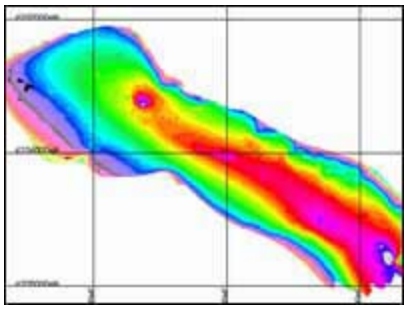
Holy Loch

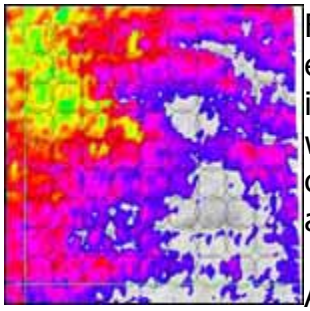
Recovery of Widespread Dockyard Debris 1998-2001

After US Navy operations ceased at the Holy Loch Submarine Base in 1992, a large volume of dockyard debris was believed to have been discarded on the seabed. The Ministry of Defence commissioned a survey of the entire loch in order to determine the location and level of significant debris areas. This survey was carried out in 1996 by SRD using the Seabed Visualisation System (SVS).



This initial high-resolution bathymetaric survey established a working grid of 25m x 25m blocks. The survey data also returned a 'Reflectivity Index' or Scintillation Count for each block within the grid. This figure proved to be a valuable indication of the presence of artefacts such as sheet metal, dock structures and scaffolding, and was used extensively to plan the subsequent debris recovery operations.

An ROV investigation later in 1996 identified the nature of several wrecks located with the bathymetric survey.



For the debris clearance operations (1998-2001), each block within the working grid was subdivided into four 12.5m x 12.5m sub-blocks, which in turn were divided into a 9 x 9 matrix of 1.38m diameter cells, broadly equivalent to the diameter of the grab and magnet used for lifting operations.

An RTK DGPS base station and an SRD Tide Gauge were established onshore to provide online data for the SRD systems onboard the crane barge. The barge was supplied with RTK DGPS information, which provided cm accuracy to position the SVS transducer array. The array included an ARTX transducer, whose 'beam steering' capability allows the illumination of a tract of seabed from a stationary (moored) vessel. In this manner, a high-resolution bathymetric survey and DTM of each sub-block were produced in virtual real time before and after debris lifting phases was carried out.

After a pre-clearance survey had been performed, a display of the seabed terrain was immediately available for inspection by the SRD operator. Debris targets could then be identified, with the onscreen display of target cells fed directly to the crane driver. A second RTK

antenna sited above the lifting point of crane jib allowed the crane driver to accurately position the grab/magnet vertically over the targets. Additionally, an active transponder attached to the crane hook was tracked using the ARTX system and was used to monitor the movement of the hook in the water column. Both these positioning aids ensured that comprehensive clearance of debris was achieved, with each position of grab closure or magnet activation being colour coded on the screen displays.

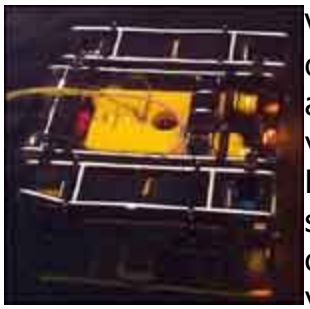
The lifting operation was later enhanced by the installation of a load cell that gave a realtime reading of the weight being lifted. This contributed to the safety of equipment and provided the weight statistics for each cell and sub block. A hydraulic pressure sensor enabled the operator and crane driver to observe the amount of pressure exerted by the grab, this combined with the load cell information helped to determine if the load was debris or mud. SRD also devised a voltage fluctuation display that determined magnet efficiency and further enabled the operator to use the electromagnet to search for large buried metal objects. By utilising these methods, the grab or magnet was only recovered to the surface when it was determined that it contained debris. As each lift took five minutes to recover and re-deploy, efficiency was significantly improved by not recovering an empty grab or magnet.

As loads were lifted from the seabed, the ARTX system could detect significant trailing debris (wire, cable or railings) beneath the grab or magnet. This valuable safety information was then relayed to the deck crew prior to the load breaking the surface.

All loads were landed on a specific area of deck, washed down to remove excess mud, then to cut into manageable sizes. The debris was sorted into ferrous, non-ferrous and landfill types before being deposited into skips for transporting ashore.

The different video cameras onboard were used to record all deck activities. The SRD operator would select the most appropriate picture to show the lifting and processing of debris and the transfer and weighing of the different skip types as they were sent for recycling.

Following the clearance of a sub block, the area was re-surveyed using SRD's ARTX system. Any remaining targets were identified and recovered in preparation for a final visual inspection of the area.



Video confirmation of seabed clearance was obtained with systematic footage for each sub block, and was acquired using one of two methods. A video cage could be lowered from the crane or an ROV could be used to capture seabed images, each system being equipped with four downward-looking cameras. The positioning of the images via the video cage was conducted using a transponder and the ARTX system, whilst the ROV was tracked using an additional SVS system located at the bow of the barge. These systems were integrated allowing a target to be identified on one system and inspected using another. The final result was a video mosaic of the entire sub-block, which was inspected by the client for approval.

The ROV surveys were also used to identify occasional discrete targets in adjacent areas where systematic clearance was not required. Such targets were marked on clearance sheets that were then passed to the SRD operator who in turn guided the crane driver for the successful recovery of the identified targets.

All information regarding the project was contained within the SRD Whole Field Model database. This information included the x and y co-ordinates of each grab/magnet operation, its weight, date, time and debris composition. The database catalogued over 850 debris skips removed, 2200 video tapes and more than 2500 tons of processed debris. The total weight recovered from the seabed amounted to more than 4300 tons. Additional detailed reports, giving operational details and progress status were submitted to the client on a daily basis.

The reporting of clearance activities for each sub block comprised:
· a photo-mosaic of seabed images,
· a chart containing the pre- and post-bathymetric surveys,
· a difference bathymetric chart,
· volume calculations derived from this difference chart,
· lift statistics, detailing weight and debris types for the block
· a general comments section with a small chart showing the location of the block within the comprehensive 1996 survey.