Paper for Consideration by NCWG
Standards for coloured ZOC diagrams

Submitted by:	The Netherlands in cooperation with Sweden and Norway
Executive Summary:	Coloured ZOC diagrams
Related Documents:	S4 B-297
Related Projects:	NCWG5 agenda item 6.12 (2019)
	NCWG9 agenda item 5.11
	Action 9/13

Introduction / Background

A growing number of paper charts contain ZOC-diagrams instead of source diagrams. ZOC diagrams give an impression of the quality of data and are in closer agreement with the ENC's as the source diagrams.

In S4 chapter B-297 the rules for ZOC-diagrams are described.

EXAMPLE B: ZONES OF CONFIDENCE DIAGRAM

In the S4-guidelines the various ZOC values are displayed in text. However: there could be an advantage to display the areas in colour. It can improve the readability but requires standardization.

In NCWG5 2019 there was already a paper about this subject. Four years later the development of automated production of paper charts is progressing and generation of ZOC diagrams could be easier when areas are defined in colours instead of text. In NCWG 9 there was an agreement about the use of coloured ZOC diagrams.

After discussion about which colours should be used Action 9/13 was defined:

"*Netherlands to draft S-4 amendments and propose the colours for coloured CATZOCs based on the NO example.SE will support from a testing POV.*"

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NCWG10-6.2A

Analysis / Discussion:

During NCWG9 many different options for colour use were discussed, also aspects like colour blindness and night conditions (red light). Sweden was planning to do some testing with colours and Norway had some testing experience with coloured diagrams.

Some interesting issues in the discussions were:
- The Working Group agreed that coloured ZOC diagram was an acceptable option to support clarity and therefore the colours should be standardised
- Using letters to describe each area is not optimal, some areas are very small / thin making a requirement for using arrows / lines
- Red/Amber/Green is not a good solution due to the varying light/display conditions on a vessel
- Different shades of the same colour might be a better solution but may be an issue from a colour blindness point of view

Lots of different views on this subject. In a teams-meeting with SE, NO and NL we talked about a plan for a proposal of a ZOC-diagram in colour. We made some conclusion about the way forward:

- ZOC-diagrams are mainly used for planning purposes
- The aspect of colorblindness will make it very complex to make a good choice of colors. In practice navigation officers are not colorblind and ZOC-diagrams are mainly used for planning purposes.
- For the same reason we will not care too much on dark light circumstances.
- Norway showed an example, based on an earlier proposal of Netherlands, which could be of use in the investigation.
- The proposal for coloured ZOC-diagrams to NCWG will be based on an investigation of Sweden and the results will be used to decide upon the colors.
- Testing will include the use of a thin black/grey outline, which could be used as an option.
- Color specs should be defined in a color scheme to be used in Base Line Symbology.
- Norway showed an example of how "foreign areas" could be charted in the ZOC-diagram. This should be included in the final paper.
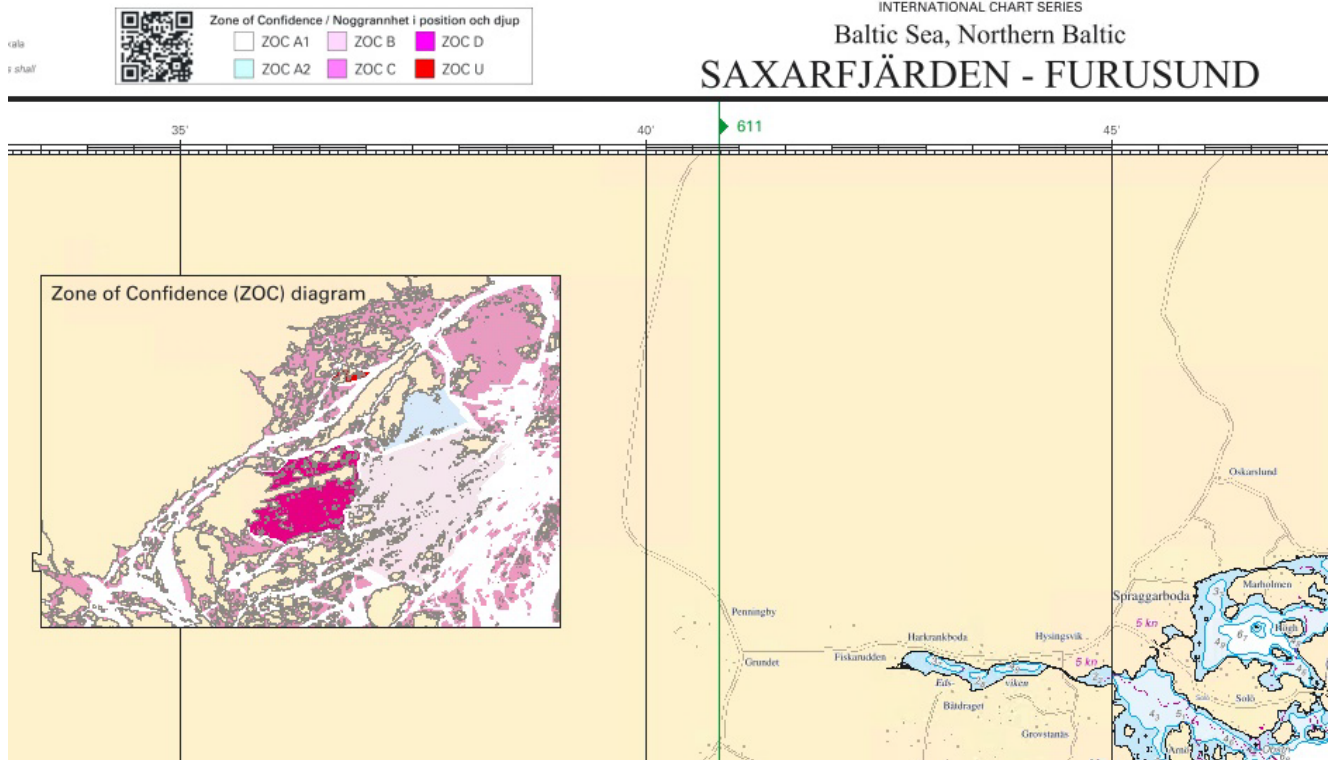
The Swedish test was finished in June and resulted in various color schemes. We agreed that one of the color schemes was the best option and in line with an earlier test of Norway and the Netherlands.

After studying the various colour schemes from the Swedish test, there was an agreement what colour schema should be used for the proposal in the coloured ZOC-diagram.
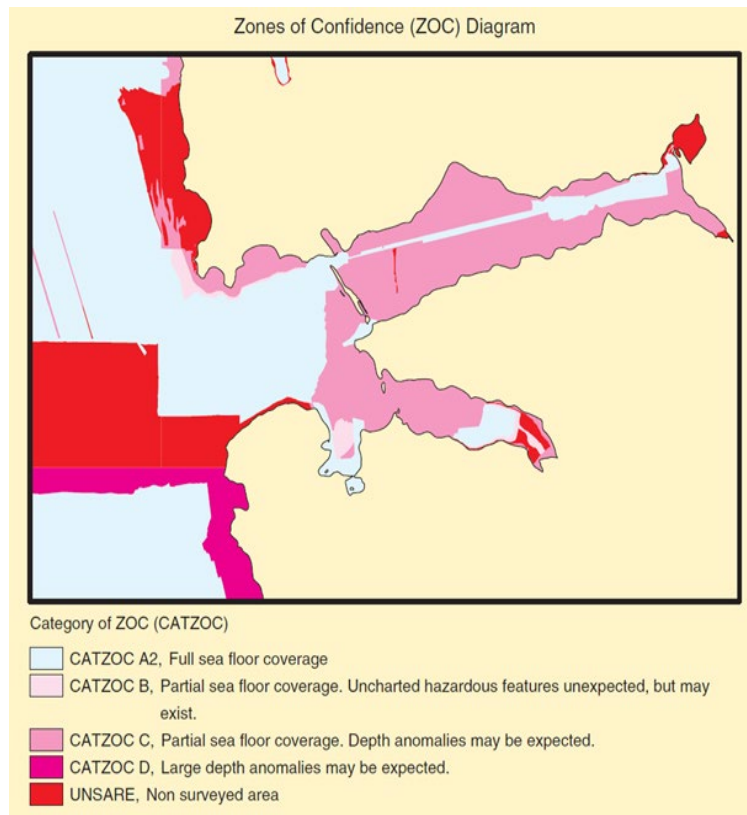
This was a colour schema white-blue-magenta-red with a 50% black coastline. Because some areas are quite complex, a choice was made not to indicate area limits of CATZOC areas, which improves readability and avoids clutter on these small scales. The choice to indicate area limits was left as an option to use for the cartographer.

Below are 3 examples of how this would look like in a ZOC-diagram:
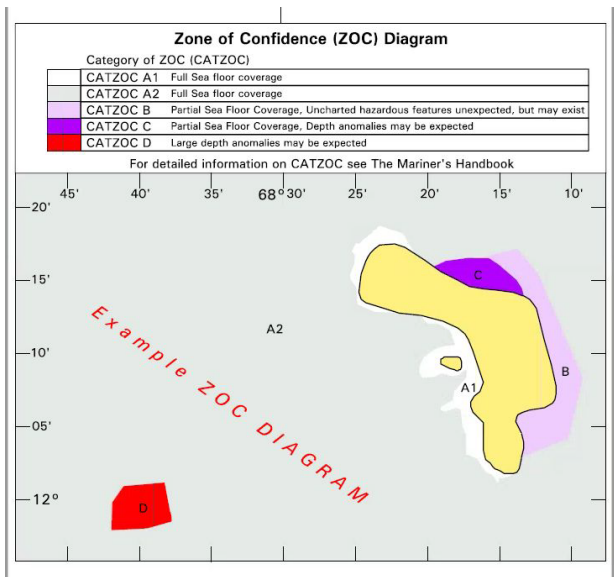
Example from Sweden:

Example from Norway

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Example from the Netherlands:

CATZOC values in this diagram are only displayed for testing purposes.

Proposal

When using coloured ZOC-diagrams the following colours could be used using RGB colours and looking at the scheme from the Baseline Symbology PT the following colour schedule could be used.

Proposed colour specifications for CATZOC diagram (RGB)

CATZOC catagory	Description	Colour	Colour display	Red	Green	Blue
A1	Full sea floor coverage +/- 5m	White		255	255	255
A2	Full sea floor coverage +/- 20m	Medium blue		177	225	244
B	Partial seafloor coverage +/- 50m	Light pink		244	223	235
C	Partial seafloor coverage +/- 500m	Medium pink		244	154	193
D	Large depth anomalies may be expected	Dark pink		236	0	140
U	Unsurveyed	Warm red		237	28	36
	Foreign area/after disaster survey*	Grey tint		200	200	200

However: When RGB colours are used the result on paper can be quite different, depending on the printing process. (When you print this paper and look at the colours in the table on paper you know why).
Because the colours for ZOC-diagrams will be used on paper charts it is better to give the colour guidelines in CMYK.

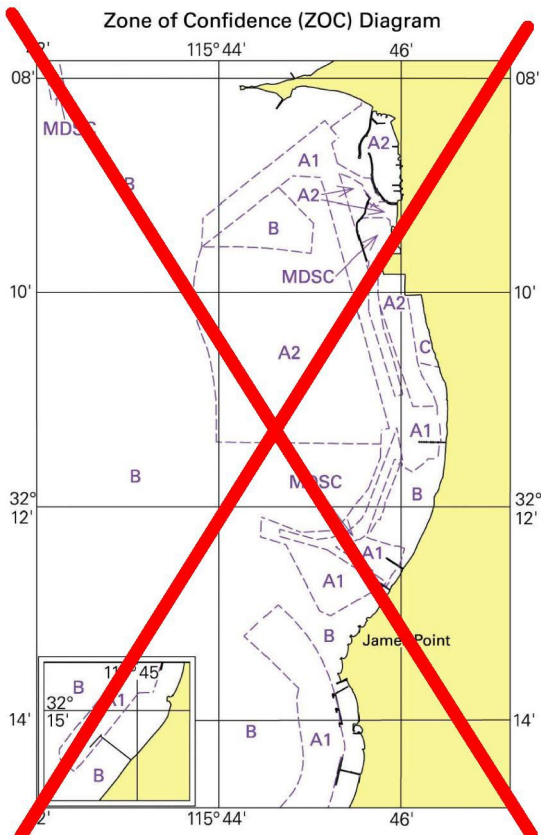**Proposed colour specifications for CATZOC diagram (CMYK)**

CATZOC catagory	Description	Colour	Colour display	Cyane	Magenta	Yellow	Key (Black)
A1	Full sea floor coverage +/- 5m	White		0	0	0	0
A2	Full sea floor coverage +/- 20m	Medium blue		20%	0	0	0
B	Partial seafloor coverage +/- 50m	Light pink		0	20%	0	0
C	Partial seafloor coverage +/- 500m	Medium pink		0	50%	0	0
D	Large depth anomalies may be expected	Dark pink		0	100%	0	0
U	Unsurveyed	Warm red		0	100%	100%	0
	Foreign area/after disaster survey*	Grey tint		0	0	0	50%

*When foreign areas (with unknown ZOCs) or after disaster areas are part of a ZOC-diagram they can be displayed in grey with an explanatory text in the area.
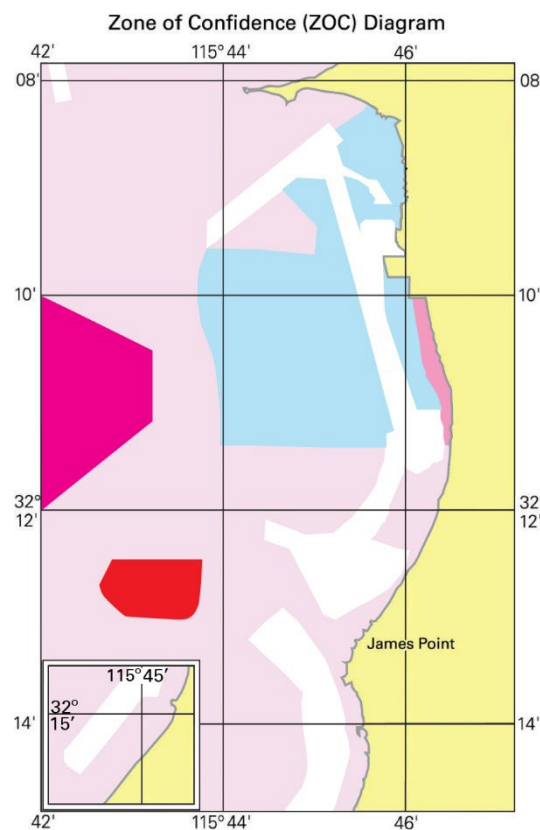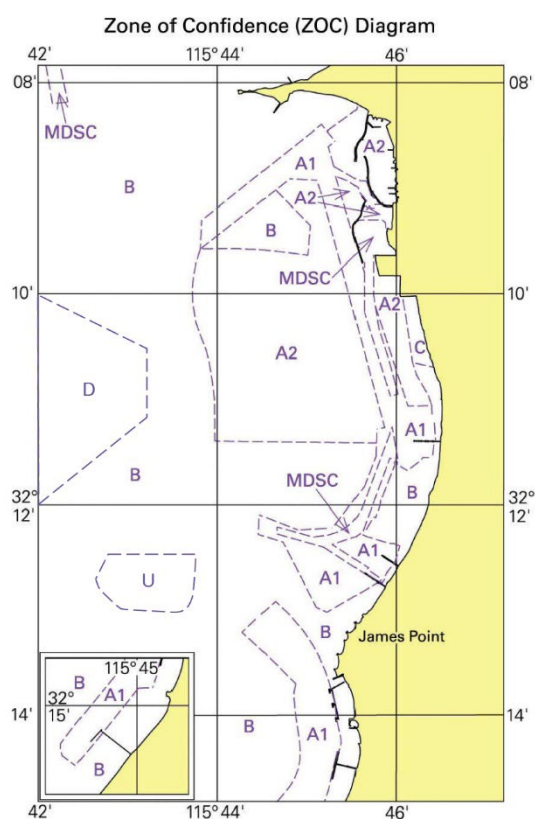
Proposed change in S4

Suggest amend B-297 as follows (changes marked in Red)

~~B-297   ZONES OF CONFIDENCE (ZOC) DIAGRAMS~~

B-297   **ZONES OF CONFIDENCE (ZOC) DIAGRAMS**

Zone of Confidence (ZOC) Diagram

Zone of Confidence (ZOC) Diagram

ZOC CATEGORIES
(For details see Australian Notice to Mariners No 25)

ZOC	POSITION ACCURACY	DEPTH ACCURACY	SEAFLOOR COVERAGE
A1	±5m	=0·50m + 1%d	All significant seafloor features detected.
A2	±20m	=1·00m + 2%d	All significant seafloor features detected.
B	±50m	=1·00m + 2%d	Uncharted features hazardous to surface navigation are not expected but may exist.
C	±500m	=2·00m + 5%d	Depth anomalies may be expected.
D	Worse than ZOC C	Worse than ZOC C	Large depth anomalies may be expected.
U	Unassessed - The quality of the bathymetric data has yet to be assessed.		
MDSC	Maintained Depth See Chart		

ZOC CATEGORIES
(For details see Australian Notice to Mariners No 25)

ZOC	POSITION ACCURACY	DEPTH ACCURACY	SEAFLOOR COVERAGE	COLOUR	COLOUR DISPLAY
A1	±5m	=0·50m + 1 %d	All significant seafloor features detected.	White	
A2	±20m	=1·00m + 2 %d	All significant seafloor features detected.	Medium blue	
B	±50m	=1·00m + 2 %d	Uncharted features hazardous to surface navigation are not expected but may exist.	Light pink	
C	±500m	=2·00m + 5 %d	Depth anomalies may be expected.	Medium pink	
D	Worse than ZOC C	Worse than ZOC C	Large depth anomalies may be expected.	Dark pink	
U	Unassessed - The quality of the bathymetric data has yet to be assessed.			Warm red	
MDSC	Maintained Depth See Chart				

EXAMPLE B: ZONES OF CONFIDENCE DIAGRAMS (TEXTUAL AND COLOURED)

B-297.1   **Zones of Confidence (ZOC) diagrams** enable mariners to assess the quality of the hydrographic data from which the chart was compiled. The use of ZOC diagrams provide consistency in the display of source data between digital and paper charts, as the Category of Zones of Confidence (CATZOC) definitions are derived directly from S-57. A copy of the CATZOC table from S-57, With relevant footnotes, is included at B-297.9.
ZOC diagrams may be displayed in textual form or with colour filled areas. A legend must explain the CATZOC values. See example B.

B-297.2   **Continous black lines** should be used for ZOC diagram's borders ~~and coastline~~.

Textual ZOC diagrams: the coastline is a continuous black line. Area limits and identifying CATZOC values may be magenta and may be repeated as necessary.

Coloured ZOC diagrams: the coastline is a 50% grey line. As an option CATZOC-area limits may be emphasized with a thin black line. The infill for the various CATZOC-values should be

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according to the following colour table:

CATZOC catagory	Description	Colour	Colour display	Cyane	Magenta	Yellow	Key (Black)
A1	Full sea floor coverage +/- 5m	White		0	0	0	0
A2	Full sea floor coverage +/- 20m	Medium blue		20%	0	0	0
B	Partial seafloor coverage +/- 50m	Light pink		0	20%	0	0
C	Partial seafloor coverage +/- 500m	Medium pink		0	50%	0	0
D	Large depth anomalies may be expected	Dark pink		0	100%	0	0
U	Unsurveyed	Warm red		0	100%	100%	0
	Foreign area/after disaster survey	Grey tint		0	0	0	50%

When foreign areas (with unknown ZOCs) or after disaster areas are part of a ZOC-diagram they can be displayed in grey with an explanatory text in the area. (After disaster surveys see also B-417.8)

~~Grey tint (or another colour except green, blue or magenta) may be used to highlight areas covered by after disaster surveys (see B-417.8)~~

B-297.3 **The linear dimensions** of the ZOCdiagram shown on paper charts should be ………..

Justification and Impacts

Multi-coloured ZOC-diagrams can improve readability and automation of the process in paper chart production. However: Without standardization this can cause confusion when interpreting the quality of source data. With standardized colours ZOC-diagrams will be better readable and intuitive to interpret.

An advantage for automated paper chart production would be that coloured areas are easier to generate in the ZOC-diagram.

The impact for S4 is that these changes (if agreed) must be included in a new version of S4.

Action required of NCWG

The NCWG is invited to agree with the text concept and proposed colour use in S4 or to give additional comments.

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