


Contour Line Bathymetry

Additional Military Layers Production: The Challenge with Supplementing the S-57 ENC



 National Defence
Défense nationale

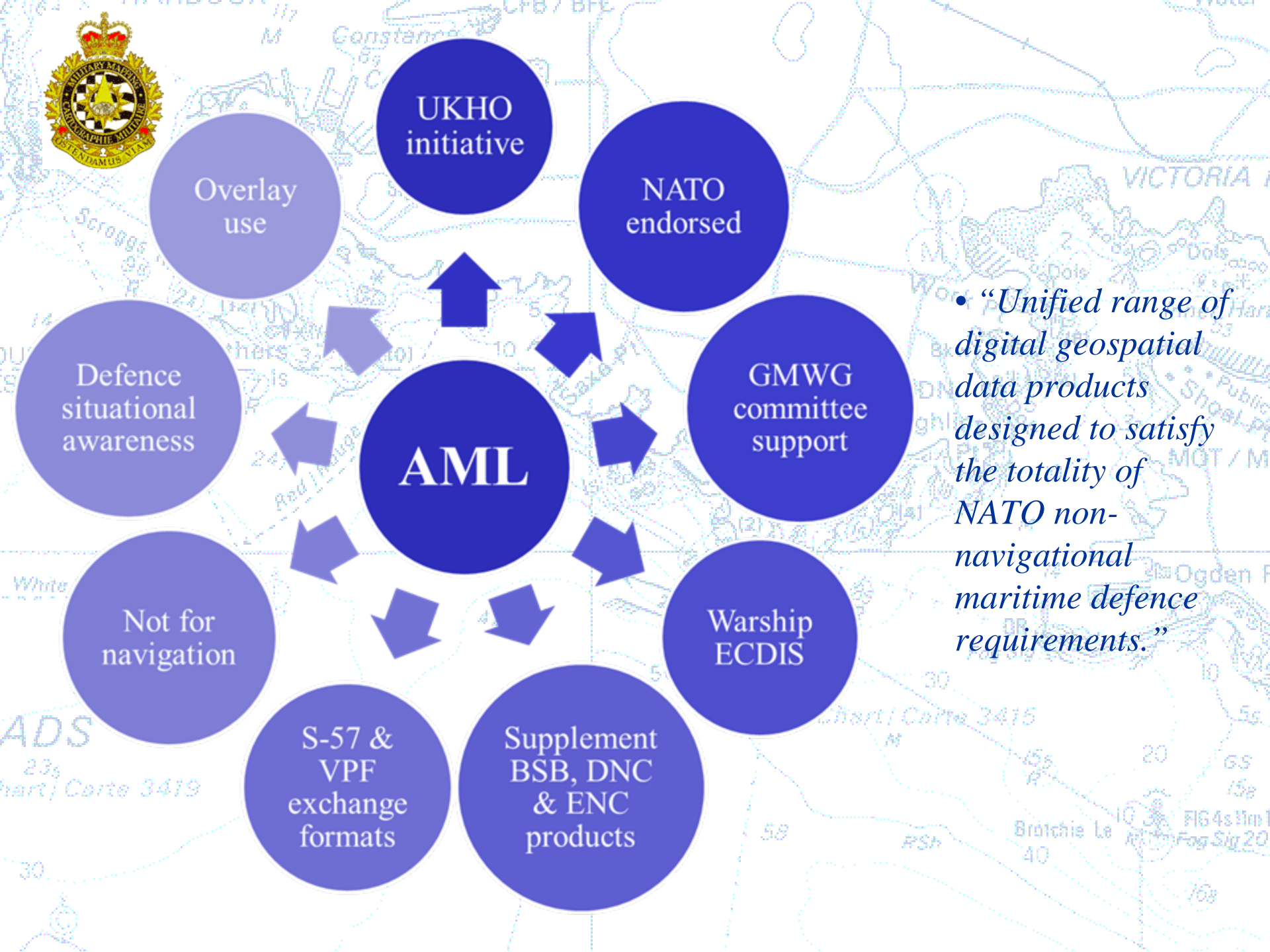


Kevin Jones, B.Sc.
Geomatics Technician
HSO (Esquimalt)



Topics to be Covered

1. Additional Military Layers (AML)
2. Operation PODIUM Contour Line Bathymetry (CLB) AML production
3. Warship ECDIS (WECDIS) AML Display Issues
4. Closing Thoughts



UKHO
initiative

NATO
endorsed

GMWG
committee
support

Warship
ECDIS

Supplement
BSB, DNC
& ENC
products

S-57 &
VPF
exchange
formats

Not for
navigation

Defence
situational
awareness

Overlay
use

• “Unified range of digital geospatial data products designed to satisfy the totality of NATO non-navigational maritime defence requirements.”



- Four revisions of the AML Product Specification:
 - Version 1.0 – October 2001,
 - Version 2.0 – July 2004,
 - Version 2.1 – November 2005, and
 - Version 3.0 – August 2008.
- Canadian AMLs are either Version 1.0, 2.1 or 3.0.
- The AML specification used depends on factors such as *client requirements* and the *type/version of Warship ECDIS used for display*.



Operation PODIUM AML

Contour Line Bathymetry (CLB) Production

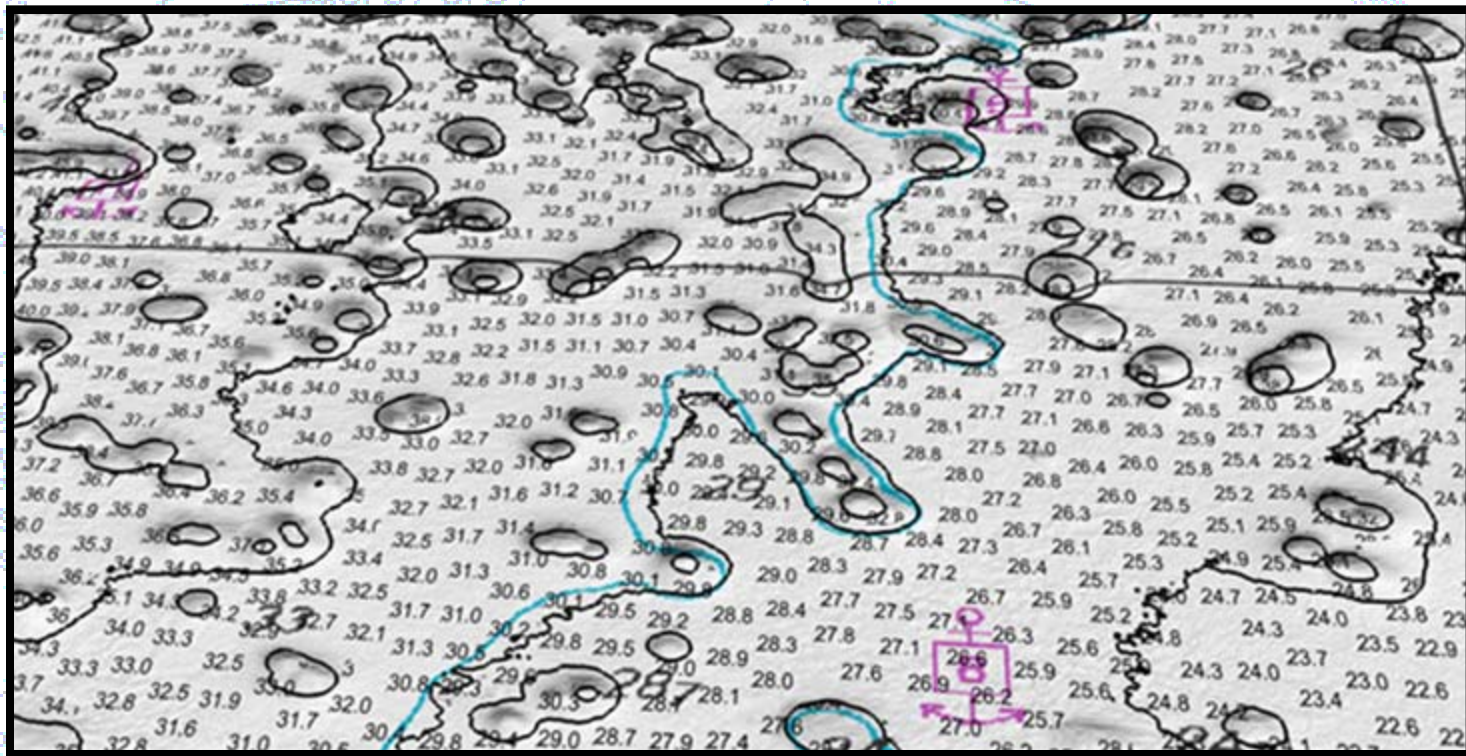




- In February and March, 2010, Vancouver and the resort community of Whistler co-hosted the 21st Olympic and 10th Paralympic Winter Games.
- DND was a key partner within the RCMP-led Vancouver 2010 Integrated Security Unit (V2010 ISU).
- DND support was provided as “Operation PODIUM” through Joint Task Force Games (JTFG).
- The Canadian Navy assisted with maritime surveillance and port security operations.
- HSO produced some Olympic CLB AMLs to support JTFG.



- 2008 – CHS resurveyed Vancouver Harbour with Kongsberg EM1002 and EM3002 multi-beam echo sounders.
- The pockmarks were formed by sediment liquefaction processes during an earthquake event, possibly the last mega-thrust earthquake of 1700 AD.
- The 200+ depressions range in size from 15m to the size of a football field and from 5 to 15m deep. They are found in water depths between 18 to 65m around English Bay and the approaches to Vancouver Harbour.
- The pockmarks are not dangerous to surface navigation but they could have been used to conceal subsurface threats such as mines during the Olympic Games.

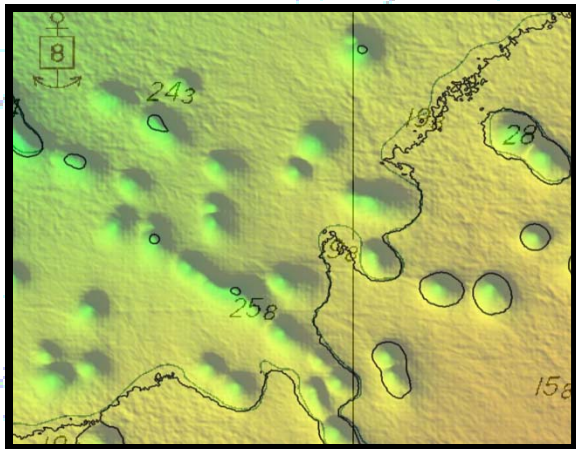


- Nautical charts are not always up-to-date with the latest information.
- Nautical chart sub bottom bathymetry is generalized.
- Produced using the CARIS desktop solutions *S-57 Composer* and *Bathy DataBase*, an AML Contour Line Bathymetry (CLB) product provides enhanced depth information, represented as points (soundings), lines (depth contours), and areas (depth areas).
- CLBs are used for purposes such as tactical ocean operations, mine counter measures (MCM), amphibious operations, and anti-submarine warfare (ASW).

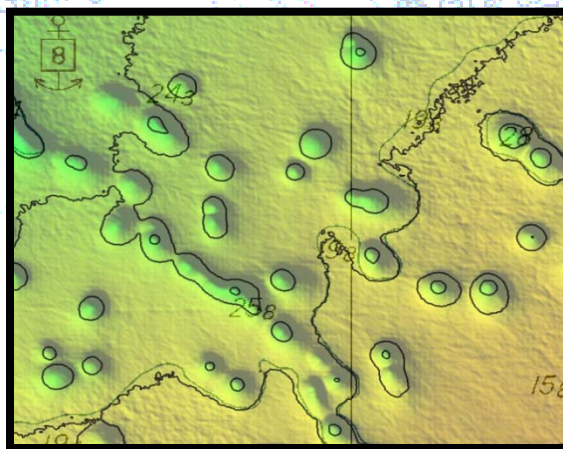


CLB Depth Contours

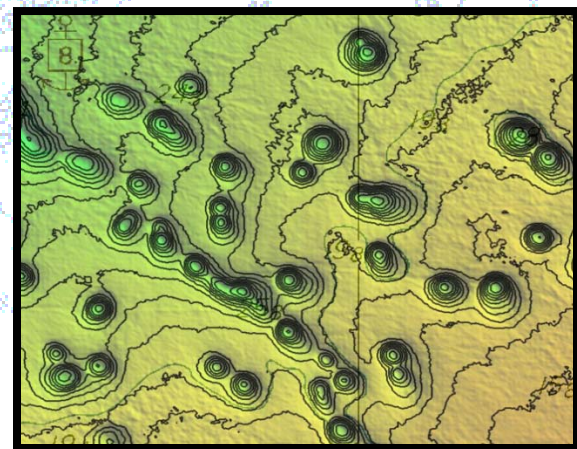
- Determine an appropriate vertical contour interval and contour depth range.
- The contour interval depends on variables such as the AMLs *display scale band* and the *resolution/scale of the existing Product surface*.
- It is a balance between showing adequate seafloor detail while minimizing the obscuring effects of supplemental information in a WECDIS.
- HSO used a 1m (0-10m), 5m (10.1-100m), and 10m (+100m) contour interval for the 1:5,000 scale OP PODIUM CLBs.
- Classifying by an arbitrary choice of breaks between categories can hide a clear trend or oversimplify important detail.



2m (depths 0-2m), 5m (2.1-5m), 10m (5.1-10m), 20m (10.1-20m)... contours.



1m (0-10m), 5m (10.1-100m), and 10m (+100m) contours.

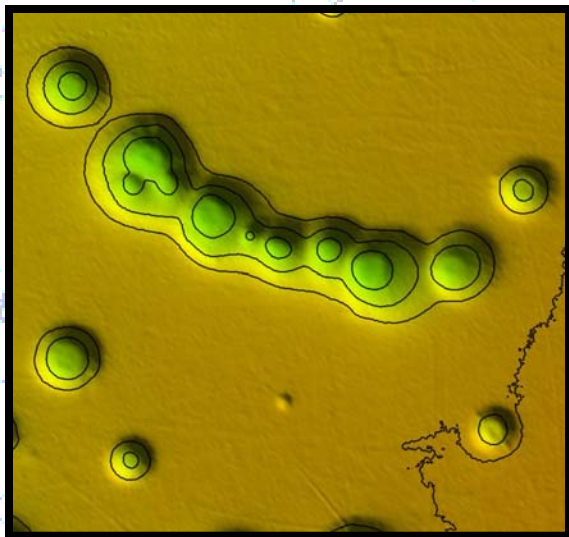


1m (0m to +100m) contours.

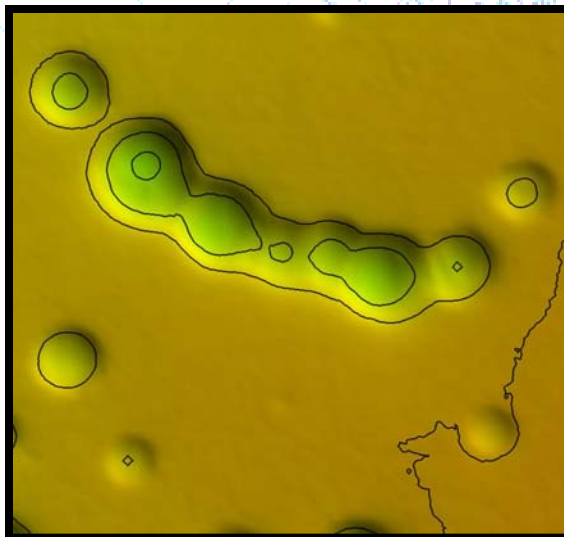


CLB Product Surface Generalization

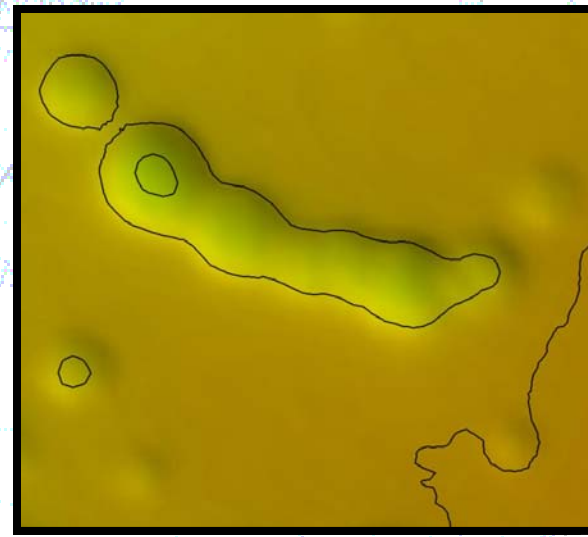
- The Product surface scale should match the scale of the CLB.
- Surface generalization affects the level of seafloor detail and influences the shape and distribution of depth curves during the vector contouring process.
- The same 1m (depths 0-10m), 5m (10.1-100m) and 10m (+100.1m) contouring interval rules were applied to the three BASE surfaces below.
- To create the CLBs, HSO used the generalization algorithm *3D Double Buffering* to produce a 5m resolution 1:5,000 scale surface.
- For a coarse resolution surface (e.g. 10m), an alternative contour interval is required (e.g. 1m contours) to show the pockmarks in sufficient detail.



2m Resolution



5m Resolution



10m Resolution



AML Warship ECDIS Display Issues



8 January 2005 – *USS San Francisco* – Near Guam – Full flank – “Uncharted” seamount appeared on the DNC and BA charts but not on classified bottom charts.



21 February 2007 – German mine hunter *M1064 Grömitz* – Near Norway – Radar error (snowy night conditions) – Charted rock.

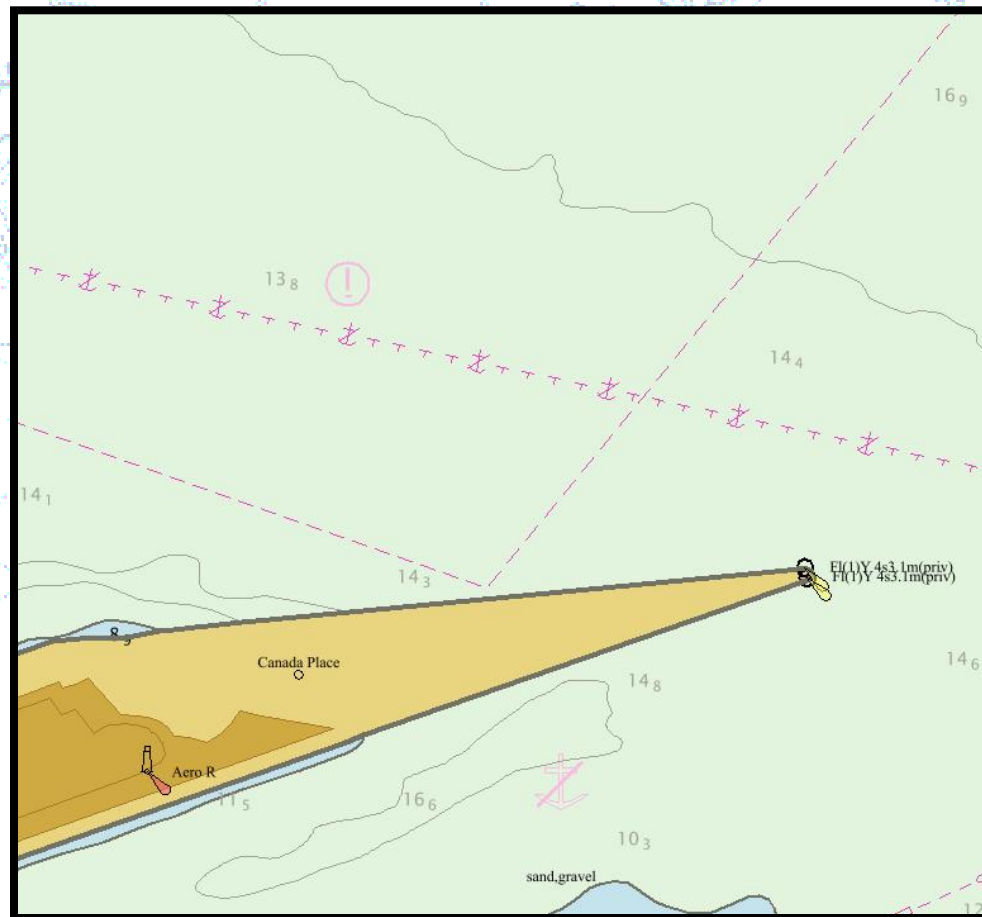
- Could the use of some types of AML supplemental information impact the display of other information in a Warship ECDIS?
- The dangers of relying on a single source of information.



- AML is meant to **supplement but not replace** navigational products such as the S-57 ENC.
- AML is designed to ‘overlay’ with other products.
- The ‘overlay’ of information could mask/obscure critical underlying information required for safe navigation.
- A Contour Line Bathymetry (CLB) AML will obscure an Warship ECDIS chart display window.
- The Warship ECDIS *Offshore Systems Ltd. ECPINS-W Sub* was used to demonstrate the display issue.



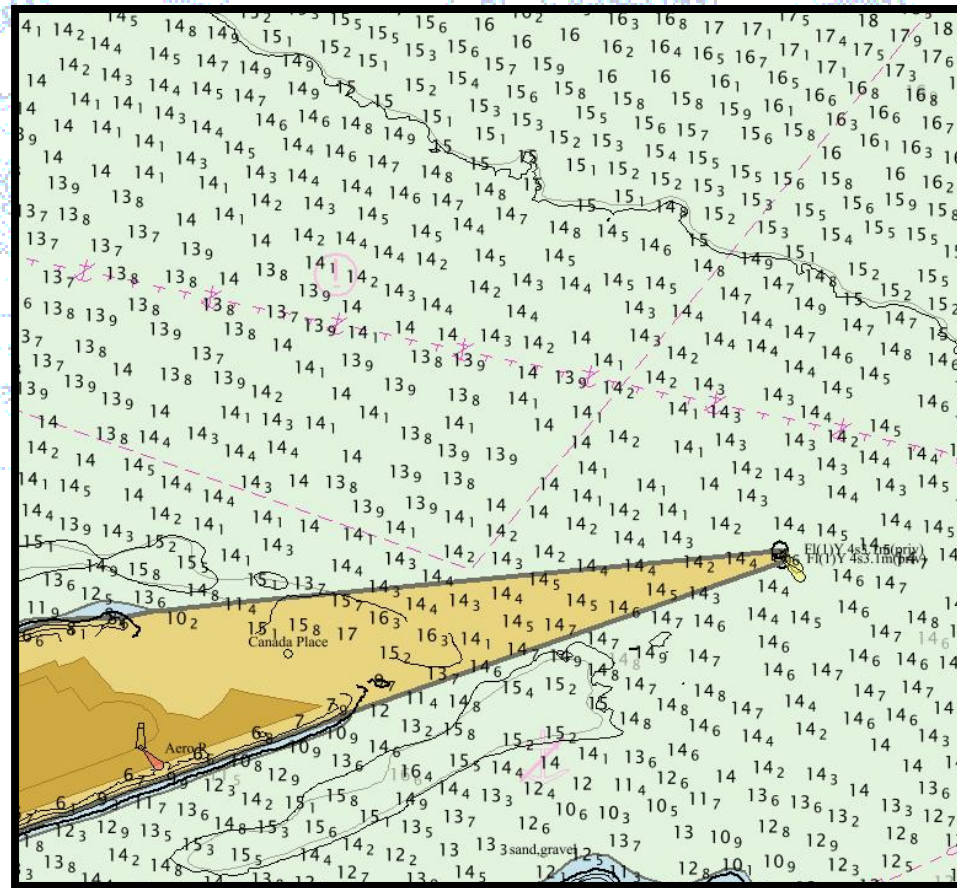
- The ENC below contains features such as: ferry routes, administrative harbour areas, lights, land, restricted areas, shoreline construction and sea-plane landing zones.
 - What do you think will happen to the ENC if the AML is ‘overlayed’?
-
- The AML Depth Area objects visually obscure all underlying ENC information.
 - Are there any solutions?
 - HSO offers two potential solutions to consider:
 1. “Transparent” AML CLB, and
 2. Enhanced Bathymetry ENC.





“Transparent” AML CLB

- An AML consisting of only Depth Contours, Soundings and Metadata objects.
- Group 1 “Skin of the Earth” Depth Area objects are removed from the CLB.
- Ignore some *S-58 Recommended ENC Validation Checks* (i.e. Test 519 - Group 1 coverage and consistency).
- ENC details are not visually masked by the AML CLB ‘overlay’.





Enhanced Bathymetry ENC

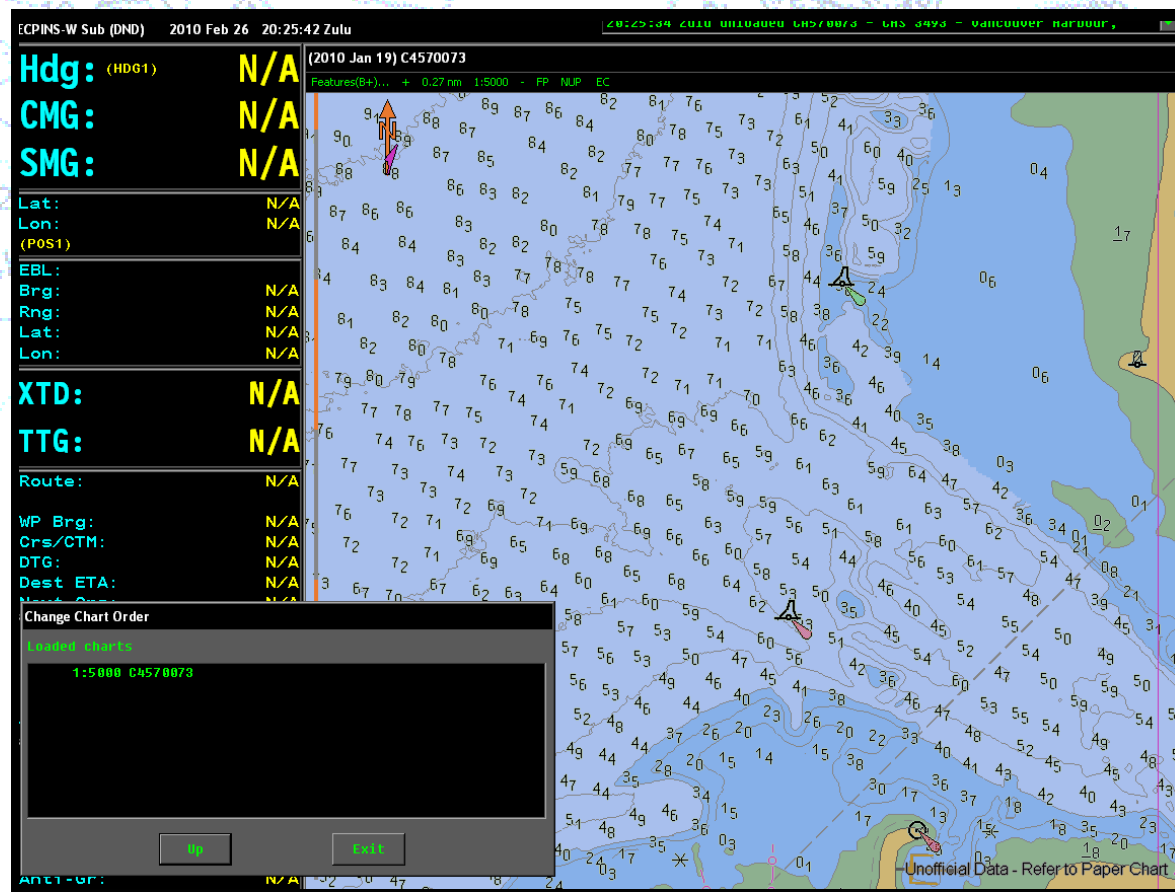
- Bathymetry data is inserted as an 'inlay' and not as an 'overlay' within a standard S-57 ENC.
- Uses the standard IHO S-57 ENC Objects and Attributes catalogue.

- Only sections of the original ENC bathymetry is updated where new hydrographic source exists.

- All other ENC chart elements remain the same.

- *M_COVR* Meta object from the AML CLB is 'inlayed' into the ENC.

- Provides a clear break between original and new bathymetric source.





Closing Thoughts

- HSO (Esquimalt) has been producing AML CLB datasets since June, 2009 with the OP PODIUM Vancouver Harbour datasets being the first produced in-house by DND.
- How does HSO compare and confirm if the datasets Canada produces are consistent with those of other producer nations?
- Existing CLB Product Specification guidelines are ambiguous and vague.
- Determining an appropriate contour interval and level of gridded Product surface generalization is a user defined process that requires the careful use of cartographic licence.
- No guidance from the GMWG concerning how ‘overlay’ supplementary datasets should be produced to prevent the obscuring of underlying navigational information in a WECDIS display.
- The types of supplemental AML information required and how the product displays in an electronic charting system should be based on the opinions and advice of practicing mariners.



Questions?



**National Défense
Defence nationale**



**Kevin H.M. Jones, B.Sc.
Geomatics Technician**

Hydrographic Services Office (Esquimalt)
PO Box 17000 Station FORCES
Victoria, BC V9A 7N2
Ph: 250-363-5342 Fax: 250-363-4889
E-mail: Kevin.Jones2@forces.gc.ca