Nō te rere moana Aotearoa
MARITIME NEW ZEALAND

Land Information New Zealand
Toitū te whenua

Good Practice Guidelines for Hydrographic Surveys in New Zealand Ports and Harbours

New Zealand Government

Good Practice Guidelines for Hydrographic Surveys in New Zealand Ports and Harbours

Last updated: November 2020

This document is uncontrolled if printed. Please refer to the Maritime New Zealand website for the latest version.

In this guide

In this guide (continued)

1. Introduction

These guidelines provide guidance to decision-makers and operators for planning, carrying out and managing hydrographic surveys that:

- support the safe navigation of vessels in New Zealand ports and harbours
- help to protect our marine environment.

The guidelines have been produced by Maritime New Zealand (Maritime NZ) and the New Zealand Hydrographic Authority, Land information New Zealand (LINZ).

They are one of a series of guideline documents that support the New Zealand Port and Harbour Marine Safety Code 2020 (the Code) published by Maritime NZ. These guidelines are authorised under the Code.

The Code is a voluntary national standard for the safe management of marine activities in New Zealand ports and harbours, and supports national and local legislation. The Code applies to:

- operators of commercial ports
- councils, as local regulators of maritime activity within their regional waters
- Maritime NZ, as the national regulator of maritime safety and marine protection.

The objective of the Code is to ensure the safe management of ships navigating in New Zealand ports and harbours, including the prevention of:

- injury to people or loss of life
- damage to the environment, particularly to the marine environment, but also to property.

These guidelines inform and support all those involved in decision-making processes for planning, contracting, specifying and conducting hydrographic surveys in New Zealand ports and harbours.

There are three core sections to the guidelines.

- Section 2 is an overview for councils and port operators who are responsible for navigational safety of New Zealand ports and harbours.
- Section 3 is guidance for harbourmasters, port engineers and surveyors who are responsible for managing surveys.
- Section 4 is guidance for hydrographic surveyors who provide hydrographic survey services to councils and port operators.

Annex 1 has extracts from the Code relevant to hydrographic surveying and Annex 2 gives information on Category of Zone of Confidence (CATZOC).

2. Overview for port operators and councils

This section is for port operators and councils who are responsible for navigational safety of New Zealand ports and harbours. There is information on what to consider when hydrographic surveys are being commissioned, for example, complying with the New Zealand Port and Harbour Marine Safety Code (the Code) and the business needs of the port.

Read the Code at **www.maritimenz.govt.nz**

2.1 Port operator and council responsibilities under the Code

Port operator and council responsibilities are laid out in the Code[1]. Parts of the Code relevant to hydrographic surveys include requirements that:

- port and harbour safety plans have provisions for hydrography (see Harbour safety plans, pages 26–27 of the Code)
- information is provided on the height of tide as well as other relevant observations to harbour users (see Prevailing and forecast conditions, Appendix 1 of the Code)
- there is a clear policy on hydrography (see Hydrography, Appendix 1 of the Code).

See Annex 1 of these guidelines to read these sections of the Code in full.

Responsibilities include port operators monitoring and maintaining navigable channels necessary for the safe operation of the port and to take reasonable care to ensure that stated water depths are correct.

Councils are responsible for providing adequate information about harbour conditions so that users can determine whether they are safe. These responsibilities mean that port operators and councils must work closely together.

[1] *The Code (pages 16 and 17).*

The harbourmaster, who is usually appointed by the council, can oversee the relationship between the port operator and council, and ensure that a Safety Management System (SMS) is in place. This includes the requirement to carry out hydrographic surveys to support the safe operation of the port and harbour.

Typically, the port operator focuses on a port's commercial areas and carries out the hydrographic surveying, monitoring and dredging required for the safe operation of the port. The harbourmaster has oversight to ensure this is happening. Councils have a conservancy role and are generally responsible for a larger area beyond the commercial port.

Councils may be responsible for some areas of the port that do not come under the commercial interests of the port operator (eg, marinas, small boat berths and recreational areas). Councils and port operators should work together to agree who is responsible for hydrographic surveying and dredging, and this should be documented. Generally, hydrographic survey resources focus on commercial port areas since vessels in these areas operate closer to the limits of safe navigation.

The Code[2] emphasises that accurate hydrographic information is essential for safe navigation and there should be a clear policy on hydrography. The harbourmaster and the port operator should develop the policy together. Both are responsible for ensuring that relevant hydrographic information for the port and harbour is readily available, accurate and up to date. The hydrographic policy is part of the SMS and includes procedures required to give effect to the policy.

2.2 The need for hydrography

Hydrography underpins almost every activity associated with the sea, including safety of navigation, protection of the marine environment, national infrastructure development and coastal zone management.

Modern nautical charts are required for safe navigation through the waters of a country and to enter its ports. Inadequate nautical charts can inhibit or prevent the development of maritime trade. As an island nation, we are highly dependent on international trade and the majority of goods by tonnage entering and leaving New Zealand do so through ports and harbours.

Internationally, the commercial pressure to drive down costs has meant that ships are getting bigger.[3] In New Zealand, ports and harbours are now visited by increasingly larger vessels, especially container and cruise ships that are challenging the limits of ports' capacity to accommodate them. Most notable is the manoeuvrability of large ships within the confined waters of a port. The full extent of designated channels, berths and swing basins need to be defined by high-quality surveys for ships to safely enter and depart a port.

The public is generally more aware of the environmental impact of shipping and is less tolerant of environmental damage. This is reflected in one of the Code's objectives: preventing damage to the environment.

[2] *The Code, Hydrography (page 31).*

[3] *Bigger ships – what are the implications for New Zealand? NZIER report to NZ Shippers' Council, 5 December 2017.*

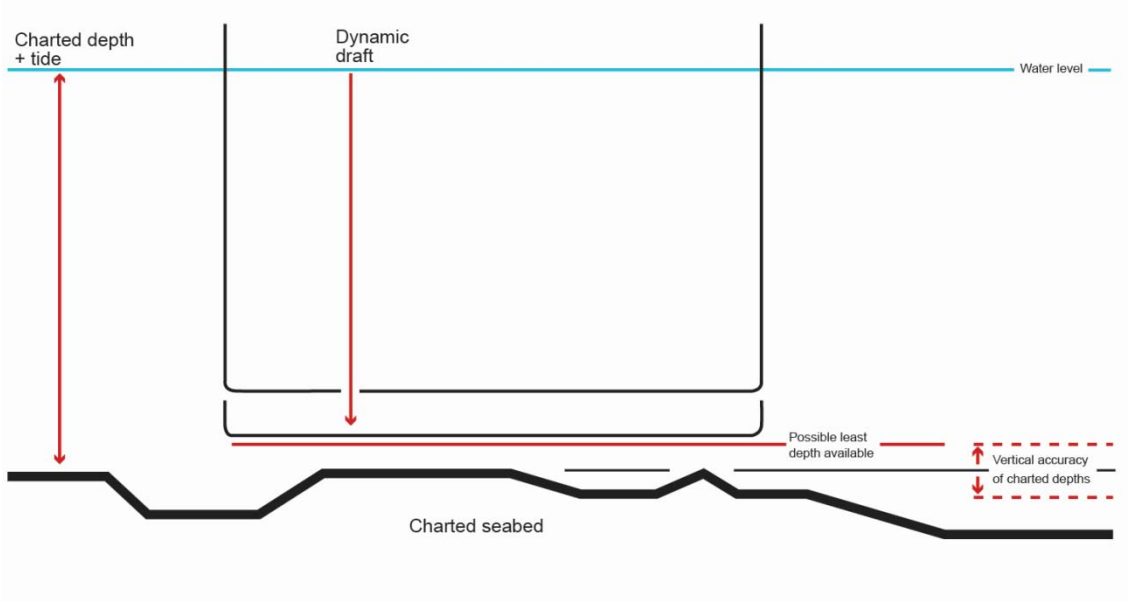
2. Overview for port operators and councils (continued)

For larger ships with reduced operating margins, and with minimal tolerance for adverse environmental impact, the potential financial consequence of an incident can be great.

The responses to meet these challenges are all generally dependent on improved hydrographic information. There is greater reliance on the quality and accuracy of the underlying hydrographic survey data and the requirement for full and comprehensive seabed coverage.

Computer-based modelling assesses the operating characteristics of larger ships in ports and determines safe operating margins. Bridge simulations are routinely used to train marine pilots and rely on accurate hydrographic data to faithfully represent the parameters of a specific port.

Ports have developed Dynamic Under-Keel Clearance (DUKC) systems that accurately model the characteristics of vessels using the port under different environmental conditions. This allows vessels to use the port with a reduced under-keel clearance while maintaining an acceptable level of risk. Larger vessels can use the port safely and, where the height of tide is a constraint, the tidal window may be extended. The accuracy of the charted depth, determined through a hydrographic survey and the observed tide level, are critical parameters in these systems.



Vertical accuracy of charted depth, a critical parameter of a DUKC system[4]

[4] *Reproduced with permission from the Australian Hydrographic Office, published in AHP20 Supplement: Mariner's Guide to Accuracy of Depth Information in ENC.*

The International Maritime Organization's (IMO) development and implementation of e-navigation[5] to enhance berth-to-berth navigation using an Electronic Chart Display and Information System (ECDIS) with Electronic Navigational Charts (ENC) improves navigation safety and protection of the environment. Ships can navigate more precisely and have the potential to use the maximum available water when entering ports. This can only happen if the underlying bathymetry is comprehensive and accurate.

Accurate measurement and comprehensive coverage of the seabed through high-quality hydrographic surveys underpins the safe operation of every port and harbour in New Zealand.

Factors to consider when carrying out hydrographic surveys

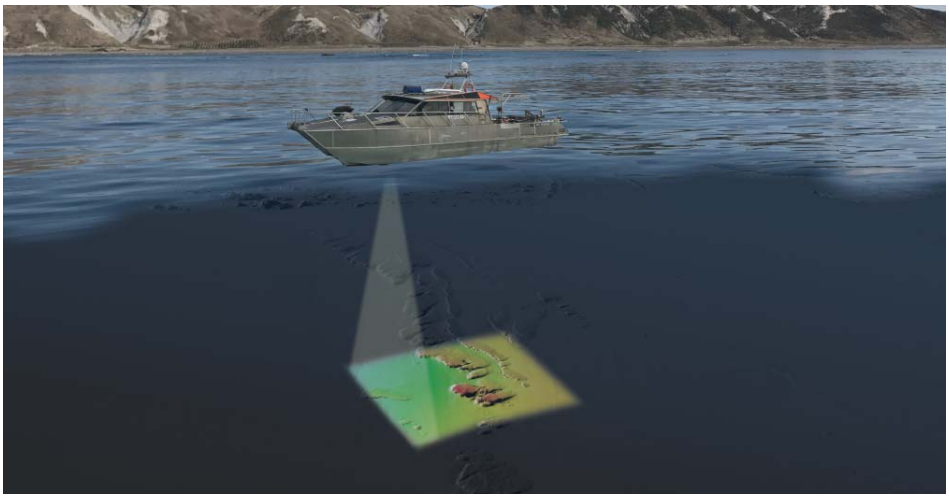
Ensure technology is fit for purpose

The trend towards larger ships and reduced operating margins has been accompanied by an improvement in the technology available to hydrographic surveyors.

Satellite positioning systems are now universally employed and new technology has dramatically improved horizontal and vertical accuracy and reliability. Motion sensors are fully integrated into survey systems to correct for swell and vessel motion. Multi-beam echo sounders (MBES) provide full coverage of the seabed at a high resolution, where significant seafloor features are detected and depths measured.

MBES is now the preferred technology for mapping the seabed. However, other established technology can provide data that is fit for purpose to meet port and harbour requirements.

Integrated survey systems are complex and must be carefully calibrated and operated to ensure the data that is collected meets the required survey standards.



Full seafloor coverage using MBES technology

[5] *E-navigation is defined as the harmonised collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth-to-berth navigation and related services for safety and security at sea and protection of the marine environment. See www.imo.org/en/OurWork/safety/navigation/pages/enavigation.aspx*

Use appropriately qualified and experienced personnel

It is recommended that surveys are overseen by appropriately qualified and experienced personnel given the complexity of survey systems. The hydrographic surveyor is responsible for conducting the survey. They provide direction and supervision at all stages of the survey, from planning to delivering the results, and they provide assurance that all requirements have been met.

Ensure surveys are conducted to a recognised standard

Hydrographic surveys should be conducted to a recognised standard. The International Hydrographic Organization (IHO) publishes international standards and the New Zealand national standards are published by LINZ, based on the IHO standards.

Meeting the standard gives assurance that hydrographic information is fit for purpose and meets the needs of the port and harbour operations.

Ensure the required accuracy is achieved

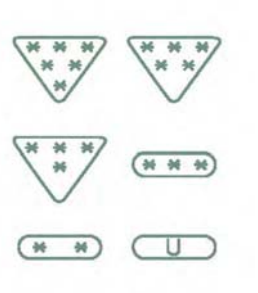
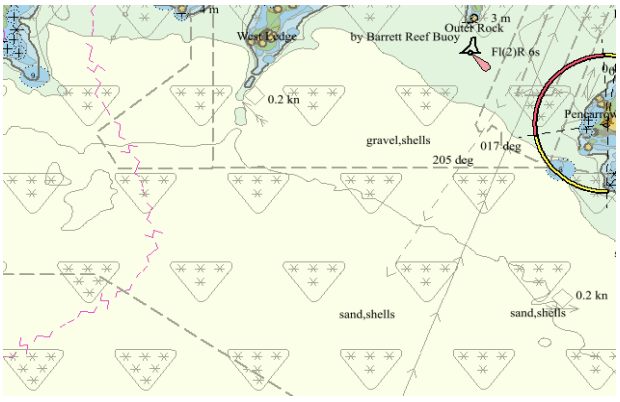
The hydrographic surveyor must confirm and provide evidence that the required accuracy has been achieved. This gives the port operator or council confirmation that the standard is achieved.

2.3 The importance and benefits of a high-quality survey

There are benefits to high-quality hydrographic surveys being carried out by experienced and qualified personnel to a recognised standard, and using equipment that provides full coverage of the seafloor.

Using MBES technology ensures the entire area is examined and that the position, extent and least depth of potential hazards to shipping (man-made or natural) are identified. Full seabed mapping enables a comprehensive understanding of the dynamic nature of the seabed and, in particular, critical shoal areas in port and harbour navigation channels and berths.

High-quality survey data, compiled into official ENCs produced by a national authority, provides a high level of confidence for passage planning and the safe conduct of a ship through confined waters. Official ENCs have a quality rating based on the age of the survey data and the survey methodology. The A1 and A2 rating can only be achieved using a survey system that provides full seafloor coverage.

ENC ZOC Symbols 	6 stars = A1	
	5 stars = A2	
	4 stars = B	
	3 stars = C	
	2 stars = D	
	U	

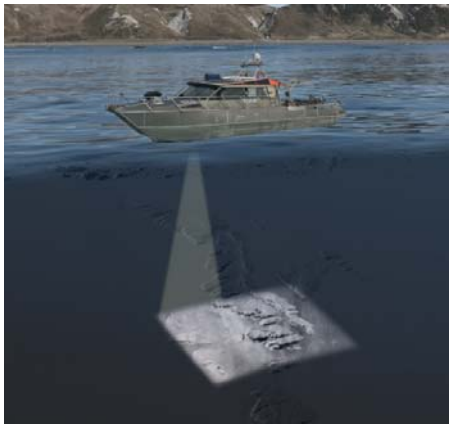
Zones of Confidence symbols, categories and depiction on an ENC

Dredging to maintain channel depths is a significant cost of running a port. It is important to accurately calculate how much material needs removing and to confirm the correct depth is reached during and after dredging. Routine monitoring of channels and berths is important to maintain confidence that the notified depth is preserved, particularly in areas of rapid sedimentation.

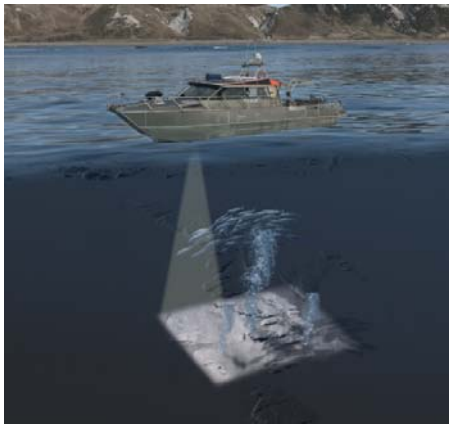
Hydrographic surveys provide fundamental data that supports monitoring and remediation of coastal erosion and land reclamation, the establishment and monitoring of spoil dumping grounds, extraction of mineral deposits, aquaculture, and transport and public works projects including construction of near-shore infrastructure.

The information collected by a hydrographic survey is essential for marine spatial planning and coastal zone management. The data is fundamental for evidence-based decision-making where there are conflicting requirements within coastal areas.

Modern hydrographic survey systems can acquire a range of data other than bathymetry. This may include sea level information, current and tidal flow, sediment type, positions of structures and Aids to Navigation and other marine geospatial information that contribute to knowledge and understanding of the port and harbour environment.



Seafloor type



Water column information

2.4 Sharing information and data with LINZ

There is significant benefit in sharing hydrographic information and data with the New Zealand Hydrographic Authority at LINZ, who produces and maintains official nautical charts. This ensures the latest survey data is compiled into official ENCs that are available to mariners using ECDIS and marine pilots using Portable Pilot Units (PPU), and allow all parties to access and use the same information.[6]

This contributes to a common understanding among the bridge management team and is essential to achieving a high standard of bridge resource management and best practice as set out in the IMO Convention on Standards of Training, Certification and Watchkeeping for Seafarers.

[6] *IHO Publication S-65 Annex A High Density (HD) ENC Production and Maintenance Guidance (Edition 1.0.0, January 2020)*

2.5 Sharing information with port & harbour users

Reliable and timely information about prevailing and forecast conditions in the port and harbour is critical to ensure that ships can navigate safely and ship operations are incident free. Tide predictions and real-time tide information should be made available to ensure ships can navigate safely in ports and harbours.

2.6 The full potential of data

The greatest benefit from sharing information comes from ensuring maximum use and usability of marine geospatial data by applying FAIR Data Principles. FAIR Data Principles are a set of guiding principles to make data findable, accessible, interoperable and reusable. By adopting FAIR Data Principles hydrographic datasets can be used to support a variety of activities and outcomes, including marine spatial planning, understanding and responding to climate change and supporting scientific research.

2.7 Natural disasters

As part of port operators' and councils' safety management systems, the Code requires them to have plans in place to deal with emergencies in their ports and harbours.[7] In the event of a natural disaster such as an earthquake, which may affect water depth of the port and its approaches, there is benefit in making the latest surveys available to organisations responding to the event. The port operator is responsible to have procedures in place to carry out hydrographic surveying in the aftermath of such an event.

[7] *The Code, Response and Recovery (page 41).*

3. Guidance for harbourmasters, port engineers and surveyors

This section supports those personnel in councils and port companies responsible for carrying out hydrographic surveying. The hydrographic programme and procedures are to be undertaken in accordance with the hydrographic policy which is included in the Safety Management System (SMS).

3.1 Hydrographic survey standards and guidelines

Hydrographic survey standards and guidelines generally fall into three categories.

International standards

International Hydrographic Organization (IHO) standards are approved and adopted by IHO Member States. This ensures there is a consistent quality of hydrographic information on official nautical charts worldwide.

The IHO's *Standards for Hydrographic Surveys Special Publication No 44* (IHO S-44)[8] provides minimum criteria that must be met to achieve a recognised level of accuracy, or 'Order' of survey.

National standards

National standards are produced by IHO Member States. They are based on IHO S-44 and modified to suit national requirements. Their primary purpose is to provide minimum standards and specifications to capture hydrographic information that supports official nautical charts.

The standards are detailed and contain mandatory requirements. They may also have specifications for additional marine datasets that can be used for other activities and outcomes.

The national standard for hydrographic surveys for nautical charting in New Zealand is HYSPEC[9] and is published by LINZ.

Other national and local guidelines for hydrographic surveys

Ports and harbours and other national organisations publish specifications and guidelines describing good practice and procedures for hydrographic surveys. They focus on the areas of hydrographic surveying that support safety of navigation and a particular activity or outcome, for example, dredging and engineering surveys.

An example of a national guideline is produced by Ports Australia, *Principles for Gathering and Processing Hydrographic Information in Australian Ports*.[10]

[8] *IHO www.iho.int*

[9] *LINZ www.linz.govt.nz*

[10] *Ports Australia, Version 1.5, November 2012. www.portsaustralia.com.au/blog/principles-for-gathering-and-processing-hydrographic-information-in-australian-ports*

3.2 Survey standards, depth accuracy and data quality

IHO and LINZ standards

IHO S-44 describes each standard.

Special Order is used where under-keel clearance is critical and in depths of 40 metres or less. It requires a full seafloor search; high depth accuracy and the detection of potential hazards.

LINZ-Special Order is the equivalent standard in HYSPEC.

Order 1a is appropriate where the under-keel clearance is less critical than Special Order. It requires a full seafloor search; however, depth accuracy and feature detection criteria are less rigorous than Special Order.

LINZ-1 and LINZ-2 are the equivalent standards in HYSPEC.

Order 1b is appropriate where under-keel clearance is not critical and there are unlikely to be man-made or natural features on the seabed that may pose a hazard to shipping.

Order 2 is recommended for surveys in water deeper than 100 metres.

The required standard must be stated and form part of the survey specification.

Depth accuracy

For a safety of navigation survey, the hydrographic surveyor must provide a statement that all bathymetry meets the required standard. There must be evidence of this in the final survey report.

ENC quality attribute – Category Zone of Confidence

The IHO has developed a quality attribute for national authorities producing official ENCs. The Category Zone of Confidence (CATZOC)[11] represents the degree of reliance that can be placed on the depth information within an ENC.

The quality of source surveys used to compile high density (HD) bathymetric data should be the equivalent to ENC data CATZOC values A1 or A2.[12]

Table 1 indicates the alignment of CATZOC to IHO S-44 and LINZ HYSPEC.

[11] *See Annex 2 for a full description of CATZOC ratings.*

[12] *IHO Publication S-65 Annex A High Density (HD) ENC Production and Maintenance Guidance (Edition 1.0.0, January 2020)*

Table 1: The alignment of CATZOC to IHO S-44 and LINZ HYSPEC

IHO S-44	LINZ HYSPEC	CATZOC
Special Order and Order 1a	LINZ-Special Order and LINZ 1	A1
Order 1a	LINZ-1 and LINZ-2	A2
Order 1b	-	B

3.3 Hydrographic Surveyor – competencies

The hydrographic Surveyor-in-Charge will be able to demonstrate they are qualified and experienced and can provide assurance that the survey meets the required standard.

Qualifications

A professional hydrographic surveyor may have successfully completed an internationally recognised Category A or Category B Hydrographic Survey programme.

The FIG/IHO/ICA[13] International Board of Standards of Competence (IBSC) S-5A and S-5B publications[14] describe the competencies for hydrographic surveyors at two levels: Category "A" and Category "B". They also describe the minimum degree of knowledge considered necessary for hydrographic surveyors to meet national and international hydrographic and charting requirements and the diverse needs of industry.

A Category "A" qualified person, with appropriate experience, is a senior professional in their chosen area of activity (eg, government, industry, academia). A Category "B" qualified person, with appropriate experience, is a technical professional preparing and delivering products and services to meet specifications and outcomes.

Professional certification

A qualification alone is insufficient to demonstrate a hydrographic surveyor's competence. It must be followed up by practical experience that show the surveyor can put their knowledge into practice.

[13] *International Federation of Surveyors (FIG), International Hydrographic Organization (IHO) and the International Cartographic Association (ICA).*

[14] *Standards of Competence for Category "A" Hydrographic Surveyors, Publication S-5A (http://iho.int/iho_pubs/standard/S-5/S-5A_Ed1.0.2.pdf) and Standards of Competence for Category "B" Hydrographic Surveyors: Publication S-5B (http://iho.int/iho_pubs/standard/S-5/S-5B_Ed1.0.1.pdf)*

Professional certification through the Australasian Hydrographic Surveyors Certification Panel (AHSCP)[15] provides a formal and comprehensive method of demonstrating the combination of qualifications and experience. This is provided by the Hydrography Commission of the Surveying and Spatial Sciences Institute of Australia. Certification is encouraged by the Hydrography Professional Stream of Survey and Spatial New Zealand.

The AHSCP is an IBSC-recognised professional certification scheme and provides two levels of certification: Level 1 and Level 2. A hydrographic Surveyor-in-Charge responsible for carrying out critical safety of navigation surveys in confined waters in ports and harbours would normally hold Level 1 certification.

To reduce risks in critical safety of navigation surveys, ports and harbours may require that the hydrographic Surveyor-in-Charge has successfully completed a recognised Category A hydrographic surveying programme and/or hold AHSCP Level 1 certification.

Qualified and competent staff are a measure that a SMS is functioning effectively[16]

3.4 Determining the need for hydrographic surveys by risk assessment

The varied nature of ports and harbours in New Zealand dictates that the frequency and methodology for hydrographic surveys should be determined primarily by a formal risk assessment that forms an integral part of the port or harbour SMS, as required by the Code.[17]

Risk assessments should include the dynamic nature, stability of the seabed and depth of available water in relation to draught of vessels, as well as future infrastructure development that may affect the navigable depth in confined waters. Other considerations may include:

- vessel type, characteristics and operations (eg, high speed, deep draught, restricted in ability to manoeuvre)
- proximity to environmentally sensitive areas
- quality and reliability of existing hydrographic information
- complexity of the port and harbour area
- fairway/channel design
- investigation of a grounding or report of shoaling
- competency of person(s) responsible for the surveys.

[15] *Guidelines for certification: http://www.hydro.gov.au/factsheets/WFS_AHSCP_Certification.pdf*

[16] *The Code, Measures of SMS performance (page 29)*

[17] *The Code, Risk assessment (page 25)*

A requirement of the Code[18] is to develop a hydrographic policy covering the type, frequency and extent of surveys. This is developed and agreed between councils and port operators, and documented. The policy also includes a procedure to respond to emergency situations, such as a vessel grounding.

3.5 Types of hydrographic surveys

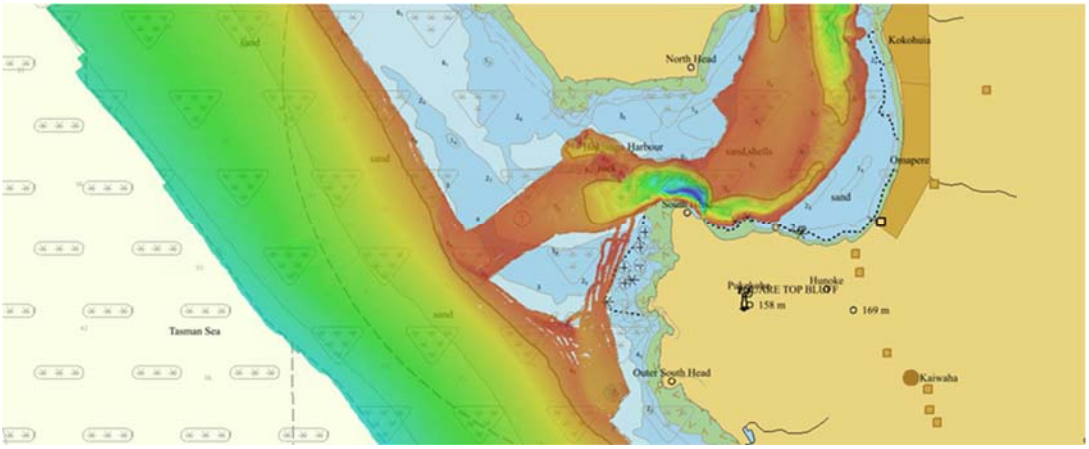
Safety of navigation surveys: Confirming the least depth and dimensions of a channel, berth or swing basin where under-keel clearance is critical. This requires a full seafloor search, where significant seafloor features are detected and depths measured, to achieve IHO S-44 Special Order or HYSPEC LINZ-Special Order and a CATZOC rating of A1.

Port authorities, under guidance from LINZ or suitably qualified and competent hydrographic surveyors, may set their own specifications using IHO or LINZ standards as a minimum.

Routine resurveys: Repeat or check surveys are required at regular intervals to confirm the least depth in channels and monitor any significant changes to the seafloor. Repeat surveys may provide early warning of potential sedimentation or the discovery of a new hazard.

Other surveys include:

- dredging surveys: pre, post and during dredging operations to ensure the design specification is met
- port infrastructure development surveys
- environmental monitoring, investigation, seabed habitat mapping, reconnaissance surveys, mooring surveys
- New Zealand bar harbours where the seabed or sand bar at the entrance to a port is extremely mobile and least depths may change quickly. A survey will often be done before a vessel enters the port and the results communicated directly to the vessel's Master.



Bar entrance, Hokianga Harbour

[18] *The Code, Hydrography (pages 31 and 32).*

3.6 Surveying requirements and specifications

Port and harbour requirements are used to define survey specifications. Well-defined specifications are important to ensure survey objectives are achieved. LINZ or suitably qualified and competent hydrographic surveyors can assist in this task. Once the specification has been determined, a method statement is necessary to detail how the requirements are to be achieved.

The following parameters may be included in the specification.

- Purpose of survey – this will assist the hydrographic surveyor determine the appropriate standard and scope to meet the requirements.
- Survey area – extent of the area being surveyed.
- Horizontal and vertical datums, for example, NZGD2000 and NZVD2016.
- Standard – the specification should clearly define the standard, for example, LINZ-Special Order, LINZ-1, LINZ-2.
- Seafloor coverage – this is defined by the survey standard. Using MBES is recommended for full seafloor coverage.
- Feature detection – identify position, least depth and extent of all seabed features.
- The position and characteristics of Aids to Navigation (fixed and floating), topographic features and coastline.
- Current and tidal stream observations.
- Seabed characteristics, for example, sand, shells, mud.
- Reduction of soundings to Chart Datum.
- Sea level observations – depending on the method statement, sea level gauges may be required to record sea level information for reducing soundings to Chart Datum. Sea level gauges must be calibrated and connected to benchmarks. Where existing gauges are used, it is recommended that these are calibrated at least every two years or following any change to the installation caused by operational requirements or a natural event, such as an earthquake. LINZ HYSPEC provides information on calibrations.
- Survey deliverables – clearly define the requirements for reporting and data deliverables, including format, file type and metadata.

3.7 Method statement

The method statement[19] details how a survey will be carried out and, specifically, how the hydrographic surveyor will ensure the data meets the required standard. It should be developed before starting work and approved by the responsible authority commissioning the survey. There is further detail about method statements in Section 4: Guidance for hydrographic surveyors.

3.8 Survey deliverables, metadata and data sharing

Survey deliverables

Survey data and information may consist of:

- report of survey detailing the survey activity, describing the results and stating the accuracy achieved
- digital data – raw data (proprietary formats) and processed depths (ASCII XYZ)
- depths plotted at an appropriate scale (digital, hard copy or PDF)
- 3D visualisation of the data as a 'fly-through' animation
- metadata (information about the data).

The level of documentation that accompanies the survey data depends on the purpose of the survey but, generally, if the data is to be re-used then the documentation must be sufficiently detailed to support this.

It is important the surveyor makes definitive statements on the coverage and accuracy achieved. There should be sufficient information to support these statements.

Metadata

Metadata provides information about the survey. It should be an integral part of the digital survey record and may contain:

- project name
- survey area and location
- survey start and end dates
- echo sounder used, for example, type, model, frequency
- horizontal and vertical datums
- vessel name
- accuracy standard achieved

[19] *Principles for Gathering and Processing Hydrographic Information in Australian Ports 2012 www.portsaustralia.com.au/blog/principles-for-gathering-and-processing-hydrographic-information-in-australian-ports.*

- seafloor coverage achieved
- data collected, for example, bathymetry, seafloor backscatter, water column backscatter
- file naming convention
- file format, for example, ASCII XYZ
- data custodian contact details.

Data sharing

The Code[20] requires a clear policy on hydrography that includes the distribution of hydrographic information to the New Zealand Hydrographic Authority, LINZ, to maintain official nautical charts and publications through New Editions or New Charts and Notices to Mariners. This may be accomplished through formal data sharing or bilateral arrangements.

[20] *The Code, Hydrography (page 31)*

4. Guidance for hydrographic surveyors

This section is for hydrographic surveying professionals.

The method statement is critical for demonstrating that the required standard will be achieved, and it should clearly state how the requirements detailed below are met.

4.1 The hydrographic surveyor

The hydrographic surveyor responsible for conducting the survey should be suitably qualified and competent to undertake the work.[21]

4.2 Method statement

A method statement[22] is required for each type of survey. It should clearly set out the personnel, equipment, datums, calibration methods/frequency, methodology for the reduction to sounding datum and the standard to be achieved.

As a minimum, the method statement should include:

- horizontal positioning
- vertical datum
- depth measurement
- seabed coverage
- sounding reduction
- data quality.

4.3 Survey report

The survey report should contain the following information as a minimum:

- an executive summary covering scope of the survey, fieldwork start and end dates, vessel and equipment used and results
- a statement by the hydrographic surveyor on how all aspects of the specifications were achieved
- a record of any difficulties encountered and an overview and statement of system performance
- personnel, including qualifications and roles in the survey
- horizontal datum used
- vertical datum used and connection between sea level gauges and benchmarks or reduction process if using RTK

[21] *The Code, Measures of SMS performance (page 29)*

[22] *See the example method statement in Standards for Hydrographic Surveys in Queensland www.msq.qld.gov.au*

- survey systems used and calibrations conducted
- a summary of the data processing workflow, including reduction to the vertical datum
- the achieved standard and error analysis
- description of any wrecks or objects detected
- description of Aids to Navigation identified during the survey, if appropriate
- description of survey data deliverables (refer to LINZ HYSPEC section 6).

4.4 Metadata

Metadata for each survey area and sensor type within each area should be provided in CSV format. Examples of metadata are:

- survey authority, for example, Port of Tauranga
- survey company name
- name of hydrographic surveyor
- project name
- survey location
- survey start date
- survey end date
- survey vessel name
- horizontal datum, for example, NZGD2000
- vertical datum, for example, NZVD2016
- horizontal positioning system
- bathymetric sensor type, for example, MBES
- bathymetric sensor model, for example, Kongsberg EM2040
- bathymetric sensor frequency, for example, 400kHz
- sea level reduction, for example, sea level gauge
- seafloor coverage achieved, for example, ‘full’
- accuracy standard achieved, for example, LINZ-Special Order
- bathymetric gridded surface method, for example, shoal depth true position
- bathymetric gridded surface resolution
- seafloor backscatter file type (where recorded)

- water column backscatter file type (where recorded)
- file naming convention.

LINZ HYSPEC provides further information.

Annex 1. Extracts from New Zealand Port and Harbour Marine Safety Code, 2020

Part 2: Responsibility for the Code (pages 12–18)

The Code standard (pages 16–17)

Port operators

Port operators:

- ensure that the port is in a fit condition for use by the ships that it serves, including the provision of adequate channels and berths
- provide port users and the Harbourmaster with adequate information about the port facilities and operating limitations
- agree provision of aids to navigation within the port with the harbourmaster.

In line with their assessment of any risks, they:

- mark, monitor and maintain the navigable channels necessary for the safe operation of the port
- take reasonable care to ensure that stated water depths are maintained
- provide any necessary marine services such as pilotage and towage.

Not all ports and harbours will have a commercial port or an obvious port operator. In this case the regional council works directly with ship operator, marine services providers and other relevant agencies such as owners of wharf facilities, to manage marine activity. The Council may carry out some of the above port operator functions itself.[23]

Councils

Councils:

- use their statutory powers to manage and maintain their harbours so they are fit for their intended uses
- provide adequate information about the condition of their harbours including prevailing environmental conditions, so users can determine whether they are safe
- consider the safe and efficient operation of services and amenities provided in the harbour
- make sufficient resources available to discharge their maritime safety[24] obligations under the MTA
- ensure that commercial considerations do not interfere with the effective discharge of their public interest, marine and navigation safety duties.

[23] *Examples include the Bay of Islands, Milford Sound and Akaroa.*
[24] *The term "maritime safety" is used here as that is the term used in Section 33C of the Maritime Transport Act in relation to the functions of regional councils.*

Specifically, they:

- ensure hydrographic and hydrological records are kept, taking reasonable care to ensure that stated depths are correct
- provide this information to the public and harbour users, including appropriate warnings if hydrographic and hydrological information is not current.

In line with their assessment of any risks, they:

- monitor and mark the navigable channels in the harbour in conjunction with the port operator[25]
- exercise powers to remove wrecks and obstructions to allow safe navigation.

Part 3: Developing and operating a port and harbour Safety Management System (SMS) (pages 19–29)

Harbour safety plans (pages 26–27)

Port and harbour safety plans describe the methods by which risks are identified and managed at both council and port operator level. The respective plans of both organisations should describe:

- roles and responsibilities of all parties – where functions are delegated or contracted out, there should be confirmed arrangements in place for this
- how the risk assessment is reviewed and kept up to date, including any triggers for review – there should be evidence of this process working in practice and it should be clear who is responsible for maintaining the risk assessment
- how performance is monitored and reported – for example, how the Harbourmaster reports to the council, or marine service providers report to port operator management
- how and when the SMS will be reviewed and updated, and any arrangements for ongoing auditing
- the system for recording accidents, incidents and near misses – how these are followed up, and how this feeds back into the risk assessment, as well as into policies, procedures and operating practices
- a list of matters that standard operating procedures apply to, both at the council level and at the port operational level – this provides assurance that comprehensive risk management provisions are in place and that the scope of those provisions is clear
- how training needs are identified, what is provided, how this is undertaken and documented
- a clear process for change management, including the use of new technology and/or equipment – how the risks from new operations or changed conditions will be assessed and those new risks managed, possibly as part of the ongoing risk assessment process

[25] *Refer to Good Practice Guidelines for Hydrographic Surveys in NZ ports and harbours.*

- a process for assessing requirements for technical equipment that enhance safety e.g. PPU's and other safety equipment of this type and written procedures for their safe and proper use
- a programme of future work, if applicable, identifying actions to be undertaken in response to risks identified or changes to operations
- the provisions made in relation to the following items, including where applicable:
  - hydrography
  - prevailing conditions
  - aids to navigation
  - anchorages
  - wrecks
  - works in harbours
  - traffic management and vessel information services
  - passage planning and guidance
  - pilotage and pilotage exemptions
  - marine services
  - tugs
  - berthing
  - dangerous goods and harmful substances
  - response and recovery
  - marine pollution and ships in distress.

Appendix 1 contains further information about good practice in relation to these activities and how they could be addressed in the SMS.

Measures of SMS performance (page 29)

When an SMS functions effectively:

- there is clear evidence of ownership of the SMS at the top level of both the Council and port operator
- delineation of maritime safety responsibilities within the organisations and between them is clear
- relevant staff within each organisation are familiar with the SMS and their roles in it
- staff are qualified and competent to do their jobs

- there is a functioning harbour safety plan and/or manual that is regularly reviewed and updated
- regular and effective communication between the Harbourmaster and port operators takes place e.g. joint marine safety committee meetings
- their working relationships are documented in the manual and function well
- there is evidence that incidents involving ships in the waters of their jurisdiction are reviewed and any risks reassessed.

When carrying out their review, panels may also look for other evidence of commitment from the council and the port operator to the management of maritime safety, and to the Code. A council's long-term community plan or annual plan, and the port operator's annual reports or website are likely places where commitment to the Code would be publicly visible.

Appendices (page 30)

Appendix 1: Statements of good practice for local maritime regulation and safe operational activity (pages 31–32)

This appendix provides statements of good practice about the following maritime activities:

- hydrography
- prevailing conditions
- aids to navigation
- anchorages
- wrecks
- works in harbours
- vessel traffic services
- passage planning and guidance
- pilotage and pilotage exemptions
- marine services
- tugs
- berthing
- dangerous goods and harmful substances
- response and recovery
- marine pollution and ships in distress.

The Safety Management System (SMS) include arrangements for how these practices are implemented.

Hydrography

Accurate hydrographic information is essential to allow safe navigation within the port and harbour areas identified using the Code Application Assessment.

There should be a clear policy on hydrography covering the following:

- the extent and frequency of survey – this should be determined from the risk assessment for the port and harbour, and kept under review
- the maintenance of channels and depths, as applicable, and any dredging programme to achieve that
- distribution of hydrographic information through local Notices to Mariners, including the publishing of warnings on reductions in depth or navigation hazards
- the provision of hydrographic information to Land Information New Zealand (LINZ), the New Zealand Hydrographic Authority, to update official nautical charts and publications through Notices to Mariners
- criteria for determining when resurveying may be required – if for example, harbour operations change, such as:
    - the use of berths or larger ships
    - significant increases in harbour traffic, which may require additional passing places and anchorages, or
    - in the event of a significant earthquake or flood which may affect the seabed.

The Harbourmaster works with the port operator to ensure that the hydrographic policy is developed and followed, and that relevant hydrographic information for the port and harbour area is readily available, accurate and up-to-date.

The SMS should include the hydrographic policy and supporting procedures to give effect to it. Where there is an agreed division of responsibilities for survey and dredging between the Council and the port company, such arrangements should be documented in a Memorandum of Understanding or other formal agreement.

Prevailing and forecast conditions

Reliable and timely information about prevailing and forecast conditions in the port and harbour is critical to ensure that ships can navigate safely, and ships operations can be conducted without incident.

The SMS should include arrangements for determining what information is required and ensuring it is provided.

The extent of the information that should be provided will be determined and agreed as part of the risk assessment for the port and harbour. The information should cover general conditions and include:

- wind
- tide
- wave height
- current
- any other factors that could be affected by the weather or the way the harbour is used, e.g. swell conditions, long period swells and tsunamis.

This information should be accessible to harbour users in a timely and systematic way.

Annex 2. Category of Zone of Confidence (CATZOC)[26]

1	2	3		4	5
ZOC[1]	**Position Accuracy**[2]	**Depth Accuracy**[3]		**Seafloor Coverage**[4]	**Typical Survey Characteristics**[5]
A1	± 5 m + 5% depth	=0.50 + 1% depth		Full area search undertaken. Significant seafloor features detected[4] and depths measured.	Controlled, systematic survey[6] high position and depth accuracy achieved using DGPS or a minimum three high quality lines of position (LOP) and a multibeam, channel or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 0.6		
		30	± 0.8		
		100	± 1.5		
		1000	± 10.5		
A2	± 20 m	=1.00 + 2% depth		Full area search undertaken. Significant seafloor features detected[4] and depths measured.	Controlled, systematic survey[6] achieving position and depth accuracy less than ZOC A1 and using a modern survey echosounder[7] and a sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
B	± 50 m	=1.00 + 2% depth		Full area search not achieved; uncharted features, hazardous to surface navigation are not expected but may exist.	Controlled, systematic survey achieving similar depth but lesser position accuracies than ZOCA2, using a modern survey echosounder[5], but no sonar or mechanical sweep system.
		Depth (m)	Accuracy (m)		
		10	± 1.2		
		30	± 1.6		
		100	± 3.0		
		1000	± 21.0		
C	± 500 m	=2.00 + 5% depth		Full area search not achieved; depth anomalies may be expected.	Low accuracy survey or data collected on an opportunity basis such as soundings on passage.
		Depth (m)	Accuracy (m)		
		10	± 2.5		
		30	± 3.5		
		100	± 7.0		
		1000	± 52.0		
D	Worse than ZOC C	Worse than ZOC C		Full area search not achieved; large depth anomalies may be expected.	Poor quality data or data that cannot be quality assessed due to lack of information.
U	Unassessed - The quality of the bathymetric data has yet to be assessed				

[26] *IHO S-57 Ed3.1 Supp 3 (Jun 2014), pp 13–14*

Remarks:

To decide on a ZOC Category, all conditions outlined in columns 2 to 4 of the table must be met.

Explanatory notes quoted in the table:

[1] The allocation of a ZOC indicates that particular data meets minimum criteria for position and depth accuracy and seafloor coverage defined in this Table. ZOC categories reflect a charting standard and not just a hydrographic survey standard. Depth and position accuracies specified for each ZOC category refer to the errors of the final depicted soundings and include not only survey errors but also other errors introduced in the chart production process.

[2] Position accuracy of depicted soundings at 95% CI (2.45 sigma) with respect to the given datum. It is the cumulative error and includes survey, transformation and digitizing errors etc. Position accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on type of equipment, calibration regime, historical accuracy etc.

[3] Depth accuracy of depicted soundings = a + (b*d)/100 at 95% CI (2.00 sigma), where d = depth in metres at the critical depth. Depth accuracy need not be rigorously computed for ZOCs B, C and D but may be estimated based on type of equipment, calibration regime, historical accuracy etc.

[4] Significant seafloor features are defined as those rising above depicted depths by more than:

	Depth	Significant Feature
a	<40m	2m
b	>40m	10% depth

A full seafloor search indicates that a systematic survey was conducted using detection systems, depth measurement systems, procedures, and trained personnel designed to detect and measure depths on significant seafloor features. Significant features are included on the chart as scale allows. It is impossible to guarantee that no significant feature could remain undetected, and significant features may have become present in the area since the time of the survey.

[5] Typical Survey Characteristics – These descriptions should be seen as indicative examples only.

[6] Controlled, systematic surveys (ZOC A1, A2 and B) – surveys comprising planned survey lines, on a geodetic datum that can be transformed to WGS 84.

[7] Modern survey echo-sounder – a high precision single beam depth measuring equipment, generally including all survey echo-sounders designed post 1970.