

**5<sup>TH</sup> MEETING OF THE HYDROGRAPHIC SERVICES AND STANDARDS COMMITTEE**  
**Seagull On The Bund Hotel, Shanghai, China, 5-8 November 2013**

**Report of the Tidal and Water Level Working Group**

<b>Submitted by:</b>	Chairman, TWLWG
<b>Related Documents:</b>	Report of TWLWG 5 meeting (available from IHO web site).
<b>Related Projects:</b>	None

<b>Chair:</b>	Gwenaële Jan, France
<b>Vice-Chair:</b>	Christopher Jones, UK
<b>Secretary:</b>	David Wyatt, IHB
<b>Member States:</b>	Australia, Brazil, Canada, Chile, China, Cuba, Denmark, Ecuador, Finland, France, Germany, India, Indonesia, Italy, Japan, Korea Rep of, New Zealand, Norway, Portugal, South Africa, Spain, UK, Uruguay, USA, Venezuela.
<b>Expert Contributor Organisations:</b>	Bohdan Pillich (Tidal Expert) IOC-GLOSS
<i>see Annex A for full details</i>	

**Meetings Held During Reporting Period**

TWLWG 5      14 - 16 May 2013, Helsinki, Finland

**Next Meeting**

TWLWG 6      April 2014, venue Wollongong, Australia

**Work Program**

The 5<sup>th</sup> meeting of the TWLWG took place at the offices of the Finnish Transport Agency, Pasila, Helsinki, Finland from 14 – 16 May 2013 and was hosted by the Finnish Transport Agency (FTA). The meeting was attended by 11 representatives from 9 IHO Member States and the IHB.

During discussion on the Standard Constituent List (Task A), UK gave a presentation, which highlighted variations in the angular speed of harmonic tidal constituents and orbital elements based on the most helpful correspondence with the Korean delegate following TWLWG 4. It was agreed UK and France would investigate the angular speed of harmonic tidal constituents with a view to improve the precision of tide predictions; it was considered as a minimum 7 decimal places should be quoted.

An update on NOAA progress towards direct time series predictions based on Chart Datum (CD) for on-line availability was provided via teleconference link. It was noted where sufficient information was available for harmonic analysis for predicted tides; this was being conducted whilst maintaining time and height for areas of sparse data. It was highlighted NOAA intend to move away from domestic hard copy tide tables but the issue of international uses still required to be addressed. The draft document, which contained suggested feature attributes to be included in digital tide tables, was brought to the attention of all participants.

A background brief on S-100 Product Specifications was provided with additional information provided by the IHB via teleconference, particularly guidance on the appropriate initial areas to be discussed and considered within the TWLWG capabilities. The use of gridded data component should be an area for further discussion. It was agreed that the WG concentrate on the product that will be used in the ECDIS first and leave the transfer format

for later. It was suggested once the WG has a clear understanding of the nature of the requirement, it will be in a better position to define components / services that are needed make it happen.

It was recognised that what is required is a type of bathymetric attributed grid/ product that can be used as a layer within an ECDIS. The grid would be based on full resolution survey data, and the choice of grid interval would be determined by the quality of the underlying survey data and the intended use; i.e. in a port area where depths are critical and tidal variations significant, a small (fine) grid interval grid would be more appropriate (provided that the underlying survey data can support it) than a course one. It was noted that the depth information in existing ENC is not sufficiently comprehensive to support this type of application and therefore some form of time variable layer based on a gridded bathymetric surface or triangulated irregular network (TIN) surface would be more viable.

The gridded dataset would effectively become a navigational surface (based on chart datum CD), and the next issue to consider would be how to apply the tidal model including the temporal component to the navigational surface in order that CD depths are adjusted to reflect the tidal / time variables. The tide adjusted depth at each grid cell would drive the portrayal within the EDCIS. This could simply be as a colour coded bathymetric surfaces, or green (safe) amber (beware) and red (no go) areas based on the vessels draft.

It was noted a number of there are a number of issues that may need further discussion such as;

- a. appropriate metadata for data quality, grid resolution, source bathymetry, tidal regime portrayal;
- b. what would trigger alarms (e.g. grounding alarm etc ...) in the ECDIS.

A basic outline scope requirement was generated for review by TSMAD, see Annex B.

As a result of considerable intersessional correspondence and further work during the meeting, the review into IHO Resolution 3/1919, as amended, (Datums and Benchmarks) was brought to a conclusion. Finland briefed on the discussions and principles involved, including a detailed explanation on the complex issues between adjacent areas and how these could be considered by national HOs. The main challenges were the articulation of the correct terminology for areas connected to ocean areas with appreciable variations of water level and areas with minimal variation in water level and limited connection to oceans. An agreed text to IHO Resolution 3-1919, as amended, was generated for submission to HSSC 5 and subsequent Member State approval, see Annex C.

A minor amendment to IHO Resolution 2/1977, as amended, (National TIDAL Constituent Banks) was proposed to reflect the new WG title, see Annex D. It was agreed a revised text for IHO Resolution 27/1919, as amended, (Time To Be Used) was required to reflect the supply of digital tidal data; the proposed revised text for submission to HSSC 5 and subsequent Member State approval is at Annex E. Revision of IHO Resolution 27/1919, as amended, highlighted a need for a minor amendment to IHO Resolution 1/1977, as amended, see Annex F. Concerns were raised over the consistency with other related IHO publications, in particular S-4 and C-13.

In response to an output from an IHO/EU bilateral meeting, the TWLWG were invited to investigate the establishment and maintenance of vertical reference frameworks for the high resolution bathymetric surfaces. UK briefed on background and work in progress by NSHCTWG and previous work undertaken by Belgium, Denmark, Germany, France, Netherlands, Norway and UK. It was noted similar work was being undertaken by France and Norway. Sweden highlighted associated work and the connection with the EVR System and its similarities with the EVRF and the move towards a common reference model. UK articulated the actions required and noted the liaison required with NSHCTWG, of which France, Norway and UK were members, in addition to Belgium, Denmark, Germany and Netherlands. In addition the work undertaken by the Netherlands and the BLAST Project were noted. Sweden highlighted a paper from the University of Southern Mississippi on a similar subject and Chile noted the large quantity of work already being undertaken by specialists in various countries and organizations, including the associated workshops on Geodetic Vertical Monitoring developed in

conjunction of the sessions of the Group of Experts of GLOSS. Feedback and comment for the following bilateral IHO/EU meeting was subsequently coordinated by the UK.

Correspondence with CSPCWG regarding sections of publication S-4, which relate to tidal issues, were discussed. It was agreed to recommend to HSSC 5 to move Resolution 1/2008, as amended, from Section 2.3.1 to Section 2.2 of IHO publication M-3. After further discussion it was felt Resolution 3/1947, as amended, still had relevance and a number of occurrences on charts where this Resolution applied. It was felt there remained a need to retain this Resolution. TWLWG wished to liaise further with CSPCWG before providing any recommendation on the removal of Resolution 3/1947. In addition it was considered S-4 may require further review by CSPCWG once the revised wording to Resolution 3/1919 has been approved by Member States.

In the draft Work Plan, attached at Annex G, the completion dates for some items have been amended to reflect progress made to date.

**Progress on HSSC Action Items**

N/A

**Problems Encountered**

N/A

**Any Other Items of Note**

N/A

**Conclusions and Recommended Actions**

N/A

**Justification and Impacts**

N/A

**Action Required of HSSC**

The HSSC is invited to:

- a. note this report
- b. re-appoint the TWLWG to continue its work under its current Terms of Reference
- c. endorse the draft Work Plan at Annex G
- d. approve the draft IHO Resolution 3/1919 as amended, (Datums and Benchmarks) and the definitions of Low Water, Mean Water and High Water for submission to IHO Member States at Annex C.
- e. approve the minor amendment to IHO Resolution 2/1977, as amended, (National Tidal Constituent Banks), Annex D .
- f. approve the draft revised text for IHO Resolution 27/1919, as amended, (Time to be Used), Annex E.
- g. approve the minor amendment to IHO Resolution 1/1977, as amended, (Collection and Publication of Tidal Data), Annex F.

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**Annex A to TWLWG Report to HSSC 5**

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Annex A to TWLWG Report to HSSC 5

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Annex A to TWLWG Report to HSSC 5

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Annex A to TWLWG Report to HSSC 5

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## 1 TWLWG Work Plan

### 1.1 TWLWG Tasks

- A Maintain Standard Tidal Constituent List (IHO Work Programme 3.2.4 refers)
- B Prepare a Standard for Digital Tide Tables (IHOTC Report to the XVII<sup>th</sup> IHC as adopted)
- C Liaise with TSMAD on tidal matters relevant to the Dynamic Application of Tides in ECDIS and develop a Standard of the transmission of real-time tidal data (Action HSSC1/18)
- E Review the various definitions of MSL and their relevance to Hydrographic Offices and review the IHO tidal resolutions to ensure that they are compatible with the requirements of non-tidal areas such as the Baltic Sea.
- F Prepare and maintain an inventory of tide gauges used by Member States and to publish it on the IHO/TWLWG web site.
- H Compare the tidal predictions generated as a result of analysis of a common data set using different analysis software.
- I Review and provide feedback of On-line real time water level observation document

Task	Work item	Priority H-high M-medium L-low	Milestones	Start Date	End Date	Status P-planned O-ongoing C-completed	Contact Person(s) * indicates leader	Related Pubs/Standard
A.1	Maintain Standard Tidal Constituent List	H	No updates required in 2012	Continuous		O	Chris Jones*	
A.2	Compare the tidal predictions generated as a result of analysis of a common data set using different analysis software.	H	Select Common data set Analyse using different software Predict common set of tides Compare results	Continuous		O	Stephen Gill*	

Task	Work item	Priority H-high M-medium L-low	Milestones	Start Date	End Date	Status P-planned O-ongoing C-completed	Contact Person(s) * indicates leader	Related Pubs/Standard
B.2	Prepare a Standard for Digital Tide Tables	H	Prepare draft Standard	2009	2013	O	Stephen Gill* Chris Jones Zarina Jayaswal	
C.1	Liaise with TSMAD and DIPWG on tidal matters relevant to the Dynamic Application of Tides in ECDIS	H	Prepare draft pages for Objects and Attributes.  Prepare draft Product Specifications (S1**) for tidal data in S-100.	2010  2012	2012  2013	O  O	ZarinaJayaswa* Stephen Gill Chris Jones Juan Fierro Ruth Farre Dan Pillich	
C.2	Develop a Standard for the transmission of real-time tidal data	H		2009	2013	O	Stephen Gill* Chris Jones Zarina Jayaswal Juan Fierro	
E.1	Review the various definitions of MSL and their relevance to Hydrographic Offices and review the IHO tidal resolutions to ensure that they are compatible with the requirements of non-tidal areas such as the Baltic Sea.	H	Reviewed at TWLWG2- Further work undertaken at TWLWG3 and TWLWG4. Definition of MSL approved for submission to HDWG. Work on the IHO resolutions ongoing.	2009	2013	O	Jukka Varonen* Tor Tørresen Phil MacAulay Stephen Shipman Chris Jones Stephen Gill	
F.1	Prepare and maintain an inventory of tide gauges used by Member States and to publish it on the IHO/TWLWG web site.	H	Initial inventory from TWLWG members available on IHO web site. CL36/2010 sent to Member States seeking wider input.	Continuous		O	David Wyatt* Stephen Gill	

Task	Work item	Priority H-high M-medium L-low	Milestones	Start Date	End Date	Status P-planned O-ongoing C-completed	Contact Person(s) * indicates leader	Related Pubs/Standard
H1	The study of long term data sets for the determination of global sea level rise.	H		2011	2014	O	Chris Jones Salvador Moreno Stephen Gill Tor Tørresen Gwenaële Jan Do-Seong Byun	
I1	On-line real time water level observation document	H	Review and feedback by 1 August 2012	2012	2013	O	David Wyatt	

## 1.2 TWLWG Meetings (IHO Task 3.1.11 refers)

Date	Location	Activity
14 – 16 May 2013	Helsinki, Finland	5 <sup>th</sup> Meeting
April 2014	Wollongong, Australia	6 <sup>th</sup> Meeting

Chair: Gwenaële Jan      Email: gwenaee.jan@shom.fr  
Vice-Chair: Christopher Jones      Email: christopher.jones@ukho.gov.uk  
Secretary: David Wyatt      Email: adso@iho.int

TITLE	Reference	Last amendment (CL or IHC)	1 <sup>st</sup> Edition Reference
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<b>DATUMS AND BENCH MARKS</b>	<b>3/1919 as amended</b>	<b>[19/2008]</b>	<b>A2.5</b>
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- 1 It is resolved that the datum of tide/water level observations and predictions for mariners shall be the same as chart datum (datum for sounding reduction).
- 2 It is resolved that chart datum and other tidal/water level datums used should be clearly stated on charts and all other navigational products.
- 3 It is resolved that chart datums (datums for sounding reduction), the datums of tide/water level prediction and other tidal/water level datums shall always be connected with the general land survey datum, and, in addition, with a prominent and permanent fixed mark in the neighbourhood of the tide gauge, station, observatory etc.
- 4 It is resolved that ellipsoidal height determinations of the vertical reference marks used for tidal/water level observations should be made, in order to support the production of seamless data sets; i.e. to allow the translation between data sets with differing vertical datums. It is further resolved that such observations should relate to a geocentric reference system, preferably the International Terrestrial Reference System (ITRS) or one of its realizations e.g. the World Geodetic System 1984 (WGS84).

In oceans and geographical areas connected to oceans

- 5 It is resolved that heights on shore, including elevations of lights, should be referred to a HW datum.
- 6 It is resolved that the Lowest Astronomical Tide (LAT), or as closely equivalent to this level as is practically acceptable to Hydrographic Offices, be adopted as chart datum. Alternatively the differences between LAT and national chart datums may be specified in nautical documents. If low water levels in a specific area frequently deviate from LAT, chart datum may be adapted accordingly.
- 7 It is resolved that Highest Astronomical Tide (HAT) be adopted as the datum for vertical clearances. Alternatively the differences between HAT and national datums for vertical clearances may be specified in nautical documents. If high water levels in a specific area frequently deviate from HAT, the datum for vertical clearances may be adapted accordingly.

Note: LAT (HAT) is defined as the lowest (highest) tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions. It is recommended that LAT and HAT be calculated either over a minimum period of 19 years using harmonic constants derived from a minimum of one year's observations or by other proven methods known to give reliable results. Tide levels should, if possible, reflect the estimated uncertainty values obtained during the determination of these levels.

In geographical areas with limited connection to oceans and negligible tidal range (< 30 cm)

- 8 It is resolved that depths, and all other navigational information should be referred to Mean Sea Level (MSL) or other level as closely equivalent to this as is practically acceptable to Hydrographic Offices.

Note: The adopted level may be a well-defined geodetic datum as used for heights in land survey applications or an observed local Mean Sea Level (MSL) based on long series of water level observations.

- 9 In order to support other non-navigational applications as UNCLOS and also to indicate the characteristics in the area, it is recommended to adopt the mean of yearly lowest/highest water levels observed over a long time period.

Inland Waters

10 It is resolved that depths, and all other navigational information should be referred to an appropriate level practically acceptable to Hydrographic Offices or if needed LW as a reference level for depths and HW for vertical clearances. The selection of which one of the alternatives to be used is a difficult issue which can only be determined locally and which will be largely dependent on seasonal hydrological conditions. LW and HW are defined preferably as the mean of lowest/highest water levels, or as a suitable percentile of lowest/highest water levels, observed over a long time period.

<b>NATIONAL TIDAL CONSTITUENT BANKS</b>	<b>2/1977 as amended</b>	<b>42/2000</b>	<b>A6.8</b>
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It is resolved that the National Tidal Constituent Banks should store the following information for each location:

- a) Location identification by number, name, country, body of water, and geographic coordinates;
- b) Source, date, time zone, and duration of data used in analysis;
- c) Identification of geodetic levelling datum, and date of reference to this datum, elevation of mean sea level and, where applicable, the connection to and identification of the appropriate bench mark(s); and
- d) Listing of values for tidal constituents giving amplitudes in metres and Greenwich phase lags in degrees and designation of organization responsible for analysis. (Tidal constituents used should form part of those in the Standard List prepared by the ~~IHO~~ **TWLWG** and published on the IHO website.)

See also 9/1919 (A 6.1) and 10/1919 (A 6.2).

TIME TO BE USED	27/1919 as amended		G1.2
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It is resolved that the time system employed in printed Tide Tables shall be ~~that actually used~~ Standard Time as observed at the port.

It is resolved that daylight saving time shall not be used in the predictions in the printed Tide Tables but that a notice or caution relative to its use and the period of its application shall be included therein.

It is strongly recommended that the time system employed in Digital Tide Tables (DTT) published in web sites shall be Standard Time as observed at the port, without daylight saving time application. A notice or caution relative to its use and the period of its application shall be included therein. Additionally, DTT can offer to the user the possibility to set automatically another time system.

<b>COLLECTION AND PUBLICATION OF TIDAL DATA</b>	<b>1/1977 as amended</b>	<b>42/2000</b>	<b>A6.7</b>
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It is recommended that Member States gather tidal data from as many locations as feasible and maintain sets of harmonic constants in National Tidal Constituent Data Banks.

It is recommended that Member States make public, using their ~~WEB~~ website or other suitable means, **tidal and tidal stream predictions and** a list of locations included in their own Tidal Constituent Data Banks.



**'Scoping Document'**  
**Dynamic Tides and Water Levels in ECDIS**

**Basic Outline Scope and Requirement**

Generate a time variable layer which displays, as designated by the user, the appropriate available safe water on an ENC in an ECDIS.

Depth variability should be based on the available gridded bathymetric surface or triangulated irregular network (TIN) surface, with water level predictions or near real-time observations, generated from single point, simple zone model, complex zone model or co-tidal models. Also it should be based on forecast meteorological surge where these are available.

The display should be capable of showing predicted tides for voyage planning and near real-time tides for voyage execution.

The metadata associated with the display should be available with the delivered tidal data.

Deliver this information with an ENC, or make it available to be applied to an ENC in an ECDIS.