AUS SEABED

Coordinating and Measuring our Seabed Mapping Progress

Workshop Report 22nd June 2023

Rocky foreshore, Western Australia by Geoscience Australia

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Introduction

We are at a pivotal time for ocean mapping. United Nations Decade of Ocean Science for Sustainable Development has garnered the attention of governments across the globe. Nippon Foundation - GEBCO Seabed 2030 is shining a spotlight on how much or how little of the global seabed is mapped. Nationally, AusSeabed has been bringing the seabed mapping community together since before its official establishment in 2018 and the Australian Hydrographic Office has been successful in gaining support to continue the National Hydrography Program, i.e., the Hydroscheme Industry Partnership Program, for many years to come. With the collaborations and technology to truly map the seabed efficiently and effectively at our fingertips, and funding becoming more available to attain mapping goals, the Australian seabed mapping community is well positioned to support Australia's growing Blue Economy, environmental objectives and the associated wellbeing of its population.

Since its inception in 2018, the AusSeabed initiative has been hosting an annual workshop with stakeholders and end-users to grow uptake, inform future development, understand community needs, and progress its work plan. This purpose of this year's workshop is to delve into issues specific to enhancing and streamlining the national seafloor mapping efforts currently undertaken within the Australian community.

Thirty-eight invited attendees joined the one-day AusSeabed workshop, participating in two sessions with the following overarching objectives:

1. Session 1 – How much of our Seabed is 'mapped'? Seabed mapping data is being reported and interpreted inconsistently. Without a consistent quality assessment framework and data coverage approach agreed upon and applied, we will continue to see contradictory estimates used to establish national context over the years to come. Agree on a quality assessment and reporting framework that would provide the AusSeabed community a means to communicate official metrics on a regular basis through our data management practices.
2. Session 2 – Developing a National Seabed Mapping Plan. The purpose of this session was to explore possibilities for better coordinated efforts (data collation and acquisition) nationally to improve engagement at executive and departmental level, the tracking of our progress and coordination of data acquisition.

Workshop attendees brought expertise and input from key sectors: Federal and State Government, Academia, and Industry (Surveyors and Energy).

Workshop Summary

Session 1 - How much of our Seabed is mapped?

Session	How much of our Seabed is mapped?
Date	June 22nd 2023, 9:30am – 11:30am
Attendees	Refer to Table 10, Appendix A.
Topics Overview	National Reporting Requirements – Quantifying "Mapped"– 1. Relevant Reporting Metrics 2. Spatial boundaries for reporting 3. Possible data sources for reporting 4. Area Assessment Methodology
Key Discussion Points	
Relevant Reporting Metrics	• Recognition that historically, "mapped" and "surveyed" have been used interchangeably but could be defined consistently as two discretely different activities and that both should be considered in national reporting figures. • A number of alternatives were considered to qualify the various figures that could contribute to a "mapped" figure with many calling out the Category Zone of Confidence (CATZOC) ratings as a means for qualifying the data. These will also be considered as the reporting framework is developed. Outstanding questions/requirements identified for further discussion: • Ability to filter data and coverages by quality, purpose, e.g. nautical charting or research, and sensor. Response: This should be an aim through the capture of metadata and quality metrics. • Have we considered what other countries are doing? e.g. US National Mapping (NOMEC), others? Response: We have not, but we should use our relationship under the Aus/US MoU to seek feedback. • Are we quoting IHO/HIPP standard value, or specifying specific values to this survey that the Surveyor in Charge has to calculate? Response: Should be IHO/HIPP standard. However, the flexibility of the IHO matrix Table 5) should allow for assigning easily values and filtering to meet criteria threshold that would be defined by other applications (e.g. habitat mapping, engineering, etc.).
Spatial boundaries for reporting	• A variety of spatial boundaries were discussed. Participants agreed that the relevant reporting boundaries should leverage the existing spatial extents reported on by the AHO combined with advice from GA's maritime boundaries program.
Data Sources for Reporting	• A number of data archives were identified as potential/contributing sources for inclusion in national reporting figures. These included: Seabed 2030, AusSeabed Bathymetry Acquisitions Coverage layer, as well as organisational coverage layers that would remain the responsibility of the individual organisations. • Multiple groups suggested reporting on depth bands.
Area Assessment Methodology	• The methodology to be used to assess an area

Session 2 – National Seabed Mapping Plan

Session	
Date	June 22nd 2023, 12:15pm – 13:45pm
Attendees	Refer to Table 10, Appendix A.
Topics Overview	National Seabed Mapping Plan: a. Participant Assessment b. Goals of the National Seabed Mapping Plan/Strategy c. National Seabed Mapping Plan – Pathway Forward
Key Discussion Points	

Participant Assessment	Nearly all participants indicated:
	• an intent to acquire seafloor mapping data within the next 5 years.
	• Acquisition is planned on a 1-8 year planning cycle
	  ○ A variety of data types were to be collected, with backscatter and depth data topping the list
	• Approximately half the participants had previously engaged in AusSeabed tools for planning
	• All participants agreed on the benefit of a coordinated approach to seabed mapping for the nation.
	  ○ A number of barriers to engaging with this coordinated effort were identified.

Goals of the National Seabed Mapping Plan/Strategy	Goals for the National Seabed Mapping plan were discussed in terms of outcomes to be achieved through its operation. • 100% mapped Australian Jurisdiction, with increased efficiencies; • Development of a dynamic dashboard indicating progress; • Increased alignment of science to agency delegations/responsibilities/priorities. These will be further articulated in subsequent workshops and engagements with the community.
Pathway Forward	The June 2023 workshop was an extremely successful start to an ongoing conversation with the marine community. Further engagements (workshops) and communications will continue to be developed throughout the FY23-24.

Session 1 – Detailed Results and Outcomes

During this session, through presentations, questionnaire and breakout discussions, participants explored ways to qualify and quantify seabed mapping data for the purpose of reporting and identifying what data they could use. This section presents a summary of the discussions according to guiding questions.

Based on the pre-workshop questionnaire, participants identified multiple reasons and specifications for publishing annual estimates of Australian seabed area mapped supporting a variety of needs, including annual reporting, nautical charting, planning, and discovery/development of resources. Hinderances in assessing the area mapped include unprocessed data, data not accessible, historic holdings, incomplete metadata and attributes, inaccurate bounding polygons, lack of delineation of lines of soundings or holes in dataset on seabed mapping data coverage.

National Reporting Requirements – Quantifying "Mapped"

1. Relevant Reporting Metrics:

What categories/metrics is relevant to report on at a national level when considering 'How much of our Seabed is 'mapped' bathymetry-wise?

i. Mapped vs Surveyed.

The terms "mapped" and "surveyed" have been used interchangeably by the community. As a starting point to establish a minimum categorisation, participants were asked to define these.

"Mapped" - refers to scientific seabed mapping, primarily informing the topography/bathymetry. It may involve opportunistic acquisition and has some limitations in explicit quality metrics.

- Refers to scientific seabed mapping, primarily informing the topography/bathymetry of the seabed.
- It may involve opportunistic acquisition and has some limitations in being described with explicit quality metrics or not having been quality-controlled yet.
- Nippon Foundation - GEBCO Seabed 2030
- AusSeabed

"Surveyed" - indicates a more comprehensive and reliable data collection process suitable for navigation charting and engineering planning purposes, conducted by qualified professionals following defined standards.

- Indicates a comprehensive and reliable data collection process suitable for navigation charting and engineering planning purposes.
- Conducted by qualified professionals following defined standards.
- Where data is collected for non-hydrographic purposes, the end results could also be qualified as surveyed, but only once it has been quality-assured and approved by a qualified professional.
- In summary, only the data validated by the Australian Hydrographic Office should be identified as 'surveyed'.

ii. Other categories

In the pre-workshop survey and the introductory presentations, participants identified more categories on which they calculate coverage for these various purposes. These included Category Zone of Confidence (CATZOC) for navigational charting, discovery and development of hydrocarbons, organisational annual reporting.

During the breakout discussions, participants identified the most important categories to report on at a national level and others to reflect on (Table 1). The top three included for nautical charting per CatZOCs, progress towards Seabed 2030 for our region, and full bathymetric coverage using techniques like MBES, Lidar, and Satellite Derived Bathymetry (SDB). The report should also consider factors, such as mapped vs. surveyed data area, adherence to IHO survey standards, public understanding, resolution considerations, data gaps, contributions to Seabed 2030, and data accessibility (Table 1).

Table 1. List of relevant categories to report on per popularity with notes.

Categories/Metrics	Score	Comments
Hydrographic Charting per CatZOCs	5	• While it is important to note that the CatZOC terminology may not be widely understood by the general population, reporting against these categories is valuable. • Reporting using CatZOC, considering the order of survey, differentiating between mapped and surveyed areas per depth, and reporting line kilometer and coverage area, contributes to a more comprehensive understanding of the extent of seabed mapping bathymetry-wise at a national level.
Full bathy coverage (MBES, Lidar,…)	4	• It should also include Satellite Derived Bathymetry. • It is more detailed than Seabed 2030 and has hydrographic components. • What is full bathymetry? Metadata is essential and needs to be defined.
Seabed 2030	2	• Seabed 2030 is indeed relevant but there are a few considerations and comments to be made: • Seabed 2030 calculations should be validated • "coverage" should be clearly defined and understood • Should request AHO metric on coverage • Lack of coordination • Should contact AusSeabed for data contribution
Per resolution potential	2	• Smoothed polygon gridded at each 100m resolution • Potential should be reported
Data/No Data	2	• Data/No Data alone may not provide sufficient detail to accurately report on the extent of seabed mapping bathymetry-wise at a national level
Australian entity contribution to Seabed 2030	1	• AusSeabed plays a significant role in contributing to the Seabed 2030
Access/No access	1	
Report on standards		
Grid size		• It indicates data density more than data/no data

2. Spatial Boundaries for Reporting

What are the zones/areas we should report on?

The three most relevant areas participants identified to report on at national scale (table 2) are the:

1. Australian Marine Jurisdiction with the Exclusive Economic Zone (EEZ) and State/Internal waters reported separately to the Australian-Antarctic Territory;
2. State boundaries and the
3. Australian Charting Area (ACA).

Multiple groups suggested reporting on the depth bands, in particular less than forty meters water depth. This would provide an indication of the rate of effort, which is considerable when mapping shallow waters.

Table 2. List of zones/areas to report on per popularity with notes.

Zones/Areas	Count	Comments
Exclusive economic zone (EEZ), include State and internal waters	6	This zone is very important and most relevant to Australia
Australia Charting Area (ACA)	5	Considered as not so important only by one group. There is a concern that this may distort percentage.
State boundaries	5	This requires further details on coastal zones and economic zones. This is essential for the states as they want to know specifics to their state.
Commonwealth waters	4	This should also include ACA. Reporting on everything will muddy the funding waters.
Depth bands	4	It is identified as very important e.g., 40m and above and below 200m. It is also valuable for level of effort.
Australian Antarctic Treaty	3	Mostly research and not hydrographic survey, this should be reported separately. ACA is an overarching area.
Marine Parks	3	Derived – agency responsibility.
Petroleum and Carbon Capture Storage lease areas	3	Important. Management of Lease.
Offshore renewable declared area	2	
Broad geomorphic areas (shelf, slope, rise)	2	Should include economic zones and maritime boundaries.
Sea countries when/if become available	2	Metadata must relate to prescribe body corps/mobs. It needs to be better defined.
Marine National Facility coverage	1	Noting that this can be in international waters.

3. Data Sources for Reporting

What do we use to report on considering the above & who is responsible to calculate and report these?

The sources for reporting areas should primarily be based on the AusSeabed survey coverage layer (sensor-specific or data-level specific data) with support from organisational coverage, and the Nippon Foundation-GEBCO Seabed 2030 coverage.

AusSeabed should take the responsibility for calculating the metrics and generating reports, with potential contributions from the AHO or other relevant organisations.

The frequency of reporting should be annual, with the aim of developing a dynamic dashboard for more real-time updates in the future.

Table 3. List of report categories to report on per popularity with notes.

Data to use	Count	Comments
AusSeabed coverage	6	Maintained by AusSeabed
Organisational coverage	4	• Each Organisation for difference purposes. • AusSeabed for all data submitted to AusSeabed.
NF-GEBCO Seabed 2030 coverage	4	• GEBCO and AusSeabed for ACA to compare. • AHO.
Sensor specific	4	Use the AusSeabed coverage metedata
Data level specific (L0, L2 proc, L3, etc)	4	• Gridded data – with QA/QC • L0 L2 organisational, L3 AusSeabed • Metadata stipulates what levels are available (L2 or L3).

4. Area Assessment Methodology

How should we assess an area? What is our area assessment methodology?

i. Identify the critical criteria to assess, the specific value breakdown for each and difficulty level in assessing

Thirteen criteria were identified as critical (indicated in blue in Table 4). These criteria were drawn upon the IHO S-44 matrix and input from the workshop participants through the pre-workshop surveys, as well as the workshop discussions. All criteria were assessed and adjusted during the workshop breakouts.

Of these critical criteria, the participants identified most to be rather difficult to assess for science voyages and if the assessor is not a qualified hydrographer (Table 5). Some suggested that a level 1 surveyor be present during data acquisition but noted that this would be challenging for any science voyage. Guidelines are considered critical to remove ambiguity. There needs to be more discussion to provide clarity around which data format (e.g. surface vs point cloud) should be assessed, guidelines to follow and other data types, such as backscatter, slope, habitat, to consider.

Table 4. List of critical quality criteria (blue background) with feedback about the level of difficulty in assessing these criteria.

Criteria	Count	Is criteria critical and how easy to assess
Depth THU "a_{THU}" [m] (Total Horizontal Uncertainty)	Easy 4 Hard 1	• Assigned at point and surface level (L2 and L3) • Easy for hydrographic surveys. Easy based on equipment and depth. • Hard for individual soundings and require assessment by level 1 surveyor. Hard for others and require training.
Depth THU "b_{THU}" [% of depth] (Total Horizontal Uncertainty)	Easy 3 Hard 1	• Easy based on equipment and depth. • Hard for individual soundings and require assessment by collecting level 1 surveyor.
Depth TVU "a_{TVU}" [m] (Total Vertical Uncertainty)	Easy 3 Hard 1	• Assigned at point and surface level (L2 and L3) • Easy unless not supplied. Easy based on equipment and depth. • Hard for transit data and for individual soundings and require assessment by collecting level 1 surveyor.
Depth TVU "b_{TVU}" (Total Vertical Uncertainty)	Easy 3 Hard 1	• Easy based on equipment and depth. • Hard for transit data and for individual soundings and require assessment by collecting level 1 surveyor.
Feature Detection "a_{FD}"[m]	Hard 2 Easy 1	• Job specific, not commonly measured for science voyage • Hard for individual soundings and require assessment by assigned level 1 surveyor. • Easy based on equipment and depth. • If available, should be captured, however not mandatory
Feature Detection "b_{FD}" [%]	Hard 2 Easy 1	• Job specific, not commonly measured for science voyage • Hard for individual soundings and require assessment by assigned level 1 surveyor. • Easy based on equipment and depth. • If available, should be captured, however not mandatory
Feature Search	Hard 2 Easy 2	• Job specific, not commonly measured for science voyage • It should be ok to assess • If available, should be captured, however not mandatory
Bathymetric Coverage [%]	Easy 4 Hard 1	Use QAX and grid size.
Sensor Type	Easy 5	• This criteria should be replaced by GEBCO TID considering it already covers a wide range of sensors and data sources, and is applied globally (see appendix E).
Minimum depth [m]	Easy 4	Remove. Not critical.

Criteria	Count	Is criteria critical and how easy to assess
Maximum depth [m]	Easy 4	Remove. Not critical.
Sounding (sndg) Density	Easy 4 Hard 1	• Easy, but not for transit data and SDB. • How is this derived? Per resolution associated with depth bands
Resolution [m]	Easy 5	Important – gridded data (L3) versus original data potential.
Data Fliers [% of Not Empty Nodes QAX]	Easy 2	Remove. Not critical.
SVP Frequency [× Daily]	Easy 3 Hard 1	• Not highly relevant as it is implicit to TVU • But it depends on survey duration and location.
Temporal Currency	Easy 2 Hard 2	• It is subjective and depends on seafloor type, geology, depth and currents. • Time stamp is important, but currency varies with environment.
Survey type/purpose (dropdown) - MBES guidelines		This provides guidance to survey planning
Date of dataset		
Survey speed (see Sounding (sndg) above)		
Additional datasets produced?		Information about other datasets associated with the survey
Surface node sounding density	Easy 1	

ii. Assessment and Coverage of Transit vs Focused Data Areas

All participants agreed on the need to assess transit and focused data areas separately. However, the requirements for assessing separately may vary depending on the purpose of the voyage, i.e., whether it is surveying or mapping as per definition in section 1.

While participants agreed the assessment results should be captured within a metadata field, separating the coverage of the transit from the focused areas within the AusSeabed national layer was mostly deemed unnecessary. However, it was pointed out that separating these areas is unnecessary for creating coverage, it is essential for conducting accurate assessments of coverage assessment.

Table 5. Quality matrix including critical criteria selected in the workshop (modified from S-44 IHO, 2022 Section 7.6 matrix)

Criteria		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Depth THU "a_{THU}" [m]**	500	200	100	50	20	15	10	5	2	1	0.5	0.35	0.1	0.05
2	**Depth THU "b_{THU}" [% of depth]**	20	10	5	2	1	0.5	0.25	0.1						
3	**Depth TVU "a_{TVU}" [m]**	100	50	25	10	5	2	1	0.5	0.3	0.25	0.2	0.15	0.1	0.05
4	**Depth TVU "b_{TVU}"**	0.2	0.1	0.05	0.023	0.02	0.013	0.01	0.0075	0.004	0.002				
5	**Feature Detection "a_{FD}"[m]**	50	20	10	5	2	1	0.75	0.7	0.5	0.3	0.25	0.2	0.1	0.05
6	**Feature Detection "b_{FD}" [%]**	25	20	10	5	3	2	1	0.5	0.25					
7	**Feature Search**	1	3	5	10	20	30	50	75	100	120	150	200	300	
8	**Bathymetric Coverage [%]**	1	3	5	10	20	30	50	75	100	120	150	200	300	400
9	**Sounding Density**	10	20	30	40	50	60	70	80	90	100		YES		
10	**Resolution [m]**	200	100	50	25	15	10	5	2	1	0.5		YES		
11	**SVP frequency [xDaily]**	**1**	**2**	**3**	**4**	**6**	**8**	**12**	**24**	**48**	**96**				
12	**Temporal Currency**	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined
13	**GEBCO Type Identifier (TiD) * appendix 6**	0	10	11	12	13	14	15	16	17	40	41	42	43	44

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iii. Assessment and Coverage of Sensor Specific Data

Most groups agreed that coverage should be defined separately for each sensor type considering their distinct specifications (e.g., resolution, uncertainty, density, etc). However, thought needs to be given to whether coverage should be separated based on the sensor technology type (e.g., multibeam echosounder, Lidar, satellite derived bathymetry) and/or sensor models (e.g., EM710, EM2040, R2Sonic 2026).

5. Standardisation of assessment and reporting

All groups acknowledged the significance of standards and emphasised the need for a standardised template for assessment and reporting purposes. They suggested that the template encompass essential information, such as survey purpose and standardisation of key parameters (e.g., standard deviation, agreed banded-depth, and area).

All groups unanimously agreed that the L3 Gridded MBES Bathymetry Product Specification is highly desirable for creating the coverage area. Furthermore, the groups recommended that AusSeabed takes responsibility for collecting critical quality parameters and capturing them as metadata. This would enable enhanced search capabilities for users, ensuring that the necessary information is readily available. Importantly, to ensure broad adoption, it is critical that AusSeabed communicates clearly and concisely on the purpose and reasoning for providing assessments.

6. Summary of reporting dashboards and critical quality criteria matrix

This section proposes three reporting dashboards summarising the inputs provided during the session and capture in the section above. How to calculate these has yet to be determined and will need to consider inputs provided in regard to separately assessing and capturing data for transit and focus areas or sensor-specific.

Table 6. Reporting Dashboard 1: Seabed coverage of the Australian Marine Jurisdiction (incl., mainland Australia, Antarctica and Territories marine region). Definition of Mapped vs Surveyed as defined in section 1 above.

	Mapped	Surveyed	Total % seabed covered
% seabed covered (based on coverage km2)	All coverage in AusSeabed from MBES, Lidar, SDB, SeisDB and not assessed by AHO or qualified surveyor	All coverage assessed by AHO or qualified surveyor and assigned a CATZOC. Includes openly known and proprietary coverage held by AHO	Total area mapped plus surveyed (no coverage overlap)
% effort (based on line nm estimate*) **Total EEZ: 10.825Mnm** **Antarctica: 0.530Mnm**			

*Estimate developed by IXBlue, 2020 . However, these may need to be vetted and/or replaced by AHO for the Australian Marine Jurisdiction

Table 7. Reporting Dashboard 2: Detailed coverage area per regions

Jurisdictional Area	AusSeabed	Navigational Charting			Seabed 2030
	MBES, Lidar, SDB, SeisDB and where resolution can meet ASB depth bands specifications	CatZOC			
		A	B	C	1 sounding per depth cell
Australian Charting Area	Z%	X%	X'%	X''%	Y%
Australian Marine Jurisdiction (Mainland, Territory and Antarctica)					
Australian Commonwealth waters					
Australian mainland EEZ from Coast					
Australian Antarctic Territory (area km2)					
External Territories					
WA					
NT					
Queensland					
NSW					
Victoria					
Tasmania					
South Australia					
Data inputs	**AusSeabed coverage**	**AHO Bathy database**			**GEBCO coverage**
Responsible Organisation *	**AusSeabed/GA/States**	**AHO/States**			**Seabed 2030**

*aim will be to reconcile existing open coverage from various databases (State, AHO, GEBCO, etc into the AusSeabed acquisition coverage. Organisations with proprietary coverage holding will continue to take responsibility to report on these.

Table 8. Reporting Dashboard 3: Accessible datasets

Number of AusSeabed Acquisition Coverages ('surveys')	Number of coverages where dataset is published and accessible online
Unpublished and published	published

Session 2 – Detailed Results and Outcomes

Seabed mapping data is fundamental to most coastal and offshore activities. Since 2018, AusSeabed developed the Marine Data Portal with focus on ingesting and publishing data for public goods. AusSeabed has also sought end-users mapping priorities through the Areas of Interest of the Survey Coordination Tool initiative to understand stakeholders' data needs, assist with planning data acquisition and identify high value data poor regions.

Today, as a result of government and private activities, large-scale seabed data acquisition led by a few key organisations with complementary scope is on the horizon. By understanding each other's plans and coordinating efforts, we can improve how these large areas are mapped and facilitate the delivery of large-scale data.

This session aimed to explore possibilities for better coordinating efforts (data collation and acquisition) nationally to improve engagement at executive and departmental level, the tracking of our progress and coordination of acquisition. A series of questions posed through the pre-workshop surveys and workshop questions during the breakout groups:

Participant Assessment:

Does your organisation have a strategic goal or purpose for mapping the seabed? Do you plan to conduct seabed mapping acquisition in the next 5 years? (Indication of cycles for planning seabed mapping and objectives for acquisition)

Nearly all of the respondents/participants have a strategic goal or purpose for mapping the seabed, and plan to acquire seafloor mapping data in the next 5 years, on varying planning cycles (1-to-8-year planning cycles). The objectives and goals for the mapping activities cover 100% coverage, safety of navigation, seafloor geomorphology and habitat classification, identification of biological habitat, support of state and federal marine parks and estates, marine spatial planning, and to support recreational and commercial activities such as fishing.

What region or depth range will your organisation focus on in future efforts? What data types are you principally collecting?

Table 9. Responses indicated mainly mapping within the EEZ in depth ranged between 0-400m, and within State and Territory waters in less than 150m. One response stated that they would be donating transit data and also encouraging others to do so.

Data Type	Number of Responses
Backscatter	13
Depth	12
Basic seabed classification/habitat information	8
Water column	6
Sub bottom	5
Sediment samples	4
Tidal (Height & stream)	3
Video imagery	3
Magnetometer	1
Ground samples	1
Oceanographic data	1
BRUVs, AUVs, towed video, ROV	1
Temp	1
Geotechnical and seismic	1
Heritage	1

Have you submitted your upcoming surveys into the Survey Coordination Tool for display in the AusSeabed Marine Data Portal or used Upcoming Surveys layer to plan your organisations' seabed mapping activities? Why and how?

Approximately half of the organisations had utilized the AusSeabed Portal to support science and planning activities. The remaining half were either aware of the portal, had not integrated the tool into their workflow, or did not have custody over the data as they were working for third party clients.

Would your organisation engage in the development of a national coordination of seabed mapping effort? What is the value/benefit in a National Seabed Mapping Plan/Strategy focused on both data collation and acquisition? How would it help your organisation?

The workshop attendees, both from the standpoint of the benefits and a wide participation desire, overwhelmingly supported this initiative. A coordinated Program would provide a planned approach to national acquisition of seafloor mapping data and a framework that would lead to consistency of standards, identification of data gaps, increased efficiency of cost and effort, reduce risk of duplication, a centralised point of data discovery and accessibility, and provide opportunity for a higher degree of collaboration.

The organisations currently involved in seafloor mapping are conducting these activities for a variety of objectives, that can all feed into, enhance, and be delivered through a National Seabed Mapping Program. Planning schedules by organisations vary and would need to be considered (and possibly adjusted) as a National Program is developed. While some groups maintain collect and maintain proprietary datasets, there is willingness to discuss provision of coverage polygons, with access potentially being allowed through direct requests. Groups suggested that a risk assessment be conducted for priority areas to be mapped.

What are the barriers for your organisation to collaborate in a national effort?

Challenges and barriers to contributing to, or integration within a National Seabed Mapping Plan are recognised and should be considered. These include Operational and Commercial barriers.

Operational barriers:

- timelines for planning,
- lack of hydrographic assets and specialist hydrographic surveyors nationally,
- Zone of confidence (ZOC) process utilised in the charting sector.

Commercial barriers:

- propriety datasets,
- data security,
- backlog of QC of datasets for release,
- lack of prioritisation of seabed mapping and limited allocation of sea time.

What would be the goal of a National Seabed Mapping Plan/Strategy?

The goals of a National Seabed Mapping Program should be:

- 100% mapped Australian Jurisdiction, with increased efficiencies;
- development of a dynamic dashboard indicating progress;
- increased alignment of science to agency delegations/responsibilities/priorities.

National Seabed Mapping Plan – Pathway Forward

The following 'next steps' are a summary of the steps identified by the groups during the session:

a) Create a working group to developing a strategic plan/framework to achieve 100% coverage of Australian Marine Jurisdiction and meeting standard with the following areas to consider, but not limited to:

- Addressing barriers
- Focus areas
- Mapping needs
- Data access
- Long term AusSeabed uptake and support
- 2024 VIP event in Canberra to Launch a National Seabed Mapping Plan, and a Statement of how much of Australia's Seabed is mapped/surveyed and what we are doing to map the rest.

b) Garner legislative support for future funding and policymaking

c) Facilitate closer relationship with industries (oil and gas/wind/fisheries, etc.) to explore collaborations

d) Prioritise outreach activities to elevate visibility of National Seabed Mapping activities, including standardisation of briefing slides for outreach/briefings to government, leadership, partners, and public.

Conclusion

The implementation and management of AusSeabed continues to thrive through direct engagement with stakeholders and key sectors. This workshop has benefited from previous efforts and advice and has provided an invaluable platform from which to move forward in a productive and focused manner. The 2023 workshop has led to guidance on specific assessment and reporting requirements (Session 1 section 8), as well as a broad acknowledgement and indication to adopt and move forward with a National Seabed Mapping Plan (Session 2).

Acknowledgement

AusSeabed acknowledges the Traditional Owners of Country and Sea Country throughout Australia, particularly the Dharawal people, the traditional owners of the land this workshop was held on. AusSeabed recognises the continuing connection to lands, waters and communities. We pay our respect to Aboriginal and Torres Strait Islander cultures; and to Elders past and present.

Thank you to all the workshop participants and the pre-workshop respondents for providing their time and valuable inputs to advance coordination of our seabed mapping efforts. Thank you to Emma Hickerson, Kim Picard, Nigel Townsend, Justy Siwabessy for planning the workshop; Michele Spinoccia, Michal Wenderlich, Natalie Lennard, Pip Bricher and Neal Evans for the dry run; and Jenna Kiggins for taking notes on the workshop day.

Appendix A

Due to the limited entry for this workshop AusSeabed targeted invitations to represent a broad range of perspectives, including private sector, research, and state and federal governments.

Workshop participants

Participant	Organisation
Rob Beaman	James Cook University
Chris Berry	CSIRO
Patrick Bunday	AIMS
Mark Case	AIMS
Charles Collins	EGS
Dylan Colson	Hydrographic Services
Andrew Coulls	AHO
Richard Cullen	AHO
David Donohue	Revelare
Tom Doyle	NSW DPE (Facilitator)
Jane Ham	SARDI
Ursula Harris	AAD
Mick Hawkins	Fugro
Emma Hickerson	Geoscience Australia
Tim Ingleton	NSW DPE (Facilitator)
Zarina Jayaswal	AHO
Alysha Johnson	University of Wollongong
Chris Kennedy	MMA Offshore
Jenna Kiggins	AHO
Geoff Lawes	Revelare
Scott Lytton	AHO
Jak McCarroll	DEECA Victoria
Cisco Navidad	CSIRO
Daniel Ning	Maritime Safety - Queensland
Karl Perry	Woodside
Kim Picard	Geoscience Australia
Paul Seaton	Fugro (Facilitator)
Shereen Sharma	Survey and Spatial Consultants (Facilitator)
Justy Siwabessy	Geoscience Australia
Jodie Smith	Geoscience Australia
Michele Spinoccia	Geoscience Australia
Ralph Talbot-Smith	WA Department of Transport
Nigel Townsend	AHO
Hilary Thompson	AHO

Martin Tunwell	Ocean Infinity (Facilitator)
Michal Wenderlich	Geoscience Australia
Magnus Wettle	EOMAP Australia
Mary Young	Deakin University (Facilitator)

Appendix B

Survey question responses – Session 1

Question	Compiled responses
Q2. Has your organisation developed or published estimates of Australian seabed area mapped? If so, what is/was the primary purpose of your need to assess area mapped?	8/17 Yes 9/17 No Primary purpose: MNF & AusSeabed (also contributed to GEBCO) annual reporting; To discover and / or develop hydrocarbons; Assess area adequately mapped for nautical charting; planning for future projects -baseline knowledge and data gaps; Understand how big an area needed to be captured and approximate cost; IHO Publication C-55 reporting, HIPP (SEA2400-1) business case; Several years ago, we developed a tool to estimate how many line miles of survey would be required to survey Australia's EEZ to IHO Order 1a standard.
Q3. What parameters (e.g. coverage, sonar type, jurisdictional boundaries, Survey order, horizontal accuracy, etc.) and rules (e.g. thresholds on these parameters, such as Multibeam, 100% coverage, EEZ/State, IHO 1a, etc.) you used to calculate these area estimates?	CATZOC (horizontal + vertical accuracy, seafloor coverage & survey characteristics), jurisdictional boundaries (EEZ, State, etc), technique of sounding (MBES, SBES, LiDAR); Depth, Turbidity, Adjoining surveys, state jurisdiction; Coverage, sonar type, jurisdictional+geological, 100% coverage; Multibeam; Per AHO, as much info as possible; All parameters related to survey uncertainty, coverage, applicable standards etc. Less so aspects like jurisdictional boundaries; IHO order 1a or better; currency; coverage; (+ with 20% overlap) Survey order 2 by default, 128m or 210 resolution CUBE surface using Albers projection within GDAL
Q4. Do you use an existing quality framework or matrix for assessing coverage, etc. (e.g. IHO orders, IHO ZOC)?	8/17 Yes 8/17 No CATZOC; IHO orders (7) (+1 – with 20% overlap) and ZOC; IHO orders, HIPP specifications, Ports Australia specifications, survey specifications (e.g. Pilbara Ports, Rio Tinto etc); Multiple frameworks from first pick seismic to IHO orders
Q5. Do you have your own quality framework?	4/17 Yes 11/17 No https://www.msq.qld.gov.au/Waterways/Hydrographicsurvey-standards; HIPP Statement of Requirements: www.hydro.gov.au/NHP; Not published - but based on VIC approach to seabed mapping (from NSW)
Q6. Are there limitations you have encountered that hindered your assessment for area mapped?	6/17 Yes 8/17 No If data is not processed, we are relying on estimates of swath coverage based on 4 x water depth; Independent contractor. All data owned by clients within Australia's charting areas and or provided to the AHO; A large chunk of our pre-digital data holdings (pre-1990s data) are manuscript. Evaluation of that that has been digitised impacted low resolution compared to modern digital datasets; Supplied metadata is incomplete or not descriptive enough; sea conditions, accesibility, procurement; Inconsistent dataset attribution (esp. related to survey technique & coverage), accuracy of bounding polygons (including some not delineating lines of soundings or holes in dataset), incomplete data holdings and quality attribution

Question	Compiled responses
Q7. What would assist you to enhance your assessment of seabed area mapped? Are there class/parameter/tools that doesn't currently exist, that would help?	Data holding gap analysis, internal processes; Approximate cost calculators for budget allocation; Currency of ZOC areas (eg highly dynamic seafloor, siltation rates); Tools for assessing coverage outside of processing programs (e.g., CARIS). Or that don't require specific exports from those processing programs if those aren't available (e.g., QAX uses additional layers to depth, which may not be available); Standard metadata; Consistency, framework, eg use same projection, same method/tool for generating polygons. Could be beneficial for one organisation to make the overall estimation of area mapped
Q8. What do you consider to be the definition and limits of the Australian Seabed (E.g., EEZ, EEZ + Australian Antarctic treaty, Australian charting area, etc.)?	EEZ, including that of offshore territories and EEZ off the Australian Antarctic Territory (5); EEZ (4); Depends on the application EEZ at a minimum; good to not be exclusive from other SWPac; Australian Charting Area (AHO)
Q9. Would you support a nationally coordinated effort to provide updated seabed area mapped statistics annually on the AusSeabed website?	14/17 Yes 3/17 No
Q10. What nationally coordinated statistics do you think we should be collecting and reporting?	Areas of full bathymetric coverage (i.e. from MBES), change from previous year(s), contributions to GEBCO / Seabed 2030 by Australian entities; area, costs, status, resolution; I am not sure what we are reporting now BUT how many people are getting what they need from AusSeabed. Are they looking but not downloading because they cant FIND what they need? Are federal agencies using the system MORE than State and local government. What do the customers want. With our new WA bathymetry portal I am trying to anticipate what customers want in terms of managers and tech people. People are already commenting to me that the BAG files are great because they contain metadata about surveys. Then managers are saying they need colour coded data to make management decisions. Guidelines about costs are very valuable for managers. We must know how much money is needed to capture areas for yearly budgets. It also guides us about how big those areas can be; New areas mapped; how much left to go (state; shelf); Whatever information is able to be easily collected or discerned; Percentage, age/currency of Australian Seabed (Aust Charting Area) mapped; Area covered in different depth classes with resolution standardised by depth class, upcoming surveys expanding coverage; the usual survey metadata but at least: date, purpose, standards used, coverage, custodian, data link, creative commons / access restrictions; coverage of petroleum and CCS leases; An approach consistent with GEBCO Seabed2030 to generate a higher level of cooperation and coordination for this initiative; Area surveyed by method (MBES, Lidar etc); As much as possible. Certainly anything captured under Government funded mapping programs.

Acronyms

Acronym	
AAD	Australian Antarctic Division
ACA	Australian Charting Area
AHO	Australian Hydrographic Office
AIMS	Australian Institute of Marine Science
ASB	AusSeabed
AWS	Amazon Web Services
CATZOC	Category Zone of Confidence
CCS	Carbon Capture and Storage
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEECA Victoria	Department of Energy, Environment and Climate Action
DEM	Digital Elevation Model
ENC	Electronic Navigational Charts
EEZ	Exclusive Economic Zone
GA	Geoscience Australia
GBR	Great Barrier Reef
GEBCO	General Bathymetric Chart of Oceans
GSM	Geophysical Survey and Mapping
HIPP	Hydroscheme Industry Partnership Program
IHO	International Hydrographic Organization
IMOS	Integrated Marine Observing System
MBES	Multi Bean Echosounder Equipment
MBH	Marine Biodiversity Hub
MNF	Marine National Facility
NF	Nippon Foundation
NOAA	National Oceanic and Atmospheric Administration
NOMEC	National Ocean Mapping, Exploration and Charaterization (NOAA)
NSW DPE	New South Wales Department of Environment
QA/QC	Quality Assurance/Quality Control
QAX	Quality Assurance Tool
SARDI	South Australia Research Development Institute
SBES	Singlebeam Echosounders
SCT	Survey Coordination Tool
SDB	Satellite Derived Bathymetry
SSSI	Surveying and Spatial Sciences Institute
SVP	Sound Velocity Profile
THU	Total Horizontal Uncertainty
TID	Type Identifier
TVU	Total Vertical Uncertainty
UTAS	University of Tasmania
VCMP	Victorian Coastal Monitoring Program
WA	Western Australia
WHD	World Hydro Day
ZOC	Zone of Confidence

GEBCO TID Codes

The table below details the coding of the GEBCO Type Identifier (TID) grid

TID	Definition
0	Land
Direct Measurements	
10	Singlebeam – depth value collected by a single beam echo-sounder
11	Multibeam – depth value collected by a multibeam echo-sounder
12	Seismic – depth value collected by seismic methods
13	Isolated sounding – depth value that is not part of a regular survey or trackline
14	ENC sounding – depth value extracted from an Electronic Navigation Chart (ENC)
15	Lidar – depth derived from a bathymetric lidar sensor
16	Depth measured by optical light sensor
17	Combination of direct measurement methods
Indirect measurements	
40	Predicted based on satellite-derived gravity data – depth value is an interpolated value guided by satellite-derived gravity data
41	Interpolated based on a computer algorithm – depth value is an interpolated value based on a computer algorithm (e.g. Generic Mapping Tools)
42	Digital bathymetric contours from charts – depth value taken from a bathymetric contour data set
43	Digital bathymetric contours from ENCs – depth value taken from bathymetric contours from an Electronic Navigation Chart (ENC)
44	Bathymetric sounding - depth value at this location is constrained by bathymetric sounding(s) within a gridded data set where interpolation between sounding points is guided by satellite-derived gravity data
45	Predicted based on helicopter/flight-derived gravity data
46	Depth estimated by calculating the draft of a grounded iceberg using satellite-derived freeboard measurement
Unknown	
70	Pre-generated grid – depth value is taken from a pre-generated grid that is based on mixed source data types, e.g. single beam, multibeam, interpolation etc.
71	Unknown source – depth value from an unknown source
72	Steering points – depth value used to constrain the grid in areas of poor data coverage

Appendix D

The below document contains the information, questions and responses from Session 1 of the 2023 AusSeabed Workshop. Responses, changes and comments from participants are included in dark green text.

Workshop Instructions

Session 1 How much of our seabed is 'mapped'?

Background

In 2019, we held a 2-day workshop on the AusSeabed Data hub focused on establishing an agreed metadata profile and understanding data inventory, and we touched based on quality assessment. At the time, requesting any statement of quality with data was deemed complex and would raise a barrier to sharing data and establishing momentum for AusSeabed.

Introduction

Today, we have come a long way. We have guidelines, a new marine data register leveraging metadata and data submission tools, a quality assessment tool (QAX) with improved functionality, an operational publishing pipeline, and continually improved national data coverage.

However, we are still unsure or have different views about how much of our EEZ is 'mapped'. Without a consistent quality assessment framework and data coverage approach agreed upon and applied, we will continue to see contradictory estimates used to establish national context over the years to come.

This session thus aims to:

1. Agree on a quality assessment and reporting framework that would provide the AusSeabed community a means to communicate official metrics on an annual basis through our data management practices.

Session Breakdown:

1. On arrival and during breaks, answer the **Overarching questions on the Wall**
    a. Which **initiatives/programs rely** on metrics associated with seabed coverage? **How often** is the reporting and which metrics are used?

Response:

- MNF for annual reporting
- AHO mapped for nautical charting

    b. Define **'Mapped'** vs **'Surveyed'**

Response:
Mapped:

- For Science
- Sea floor mapping meets the needs of scientists but doesn't meet charting requirements
- Data that informs of topography
- First return seismic pick data (25m bin size). Not engineering quality
- Data has been collected but lacks associated quality metrics W.R.T. accuracy and uncertainty
- Seabed 2030 Definition
- Geospatial data with minimum metadata for inclusion in AusSeabed databases i.e. MBES guidelines or backscatter guidelines satisfied
- Opportunistic

- Doesn't meet density threshold i.e. satisfies GEBCO 1 sounding in grid but not relevant survey standard e.g. 5 per bin
- Published geo-referenced data
- Public available/official published data, mix of variable quality

Surveyed:

- Surveyed means data collected to a known accuracy, usually to meet charting requirements
- Data that has quality controlled outputs and known uncertainties and reporting (metadata)
- For navigation
- "Adequately"
- Data has been collected together with associated quality metrics (i.e. an understanding of accuracy and uncertainty)
- Measured to high accuracy/precision using defined datums
- High density data may not be publicly available
- Of a defined survey quality standard
- -Controlled, systematic collection
- -AHSCP CPMS1 Sign-off for data
- -Validated by AHO and approved for chart action
- - All 3 above needed for "surveyed"
- Data that can be input into engineering design and planning
- Supported by reporting by appropriately qualified professional
- Meets a defined standard

Summary:

Mapped:

- For science
- Opportunistic
- 25m bin, 1st 3D seismic return
- Seabed 2030
- Lack quality metric
- Inform topo

Surveyed:

- Quality controlled outputs, uncertainty metadata
- Meet charting navigation
- Use for engineering planning
- By qualified professional
- Defined standard
- Adequately, assured

c. Identify **existing data coverage** that ISN'T on the AusSeabed coverage and who to contact? Refer to AusSeabed Marine Data Portal.

- Response:
  - Southern Surveyor Data

2. Four organisations **present their use case** of coverage metrics, quality assessment matrix and give their opinion about what to report on nationally through AusSeabed.
3. Two Breakout sessions (Table Assignments) to put you to work.
   a. Define the **minimum 'categories' AusSeabed should report** on nationally and how to define them? (30 min)
   b. Agreed list of **optimal criterion** needing to be assessed and provided when submitting/publishing data (coverage or data) in AusSeabed. (45 minutes)

Session Material:

- **Each table:**
  - **Instruction summary table**
  - **Worksheets** to capture notes for each questions.
  - **Complementary information** (summary of survey answers, trigger maps)

    - **Parking lot sheet** for the stray discussion to tackle at a later point
- **On the Wall Questions:**
    - **Flip charts and sticky notes**:
    - During breaks, add your definition of the words “Mapped” vs “Surveyed”

Participant’s responsibilities per table:

- The **Facilitator** has been identified for each table to ensure that discussions keep moving;
- Choose a **Note taker** for your table to capture consensus on worksheets (paper or laptop copy – these will be collected for workshop report development); and
- Use **Parking Lot** to capture discussions points that have disagreement on or are going away from topic

Session 1a - 30 mins – p.4-13

Objective and Outcomes	Questions	Material to assist
Define the minimum categories we should report on nationally? And how are these defined? **Consensus achieved on the terminology and method adopted by AusSeabed to report coverage area.**	1. What categories/metrics is relevant to report on at a national level when considering 'How much of our Seabed is 'mapped' bathymetry-wise? p. 4 2. What are the zones/marine areas we should report on? p. 5 e.g. Australia Charting Area (ACA), Exclusive economic zone (EEZ), etc. 3. What do we use to report on considering the above and who is responsible to calculates and report these? p.6	Parking Lot p. 7 Proposed Strawman p.8 Maps of the marine zones p.11-12 (EEZ, ACA, etc) AusSeabed coverage map p.13 Survey responses (Qs.2,4,5 & 8) p.20-21

Session 1b – 45 mins - p.14-20

Objective and Outcomes	Questions (from above)	Material to assist
Agree on a list of optimal criterion needing to be assessed and provided when publishing data (coverage or Ls) in AusSeabed. These are to be used nationally by AusSeabed to classify and report on what is mapped/surveyed for potentially X, Y and Z purposes. **A list of rules and parameters to create the coverage area.**	All Tables (~20 min) p.12-15 1. Identify the critical criterion to assess? Any missing? p.12 2. Are the specific value breakdown for each criteria adequate? p.13 3. Are the critical criterion easy to assess and what may be the difficulties? p.15 Tables 1, 2, 3 (~25 min) p.16 4. Do we assess transit vs focused area data separately? 5. Do you assess per sensor used within a survey/focused area? Anything else? 6. Do we need to standardise any part of the approach for assessing and reporting? Tables 4, 5, 6 (~25 min) p. 17 7. What data level should be used to estimate the coverage area? 8. Do we define coverage per sensor type, in particular where survey has multiple sensors is used? 9. Do we separate coverage for transit vs focused area. Any other considerations? 10. Is AusSeabed coverage the best place to record the critical quality parameters value? If not, where?	GEBCO Type Identifier (TiD) p.14 AusSeabed Data Levels p.14 Parking lot p.18 Survey question responses p.19-20

Worksheets Session 1a

Q1. What categories/metrics is relevant to report on at a national level when considering 'How much of our Seabed is 'mapped' bathymetry-wise?

e.g.
- 40% of our EEZ has been 'mapped' with multibeam, lidar, satellite-derive bathymetry and 3D seismic reflection.
- 32% of the EEZ has been mapped for habitat purposes
- 43% of our EEZ has been mapped according to Seabed 2030
- 2% of the Australian Charting Area has been surveyed for charting purposes, of which 0.5% is ZOC-A, 1% is ZOC-B and 0.5% is ZOC-C.

Categories/Metrics	YES/NO	Comments
Hydrographic Charting per CatZOCs	Yes – 5	Mapping vs surveyed/depth (don't want to dilute message by combining) We report against what is surveyed IHO orders of survey– survey stds (HIPP) Population wouldn't understand CATZOC at national level National
Seabed 2030	Yes – 2 No - 2	Validate Seabed 2030 calculations But needs caveats on what "coverage" means Resolution too much 2030 request AHO metric on coverage 2030 open to data submission – no barriers but does this mean lack of coordination 2030 should contact AusSeabed for data contribution to 2030
Full bathy coverage (MBES, Lidar,…)	Yes – 4	+ SDB? More detail than Seabed 2030 Has hydrographic component What is full bathy? Metadata essential, needs to be defined
Per resolution potential	Yes - 2	Smoothed polygon gridded at @ 100m resolution Potential should be reported
Data/No Data	No – 2	Doesn't give any detail of cover
Australian entity contribution to Seabed 2030	No – 1 Yes -1	AusSeabed contricute to 2030
Access/No access	Yes – 1 No - 1	
Report on Std	Yes	
Grid size		Indicates data density more than data/no data

Comments

- Monitor change per year (from survey findings)
- Cost guidelines for mapping X areas to help manager evaluate (from survey findings)
- 'modern stds' = multibeam or SDB (for whom/what)
- Mapped – data that doesn't link to a standard
- Surveyed – has a standard attached/accom (inc. QA/QC)

Q2. What are the zones/areas we should report on?

Zones/Areas	YES/NO	Comments
Australia Charting Area (ACA)	Yes – 4 No – 1	Not so important Def. - AHO But distorts Percentage PCA Areas
Exclusive economic zone (EEZ), inclusive State and internal waters	Yes – 6	Very important Def. - nationally Most relevant waters to Australia
Australian Antarctic Treaty	Yes – 3 No - 1	Reported separate – mostly research, not hydro ACA is overarching area
Commonwealth waters	Yes - 4	But include in ACA Reporting on everything will muddy the funding waters
State boundaries	Yes – 5 N - 1	Further details – Coastal Zone, Economic Zones DPE States want to know specifics to their state
Marine Parks	Yes – 3 ~ - 1 No - 2	Derived – agency responsibility
Offshore renewable declared area	Yes – 2 No – 3	
Petroleum and CCS Lease areas	Yes – 3 No - 2	Important. Management of Lease
Depth bands **Above/below 200m**	Yes – 4 No - 1	Very important; or 40m? Valuable for level of effort Big yes
Broad geomorphic areas (shelf/slope/rise)	No –2 Yes - 1	Economic zones? Maritime boundaries
Sea countries when/if become available	Not sure – 1 No – 2 Yes - 2	Metadata has to relate to prescribe body corps/mobs. Needs more definement
MNF seabed coverage (can be in international waters)	~ - 1 No – 2 Yes - 1	
Australian Marine Jurisdiction	Yes - 1	

Comments

- All above from single source to make it easy/consistent
- Dep det – use risk assess for priority areas mapped – MD (??) is a consideration

Q3. What do we use to report on considering the above Qs and who is responsible to calculate these?

Considering who holds and owns the required information

Data to use	YES/NO	Comments
AusSeabed coverage	Yes - 6	AusSeabed AusSeabed response (GA)
Organisational coverage	Yes – 4 No - 1	Each Organisation – difference purposes AusSeabed to provide – all data submitted to AusSeabed
GEBCO/Seabed 2030 coverage	Yes – 4 No - 2	GEBCO + AusSeabed for ACA to compare AHO

Sensor specific	No – 1 Yes – 4	AusSeabed
Data level specific (L0, L2 proc, L3, etc)	Yes – 4 ? - 1	Metadata AusSeabed Gridded data – with QC/QC AHO LO L2 organisational L3 AusSeabed Metadata stipulate what levels are available L2? L3?
		-LO/L2/L3 check with AusSeabed holdings

Comments:

- Responsible to calculate
    - AusSeabed
- Frequency of reporting
    - Annual, goal – a Dynamic Dashboard

Broad Categories/Levels
Survey (to a standard)
Mapped (not a standard)
No Data

- Density as criteria for mapped vs. Surveyed?

Parking Lot discussion - Session 1a Table _____

Topics for discussion
'modern stds' - for whom/purpose. Difference for mapping vs surveying.
Temporal Change: Does CATZOC A have a life span?
States work with AHO and AusSeabed to report on state mapping

COMPLEMENTARY MATERIAL

Strawman - Reporting

Add an expected /achieved area and line kms

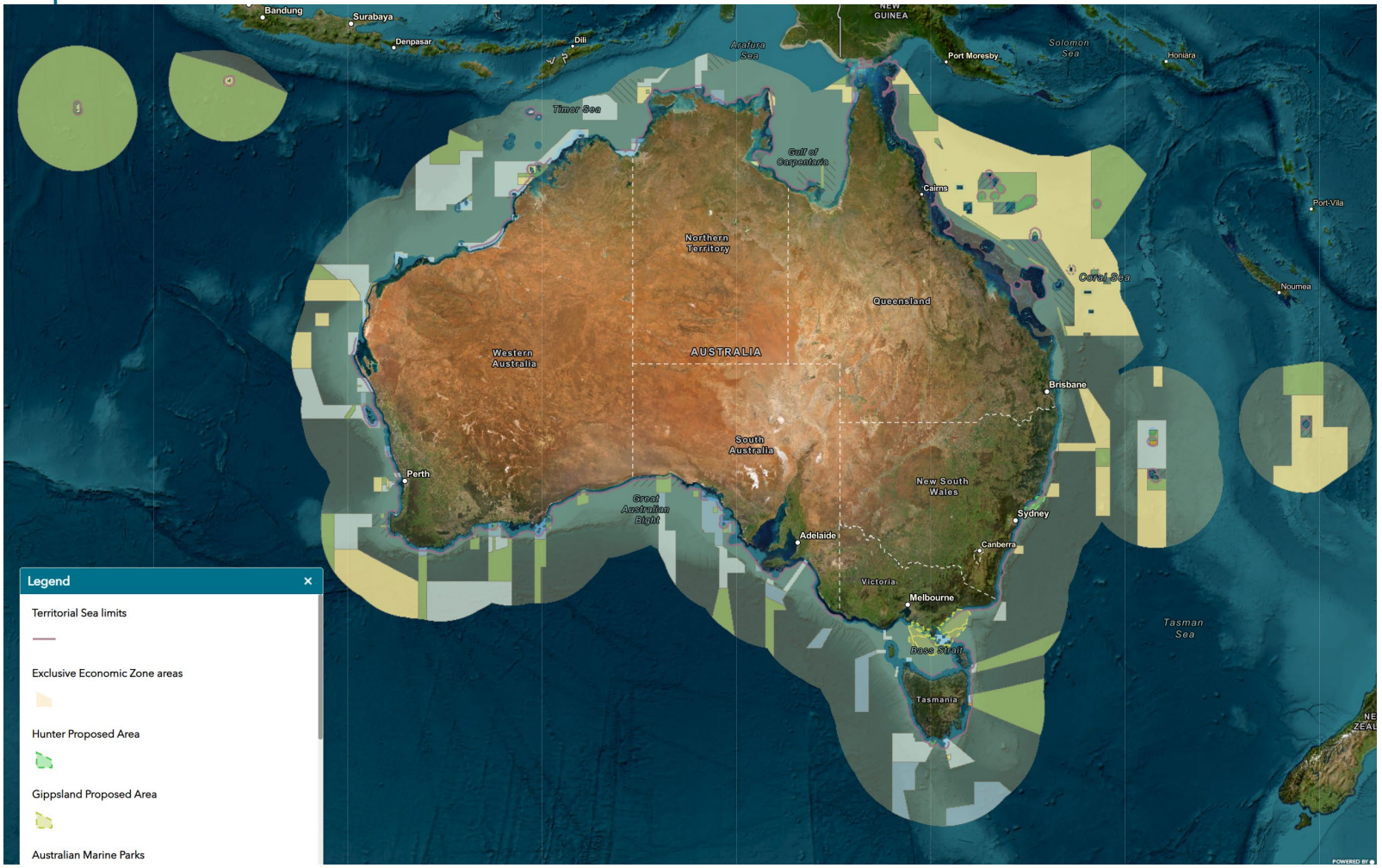
	Hydrographic Charting CatZOC A	B	C	Seabed 2030 1 Sounding/Cell (Depth depend) (Column 'B')	AusSeabed 100% coverage where resolution can meet ASB Depth Band (MBES, Lidar, SDB, SeisDB)
Australian Charting Area	X%	X'%	X''%	Y%	Z%
EEZ from Coast	A%	A'%	A''%	B%	C%
Australian Antarctic Territory	D%	D'%	D''%	E%	F%
State Boundaries	M%	M'%	M''%	N%	O%
Data inputs	AHO Bathy database			GEBCO coverage	AusSeabed coverage
Responsible Organisation	AHO/State			Seabed 2030	AusSeabed/GA

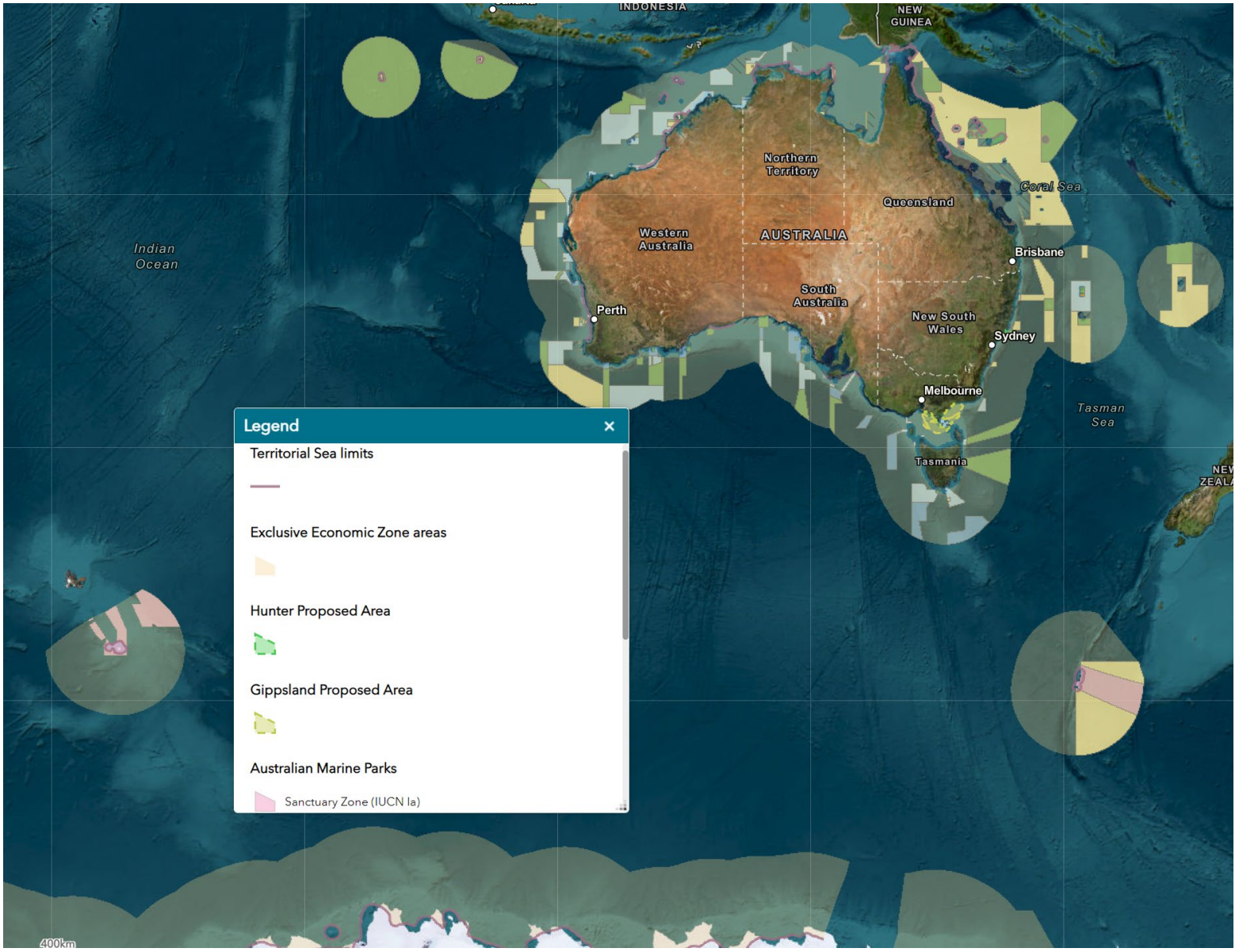
*For State reporting, State organisation could/should be responsible to report if coverage isn't the same as AusSeabed

Comments:

- State boundary: split table into the states – shows change per state.
- AusSeabed focused on Australian waters
- Seabed 2030 – global is less important on the national level
- Maybe drop Column "B"?

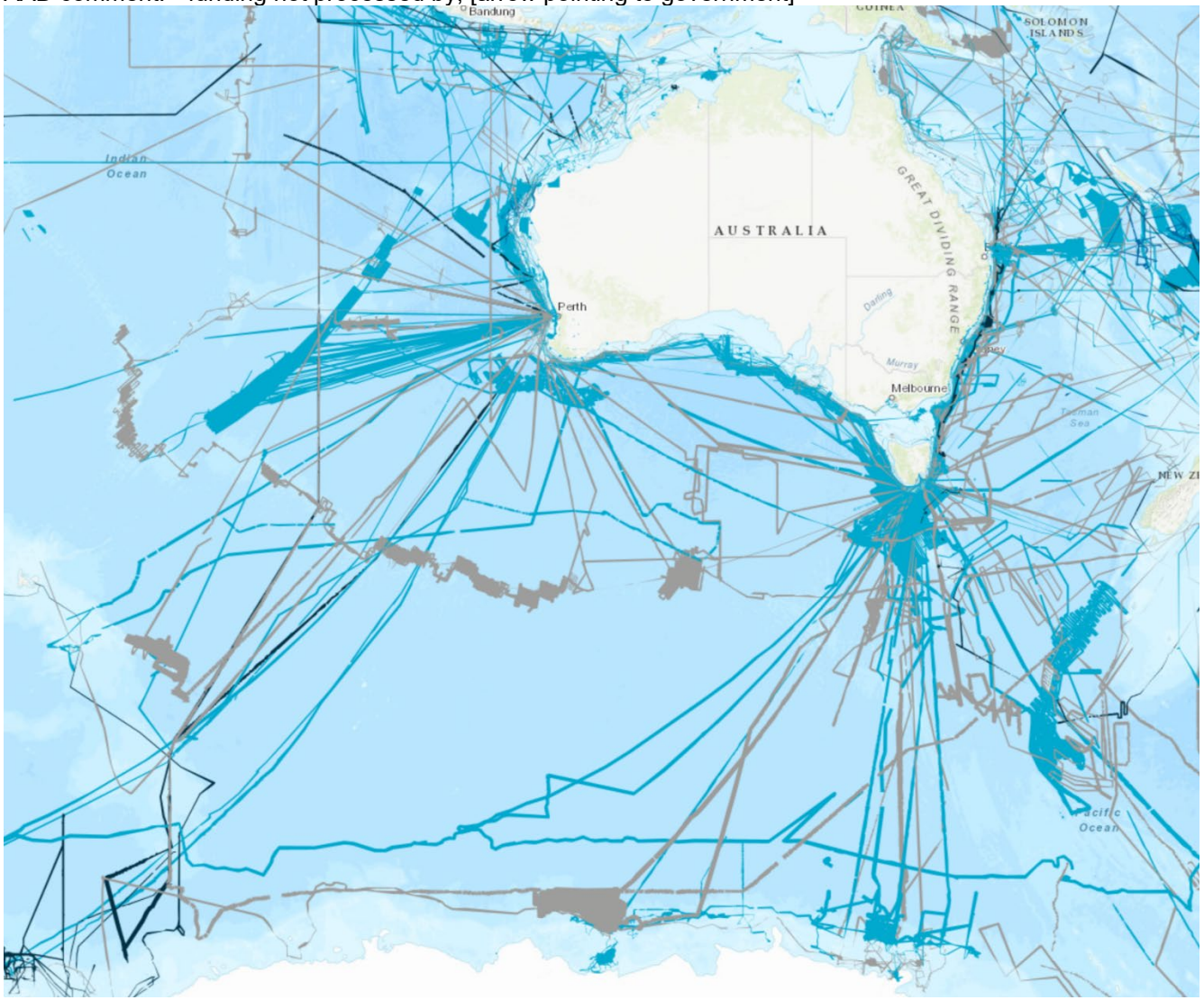
Map of Marine zones




INDONESIA
NEW GUINEA
Northern Territory
Coral Sea
Queensland
Indian Ocean
Western Australia
AUSTRALIA
Brisbane
South Australia
Perth
New South Wales
Sydney
Melbourne
Tasman Sea
Tasmania
Legend
Territorial Sea limits
Exclusive Economic Zone areas
Hunter Proposed Area
Gippsland Proposed Area
Australian Marine Parks
Sanctuary Zone (IUCN Ia)
400km

Map of AusSeabed coverage per sector

AAD comment. * funding not processed by, [arrow pointing to government]



Worksheets Session 1b (20 Min)

Q1. Identify the critical criterion to assess? Any missing? First, do a quick pass through all criterion, then discuss

Parameters modified (Red text) from IHO S-44

	Criteria	YES/NO	Comments
a	**Depth THU "a_{THU}" [m] (Total Horizontal Uncertainty)**	Yes – 5	Point, and Surface Absolute Point cloud only relevant Job specific considerations
b	**Depth THU "b_{THU}" [% of depth] (Total Horizontal Uncertainty)**	No – 1 Yes - 3	Depends on Standard Point cloud only relevant
c	**Depth TVU "a_{TVU}" [m] (Total Vertical Uncertainty)**	Yes - 5	Point, and Surface Point cloud only relevant
d	**Depth TVU "b_{TVU}" (Total Vertical Uncertainty)**	Yes - 4	Depth variable Point cloud only relevant
e	**Feature Detection "a_{FD}"[m]**	Yes – 4 No – 1	Job specific consideration, task oriented, depends on outcome
f	**Feature Detection "b_{FD}" [%]**	Yes – 4 No - 1	Job specific consideration, task oriented, depends on outcome
g	**Feature Search**	Yes – 4 No - 1	Job specific consideration, task oriented, depends on outcome
h	**Bathymetric Coverage [%]**	Yes – 4 Too hard	Job specific consideration, task oriented, depends on outcome
i	**Sensor Type**	Yes - 5	
j	**Minimum depth [m]**	No –4 Yes -1	Already assessed - could be in metadata though
k	**Maximum depth [m]**	No – 4 Yes -1	
l	**Sounding (sndg) Density**	Yes - 5	Need to be clear; gridded output, other known source
m	**Resolution [m]**	Yes - 5	
n	**Data Fliers [% of Not Empty Nodes QAX]**	No – 2 Yes - 2	If it is gridded shouldn't need (but should have commentary on this) Subjective even using QAX
o	**SVP Frequency [× Daily]**	Yes – 3 No – 2	Already assessed/included in TVU Irrelevent as uncertainty reported
p	**Temporal Currency**	Yes – 5	Date of Capture
x	**Survey type/purpose (dropdown) - multibeam guidelines.**		*guidance on whole survey/zones/transit via site based
x	**Date of dataset**	**Y**	
x	**Survey speed (see "l" above)**		

	Criteria	YES/NO	Comments
x	**Additional datasets produced? (Dep. Defence – Scott Lytton)**		Could be none Could be backscatter, slope, habitats, …….
x	**Surface node SD**		

Comments:

- A thru h above – dependent on AusSeabed users?
- I thru p above – Yes for AHO, but possibly not for AusSeabed
- Guidance on whole survey/zones/transit via site based

Criteria
Depth THU "a_{THU}" [m] **Depth TVU "a_{TVU}" [m]** **Depth TVU "b_{TVU}"** **Feature Detection "a_{FD}"[m]** **Feature Detection "b_{FD}" [%]** **Feature Search** **Bathymetric Coverage [%]** **Sensor Type** **Sounding Density** **Resolution [m]** **Temporal Currency**
Additional: **Survey type/purpose (dropdown) - multibeam guidelines** **Date of dataset** **Survey speed (see "l" above)** **Additional datasets produced?** **Surface node Standard Deviation**

Q2. Are the specific value breakdown for each criteria adequate?

Table modified (Red rows) from IHO S-44

	CRITERIA	1	2	3	4	5	6	7	8	9	10	11	12	13	14
BATHYMETRY															
a	Depth THU "a_{THU}" [m]	500	200	100	50	20	15	10	5	2	1	0.5	0.35	0.1	0.05
b	Depth THU "b_{THU}" [% of depth]	20	10	5	2	1	0.5	0.25	0.1						
c	Depth TVU "a_{TVU}" [m]	100	50	25	10	5	2	1	0.5	0.3	0.25	0.2	0.15	0.1	0.05
d	Depth TVU "b_{TVU}"	0.2	0.1	0.05	0.023	0.02	0.013	0.01	0.0075	0.004	0.002				
e	Feature Detection "a_{FD}"[m]	50	20	10	5	2	1	0.75	0.7	0.5	0.3	0.25	0.2	0.1	0.05
f	Feature Detection "b_{FD}" [%]	25	20	10	5	3	2	1	0.5	0.25					
g	Feature Search	1	3	5	10	20	30	50	75	100	120	150	200	300	
h	Bathymetric Coverage [%]	1	3	5	10	20	30	50	75	100	120	150	200	300	400
	Sensor Type	~~ENC~~	SB	SeisDB	SDB	SDGrav	Lidar	MBES	IntSSS						
	~~Minimum depth [m]~~	12000	5120	2560	1280	640	320	160	80	40	20	0	REMOVE		
	~~Maximum depth [m]~~	12000	5120	2560	1280	640	320	160	80	40	20		REMOVE		
	Sounding Density	10	20	30	40	50	60	70	80	90	100		YES		
	Resolution [m]	~~210~~200	~~128~~100	~~64~~50	~~32~~25	~~16~~15	~~8~~10	~~4~~5	2	1	0.5		YES		
	~~Data Fliers [% of Not Empty Nodes QAX]~~	50	40	30	25	20	15	10	5	1	0		NOT SURE OF VALUE		
	~~SVP Frequency [× Daily]~~	1	2	3	4	6	8	12	24	48	96				
	(When?) Temporal Currency – Date?	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined	To Be Defined
	GEBCO Type Identifier (TiD)	0	10	11	12	13	14	15	16	17	40	41	42	43	44

Comments

- Sensor type: re-ordered/or order is not right (should it be static?)
- Temporal = key to know the when – but would vary in environment
- Temporal currency – AAD time of day to match with tides/AHO monitor sand wave movement over time/temporal movement maybe over 1 year for sand wave to move

through. Resurvey req after 1 year. Needs more definition

- What is “GEBCO Type Identifier” (TiD)”?

Depth THU $(d) = \pm(a_{THU} + b_{THU}\% \times d)$

Where: a_{THU} is a constant that represents that portion of the horizontal uncertainty that does not vary with the depth

b_{THU} is a percentage that represents that portion of the horizontal uncertainty that varies with the depth

d is the depth

Depth TVU $(d) = \pm\sqrt{a_{TVU}^2 + (b_{TVU} \times d)^2}$

Where: a_{TVU} is a constant that represents that portion of the vertical uncertainty that does not vary with the depth

b_{TVU} is a coefficient that represents that portion of the vertical uncertainty that varies with the depth

d is the depth

Feature Detection $(d) = \pm(a_{FD} + b_{FD}\% \times d)$

Where: a_{FD} is a constant that represents that portion of the feature detection uncertainty that does not vary with the depth

b_{FD} is a percentage that represents that portion of the feature detection uncertainty that varies with the depth

d is the depth

ACRONYMS:

ENC = depth value extracted from an Electronic Navigation Chart (ENC)
SB = depth value collected by a single beam echo-sounder
SDGravD = predicted depth based on satellite-derived gravity data
SeisDB = depth value collected by 3D seismic methods
SDB = satellite derived bathymery
Lidar = depth derived from a bathymetric lidar sensor
MBES = depth value collected by a multibeam echo-sounder
THU = total horizontal uncertainty
rU = total vertical uncertainty

TID codes

The table below details the coding of the GEBCO Type Identifier (TID) grid.

TID	Definition
0	Land
Direct measurements	
10	Singlebeam - depth value collected by a single beam echo-sounder
11	Multibeam - depth value collected by a multibeam echo-sounder
12	Seismic - depth value collected by seismic methods
13	Isolated sounding - depth value that is not part of a regular survey or trackline
14	ENC sounding - depth value extracted from an Electronic Navigation Chart (ENC)
15	Lidar - depth derived from a bathymetric lidar sensor
16	Depth measured by optical light sensor
17	Combination of direct measurement methods
Indirect measurements	
40	Predicted based on satellite-derived gravity data - depth value is an interpolated value guided by satellite-derived gravity data
41	Interpolated based on a computer algorithm - depth value is an interpolated value based on a computer algorithm (e.g. Generic Mapping Tools)
42	Digital bathymetric contours from charts - depth value taken from a bathymetric contour data set
43	Digital bathymetric contours from ENCs - depth value taken from bathymetric contours from an Electronic Navigation Chart (ENC)
44	Bathymetric sounding - depth value at this location is constrained by bathymetric sounding(s) within a gridded data set where interpolation between sounding points is guided by satellite-derived gravity data
45	Predicted based on helicopter/flight-derived gravity data
46	Depth estimated by calculating the draft of a grounded iceberg using satellite-derived freeboard measurement.
Unknown	
70	Pre-generated grid - depth value is taken from a pre-generated grid that is based on mixed source data types, e.g. single beam, multibeam, interpolation etc.
71	Unknown source - depth value from an unknown source
72	Steering points - depth value used to constrain the grid in areas of poor data coverage

Q3. From the critical criterion identified in Q1, are these easy to assess and if not, what may be the difficulties?

	Criteria	Easy/Hard	Comments on difficulty
a	**Depth THU "a_{THU}" [m] (Total Horizontal Uncertainty)**	Easy – 4 Hard - 1	Unless not supplied Individual soundings and assessed by collecting Lv1 suveyor Hydro easy, others could be without theoretical training
b	**Depth THU "b_{THU}" [% of depth] (Total Horizontal Uncertainty)**	Easy – 3 Hard - 1	Individual soundings and assessed by collecting Lv1 surveyor
c	**Depth TVU "a_{TVU}" [m] (Total Vertical Uncertainty)**	Easy – 3 Hard - 1	Unless not supplied; Hard for CSIRO (transit survey) Individual soundings and assessed by collecting Lv1 surveyor
d	**Depth TVU "b_{TVU}" (Total Vertical Uncertainty)**	Easy - 3	Hard for CSIRO Individual soundings and assessed by collecting Lv1 surveyor
e	**Feature Detection "a_{FD}"[m]**	Hard – 2 Easy - 1	Remove Individual soundings and assessed by collecting Lv1 surveyor
f	**Feature Detection "b_{FD}" [%]**	Hard – 2 Easy 1	Remove Individual soundings and assessed by collecting Lv1 surveyor
g	**Feature Search** (size?)	Beyond Hard - 2 Easy - 2	Remove Should be okay
h	**Bathymetric Coverage [%]**	Easy – 4 Hard - 1	QAX, grid size
i	**Sensor Type**	Easy - 5	Re-ordered/or order is not right (& shouldn't it be static?)
j	**Minimum depth [m]**	Easy - 4	Remove
k	**Maximum depth [m]**	Easy - 4	Remove
l	**Sounding (sndg) Density**	Easy – 4 Hard - 1	How is this derived? Not for CSIRO, SDB QAX
m	**Resolution [m]**	Easy - 5	*Important – gridded data vs. original data
n	~~**Data Fliers [% of Not Empty Nodes QAX]**~~	? - 1 Easy - 2	Remove; Depending if you use QAX/NA If using QAX
o	~~**SVP Frequency [× Daily]**~~	Easy – 3 Hard - 1	Depending on survey duration and location
p	~~**Temporal Currency**~~	Easy – 2 Hard – 2	Subjective, seafloor type, geology, depths, currents Key to know the WHEN – but would vary with environment Date/time stamp
	Surface node SD	**Easy - 1**	
a-f			'easy' call based on equipment and depth

See above refined table and synthesis.

Comments

- Hydro – actual post survey values not manufacture spec sheet quotes

Questions for Table 1, 2, and 3 – 25 min

Q4. Do we assess transit vs focused area data separately?

- Mapping – no
- Surveying/Nautical Charting – yes
- "Transit" - is it monitored?
- Consider separate – different purposes
- Consider survey speed?
- Map (transit) vs survey (focused area?)
- Metadata field
- Yes

Q5. Do you assess per sensor used within a survey/focused area? Anything else?

- Sensor (model?) - probably not
- Yes – technology type but not brand/model.
- Easy to report
- *used to filter data by users (future)
- Yes – allows for better data quality delivery
- -diff abilities and accuracy of diff sensors – so allows for higher data stds for different parameters
- Yes

Q6. Do we need to standardise any part of the approach for assessing and reporting?

- Yes, Centralised AusSeabed Reporting
- 'modern stds'
- 'shallow vs deep'
- Area
- 'survey purpose/type' (parts of survey)
- 'mapping vs surveyed'
- What's the total
- But key to communicate the 'so what'?
- Template for assessment and reporting - HIPP started on one (simplified and standardised)
- Min metadata template – minimum criteria for a survey; supporting evidence for higher quality data
- Yes, minimum standards to search AusSeabed

Questions for Tables 4, 5, and 6 – 25 min

Q4. What data level should be used to estimate the coverage area?

S1 Survey Metadata Specification

L0 Raw MBES Data Specification

L2 Processed MBES Data Specification

L3 Gridded MBES Bathymetry Product Specification

- L3 – Grid Coverage
- L3 Gridded bathy – this is what is important to the "user"
- L3 Gridded MBES Bathymetry Product Specification

Q5. Do we define coverage per sensor type, in particular where survey has multiple sensors used?

- No – in quality framework, not in survey coverage
- Yes, different sensors deliver different resolution, THU, TVU, density, etc.
- Yes

Q6. Do we separate coverage for transit vs focused area. Any other considerations?

- Not for National Coverage assessment.
- Yes. Different standards between both. SVP, density, etc.
- No. As long as metadata is complete transit and focused areas not an issue.

Q7. Is AusSeabed coverage the best place to record the critical quality parameters value? If not, where?

- Yes, ASB should collect these values
- Yes, enables search capability for users.
- This is part of the metadata.
- All data should remain in the same place
- Relevant to boundary polygon in line with S57

PARKING LOT DISCUSSIONS Session 1b Table

Filter by – quality; purpose e.g. Nautical Charting; sensor
Have we considered what other countries are doing? e.g. US National Mapping (NOMEC), others?
Q3. Are we quoting IHO/HIPP standard values, or specifying specific values to this survey that the SiC has to calculate?
Separate surveys by research/hydro surveys

Appendix E

The below document contains the information, questions and responses from Session 1 of the 2023 AusSeabed Workshop. Responses, changes and comments from participants are included in dark green text.

Workshop Instructions

Session 2 Developing a National Seabed Mapping Plan

Introduction

Seabed mapping data is fundamental to most coastal and offshore activities. Since 2018, AusSeabed developed the Data Hub with focus on ingesting and publishing data for public goods. AusSeabed has also sought end-users mapping priorities through the Areas of Interest initiative to understand stakeholders' data needs, assist with planning data acquisition and identify high value data poor regions.

Today, as a result of government and private activities, large-scale seabed data acquisition led by a few key organisations with complementary scope is on the horizon. By understanding each other's plans and coordinating efforts, we can improve how these large areas are mapped and facilitate the delivery of large-scale data.
This session aims to:

- Explore possibilities for better coordinating efforts (data collation and acquisition) nationally to improve engagement at executive and departmental level, the tracking of our progress and coordination of acquisition.

Session Breakdown:

1. To warm up the discussion, a select number of organisations will **present their plans and potential views** about developing a national plan (45 min).
2. Leveraging of the presentations and the survey responses, we will moderate a discussion to explore opportunities. The following questions will be asked
    a. **Are you happy with the current status?**
    b. **What is the value/benefit in a National Seabed Mapping Plan/Strategy focused on both data collation and acquisition?**

Response:

- Identifying data gaps
- Reduces duplication of survey (reduce wastage)
- Consistent standards – leading to higher quality outcomes/data
- Highlight to Government enormity of the task
- Collaboration
- Reduction of duplication
- Maximise resources
- Reduce cost
- Building relationships
- Improve standards + using common tools (QAX)
- Better understanding of legislation
- Reduce duplication

- Helps plan more efficiently/effectively
- Engage more people
- Coordinated approach to mapping in Australia – clearer bonds for each agency/player
- Coastal mapping coordinating with deep/shelf mapping
- Stops duplication of capture
- Continuity of collection
- Aids coordinating surveys (e.g. ID zones with sparse coverage
- Understanding areas of critical need and a clear plan would allow us to build this into schedules (research voyages) and potentially add a few days in to collect necessary data
- Users have a one-stop shop for bathy
- Know what is valued or required
- Shared costs
- Collation
    - No repeat/overlap
    - More coverage
    - Quality
- Acquisition
    - Better coordination
    - Collaboration

c. How would it help your organisation?

- Less cost for capture
- Better justification
- State and local Government have a framework to guide provincial-scale planning
- Shared costs
- Informed decisions
- Funding sources
- Better facilitator
- Open-access sci/data
- More efficiency
- More resources
- Upskill
- Knowledge TX (transfer)
- Budget support
- Strategic support/outlook
- Inform top of food chain
- Drive policy from top down
- Forces teamwork/cooperation between agencies
- Helps organisations prioritise
- Provides visibility
- Raising profile of need to meet obligations
- Improve research opportunities
- Common metadata (National Plan)
- Identify overlap/priorities
- National focus

d. What would be the goal of a National Seabed Mapping Plan/Strategy?

- 100% mapped with increased efficiencies
- Continuous funding for AusSeabed program – leading to keeping coordination going
- Better align science to agency delegations/responsibilities/priorities
- National coverage
- Bathy and science combined

- No plan = no chance of success
- Coordinate stakeholders
- Collaborate for success
- Get footprint where open data exist even unavailable
- Informal decision making
- Encourage stakeholder participation
- Index – know what has been acquired
- Supply focus areas – identifying gaps
- Set standards
- Minimise resources or long term planning
- Drawing on multi-organisation expertise
- Complete coverage
- Quality assured/consistent standards
- Highlight shortcomings in coverage
- Highlight the enormity of the task to achieve coverage of Aus ACA to modern standards
- Increase chances of having government increase funding to survey/map AusSeabed
- Highlight/recognize benefit of having numerous agencies work together for benefit of nation
- Foundation knowledge
    - Topography
- Status of data holding
- Points of contact
- Metadata
    - Register
- Using foundation to focus the future effort

e. Where do we go from here?

- Develop Strategic Plan to map Australia (Is it ASB responsibility to coordinate?)
- Australian Charting Area (ACA) to modern standards
- Defence. Plan survey EEZ by 2050
- AAD – Antarctica
- Marine Parks Australia
- CSIRO legacy data backlog and leverage capabilities/technologies between groups
- Framework (?) for the plan
- Working group
- Educate big industry (oil/gas/fisheries) to understand use AusSeabed
- Standardised briefing slides to present to senior executives
- Higher adoption from Australia that AusSeabed is critical and needs funding (How to?)
- Centralise data planning submission centre (??)
- Generate more awareness/interest in community
- Advertise successes
- Time is critical (Design system to be more efficient due to lack of resources??)
- More communication with data provider
- Lobby for legislation change
- Public education (Goal?)
- Community outreach (Goal?)
- Identify the needs
    - Marine habitats
    - Hydroid model
    - Etc
- More funding
- Policies in place
- Merge coastal bathy for each state

    - State needs to participate
- Coordinated strategy
    - Includes focus areas
    - Data access
    - Targeted funding
    - Long-term AusSeabed support
- Show what has been done
- Integrate into best practice guidelines
- Data portal – Data repository (service to company/organisations/people)

Session Material:

- **Each table:**
    - **Instruction summary table**
    - **Flipcharts** with key questions and sticky notes

Survey question responses – Session 2

18 respondents

Question	Responses
Q2 Does your organisation have a strategic goal or purpose for mapping the seabed?	16/18 yes 2/18 no
Q3 Do you plan to conduct seabed mapping acquisition in the next 5 years?	17/18 yes
Q4 What are your cycles for planning seabed mapping activities?	Annually - 12-24 months ahead; two years ahead; 3-year; 8 years - dependant on gov priorities; 8 years currently; depends on govt program priorities; Annually (4), as needed; 1,2 and 5 year; Constantly, but project based; opportunistic based on weather. As per risk-based assessments in Standards for Hydrographic Surveys within Queensland Waters; Depends on the funding source, usually it is around 2 years ahead with some projects having little notice and is completed within a year; needs be; Contract-based; to support hydrocarbon exploration and construction engineering; Restricted by scientific objectives of voyages. Voyage planning occurs several years prior to sailing.
Q5 What are your objectives or rules when you plan acquisition of seabed mapping data?	Safety of navigation, achieve full seafloor coverage, prioritise poorly charted areas; Seafloor geomorphology and habitat classification; meet state objectives for all agencies; Knowledge baseline and fill data gaps for unmapped areas of NSW (inc. secondary sediment compartments); baseline knowledge data gaps for previously unmapped areas of NSW Seabed for secondary sediment compartments; also benefiting marine estate/parks - State waters focus; biological indicators; Combination of parameters including ausseabed input.; It depends on the application of the project - ports work requires a different approach to HIPP work for example; Standards for Hydrographic Surveys within Queensland Waters; Usually for scientific purposes such as habitat mapping, species habitat associations, marine spatial planning, calculating offshore sediment budgets. We try to collect the highest quality data possible on our small vessel including collecting crosslines for analysing how well our data meets IHO orders; IHO standards; Fulfill client specifications; Safety of navigation through updated nautical charts; Criteria for acquisition areas are: poor data resolution, depth between 30m and 100m, populated region's and recreational fishing areas.
Q6 What region or depth range (e.g. State waters, EEZ, Tropical, Ocean Deep water) will your organisation focus on in future efforts?	Primarily EEZ in depths <200m, but with some activity in other regions and depth ranges; Ocean Deep water; State waters, inner continental shelf (<150m); Between 0 - 400m depth range; No restriction; All, not much Ocean Deep water however.; State Waters (typically less than 20m); Mostly in the Victorian State Waters with some additional surveys outside such as the Apollo Marine Park in commonwealth waters; Territory waters; HIPP Priorities within EEZ; 0-100m; EEZ; Donating transit data and encouraging private sector clients to share data that they own; Again is dictated by science, although effort largely focused on deepwater; 30m-100m, starting tropical waters of QLD.
Q7 What data types are you principally collecting? (e.g. depth, backscatter, water column, sub-bottom, habitat information)	Depth (12), backscatter (13), basic seabed classification; habitat information (7); Bathymetric and Topographic Lidar, Multibeam and Laser Survey; sediment samples (4), video imagery (3), Tidal (height & stream) (3) and Geodetic; water column (6), sub bottom (5), magnetometer, ground samples, oceanographic data . Habitat information using multiple observation techniques (BRUVS, AUVs, towed video, ROV); SV, Temp; heritage, geotechnical and seismic.
Q8 Have you submitted your upcoming surveys into the Survey Coordination Tool for display in the AusSeabed Marine Data Portal, or used the Upcoming Surveys layer to plan your	6/18 Yes. State-wide science and Parks Australia mapping; Survey Coordination Tool, to see if there is any addition surveys in Remote areas planned; Victorian State priority areas into the Survey Coordination Tool. 7/18 No

Question	Responses
organisations' seabed mapping activities? Why and How?	We work for third party clients and they have custody over the data; it's not in people's mindset to contribute towards it; not part of their workflow; may be don't know about it
Q9 Is there potential for your organisation to engage in the development of a national coordination of seabed mapping effort?	17/18 yes 1/18 no
Q10 Are there barriers for your organisation to collaborate in a national effort? What are they?	7/18 No. Within remit and funding intent 11/18 Yes. Collaborative communication; Depends on alignment with State needs and priorities; Lack of specialist hydrographic surveyors; Commercial barriers (2); Resources/priorities/Complying with internal IT protocols; For-profit market listed organisation, only paid work is performed; Data security. Defence data release policies and sensitivities; understanding the legal framework with our joint venture partners who also own our data; Seabed mapping is not always primary voyage objective.