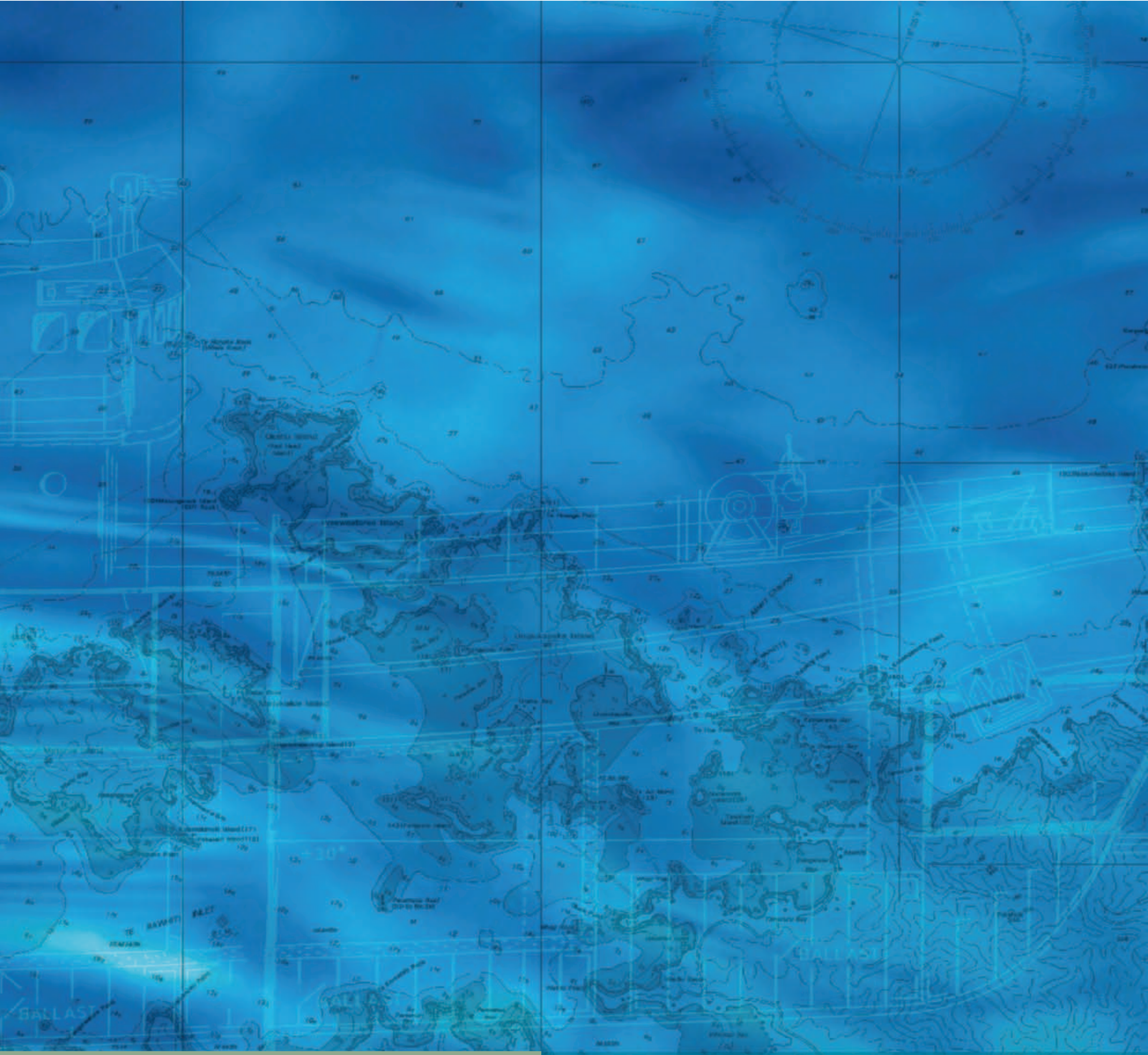

FINAL GUIDELINES OF

Good Practice for Hydrographic Surveys in New Zealand Ports and Harbours

KEEPING YOUR SEA SAFE FOR LIFE

Maritime Safety

MARITIME SAFETY AUTHORITY OF NEW ZEALAND
Kia Maanu Kia Ora

ISBN Number

Table of Contents

Preface

These guidelines are one of a series supporting the New Zealand Port & Habour Marine Safety Code. They provide detailed and, in some cases, technical guidance relating to the specific measures, identified in that Code, that fall to regional councils, port companies and other participants to implement in fulfillment of their duties and exercise of powers under the law.

The guidelines, as also the Code itself, are not statements and good practice intended to stand for all time. Rather, they are living documents to be revised in the light of the lessons drawn from experience, advances in technical knowledge and capability, and the ongoing imperative of continually improving safety management within our port and harbour system.

As at August 2004, the Code is supported by –
Guidelines for Port & Harbour Risk Assessment and Safety Management Systems in New Zealand
Guidelines for Providing Aids to Navigation in New Zealand
Guidelines of Good Practice for Hydrographic Surveys in New Zealand Ports & Harbours

Additional guidance documents are in preparation or planned. Support for participants when considering the relevance of various metrological and hydrographic occurrences will be available in a report on environmental factors affecting safe access and operations in ports and harbours, due to be published in September 2004. During the next year, MSA with be working with participants to produce guidelines for vessel traffic services as well as standards for harbourmasters. It is further proposed to adopt an existing standard for the use of tugs in ports published by the Nautical Institute.

Comments and queries relating to these guidelines, as well as any questions concerning the New Zealand Port & Harbour Marine Safety Code should be addressed to –

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Copies of the guidelines and the Code are available from MSA free of charge. Electronic versions are available from www.msa.govt.nz.

Russell Kilvington
Director of Maritime Safety

August 2004

Introduction

This document outlines the basic "good practice" guidelines that should be considered in the planning, execution and management of hydrographic surveys used to support the safe navigation of vessels in New Zealand ports and harbours. These guidelines have been endorsed by the National Hydrographic Authority, Land Information New Zealand (LINZ).

1. Scope

These guidelines are intended for use in New Zealand ports and harbours where hydrographic surveys are conducted to support, either directly (e.g. to define the least depth in a shipping channel) or indirectly (e.g. post dredge survey) the safe navigation of vessels. They are based upon widely accepted "good practice" for the planning, execution and management of hydrographic surveys. The guidelines should be used in determining those aspects of a hydrographic nature that should be considered in the development of robust risk assessments relevant to the safe navigation of vessels.

This document is primarily intended for those with responsibility for the provision of hydrographic information in NZ ports and harbours. Others include users of the charts and other products generated from this information that require confidence in the work done through documented processes.

2. Term(s) and Definition(s)

Table 1

AHSAP	Australasian Hydrographic Surveyors Accreditation Panel
BM	Benchmark
CD	Chart Datum
DGPS	Differential GPS
IHO	International Hydrographic Organisation
MBES	Multibeam Echosounder
MSA	Maritime Safety Authority
LINZ	Land Information New Zealand
PDOP	Position Dilution of Precision
RTK	Real Time Kinematic – a high accuracy application of GPS
SBES	Single Beam Echosounder
SV	Sound Velocity
TPE	Total Propagated Error
WGS84	World Geodetic Datum 1984

3. Responsibilities

*(An exert from the **"NZ Port & Harbour Marine Safety Code - Part 1"**)*

1.2.2.2	A regional council has a duty to manage and maintain the harbour with regard to its use and the type and size of vessels that use it. The duty to manage and maintain the harbour covers several specific requirements: (a) to keep proper hydrographic and hydrological records (b) to ensure public notification or dissemination as conspicuously and widely as is appropriate of such further information as will supplement the guidance given by navigation marks (c) to communicate appropriate warnings to harbour users if hydrographic and hydrological information is not current.
1.2.2.3	Port companies have a duty to find, mark and monitor the appropriate navigable channel or channels in the harbour where the port risk assessment demonstrates this is required.
1.2.2.4	Regional councils have a duty to mark and monitor any other channel or area of harbour seabed where the harbour risk assessment demonstrates this is necessary to ensure the safe navigation of vessels. Regional councils may perform such work themselves, contract the work out, or apply to LINZ for assistance with any required hydrographic survey.
1.2.2.5	Where arrangements are entered into for other parties to have functions and powers for harbour maintenance and management, these arrangements must be clearly documented in a memorandum of understanding between the regional council and the other parties.
1.2.2.6	Where a regional council or a port company holds out that there is a certain depth of water available for the use of a harbour, it must take reasonable care to ensure that the depth of water is available under normal conditions, or give warning that the advertised depth has not been maintained.

4. Reference to Other Hydrographic Standards and Guidelines

Standards and guidelines concerned with hydrographic surveying for the purposes of safe navigation generally fall into three levels, each with differing content and application.

4.1 Level 1 – Overarching International Standards

Level 1 standards comprise the overarching standards for hydrographic surveys adopted by the International Hydrographic Organisation (IHO). These high-level standards form the basis from which member states can produce their own national standards and have been produced to ensure a consistent quality of the hydrographic information contained on internationally recognised nautical charts.

IHO have produced Special Publication 44 "Standards for Hydrographic Surveys" (S-44). This document primarily states a set of minimum criteria, which must be met to achieve a recognised level of accuracy, or "Order" of survey. It does not provide detailed survey methodology but does include broad guidance on key areas.

Reference should be made to S-44 concerning standards relating to the wider science of hydrography, particularly for authoritative definitions of common hydrographic terms. The entire document can be downloaded from the following IHO website: http://www.iho.shom.fr.

4.2 Level 2 – National Hydrographic Standards

Level 2 standards are those produced by IHO member states that are predominantly based on the IHO S-44, modified to suit each country's unique requirements. These standards are usually quite detailed and contain considerable prescriptive processes. Similarly to S-44, their purpose is to provide minimum standards for the capture of hydrographic survey data to support the production of official nautical charts.

New Zealand national hydrographic standards provide greater amplification of the broad processes outlined in documents such as the Level 1 standards described at 3.1 above. The national standard for hydrographic surveys in New Zealand is HYSPEC, produced by LINZ. This document can be downloaded from the LINZ website: http://www.linz.govt.nz

4.3 Level 3 – Guidelines of Good Practice for Hydrographic Surveys

Guidelines and standards are often produced by agencies and organisations describing good practice and procedures for hydrographic surveys. The scope of such guidelines are often narrower than national standards and focus on key areas of hydrographic surveying that support a particular type of operation, e.g. hydrographic surveys in support of port operations. The "Guidelines of Good Practice for Hydrographic Surveys in NZ Ports & Harbours" falls into this category.

One example of this type of document that should be considered in the above context is the hydrographic survey section in the "Guide to Good Practice on Port Marine Operations" (UK DTLR, March 2000).

5. The Guidelines

Various methodologies exist for the collection, processing and presentation of hydrographic survey information. Whilst the presentation of such information is largely determined by the end user, the fundamentals of hydrographic data collection remain the same: accurate measurement of the depth of water above a stated datum and the position of this measured depth. For many years, the widely accepted means of obtaining depth data has been with a single-beam echosounder (SBES) with position provided by electronic ranging equipment. Subsequently, positioning has been made easier with the advent of GPS and more recently, DGPS. In the past five years, the introduction of Multi-Beam echosounders (MBES) with their ability to measure much greater areas of sea-floor at an increased level of detail, has seen an associated increase in the knowledge required to effectively use them.

5.1 Types and Frequency of Hydrographic Surveys – Risk Assessment

The varied nature of the ports and harbours across NZ dictates that the frequency and methodology for hydrographic operations relating to them should be determined primarily by a risk assessment rather than by the blanket adoption of a set of rigid criteria. The usefulness and credibility of associated risk assessments depend greatly upon the quality of the balanced and quantifiable information on which they are based. They should be undertaken in a rigorous manner and be consistent with the "Guidelines for Port & Harbour Risk Assessment and Safety Management Systems in New Zealand".

An important product of the risk assessment is a survey plan that describes the requirement for surveys including the type, extent and frequency. Hydrographic factors for consideration in risk assessments should take account of the stability of the seabed and depth of available water in relation to draught of vessels as well as intended development that will affect the navigable depth in a given area. Other considerations shall include (but not be limited to):

- Vessel type and operations (high speed, restricted in ability to manoeuvre etc.)
- Potential environmental impact of a hydrographic related event
- Quality and reliability of existing hydrographic information
- Complexity of area
- Stability of seabed
- Depth and width of navigable water in relation to vessel draught
- Regional development
- Fairway design
- Investigation of a grounding or reported depth discrepancy
- Competency of person(s) responsible for the surveys (refer to Section 6 of this document).

5.2 Survey Equipment

Equipment to be used during hydrographic survey operations falls within the broad groupings of depth measurement equipment, positioning equipment and water level measurement equipment (e.g. automatic tide gauges). Generic considerations for the use of such equipment are covered in this section.

Advances in survey equipment technology have significantly reduced the level of user input in normal modes of operation. It is however vital that users possess a reasonable understanding of the capabilities, and more importantly, the limitations of the survey equipment operated. In particular, it should be understood that manufacturers' specifications rarely guarantee equipment performance unless the equipment is operated in accordance with strict parameters and under optimum environmental conditions. Regardless of stated manufacturers' specifications, the fundamental good practice requirement of the surveyor to identify, eliminate or reduce, and quantify remaining sources of error in an appropriate error budget remains extant (refer Section 5.4.1).

5.2.1 Depth Measurement Equipment

Depth measurement is normally achieved using either Single Beam (SBES) or Multibeam (MBES) echosounders. Sweep-system echosounders fall into the latter category; however, due to the infrequent employment of such systems in the region they have not been addressed in these Guidelines.

It should be noted that SBES is still the most common tool used in port and harbour surveys and will continue to give valid results when used correctly in a well planned and executed survey. Unless capital and operating costs reduce significantly, it is unlikely that MBES will replace SBES for routine surveys in the average port and/or harbour in the short term.

5.2.1.1 Single Beam Echosounder

SBES should be calibrated by bar checks to correct for index error, set the correct draught setting and ensure that the instrument records the depth below the sea surface and not below the transducer. A bar check should be conducted at least daily and on any change of survey area during the day to ensure consistency of data quality.

5.2.1.2 Multibeam Echosounder

The use of MBES as a hydrographic survey tool has significant advantages over SBES in the capability to detect small objects and achieve full bottom coverage. MBES require key ancillary equipment such as an appropriate motion sensor and gyro, which must be correctly integrated for correct operation. The ability to measure SV profiles through the water column is also required to correct for the refraction of beams, particularly when using wide swathe widths.
Users should be aware of the expected performance of the system and employ robust methodology to prove this before accepting the system as operational. Careful calibration of MBES is required at regular intervals thereafter (refer Section 5).

Inherent with the increased detail and coverage achieved with MBES is the ability to clearly see errors associated with incorrect vessel offsets, SV or excessive vessel motion. The ability to “average” or “smooth” out such errors in subsequent processing is potentially misleading and should be avoided unless the magnitude of the change from the raw to the smoothed record is clearly stated. Such errors should be included in the calculation of the overall accuracy value accompanying the data.

5.2.2 Positioning System Equipment

Differential GPS has been widely adopted as the primary method to fix vessel position during hydrographic surveys. The source of the differential corrections should be proven by comparison with a known mark, particularly if a local base station is established. GPS receivers should be configured to output position in the desired datum (normally WGS84) with associated quality tags. Close monitoring of position quality during sounding operations through examination of the number of tracked satellites and PDOP, and/or real-time comparison with a second system, is recommended.

Kinematic GPS offers increased precision in terms of horizontal position, provided that the footprint of the echosounder in use is of a comparable dimension.

5.2.3 Motion Sensor Equipment

The demand for greater transparency in the derived accuracy of measured soundings obtained in swell conditions has seen the use of motion sensor equipment become standard in an increasing number of port and harbour surveys.

Standard motion sensing equipment is of the accelerometer type, ranging in complexity and the precision they are capable of achieving. The correct installation and definition within the vessel reference frame is vital and consideration should be given to obtaining assistance from the manufacturer if the user is unfamiliar with the equipment.

Use of Kinematic GPS as a source of vessel motion corrections in conjunction with, or in lieu of, accelerometer based motion sensors is slowly increasing. Users of both types of motion sensors should take all practical steps to check their correct operation, preferably by some means of ground-truthing (e.g. quantifying motion error residual in data collected over a known flat seabed).

5.2.4 Tide Gauge Equipment

Sea level (tide) measurements of height and time are required to reduce collected soundings to Chart Datum and are subsequently used (as a continuous record over long periods) to define tidal reference levels (e.g. MHWS).

Tidal observations are normally obtained via automatic recording gauges, such as those permanently installed in most NZ standard ports. Other methods used to obtain tidal information include manual tide pole (or staff) readings referenced to a recognised datum (normally chart datum) and, in recent years, using the centimetric precision achievable with Kinematic GPS in the vertical dimension. This latter method provides a source of total height measurement, including tide; however, the geoid to ellipsoid difference must be accurately known and base station-rover range limitations clearly understood. If Kinematic GPS is used in this manner, it is considered good practice to regularly correlate the results against tidal observations obtained by traditional (e.g. gauge) methods.

Regardless of the type and method used, the equipment must be capable of measuring the tide to the required accuracy. If the method of tidal reduction requires interpolation between individual observations, the interval between observations must be such as to provide an adequate representation of the tide curve.

If automatic tide gauges are used, these must be regularly calibrated against a staff gauge to ensure their accuracy. The accuracy of the tide readings used to reduce soundings impacts directly on the overall accuracy of the survey. Further guidance is available in the "Standard for Official New Zealand Sea Level Information" produced by LINZ. This document can be downloaded directly from the LINZ website (http://www.linz.govt.nz).

5.2.4.1 Tidal Records

In addition to the use of tide readings to reduce sounding data, a continuous record of tidal data is important for the maintenance of accurate predictions for the port. It is recommended that an unbroken record of tidal readings is maintained and archived (accompanied by relevant calibration records) for this purpose.

5.2.5 Survey Vessel – Equipment Offsets

The position of the various sensors on the survey vessel should be carefully measured in relation to a common datum point and correctly applied within the survey acquisition software. This information should be included in the survey documentation.

6. General Methodology

The hydrographic survey process is divided into five major stages with each stage divided into a number of groups of instructions or procedures. This section contains broad guidelines that relate to each of these stages.

Table 2: Survey Process

Table 2 - Five Stages of the surveying process		
Stage	**Group**	**Instructions or Procedure**
Preparation	Planning	▪ Extract current survey data from existing sources and plan observations
	Calibration	▪ Elimination of systematic errors from survey instruments prior to observations
Data Collection	Verification	▪ Configuration of equipment to ensure instruments are collecting data to correct standard during survey operations
	Observations	▪ Data collection, including those observations necessary for ongoing validation
	Data Logging	▪ Ensure appropriate data is logged to correct parameters
Data Processing	Data cleaning	▪ Removal of invalid data
	Data Selection	▪ Selection of valid data for further processing/rendering
	Data Storage	▪ Storing of selected processed data in appropriate formats
Data Analysis	Quality	▪ Determine quality of surveyed data via proven methods and compare with required standards
	Coverage	▪ Determine if sufficient valid data has been collected

Data Rendering	Reports	▪ To document the survey process and results to provide adequate transparency
	Plots	▪ To render data as graphics as required
	Digital Data	▪ To render/archive digital data
	Field Records	▪ To render/archive field records

6.1 Survey Preparation

Survey preparation includes the planning of hydrographic observations and ancillary activity necessary to support the collection of data, e.g. equipment calibrations.

6.1.1 Equipment Calibrations

Equipment calibrations need to be conducted at regular intervals and documented in order to support the quality estimate given to the final survey dataset. Maintaining a datapack for key equipment and/or including the relevant information in a final report accompanying each survey is recommended.

6.1.1.1 SBES Calibration

Calibration of SBES is normally achieved by the bar check method. In addition to guidance given in 4.1.1.1, further guidance/description is available in HYSPEC Section 6.

6.1.1.2 MBES Calibrations

Initial calibration of MBES equipment is a complex task and it is strongly advised that assistance from the manufacturer, and, if necessary, a hydrographic surveyor with MBES experience, is sought.
Individual MBES error tolerances are much smaller than for SBES. Frequent check-calibrations or rigorous confidence checks are required at regular intervals (which can be as frequent as 1-2 weeks) and after significant component swap outs of key sensors. As a minimum, full calibrations should quantify the error sources or should verify the correct measurement of the parameters contained in HYSPEC Section 7. Further guidance on MBES calibrations should be sought from HYSPEC.

6.1.1.3 Tide Gauge Calibrations

It is good practice to confirm automatic gauge readings with the level of the tide observed on a co-located tide pole, referenced to Chart Datum, at least weekly, if not daily, during survey operations. These comparisons provide a valuable record of the gauge performance and should be retained (e.g. in the equipment datapack).

Where a permanently recording automatic tide gauge is installed, a full calibration of this equipment should be conducted at least annually, or when necessary after maintenance etc. This procedure involves manual observation of the pole readings over a full tidal cycle (preferably 25 hours although 12.5 hours may be sufficient) in order to correlate gauge readings with the theoretically "correct" pole readings. This method is commonly known as a "pole to gauge" calibration and is described in detail in Section 8 of HYSPEC.

Regardless of the type of automatic gauge equipment being used to observe tidal data, confirmation of the tide pole zero against the Standard Port Reference Benchmark (details contained in the NZ Nautical Almanac) should be carried out by levelling at least annually or whenever the pole is moved. Results should be fully documented and retained with the tidal archive and/or equipment datapack.

6.1.1.4 Miscellaneous Checks and Calibrations

Regular confidence checks of the vessel positioning system should be conducted at least weekly, preferably daily, during the course of a survey. A static check of the vessel's derived position against a mark ashore (e.g. a pin on a wharf) established to a higher order of accuracy is recommended.

In both SBES and MBES systems, position system latency should also be determined and applied in the survey acquisition program. Guidance on determining the latency correction can be obtained from the equipment manufacturer.

If possible, a dynamic check against a distinctive bottom target for which a known position has been derived should be undertaken, as this serves to reveal any latency or vessel layback errors not otherwise detectable with a static check. Bottom targets should be located in shallow (ie. less than 10m) water to ensure the echosounder footprint and subsequent resolution of the target is comparable with the positioning system in use.

Calibration of ancillary equipment e.g. SV probes, should be carried out by the equipment manufacturer or agent in accordance with manufacturers guidelines and copies of subsequent certificates retained in the equipment datapack.

6.2 Data Collection

Methods employed by surveyors to collect hydrographic data do not greatly vary – all involve the collection of data required to meet the overall objective as well as the collection of additional data that is used for validation purposes throughout the survey. Some hydrographic standards prescribe rigid procedures and criteria to achieve this (e.g. HYSPEC) but these may not be appropriate in the port and harbour environment where repeat surveys are regularly undertaken and such rigid requirements can be considerably relaxed. For example, survey line spacing may be increased when conducting repeat surveys with SBES operations where the likelihood of undetected shoals is minimal.

Different methods for sounding are required when using either SBES or MBES. In general, the traditional methods, involving the running of systematic parallel lines at set distances apart according to the desired scale of the final sounding sheet, apply to SBES but are not necessarily appropriate for MBES operations. Significant differences of methodology for MBES operations include the orientation of the survey lines in relation to depth contours and the varying of the line spacing dependent on the least depth of water, which determines the effective swathe width.

Regardless of the type of equipment in use, the running of additional lines (check or cross-lines) for the sole purpose of checking data quality at the data analysis stage is considered essential.

It is important that the limitations of the survey equipment in use are fully considered during sounding operations. In particular, the performance of motion sensor equipment should be carefully monitored and survey operations suspended when it is apparent that the equipment is not coping with existing sea conditions. This is particularly important in MBES operations where error tolerances are much smaller.

The tidal regime varies greatly from port to port and will often require different survey methodologies to enable appropriate tidal reductions to sounding data. The “hydraulic gradient” across a survey area can be considerable, particularly in estuarine dominated harbours. The use of multiple gauges to quantify and if necessary correct for such an error source should be considered. Many hydrographic survey-processing packages have co-tidal functionality that can be used to correct for this effect.

An imprecise value for the velocity of sound in water during sounding operations can be a source of significant error and this should be quantified and allowed for if necessary.

The effects of squat and settlement on the small vessels typically used for sounding operations in ports and harbours are likely to be significant, particularly where the vessel survey speed is above 5 knots in shallow water. The various techniques used to determine the magnitude of this error source normally involve the accurate measurement of the apparent change in vessel draught at various vessel speeds. It is recommended that trials are conducted to quantify squat and settlement, and corrections applied if appropriate.

Further detail concerning SBES and MBES methodologies are contained in Section 6 and 7 of HYSPEC respectively. The content therein should be used as the basis of “Good Practice” guidelines developed by each port or harbour authority conducting hydrographic surveying, and modified to suit the particular requirements of the task involved.

6.3 Data Processing

The processing of hydrographic data involves the removal of invalid data and the selection of a “cleaned” data set for further processing or for the generation of required products (e.g. sounding sheets) for subsequent analysis. It is also the stage where tidal data is normally applied or where tidal level data collected in real time and applied during data acquisition (e.g. from RTK) is validated.

It is recommended that data processing be conducted using a dedicated hydrographic processing package that preserves data integrity through audit functions and is capable of shoal bias thinning. Modern packages offer almost complete flexibility and the potential to “manipulate” or overly “smooth” data – this practice is potentially misleading and should be avoided unless the magnitude of the change in the raw to the smoothed record is clearly stated. This is especially relevant where sounding sheets are produced from “gridded” data. Surveyors should refer to the manufacturers’ instructions accompanying survey processing packages and develop a series of standard operating procedures for the processing of data, mindful of the above considerations.

Where possible, standard nautical hydrographic symbology should be used on survey sheets. In particular, the standard convention of displaying depths as metres and decimetres where the decimetre is shown in subscript form should be followed (e.g. 5_6 instead of 5.6).

6.4 Data Analysis

Data collected during survey operations should be monitored closely to ensure the required standard and the desired extent of coverage is being met; however, it is not possible to fully assess the overall quality until all data can be viewed together or in suitably sized blocks. Cross-line comparisons and various other consistency checks are undertaken at this time. Areas requiring re-running, either because of gaps in coverage or due to suspect data, are identified at this stage.

6.4.1 Accuracy of Soundings

Perhaps the most crucial aspect of the data analysis phase is the assessment of the accuracy achieved. Soundings on a chart, sounding sheet or other plots used as decision aids in navigation (including post dredge surveys) are meaningless without associated information on their quality.

The accuracy of soundings cannot simply be estimated without proper justification. In determining depth accuracy all sources of individual errors need to be quantified and incorporated into a statistical model to derive the “Total Propagated Error” (TPE). Individual error values should be derived from the various calibrations conducted at the preparation phase and throughout the survey and appropriately documented.

Generic guidance on the compilation of a TPE is described in HYSPEC Section 5.

6.5 Data Rendering

Hydrographic data can be rendered in a number of formats and styles, depending on its intended purpose. The underlying principle that should be observed in compiling records of any survey is that they must be entirely intelligible to any person having a sound knowledge of the type of survey concerned, but who was not involved in the survey. A large proportion of hydrographic surveys in ports and harbours will be repeat surveys for a specific purpose and for specific end users. Thus the extensive reports and deliverables required by, for example, HYSPEC are not necessarily appropriate. Nevertheless, a minimum level of information should accompany sounding data, not only to provide the necessary confidence that the data is fit for its intended purpose, but to allow subsequent exploitation by users with different requirements. This information is called metadata.

Metadata should comprise at least the following information:

- information about the survey in general, e.g. date, area, equipment used, name of survey platform
- the name of surveyor/agency who conducted the work
- the geodetic reference system used, such as horizontal and vertical datum
- calibration procedures and results
- tidal datum and reduction details
- Total Propagated Error (including respective confidence levels).

Most of the above information can easily be incorporated on the sounding sheets using a simple template.

The remainder of the recommended metadata that is impractical to show on sheet templates (e.g. calibration procedures and results) should be documented in a manner that it can be subsequently recovered if necessary to confirm associated data quality. This could be achieved through the use of a separate report.

6.5.1 Horizontal Datum

Hydrographic surveys of ports and harbours conducted by port authorities have historically been referenced to local circuit grids based on the NZGD49 Datum. With the advent of GPS the usefulness of local circuit grids is reducing and in some cases, requires the unnecessary transformation of data that may introduce distortions. All national land based mapping and hydrography in New Zealand has adopted the WGS84 Datum (or NZ Datum 2000, which for all practical purposes is the same as WGS84), using either UTM or NZTM as a grid or latitude and longitude as required. If at all possible, this should be used as the geodetic reference frame for all surveys undertaken, with an aim of complete migration to Datum 2000 by 2008.

6.5.2 Digital Data

In addition to paper plots and reports, digital data is an output from most modern surveys. This primarily comprises point information for each sounding but can also include coastline, SV, tide etc. Standard formats for the archive and distribution of this data is encouraged. All hydrographic survey packages are capable of outputting sounding data in ASCII format: as latitude, longitude and depth; or eastings, northings and depth. To facilitate future sharing/use of the data, preference should be given to archiving this sounding information in ASCII format using WGS84 latitude and longitude and depths below Chart Datum (CD).

The archive of line information (e.g. coastline) or certain point information in DXF is accepted practice; however, this format should not be used for sounding data as the subscript decimal place used in standard hydrographic sounding presentation is not fully supported.

7. Hydrographic Surveyor – Competencies

The nature and extent of hydrographic surveys required to support safe navigation in a port or harbour should be determined primarily by a risk assessment (refer Section 4.1). The same risk assessment process should also address the minimum level of competencies required by those charged with the conduct of such work.

Detailed guidance on appropriate competencies for particular hydrographic surveys is available in the IHO Publication "Standards of Competence for Hydrographic Surveying". This document includes guidance specific to the port and harbour environment and can be downloaded direct from the IHO website (www.iho.shom.fr).

Formal qualifications supported by practical experience, accreditation by recognised professional body or demonstrable experience are all valid means of determining an individual's level of hydrographic competency. These are outlined below:

7.1 Hydrographic Survey Qualifications

Professional qualification as a hydrographic surveyor is normally achieved by completion of an IHO/FIG Category "A" Hydrographic Survey course which provides international recognition of a wider level of competencies than might be required for the more specific port and harbour environment. IHO/FIG Category "B" qualifications give recognition of entry-level hydrographic survey knowledge and a reduced level of competencies.

7.2 Hydrographic Survey – Accreditation

In lieu of completing an IHO Cat A or B course, accreditation by a recognised professional survey society or organisation may be appropriate, especially if the range and nature of the surveys expected to be conducted are limited. Suitable accreditation is offered by the following organisations:

- Australasian Hydrographic Surveyors Accreditation Panel (AHSAP). Guidelines for accreditation can be downloaded from the following the AHSAP website (www.isaust.org.au/groupHydrography/AHSAP/).
- The Royal Institution for Charted Surveyors (RICS). Refer to RICS website (www.rics.org).

7.3 Demonstrable Experience

In many ports and harbours in New Zealand, the personnel charged with the conduct of hydrographic surveys do not possess formal survey qualifications or have any recognition by a professional body relating to hydrography. Such personnel would normally be "self taught" and have, in some cases over many years, developed competencies specific to the work been carried out. In these instances, it should be demonstrated that personnel conducting hydrographic surveys possess the appropriate broad-based knowledge and comprehension of the aspects of hydrography considered necessary by the risk assessment. This should be achieved by periodic external audit by an experienced IHO Category "A" or AHSAP Level 1 Hydrographic Surveyor.