

6. Towed Side Scan Sonar

During hydrographic surveys, the use of side scan sonar may be required for supplementing echo-sounding by searching the region between regular sounding lines for additional indications of dangers and topographic irregularities. Any requirement for side scan sonar coverage in conjunction with a hydrographic survey will be specified in the Hydrographic Survey Letter Instructions or Statement of Work.

6.1. Coverage

Scanning coverage is the concept used to describe the extent to which the bottom has been covered by side scan sonar swaths, that is, the band of sea bottom which is ensonified and recorded along a single vessel track line. For hydrographic purposes, scanning coverage of an area is expressed in multiples of 100 percent, and is cumulative. One hundred percent coverage results in an area ensonified once, and two hundred percent coverage results in an area ensonified twice. Advisory note: Side scan coverage may not be achieved as planned due to varying water conditions, such as thermoclines, limiting such coverage.

The scanning coverage requirements will be stated in the Hydrographic Survey Letter Instructions or Statement of Work. Approved 200-percent coverage techniques are as follows:

- *Technique 1.* Conduct a single survey wherein the vessel track lines are separated by one-half the distance required for 100-percent coverage.
- *Technique 2.* Conduct two separate 100-percent coverages wherein the vessel track lines during the second coverage split the difference between the track lines of the first coverage. Final track spacing is essentially the same as technique 1.
- *Technique 3.* Conduct two separate 100-percent coverages in orthogonal directions. This technique may be advantageous when searching for small man-made objects on the bottom as the bottom is ensonified in different aspects. However, basic line spacing requirements for single-beam echosounders may not be met when using this technique.

6.2. Side Scan Acquisition Parameters and Requirements

6.2.1. Accuracy

The side scan sonar system shall be operated in such a manner that it is capable of detecting an object on the sea floor that measures 1 m x 1 m x 1 m from shadow length measurements.

6.2.2. Speed

The hydrographer shall tow the side scan sonar at a speed such that an object 1 m on a side on the sea floor would be independently ensonified a minimum of three times per pass.

The number of pulses per unit time, or pulse repetition rate, determines the speed at which the transducer (i.e. the vessel) can move along the track and still maintain the required coverage of the bottom. Longer operating ranges have slower pulse repetition rates, which requires the vessel speed to be slower if the entire bottom is to be ensonified.

The maximum vessel speed for three ensonifications can be calculated if the pulse repetition rate (pr) or the pulse period (pp) is known. The rate is the reciprocal of the period. This rate and/or period is usually published in the operating manual for the side scan sonar system. The calculation is as follows:

Maximum vessel speed (meters/second) = target size (meters) X prr/3 (sec⁻¹).

6.2.3. Towfish Height

The hydrographer shall operate the side scan sonar system with a towfish height above the bottom of 8 percent to 20 percent of the range scale in use. For any towfish height below 8 percent of the range scale in use, the effective scanning range is defined to equal 12.5 times the towfish height, provided adequate echoes have been received.

6.2.4. Horizontal Range

The achievable horizontal range of a side scan sonar is a function of several parameters. Among these are sonar conditions, sea bed composition, the range scale in use, side scan sonar system characteristics, and towfish height. Actual conditions in the survey area will determine the effective range of a particular side scan sonar system. The maximum allowable range scale for any towed side scan sonar is 100 m.

If the effective range scale of the side scan sonar is reduced due to external factors, then the representation of the swath coverage should be reduced accordingly. For example, changes in the water column or inclement weather may distort the outer half of the 100 m range scale. In this case, only 50 m of effective range could be claimed.

6.3. Quality Control

6.3.1. Confidence Checks

Confidence checks of the side scan sonar system shall be conducted at least once daily. These checks should be accomplished at the outer limits of the range scales being used based on a target near or on the bottom. Each sonar channel (i.e., port and starboard channels) shall be checked to verify proper system tuning and operation. Confidence checks can be made on any discrete object, offshore structure, or bottom feature which is convenient or incidental to the survey area. Targets can include wrecks, offshore structures, navigation buoy moorings, distinct trawl scours, or sand ripples.

Confidence checks can be made during the course of survey operations by noting the check feature on the sonargram. If a convenient or incidental target is not available, a known target may be placed on or near the bottom and used for confidence checks. Confidence checks shall be an integral part of the daily side scan sonar operation and shall be annotated in the side scan sonar data records.

6.3.2. Significant Contacts

In depths of water less than or equal to 20 m, contacts with computed target heights (based on side scan sonar shadow lengths) of at least 1 m should be considered "significant." In depths of water greater than 20 m, contacts with computed target heights rising above the bottom at least 10 percent of the depth should be considered "significant". Other contacts without shadows may also be considered "significant" if the sonargram signature (e.g., size, shape, or pattern qualities) is notable. In addition, contacts with less than 1 m target heights should be considered "significant" if they are found near the critical navigation depths of the local area. For example, if a 0.5 m contact is discovered in 10 m of water at the seaward approach to a dredged channel with a controlling depth of 10 m, then the contact should be considered significant.

6.3.3. Contact Correlation

The hydrographer shall examine and correlate targets between successive side scan sonar coverages (i.e., compare the first 100 percent with the second 100 percent sonar coverage). If applicable, the hydrographer shall examine the Multibeam data and correlate anomalous features or soundings with the side scan sonar data. Anomalous features or targets which appear consistently and correlate in each type of data record provide increased confidence that acquisition systems are working correctly and help to confirm the existence of these features or targets. The hydrographer shall cross reference and remark on each target correlation in the *Remarks* column (column 7) of the Side Scan Sonar Contact List (see Section 8.4.2.).

6.3.4. Identification of Potential Field Examinations

The hydrographer shall use the sonar contact list, in conjunction with an analysis of echosounder least depths, to identify hydrographic features which may require further examination.