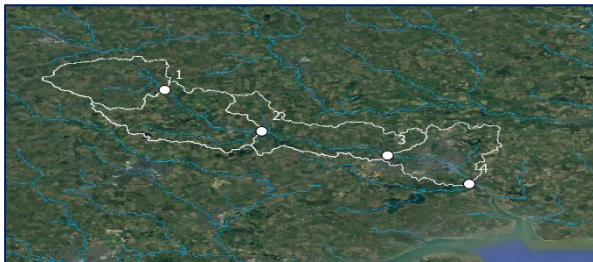


UK WORK

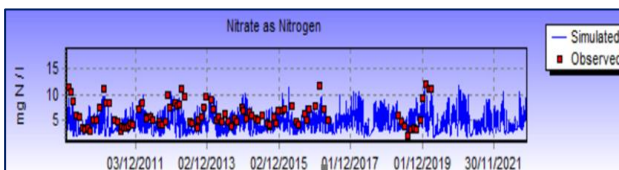
Forecasting Flow and Water Quality from Satellite Data

Paul Whitehead and Gianba Bussi are working with Aquascope Ltd to develop a water quality forecasting system for the River Thames and for the River Colne (Essex). The project utilises the Integrated Catchment Model (INCA) for flow and water quality to simulate nutrients (N and P), sediments, dissolved oxygen and Biochemical Oxygen Demand (BOD) as well as algal blooms. The model utilises either met office data or satellite data to drive the model using estimated rainfall and temperature and produces forecasts of flow and water quality along the river systems.



River Colne Catchment in Essex

Preliminary results are very promising with nitrate predictions at the downstream abstraction point for the River Colne at Colchester, especially useful to predict post dry summer high nitrate loads and concentrations. A sign of future climate change as dryer summers mineralise soil N and autumn storms then flush the N out into rivers.



Simulated nitrate (as N) and observed values at Colchester over a 10 year period

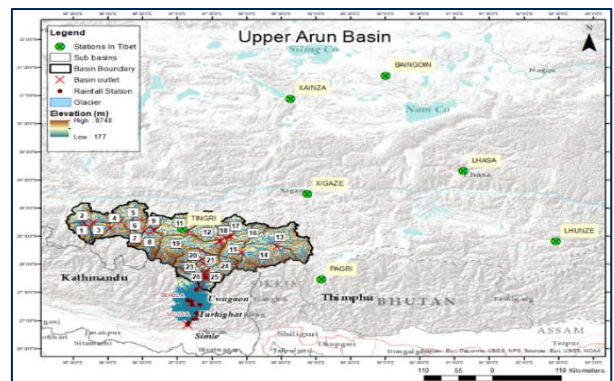
London Road Appeal Hearing

WRA Partner Dr Harvey Rodda provided expert witness services for a local residents group opposing a proposed caravan park on the London Road near Moreton-in-Marsh. The site was a narrow strip of land only 25m wide and 200m long and the proposed layout of caravan hardstanding areas and access roads did not provide adequate space for managing surface water runoff. The planning inspector rejected the proposed development citing flood risk as a key issue.

OVERSEAS WORK

Tibet Evaporation Estimates

The Pum Qu is a river basin located in Tibet with a catchment area similar to the country of Belgium, but with the greater part of the basin perched at an altitude of that of the Matterhorn (4,478m). The basin has an approximate T-shape, and isolated peaks of more than 6,000m are dotted around, with the highest peak Chomolungma (8,849m) situated on the border with Nepal (Figure 1). The basin has a semi-arid cold climate in direct contrast with the more moist and warmer climate on the Nepalese side of the border. The hydrological behaviour of this basin is very important for Nepal, as it provides the major portion of the river flows to a chain of 5 potential hydropower stations located along the downstream stretches, now called the Arun River.



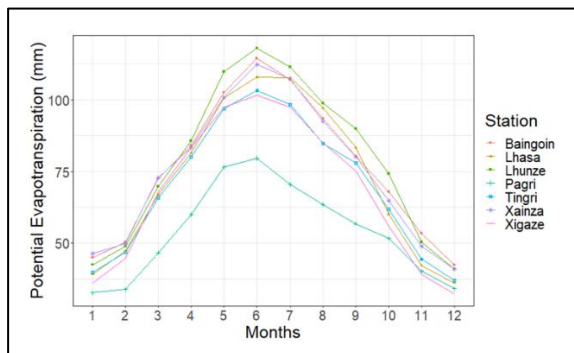
Relative location of 7 climate stations to the Pum Qu river basin

Recently the University of Cincinnati undertook a detailed hydro-meteorological study of this Pum Qu basin. Because of the virtual dearth of ground-based observations, this study relied heavily on satellite-derived estimates of variables and the use of a distributed rainfall-runoff conceptual model. Associates Ron Manley and Nick Mandeville provided a *pro bono* contribution to this study, by estimating monthly values of potential evapotranspiration and open water evaporation at seven locations in the neighbouring region (see Figure below).

Near complete monthly climate records for the 15 year period 1986-2000 were found for the 7 stations shown in Figure 1, one of which, Tingri, lies at the heart of the Pum Qu basin. Actual observations of mean temperature, relative humidity, and wind speed were

abstracted from the Spanish website <https://en.tutiempo.net/climate>, while estimates of long-term means, over the period 1961-90, of sunshine duration were downloaded from the <https://www.cru.uea.ac.uk> website of the Climatic Research Unit of the University of East Anglia in UK.

The Penman-Monteith formula was used to estimate monthly values of potential evapotranspiration and open water evaporation for these seven stations, using a module from the most recent version of the HYSIM rainfall-runoff model. Figure 2 shows that consistent results were obtained for six out of the seven stations, but Pagri station possessed much lower values. One possible explanation for this anomaly is that because the location of this station is close to the southern border, an ingress of much moister air can be drawn in from the Indian plains.



Monthly variation of potential evapotranspiration (mm) estimates

Heavy Metals Modelling in Ethiopia

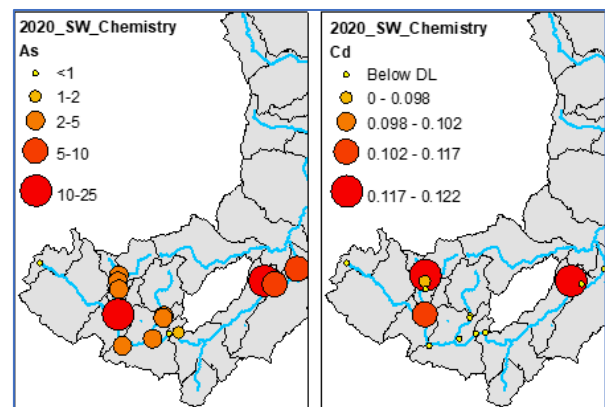
WRA's Prof Li Jin, Gianba Bussi and Paul Whitehead have been working with the AWASH Water authority to assess pollution levels in the AWASH River in Ethiopia. With the rapid development of industry, tanneries and increasing population levels in Addis Ababa there are pollution pressures building up.

Working with Yosef Abebe we have been sampling the AWASH, undertaking metals chemistry and then modelling heavy metals along the river.

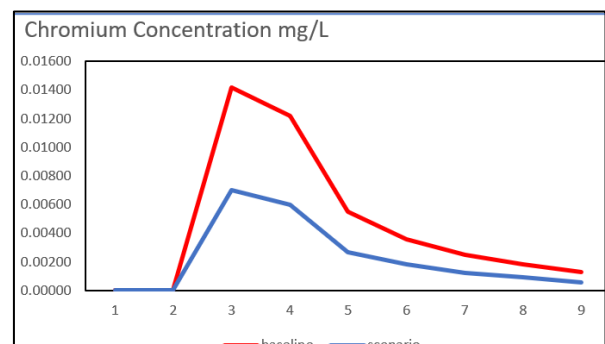
The maps below show the levels of arsenic and cadmium in the river system indicating quite high levels of metal pollution in the river system. Authorities need to put in place water quality control measures urgently so that levels can be reduced before they threaten public water supplies. The model simulations show that treatment measures are required to significantly reduce pollution levels for metals such as Chromium which is highly toxic.



Map of Ethiopia showing the central Awash River Basin



Upper Awash Arsenic and Cadmium levels



Simulations of Chromium downstream of Addis with and without treatment at the Tanneries

Training News

WRA has been running a water quality modelling & management course, available online at <https://www.omb.co.uk/courses>

Next WRA Board Meeting

6th October 2023, at 09.30 hrs.

The WRA Bulletin is a quarterly publication, and relies on contributions submitted by Partners, 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 Whitehead: paul.whitehead@watres.com

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