Sub Bottom Profiling in Shallow Water

In order to monitor sediment ponds, reservoirs or other water bodies subject to sedimentation, the as constructed design base model is required to accurately monitor the accumulation of sediments. Unless this survey is completed prior to the water body filling with water, or immediately after via bathymetry, then it is very difficult to obtain at a later instance after sediments have accumulated.

Currently the most common technique for attempting to identify sediment information in shallow waters is the use of dual frequency Single Beam Echo Sounders (SBES). The results produced from this are often inconclusive and the method is limited in terms of achieving repeatable results. The limitations of this method include:

• SBES have been designed for the primary purposes of:
  - Surveying the bed of a water body; and
  - Under keel clearance surveying

This means they are designed to survey the shallowest part of the bed of a water body, not its sediments.

• SBES have both the transducer (transmit) and hydrophone (receive) devices mounted within the transducer. This results in noise from the transducer ‘ringing’ after it’s transmission pulse. To combat this ringing the listening process requires a ‘blanking’ of the first section of the pulse. Hence, the low frequency requires at least 1m of water to achieve any results as the first segment of the pulse has to be omitted.

• Minimal penetration is achieved with frequencies between 20kHz and 40kHz. In soft sediments you can achieve up to 2m of penetration whereby only 60% of this penetration can be used to acquire survey data.
A Sub Bottom Profiler is a system that is specifically designed for acquiring ‘sub bottom’ information. These systems have over 10 times the penetration capacity of a SBES and are designed specifically for this purpose.

Some of the advantages of a sub bottom profiler when compared to a SBES include:

- Sub bottom profilers can have a separate hydrophone array (receive) which removes the need for ‘blanking’ any of the data. As long as the transducer and hydrophone array are submerged, the system will receive clean data. Importantly, this device can still maintain 100% operational capacity when traversed on the bed of the water body.
• Sub bottom profilers have the capacity to penetrate up to 40m below the bed of the water body – resulting in any layers becoming far more obvious and therefore able to be processed with far greater confidence. The ability for these systems to penetrate so deeply is because the operating frequency can be as low as 2kHz.

3.5kHz, 6-9m water depth, 11m penetration in hard packed sand. As this image shows, even in sand the unit can penetrate up to and beyond 11m.

15kHz, 20-30m water depth, 25m penetration in glacial lake, soft sediment.

The above two images show that extensive penetration is possible in all variety of sediments although clearly soft sediments enable deeper penetration into the sub bottom material sediments.

In regard to identifying the depths of sediments in all conditions, sub bottom profiling is a superior technology to SBES.