

Action DQWG10-8C

Guidance on how to use temporal variation. (draft version)

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03 May 2016

Introduction

Nautical publications show a portrayal of all items at sea which are relevant for safe navigation. The time of recording and time of publication are never the same. It would require true time acquisition, data processing, data validation and presentation to minimise the time between recording and presentation. All items in a nautical publication suffer from temporal variation. However for most items in the publication this is not an issue as these items hardly move in time (e.g. fixed landmarks, lighthouses, most coastlines). This paper is concerned with items that do change over time and are important to the mariner.

Temporal variation in Depth Areas

The decision tree for the assessment of QualityOfBathymetricData developed by the IHO-DQWG in 2015 is divided into five steps: 1) Status of assessment, 2) Temporal, 3) Feature detected, 4) Completeness, and 5) Uncertainty thresholds. This paper gives guidance how to interpret item 2, Temporal.

Two major risks for the mariner are collision and grounding. Collision should be avoided by good seamanship. Grounding will occur when the Under Keel Clearance (UKC) becomes too less for safe navigation. The mariner uses a paper or digital chart to perform navigation for safe passage and thus assuring UKC is sufficient in all circumstances. The issue date of the chart is either printed on paper or electronically fixed in the product.

The nautical chart will show areas with minimum and maximum depth values, relative to the agreed vertical reference level (usually Lowest Astronomical Tide). Within these areas the shallowest depth sounding will be shown on the chart. These spots are important to the mariner as it depicts the position of greatest risk of grounding in the area. Depth contour lines give guidance on levels of similar depths hence giving an assurance of UKC (assuming vessel draft is constant). When tidal levels are taken into account, the UKC is almost always more as all depths are presented relative to the minimum waterlevel the mariner may expect in this area.

Guidance on temporal variation

The shown depth areas and shallowest soundings may not represent reality at the time of passing the area. In case of an extreme event (e.g. earthquake, tropical storm) the mariner should receive a Notice to Mariners to take precaution when entering the area. These events are rare and countermeasures are the responsibility of the local authorities. Data quality level for the area is automatically set to level 5.

In normal circumstances, seabed dynamics may change gradually over time (e.g. years). This has an effect on both depth areas and soundings. The minimum value of the depth area may change. In case it increases, the UKC increases and the vessel can optimise its travel by selecting a more economic route to its destination. However when the value decreases, the UKC decreases and the risk of grounding increases. Another option is that the minimum value of the depth area remains constant but the position of the minimum value shifts horizontally. This is important if this shift is into a regular traffic scheme or a favourite route of many vessels. This can be checked using AIS data from vessels in the area.

Notice to Mariners

As a guideline the following numbers may be used to give a NtM:

Depth areas 0-10m, shoaling greater than 0.5 metres.

Depth areas 10-30m, shoaling greater than 1.0 metres.

Depth areas 30-200m, shoaling greater than 5% of depth.

Depth areas 200-800m, shoaling greater than 10% of depth.

Deep Water routes, shoaling greater than 0.1 metres.

Placed in a table this becomes:

depth boundary	shoaling number	Special survey	1a survey	1b survey	2 survey
0m	0.5m	0.25m	0.50m	0.50m	0.50m
10m	0.5m	0.26m	0.52m	0.52m	1.03m
11m	1.0m	0.26m	0.52m	0.52m	1.03m
30m	1.0m	0.34m	0.63m	0.63m	1.21m
31m	1.5m	0.34m	0.64m	0.64m	1.23m
200m	10m	1.52m	2.65m	2.65m	4.71m
201m	20m	1.53m	2.66m	2.66m	4.73m
800m	80m	6.01m	10.41m	10.41m	18.43m

The shoaling values are checked against S-44 survey types.

The following guidelines are given to these type of surveys:

> Special: areas where under-keel clearance is critical;

> 1a : areas shallower than 100 metres where under-keel clearance is less critical but features of concern to surface shipping max exist.

> 1b : areas shallower than 100 metres where under-keel clearance is not considered to an issue for the type of surface shipping expected to transit the area.

> 2 : areas generally deeper than 100 metres where a general description of the sea floor is considered adequate.

Conclusion is that for shipping in an area up to depth of 10 metres, special order surveys need to be carried out as order 1a surveys will not necessarily detect temporal variation to the required vertical accuracy. If Order 1a or less is carried out, the area is supposed to be not critical for UKC.

Horizontal shifting of soundings

In order to estimate if a horizontal shift is important to the mariner, the chart scale used has a relation to the actual position of the minimum sounding and the Closest Point of Approach a vessel may use. The following chart scales are in use:

Chart type	Scale	shift (m)	shift (nm)
Overview	1:250000	2500	1.35
General	1:150000	1500	0.81
Coastal	1:90000	900	0.49
Approach	1:40000	400	0.22
Harbour	1:20000	200	0.11
Berthing	1:1000	10	0.005

Soundings are displayed in the chart in an area of 1 cm. The smallest notable difference that can be depicted is a difference of 1 cm between presented and actual position. This is illustrated in column 3 and 4.

Usually a safety zone of 500 meters is required from any physical obstruction at sea (offshore installations). Following these guidelines, any chart from Approach or better should have the correct position of minimal sounding in an area. Coastal, General and Overview charts give the mariner a false sense of security when using CPA values of 500 metres or 1/4 of a nautical mile.

Using Temporal as quality indicator

According to the decision tree for the assessment of QualityOfBathymetric data the Temporal step has five different categories:

- 1) Unassessed
- 2) Extreme event
- 3) Likely to change
- 4) Likely to change but significant shoaling not expected.
- 5) Unlikely to change

Unassessed should be used if the area has not been surveyed or only been surveyed once and there is no other knowledge of the dynamic behaviour of the area (e.g. soil type is unknown)

Extreme event should be used in case of a rare event when severe abrupt changes to the seabed can be expected.

Likely to change should be used if the area has been surveyed more than once and the displacement and time difference are well known. Other information (e.g. many groundings in the past, sand bottom) may contribute to this criterium.

Likely to change but significant shoaling not expected should be used when the area has been surveyed more than once and minimum depth values are not affected over time. Position of shallowest sounding is also not affected.

Unlikely to change should be used if the area is known for its stable seabed (e.g. rock structure, no seismic activities) or has been surveyed multiple times and no significant displacement was found. If there are displacements in an area but the resurvey policy has a frequency that monitors the displacements carefully and new publications of the area are published in time, the indicator should also be set to this level.