

Application Note

GeoSwath Plus Mapping Hydroelectric Dams



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KONGSBERG GEOACOUSTICS GeoSwath Plus Multibeam Applications

GeoSwath Plus

The *GeoSwath Plus* shallow water multibeam offers very efficient simultaneous swath bathymetry and side scan seabed mapping with accuracies that exceed the IHO standards for hydrographic surveys.

The applied phase measuring bathymetric sonar technology has an insonification angle of 240°, providing seafloor coverage beyond 12 times the water depth and makes it possible to image vertical structures up to the water line. The splash proof compact version of the system is readily installed on the smallest craft allowing to survey the shallowest and most confined areas.

Small hydroelectric dams

By the end of 2008 small hydro dams were generating over 85 GW of power from installations with capacities of a few hundred kW up to a few tens of MW (compared to the Hoover dam at over 2000 MW). These installations often use existing dams or are developed alongside new dams whose pri-

mary purpose is river water-level control or irrigation. There are many thousands of these small dams worldwide (over 95,000 in the USA alone) and maintaining this infrastructure requires accurate mapping and monitoring. This presents some challenges to the hydrographic surveyor. Here, the experiences of one company providing hydrographic surveys of dams in the Apennine mountains of Italy are described.

Pangea Srl Surveying small hydroelectric dams in Italy

In 2007 Pangea Srl was contracted by Enel SPA to perform bathymetric and topographic surveys around hydroelectric plants located in the Lazio and Abruzzo regions of central Italy, including installations on rivers such as the Liri (province of Frosinone) and the Tiber (upstream of Rome). The project covered many sites but each individual survey project was fairly limited in area, including some dams only a few tens of meters across. The accuracy requirements for

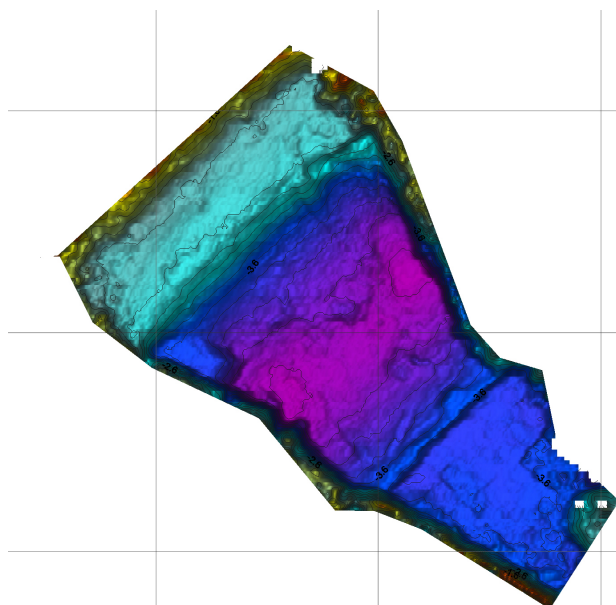
monitoring the sedimentation and shape of a dam floor are comparable to a ship navigation channel or dredge works. Knowledge of the



Surveying a small dam near Volci, Italy

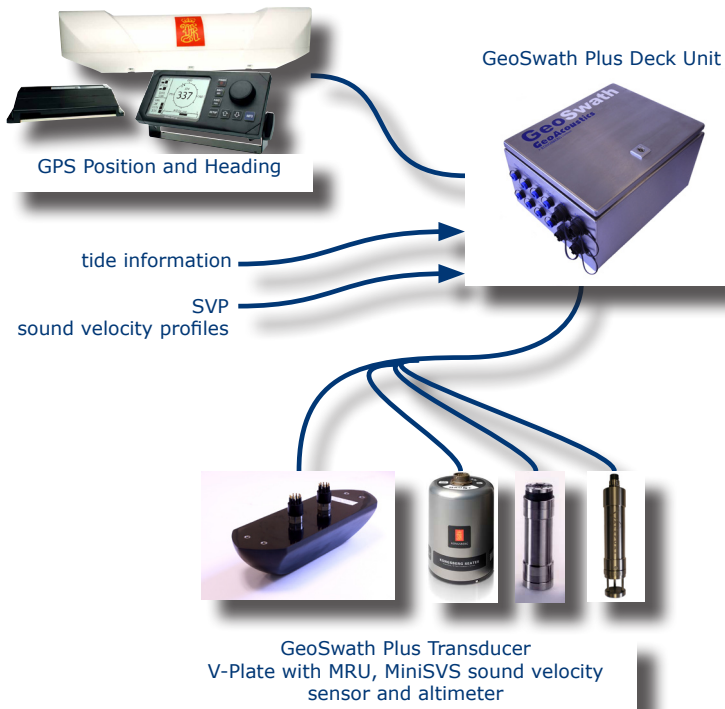
water depth and total volume is required for dam maintenance and to maximise the renewable energy output. Detailed bathymetry allows improved irrigation planning and flood control, and survey images show the status of the dam infrastructure. Accurate depth maps can also be critical to the safe operation of the hydroelectric facility and inform the risk assessment of the dam structure.

The difficulties posed are in two main areas. First, the difficulty of mobilisation of survey assets caused by the remoteness of the survey site, limited access to the banks and the lack of piers. Second, running the survey lines is difficult because of the limited depth of water (sometimes less than a meter over much of the dam periphery) along with the presence of hazards to navigation such as trees or submerged structures. These difficulties exclude the pos-



Bathymetry map of a small hydroelectric dam

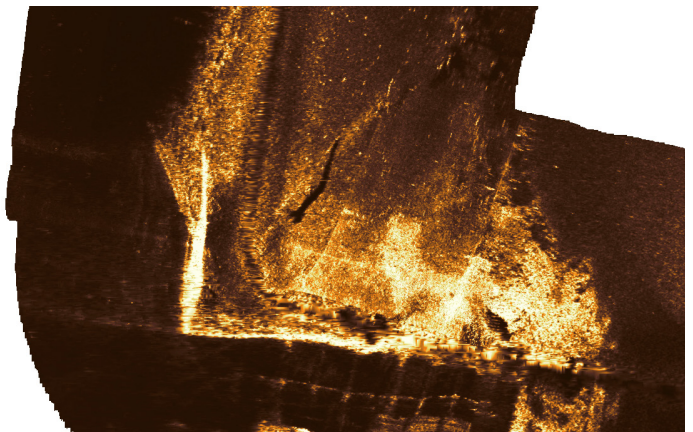
GeoSwath Plus Compact



GeoSwath Plus compact set-up

The typical set-up for over-the-side installation for small boat operations comprises the wet-end transducer v-plate, which holds the port and starboard transducers, together with a sound velocity sensor (MiniSVS), an altimeter (single beam echosounder), and a motion reference unit (MRU).

The compact deck unit houses the sonar electronics together with an integrated PC, running *GeoSwath Plus* software under Windows for data acquisition, system calibration, post-processing and data presentation, making the *GeoSwath Plus* a truly turn-key solution. The vessel's position and heading sensors also link to the deck unit with tide information and sound velocity profiles added to complete the calculation.



Geo-referenced side scan data of a dam

sibility of using a standard survey launch; something much lighter and man-launchable is required, but it still has to carry a fully capable hydrographic survey rig. Pangea chose two vessels: a 3.7 m long aluminium boat and a 4.30 m inflatable boat. Choice of a suitable integrated hydrographic package was key to successful completion of the contracts. The requirements



Access was often difficult

were for wide swath bathymetric mapping to better than IHO special order specifications along with co-registered side-scan images for structure inspection, with reasonable productivity in water depths often less than 1 m and data collection up to the waterline. The GeoSwath Plus was chosen. One of the great advantages of the system for this type of small boat work is its compactness. Another advantage is the robustness of the transducers; more than once an accidental grounding left the system undamaged. The equipment sometimes had to be hand carried over rough terrain to the water-side, which is only feasible for a compact system.

The data deliverables were

bathymetry and side scan data processed by GS+ software as well as depth profiles exported directly from the real-time data collection windows. The real-time side scan data displays also proved to be very useful for data interpretation on-site. After carrying out successful survey seasons in 2008 and '09 Pangea can report that the compact GeoSwath Plus is ideal for this type of small boat hydrography in harsh environments.

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