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INIS HYDRO

Seabed Mapping Technical Specification

INIS Hydro is a project supported by the European Union's INTERREG IVA Programme managed by the Special EU Programmes Body.

INIS HYDRO

Seabed Mapping Technical Specification

Project Summary

Reliable maps of the seabed are essential for safe shipping and for effective management and conservation of the marine environment. While terrestrial maps are largely very accurate, seabed maps are much less so. Many 'current' nautical charts are based on data from the mid-19th century when depth was measured by lowering lead lines to the seabed at wide intervals.

The INIS Hydro project brings together seven partners from the Republic of Ireland and the United Kingdom to generate high-resolution bathymetric charts of 1400 km² of key coastal seabed areas off the coasts of Ireland, Northern Ireland and Scotland using the very best in seabed mapping techniques to collect data to the most rigorous international standards.

The project will contribute to complying with international Safety of Life at Sea requirements, will underpin all forms of marine data including marine geology, habitat and environmental information, and will also enhance oceanographic modelling and marine spatial planning.

On completion of survey operations, the data will be made freely available.

Delivering the INIS Hydro outputs costs in the order of £3.2 million. This investment is supported by the European Union's INTERREG IVA Programme with part funding from the Department of the Environment in Northern Ireland, the Department of Environment, Heritage and Local Government in the Republic of Ireland, the Maritime and Coastguard Agency, the Natural Environment Research Council, and the Northern Lighthouse Board.

Scope



This document details the specification for the INIS Hydro Seabed Mapping Project. The specification is in modular format. Each module may be selected by the commissioning authority for a survey and dictated as mandatory.

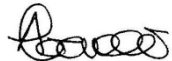
Each module has a unique version number, meaning that the module can be updated in isolation, without all modules needing to be re-released.

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Record of Changes

The table below documents the version history of the INIS Hydro seabed mapping technical specification. The INIS Hydro Project Director has final sign off on all changes made to the specification as a whole or the modules contained herein.

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

Modules

The INIS Hydro Seabed Mapping Specification contains the modules outlined below. The current version number, issue date and the INIS Hydro survey requirement for each module are shown:

Module Title	Current Version Number	Issue Date	Module Required
A - Mandatory Modules			
A1 - Personnel	1	19.04.2013	✓
A2 - Planning & Progress	1	19.04.2013	✓
A3 - Safety	1	19.04.2013	✓
A4 - Deliverables	1	19.04.2013	✓
B - Bathymetry			
B1 - MBES to IHO 1a	1	19.04.2013	✓
C - Positioning and Survey Control			
C1 - Dynamic Positioning	1	19.04.2013	✓
C2 - Static Positioning for Survey Control	1	19.04.2013	✓
C3 - Optical Levelling	1	19.04.2013	✓
C4 - Station Marking and Descriptions	1	19.04.2013	✓
D - Tidal Data and Reduction of Soundings			
D1 - Coastal and Offshore Tide Gauges	1	19.04.2013	✓
D2 - Reduction of Soundings - GNSS and VORF	1	19.04.2013	HI1351, 1354, 1355
D3 - Reduction of Soundings - Tidal Data	1	19.04.2013	HI1353, 1362
E - Environmental Data			
E1 - Water Column	1	19.04.2013	✓
F - Seabed Features and Contacts			
F1 - Wreck Investigations	1	19.04.2013	✓
F2 - Seabed Sampling	1	19.04.2013	✓
F3 - Seabed Classification	1	19.04.2013	✓
G - Additional Data for Charting			
G1 - Navigational Data	1	19.04.2013	✓

Symbols & Abbreviated Terms

ADCP	Acoustic Doppler Current Profiler
AFBI	Agri-Food and Biosciences Institute
CD	Chart Datum
CORS	Continuously Operating Reference Station
DGPS	Differential Global Positioning System
ETRS89	European Terrestrial Reference System 1989
FIG	Fédération Internationale des Géomètres
GDOP	Geometric Dilution of Precision
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GRS80	Geodetic Reference System 1980
GSF	Generic Sensor Format
GSI	Geological Survey of Ireland
HI	Hydrographic Instruction
HMOG	Hydrographic & Meteorological Operational Guidance
IHO	International Hydrographic Organization
IMCA	International Marine Contractors Association
MBES	Multibeam Echosounder
MCA	Maritime & Coastguard Agency
MI	Irish Marine Institute
MSL	Mean Sea Level
NLB	Northern Lighthouse Board
OD	Ordnance Datum
PPP	Precise Point Positioning
RICS	Royal Institution of Chartered Surveyors

RINEX	Receiver Independent Exchange Format
RoS	Report of Survey
RTK	Real Time Kinematic
SAMS	Scottish Association for Marine Science
UKHO	United Kingdom Hydrographic Office
USB	Universal Serial Bus
UTM	Universal Transverse Mercator
VORF	Vertical Offshore Reference Frame
WADGPS	Wide Area DGPS (i.e. multiple reference station)

Acknowledgements

1. UK Civil Hydrography Programme Survey Specification v1.3 – 5/10/12
Maritime and Coastguard Agency

A

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MANDATORY MODULES

Module A1 – Personnel

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements of personnel.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
A2	Planning & Progress
A3	Safety

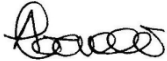
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Requirements

Code	Title	Description
A1 - 1	Charge Surveyor	<p>A Charge Surveyor (Party Chief/Surveyor in Charge) shall be on site at all times during survey operations.</p> <p>The Charge Surveyor shall possess an IHO/FIG Category A accredited qualification (or equivalent) with a minimum of 5 years offshore surveying experience including surveying for Nautical Charting purposes.</p> <p>The Charge Surveyor shall have the authority and experience to make and implement operational decisions and will be available for project partners to contact regularly to assess progress and modify the survey plan if necessary.</p> <p>The Charge Surveyor's other duties and responsibilities shall be arranged such that they do not interfere with the management of the project.</p>
A1 - 2	Survey Team	<p>The Partner shall be able to list the number, qualifications and experience of the survey personnel and provide these to other project partners at any time.</p> <p>Survey teams will include personnel with adequate experience both in charge of and in assisting with all aspects of surveys of complex offshore areas for nautical charting purposes, including office data compilation as well as fieldwork.</p>



Module A2 – Planning & Progress

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the planning and progress requirements.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
A1	Personnel
A3	Safety


4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Requirements

Code	Title	Description
A2 - 1	Permissions	The Partner shall be responsible for arranging all permits, permissions and licenses for access and frequency clearance for all survey operations whether ashore or afloat.
A2 - 2	Fishing Industry	Liaison with, and compensation to, fishermen for loss/damage to fishing gear are matters which rest entirely with the Partner. The Partner is to liaise closely with local fisheries groups and the appropriate local District Fisheries Inspectors well in advance of the commencement of fieldwork.
A2 - 3	Daily and Weekly Progress Report	<p>Progress reports detailing progress, planned activities, weather downtime and any problems encountered shall be completed and e-mailed to the MCA on a daily basis.</p> <p>A short (e.g. 1-page) summary progress report shall be completed and e-mailed to the MCA Project Manager and Project partner manager on a weekly basis.</p>
A2 - 4	Quality Control	Robust quality control procedures shall be provided and adhered to during processing of all data. These procedures shall be available to other project partners.
A2 - 5	Portable electronic media	The Partner shall provide all media required for transferring data from ship to shore and for rendering completed surveys to the UKHO.



Module A3 – Safety

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the safety requirements.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
A1	Personnel
A2	Planning & Progress


4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Requirements

Code	Title	Description
A3 - 1	Responsibility	Equipment and survey personnel provided by the Partner for work in connection with the project shall be the Partner's responsibility at all times. The said equipment and survey personnel and any loss, injury or damage suffered or caused by them shall be at the Partner's risk throughout.
A3 - 2	Safety Management Plan	Partners shall have a safety policy and Safety Management Plan which can be made available to other project partners at any time.
A3 - 3	Drugs and Alcohol Policy	The Partner shall have a drugs and alcohol policy, which forbids the presence of drugs or alcohol in vessels or offices used under this project. Other project partners may ask for evidence of the regime in place at any time throughout the life of the project.
A3 - 4	Daily Meetings	<p>The Surveyor-In-Charge shall hold daily "Toolbox Meetings" with members of the navigational watch. Meetings shall be minuted (briefly), posted in the mess and shall include the following headings as a minimum:</p> <ul style="list-style-type: none"> • Date, Time, List of attendees • Activities - Last 24 Hours • Planned Activities – Next 24 Hours • Safety / Hazards
A3 - 5	Work in poorly surveyed waters	The vessel master is responsible for the overall navigational safety of the vessel and crew. If the master considers that there is a conflict of interest in terms of the safety of the vessel and crew with regard to the proposed survey areas, he has the overriding authority to refuse to survey those areas.
A3 - 6	Medical Certification	All offshore survey personnel must have an in-date medical certificate of at least "ENG1" standard. Evidence of certification may be asked for by other project partners at any time.

<p>A3 - 7</p>	<p>Safety Training Certification</p>	<p>All offshore survey personnel must have in-date certification to demonstrate completion of the STCW 95 Basic Safety Training package including:</p> <ul style="list-style-type: none"> • Personal Survival Techniques (STCW A-VI / 1-1) • Fire Fighting and Fire Prevention (STCW A-VI / 1-2) • Elementary First Aid (STCW A-VI/ 1-3) • Personal Safety and Social Responsibility (STCW A-VI/1 – 4) <p>(Note that survey personnel and supernumeraries may alternatively have in-date certification to demonstrate completion of an Offshore Petroleum Industry Training Organisation approved course adhering to the “Minimum Industry Safety Training Standards”).</p> <p>Evidence of certification may be asked for by other project partners at any time.</p>
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<p>A3 - 8</p>	<p>Familiarisation Training</p>	<p>All offshore survey personnel must undertake familiarisation training prior to sailing which must ensure attendees are able to:</p> <ul style="list-style-type: none"> • Communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarms; • Know what to do if: a person falls overboard; fire or smoke is detected; the fire or abandon ship alarm is sounded; • Identify assembly and embarkation stations and emergency escape routes; • Locate and don lifejackets; • Raise the alarm and have a basic knowledge of the use and types of portable fire extinguishers; • Take immediate action upon encountering an accident or other medical emergency, before seeking further medical assistance on board; and close or open the fire, weathertight and watertight doors fitted in the particular ship, other than those for hull openings. <p>Evidence of training may be asked for by other project partners at any time.</p>
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Module A4 – Deliverables

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the deliverables requirements.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

None

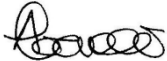
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Requirements

Code	Title	Description
A4 - 1	Data delivery deadline	All data and associated documents are to be rendered to the UKHO before completion of the project.
A4 - 2	Labelling of records & deliverables	<p>Project Name: INIS Hydro</p> <p>Hydrographic Instruction Name: As detailed in each Hydrographic Instruction</p> <p>Hydrographic Instruction Number: As detailed in each Hydrographic Instruction</p> <p>Each rendered item of digital data shall bear a depiction of the INIS Hydro logo, together with the project name, HI name and HI number.</p>
A4 - 3	Report of Survey (RoS)	A Report of Survey (RoS) shall be rendered in digital format in accordance with the latest UKHO requirements for digital RoS for each Hydrographic Instruction.
A4 - 4	"H Forms"	"H Forms" have been designed by the UKHO to facilitate checking and validation of rendered data. The Partner shall always use the appropriate "H Form" where one exists for a process which is undertaken.
A4 -5	Digital Data Media	All Data shall be delivered on USB 3 hard drives or equivalent. No rendered data file shall be larger than 2 Gigabytes in size.
A4 - 6	Retention of data	All raw and processed digital records shall be retained and maintained by the Partner for a period of 2 years from the date of project completion. On completion of this two year period, the Partner may seek permission from all other project partners to dispose of the data as they so wish.

<p>A4 - 7</p>	<p>Data ownership</p>	<p>All data and accompanying documents and records, both working and final, originating from the survey become the property of the European Union and must be handed over on demand. Where appropriate, they are to carry the following official markings:</p> <p>"A project supported by the European Union's INTERREG IVA Programme managed by the Special EU Programmes Body."</p> <div style="text-align: center;">  <p>INIS HYDRO Ireland Northern Ireland Scotland Hydrographic Survey</p> </div> <div style="text-align: center;">  <p>European Union European Regional Development Fund Investing in your future</p> </div>
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B

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BATHYMETRY MODULES

Module B1 – Multibeam Bathymetry IHO Order 1a

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for acquiring bathymetry using beam forming bathymetric sonars (multibeam) to IHO Order 1a Standards.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	Order 1a

3. Related Modules

Module Number	Module Title
C1	Dynamic Positioning
D2	Reduction of Soundings – GNSS and VORF
D3	Reduction of Soundings – Tidal Data
F1	Wreck Investigations
F3	Seabed Classification

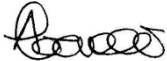
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
B1 - 1	Primary Depth Sensor	Depth will be measured throughout the survey area using a swathe bathymetry system capable of meeting all of the requirements stated below.
B1 - 2	Sounding Uncertainty	Sounding uncertainty in all dimensions shall be in accordance with IHO Order 1a. Equipment selection, positioning methods and calibrations should all take this requirement into account.
B1 - 3	Object Detection	For all parts of the survey area, the minimum size of object detected shall be: Cube with sides of 2 m in depths < 40 m Cube with sides of 10% of depth in depths > 40 m
B1 - 4	Sounding Density	Each object (see above) is to be detected by at least 3 valid data points in the along-track direction and 3 valid data points in the across-track direction, forming a minimum 3x3 grid of 9 data points. To monitor compliance with the Target Detection requirements for a given area, a minimum sounding density of 9 accepted soundings will be achieved in the following bin sizes: Bin with sides of 2 m in depths < 40 m Bin with sides of 10% of depth in depths > 40 m
B1 - 5	Survey line spacing	Not defined as full sea floor search is required.
B1 - 6	Presentation of soundings data	Soundings shall be logged to at least two decimal places of a metre and presented as depths below Chart Datum.
B1 - 7	Shoals and suspected wrecks	All significant shoals together with suspected wrecks located during the course of the survey shall be reported (with respect to position, orientation, extent and least depth). For Wreck investigation requirements see Module F1.

B1 - 8	Backscatter	<p>Full backscatter (format will depend on the sonar manufacturer) shall be recorded at all times during data acquisition.</p> <p>Gain, pulse length or any other system changes that affect backscatter intensities shall be minimised throughout the survey.</p>
B1 - 9	Data Cleaning	<p>All accepted soundings within the final bathymetric dataset shall fall within the IHO Order 1a uncertainty allowance. All systematic errors and obvious outliers shall be rejected from the bathymetric data. Data points falling within the Order 1a depth requirements but still numerically distant from the main dataset will still be regarded as outliers, and should be rejected.</p>
B1 - 10	Crosslines	<p>A minimum of 4 bathymetric crosslines shall be run for each Hydrographic Instruction, at approximately equal spacing, with an optimum of 4 crosslines for each survey block. These crosslines shall be approximately perpendicular to the typical mainline orientation in that block.</p> <p>Crosslines shall be rendered in folders separate from the mainline data structure, and the data should be cleaned to allow for a statistical analysis.</p> <p>A statistical analysis between a cross-line and the main data set is not required in the RoS – the UKHO will undertake their own analysis against compliancy with IHO depth accuracies.</p>

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
B1 - 11	Format of Bathymetric Data	<p>Processed bathymetric data shall be rendered as files in Caris HIPS/SIPS directory format and shall contain the following attributes for each sounding as a minimum:</p> <ul style="list-style-type: none"> a. position and depth; b. swath and beam number; c. backscatter intensity; d. 95% statistical uncertainty estimation for position; e. 95% statistical uncertainty estimate for depth. <p>Corresponding raw (i.e. unprocessed) files shall also be supplied in proprietary format (containing full backscatter). Files shall be full density (i.e. not "thinned") with rejected soundings flagged but not deleted from the data set.</p>
B1 - 12	Format of Backscatter Data	<p>Data shall be provided as a backscatter mosaic in high resolution GeoTIFF format.</p> <p>The backscatter mosaic produced should be a representation of the backscatter intensity across the survey area. Artefacts (e.g. nadir striping, poor data) and backscatter changes within homogeneous areas should be corrected for.</p> <p>A full description of the backscatter processing workflow, software and settings shall be included in the RoS. Where corrective action was taken to produce a high quality backscatter mosaic, the report will detail how this was resolved.</p>
B1 - 13	Hydrographic Note	<p>Reports of any newly discovered dangers to navigation shall be passed immediately to the UKHO, using the H102 Hydrographic Note form.</p>

B1 - 14	Comparison with published charts	The sounding detail shown on the largest scale published UKHO chart of the survey area is to be critically examined and any significant differences reported. In particular, a comment is required for any charted dangers that were not discovered during the survey, or where the least depth found over a danger during the survey is deeper than charted. Any other errors, ambiguities or other defects shall be reported.
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POSITIONING AND SURVEY CONTROL MODULES

Module C1 – Dynamic Positioning

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for acquiring three dimensional dynamic position using Global Navigation Satellite Systems (GNSS).

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	
Guidelines for the use of GNSS in land surveying and mapping. RICS Guidance Note.	Edition 2	Nov 2010	www.rics.org
Guidelines for GNSS positioning in the oils and gas industry – IMCA S 015	Report No. 373-19	June 2011	www.imca-int.com

3. Related Modules

Module Number	Module Title
B	Bathymetry
D2	Reduction of Soundings – GNSS and VORF
D3	Reduction of Soundings – Tidal Data

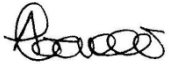
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

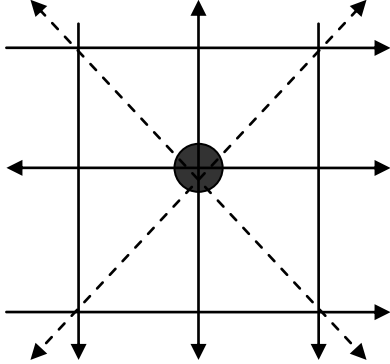
5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
C1 - 1	Vessel Positioning (utilising GNSS Height)	<p>If the use of GNSS height and VORF model for reduction of soundings to datum has been specified by the commissioning agency, three dimensional positions for the vessel and all related sensors are to be derived using dual frequency carrier phase GNSS observations combined with the relevant Ordnance Survey Active Network. This will derive positions referred to the ETRS89 coordinate reference system.</p> <p>Local reference stations may also be established if the relevant Ordnance Survey Active Network is insufficient in the survey area. These stations must meet all the requirements outlined in Sections C & D.</p> <p>If, in a given area, the above methodology proves unreliable, the surveyor may use Precise Point Positioning (PPP) as a secondary alternative.</p>
C1 - 2	Vessel Positioning (not utilising GNSS Height)	<p>If the use of GNSS height and VORF model for reduction of soundings to datum has not been specified by the commissioning agency, then as a minimum differential GNSS meeting the requirements stated in this Module is to be utilised for establishment of horizontal position.</p>
C1 - 3	Position Uncertainty	<p>Position uncertainty in all dimensions to be in accordance with the specified bathymetry module requirements (e.g Module B1 – MBES IHO Order 1a). Equipment selection, positioning methods and calibrations should all take this requirement into account.</p>

<p>C1 - 4</p>	<p>Static Positioning Check</p>	<p>A static positioning check shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor. The check shall monitor the three dimensional position of either the primary GNSS antenna or another appropriate point within the vessel reference frame, for a period of no less than 30 minutes at a 1 minute resolution. The RoS should separately state the computed statistical reliability of both the horizontal position and the height measured.</p> <p>Any local survey control utilised in this procedure shall be compliant with the requirements stated in Sections C and D.</p>
<p>C1 - 5</p>	<p>Dimensional Control</p>	<p>An appropriate dimensional control survey of each vessel utilised shall have been conducted prior to commencement. Permanent and recoverable control points are to be established on each vessel utilised, coordinated to the vessel reference frame to within a tolerance $\pm 0.01\text{m}$ relative (at the 95% confidence level) in X, Y and Z.</p> <p>All relevant components of the positioning system, motion reference units and bathymetry sensors shall be established within the vessel reference frame within a tolerance of $\pm 0.02\text{m}$ relative (at the 95% confidence level) in X, Y and Z.</p> <p>Where appropriate, the rotations of each sensor around the X, Y and Z axis shall be initially determined by the dimensional control survey to within ± 0.5 degrees (at the 95% confidence level). These values will be later further improved and refined during the sonar patch test.</p> <p>The centre of gravity (rotation) should also be estimated and its location within the vessel reference frame and method of establishment clearly stated in the RoS.</p> <p>A copy of the dimensional control report for each vessel shall be supplied with the RoS for each HI.</p>

<p>C1 - 6</p>	<p>Repeatability Test</p>	<p>A sounding Repeatability Test shall be performed at the start of each survey season or after changing out or significantly reconfiguring any survey sensor. This test should be conducted after the static check stated above.</p> <p>The test shall monitor the three dimensional position of a clearly defined small but easily detectable feature on the seabed. The feature should be first surveyed near nadir from multiple directions – as a minimum from north, south, east and west. Secondly the feature should be boxed in, so that it appears in the outer beams on port for 2 lines, and the outer beams on starboard for 2 lines.</p>  <p>The RoS should separately state the computed statistical reliability of both the horizontal position and the depth measured for the feature.</p>
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7. Optional Requirements

None

8. Deliverables

Code	Title	Description
C1 - 7	Format of Positioning Data	Position (and depth) data should be rendered in the format specified in Module(s) B – Bathymetry.
C1 - 8	Coordinate Reference System	All positioning data (real time and post processed) and the rendered RoS shall be quoted in terms of the ITRF realisation of WGS84 or ETRS89 as appropriate to the positioning system. A clear statement shall be included in the RoS and any relevant metadata (including appropriate file headers) stating the Reference Frame used.
C1 - 9	DGNSS Reference Stations	The RoS should include details of all DGNSS Reference Stations used by primary and secondary systems.
C1 - 10	Static Positioning Validations	The RoS should include a description of methodology and separately state the computed statistical reliability of both the horizontal position and the height measured of an appropriate point on the vessel reference frame.
C1 - 11	Repeatability Test	The RoS should include a description of methodology and separately state the computed statistical reliability of both the horizontal position and the depth measured of the seabed feature used during the test.
C1 - 12	Post Processed Data	Should post processing be applied to the real time solution then the following data should be rendered with the RoS: <ul style="list-style-type: none"> a. Processing Project files b. Base station data in RINEX format c. Ephemeris data in SP3 format d. Copy of the system set up parameters e. Diagram of Digital Control f. Smoothed Best Estimate of Trajectory (SBET) format files where appropriate



Module C2 – Static Positioning for Survey Control

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for establishing survey control using static Global Navigation Satellite Systems (GNSS) observations.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	
Guidelines for the use of GNSS in land surveying and mapping. RICS Guidance Note.	Edition 2	Nov 2010	www.rics.org
Virtually Level. RICS Geomatics and Ordnance Survey Guidance Leaflet.			www.rics.org

3. Related Modules

Module Number	Module Title
C3	Optical Levelling
C4	Station Marking and Descriptions

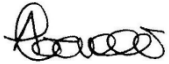
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
C2 - 1	Geodetic Control	Geodetic GNSS observations are to be carried out in support of hydrographic survey operations. Control stations should be installed as required for: use as new tidal benchmarks; as a confidence check on the height of existing benchmarks; to provide geodetic control for the validation of dynamic positioning systems; to extend existing geodetic control as required for the establishment of GNSS reference stations where required.
C2 - 2	Coordinate System	Geodetic control stations and tidal benchmarks should be referred to the ETRS89 datum, GRS80 spheroid. Where any grid coordinates are computed, the appropriate UTM grid zone should be applicable to the area of survey. Observations are to be tied in using Continuously Operating Reference Station (CORS) data appropriate to the survey area, i.e.: Ordnance Survey Active Network; Ordnance Survey Ireland Active Network; IGS data. GNSS derived ellipsoid heights should be converted to orthometric heights using OSGM02. To prevent any misunderstandings or any incorrect assumptions, the actual coordinate reference system of the final coordinates should be stated.
C2 - 3	Equipment	Dual frequency, survey quality GNSS receivers shall be used for all static GNSS observations.

<p>C2 - 4</p>	<p>Observation Method</p>	<p>Survey control shall be determined by 'Static' dual frequency carrier phase GNSS techniques. GNSS stations shall be located with substantially clear sky-view and not close to buildings or other structures that might introduce multipath effects.</p> <p>A minimum of 5 satellites must be observed for the full observation period, with a minimum elevation mask of 10°. GDOP values must not exceed 5 during the observation period.</p> <p>The antenna shall be horizontally located using an optical plummet and tribrach. The height of the antenna above the survey control point should be measured at the beginning and end of each session and recorded and reported. If the vertical reference level of the antenna is offset in the horizontal (e.g. the outer lip of an antenna plate), then the slope distance must be corrected to compute the vertical offset from the survey control point.</p> <p>The antenna and receiver types and serial numbers should be recorded and included in the RoS. Each setup should be photographed and included in the RoS.</p>
<p>C2 - 5</p>	<p>Observation Period</p>	<p>A minimum of six hours observations at 15 second (maximum) intervals are required per station. This six hour observation period should be divided into two three hour sessions. At the end of the first session the antenna should be physically moved away from the mark and then re-established over the mark before commencing the 2nd observation session.</p>
<p>C2 - 6</p>	<p>Redundancy checks</p>	<p>As a gross error check, to confirm the vertical performance of the separation model, and potentially to tie in to pre-existing inconsistent control used on older surveys, control points shall be optically levelled from two pre-existing control points referred to the appropriate Ordnance Datum. In some cases, this levelling requirement may be replaced by an entirely GNSS based redundant technique upon agreement with the INIS representative; for example when pre-existing control proves unsuitable or non-existent.</p>

C2 - 7	Processing Software	<p>The processing software should be able to process Static GNSS observations and be capable of importing and using precise ephemeris. The software should allow the use of NGS antenna phase centre offset calibration data.</p>
C2 - 8	Processing Method and Network Adjustment	<p>GNSS data from a minimum of four CORS appropriate to the survey area, i.e.: Ordnance Survey Active Network; Ordnance Survey Ireland Active Network; IGS data, should be used for processing the observation data. GNSS baselines should be processed using precise ephemeris to the following acceptance criteria:</p> <ul style="list-style-type: none"> a. Baselines <100km b. Horizontal 0.02m+1ppm, Vertical 0.02m+1ppm c. Baselines >100km d. Horizontal 0.05m+1ppm, Vertical 0.10m+1ppm <p>The adjustment of the dataset is to be performed in two stages. An unconstrained network computation shall be run holding one known point fixed. This shall demonstrate that the network is internally consistent and can be used to investigate other outlier baselines, using the following tests:</p> <ul style="list-style-type: none"> e. Network Connectivity Test (ensures that the network is well connected). f. Chi-square Test (a statistical analysis to identify gross errors). g. Tau Test (flags vectors for further evaluation and manual editing). h. Control Tie Analysis (performs an analysis of the control positions) <p>If the results of the unconstrained computation are acceptable, then a constrained computation should be performed, holding all control points fixed.</p>
C2 - 9	Uncertainty	<p>The absolute uncertainty with respect to ETRS89 for any existing or newly established survey control shall not exceed 1cm in horizontal and 2 cm in vertical at the 95% confidence level.</p>

C2 - 10	Booking Sheets	Booking sheets containing all required site and observation information should be completed and retained by the surveyor.
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7. Optional Requirements

None

8. Deliverables

Code	Title	Description
C2 - 11	Coordinate Reference System	All positioning data (real time and post processed) and the rendered RoS shall be quoted in terms of the ITRF realisation of WGS84 or ETRS89 as appropriate to the positioning system. A clear statement shall be included in the RoS and any relevant metadata (including appropriate file headers) stating the Reference Frame used.
C2 - 12	Format of Observation data	Observation data should be rendered in Receiver INdependent EXchange Format (RINEX).
C2 - 13	Format of Control Data	CORS data should be rendered in RINEX format.
C2 - 14	Format of Precise Ephemeris Data	Precise Ephemeris data to be rendered in Standard Product # 3 (SP3) for GPS and GLONASS (if appropriate).
C2 - 15	Reporting of Observations	<p>The RoS should contain the following:</p> <ul style="list-style-type: none"> a. Observation details – Station name, Antenna Type, Height, Height Type (vertical or slant), observation start time, observation period. b. Description of the methods c. A summary of the baselines observed, including stations observed, date and Julian day d. List of control points and co-ordinates e. List of observed points and coordinates f. List of files used in the processing g. Full list of observed baselines, as processed and adjusted vectors. h. Name and versions of any software used for the reduction and adjustment of observations. i. Estimated uncertainty of observations.
C2 - 16	Diagram of Control	The RoS should contain a network diagram showing the geometry of the control framework.

C2 - 17	Baseline solutions, network adjustment results and coordinates.	Copies of the reports produced by the geodetic GNSS processing software should be rendered. This data should contain copies of any computed baseline solutions, the network closures; final constrained network adjustment and transformation parameters.
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Module C3 – Optical Levelling

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for optical levelling.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	
HM Operational Guidance Volume 1 - Hydrography	HMOG 1/12		
Admiralty Tidal Handbook No. 2, Datums for Hydrographic Surveys and other related subjects	NP122(2)		

3. Related Modules

Module Number	Module Title
C4	Station Marking and Descriptions
D1	Coastal and Offshore Tide Gauges

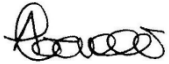
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
C3 - 1	Purpose	<p>As a gross error check, to confirm the vertical performance of the separation model, and potentially to tie in to pre-existing inconsistent control used on older surveys, control points shall be optically levelled from two pre-existing control points referred to the appropriate Ordnance Datum.</p> <p>Levelling is also required to coordinate a tide pole or tidal TBM to the local survey control.</p> <p>In some cases, this levelling requirement may be replaced by an entirely GNSS based redundant technique upon agreement with the UKHO representative; for example when pre-existing control proves unsuitable or non-existent.</p>
C3 - 2	Two Peg Test	<p>A two peg test is to be conducted for each instrument at each location to ensure the instrument has not been damaged or rendered out of calibration during transit.</p>
C3 - 3	Method	<p>Levelling is to comprise a looped traverse, starting on the first known point and finishing on the second.</p> <p>Inter-sights are not to be used, as they offer no redundancy.</p>
C3 - 4	Precision	<p>Levels should be read and recorded to a precision of 0.001m.</p>
C3 - 5	Misclosure	<p>The maximum acceptable misclosure for a looped traverse is 0.02m.</p>

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
C3 – 6	Pre-Existing Control	Where the HI refers to existing benchmarks a report on their condition (or likely destruction if not found) must be made, even if they are not used in the eventual levelling operation.
C3 - 7	Form H535 – Levelling Reduction Form	Details of levelling to a tide pole or tidal TBM to the local survey control are to be rendered on Form H535.



Module C4 – Station Marking and Descriptions

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for installing survey control points and the creation of station description documentation.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
C2	Static Positioning for Survey Control
C3	Optical Levelling
D1	Coastal and Offshore Tide Gauges

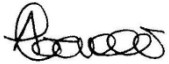
4. Module Author

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5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Requirements

Code	Title	Description
C4 - 1	Geodetic Stations – Purpose	Geodetic control stations can be installed for: use as new tidal benchmarks; as a confidence check on the height of existing benchmarks; to provide geodetic control for the validation of dynamic positioning systems; to extend existing geodetic control as required for the establishment of GNSS reference stations.
C4 - 2	Permanent Marking	<p>All new geodetic stations shall be permanently marked to assist in their future recovery. They shall be marked with either a stainless steel anchor bolt or a brass / bronze surveying bolt drilled into concrete an area where they are unlikely to be disturbed. Stations shall not be established in tarmac. If the bolt is not an expanding anchor type then epoxy resin or similar should be used to secure.</p> <p>The bolt shall be punched to mark the precise horizontal measurement point.</p>
C4 - 3	Temporary Marking	In the event of a temporary mark being required then in order to aid their recovery in the short term they should be marked using stainless steel nails (eg PK Nail or hilti nail); wooden peg or stake; cut mark or punch mark as appropriate to the surface in which they are installed.
C4 - 4	Coordinate System	The coordinate system for geodetic control stations and tidal benchmarks should be referred to ETRS89 datum, GRS80 spheroid. Where grid coordinates are computed, the appropriate UTM grid zone should be applicable to the area of survey. GNSS derived ellipsoid heights should be converted to orthometric heights using OSGM02. To prevent any misunderstandings or any incorrect assumptions, the actual system of the final coordinates should be stated. Coordinates should not be quoted to a greater precision than that of the estimated error.
C4 - 5	Suitability for Position Fixing	An assessment should be a made as to the stations suitability as a site for position fixing systems.

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
C4 - 6	Format of Geodetic Data	A list of all station descriptions rendered is to be included in the RoS. If an existing station has been reoccupied as part of ongoing survey work then any amendments to its description should be included in the RoS. If there are no changes to an existing station then a station description does not need to be rendered in the RoS.
C4 - 7	Form H159 – Description of Station	Descriptions of stations are to be rendered on Form H159. The description should include the coordinates and height of the station; a location description; a detailed description; list of other visible marks; visibility diagram and suitability for positioning fixing systems. Digital photographs, sketches, maps and/or chart extracts should be included to show views of the mark in situ and its immediate locality.



D
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TIDAL DATA AND REDUCTION OF SOUNDINGS MODULES

Module D1 – Coastal and Offshore Tide Gauges

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for establishing coastal and offshore tide gauges.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	
HM Operational Guidance Volume 1 - Hydrography	HMOG		Re-issued annually
Admiralty Tidal Handbook No. 2	NP122 (2)		

3. Related Modules

Module Number	Module Title
B	Bathymetry
C1	Dynamic Positioning
C2	Static Positioning for Survey Control
C3	Optical Levelling
C4	Station Marking and Descriptions
D3	Reduction of Soundings – Tidal Data

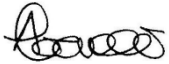
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
D1 - 1	Locations	Tidal heights will normally be required to be measured throughout the survey period and for a minimum of 30 days using a temporary or permanent tide gauge capable of meeting all of the requirements stated below. The location(s) of required tide gauge(s) will be stated in the HI.
D1 - 2	Measurement Uncertainty	All automatic tide gauges (both onshore and offshore) should be capable of resolving water level with respect to the survey control (coastal) or MSL (offshore) to within $\pm 0.01\text{m}$ in height and ± 2 min in time at the 95% confidence level for the duration of the observation period. This uncertainty shall include all of the measurement uncertainty of any pole to gauge comparisons conducted.
D1 - 3	Precision	Heights must be recorded to at least 2 decimal places of precision and at time intervals of at least 10 minutes.

<p>D1 - 4</p>	<p>Coastal Gauges – Pole to Gauge Comparison</p>	<p>All coastal tide gauges must be calibrated by reference to independent readings using a tide pole or 'top down air gap' measurements from a survey control point. Form H143 'Record of Tidal Observations' must be used for this purpose to allow for both the transducer offset from datum and the scale error of the gauge.</p> <p>Readings are to be taken at 20 minutes intervals, with 10-minute interval readings taken for the duration of one hour before to one hour after high and low water. If observing at a location with a tide range larger than 6m, or where the range is perceived to be changing rapidly, the observations are to be taken every 10 minutes, and every 5 minutes for the duration of one hour before to one hour after high and low water.</p> <p>Reports on the Pole to Gauge comparison are to be recorded using the H516 'Summary of Checks on Automatic Tide Gauge' form.</p> <p>When a permanent / established tide gauge is used, a pole to gauge comparison must still be undertaken, unless documented evidence that this check has recently (within the last 6 months) been undertaken by an appropriate owning authority.</p>
<p>D1 - 5</p>	<p>Coastal Gauges – Connection to Survey Control</p>	<p>All survey control points used to coordinate coastal tide gauges shall comply with the requirements stated in Section C.</p>

7. Optional Requirements

<p>D1 - 6</p>	<p>Transfer of Datum</p>	<p>In some cases, the Surveyor may be required to establish a tide gauge at a Standard or Secondary Port, levelled in to Ordnance Datum, and perform a transfer of datum for a minimum of a 39 hour period between this gauge and any newly established gauge in accordance with Admiralty Tidal Handbook No2 [NP122(2)].</p> <p>This requirement will be clearly stated in the HI when necessary.</p>
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8. Deliverables

Code	Title	Description
D1 - 7	Forms H143 & H516	Forms H143 – Record of Tidal Observations & H516 – Summary of Checks on Automatic Tide Gauge shall be rendered as part of the RoS.
D1 - 8	Format of Automatic Tide Gauge Data	Raw tide heights are to be submitted as a digital file, either in text file format (ASCII) or Microsoft Excel format (.xls). Tidal heights are to be rendered in metres already appropriately converted from 'head of water' accordingly. For offshore gauges, appropriate surface air pressure records should also be supplied covering the observation period.
D1 - 9	Comparison with existing tidal data	Comments should be supplied in the RoS regarding the confidence in the rendered tidal height data with respect to previously available / published tidal data for the location / area (such as Admiralty Tide Tables or TotalTide).



Module D2 – Reduction of Soundings - GNSS and VORF

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for reducing soundings using GNSS and VORF.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
B	Bathymetry
C1	Dynamic Positioning
D3	Reduction of Sounding – Tidal Data

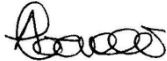
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
D2 - 1	Vessel Positioning (utilising GNSS Height)	Vessel Positioning shall meet the requirement C1-1.
D2 - 2	Reduction of Soundings to Chart Datum	The appropriate VORF CD correction model shall be applied to the vertical component of each sounding to convert all heights from the ETRS89 coordinate reference system to depths in metres above or below chart datum.
D2 - 3	Verification of VORF Model and Vessel Vertical Offsets	<p>At each tide gauge location (including both offshore and coastal gauges), the Partner shall perform a static validation of the VORF model. This comparison shall be conducted by stationing each survey vessel within 1km of the tide gauge location for a minimum of 8 hours and logging corresponding water levels using the GNSS and VORF system, compared to the tide gauge data. This 8 hour period shall include successive high and low water events. The vessel shall be stationary during this period.</p> <p>Comparisons between GNSS/VORF derived tidal heights for the vessel and the observed tidal heights (with co-tidal corrections) from the tide gauge(s) shall be made at regular intervals covering the entire survey period to confirm the VORF values and methodology.</p>

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
D2 - 4	Bathymetry Data	All rendered bathymetry which has been reduced to chart datum shall meet the requirements stated in the relevant module in Section B.
D2 - 5	VORF vs Tidal Comparison	The results of the comparisons conducted in requirement D2-3 should be presented in both tabular and graphical format in the RoS.



Module D3 – Reduction of Soundings - Tidal Data

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for reducing soundings using tidal data.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
B	Bathymetry
C1	Dynamic Positioning
D1	Coastal and Offshore Tide Gauges

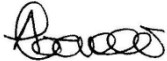
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
D3 - 1	Vessel Positioning (not utilising GNSS Height)	Vessel Positioning shall meet the requirements outlined in Module C1.
D3 - 2	Reduction of Soundings to Chart Datum	Observed tides meeting the requirements stated in Module D1 shall be applied to all sounding data, ensuring that all requirements stated in Section B are met in full.

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
D3 - 3	Bathymetry Data	All rendered bathymetry which has been reduced to chart datum shall meet the requirements stated in the relevant module in Section B.



E



ENVIRONMENTAL DATA MODULES

Module E1 – Water Column Measurements

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the water column measurement requirements.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

None

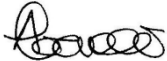
4. Module Author

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5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
E1 - 1	Secchi Disk	<p>Secchi depths are to be collected with an appropriate Secchi disk – for freshwater environments a 20cm black & white quartered disk; for marine environments a 30 or 51 cm all-white disk. Only one type of Secchi disk can be used with a survey.</p> <p>The Secchi disk should be lowered on the shady side of the ship to reduce reflection from the sea surface. The disc should be lowered into the water on a marked lowering line with the ship stopped and drifting. The marks on the lowering line shall be at no greater than 0.5m intervals.</p> <p>Reported Secchi measurements are preferably collected at any point two hours before or after noon. Secchi measurements are not acceptable one hour after dawn or one hour before dusk.</p> <p>During Secchi collection, where possible, all observations should be conducted by the same member of survey staff. Where different observers are used this shall be noted in the deliverables.</p> <p>Secchi depths are to be reported to the decimetre or better.</p> <p>Secchi disk observations shall be undertaken at each sediment sampling location with a spacing no greater than 5 km.</p>
E1 - 2	Sound Speed	<p>The Partner shall observe sound speed profiles as and when required at an interval consistent with the proposed error budget.</p> <p>Evidence of calibration certification may be asked for by other project partners at any time.</p>

7. Optional Requirements

Code	Title	Description
E1 - 3	Water Column measurements	<p>Instruments shall be used to measure one or more of the following water column attributes:</p> <ul style="list-style-type: none"> • Conductivity • Temperature • Density • Salinity • Turbidity • Fluorimetry • Dissolved Oxygen <p>Measurements shall be undertaken at locations and depths the Partner deems appropriate.</p> <p>Evidence of calibration certification may be asked for by other project partners at any time.</p>

8. Deliverables

Code	Title	Description
E1 - 4	H631 Form	An H631 Secchi Disk Observations Reporting Form shall be completed for all Secchi Disk Observations.
E1 - 5	Format of Sound Speed Data	Sound speed records shall be rendered in digital format.
E1 - 6	Format of water column measurement Data	Water column measurement records shall be rendered in ASCII format as well as the proprietary raw data format for the sensor model utilised.



F
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SEABED FEATURES & CONTACTS MODULES

Module F1 – Wreck Investigations

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for undertaking wreck investigations.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
B	Bathymetry

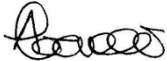
4. Module Author

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Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
F1 - 1	Investigations with Swathe Bathymetry System	<p>All significant non-natural contacts and wrecks located during the course of the survey shall be reported (with respect to position, orientation, extent and least depth).</p> <p>All suspected wrecks are to be further investigated by running one survey line, centred over the centre of the wreck and orientated along the major axis, followed by two further parallel lines offset either side from the major axis. This offset should be estimated to ensure the feature is approximately half way between nadir and the outer beams.</p> <p>Additional lines run at right angles to the first so as to cover the entire length shall also be run.</p> <p>All investigation lines are to be run at as slow a speed as is possible, to maximise the sounding density.</p>
F1 - 2	Swathe Bathymetry Water Column Data	<p>Swathe bathymetry water column data shall be logged for further analysis during all wreck investigation lines. This data shall be analysed in an appropriate software package to compare the data digitised in real time by the swathe bathymetry with other features present in the water column. The Surveyor shall have the ability to re-pick fully georeferenced depths from the water column data for inclusion in the final sounding data if a shoaler depth over a given feature has been found within the water column data.</p> <p>The Partner may be asked to supply details of the procedure and software to be utilised for swathe bathymetry water column data interpretation by other project partners at any time.</p>

7. Optional Requirements

Code	Title	Description
F1 - 3	Magnetometer	<p>All suspected wrecks are to be investigated by obtaining magnetometer data. A minimum of two lines are required, one centred over the centre of the wreck and orientated along the major axis, and the second run at right angles to the first across the minor axis.</p> <p>The magnetometer shall be capable of detecting deflections of 10 nano-Teslars from the background noise.</p> <p>Magnetometer data must be processed onboard the vessel and magnetometer signal strength overlaid, graphically, on a colour-coded bathymetry plot in order to correlate local magnetometer field distortions with potential bathymetric features.</p>

8. Deliverables

Code	Title	Description
F1 - 4	H525 Form	An H525 Report of Wreck Investigation Form shall be completed for each investigation.
F1 - 5	Format of Water Column Data	<p>Images or animations shall be supplied with the RoS showing the water column replay for each wreck to support the designation of least depth.</p> <p>Raw and processed proprietary data formats for all files shall also be rendered.</p>
F1 - 6	Format of Magnetometer Data	Magnetometer data shall be supplied as an electronic file containing lat, long and magnetometer signal strength in a documented file format.



Module F2 - Seabed Sampling

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for conducting seabed sampling.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
B	Bathymetry
E1	Water Column Measurements
F3	Seabed Classification

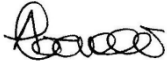
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
F2 - 1	Sampling Resolution	<p>Seabed sampling is to be conducted on an approximate 5 km grid.</p> <p>This grid shall be designed (once the area has been fully surveyed) to target each major textural area identified from backscatter data. At least one sample shall be taken in each major textural area identified.</p> <p>Likely or charted anchorages shall also be sampled irrespective of the wider sampling regime.</p> <p>A maximum of three attempts should be conducted at each location in order for a sample to be obtained.</p>
F2 - 2	Sampling Equipment	<p>The sampling device should be appropriate for the anticipated substratum (note that accurate particle size analysis requires a minimum of 10,000 particles in the largest diameter class).</p> <p>Samples are to be taken with the ship stopped in the water or with samplers fitted with underwater positioning equipment, e.g. USBL (Ultra-Short Base-Line).</p>
F2 - 3	Munsell Colour	<p>On recovery of a sample, the Munsell colour shall be determined.</p>
F2 - 4	Sample Photographs	<p>A photograph shall be taken of each sample on a plain white background with a ruler or scale bar clearly included.</p>
F2 - 5	Sample Classification	<p>The surface substratum shall be documented using the simplified Folk classification below:</p> <ul style="list-style-type: none"> • Rock / Sediment Absent • Mud and sandy mud • Sand and muddy sand • Mixed sediment • Coarse sediment • Pelagic Ooze

F2 - 6	Sample Preservation	Plastic screw top containers are to be used to preserve the samples. The use of polythene bags for preserving samples is not acceptable.
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7. Optional Requirements

None

8. Deliverables

Code	Title	Description
F2 - 7	H575 Form	An H575 Record of Seabed Samples and Cores form shall be completed.
F2 - 8	Sample Photographs	Photographs of each sample should accompany the H575 form.
F2 - 9	Digital Data Format of Seabed Sampling	The surface substratum classified using the simplified Folk classification must be rendered in an ESRI Shape File format. Each sample shall be expressed as a point and shall contain the attributes included in the H575 form.
F2 - 10	Retained Seabed Samples	Plastic screw top containers are to be used to preserve the samples. The use of polythene bags for preserving samples is not acceptable. All samples are to be forward to a laboratory undertaking a Nationally recognised external quality control scheme, e.g. NMBAQC (National Marine Biological Quality Assurance Quality Control) or the British Geological Survey.



Module F3 - Seabed Classification

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the requirements for classifying the texture of the seabed.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

Module Number	Module Title
B	Bathymetry
F2	Seabed Sampling

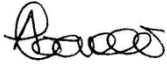
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: Maritime & Coastguard Agency

Email: robert.kinnear@mcga.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
F3 - 1	Seabed Classification	<p>Bathymetry, backscatter and ground truthing information (eg: sediment samples, video trawls) are to be used to produce a seabed texture classification of the entire survey area.</p> <p>The requirements and attributes for the complete classification are outlined in F3-2 through F3-6.</p> <p>This list is not absolute and any extra features may be added at the discretion of the Partner.</p>
F3 - 2	Seabed Substratum	<p>The seabed substratum must be documented using either the full Folk sediment classification or the simplified Folk classification:</p> <p>Full Folk classification</p> <ul style="list-style-type: none"> • Rock / Sediment Absent • Mud • Sandy Mud • Muddy Sand • Sand • Gravelly Sand • Gravelly Muddy Sand • Gravelly Mud • Muddy Gravel • Muddy Sandy Gravel • Sandy Gravel • Gravel • Pelagic Ooze <p>Simplified Folk classification</p> <ul style="list-style-type: none"> • Rock / Sediment Absent • Mud and sandy mud • Sand and muddy sand • Mixed sediment • Coarse sediment • Pelagic Ooze

<p>F3 - 3</p>	<p>Mobile Sediment Areas</p>	<p>Areas of Mobile Sediment identified in the survey area are to be documented using the following feature types:</p> <ul style="list-style-type: none"> • Sandwave Area • Ribbon Area • Ripple Area
<p>F3 - 4</p>	<p>Other Seabed Texture Areas</p>	<p>Areas of Seabed Texture identified in the survey area that are not mobile sediment are to be documented using the following feature types:</p> <ul style="list-style-type: none"> • Scour Area • Thermal Vent Area • Vegetation Area
<p>F3 - 5</p>	<p>Seabed Texture line features</p>	<p>Seabed Texture features identified in the survey area that can be represented as lines are to be documented using the following feature types:</p> <ul style="list-style-type: none"> • Sandwave Crest • Bedrock Scarp • Ridge • Cable • Scour Line
<p>F3 - 6</p>	<p>Seabed Texture point features</p>	<p>Seabed Texture features identified in the survey area that can be represented as points are to be documented using the following feature types:</p> <ul style="list-style-type: none"> • Sediment Sampling Point • Pockmark • Seabed Spring • Wreck (Charted & Non-Charted) • Sonar Contact (< 5 m) • Large Bottom Object (> 5 m other than wreck) • Highly Reflective Patch

7. Optional Requirements

None

8. Mandatory Deliverables

Code	Title	Description
F3 - 7	Digital Data Format of Seabed Classification	<p>The seabed texture classification must be rendered in an ESRI Shape File format.</p> <p>Shapefiles may be either a polygon (areas), polyline (line), or polypoint (point). Each feature type must be created using the most appropriate shapefile geometry.</p> <p>Each feature type should be contained in one shapefile (note that many instances of that feature type may exist within the shapefile).</p> <p>Where polygon shapefiles are required, all areas should butt join to each other (i.e. no gaps or overlapping).</p> <p>ESRI ISO 19115 Metadata should be fully populated and must include geospatial information.</p>

9. Optional Deliverables

Code	Title	Description
F3 - 8	Data Format of Seabed Classification	<p>A PDF sheet showing the complete seabed texture classification shall be rendered.</p> <p>The document is to contain a legend, scale bar, location map, project title, equipment used, data projection and any other notes.</p>



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ADDITIONAL DATA FOR CHARTING MODULES

Module G1 – Navigational Data

1. Introduction

This module of the INIS Hydro Seabed Mapping Specification details the navigational requirements.

2. Related Standards and Documents

The relevant sections of the following documents are to be adhered to in full in conjunction with this module;

Name	Version Number	Date of Issue	Comment
Standards for Hydrographic Surveys. Special Publication No. 44	Edition 5	February 2008	

3. Related Modules

None

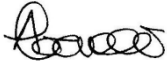
4. Module Author

Suggested amendments or updates should be sent to:

Organisation: UK Hydrographic Office

Email: david.parker@ukho.gov.uk

5. Record of Changes

Version	Date	Status	Approved	Signature
0.1 (Draft)	10.10.2012	Working draft	-	-
1.0	19.4.2013	First Release	AVC	

6. Mandatory Requirements

Code	Title	Description
G1 - 1	Eddies and Over-falls	<p>Observations of any eddies or over falls which may be significant to small craft are to be rendered in the RoS, stating the approximate geographic extents of such features, and how they relate to tidal and weather conditions.</p> <p>All previously charted eddies and over-falls must be reported on, even if just to state that the current charted information is correct.</p>
G1 - 2	Amendments to sailing directions	<p>The relevant Admiralty Pilot shall be checked in the field and appropriate amendments rendered. Particular attention shall be paid to any recommended approach routes and anchorages within or adjacent to the survey area. If no changes to the relevant Admiralty Pilot are thought to be required by the Partner, this should also be recorded in the RoS.</p>
G1 - 3	Views for sailing directions	<p>Details of photographs required to update existing views in the relevant Admiralty Pilot will be supplied in each HI. Views shall be supported by appropriate records in accordance with NP100 paragraph 4.83. New photography shall be in colour and prepared in accordance with NP100. Digital cameras shall be used and must be either Single Lens Reflex or described by their manufacturer as a "Bridge" or "Bridging" camera and shall have at least 6M pixel resolution.</p>
G1 - 4	Fixed and floating aids to navigation	<p>The positions and characteristics of all fixed and floating aids to navigation visible from the survey area are to be determined. Photographs are only required to support information where it differs from that included in current UK nautical charts and publications.</p>
G1 - 5	Leading Lines & tracks	<p>The leading lines and recommended tracks along channels and into harbours and anchorages must be very carefully examined. Their bearings, together with the characteristics of associated lights, are to be carefully checked and verified against the charted information and the Lights' List.</p>

<p>G1 - 6</p>	<p>Light characteristics</p>	<p>Light characteristics and sectors shall be rendered. They are to be compared with the entry in the current Admiralty List of Lights Volume A NP74, amended to date. Light sectors are to be checked against the entry in the remarks column (column 8). Column 8 TE/(T)/(P) remarks should also be confirmed or denied especially the more historic entries. Any amendments are to be noted in the RoS. Significant changes which could lead to a danger to navigation are to be reported immediately to the UKHO.</p> <p>All leading lights and light sectors must be reported on, even if just to state that the current charted information is correct.</p>
<p>G1 - 7</p>	<p>Magnetic Anomalies</p>	<p>Charted or newly discovered magnetic anomalies are to be investigated.</p> <p>The ship should be steamed slowly in a wide octagon shape centred on the charted anomaly, both to port and starboard, made with the standard magnetic compass on 8 equidistant points during each turn. The ship should be steadied on each heading for at least a minute before the observation to allow the sub permanent magnetism resulting from the last course, to disappear. On each leg of the octagon, both magnetic and GNSS derived headings shall be logged and compared.</p> <p>Any anomaly found, or not found, shall be reported in the RoS, including the extent and magnitude of local variations.</p>

7. Optional Requirements

None

8. Deliverables

Code	Title	Description
G1 - 8	Admiralty List of Lights & Pilot	Amendments to the Admiralty List of Lights and Admiralty Pilot shall be rendered in digital format.
G1 - 9	Photographs	Photographic views shall be rendered in digital format.

