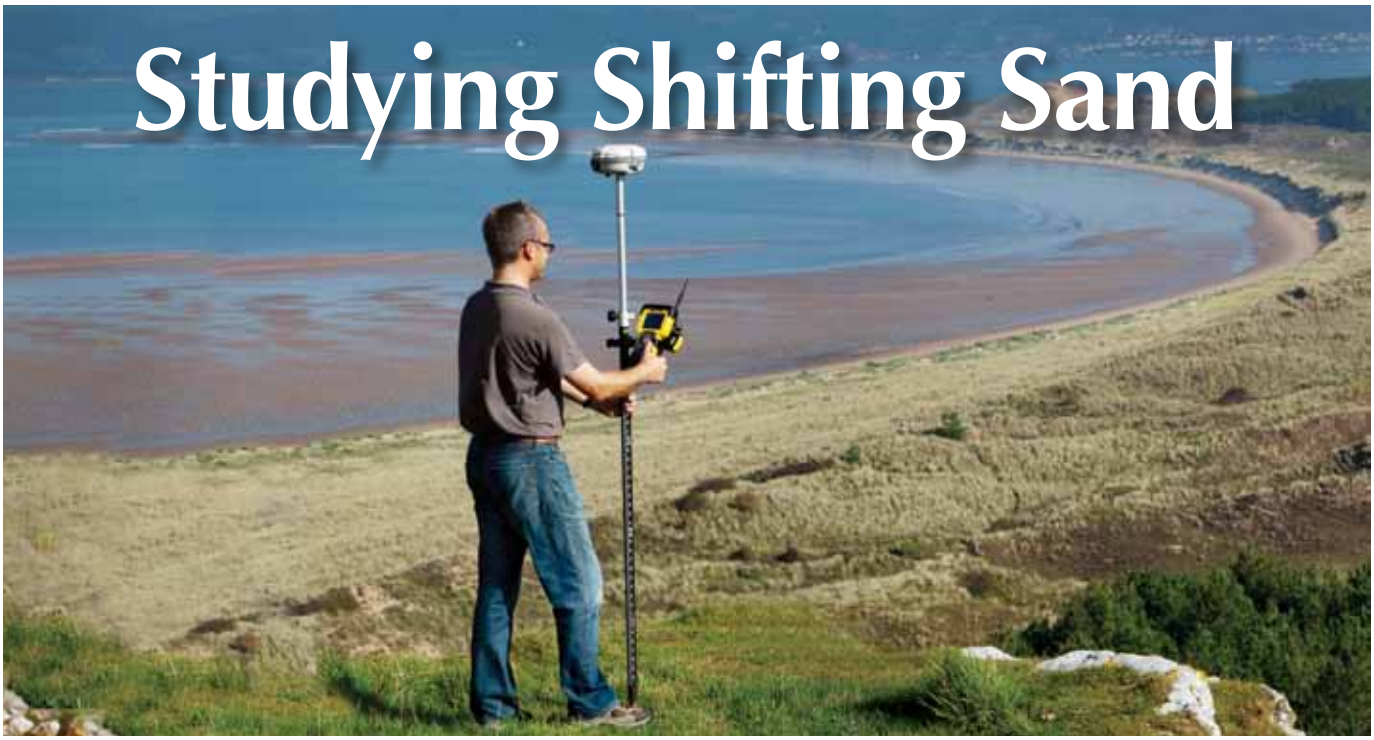
Studying Shifting Sand



Older residents of Cwm Ivy in South Wales remember tossing pennies from the cliffs above the coastline onto anchored boats below. Today, the edge of the sea has slipped out nearly 500 m (1,640 ft), and where there was once deep water is now sand dunes.

Wetland hydrologist Charlie Stratford is studying those shifting dunes and one of his key research tools to record the land's movements is the Trimble S3 Robotic Total Station. Using optical as well as GNSS surveying techniques, Stratford and his research crew are able to monitor and survey this dynamic site using Integrated Surveying™ techniques.

Stratford works for the Centre for Ecology & Hydrology (CEH) and collaborates with the British Geological Survey (BGS), both part of the Natural Environment Research Council, to study freshwater ecosystems and their interaction with the atmosphere.

The dunes and salt marshes are located on the Gower Peninsula in Swansea, on the north coast of South Wales.

Managing Change with Change

The South Wales site is of particular interest to the Centre because it is constantly changing; one storm can remodel vulnerable parts of the coastline overnight, while over many years erosion can significantly alter the land's contours. As the landscape changes, the water in the wetland becomes transformed as well. The salt water loses its salinity, enabling new plant and animal life to inhabit the area.

"Few landscapes can exist as freely and as independent from human intervention as the one we are seeing in South Wales, and that makes it particularly significant and exciting for us," Stratford explains. "This is a dynamic ecology that really is doing its own things and the key to observing, monitoring and understanding these changes—in fact, the linchpin in our research—is reliable topographic survey data."

The joint CEH/BGS team aims to monitor the South Wales site over the next 5–10 years and wanted to upgrade their equipment and take advantage of any relevant technological advances since their last purchase.

Stratford planned to carry out most of the survey work using optical surveying methods which would also sidestep any problems caused by carrying out GNSS surveys in a forested area near the site, located in the Whiteford Burrows National Nature Reserve. Also, he hoped to do most of the surveying himself, so he needed lightweight, portable gear. His choice was a Trimble S3 Robotic Total Station and Trimble TSC2® Controller using Trimble Access Software.

On the GNSS side, the upgrade included a Trimble R8 GNSS System to enable surveys to pick up both GPS and GLONASS satellite signals to capture the data he needed, even in the ever-changing coastal dune site.

So that Stratford wouldn't have to re-measure things or use permanent markers, he also chose to use the Trimble VRS Now™ Network subscription service providing instant access to RTK corrections throughout the UK.

"This is an evolving site so permanent markers may be buried by sand or washed away during storms," explains Stratford. "The obvious solution was the R8 GNSS which, on the one hand, would take away a whole layer of uncertainty for us and on the other, provide us with excellent mapping functionality and the ability to do repeat surveys."

Integrated Surveying

The idea of Integrated Surveying is to seamlessly integrate GNSS or GPS receivers and optical total stations so that surveyors see them as a combined system. The field controller and software provide a common file and interface to GNSS/GPS and conventional survey instruments.

In Stratford's case the key to the seamless connectivity of the two systems is the Trimble TSC2 Controller using Trimble Access Software. With this system, Stratford can simply toggle between optical and GNSS data collection while the Trimble Total Station and GNSS Rover are both active.

"If sand hills compromise our line of sight with the optical instrument, or heavy tree canopy affects our GNSS signal, we simply push a button and switch over," Stratford said.

"The TSC2 controller connects with the two systems at the same time. It's a simple process that has increased our productivity enormously; depending on the task, by 50 to 100 percent compared to using our old systems individually—it's fantastic."

"In many cases the robotic total station has turned our surveys into a one-person operation, freeing up the second site-surveyor to carry out other pressing work while the reflectorless option allows us to get a general feel for heights of dune ridges which is particularly useful. The VRS has also worked well. Some of these coastal areas are very challenging but with Integrated Surveying we are always confident of getting good data."

Using the Trimble R8 to position the total station, Stratford carried out a resection to establish himself on the Ordnance Survey grid and was ready to go. Having a choice of GNSS or optical instruments provides positions always recorded to a six-figure OS grid value, which in turn can cut back on any post processing and give Stratford maximum flexibility for his surveys.

Once data are collected they are downloaded back at the office and Trimble Business Center™ Software is used to display the data or to overlay collected data on to Google aerial maps. Additional analysis can be carried out in Esri ArcGIS software.

Stratford concludes, "Spatial analysis is the key to our team truly understanding the changes. We've still a long way to go with this project but already, using overlays of our collected data, we can look back at old aerial photographs and identify clear differences between then and now. We expect to repeat our surveys annually, possibly more if we know a major storm has taken place, and build up a time series of topography. Through continued training we will ensure that we are taking advantage of the full functionality of our survey instruments and our project will continue to benefit as a result."

See feature in GeoConnexion's October 2011 issue: www.geoconnexion.com