FATHOMS' GUIDANCE NOTE 3

BATHYMETRY

1 INTRODUCTION

Bathymetry (depths) may be required for many differing reasons. The ultimate purpose to which the depths will be put should determine the best method for obtaining those depths.

2 OPTIONS

Modern echo sounding systems are either the traditional single beam echo sounder (SBES) or the more recent multibeam echo sounder (MBES). The fundamental difference is that an SBES system will provide a discreet line of depths under the track of the survey vessel whereas the MBES provides 100% ensonification of the seabed. This latter approach sounds the ultimate answer except that there can be a large extra cost implication.

The purpose for which the data are being gathered is all important in determining the better or more cost effective method to be used. For instance, our experience with clients has shown that the extra detail obtained by the MBES can provide savings in volumes required to be dredged. However, the location and details of the site to be surveyed will also have a major influence on the correct decision.

In shallow water, some MBES systems lose their cost effectiveness as the width of the swathe of the seabed covered is small and not that much bigger than a conventional SBES system i.e. there could be a huge cost increase to achieve 100% ensonification of the seabed in very shallow waters. There are certain types of MBES systems that cope very well with shallow waters but lose their improved effectiveness as the water becomes deeper.

3 METHOD

SBES

This is the time-honoured traditional method of obtaining bathymetric data. The distance between adjacent lines – and therefore density of data - will depend upon the scale of the survey and/or the requirements of the survey. If a very dense pattern is required to provide detailed coverage, consideration should be given to the use of an MBES system.

Where the seabed is irregular, extra lines should be run by the surveyor to ensure that nothing has been missed between the regular line pattern.

If a general survey of an area is required, the conventional method is to use SBES for the bathy with a side-scan sonar (SSS*)* survey to ensure that no object remains undetected on the seabed.

MBES

The ability to ensonify 100% of the seabed to obtain accurate bathymetric data is a recent advance resulting from technological progress in both hardware and software.

Whereas an SBES system only requires a heave compensator to remove the vertical motion of the survey vessel, an MBES system requires a more sophisticated motion reference unit (MRU) to remove heave, roll and pitch.

The hardware for the MBES system itself is also very costly as is the software required to both gather and process this multitude of data. Users of MBES systems will also require specific training in order to produce accurate results.

The results from MBES systems can be extremely detailed with seabed topography mapped to 20cm resolution.

As with all aspects, the more detail or precision that is required, the greater the cost will be.

4 SPECIFICS

SBES.

Single beam echo sounders are found in most seagoing craft. Survey specification sounders, however, are specialised and more costly systems.

Typically they employ two frequencies – c.210 & 33kHz. The higher frequency provides depth to the seabed but the lower frequency will provide limited penetration in fine mud and silty seabeds. This allows the surveyor to determine the thickness of silt cover where present. Survey SBES systems have full calibration capability and should be calibrated for the depth of the transducer below the sea surface and the variations in the velocity of propagation of sound in seawater.

MBES.

There are fundamentally two types of modern MBES systems – the beam formers and the phase differencing bathymetric sonars (PDBS) sometimes known as interferometers.

The hardware in the former is much costlier but these systems tend to produce cleaner raw data sets which should require less editing. The latter's hardware is cheaper to produce and has greater swath coverage though the data towards the edges of the swath tend to be less reliable. MBES systems require a careful and detailed calibration routine before any survey starts. Also required is a velocity probe to measure the speed of sound in water for the system.

Both systems require the same software and both take considerably longer to process than SBES data especially as the number of data points is vast. Typically, once can expect a ratio of 1:1 for MBES processing i.e. it takes one hour to process what took one hour to gather.

Seabed Morphology.

It is possible to determine the differing areas of seabed morphology from side scan sonar surveys. As PDBS systems use the same underlying technology, they also are able to produce similar results except that the transducer is surface mounted for PDBS systems but towed for SSS surveys (see Guidance Note No 1 Seabed Searches).

With extra software developed specifically for this, beam forming MBES can also produce seabed morphology data. In all cases, the interpretation is subjective – but can be very accurate with certain types of seabed and experience – and ground truthing is needed to qualify the results.

5 QUALITY

It is somewhat hard for the outsider to judge whether proper techniques have been applied to the gathering of bathymetric data especially as modern software can produce some very 'sexy' looking results whether they are accurate or not.

It has always been easy for the less scrupulous surveyor to adjust the results to make them look better. There is no easy way to counter this other than to use more reputable companies. Certain parameters could be required to be included in the report such as a plot of the cross-overs (best practice requires cross lines to be run throughout the main survey area – any discrepancies between the cross-lines and main lines will indicate the presence of errors), full results of all calibrations undertaken and details of methods used for the surveys.