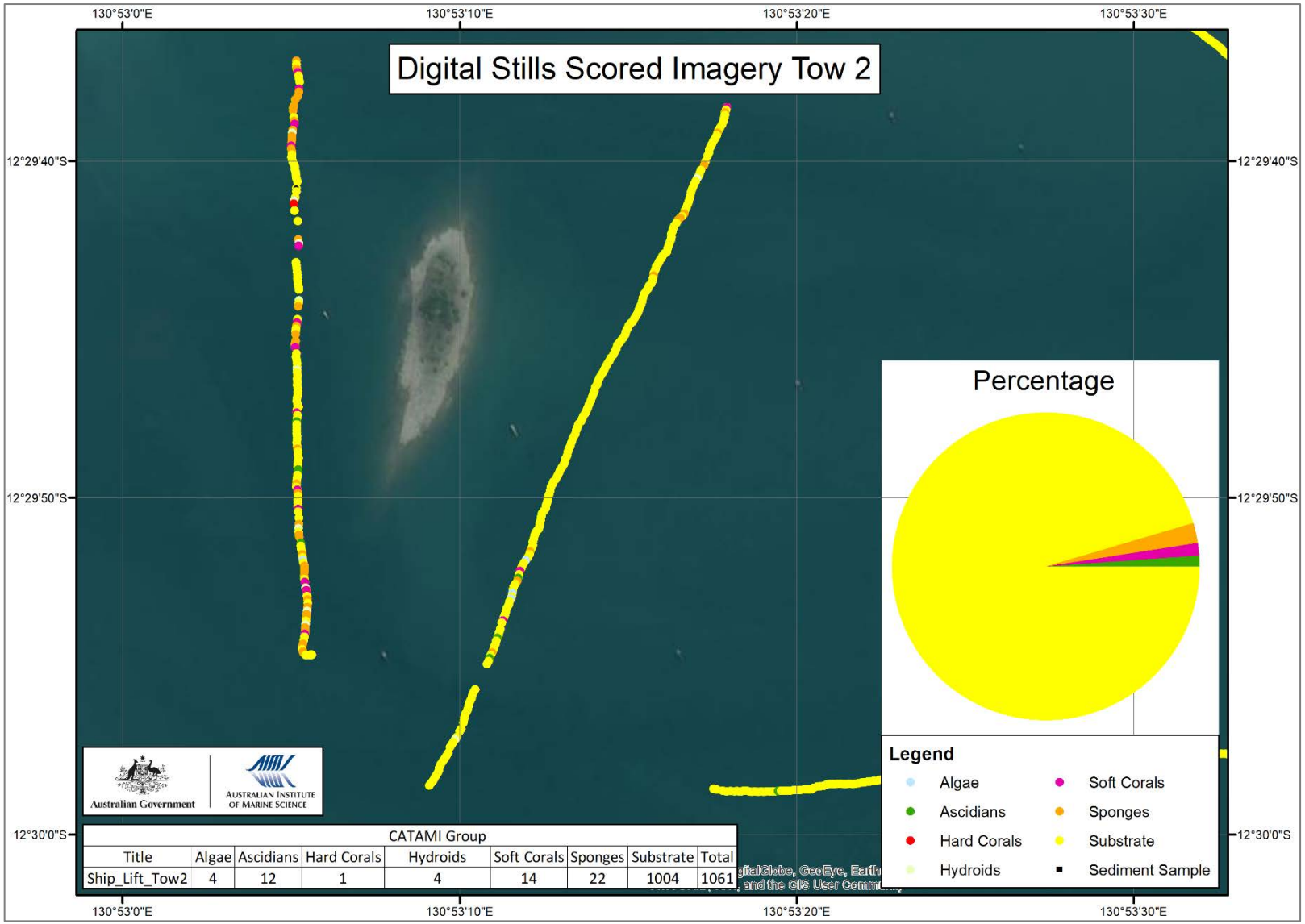


Figure 6. Benthic groups identified along towed video transect 2 (line east of South Shell Island)

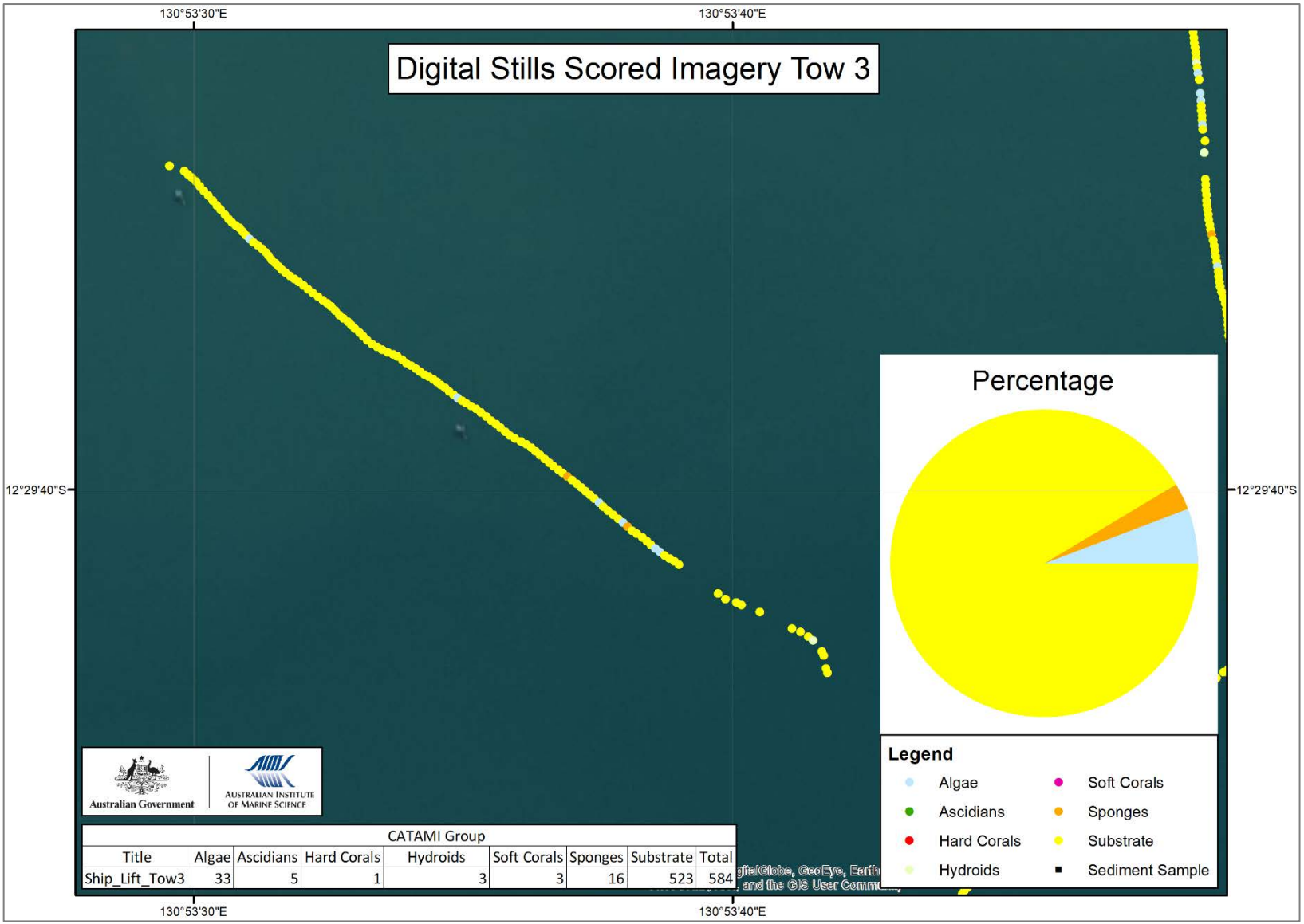


Figure 7. Benthic groups identified along towed video transect 3 (entrance to Marine Supply Base)

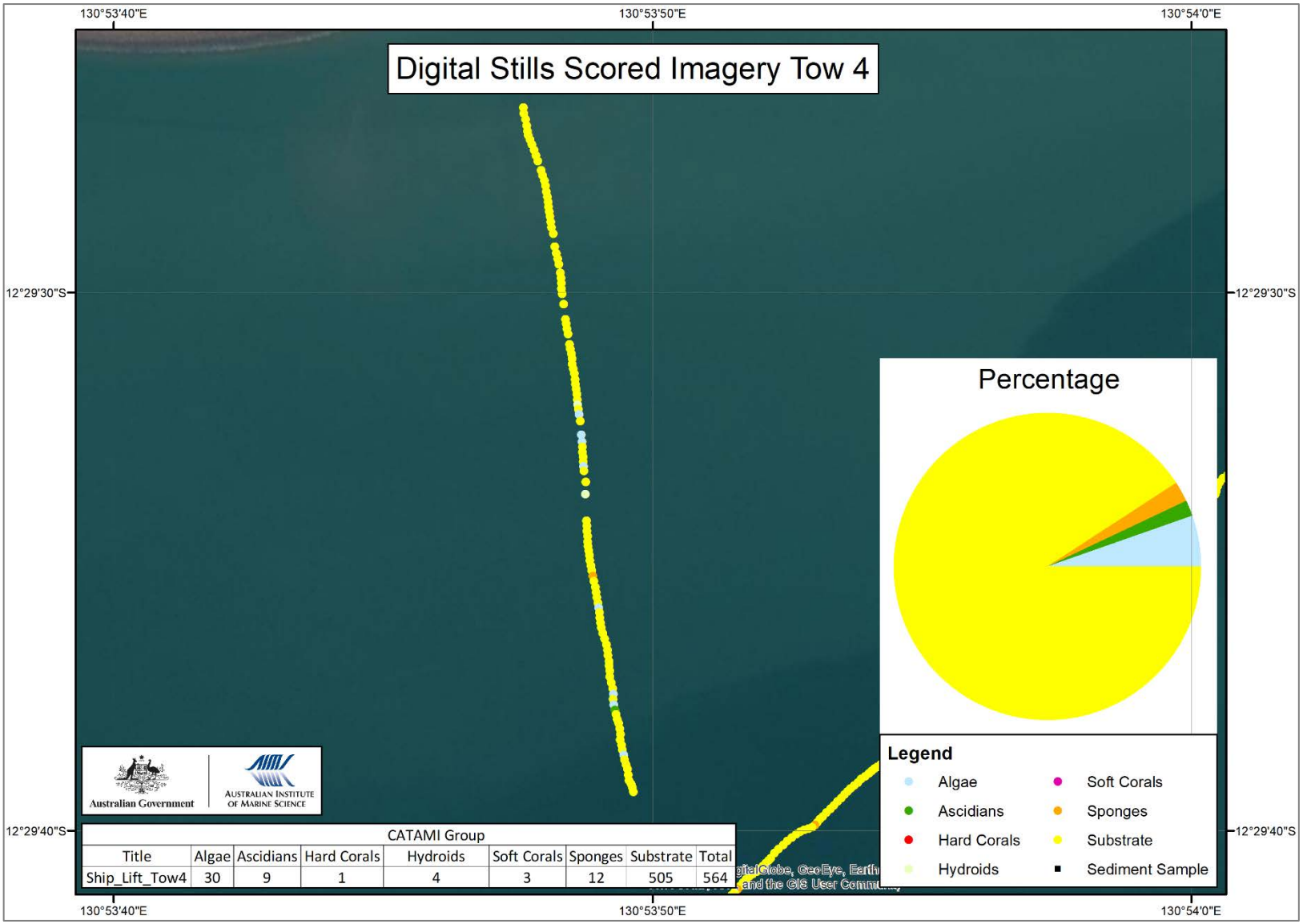


Figure 8. Benthic groups identified along towed video transect 4 (Ship Lift footprint)

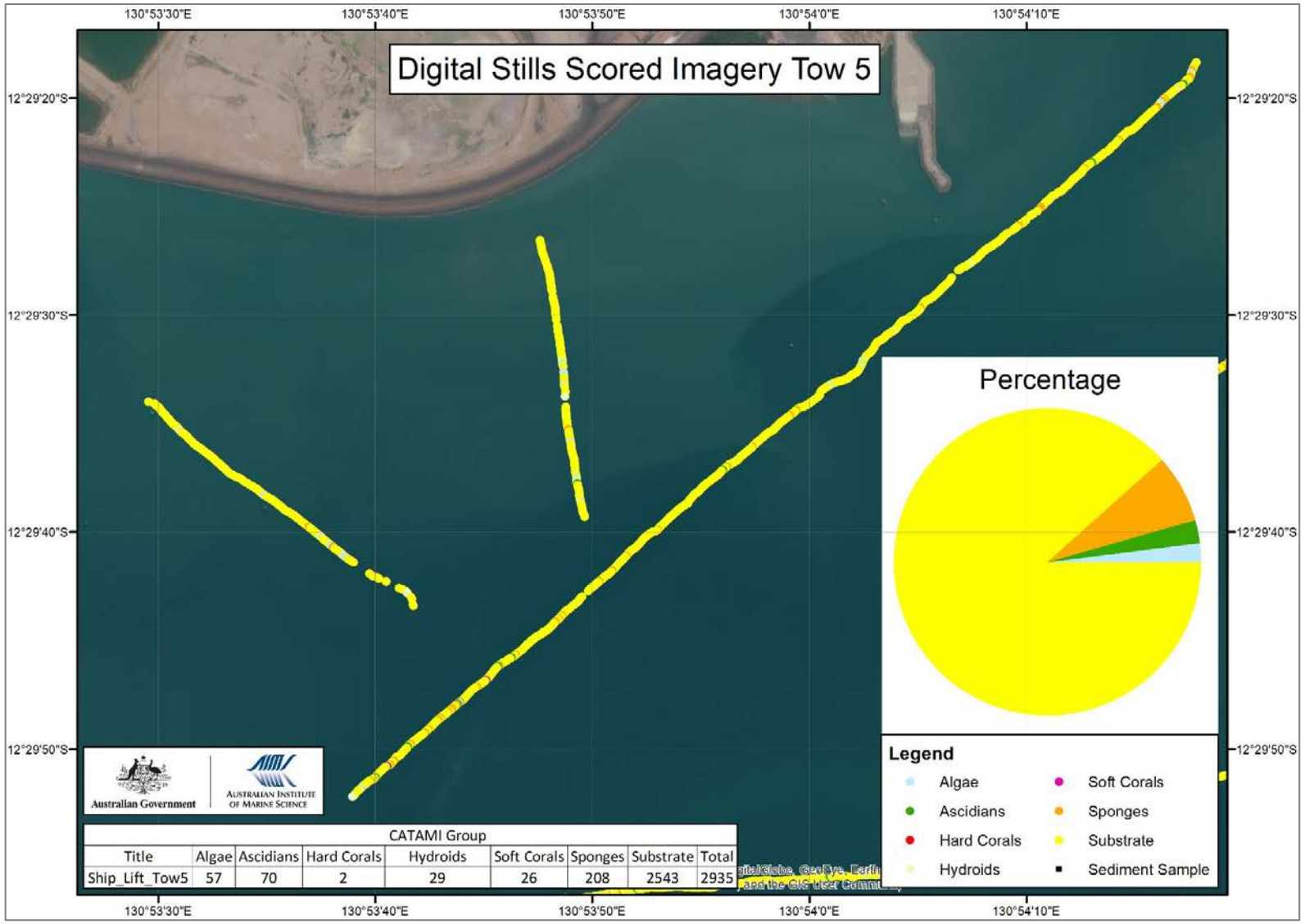


Figure 9: Benthic groups identified along towed video transect 5 (Long line from north-east to south-west across the seaward side of Ship Lift footprint)

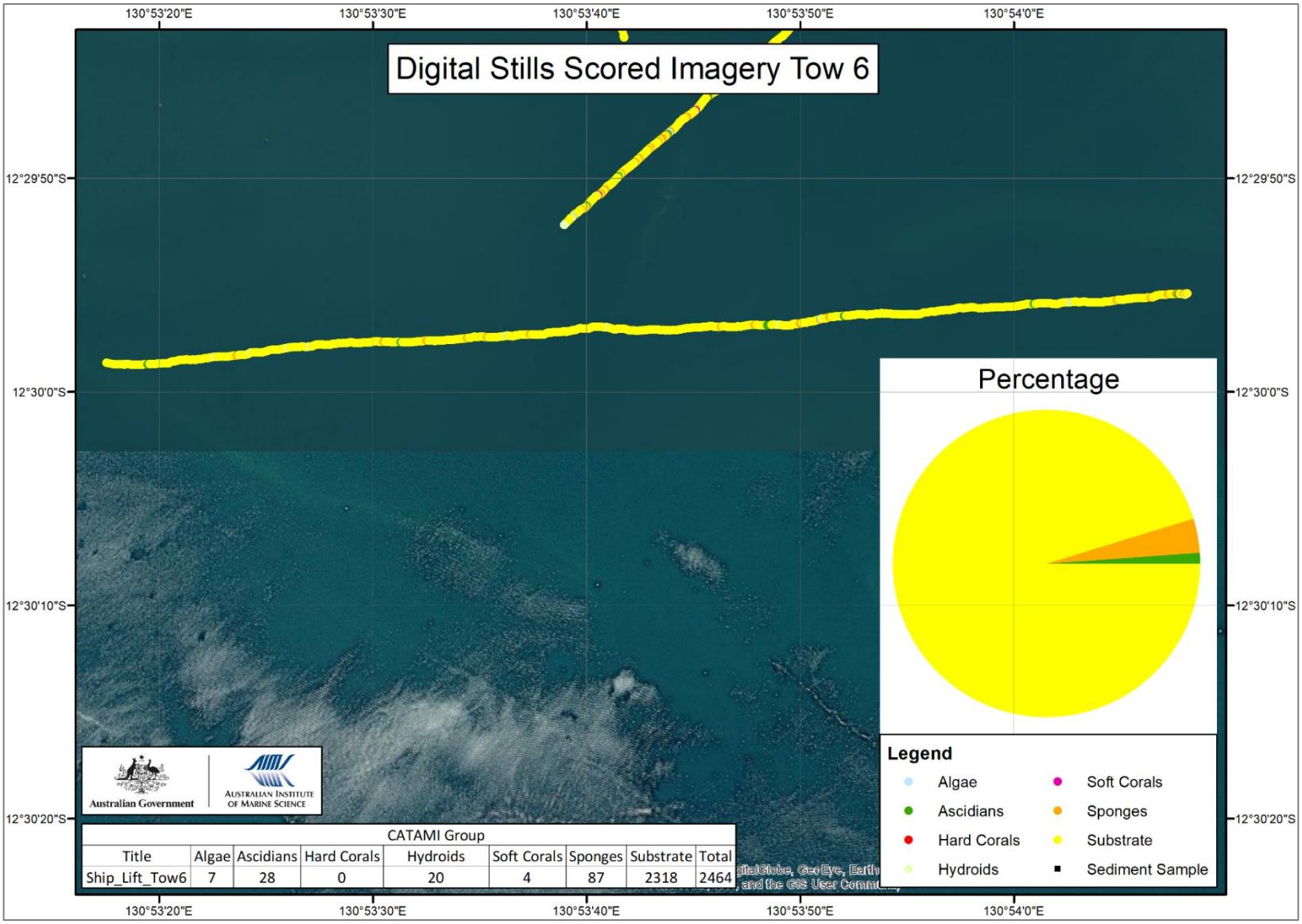


Figure 10: Benthic groups identified along towed video transect 6.

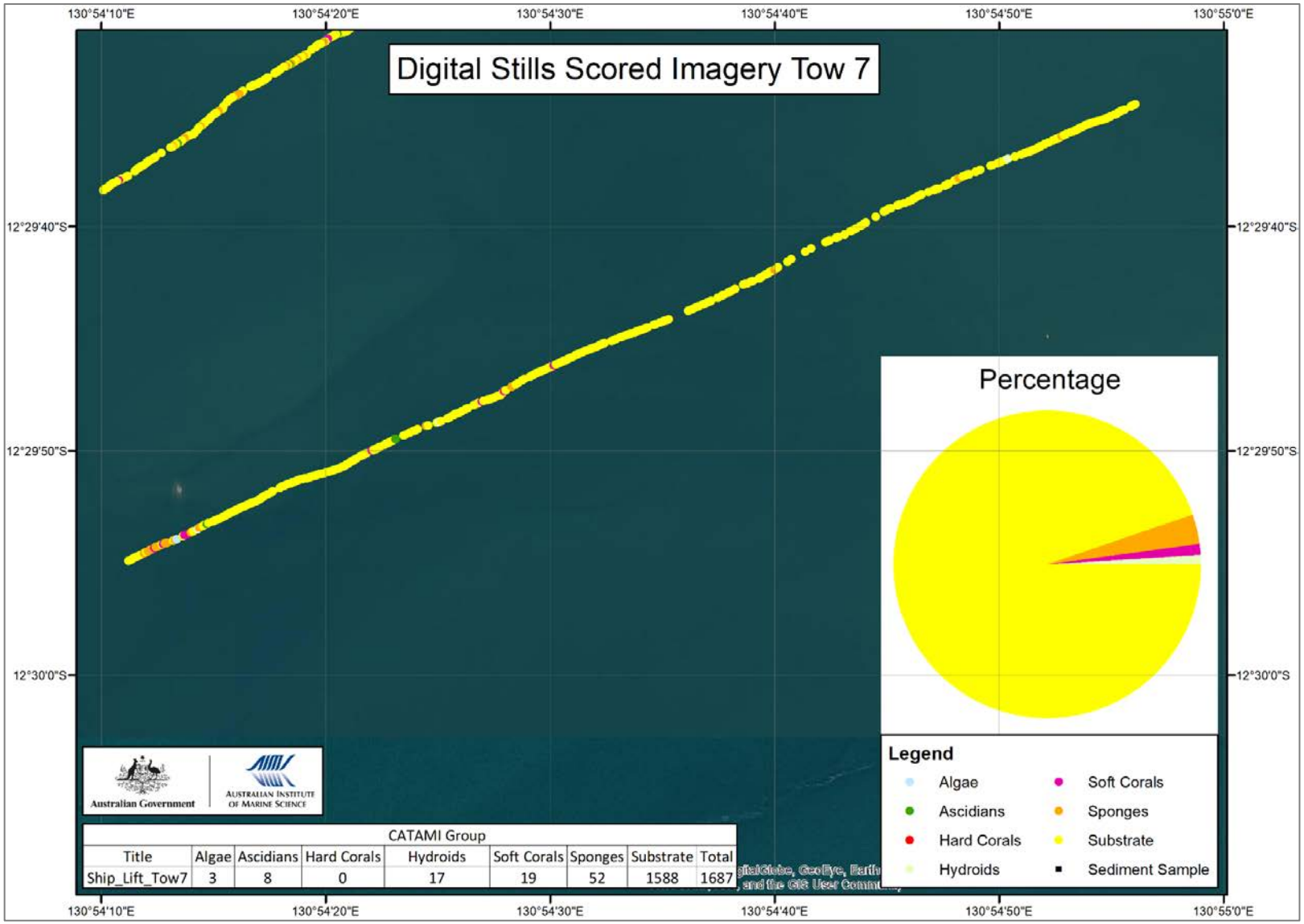


Figure 11: Benthic groups identified along towed video transect 7.

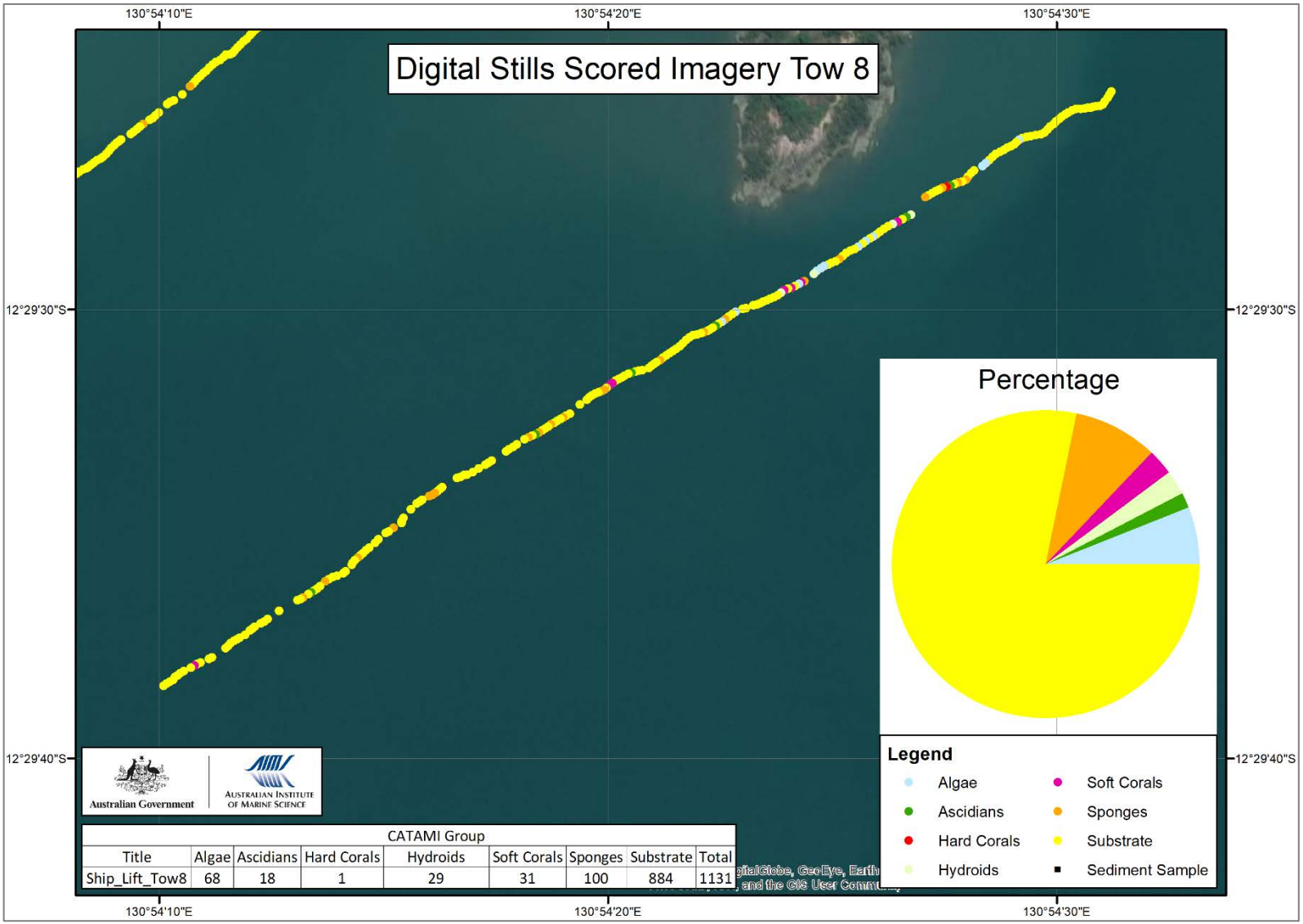


Figure 12: Benthic groups identified along towed video transect 8.

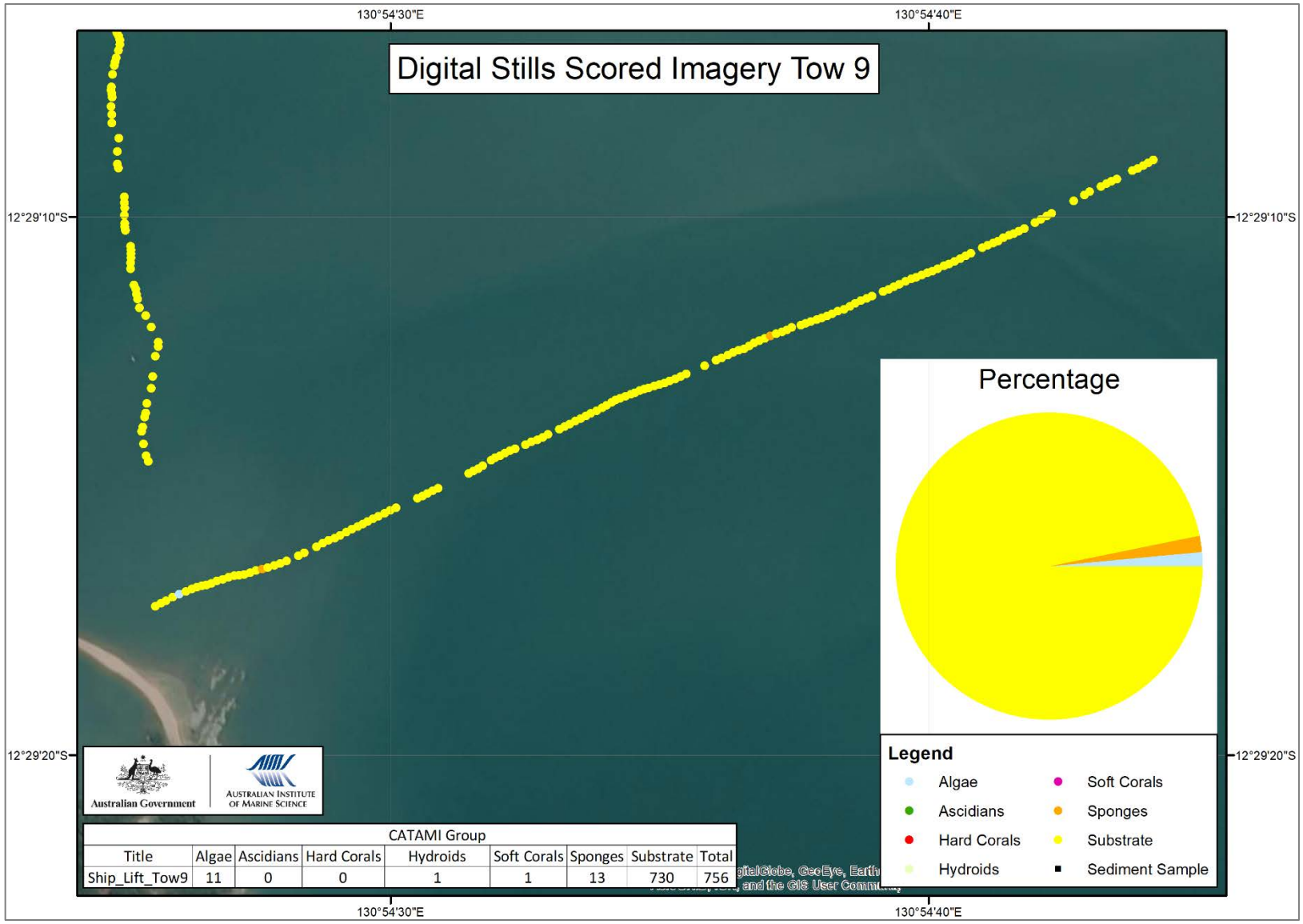


Figure 13: Benthic groups identified along towed video transect 9.

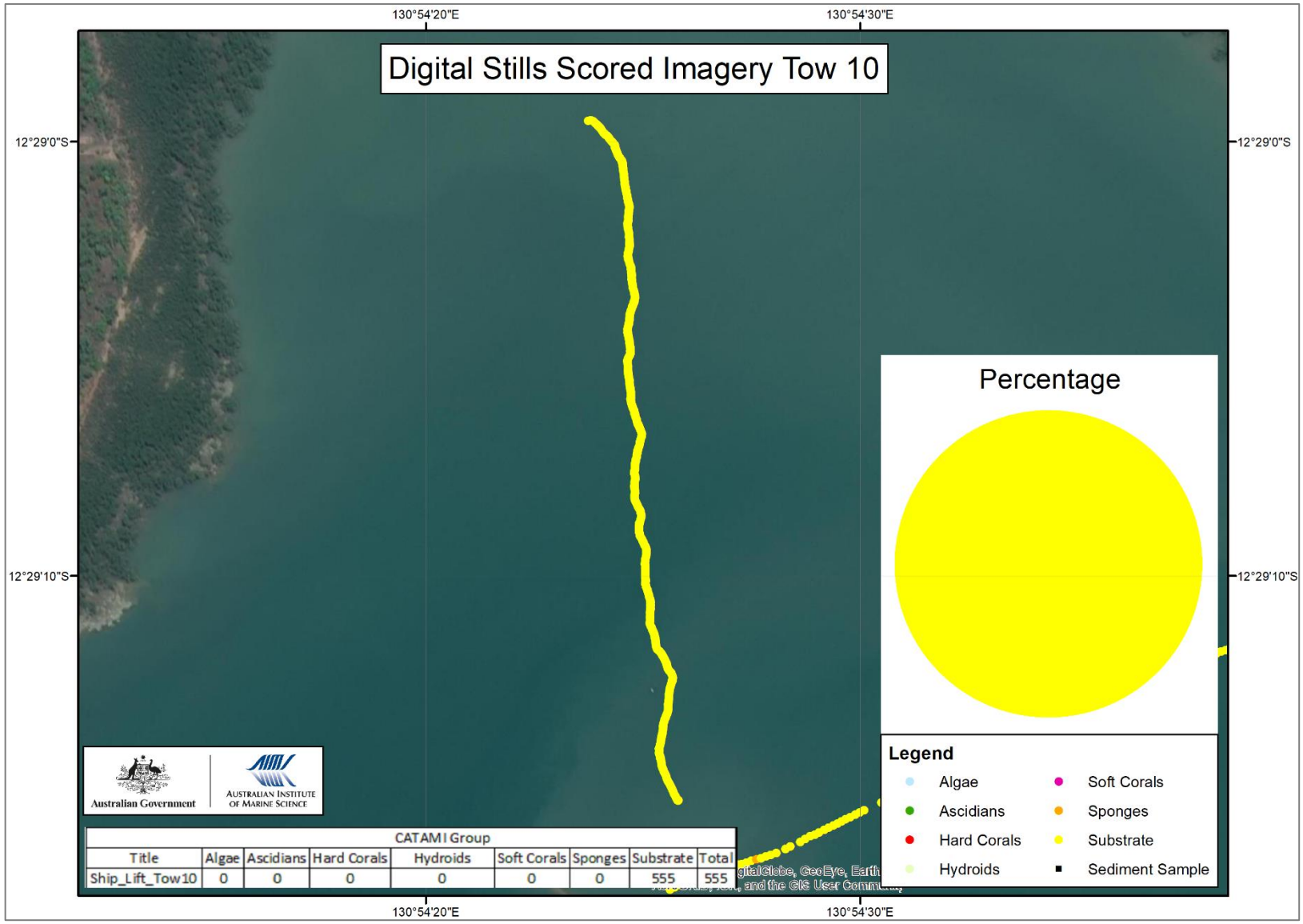


Figure 14. Benthic groups identified along towed video transect 10.

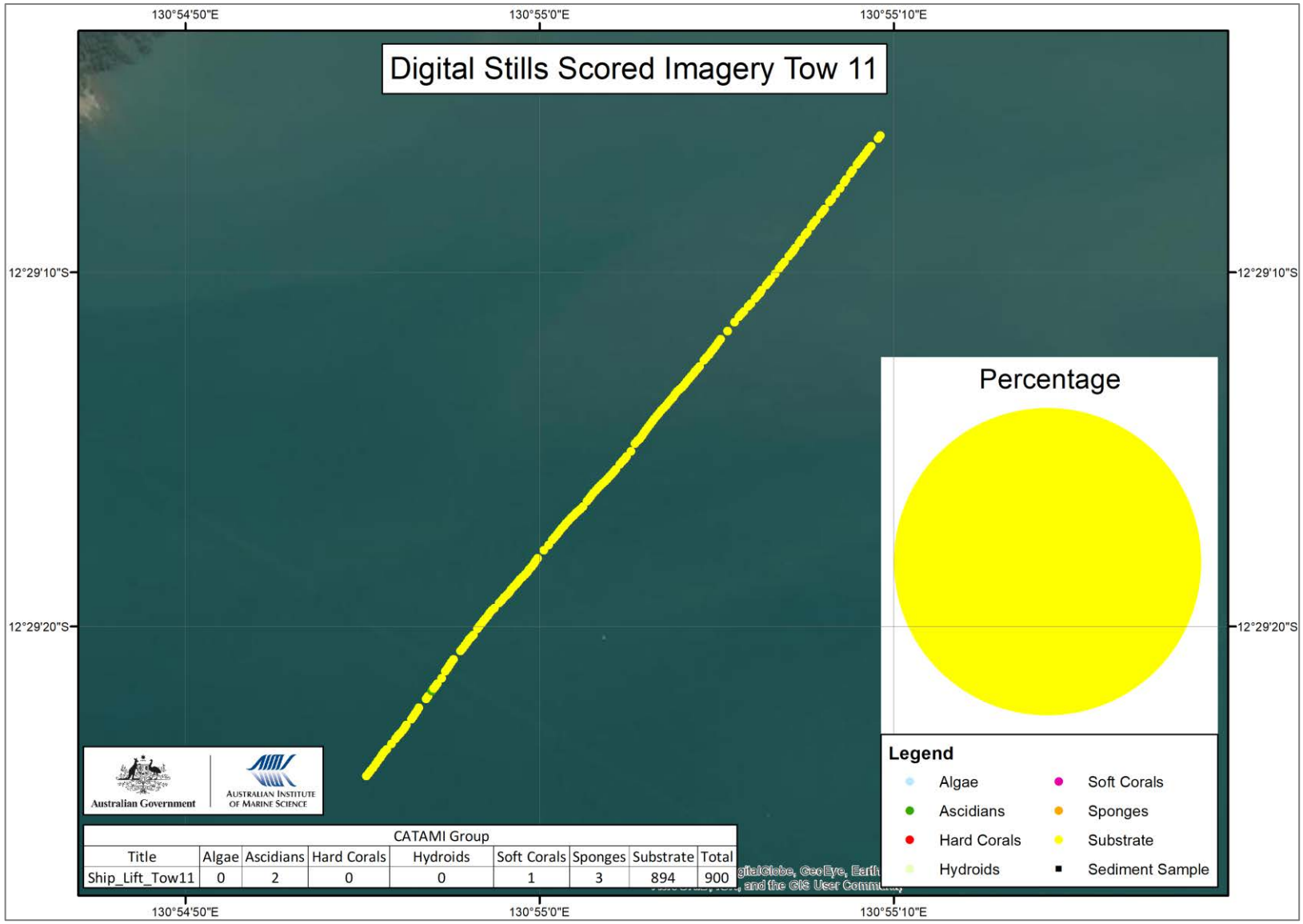


Figure 15. Benthic groups identified along towed video transect 11.

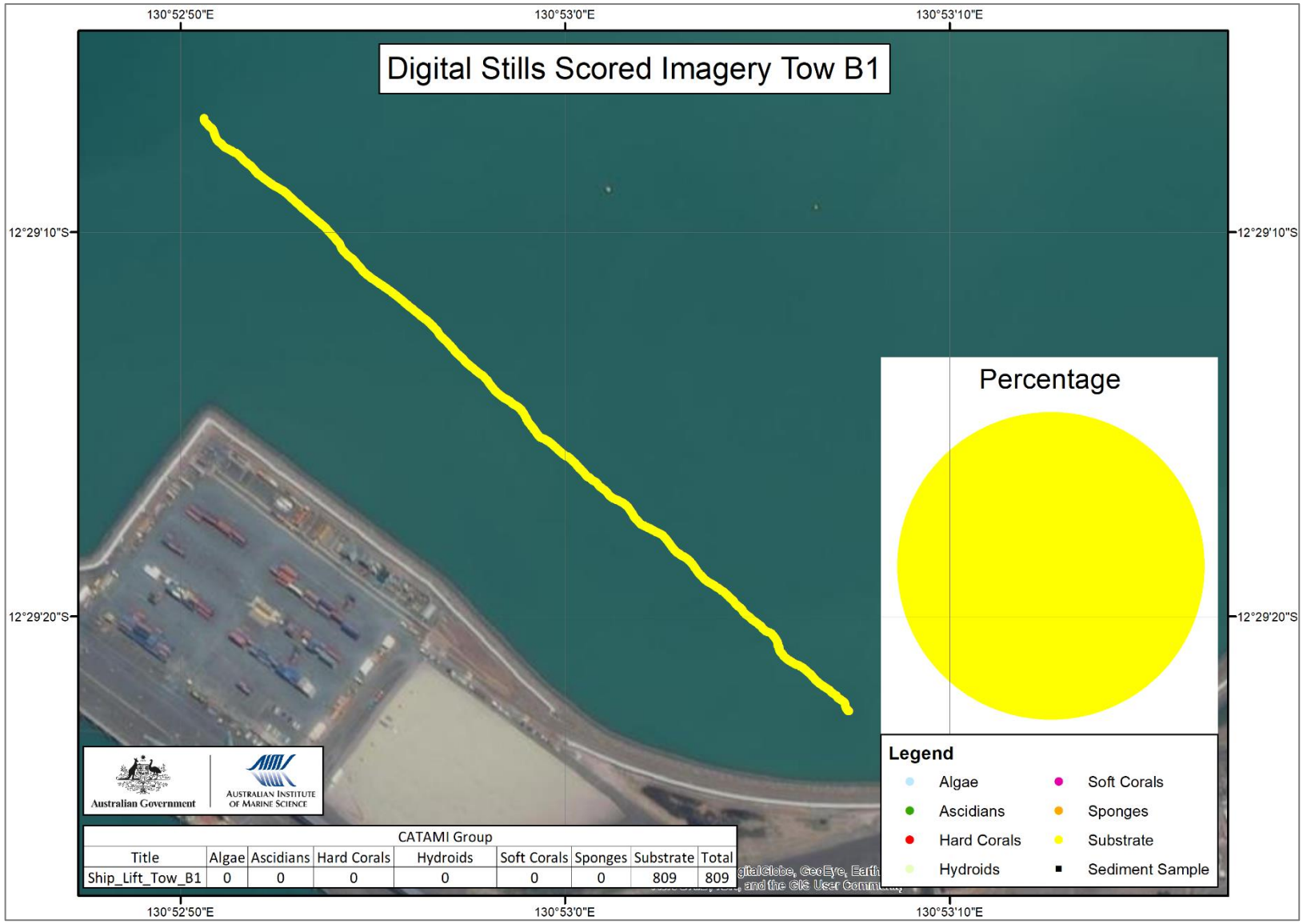


Figure 16. Benthic groups identified along towed video transect B1 (outside of study area).

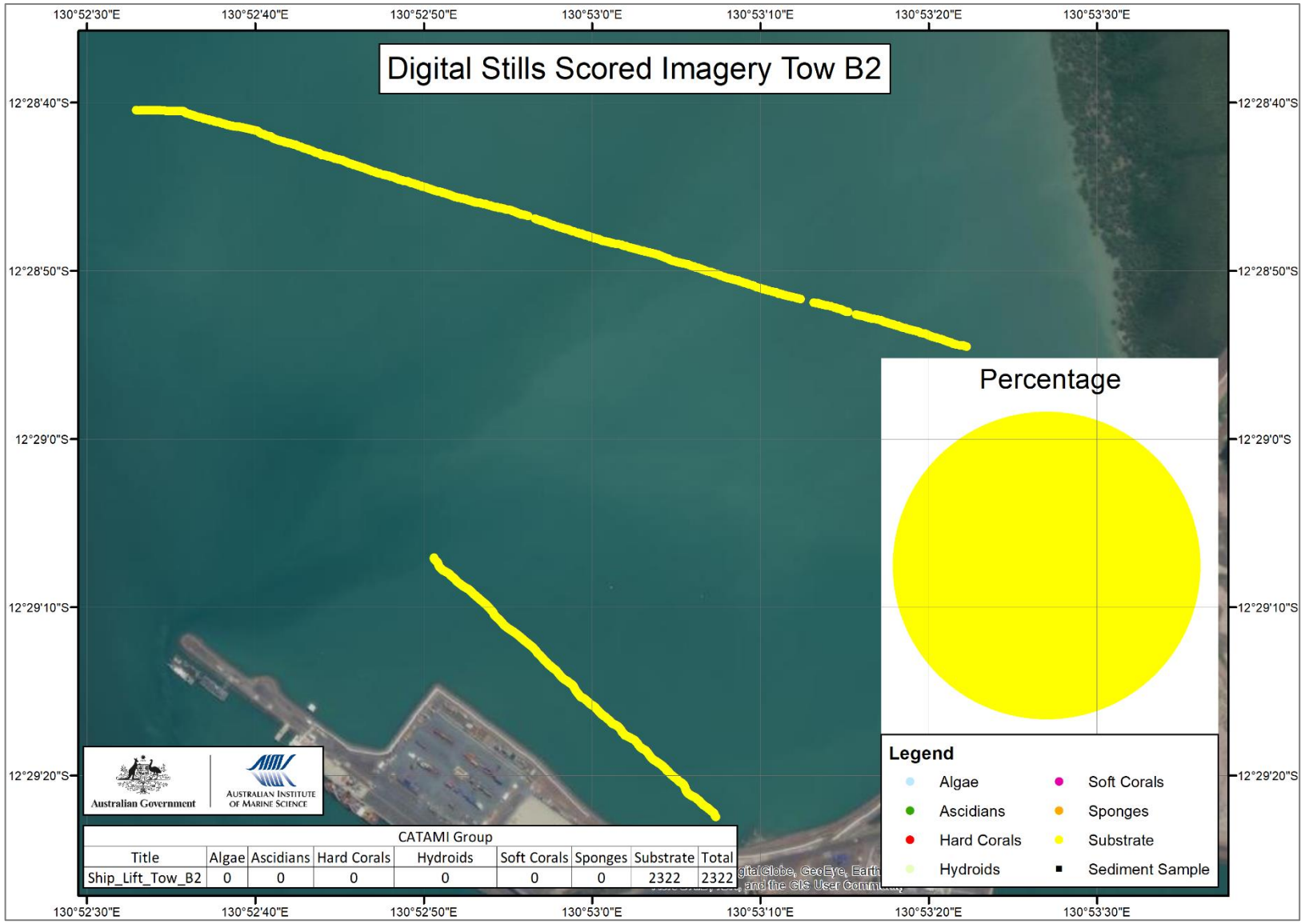


Figure 17. Benthic groups identified along towed video transect B2 (outside of study area).

5 REFERENCES

Galaiduk R, Radford B, Harries S, Case M, Williams D, Low Choy D, Smit N (2019) Technical Report: Darwin – Bynoe Harbours Predictive Mapping of Benthic Communities. Australian Institute of Marine Science, Perth.

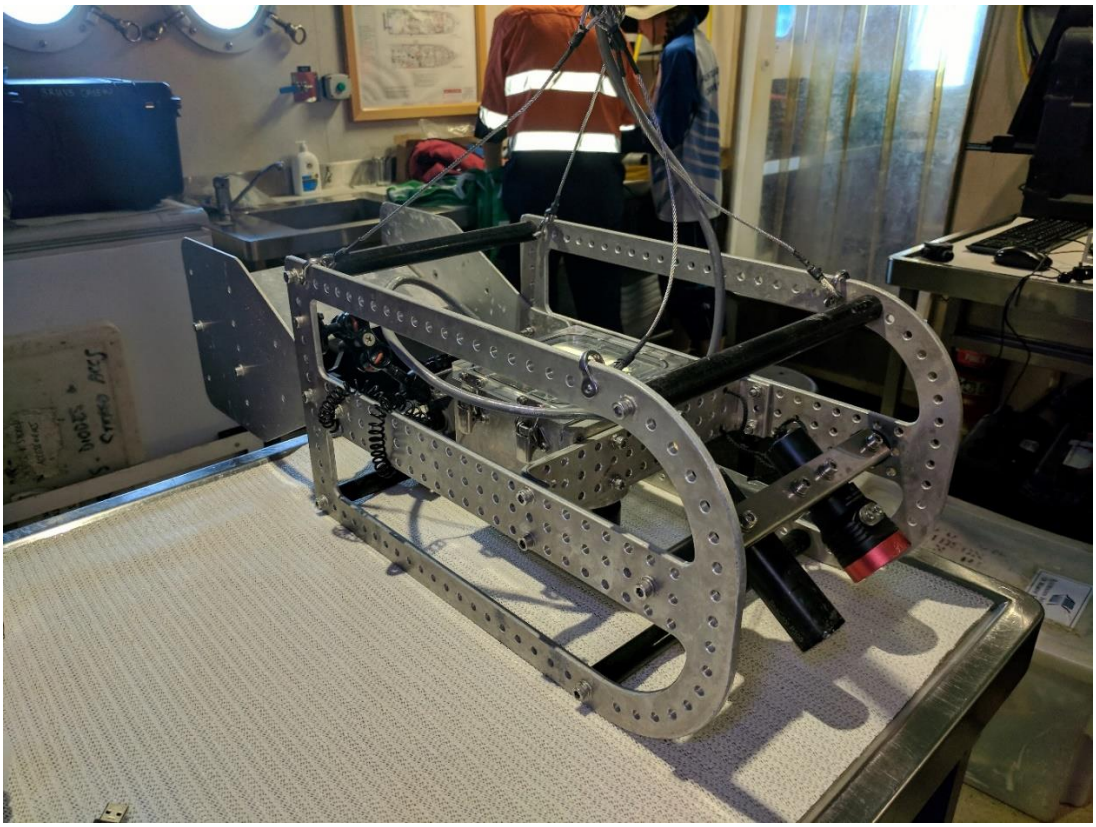
Heyward A, Jones R, Meeuwig J, Burns K, Radford B, Colquhoun J, Cappo M, Case M, O'Leary R, Fisher R (2012) Monitoring study S5 banks and shoals, Montara 2011 offshore banks assessment survey. Report for PTTEP Australasia (Ashmore Cartier) Pty, Ltd Australian Institute of Marine Science, Townsville 253.

Stevens DL, Olsen AR (2004) Spatially Balanced Sampling of Natural Resources. Journal of the American Statistical Association 99:262–278.

APPENDICES

Appendix 1. AIMS Standard Operating Procedures (SOPS) for Slowvid

AIMS Slow Video (SlowVID) SOP



1 SLOW TOWED VIDEO SYSTEM OBJECTIVE

The Slow Towed Video (Slowvid) system is a small hand deployable system designed to be utilised from a tender or small vessel which records video and imagery of the benthos in shallow water underwater along a defined transect. This enables observations to be made regarding the health and distribution of the benthos. It also provides insight into impacts of coral bleaching, habitat destruction or other environmental impacts.

2 SLOWVID MISSION DESCRIPTION

Waypoints are selected by AIMS staff to define the desired Slowvid transect. Operation of the system requires 2 personnel, one tender operator and one Slowvid operator. The tender operator maintains position and speed along the transect line via a handheld or small portable GPS. The Slowvid operator configures the topside Slowvid system, deploys the towbody, adjusts the height of the towbody based on feedback from the live underwater video feed, and retrieves the towbody at the end of the transect.

3 EQUIPMENT DESCRIPTION

The Slowvid system has three components.

1. Video Recorder: Black pelican case containing:
    - 1 x Lead Acid Battery
    - Voltmeter
    - Battery Charger
    - Fuse protection.
    - HD video capture device
    - HD Screen
    - Remotes

Note: There is a secondary system in a yellow pelican case for back up.

2. Towbody: Contains:
    - Video Camera;
    - Video Lights
    - Down facing still camera
    - Strobe Light
    - GoPro camera (optional);
3. Tow cable: 15M or 30m Tow cable containing strength member and conductors.

4 SYSTEM DESCRIPTION

The Slowvid system is a light weight battery powered video and still imagery capture system that is deployed and controlled by hand from a tender or small vessel.

The towbody is attached to a tow cable which serves as both the lifting point for the system, and to transmit power to the underwater video camera and the video signal to the surface video recorder. Battery powered underwater video lights are used to provide additional light for the forward facing video camera and the down facing still camera.

The SDI HD video signal is delivered to the surface video screen and recorder via a BNC connector on the end of the hydrocable. The video display is used to position the towbody at the correct height from the bottom to capture accurate in focus still images. The video signal can recorded onto a removable 32gig memory stick via the video recording system.

5 SYSTEM COMPONENTS

The Primary System components are listed below.

5.1 Tow body

The towbody has been designed to enable easy adjust of equipment position and angles. A light weight bridle system provides a connection point for the tow cable. Currently fitted to the towbody;

- Forward facing SDI HD Video Camera
- Forward facing Flare 2500 Pro LED Light
- Downward facing stills camera
- Down facing Inon strobe
- Go-pro mount (optional)

5.2 Video Recorder

The video recorder system contains a portable battery and charger, as well as an external 12VDC inlet. This enables the system to be used independently of a power source if required. However for normal use, the system is plugged into the tenders 12VDC outlet allowing the unit to be used all day without charging. The system contains:

- 1 x 9Ah 12VDC lead acid battery
- Fuse protection
- Battery voltage meter
- HD 10 inch Screen
- HD video recorder
- Ambient light block out screen
- 32Gig memory stick
- 12VDC inlet
- External 240VAC 12VDC Charger
- BNC Video Lead
- 12VDC Power Lead (for tender operations)

The backup video recorder system contains a portable battery and charger, which provides 12VDC to a video recorder and video camera. The batteries have a combined rating of 18 Ahrs, which will give a complete days operation without recharging. The system contains:

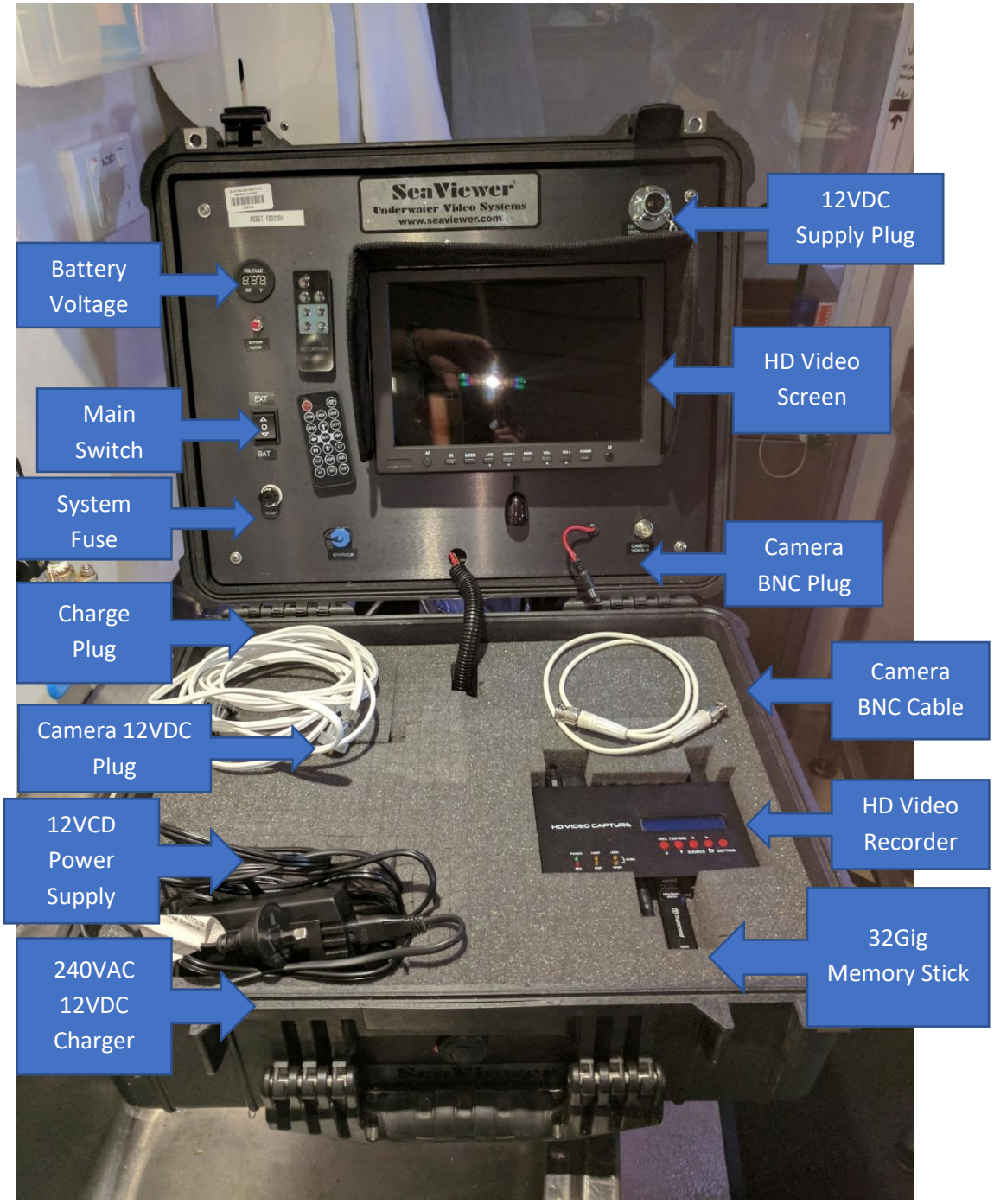
- 2 x 9Ah 12VDC Lead acid batteries connected in parallel
- Fuse Protection block
- ATOMOS Shogun video screen and recorder
- Battery voltage meter
- C-Tec 5A Smart battery charger
- Ambient light block out screen cover

5.3 Tow cable

Either a 15m or 30m tow cable is used to connect the towbody to the recorder device. It contains an internal strength member and conductors. The video signal is transmitted on a 75ohm coaxial lead while the 12VDC supply is transmitted by 2 copper conductors (0.75mm). The wet end is terminated directly to an underwater SDI HD video camera. The surface end is split into a BNC connector and a standard 12VDC plug. A reinforced bridle connects the tow cable to the towbody via a shackle.

6 OPERATION – PRE-DEPLOYMENT

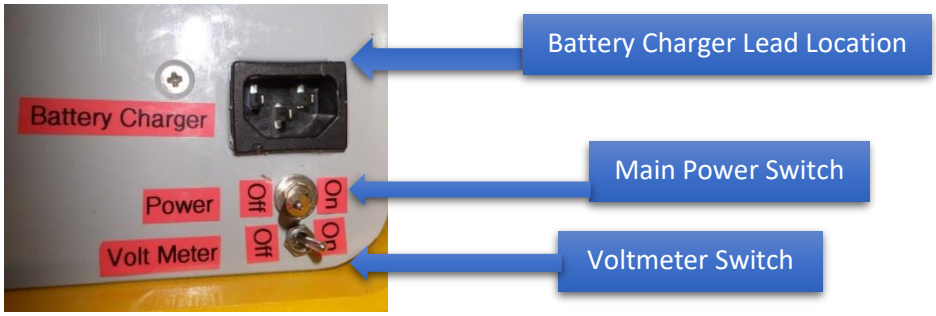
6.1 Video Recorder System

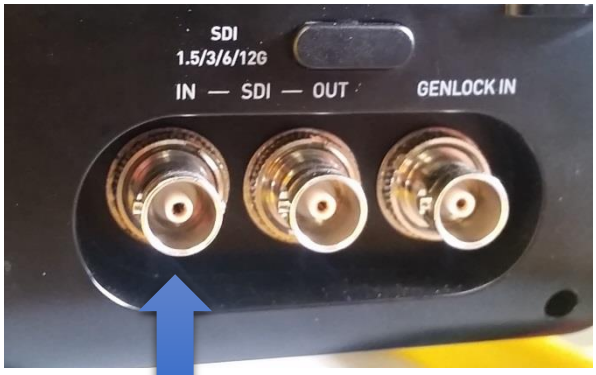


1. For standalone use the recorder system must be fully charged. To charge the system the battery charger cord must be plugged in to a 240VAC mains outlet and the recorder system via the 12VDC charge plug. Check the system voltage by pressing and holding the red button below the volt meter and ensure the battery is charging by watching the voltage rise to around 14VDC. Once the battery is fully charged (2 hours minimum) disconnect and check battery voltage. The unit can be left on to trickle charge overnight.
2. For use with an external power supply, attach the 12VDC power cable to the 12VDC power plug and the power supply (tender).
3. Ensure the 32gig memory stick is formatted and inserted into the HD video recorder.
4. Attach the HD video camera to the tow body.
5. Plug tow cable BNC connector into the video recorders SDI in male BNC connection.
6. Plug tow cable power lead into recorder system.
7. Turn main power switch to either “bat” for standalone use, or “ext” for external power supply use.
8. Attach ambient light block out screen cover.
9. Ensure video signal is present.
10. To record video press record on either the attached remote control, or the record button on the HD video recorder.

Back up video recorder system operating instructions.

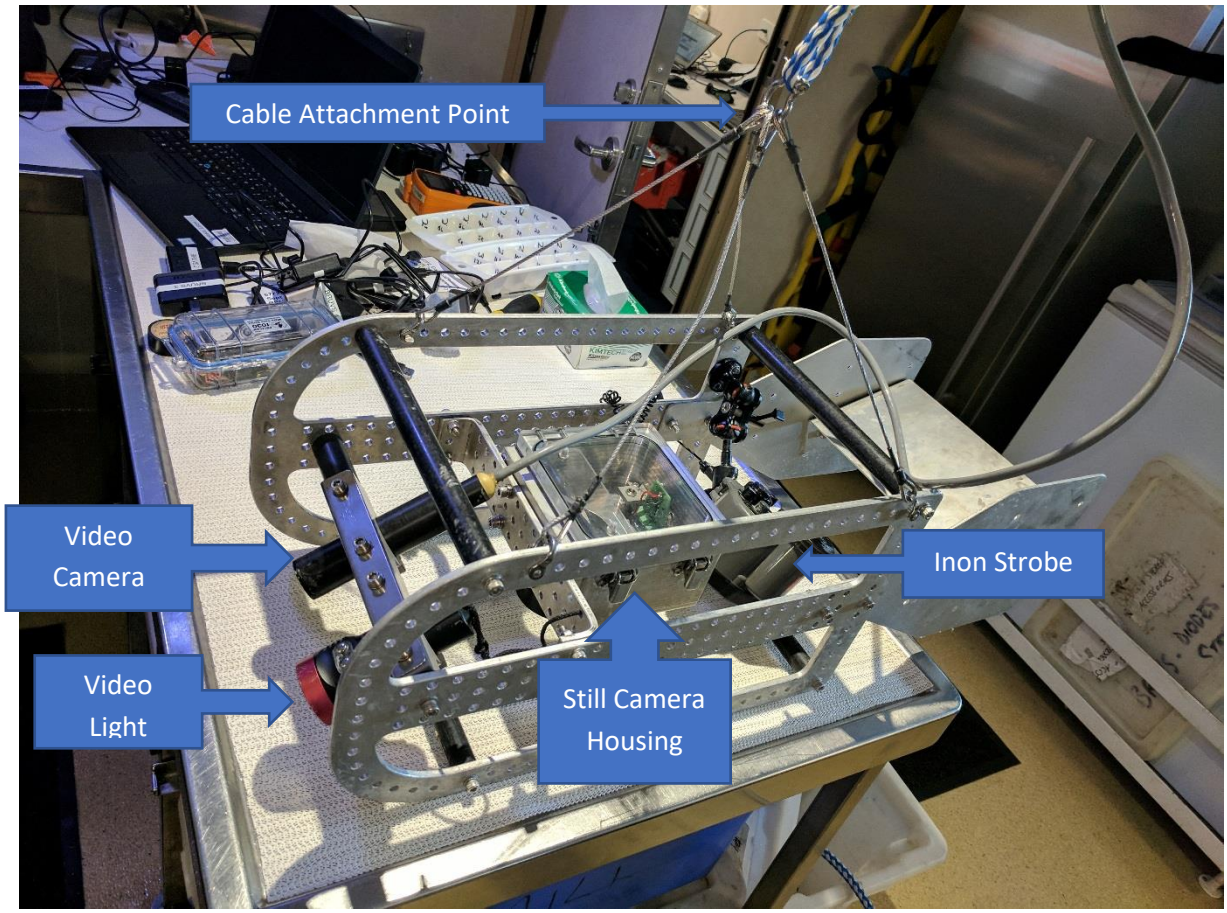
1. Before use each day the recorder must be fully charged. To charge the system the battery charger cord must be plugged in to a 240VAC mains outlet and the recorder system via the standard PC power plug. Turn volt meter on and ensure the battery is charging by watching the voltage rise to around 14VDC. Once the voltage stabilises around 13.4VDC, the battery is fully charged (1 or 2 hours). The unit can be left on to trickle charge overnight.
1. SSD drives must be formatted ready for use.
2. Plug tow cable into towbody SDI camera.
3. Plug tow cable BNC connector into the video recorders SDI in male BNC connection.
4. Plug tow cable power lead into recorder system.
5. Turn volt meter on.
6. Turn main power switch on, noting there is a latch that must be pulled up on the switch.
7. Raise video screen and attach ambient light block out screen cover.
8. Turn ATOMOS Shogun video recorder on (switch on right hand side).
9. Ensure video signal is present.





Tow cable BNC Connection Point

6.2 Tow Body



1. Ensure LED light battery is fully charged (can take several hours)
2. Check all o-rings for wear and are lightly greased with silicon grease. Replace, clean and regrease if necessary.
3. Install batteries in LED lights and test operation.
4. Install batteries in Inon strobe.
5. Ensure still camera batteries are fully charged.
6. Ensure still camera SD are formatted ready for use.
7. Install charged GoPro camera. (optional)
8. Connect tow cable lifting point to towbody bridle.
9. Install video camera and check orientation.
10. Check security of all shackles.
11. Ensure clocks on the Video Recorder, Gopro (if used) and Stills Camera are synced to GPS.
12. Ensure still camera is triggering the strobe.

7 OPERATION - DEPLOYMENT

7.1 Roles – Tender operator

The tender operator is responsible for the following:

1. Maintaining communication with Slowvid operator in regards to transect start, finish and environmental conditions (waves etc.).
2. Maintaining position during transect using GPS.
3. Maintaining speed as per direction of Slowvid operator.
4. Avoiding obstacles as per directions of Slowvid operator.
5. Maintaining communications with main vessel.

7.2 Roles – Slowvid operator

The video operator is responsible for the following:

1. Checking security of towbody attachment shackles.
2. Ensure cable is ready to deploy (spooled out ready).
3. Starting the video recorder. Ensure clapboard is captured.
4. Starting still camera ensuring clapboard is captured.
5. Turning on video light.
6. Deploying the towbody, using gloves to prevent cable slippage.
7. Maintaining towbody height according to feedback from video feed.
8. Directing the tender operator in regards to speed and obstacles.
9. Retrieving the towbody.
10. Observing operating voltage before and after tow (standalone). Record details preferably.
11. Stopping the video recorder. Record file names, date, time etc.

8 FAULT FINDING

8.1 Protection

The recorder system has a fuse to protect the system. If the system doesn't not turn on check fuse. The backup recorder system several fuses protecting the system. The following table shows the fusing for the backup system.

LH Battery +	20A	20A	RH Battery +
N/A	N/A	4A	Video Recorder
Voltmeter +	1A	4A	Video Camera

8.2 Video signal

The video signal is an SDI (Serial Digital Interface) run over a 75 ohm coaxial lead. This signal is sensitive to impedance mismatches and will not work if the connections are poor. An indication of a poor signal is;

1. Picture dropping in and out.
2. Only part of the image showing.
3. No image at all.

If the image is poor or dropping out, inspect the BNC cable and fitting for wear or corrosion. Replace the BNC cable or fittings if necessary.

8.3 Power – Voltmeter (backup system)

The voltmeter is powered by a separate 9V battery. This battery can be replaced by undoing the 4 screws on the face plate of the video recorder system pelican case and carefully lifting it up. The battery is located near the system power switches.

If the voltmeter display is not showing or getting dim the battery should be replaced.

If the volt meter is showing OV the sensing fuse may have blown. Check the condition of the 1 amp fuse and replace if necessary.