

# A Step Beyond



**The Coal Authority, following its establishment in 1994, adopted a comprehensive and rigorous management regime for the disused coal tips in its ownership. This regime includes regular inspections and maintenance of the infrastructure for both surface and subsurface water with additional flow monitoring where appropriate.**

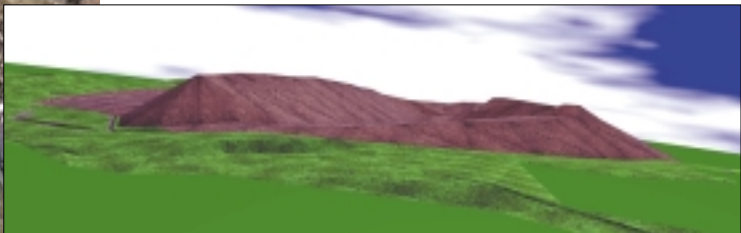
Recent advances in technology have now enabled the Authority to obtain reliable information from remote monitoring of important factors that could impact on the stability of tips and other land in the Authority's ownership. Remote monitoring equipment is being progressively installed to obtain information to supplement that obtained from the systems already in operation. This real time data will provide the Authority with an early warning of any significant changes that may require attention.

Because of the climate and topography of the South Wales coalfield, great importance is being placed on tip drainage due to the number of colliery tips that were constructed on hillsides underlain by aquifers and old mine workings

because of the shortage of available land.

Much of the coalfield receives annual rainfall in excess of 1600mm with parts of the central upland area receiving over 2400mm. Water flowing from spring lines and mine entries has caused tip failures in the past. The Authority is committed to ensure that tip failures will not occur.

The region also experiences a large number of landslides due to the local geology and landform, again influenced by the climate and human interference, principally mining activity. There are over 100 known active landslides in the coalfield and the Authority has four properties containing seven disused tips, which are affected by active landslides.





# Marine Colliery

**Marine Colliery tips 568 and 569 are two of four large disused tips sited on the steep hillside above the Ebbw Fawr. The hillside, which is affected by ancient landslides, comprises a major aquifer and coal seams that have been worked by means of adits.**

Following historic instability triggered by water issues, the tips were extensively reprofiled in the late 1970's and a drainage tunnel over 700 metres long was constructed to draw water out of the aquifer and discharge it safely to the river. Maintenance of effective drainage through the tunnel is a vital element of tip management at Marine which was the reason for the Authority selecting the drainage tunnel for the installation of a prototype flow-monitor.

An ultrasound device linked to an on-site computer measures the depth of water in a concrete flume inside the tunnel; power to charge the batteries is provided by a solar

panel. The computer also monitors temperature and the battery charge level. Information is collected by a data logger and transmitted using telemetry to a dedicated computer in the office of the Authority's consultant JMC Mining Services Limited. When a year's data set has been compiled, the computer will be programmed to issue a telephone warning if the water flow fluctuates outside anticipated upper or lower trigger levels.

Initial results from the flow monitor have been excellent and the Authority is in the process of installing similar equipment at six further sites.



# Landslide Management at Blaencwm

The Blaencwm landslide is located on the southern slopes of the steep sided valley of Nant Selsig, a tributary of Rhondda Fawr. The Authority's property includes the major part of a deep-seated landslide that started in 1989, at the top of the valley slope.

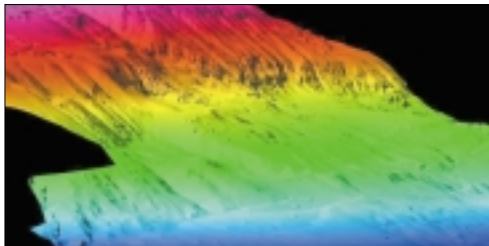
This landslide reactivated an extensive area of geologically ancient landslide deposits with the result that two main debris slides, with an overall width of 750 metres, are advancing towards a further ancient landslide block on the lower slopes adjacent to Nant Selsig. The site includes the disused tips of the former Tydraw and Glenrhondda collieries.

The Authority's current strategy for landslide management is based on a thorough understanding of the geomorphologic processes involved with regular survey monitoring and inspections and ad hoc work largely concentrated on control of surface and subsurface drainage. Movement rates have declined following various preventative works and remedial drainage measures, but the landslide remains one of the two most active in the South Wales coalfield.

The existing monitoring system at Blaencwm is simple and robust and has

coped well with changes in landslide behaviour. Historically information had been obtained five times each year and use of discrete monitoring points left gaps in coverage. Consequently, a real distribution of landslide movement is not well defined, and it is only possible to determine average rates of movement, so that correlation with rainfall events is difficult. Physical collection of survey data from parts of the landslide is becoming potentially hazardous.

A new monitoring regime employing modern instrumentation and communication systems has recently been installed to address these issues. This regime will not replace the conventional monitoring or visual inspection, but will improve the Authority's understanding of landslide behaviour and therefore enhance the decision-making processes for landslide management.



## The remote monitoring being used consists of the following:

- Terrestrial laser scanning from the opposite side of the valley. Three-dimensional digital images of the site are created to provide information on surface movement. It is believed that this is the first use of the technology for this particular type of application and results are still being evaluated.
- Automatic monitoring of ground water levels using vibrating wire piezometers in boreholes. One borehole was constructed at a site in Forestry Commission ownership above the head of the landslide; this borehole was logged to a depth of some 140 metres to provide information on rock conditions. A piezometer installed in this deep hole at the horizon of the No2 Rhondda coal seam will give advance warning of any build-up of water levels in old mine workings below and behind the landslide. Other piezometers monitor water levels within the landslide area.
- Automatic monitoring of movement using crackmeters within a geological fault zone and across fissures in two of the disused tips.
- Inclinometers to detect any movement of the ancient landslide block at the foot of the slopes.
- Tiltmeters to detect any movement of the presently stable slope below the advancing debris slide.
- Automatic recording of rainfall at the site of the deep borehole.

Digital readings from piezometers, the various movement detection devices and the rainfall gauge are recorded on dataloggers and transmitted using telemetry to a dedicated computer in the Cardiff office of the Authority's consultant, Halcrow Group Limited. Once sufficient data has been collected the equipment will be programmed to issue warnings at pre-set trigger levels. Initial results from the automatic remote monitoring are excellent and it is expected that the information gained will be a valuable input for landslide management.

Authority Civil Engineer Daryl Smith commented "that the use of the latest technology will improve the Authority's already proven management regime for disused tips and further reduce risk to public safety".

Remote monitoring systems are now to be installed at a further six sites. The design works are almost complete and the systems are due to be installed by January 2004.

