

OVERSEAS WORK

UAE Dams and Aflaj

WRA continues to support CONSER in hydrological studies and dam inspections, and recently completed assessment of seepage at Al Hayl, Wurraya, Qecheech, Sifuni, Mamdouh, Buraq, Moudainah and Muzeira Dams. In addition, a review was made of the Fili Dams and the groundwater recharge mechanism which links Buraq and Fili Dams with the Plain of Al Madam.

The design philosophy to build the dams using semipermeable embankment materials means that seepage water will be generated, so drainage is provided within and at the base of the dam to safely control such water. Clean seepage water infiltrates the wadi gravel and recharges aquifers downstream of the dam. If this was not the case the residence time of water in the reservoir would be longer, and a significant proportion would evaporate leaving less to infiltrate, because it would be inhibited by the sediment in the reservoir basin.



Spain and Portugal: Tagus River Basin

Ron Manley is currently working with ERM and Solventa on a study of the Tagus basin, which flows into the North Atlantic at Lisbon. The area of the basin is 81,310 km² of which 68% is in Spain and 32% in Portugal. The overall aim of the project is to examine the applicability of the Water Framework Directive in a river basin which is classified 'heavily modified'. Ron Manley is using HYSIM to simulate flows in the basin and to estimate the potential impact of climate change. The main focus of interest is the Portuguese part of the river basin, and has potentially important implications.

The basin is highly developed. In the basin as a whole there are 11 dams each with a capacity great than 200 million m^3 (the size of Kielder Reservoir, the largest in

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the UK). These include Alcantara reservoir with a capacity of $3,160 \text{ million m}^3$.



The dams are used to meet demands for water and hydropower. There is more than 100,000 ha of irrigation in the whole basin and the city of Madrid sits in the headwaters of the Tagus.

Whilst HYSIM is usually configured using abstraction data to avoid the need to naturalise a flow record, for the Tagus demands were so extensive it was necessary to calculate the natural equivalent flow record outside of HYSIM. In this case the main factors affecting flows were storage and water demands. Details of storage in both countries were at different time steps varying from daily to weekly and monthly, but demand data were less comprehensive. In the case of both Spain and Portugal the draft basin plans gave a breakdown of average current water demand by subbasin. For Spain the monthly distribution was included in the table whilst for Portugal it was assumed to be in the same proportion as major demands which were given for periods of several years. Bespoke software was written to extract and organise the data. As is often the case, when the data had been extracted and the influence on flow calculated small glitches showed up - apparently rapid changes in reservoir storage which were in fact typos, for example. In Spain four sub-basins were simulated and in Portugal eleven.



UK WORK

Dissolved Organic Carbon at Plynlimon

Modelling Climate Change and Drinking Water Supplies: Future Problems and Adaptation measures.



As part of an UKWIR project on climate change, Paul Whitehead and Martyn Futter have undertaken a set of modelling case studies making use of INCA to assess potential impacts on nitrogen, phosphorus, sediments, Dissolved Organic Carbon [DOC] and water colour. DOC is becoming a serious issue in the UK uplands due to rising trends in recent years, and the Acid Waters Monitoring Network has shown significant rises at a wide range of sites. In order to assess potential future increases in DOC and water colour, the carbon version of INCA has been applied to the upper Severn catchment at Plynlimon using a long run of data from 1983-2010 to help calibrate the model. The catchment in the upper Severn has peaty soils and there is a strong seasonal component as well as rising trends. The model generally performs well and simulates the seasonal and trend patterns of DOC.



The INCA-C model was used to assess potential changes in DOC under the 2020s and 2050s climate predictions using the UKCP09. The results show quite large rises in October and September months when the soils are becoming saturated and are flushing DOC.

The percentage increases are quite large and average 47% and 108%, while maxima show higher percentage gains of 95% and 245% respectively for the 2020s and 2050s. Such increases in DOC are of real interest to water companies because of the implications for the high cost of water treatment required to maintain water supplies from upland catchments. The uplands supply major conurbations (Manchester and Birmingham), so this is a question of strategic economic importance.



HYSIM

Recently HYSIM has been used on very large basins in Malaysia, Spain and Portugal, of a size and with hydrological characteristics very different to those on which the software was originally developed. It has continued to perform well. In the Tagus study at Almourol in Portugal, the correlation coefficient of daily flows was 0.91, the simulated standard deviation was 717 m^3 /s compared to the observed value of 716 m^3 /s and 81.5% of the variance was explained.

WRA LLP

In November 2012, WRA registered a new Limited Liability Partnership [LLP] and currently both WRA Ltd and WRA-LLP are operational and running in parallel. The directors' aim is to wind down the WRA-Ltd contracts during 2013, so that by 2014 only WRA-LLP will be in business.

This action will have little impact on how WRA works with clients and the WRA network of associates and consultants, but will add significant flexibility to the manner in which WRA is structured and carries out projects. This will commemorate 20 years of groundbreaking consultancy and research, and the new partners' mission is to continue to make WRA a worldclass specialised consulting service in hydrology and related fields for another 20 years and beyond

WRA Board Meeting

19 April 2013, Benson.

The WRA Bulletin is a quarterly publication, and relies on contributions submitted by Directors, Associates and Consultants. The document is circulated by email, and published on the WRA web-site, aiming to keep the WRA network, up-to-date with respect to current activities. Please email contributions for future issues to Paul Holmes: <u>pach@watres.com</u>

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