



## CHART STANDARDIZATION & PAPER CHART WORKING GROUP (CSPCWG)

[A Working Group of the Hydrographic Services and Standards Committee (HSSC)]

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### CSPCWG Letter: 07/2012

UKHO ref: HA317/010/031-09

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### To CSPCWG Members

Date 26 June 2012

Dear Colleagues,

### **Subject: Action 34 arising from 8<sup>th</sup> CSPCWG meeting**

At our 8<sup>th</sup> meeting in Finland, Michel Huet presented the results of a Data Quality Working Group (DQWG) questionnaire, based on a similar presentation at the DQWG meeting in the previous week. This expanded on the details CSPCWG8-INF2, a summary paper prepared by Sam Harper (UK) who conducted the DQWG research.

The questionnaire was designed to expose the users' real understanding of data quality information on charts (paper and ENC). However, we should note that the main purpose of the questionnaire was to compare how well ENC data quality indicators (especially CATZOC) are understood compared to the equivalents on paper charts. In the event, the questionnaire demonstrated that paper chart data quality indicators are much better understood than ENC equivalents. Nevertheless, initial analysis appeared to show that a few paper chart indicators (such as upright soundings) are not well understood.

In the final paragraphs of INF2, DQWG requested CSPCWG should further analyse the raw data and consider whether all the existing paper chart indicators are appropriate and necessary.

Action 34 from CSPCWG8 was for the Chairman and Secretary to consider the DQWG questionnaire (INF2) in more detail and advise WG members of the best way to take forward the requests from DQWG.

An annotated version of INF2 is at Annex A, with details of the analysis conducted by our Secretary on selected paper chart data quality indicators, and his recommended outcomes for your consideration. The focus of his analysis was on (i) the quality indicators for the more significant data and (ii) those indicators where the user's understanding appeared to be poor.

Please consider the explanation of the Secretary's findings at Annex A and respond to the questions at Annex B **by 21 August 2012**.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Peter G.B. Jones', with a small date '3/1/20' written at the end of the signature.

Peter G.B. Jones,  
Chairman

Annex A      Annotated copy of CSPCWG8-INF2  
Annex B      Response Form

**8<sup>th</sup> CSPWG MEETING**  
**Turku, Finland, 29 November – 2 December, 2011**

**Information Paper for Consideration by CSPCWG**  
**Summary of Results from**  
**the DQWG Questionnaire to Mariners**  
**Submitted by: Sam Harper of DQWG**

**Additions in blue by A Heath-Coleman, Secretary of CSPCWG, to fulfil CSPCWG8 Action 34**

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*Annex A. Raw Questionnaire Data Relating to Paper Charts*

**1.0 Introduction**

As part of the DQWG's work on designing new methods of representing data quality in ENCs, a questionnaire was produced to investigate the mariners' perception of current methods of representing data quality in nautical charts.

This paper is intended to provide members of the CSPCWG with a summary of the results of the questionnaire and subsequent discussions at DQWG5, ahead of the publication of the full report and presentation in December 2011.

Further, a subset of the raw (unmarked) data is provided for separate analysis by the CSPCWG. [In EXCEL spreadsheet form: used by Secretary to reassess the results for selected data quality indicators.](#)

**2.0 Summary of Results**

**2.1 General**

The questionnaire was distributed by the IHO to member states, and was available as a PDF and an on-line version via [surveymonkey.com](#). Over 600 responses were received, however due to time constraints the analysis was based on 574 responses.

[Secretary also used 574 responses for reassessment.](#)

The questionnaire was made up of both quantitative and qualitative questions. The qualitative questions can be subdivided into two types:

- Those designed to elaborate on or give context to quantitative questions, e.g. 'other' and 'please explain your answer' free type fields

- Those designed to directly test the respondents' knowledge of data quality issues, e.g. 'what does the PA abbreviation mean?'

The qualitative analysis took the form of the identification of recurring themes and the ranking of these themes by their frequency of occurrence.

## 2.2 Demographics

In terms of the survey sample, the demographic information showed that 74% (421 respondents) had over 10 years navigational experience with 63% (357 respondents) having in excess of 15 years navigational experience. In addition the results showed that a broad range of shipping sectors were represented. As a consequence, it is considered that a strong representative sample has been collected.

## 2.3 Paper Charts

Respondents who said that they used paper charts were asked whether the charts they use have either a source/reliability diagram or a zone of confidence (ZOC) diagram. The respondents that answered yes to these questions were then asked to indicate whether they used the information in the source/reliability diagram or a ZOC diagram. Figures 2.3.1 and 2.3.2 show that 73% (296 respondents) of respondents use the information in the source/reliability diagram and 75% (82 respondents) of respondents use the information in the ZOC diagram.

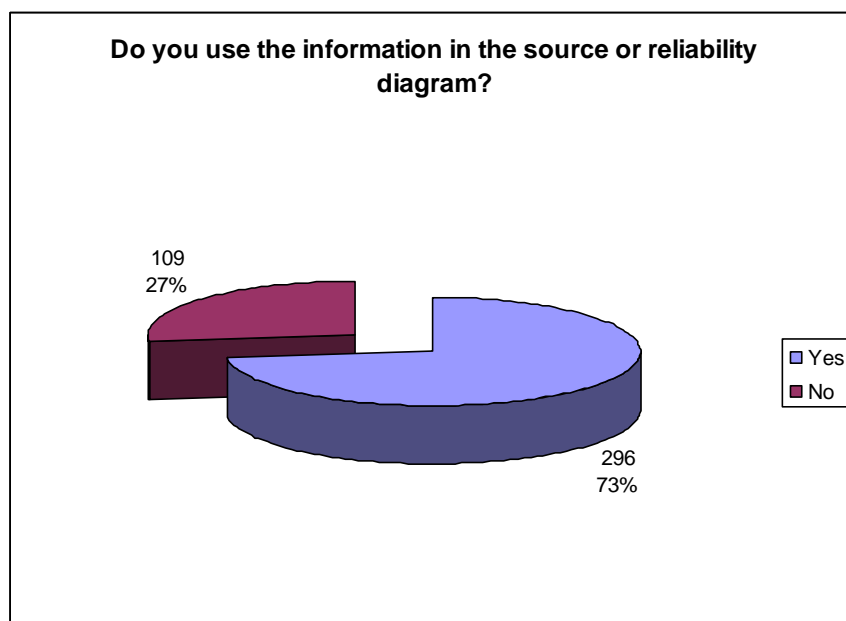


Fig. 2.3.1 Percentage of respondents that use the information in the source/reliability diagram

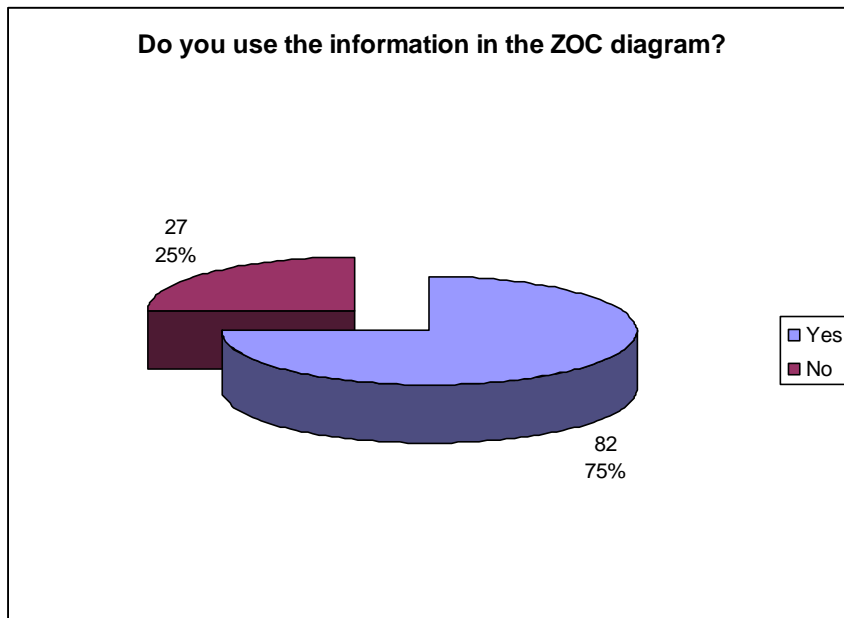


Fig. 2.3.2 Percentage of respondents that use the information in the ZOC diagram

Respondents that indicated that they did not use the information in the source/reliability diagram or ZOC diagram were then asked to explain why not via a multiple choice question. The most common reason chosen by respondents was “because I have travelled the same route many times before”. A number of respondents selected the ‘other’ free type option and the themes arising from these answers are detailed in table 2.3.1. The most common reason cited was that “I trust that the charts are correct”.

Table 2.3.1 Themes and ranks for why respondents do not to use the information in the source /reliability diagram

Theme	Rank
“I trust that the charts are correct”	1
“We are restricted by the Pilots limited area of operation and bow to their local knowledge”	2
“We rely upon experience and instruments instead”	3

Respondents were presented with a series existing data quality indicators (DQIs) that appear on paper charts and were asked to indicate whether they understood their meaning. Those that said that they did were then asked to give an explanation of the meaning of the respective indicator. These answers were then marked as either correct or incorrect. Table 2.3.2 shows a summary of these results. Those figures coloured red indicate where the percentage of respondents who gave incorrect explanations is greater than 60%. The figures that are coloured amber indicate where the results were between a 41% to 59% split. The figures coloured green indicate that either the number of respondents who indicated that they understood the DQI or those that gave a correct explanation exceeded 60%.

*Additional clarification by Sam Harper, original author of CSPCWG8 INF2: The criteria by which answers were judged to be correct or incorrect were very specific. This was because the aim of the question was to discover whether respondents fully understood the definition and context of usage of various data quality indicators, regardless of whether or not their presence elicits a similar response. For example, a mariner might choose to avoid a sounding shallower than the draft of his/her vessel whether there is a ‘Rep’d 1999’ note attached to it or not; but if they omitted the condition ‘but not confirmed’ from their explanation of the ‘Rep’d 1999’ note, it may be the case that they do not understand that it can be used in charting to indicate the presence of other unreported shoals.*

It should be noted that due to an oversight in the design of the questionnaire, respondents were asked “do you understand the meaning of the Unsurveyed and Depths notes?” This has meant that the values for the first part of the question are the same for both indicators. However, respondents were given the opportunity to explain their meaning individually. Regrettably, the same situation occurred question relating to the PA, PD, ED, SD and Rep’d (1999) notes.

*Table 2.3.2 Summary of results to questions relating to mariners’ understanding of existing data quality indicators in paper charts.*

Blue additions and bracketed figures added by A Heath-Coleman, Secretary CSPCWG.

\* The figures in brackets in the ‘Yes’ column is an adjusted score, by reducing the ‘Yes’ score by the percentage who thought they knew meaning but actually did not (ie the ‘incorrect’ column).

† Items for which the ‘raw’ data (574 responses provided in a spreadsheet) has been examined in detail by CSPCWG Secretary.

Green >60% (yes/correct), amber 40-60% (yes/correct), red <40% (yes/correct).

	Data Quality Indicator	Do you understand the meaning of...?		Of those who answered yes, how many gave a correct explanation?	
		Yes (%) + Adjusted (%)*	No (%)	Correct (%)	Incorrect (%)
1†	Broken depth contour symbol	56 (41)	44	73	27
	See detailed analysis below	70 (62)	30	89	11
2	Broken coastline symbol	66 (46)	34	69	31
3†	Dotted danger line symbol	76 (33)	24	44	56
	See detailed analysis below	(51 or more)		67	33 (or 24?)
4	Discontinuity between surveys note	53 (29)	47	55	45
	Note: from a quick examination of the free text answers it appears that Sam’s assessment is probably correct. The difficulty may lie in the legend used by UK; perhaps ‘surveys do not match’ would be easier to understand.				
5	Unsurveyed note	88 (83)	12	94	6
6	Depths note	88 (65)	12	74	26
7	PA	62 (61)	38	98	2
8	PD	62 (56)	38	90	10
9	ED	62 (51)	38	82	18
10	SD	62 (49)	38	79	21
11	Rep’d (1999)	62 (22)	38	36	64
	Note: from a quick examination of the free text answers it appears that most respondents understood the meaning of reported. Sam was looking specifically for the ‘not confirmed’ element, which accounts for his 64% incorrect assessment.				
12†	Sounding in an upright font	44 (16)	56	36	64
	See detailed analysis below	43 (25)	57	58	42

13	Discoloured water note	59	41	Corrupted	Corrupted
14	Sandwave symbol	64 (58)	36	91	9
15	Dredged to... note	98 (96)	2	98	2
16	Potentially dangerous wreck symbol	98 (74)	2	76	24
17	Bar above a dangerous wreck symbol	75 (43)	25	57	43
Note: from a quick examination of the free text answers it appears that a large proportion are incorrect. This symbol is certainly badly understood.					
18	Works in progress legend	93	7	100	0

It is important to note that consideration of the free text answers is very subjective. The different results from Sam's assessment compared with mine is due to a different perspective: Sam was trying to measure the degree to which the respondent fully understood the whole meaning of the symbol, whereas I was concerned as to whether they had sufficient understanding to result in the right navigational behaviours in relation to it.

Furthermore, the main drive was to consider the whole picture of how well understood data quality indicators on ENC compared with those on paper charts. The results clearly indicate a much better degree of understanding for paper chart indicators.

**3. Danger line.** Of the above, it seemed that item 3 the 'dotted danger line', having an understanding possibly as low as 33%, was the most worrying statistic. I therefore decided to investigate the raw data on the spreadsheet. The questions asked were:

**Dotted danger lines**

**Example:**



Do you understand the meaning of the dotted danger line symbol?  
If answer Yes, what does it indicate?

The actual question asked was: 'Do you understand the meaning of the dotted danger line symbol?' An example was shown, being a copy of INT1 K1 (ie a section of danger line backed by SWB and a danger circle filled with SWB). So, the respondent has already been told in the question (what he probably already knew) that it is a danger line. Consequently, many respondents probably assumed the question was aimed at finding what the particular examples meant, in addition to being an indication of danger. If they could not work it out, they probably answered 'No'. We cannot therefore assume that everyone who answered 'No' did not understand that the dotted line marks danger of some kind.

Of those who answered 'Yes' and attempted to answer 'what does it indicate?' many did not give an exact definition (and so were assessed by Sam as incorrect – calculated as 56%). Nevertheless, about 67% used words such as 'danger', 'shoal', 'unsafe', 'hazard', 'keep out' in their answer, which indicates that they have a good idea of the purpose of the danger line. Of the remaining 33%, about a quarter were difficult to interpret (because of language difficulties), so only about 24% of the total can really be described as 'incorrect'. However, most of those appear to have focussed on the possible meaning of the right hand example (dotted circle with SWB but no sounding) and use words like, 'reported', 'unconfirmed', 'approximate' and 'depth unknown' – which are correct in a sense. I suspect that most knew the basic meaning (after all, the

question has already told them that) so were trying to guess at the specific meaning of the examples – and have given a reasonable answer.

I therefore conclude that the question and resulting answers are fundamentally flawed and tell us very little. However, I also conclude that there is no need to be alarmed; the basic meaning of a dotted danger line is almost certainly well understood. The explanation given in INT1 K1 seems very explicit. **Recommend no further action is necessary.**

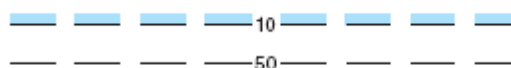
One answer however was seriously wrong: 'swept to a safe depth for yachts'! This was from the master of an ocean going yacht with more than 15 years experience and an RYA ocean certificate!

Having found that the results for danger line are of dubious value, we decided to scrutinise 'Broken contours' and 'upright soundings' in more detail.

### 1. Broken contours. The questions asked were:

#### **Broken depth contours**

##### **Example:**



Do you understand the meaning of the Broken Depth Contour symbol?  
If answer Yes, what does it indicate?

As with the danger line, the question has already been phrased to explain that this line is a depth contour, so the only issue being questioned in reality is 'why is it broken?' Analysing the raw data on the spread sheet, I found 70% of those who answered this question claimed to understand the meaning (Cf 56% found by Sam). 30% admitting to not understanding the meaning is perhaps surprisingly high (but not as bad as 44% according to Sam). Of those who answered 'what does it indicate' 89% gave an answer which implied a sufficiently close understanding of the meaning (eg included words like 'approximate', 'uncertain', 'unreliable', 'unsurveyed', 'incomplete', 'inferred'). Cf 73% found by Sam, who presumably required a more exact answer compared with INT1. This means that the actual understanding is around 62%. Some of the 'bad' answers focussed on the examples shown being 10 and 50m, eg 'depth is not critical to a kayak', missing the issue about the breaks in the lines altogether. It is difficult to suggest a better explanation of the symbol at INT1 I31 than 'Approximate depth contours'. **Recommend no further action is necessary.**

### 12. Upright soundings. The questions asked were:

#### **Upright (hairline) sounding**

##### **Example:**

12

9<sub>1</sub>

12

9<sub>2</sub>

**Upright font**

**Normal font for soundings**

Do you understand the meaning of a sounding written in an upright font?  
If answer Yes, what does it indicate?

I found a similar split between yes and no answers (Yes 43%, No 57%) as assessed by Sam. Of those claiming to understand the meaning, I gave a correct answer to 58% (Cf Sam's 36%), so that works out at only about 25% actually understand the meaning of an upright sounding. However, reading the free text answers to the 2<sup>nd</sup> question, it emerged that many were almost exactly as INT1, perhaps implying that quite a number of 'correct' answers were actually looked up (one admitted it); so it may in reality be



less than 25%. Also, from the 'bad' answers, it became obvious that some confusion may result from the fact that:

- (a) US charts (in 'english units' – a frequently used term) use upright soundings and
- (b) NO charts use upright soundings for dangerous shoals and some depths out of position.

However interpreted, it is clear from this survey that the use of upright soundings for unreliable depth is not widely understood. (Equally, it is clear that the use of upright soundings on NO charts for dangerous shoals is also not understood.)

Conclusion: to the majority of mariners (at least 75%) the upright sounding does not convey the message it is intended to convey (in many cases, the difference is not even noticed). In part, this ignorance may be due to lack of standardization. Questions arise:

- How many HOs use this device?
- Is the message it is intended to convey necessary/useful?
- Are there any options for a clearer method of warning about unreliability of soundings?
- Can the description in INT1 be improved?

One issue seems that many mariners have not noticed the difference. The equivalent in ENC is that such soundings are encircled; that at least has the merit of making the difference from an 'ordinary' sounding very visible. However, this may not be a suitable method on paper charts (eg would cause too much clutter). Another option may be to use a different colour (but perhaps only possible for multicoloured charts); suggest avoid red, because they may be difficult to read under some bridge lights.

The INT1 I14 term is 'Soundings which are unreliable or taken from a smaller scale source'. Could this be improved? - eg: Unreliable sounding (because of age, scale or quality of source data).

Generally the understanding of existing paper chart DQIs appears to be good, however the understanding of the Dotted danger line symbol, discontinuity between surveys note and the bar above a dangerous wreck symbol appear to be marginal. Further, the respondents' understanding of the Rep'd (1999) abbreviation and soundings in an upright font could be considered poorly understood.

The poor understanding of the Rep'd (1999) abbreviation is attributed to the fact that answers not including the condition "but not confirmed" were marked as incorrect. At DQWG 5 the question of whether a mariner would react to the rep'd abbreviation in a different way to any other sounding was raised.

The Sounding in an upright font was commonly misinterpreted as indicating that the value was in a different class of units (imperial or metric) to the rest of the data.

It was noted that the marking of these answers was a subjective process and as a consequence it is plausible that a different marker (from a different area of expertise) may generate different figures.

## 2.4 ENCs

In contrast to the questions relating to source/reliability and ZOC diagrams, the results show that a large portion of ENC users (77%) do not use S-57 CATZOC (Figure 2.4.1). Further, sector analysis showed that percentage is fairly stable regardless of number of years experience.

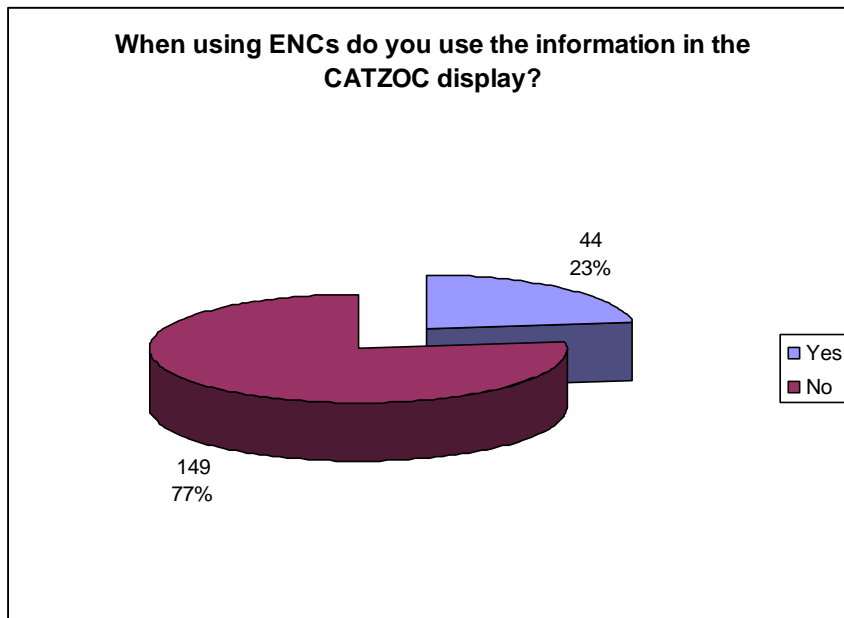


Fig. 2.4.1 Percentage of respondents that use the CATZOC display

As with paper chart DQIs, respondents were asked to indicate whether they understood the meaning of a range of S-57 data quality attributes. Those that said that they did were then asked to give an explanation of the meaning of the respective attribute. The results, detailed in table 2.4.1 show very poor understanding of the S-57 acronyms.

Table 2.4.1 Summary of results to questions relating to mariners' understanding of existing S-57 data quality attributes

S-57 Attribute	Do you understand the meaning of...?		Of those who answered yes, how many gave a correct explanation?	
	Yes (%)	No (%)	Correct (%)	Incorrect (%)
HORACC	24	76	57	43
POSACC	29	71	60	40
SOUACC	31	69	91	9
VERACC	22	78	78	22
SURATH	42	58	91	9
SURSTA	32	80	94	6
SUREND	21	79	94	6
TECSOU	43	57	96	4
QUASOU	31	69	78	22
QUAPOS	27	73	79	21

### 2.5 Wider Data Quality Issues and Future Developments

On the issue of training, 66% (183 respondents) indicated that they felt they had received insufficient training on data quality. This was reinforced by 78% (216 respondents) indicating that they would like to receive further training on data quality. The DQWG are currently investigating how training on data quality is delivered and what mechanisms for delivering further training to practicing mariners could be utilised. Mariners were presented with a variety of conceptual future methods for representing data quality and invited to comment upon the various options. In general respondents seemed to favour an on demand data quality colour overlay.

### 3.0 Conclusions and Recommendations

In general the preliminary results from DQWG4 were confirmed by the final analysis. The effort in validating the survey result confirms the following conclusions;

- Large proportions of ENC users are not using the CATZOC information
- The additional S-57 DQ indicator attributes are not understood and not used

- Majority of mariners state that they have not received enough training on data quality issues, and that they would like to receive more training

Using the results from Sam Harpers MSc thesis and the results from the questionnaire, the DQWG has the following recommendations for developing future methods of representing data quality in ECDIS. These recommendations are meant to bring in new possibilities for implementation into ECDIS systems.

- As a minimum the constituent elements of S-57 CATZOC (positional uncertainty, sounding uncertainty, features detected and seafloor coverage) must be encoded in S-101 ENC for depth areas, as separate attributes
- All encoded data quality information must be discoverable
- The data quality of near shore topography (piers/quays, fixed aids to navigation, clearances, etc) should be included, and a method of representing this data quality must be developed
- Temporal degradation of data should be encoded
- New representation methods should be able to accommodate inputs such as dynamic tides, under keel allowance and vessel specific parameters. It is understood that international efforts on standardization of display and mariner training address possible issues with user inputs.
- Where possible ENC attribute names should be more descriptive (eliminate 6 letter acronyms and make use of camelCase)
- Visualisation should take advantage of the mariner's preference for an on demand colour overlay
- Recommend to add ability for mariners to add notes to specific features, that again changes presentation of the feature (as an addition to the mariners' objects)
- Any representation method should be accompanied by an appropriate education strategy

The DQWG note that the marking of the qualitative questions relating to existing paper chart DQIs is subjective and as a consequence recommend that the relevant raw data be made available to the CSPCWG ahead of their next meeting (28/11/2011 in Finland) for their use. [Although this document was made available to the CSPCWG ahead of the 28/11/2011 meeting, the close proximity of the DQWG meeting and the CSPCWG meeting did not allow time for detailed assessment of the raw data or substantive discussion at the CSPCWG meeting.](#)

#### **4.0 Action Required of CSPCWG**

4.1 Mark and analyse the raw data provided in Annex A so that a comparison can be made against the results summarised in table 2.3.2 of this document.

[Done for selected items, see blue comments in and immediately below Table 2.3.2.](#)

4.2 Consider whether the number of individual data quality symbols, notes, abbreviations and legends are necessary in terms of how the mariner uses them. For example, would the mariner act any differently to a normal sounding as opposed to a sounding with the note 'Rep'd (1999)' associated with it?

Despite Sam's assessment, the free text answers in the spreadsheet indicate that the meaning of Rep (with date) is very well understood. The purpose of charting is clearly stated in S-4 B-424.5, and although that is not available to the mariner, it seems to be so obvious that one would expect any competent mariner to take the appropriate action. However, it seems less likely that they will understand the full meaning mentioned in S-4 (ie that 'the presence of reported dangers, usually in unsurveyed or inadequately surveyed areas, should alert the mariner to the probable existence of other shoaler depths'. Note: this is explained in UK's Mariner's Handbook at 1.21). **Recommend adding to INT1: 'may indicate other shoal depths in vicinity'**. A similar remark could be applied to 'discoloured water' which is not in INT1 (but perhaps should be – see S-4 B-424.6).

**CSPCWG8 ACTION 34**

## Response Form

(please return to CSPCWG Secretary by 21 August 2012)

[andrew.coleman@ukho.gov.uk](mailto:andrew.coleman@ukho.gov.uk)

Annex A Table 2.3.2 item	Question	Yes	No
1	It is recommended that no action is required by CSPCWG regarding the broken depth contour symbol: do you agree?		
3	It is recommended that no action is required by CSPCWG regarding the dotted danger line symbol: do you agree?		
4	Should a legend be inserted in the 'discontinuity between surveys gap' (S-4 B-416.1), eg 'Surveys do not match'?		
11	It is recommended that the term for 'Rep' in INT1 (I3.1) be enhanced by adding '(may indicate other shoal depths in vicinity)': do you agree?		
12	Does your HO use upright soundings to indicate unreliability?		
	Can you suggest any options for a clearer method of warning about unreliability of soundings? (If yes, please explain below)		
	Can the description in INT1 be improved, eg to 'Unreliable sounding (because of age, scale or quality of source data)'?		
17	Can anything be done to enhance the chart user's understanding of a bar over an obstruction or wreck (K3/30)? (If Yes, please explain below)		
Annex A paragraph 4.2	Having read the paper at Annex A, and considered the analysis of the results in Table 2.3.2, do you consider that any of the individual data quality symbols, notes, abbreviations and legends used on paper charts are unnecessary in terms of how the mariner uses them? (If Yes, please explain below)		

Please expand on any of your answers below, clearly referencing the item you are addressing:

Name:

Member State: