8th Meeting of the Data Quality Working Group (DQWG)
Wollongong, NSW, Australia, 25-28 March 2014

Paper for Consideration by the Data Quality Working Group

Report on DQWG sections submitted to the DCEG at TSMAD 27

Submitted by:	USA,NOAA
Executive Summary:	Report on data quality related sections of the DCEG that were submitted for review by DQWG to the full TSMAD at meeting in December 2013.
Related Documents:	S101_Data Classification and Encoding Guide, TSMAD27-4.5.2A
Related Projects:	Data Classification and Encoding Guide

Introduction / Background

The DQWG was tasked by the DCEG sub-working group after the TSMAD 26 to review the sections that are relevant to data quality in the DCEG that the DQWG are responsible for. The sections were rewritten by DQWG and presented to the full TSMAD working group at TSMAD 27.

Discussion

Paper TSMAD27-4.5.2A was presented to the full TSMAD by members of the DQWG. This paper laid out the changes to the three relevant sections to the DCEG that DQWG was tasked to rewrite. The three sections are 3.1 Quality of non-bathymetric data, 3.5 Quality of bathymetric data and 3.8 Quality of survey. These three sections were accepted with no changes for the inclusion in the baseline document.

The changes that were not included were either an oversight or deemed not suitable after further thought by TSMAD. DQWG needs to review the sections in question and be prepared to discuss changes at the joint DQWG/DCEG meeting that follows DQWG08.

Action Required of DQWG

DQWG is invited to:

- Review Annex A of this paper, comparing it to the sections submitted in paper TSMAD27-4.5.2A and be prepared to discuss with DCEG at joint meeting.

  Notable sentences and remarks for discussion in red:

  - *Paragraph 6 under Section 3.1.1* "Meta features **Quality of Non-bathymetric Data** and **Quality of Bathymetric Data** should not overlap". Paper submitted to TSMAD stated that Quality Non-bathymetric Data and Quality of Bathymetric Data objects can overlap.
  - *Paragraph 5 under Section 3.5.1* "The meta feature **Quality of Bathymetric Data** defines areas within which uniform assessment exists for the quality of bathymetric data, and must be used to provide an assessment of the overall quality of bathymetric data to the mariner. Areas of a dataset containing depth data or bathymetry must be covered by one or more **Quality of Bathymetric Data**, which must not overlap". Paper submitted to TSMAD stated that Quality Bathymetric Data objects can overlap. Swept area for example.
  - *Remark 12 under Section 3.5.1* "When **Quality of Bathymetric Data** and the meta feature **Quality of Non-bathymetric Data** are encoded in a dataset, they should not overlap". Paper submitted to TSMAD stated that Quality Non-bathymetric Data and Quality of Bathymetric Data objects can overlap.
  - Two remarks not included.

    QualityofBathymetricData Meta feature objects may overlap only if depthRangeMaximumValue is populated in one of feature objects and depthRangeMinimumValue is populated on the overlapping feature object

    When QualityofBathymetricData Meta feature objects overlap the depthRangeMaximumValue of one object must be equal to depthRangeMinimumValue of an overlapping object

Annex A The current Quality of data section in the DCEG baseline document (Jan 2014)

3.1 Quality of non-bathymetric data

IHO Definition: **QUALITY OF NON-BATHYMETRIC DATA**. An area within which the best estimate of the overall uncertainty of the data is uniform. The overall uncertainty takes into account for example the source accuracy, chart scale, digitising accuracy etc. (Adapted from S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.208, November 2000).

S-101 Geo Feature: Quality of non-bathymetric data (M_ACCY)

Primitives: Surface

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Horizontal distance uncertainty	(HORACC)		RE	0,1
Orientation uncertainty			RE	0,1
Positional uncertainty	(POSACC)		RE	1,1
Survey date range			C	0,1
Date end	*(SUREND)*	ISO 8601:2004	(S) DA	1,1
Date start	*(SURSTA)*	ISO 8601:2004	(S) DA	0,1
Vertical uncertainty	(VERACC)		RE	0,1
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

INT 1 Reference:

3.1.1 Quality of positions

The meta feature **Quality of Non-bathymetric Data** may be used to provide an indication of the overall uncertainty of position for all non-bathymetric features. It must not be used to provide the uncertainty of bathymetric information.

The attributes **quality of position** and **positional uncertainty** may be applied to any spatial type, in order to qualify the location of a feature.

Horizontal distance uncertainty, quality of position and **positional uncertainty** must not be applied to the spatial type of any geo feature if they are identical to the **horizontal distance uncertainty, quality of position** and **positional uncertainty** values of the underlying meta feature.

quality of position gives qualitative information, whereas **positional uncertainty** gives quantitative information.

Positional uncertainty on the **Quality of Non-bathymetric Data** applies to non-bathymetric data situated within the area, while **quality of position** or **positional uncertainty** on the associated spatial types qualifies the location of the **Quality of Non-bathymetric Data** feature itself.

Meta features **Quality of Non-bathymetric Data** and **Quality of Bathymetric Data** should not overlap.

Remarks:

- No remarks.

3.1.2 Horizontal distance uncertainty

If it is required to encode the uncertainty of a horizontal clearance (complex attributes **horizontal clearance fixed** and **horizontal clearance open**), it must be done using the sub-attribute **horizontal distance uncertainty**.

horizontal distance uncertainty applies only to **horizontal clearance fixed** and **horizontal clearance open**. There is no attribute to express the accuracy of the attributes **horizontal length** and **horizontal width**.

Remarks:

- No remarks.

3.1.3 Vertical uncertainty

If it is required to encode the uncertainty of a vertical clearance (complex attributes **vertical clearance fixed**, **vertical clearance open**, **vertical clearance closed** and **vertical clearance safe**), it must be done using the sub-attribute **vertical uncertainty**.

If several vertical clearances are given for one feature, the uncertainty given must be that of the least accurate.

Remarks:

- No remarks.

Distinction: Quality of bathymetric data; quality of survey.

3.5 Quality of bathymetric data

IHO Definition: **QUALITY OF BATHYMETRIC DATA**. An area within which a uniform assessment of the quality of the bathymetric data exists. (S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.216, November 2000).

S-101 Geo Feature: Quality of Bathymetric Data (M_QUAL)

Primitives: Surface

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Category of temporal variation		1 : unassessed 2 : event 3 : likely to change 4 : unlikely to change	EN	1,1
Depth range maximum value	(DRVAL2)		RE	0,1
Depth range minimum value	(DRVAL1)		RE	0,1
Features detected			C	1,1
Least depth of detected features measured			(S) BO	1,1
Significant features detected			(S) BO	1,1
Size of features detected			(S) RE	0,1
Positional uncertainty	(POSACC)		RE	0,1
Full seafloor coverage			BO	1,1
Sounding uncertainty	(SOUACC)		RE	0,1

Survey date range			C	0,1
Date end	*(SUREND)*	ISO 8601:2004	(S) DA	1,1
Date start	*(SURSTA)*	ISO 8601:2004	(S) DA	0,1
Technique of sounding measurement	(TECSOU)	1 : found by echo-sounder 2 : found by side scan sonar 3 : found by multi-beam 4 : found by diver 5 : found be lead-line 6 : swept by wire-drag 7 : found by laser 8 : swept by vertical acoustic system 9 : found by electromagnetic sensor 10 : photogrammetry 11 : satellite imagery 12 : found by levelling 13 : swept by side-scan sonar	EN	0,*
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

INT 1 Reference:

3.5.1 Quality, reliability and accuracy of bathymetric data (see S-4 – B-297)

Information about quality, reliability and uncertainty of bathymetric data is given using:

- the meta feature **Quality of Bathymetric Data** for an assessment of the quality of bathymetric data;
- the meta feature **Quality of Survey** for additional information about individual surveys (see clause X.X);
- the attributes **quality of sounding measurement**, **sounding uncertainty** and **technique of sounding measurement** on groups of soundings or individual features;
- the attributes **positional uncertainty** and **quality of position** on the spatial types (see clause X.X).

For the mariner, **Quality of Bathymetric Data** provides the most useful information. Therefore, the use of **Quality of Bathymetric Data** is mandatory for areas containing depth data or bathymetry on ENC datasets at maximum display scale 1:700000 and larger.

More detailed information about a survey may be given using **Quality of Survey** (see clause X.X). For example, in incompletely surveyed areas, lines of passage soundings may be indicated as such using a curve **Quality of Survey** feature. This information is more difficult for the mariner to interpret. Therefore, the use of **Quality of Survey** is optional.

For individual features (wrecks, obstructions etc), or small groups of soundings, **quality of sounding measurement**, **sounding uncertainty** and **technique of sounding measurement** may be used to provide additional information about quality and uncertainty.

The meta feature **Quality of Bathymetric Data** defines areas within which uniform assessment exists for the quality of bathymetric data, and must be used to provide an assessment of the overall quality of bathymetric data to the mariner. Areas of a dataset containing depth data or bathymetry must be covered by one or more **Quality of Bathymetric Data**, which must not overlap.

Remarks:

- To express completeness of bathymetric data, the complex attribute **features detected** must be encoded. **Features detected** indicates that a systematic method of exploring the sea floor, or the water column to the depth indicated by population of the attribute **depth range maximum value**, was undertaken to detect significant features. The sub-attributes **size of features detected** and **least depth of detected features measured** must not be encoded unless the sub-attribute **significant features detected** is set to *True*.
- Wherever possible, meaningful and useful values for the attributes **category of temporal variation**, **full seafloor coverage**, and the complex attribute **features detected** must be used for areas of bathymetry. For areas of unstable seafloors, the complex attribute **survey date range** (**date end**) must be used to indicate the date of the survey of the underlying bathymetric data.
- **Depth range minimum value** must only be used on a **Quality of Bathymetric Data** feature where a swept area occupies the entire **Quality of Bathymetric Data** surface.
- **Depth range maximum value** must only be used on a **Quality of Bathymetric Data** feature to specify the maximum depth to which all other attributes for the **Quality of Bathymetric Data** feature applies. When **depth range maximum value** is specified, values populated for all other attributes apply only to depths equal to or shoaler than **depth range maximum value**. No quality information is provided for depths deeper than **depth range maximum value**.
- **Positional uncertainty** is used on a **Quality of Bathymetric Data** feature to specify the positional uncertainty of the depths covered by the surface.
- **Sounding uncertainty** is used on a **Quality of Bathymetric Data** feature to specify the vertical uncertainty of the depths covered by the surface. When **depth range minimum value** is specified, **sounding uncertainty** refers only to the uncertainty of the swept depth defined by **depth range minimum value**.
- **Technique of sounding measurement** must not be used on a **Quality of Bathymetric Data** feature to specify a lower quality than the values populated for the mandatory attributes for the feature instance indicate.
- When the **Quality of Bathymetric Data** area contains soundings from multiple surveys of different

techniques, the attribute **technique of sounding measurement** must not be used. **Technique of sounding measurement** may be populated with multiple values only where the **Quality of Bathymetric Data** area is covered by a survey or surveys that have used multiple common techniques, e.g. an area covered by multiple surveys all using a modern echosounder combined with a sonar or mechanical sweep system.

- When the **Quality of Bathymetric Data** surface contains data from only one survey, the date of survey, if required, must be specified using the complex attribute **survey date range**, sub-attribute **date end**. When the **Quality of Bathymetric Data** surface contains data from two or more surveys, the date of the most recent and the oldest survey, if required, must be specified using the complex attribute **survey date range**.
- Additional quality information may be given using the meta feature **Quality of Survey**.
- **Quality of Bathymetric Data** areas must not be encoded over land.
- When **Quality of Bathymetric Data** and the meta feature **Quality of Non-bathymetric Data** are encoded in a dataset, they should not overlap.
- **Positional uncertainty** on the **Quality of Bathymetric Data** applies to bathymetric data situated within the surface, while **quality of position** or **positional uncertainty** on the associated spatial types qualifies the location of the **Quality of Bathymetric Data** feature itself.
- As a result of some disasters, e.g. earthquakes, tsunamis, hurricanes, it is possible that large areas of seafloor have moved and/or become cluttered with dangerous obstructions. Emergency surveys may subsequently be conducted over essential shipping routes and inside harbours. Outside these surveys, all existing detail is now suspect, whatever the quality of the previous surveys. In such cases, the attribute **category of temporal variation** should be reclassified to value *2* (event), the Boolean attribute **full seafloor coverage** set to *False*, and complex attribute **features detected**, Boolean sub-attributes **least depth of detected features measured** and **significant features detected** set to *False* in the affected areas outside the area covered by emergency surveys.

3.5.1.1 Feature detection

In the context of bathymetry, a feature is any object, whether manmade or not, projecting above the sea floor, which may be considered to be a danger to surface navigation. Refer to S-44.

The ability to detect bathymetric features must be encoded using the complex attribute **features detected**. The sub-attribute **significant features detected** indicates whether the survey was capable of detecting features of a size indicated by the sub-attribute **size of features detected**. The sub-attribute **least depth of detected features measured** indicates whether the least depth of detected features was found. For instance, if a wreck was found, but it is not certain that the least depth of that wreck was measured, **least depth of detected features measured** must be set to *False*.

3.5.1.2 Temporal variation

The changeability of the bathymetry must be encoded using **category of temporal variation**. In order for a time reference to be given for the expression of temporal variation, the relevant dates of the bathymetric data must be encoded using the complex attribute **survey date range** if **category of temporal variation** is set to *2* (event) or *3* (likely to change).

3.5.1.3 Sounding uncertainty

Sounding uncertainty is encoded using the attribute **sounding uncertainty** on **Quality of Bathymetric Data**. If it is required to encode additional sounding uncertainty information, it must be done using the attribute **sounding uncertainty** on individual geo features (e.g. **Sounding**).

The uncertainty of sounding must not be encoded using **sounding uncertainty** on the depth geo feature, unless it is different to the value of **sounding uncertainty** encoded on **Quality of Bathymetric Data**.

3.5.1.4 Technique of sounding measurement

If it is required to encode the technique of sounding measurement, it must be done using the attribute **technique of sounding measurement** on either **Quality of Bathymetric Data** or on individual geo features (e.g. **Sounding**).

The technique of sounding measurement must not be encoded using **technique of sounding measurement** on the depth geo feature, unless it is different to the value of **technique of sounding measurement** encoded on **Quality of Bathymetric Data**.

Distinction: Accuracy of data; quality of survey.

3.8 Quality of survey

IHO Definition: **QUALITY OF SURVEY**. An area within which a uniform assessment of the reliability of source survey information exists. (S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.218, November 2000).

S-101 Geo Feature: Quality of survey (M_SREL)

Primitives: Curve, Surface

Real World	*Paper Chart Symbol*	*ECDIS Symbol*

S-101 Attribute	S-57 Acronym	Allowable Encoding Value	Type	Multiplicity
Features detected			C	0,1
Least depth of detected features measured			(S) BO	0,1
Significant features detected			(S) BO	1,1
Size of features detected			(S) RE	0,1
Full seafloor coverage			BO	1,1
Line spacing maximum	(SDISMX)		IN	0,1
Line spacing minimum	(SDISMN)		IN	0,1
Measurement distance maximum			RE	0,1
Measurement distance minimum			RE	0,1
Quality of position	(QUAPOS)	1 : surveyed 2 : unsurveyed 3 : inadequately surveyed 4 : approximate 5 : position doubtful 6 : unreliable 7 : reported (not surveyed) 8 : reported (not confirmed) 9 : estimated 10 : precisely known 11 : calculated	EN	0,1
Quality of sounding measurement	(QUASOU)	1 : depth known 2 : depth or least depth unknown 3 : doubtful sounding 4 : unreliable sounding 6 : least depth known 7 : least depth unknown, safe clearance at value shown 8 : value reported (not surveyed) 9 : value reported (not confirmed) 10 : maintained depth 11 : not regularly maintained	EN	0,*
Scale value maximum	(SCVAL1)	scale value maximum < scale value minimum	IN	0,1

Scale value minimum	(SCVAL2)	scale value minimum > scale value maximum	IN	0,1
Survey authority	(SURATH)		TE	1,1
Survey date range			C	0,1
Date end	*(SUREND)*	ISO 8601:2004	(S) DA	1,1
Date start	*(SURSTA)*	ISO 8601:2004	(S) DA	0,1
Survey type	(SURTYP)	1 : reconnaissance / sketch survey 2 : controlled survey 4 : examination survey 5 : passage survey 6 : remotely sensed 7 : full coverage 8 : systematic survey 9 : non-systematic survey 10 : inadequately surveyed 11 : spot-sounding survey 12 : acoustically swept survey 13 : mechanically swept survey	EN	1,*
Information			C	0,*
Language		ISO 639-3	(S) TE	0,1
Text	*(INFORM)* *(NINFOM)*		(S) TE	1,1
Textual description			C	0,*
File reference	*(TXTDSC)* *(NTXTDS)*		(S) TE	1,1
Language		ISO 639-3	(S) TE	0,1

INT 1 Reference:

3.8.1 Survey reliability and source of bathymetric data

The survey reliability and/or details of the source surveys used in compilation may be encoded using the meta feature **Quality of Survey**.

Remarks:

- To express completeness of bathymetric data, the complex attribute **features detected** should be encoded. **features detected** indicates that a systematic method of exploring the sea floor was undertaken to detect significant features. The sub-attributes **size of features detected** and **least depth of detected features measured** must not be encoded unless the sub-attribute **significant features detected** is set to *True*.
- If the attributes **sounding uncertainty** and **technique of sounding measurement** are required, they must be encoded on either the meta feature **Quality of Bathymetric Data** (see clause X.X) or on individual geo features (e.g. **Sounding**).
- If the attribute **measurement distance maximum** is set to *0* (zero) for the full area of the survey, the attribute **full seafloor coverage achieved** should be set to *yes*.
- Where populated, the value for the attribute **measurement distance minimum** must not be larger than the value populated for **measurement distance maximum**.
- **Quality of position** on the **Quality of Survey** applies to bathymetric data situated within the area, while **quality of position** or **positional uncertainty** on the associated spatial types qualifies the location of the **Quality of Survey** feature itself.

3.8.2 Quality of sounding

If it is required to encode the quality of sounding, it must be done using the attribute **quality of sounding measurement** on either the **Quality of Survey** or on individual geo features (e.g. **Sounding**).

The quality of sounding must not be encoded using **quality of sounding measurement** on the depth geo

feature, unless it is different to the value of **quality of sounding measurement** encoded on **Quality of Survey** (see tables at clauses X.X and X.X).

Remarks:

- No remarks.

Distinction: Accuracy of data; quality of bathymetric data