THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

No. 42 May 1994

Aotearoa — Hydrometry in New Zealand: A travellers tale

Six years ago, when my sister-in-law and her husband emigrated, my wife and I decided to visit them in their new home as soon as finances permitted. After two years of planning we spent Christmas 1993 and New Year in New Zealand.

While there I planned to make contact with organisations collecting hydrometric data, in order to compare, contrast and learn techniques and management approaches from two hemispheres.

When discussing a trip like this, it is amazing how many people turn out to have friends and relations in New Zealand. One colleague, **Mike Knowles**, produced some reports sent to him by his best man, **Andy Armstrong**, who left the Lancashire River Board to work in the New Zealand water industry.

Amongst the papers was a report on a seminar on Operational Hydrometry, held in 1985 to formulate proposals for the continuing development of operational hydrometry in NZ. Its recommendations included development and implementation of a quality assurance programme, certification of hydrometricians and an associated training programme, hydrometric network review, and support of the national instrumentation centre.

All of this was sympathetic to the initiatives and ideas I had been promoting in the NRA North West Region. It became obvious that much could be learned from the NZ approach, but that the odd day 'stolen' from a holiday would not be enough. Thanks to support from the NRA I was fortunately able to spend another week in NZ talking about hydrometry.

Finding contacts was the first step: I was helped by NRA colleagues **Peter Walsh** (NW), **Phil Proctor** (NY) and (a Kiwi in exile) **Tane Humphreys** (SW). Contacts were made and a week's meetings arranged: at Wellington Regional Council and the National Institute of Water & Atmospheric Research Ltd (NIWA).

Organisation in New Zealand

Hydrometric data collection is carried out chiefly by the Regional Councils and by NIWA.

The fourteen Regional Councils were established in 1989. Their functions include water supply, sewage treatment, land drainage, flood warning, soil conservation, catchment control, water allocation and pollution control. These are in addition to their regional planning, pest and weed control and civil defence functions. As in the UK, hydrometric data are collected to support these functions.

The regional councils are required to produce regional policy statements and they may produce catchment or water management plans, which have statutory backing: there is also provision for integrated management of resources. The approach is not too dissimilar to the catchment management planning process followed by the NRA. In each case there is a requirement for public input into the planning process. In NZ this is especially



The Whataroa River is an example of a braided river on South Island, New Zealand.

important because of the cultural significance of water to the Maori people: the spiritual and physical welfare of the community is considered to depend on the well-being of the water.

NIWA is a Crown Research Institute, in effect a state-owned enterprise. Its Maori name is *Taihoro Nukurangi*, which means 'where the waters meet the sky' and describes the work of NIWA in studying the waterways and the interface between the earth and the atmosphere.

NIWA is involved in five principal areas of service: research, consultancy, advisory, training and support science. It comprises five science divisions: Ecosystems, Freshwater, Oceanographic, Atmosphere and Environmental Data. These are serviced by the Kainga Instrumentation Support Centre.

My contacts at NIWA were to be mainly in the Environmental Data, Kainga and Freshwater Divisions.

Arrival in New Zealand

I arrived on time at Auckland airport after a twenty-two hour flight. After an afternoon of relaxation by the pool and a barbecued dinner we set off to a party (well it was Saturday night!) and I was introduced to two aspects of NZ life: the first was the 'beer-off', the second was the hospitality and friendliness of the Kiwis, which was to be experienced wherever we travelled.

The beer-off was an interesting experience — the beer was stored, stacked to the ceiling, in a cool room the size of an average UK corner shop.

I found my first gauging station at seven o'clock the next morning: in a park, about a mile from my sister-in-law's house, was a flume measuring urban runoff. This finding was not a sign of the dedicated hydrologist, or a keen jogger, but an accidental observation of the bleary-eyed traveller on his way to play in a golf tournament. Very little else would get me up at that time on a Sunday morning. It was worth the effort of overcoming jet-lag as I won a prize for the longest drive — unfortunately not in the golfing sense, but as the competitor who had travelled furthest to play!

NIWA Environmental data

On Monday morning at seven o'clock I was on-board a flight from Auckland to Wellington for my first appointment with **Brian Worboys**, Acting General Manager of NIWA Environmental Data. Brian explained the legislative, financial and organisational history of water resource management in NZ, and NIWA in particular.

NIWA Environmental Data comprises approximately 90 staff covering hydrometric and meteorological data collection. There are fourteen field hydrometric teams throughout the country, headquarters staff at Wellington and the Quality Management team at Christchurch. Environmental Data are accredited to ISO 9002 for hydrometric data collection and are currently pursuing accreditation for meteorological data collection.

Funding for hydrometric data collection is through the Public Good Science Fund, administered by the Foundation for Research Science & Technology. Environmental Data provide a service to other divisions carrying out strategic research projects of national significance. Another source of funding is contract work for the Hydro-electricity & Power Boards and Irrigation Boards. NIWA Environmental Data staff also participate in the NZ Antarctic Survey.

NIWA also acts as a consultancy, offering services to other organisations and countries. Particular services were the Quality Management System, the hydrometric data management system TIDEDA, and training. **Paul Mosley**, Manager of Environmental Data, was in Sri Lanka at the time of my visit managing a major project, **Doug McMillan**, the Quality Assurance Manager, had just returned from a QA project with an Australian power generator, and the installation of a flood warning scheme in North Vietnam was being planned.

The afternoon was spent with **Bill Christie**, manager of the national hydrometric data base. My timing could not have been better as Bill was clearing his desk in preparation for retirement four days later.

The national archive contains all hydrometric data from all collection agencies. It acts as a back-up for Regional Council data, which is provided on an exchange basis: i.e. Regional Councils can request, free of charge, data collected by other agencies such as NIWA. Although NIWA is the focus for national data requests, requests which include Regional Council data are dealt with by the councils themselves.

The software system used for data management and reporting is TIDEDA (Time-dependent data processing, storage, analysis and modelling system). PC or mainframe versions are used extensively in all NZ hydrometric agencies, and in other countries in the southern hemisphere. The documentation for the package is well developed and is published in a paperback version that could be a role model for similar packages developed elsewhere.

Wellington Regional Council

08.00 hrs and another early start (well it was for me!) to meet **Lynne Barr**, Manager of Wellington Regional Council's Hydrological Services Group: an opportunity to discuss operational hydrometry. Lynne's team serves the Regional Council in the same way as hydrometric teams operated in the pre-1989 UK Regional Water Authorities. The team provides data for resource management, bulk water supply, flood defence and warning, environmental quality, fisheries and conservation purposes. In addition to the field and data team, the section provides hydrological, hydrogeological and biological services and advice.

The cost of the service is recouped through water rates, water rights (equivalent to UK abstraction licences) and a flood defence levy on the local council rates. The latter is charged on a sliding scale depending on the benefits accrued from defences: i.e. the levy was less for those living on high ground than for valley dwellers.

Licences of Right were revoked in the Resources Management Act 1991, and water rights were issued. The water rights, even for public water supply, are time-limited (10 years) and will need to be reassessed before they are renewed.

The field data collection and data management are carried out to QMS standards similar to NIWA's, and ISO 9002 accreditation is being sought. Wellington, like NIWA, use the same staff for field and office (data) duties. This is also the model operated in the NRA North West Region, where involvement in all aspects of the work has achieved a greater sense of ownership, and consequently improved quality of data and service.

From the office I was taken on a short visit into the field to look at a number of hydrometric sites. The Manuka Track flow measurement station on the Wainuiomata River is an important site: it is upstream of a river intake which provides 14% of the bulk water supply for Wellington. The catchment had been designated for water supply in the 1880s and has had restricted public access since that time, in order to protect the supply. Flow data for the catchment date from 1917.

In the vicinity were a number of rainfall sites, one of which had been operative since May 1884. The sites were on radio-telemetry for real-time flood warning usage, with daily polling of data for archiving purposes.

At these sites the NZ standard hydrometric equipment was in use; this is purchased, like all instrumentation in New Zealand, from the Kainga instrumentation centre.

Another site I visited was a groundwater observation borehole on the Wellington foreshore, at the mouth of the Hutt river. The site is a tidally-affected artesian well. Historically the area was developed by industries using the groundwater, e.g. for meat processing, wool dying and paint manufacture, and was attractive because of the nearby deep-sea port. Over-abstraction led to saline intrusion and the public supply boreholes had to be relocated further inland.

The decline in the UK market for meat (linked to our joining the EEC)

was marked by closure of the processing factories. There is now industrial rejuvenation, with rising groundwater levels and potential problems of groundwater contamination.

Once the meetings had finished in Wellington I flew down to Christchurch on the South Island. Flying down the west coast I had my introduction to the braided rivers that characterise the South Island. As we flew further south the rivers became grander and more impressive, each seeming wider than the last: the Clarence or Waiautoa, the Waiau, the Huruni, the Waipara and the Waimakariri.

The Maori word for water is Wai; hence the names are descriptive of the rivers, e.g. Waiau = the river of swirling currents, Waimakariri = the cold river, and Wairau = the plain of a hundred rivers.

Quality management systems

NIWA Environmental Data are believed to be the first organisation to be ISO 9002 accredited for hydrometric data collection (by TELARC NZ). In NRA North West we are currently implementing the equivalent framework (BS 5750 part 2) in the Hydrometric Information Service. It was therefore obvious that I should spend a day with the Quality Assurance / Staff Development Manager Doug McMillan and his assistant **John Fenwick**.

The rationale and implementation of the quality management system is described in the January edition of the *WMO Bulletin*. The principle behind the system is to supply clients with data, information and services that can be used with confidence, without the need for extensive checking, editing and correction.

NIWA's development of the system began in 1987. It covers all aspects of field work, including processes, techniques, instrumentation and safety, together with office procedures: data handling, processing, reporting, etc. The system defines standards of performance, e.g. *'at any one station, there shall be not more than 2% (approx. 7 days) missing record in a given calendar year, and not more than one calendar year in ten shall have any missing record'*. The quality system manuals are handbooks of hydrometry comparable to standard texts.

From an outsider's point of view the organisation 'breathed quality' throughout, which is a credit to NIWA for the management techniques used in developing the system and engendering ownership by all staff concerned. In discussions with some of their clients the same philosophy prevailed and the accreditation was seen as of paramount importance. Quality is a well-developed facet of NZ culture: wherever you looked quality statements could be found in newspaper adverts, posters in supermarkets, literature in hotels, etc.

I left the office that day with a sense of optimism that the initiatives started in the NW were already proven and working in NZ. That alone was worth my visit. A very enjoyable evening followed in the company of the NIWA Christchurch staff at their Christmas barbecue.

Field visit

Apart from a short field visit whilst in Wellington, I had had little opportunity for 'hands on' experience or observation of field practices. This was to change with a day in the field with **Graeme Davenport**, manager of the NIWA Christchurch field team. This team is one of the fourteen which carry out both field and data-processing duties.

I had asked to be shown some typical hydrometric sites and to look at the field quality assurance routines. By 09.30 I was having second thoughts, suspended 15 m above the Waiau River in a cableway cradle, rocking in the breeze, with the river running at 2 ms^{-1}, at a depth of 1 m, and 30 m either way to the relative safety of the cliff-edge of the gorge.

However, there was work to be done: a standard gauging using a Gurley current meter, single point (0.6d), with an exposure time of 40 s plus one revolution. The determination of flow (74.79 m^3s^{-1}) produced an error, from the rating, of - 0.9%, well within the 8% limit defined in the quality management system.

The route continued to the Waiau River Marble Point gauging station for the quality assurance checks, the procedures being similar to those practised in the UK, using standard instrumentation of a Kainga shaft encoder connected to an Aquatel II data logger and radio-telemetry. Each site is equipped with a electronic plumb-bob, similar to the diptone used in the UK.

As with many of the sites I visited, the gauging station also had a tipping bucket raingauge (TBR) connected to the logger system. Quality assurance for the TBR was maintained by using a 5" storage gauge. A difference of 5-8% between readings results in the gauge being returned to Kainga for calibration.

The TBR standard is a Japanese OTA gauge, manufactured in stainless steel. Storage gauges are a New Zealand standard, similar to the UK Met Office standard (i.e. 5" diameter), with the major difference that they are made from polyethylene. The standard installation at 12" elevation is usually maintained, but this is not always possible (e.g. above the snow-line).

Measurements are made using a dip rod. In isolated areas trampers (long distance walkers) take measurements and send returns to NIWA. In these areas the annual rain-gauge inspection can be carried out by helicopter. The gauges can record an annual rainfall total of up to *12 m* in the Fiordland area of South Island.

The next stop was a station monitoring abstraction from the Waiau River for irrigation purposes, and then we went on to the Kainga Instrumentation Centre.

Kainga Instrumentation Centre

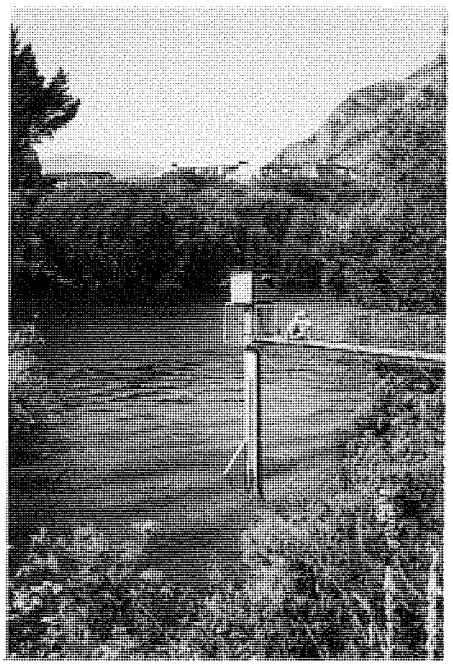
Kainga is a business unit within NIWA specialising in technical support for NIWA science units and a range of external environmental monitoring agencies. The services provided include calibration, servicing, supply and development of a wide range of hydrometric, meteorological and other environmental data collection and ancillary support equipment. Kainga is also TELARC accredited to ISO 9002, which provides clients with a high degree of product confidence. It is the national facility for current meter and raingauge calibration. The raingauge calibration follows a dynamic process similar to the one promoted by the NRA North West Region.

NIWA Freshwater Division

My last working day was spent with the staff of the Freshwater Division, learning about problems specific to New Zealand and the type of research and consultancy work they carry out. This included investigations into erosion and sediment washoff, network review, river flow and temperature modelling as part of a control process for power generation, and a critique of dam feasibility studies in the Pacific rim.

From work to play?

I was then 'demob happy' and on holiday. I flew from Christchurch to Wellington and then went by train to Auckland. The train journey was an



Frankton gauging station, River Kawarau

experience: scenic windows, sheepskin-covered seats and 12 hours of glorious scenery, with a commentary including a potted history of NZ train disasters, usually as we were passing over the bridge replacing the one that had collapsed.

For the next three weeks we travelled around the North and South Islands, taking in the sights. I had been given a copy of the NZ Hydrometric Catalogue, and this — helped by the distinctive Kainga standard installations, which were relatively easy to spot — meant that we were able to find a variety of hydrometric sites across the country.

The suggestion that I planned our routes using this guide was nothing but a malicious rumour. However, as luck would have it, we found sites ranging from V-notches measuring tip leachate in Auckland to cableway systems on the major South Island braided rivers. At one site on the Arrow River, Queenstown, we even disturbed people panning for gold at the gauging station!

South of Christchurch we crossed the most impressive of the braided rivers, the Rakaia. The main Highway 1 bridge across the river was over 6000 feet long, which presented problems: the camera was not big enough!

Our trip around the South Island was relatively trouble-free, but following us was severe weather. The storms caused extensive flooding, land-slips, damage to numerous bridges and isolation of several towns. Trampers and tourists were airlifted from some areas and a state of emergency was declared. In Queenstown 90 mm of rain fell overnight with 15 mm falling in 5 minutes. Next day the newspapers reported that the river was lapping at the door of the Shotover Jet Boat company: that was about 8 m higher than it had been two days earlier when we had experienced the jet boat ride.

On 24th January 537.5 mm of rainfall was recorded at Milford Sound in the Fiordland of South Island: this was approximately the mean *monthly* rainfall, and was part of a total of 1.2 m which had fallen since 1st January.

The rain in New Zealand is suitably described in a poem found in one of the guide-books:

It rained and rained and rained and rained,
The average fall was well maintained,
And when the tracks were simply bogs
It started raining cats and dogs.
After a drought of half an hour
We had a most refreshing shower,
And then, most curious thing of all,
A gentle rain began to fall.
Next day was also fairly dry,
Save for a deluge from the sky
Which wet the party to the skin,
And after that the rain set in.

I have tried to share here some of the information I gained in NZ and some of the hydrometric experiences of my holiday. I know I will have missed some elements of interest to BHS members, but many of the issues are covered in the New Zealand Hydrological Society's publication *"Waters of New Zealand"*, edited by Paul Mosley. *"Waters of New Zealand"* provides a wide-ranging coverage, from precipitation, floods and droughts through to groundwater and geothermal waters. It focuses on examples and information of particular relevance to New Zealand. Its readership target is professional engineers and students, which I believe it achieves through its content and its easy-to-read style.

Another book I would recommend is *"Roughness Characteristics of New Zealand Rivers"* by Pete Mason and D Hicks of NIWA. As a student using roughness coefficients I always had problems visualising how a particular value of Manning's n related to the river: this book reveals all! The book is the culmination of a three-year field data collection programme. Information is given for 78 NZ river and canal reaches, including colour photographs, cross-section and planform plots, bed and bank descriptions, bed surface material size gradings, plus tables and plots showing how the Manning and Chezy roughness coefficients vary with flow magnitude. The book provides a reference data set for use in visually estimating roughness coefficients. Although it is based on NZ rivers, the photographs clearly show that it is applicable to the UK.

Reflections

The short time I spent in New Zealand was very enjoyable and extremely useful and informative; this account can only provide a glimpse of the true situation. I hope readers in NZ will excuse any obvious errors and put it down to amnesia resulting from my enjoyment of the excellent NZ wines. I would like to thank everyone in NZ who found time in their busy schedules to see me, as well as **Sue Walker** and **Chris Harpley** (NRA North West Region) for their support and encouragement.

John Adams
NRA North West Region

Areal rainfall estimation

BHS National Meeting
University of Salford
15th December 1993

Delegates from around the country were welcomed by *Professor Ian Cluckie* to the Council Chamber at the University of Salford.

Eddie Spackman from the Climatological Studies Group at the Meteorological Office began with his paper on Calculation and Mapping of Rainfall Averages 1961-90.

Eddie explained that Annual Average Rainfall (AAR) estimates were determined on a 10 km square grid by geographical analysis, relating rainfall to variables primarily concerned with geographic position, local topography and surrounding land/sea ratios. Quality controlled data from some 13100 stations were used in the study. Final rainfall estimates were obtained by bi-linearly interpolating values calculated from the fitting functions. The standard error of these estimates varied from less than 2% of AAR in topographically homogeneous areas to greater than 5% of AAR in some upland regions. A similar analysis was undertaken to provide monthly rainfall estimates. The results are available as grid-point values at 1 km intervals and as A4-size contour maps, principally at 1:250 000 and 1:625 000 scale. A 1:625 000 wall map is also planned.

The following presentation by **Bob Sargent** (Forth River Purification Board) reviewed traditional methods used for areal rainfall estimation. He began by emphasising that a "good" areal estimation method should model rainfall amounts *between* gauges as well as providing an acceptable areal average.

The arithmetic mean as a technique produced reasonable estimations of

areal rainfall for long time periods but did not provide information on the spatial distribution of rainfall and was reliant on good raingauge coverage.

Delegates noted that weighted mean methods (e.g. Theissen polygons) and domain weighting techniques were less affected by geographical bias, with the latter providing more realistic spatial rainfall distributions but suffering from difficulties inherent in specifying each raingauge domain correctly.

Bob Sargent emphasised that isohyetal methods provided physically realistic estimates, but added that this was tempered by the subjective nature of their production. It was also noted that a form of interpolation, whereby areal estimates are derived by combining data from both recording and daily totalising raingauges, was particularly suited to short period event analysis. He stressed the value of normalising rainfall data to allow for uneven gauge distribution and emphasised that with the actual distribution of rainfall being unknown, the error of raingauge measurements should be taken into account when considering the complexity of any areal estimating procedure used.

A review of Computer Methods for Areal Rainfall Estimation, presented by the IH double act of **David Morris** and **Lisa Stewart**, came next on the programme. Dave Morris began by commenting on the procedure of normalising rainfall data by AAR. He suggested using a factor of AAR that could be varied to suit local conditions. Grid-based methods, including Theissen polygons, triangular planes and sector searches, were summarised. Discontinuity at polygon boundaries and the plateau nature, or at least the angularity, of computed rainfall surfaces were the main drawbacks of these techniques.

Dave then discussed Voronoi Interpolation in greater detail. This was a method he recommended strongly: developed from the Theissen polygon approach, it produces a gradually-varying rainfall surface which passes through observed values. The only discontinuity is in gradient at gauge locations. It was emphasised that the method was straightforward to program and logically consistent.

Lisa Stewart, left with an unequal half of the proceedings, introduced Kriging as a computer method of areal rainfall estimation. This geostatistical technique involves two stages: first the spatial structure of the variable is modelled using the analysis of experimental variograms, and then, in the second stage, the variogram model is used to interpolate the variable onto a regular grid. Two important features of the method are that observed values are preserved and a measure of the estimation variance is obtained.

Lisa moved on to discuss the need to apply areal reduction factors to point rainfall estimates when computing areal rainfall return periods. She also outlined the scope of the Hydrological Radar Experiment (HYREX), focusing on its current status and the future direction of research into the spatial variability of rainfall.

The final paper of the morning session was on the application of radar in estimating catchment rainfall, presented by **Dr Kevin Tilford** (University of Salford). He began by charting a brief history of weather radar, then detailed some of the errors involved in estimating areal rainfall from raingauge and radar data. He questioned the nature of current radar correction procedures, which inherently assume raingauge data to be the best estimate of ground truth. He evaluated two adjustment procedures: domain adjustment, as currently used by the Met Office, and a local adjustment procedure featuring surface-fitting, currently being developed in a project with NRA Anglian Region.

In conclusion, Kevin anticipated that continuing radar-raingauge comparison would prove fruitless: he considered that it would be more effective to assess end-user requirements and then select a method accordingly. He hoped that continued development of vertical-pointing radar would assist radar evaluation of areal rainfall in the future.

The only afternoon paper, Remote Sensing of Precipitation, was given by **Dr Michael Beaumont** from the Remote Sensing Unit at the University of Bristol. He substantially broadened the discussion on areal rainfall estimation to a hemispherical or global scale, commenting that at this scale the geographical distribution of precipitation was still unknown by a factor of two. The lack of information available for the southern oceans and the polar regions illustrated the potential value of satellite-based remote sensing.

Michael Beaumont summarised satellite methods of rainfall monitoring, commenting on the platforms and sensors used and the algorithms required to relate the data received by a sensor to rainfall amounts. He concluded that the ideal scenario would be a passive microwave sensor on a geostationary platform. Two current projects illustrated the use of remotely-sensed precipitation data: one monitors the development of rain-bearing weather systems over West Africa, the other estimates rainfall over the North Sea by using passive microwaves.

He ended with an enticing disclosure that the procedure to evaluate areal rainfall from passive microwave data requires calibration against weather radar!

Graeme Boyce
Exeter

GIS in hydrology

BHS / Welsh Hydrological Group / Royal Geographical Society joint Meeting Swalec Building, Cardiff 13th January 1994

The recent upsurge in interest in the use of GIS in all aspects of hydrological study was reflected in the high attendance at this one day meeting held in Cardiff. Over 80 delegates were welcomed by *Bill Harries*, **Chairman of the Welsh Hydrological Group (WHG).**

Unfortunately illness prevented two of the speakers from attending the meeting. However, **Rob Drayton**, Secretary of the WHG, stepped in at the last moment to give an excellent overview of the use of GIS in hydrological modelling. In particular, Rob outlined the kinds of spatial data likely to be used in GIS studies of this nature. He went on to describe in more detail the relative advantage and disadvantages of a vector and raster approach in hydrological modelling in terms of the types of data available (e.g. digital terrain models, soil data, land cover information derived from satellite imagery) and the nature of existing models such as the SHE model.

Kim Farthing then described work currently being carried out within the Thames Region of the NRA to investigate the use of GIS in the computerisation of the existing flood enquiry system. The aim is to use the GIS to locate an enquiry site, then to automatically check if the site is within

any flood plain, and finally to generate a report of the results of the search. Kim outlined recent progress in the project, in particular customising the system for non-GIS experts. He also described the nature of existing data sources and the types of problems in data conversion). The key advantages of a GIS approach, however, were in the reduced time involved in answering queries about flood risk. Such enquiries can be based either on postcodes or on grid references. It is possible to window in to highlight areas potentially affected by flooding and investigate the relationship of particular properties to past flooding events. Such enquiries can then be exported either to a graphics package or to a word processing package. Kim concluded by outlining future intended developments in the system.

The next presentation by **Allan Jones** (University of Plymouth) concentrated on the use of GIS in coastal management applications. He outlined the reasons for increased interest in coastal management, especially in relation to the implications and cost of sea level changes. The need for new tools in information management in such areas has led to investigations into the use of GIS in data integration in coastal environments, especially in North America. Allan then outlined the issues which are likely to effect the success of such initiatives in the United Kingdom, in particular the lack of coordination in coastal management. This is further complicated by the multiplicity of agencies involved and different definitions of the width of such zones, which has implications for the scale of analysis carried out within the GIS. Current application areas for GIS in North America include shoreline change, wetland loss, benthic community analysis, oil spills, sea level rise and estuarine water quality modelling and pollution movement modelling. Allan then presented case studies from the UK to illustrate the use of GIS in coastal studies, including production of the United Kingdom Digital Marine Atlas. Different agencies are likely to have different requirements. Generally, however, GIS has been used in two types of application: as a cartographic tool and in conjunction with modelling functionality. Allan finished by outlining the key technical and institutional challenges facing researchers in this area.

During the break, Kim Farthing gave a hands-on demonstration of the Thames Flood Enquiry System. Then **Michael Allchin** (Institute of Hydrology) presented a paper describing the use of GIS in integrated catchment planning (on behalf of **Roger Moore** who was unable to attend the meeting). Michael described a collaborative project between the Institute of Hydrology and ICL, which had resulted in WIS (Water Information System). This is a data-driven environmental information system which supports the storage, retrieval and manipulation of spatial and time-series data in a fully integrated database. He then listed the main stages involved in integrating data to create a unified database which can address planning issues at the catchment level. These included defining objectives, describing attributes of catchments, identifying potential and past influences in the river basin, auditing demands on the system, listing principal issues arising from the audit, establishing a prioritised plan of actions for the catchment, implementing and monitoring the plan and evaluating the results of the plan on the management of the basin.

Michael then described the main features of the WIS, including the use of time series data. He demonstrated how the data model has been used in the development of an integrated catchment plan, with reference to real world examples. This logical data model is defined in terms of three axes: features (where?), attributes (what?) and time (when?), which describe the 'WIS cube'. He described the use of digital terrain models within the WIS in order to generate catchment boundaries at any point on the river network. These are then used to define the area of interest in interrogating databases (natural, social/industrial and political/economical) for the particular catchment study. Finally, Michael outlined some potential developments in the WIS which will integrate with other IH applications.

In the final presentation of the day, **Michael Clark** (GeoData Institute, University of Southampton) presented a thought-provoking paper entitled 'Multicriteria classification of linear features: a challenge for river and coastal conservation', in which he argued that linear classification has to be a fundamental part of the work of the NRA. He described the purposes of classification in general, how it relates to the work of the NRA and how classification of linear features has traditionally been handled in GIS. The particular challenge of linear classification in hydrology is that we are often dealing with spatially static but temporally variable attributes. He then documented the risks and limitations of linear classifications in terms of classifying individual variables and aggregating variables with reference to Reach Conservation Classification.

Michael then described two traditional techniques of multi-criteria classification in GIS, including scoring internal attributes and weighing contributory classes. Major difficulties arise from effectively combining multiple data sets of differing spatial and temporal resolution. He concluded by suggesting guidelines for approaching the classification process. Such studies, he suggested, can easily be justified in terms of the large amount of time spent in working at the reach level by those agencies charged with the management of river environments.

This presentation concluded a very successful day, in which several of the key advantages of adopting a GIS approach were addressed, as well as technical and institutional challenges that face agencies about to embark on GIS exercises. It is only through a more widespread dissemination of information, through meetings like this, that potentially costly mistakes can be avoided at an early stage.

On behalf of the Welsh Hydrological Group, I would like to thank the speakers for their presentations and SWALEC for hosting the meeting and providing such excellent conference facilities.

Gary Higgs
University of Wales, Cardiff

Hydro-lists

For a bit of fun and a two-minute diversion, here is a feeble (?) attempt at a list of ten alternative definitions on a hydrological theme. Surely you can all do much better — so when you have a few minutes to spare, put together a list of alternative definitions, uses, etc. and send them in to the Editor. *E.g.* — You know when there's a flood when:

1. Wellies become the height of fashion
2. Shares in umbrellas soar
3. The postman arrives in a boat
4. Sunglasses are half-price
5. Animals and birds start going round in twos
6. When there's a Bank Holiday
7. Ducks swim up the motorway
8. The Wimbledon tennis championships start
9. Farmers start talking of bumper crops
10. It rains and rains and rains and rains ...

Jennifer Taylor

Discount travel

For those BHS members who are also members of the Institution of Civil Engineers, the ICE has negotiated discounted travel rates with Britannic Travel, who also offer a wide range of services to business and holiday travellers. The numbers to ring are 071 924 3993 (business travel) and 081 390 0275 (private holiday).

Louise Picton

Solute Transport Modelling

BHS Pennines Section Meeting
Warrington
23rd February 1994

The modelling of solute transport is an area of common interest for academic research, industry and regulatory organisations. Representatives of all three groups were present at this Pennines Section meeting to hear speakers discuss modelling research findings as well as the practical application of such research. About fifty brave souls ventured through wintry conditions to hear the speakers: it is hoped that everybody made it home safely as well!

After a brief welcome from **Paul Younger**, the meeting began with a presentation on 'Nitrogen Transport in the Tyne Catchment' by **Rebecca Lunn** (Newcastle University). She described her work modelling the hydrological component of the nitrogen cycle in the Tyne basin as part of the NERC/ESRC Land Use Project (NELUP). The aims of the project were to predict long-term nitrate concentrations and to assess short-term responses to inputs.

The hydrological and solute transport model SHETRAN was selected for use because of its 'physical' basis and its ability to make spatially-distributed calculations of surface and subsurface fluxes. This hydrological model has been integrated into a computerised 'decision support system' which links it with agro-economic and ecological models and a user interface, allowing types and locations of input and output data to be specified. The system has been designed to use national GIS databases on land use and soil type from which model parameters could be derived. Rebecca explained the difficulty of matching database and model grid scales and noted that although the physical 'measurability' of its parameters was perceived to be an advantage of the SHETRAN model, the databases imposed by the NELUP project were not always entirely satisfactory from the point of view of the hydrological model's requirements. There had therefore been a need to develop algorithms to extract the specific data required by the model or to use estimates from the literature.

Rebecca showed some impressive results of streamflow predictions from the SHETRAN model, but noted that for nitrate predictions there was a problem in validating the model because of insufficient measured data in the Tyne basin. Data collected by the NRA and others may sometimes be inappropriate for the needs of the modeller, especially when data collection has concentrated on the effects of some particular event or on assessing peak solute concentrations. Partly in order to overcome some of these data problems, the project is to move on to model the River Cam.

Questions from the floor centred on the availability of model validation data, the problems of calibrating the nitrogen cycling components of the model and the influence of reservoirs on runoff estimations, Kielder being of particular importance for the Tyne study. Some questions about model parameterisation led to a vigorous debate later during the tea break.

The second presentation was given by **Hannah Green** (Lancaster University) on 'Pollution Incident Modelling using the Aggregated Dead Zone (ADZ) Model'. This modelling approach stands in contrast to the previous one, being based on a relatively simple form of time-series analysis. ADZ is a development of the simple advective-dispersive equation that includes a dispersive fraction parameter, this being related to the volumetric dead zone fraction in a reach. Hannah described the mathematical derivation of the model and pointed out that the time-series approach allows for the calibration in each application not only of model parameters, but also of model structure (i.e. numbers of parameters). The ADZ approach is perceived to be especially suitable for practical applications because it is relatively quick and simple to apply. Indeed, it has been adopted for practical purposes by a number of water companies and NRA regions. It also requires relatively few data in its application, since the relationship between travel time and discharge, upon which it is based, can be estimated by linear regression between a few measured data.

This estimation however introduces a degree of uncertainty into the model's predictions (in addition to that which already results from the model's simplification of the physical system). Hannah therefore described her work in applying uncertainty estimation techniques to the ADZ approach. This starts by taking a collection of travel time/discharge regressions from various locations from which a prior distribution of likely regression coefficients may be specified for any given case, even if only one or two relationships are available for that case. Monte Carlo techniques are then applied to evaluate model responses using parameters sampled from this distribution. The distribution of the resulting simulation efficiencies may then be used to estimate the uncertainty bounds (e.g. at 5% and 95% confidence) within which the model's predictions should lie.

It was commented after the presentation that the uncertainty methodology might be improved by taking the prior distribution of regression relationships from data collected in rivers classified to be somehow similar, for example on the basis of roughness or channel width. However, Hannah replied that this would be difficult, since it may not always be possible to relate dispersion directly to such characteristics. It was also noted that it might be necessary to consider the change in channel characteristics downstream in applying the methodology to a channel network.

Another comment from the floor criticised the ADZ approach in general, suggesting that 'traditional' hydraulic engineering equations would be just as useful as the ADZ method and possibly even easier to apply. This suggestion was countered from a number of directions, however: firstly it was pointed out that the data requirements for hydraulic equations would be prohibitive, and secondly it was noted that the uncertainty framework may be of great value in the management of pollution incidents or indeed for legal purposes.

During the tea break there was a demonstration by **John Cole** (WRc) of software for predicting the effects of pollutant spills in rivers. The final presentation was then given by **Simon Halfacre** (NRA Welsh Region) on 'PRAIRIE', a software package enabling 'Pollution Prevention Using Risk Assessment'.

PRAIRIE was described as a PC-based expert system, initially developed in conjunction with the NRA to support the implementation of Section 93 of the Water Resources Act 1991, and in particular the proposed Water Protection Zone on the River Dee. Simon began by defining 'risk' as a convolution of likelihood and consequence. He explained that risk assessment is seen as a cost effective approach to pollution

prevention since management priorities may be identified *a priori* by forming a 'catchment inventory' of risks. The PRAIRIE system software contains a 'slot' for a dispersive flow model (currently DYNUT), alongside a database containing details of the catchment river network, the substances held at given locations, their toxicities, and a database of Environmental Quality Standards (EQS).

Having described the components in a little more detail, Simon courageously tangled with technology to give a live demonstration of the PRAIRIE software. He showed that the system provides quick and accessible information for non-specialists, with data on main chemical sites and catchment characteristics being pre-loaded into the system. He stressed the need for a simple, fast and robust model component, allowing for on-the-spot management of spillage incidents. A variety of chemical loss processes are available within the model component of PRAIRIE, but these are not normally used, since the main function of risk assessment is carried out by assuming worst case scenarios. Simulated incidents may be run and the resulting concentrations of pollutants plotted immediately against EQS concentrations. By simulating all possible spillages across a range of flow conditions, risks within the catchment may be ranked in order of estimated priority.

Comments on the presentation concerned the definition of risks, and the difficulty of evaluating the probability of specific incidents occurring. These issues have been subject to consultation procedures with industry, other regulators and the DoE. Comments on the utility of the risk assessment approach were positive and the talk complemented the preceding presentations by highlighting the 'end-user' perspective on model development.

Further discussion was unfortunately foreshortened by many people's concern about their return journey through the snow. Nevertheless, the meeting provided a useful forum for the exchange of ideas and generated a little heat in the process!

Rob Lamb
University of Lancaster

Reminders!

1 Please respond to **Des Walling** about your interactions with IAHS and the Royal Society.
2 Note the *Call for Nominations* circulated with this issue: the BHS Committee needs a strong membership — this could be the right opportunity for you, or one of your colleagues.

Hydrology and Mass Movement

BHS Midlands Section Meeting
University of Birmingham
2nd March 1994

This regional meeting at the School of Civil Engineering at the University of Birmingham attracted the largest attendance in recent years, with over eighty delegates gathering to listen to the three talks.

The meeting was opened by **Dr David Mitchell** (University of Wolverhampton) who addressed the changing emphasis on the role of water within mass movement. The ideas in the early 1960s focused on water solely as a lubricant. In the intervening decades, it has been realised that water is more than this, acting as an integral and crucial component within these mass movement processes. Dr Mitchell then welcomed the four speakers.

Terrace stability in Nepal

The first talk was given by **Dr John Gerrard** (University of Birmingham) and **Kegang Wu**, on behalf of **Professor John Thornes** (King's College, London). They examined water movement and slope stability on terraced slopes in Nepal. The study area encompasses the Likhu Khola watershed, comprising four larger and two smaller sub-basins, which were intensively monitored during a four-month period before and during the monsoon of 1992 (Figure 1). With 93% of the Nepalese population living on agricultural land, 43% of it on steep hill slopes, mass failures upon hillslopes pose significant physical and management issues.

The predominant types of agriculture in Nepal are khet and bari cultivation. The khet are level or irrigated wet terraces: they are intensively managed. The bari are sloping or rainfed dry terraces. In this study, Dr John Gerrard identified 65.5% of failures which were associated with khet land, 6.5% with bari land and 5.5% which occurred upon degraded bari. Seventy percent of all the mass failures were classed as slump failures, and the material of 74% of these were in the particle size range 2 – 9.9 mm.

As detailed by Kegang Wu, the objective of the research was to investigate whether khet cultivation induces higher levels of instability. Results have been obtained from field monitoring, laboratory tests and computer modelling. Whilst the identified failures were mainly small-

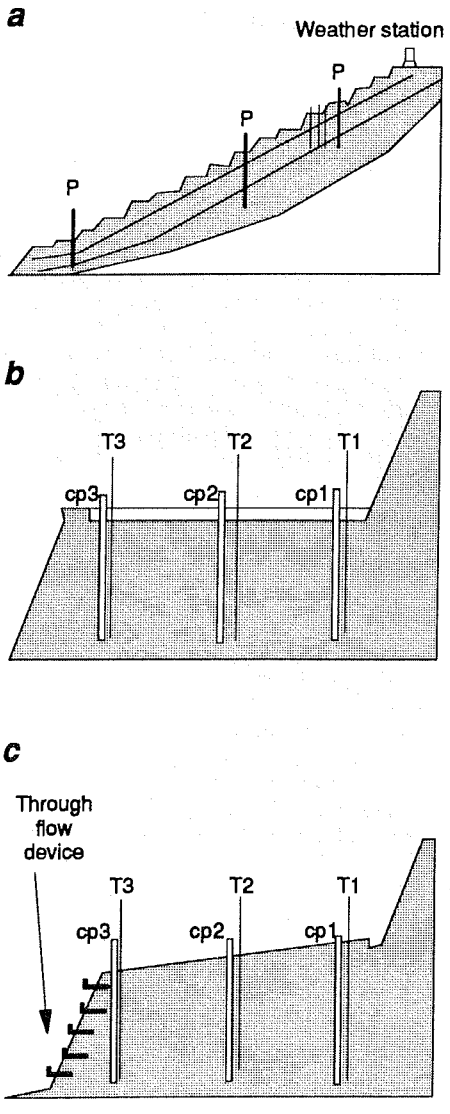


Figure 1 *Instrumentation of an agricultural terrace hillslope in Nepal: a) Cross-section of whole hillslope; b) Instruments in level terrace (khet); c) Instruments in sloping terrace (bari). P = piezometers; T = tensiometer sets; cp = capacitance probes.*
Ref.: *Wu, K. & Thornes, J.B. (in press). "The quest for sustainable development in the Ganges Basin."*

scale they posed intense management problems.

Dr Gerrard highlighted the significant difference in the strength of dry and flooded khet risers of the terraces and said that this may go some way to explaining the failure of flooded khet risers.

The application of this research will be potentially crucial as more bari land is converted to khet (because of population pressure and market forces) which may lead to increased slope instability. Dr Gerrard also highlighted the occurrence of reactivated failure surfaces, with substantial evidence suggesting that rotational slipping occurs on cultivated material that has failed in the past.

Modelling and soil profile differentiation

In the second talk **Dr Sue Brooks** (Bristol University) discussed her work on modelling the effects of soil profile differentiation on slope stability. The talk focused on soil profile differentiation, slope failures in differentiated soils and the application of modelling and validation methods. She illustrated the use of a model for assessing the effects of different soils and climates and the effects of temporal changes upon slope stability.

Soil profiles are highly variable, especially within the first metre of the profile. Failures often occur in the shallow surface material outside the weathering zone. This work modelled shallow planar failures within the relatively freely draining podzolic material of the Glen Livet area in Scotland. A marked difference can be seen between the hydrology of the A and B horizons, depending on soil type, producing different factors of safety with depth. Another conclusion noted was a decrease in the threshold of stability as profiles are progressively leached: leached soil appears to be much more vulnerable under all storm conditions, although storm intensity, duration and total precipitation also influence the factor of safety.

Dr Brooks emphasised the application of modelling in studies of this nature where field equipment may disrupt and alter results within the narrow components of the soil profile.

Groundwater and slope stability

The effects of groundwater upon slope stability formed the subject of the final presentation. **Len Threadgold** (Managing Director, Geotechnics Ltd) provided an excellent summary of the theoretical basis for slope stability evaluation with particular reference to groundwater, later emphasised with specific case histories. He emphasised the need for an understanding of the source of water pressure (Figure 2) in relation to the existing or potential pressure, thus allowing the most effective method of improving shear strength and hence the Factor of Safety (Figure 3). Four case studies from Derby, Merry Hill, Hong Kong and South Wales helped to emphasise the points raised earlier.

Questions

David Mitchell began by inquiring about the use of trees on irrigation bunds, as occurs in China. John Gerrard and Kegang Wu responded that most bunds in Nepal are fairly narrow, but in one or two instances trees are planted. Rice is the staple crop, and shade from trees would reduce the crop yield. Len Threadgold asked whether remedial work had been undertaken on failed terraces in Nepal using natural fibrous material.

Although no current research is being undertaken on this topic, local farmers do use rice straw to form matting in the terraces, and occasionally boulders are used.

David Mitchell inquired whether Sue Brooks had taken account of the structure of the soil in her modelling procedure. Sue explained that no macropore facility existed in the model; while she admitted that the macropore issue was important, it was not so significant in this case where the material was fairly coarse. In Kegang Wu's experience, the use of tensiometers did not cause a great deal of disturbance within the soil profile and could thus be used to validate this model. Sue Brooks noted that in this particular context field data are quite unreliable, since the eluviated horizons may be only 2 – 3 cm thick, and therefore the model was validated with applicable data from elsewhere and with surrogate data.

Paul Webster questioned Len Threadgold about the cost of the investigative work on the failure of land in the Derby case study, where the land had failed and impinged upon domestic property at the top of the slope. Restrictions placed on access to the slope had kept the cost of the investigation relatively small. Len estimated that the eventual total cost of stabilisation would be approximately £500,000. The cost of investigation was significantly exceeded by legal and other fees incurred to establish, in planning terms, the ecological status of the land which had slipped and how appropriate the solution proposed was in comparison to other possible solutions.

David Lloyd asked Len Threadgold whether the use of lime columns to increase shear strength in slopes was a short- or long-term solution. Len Threadgold said that in the short term this method acted quickly by suction, holding particles together, specifically seeking out wetter and weaker material. Benefit came from the columns themselves and from the surrounding soils.

Paul Webster concluded by thanking the speakers. He noted what a large amount of ground had been covered, literally and figuratively, since the topics had ranged from the terraces of Nepal to small-scale differentiated soil profiles and to case studies in our back yard.

Diane Holt and David Mitchell
Wolverhampton

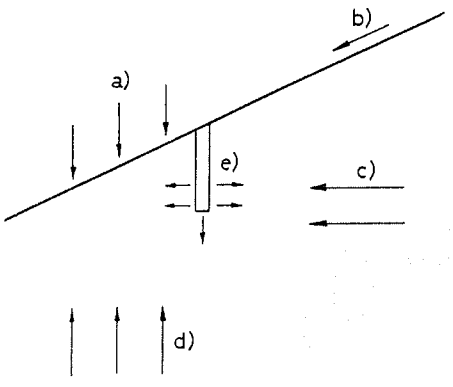


Figure 2 *Sources of water: (a) Direct infiltration; (b) Flow into slope area; (c) Lateral migration; (d) Artesian pressures; (e) Artificially induced water (soakaways, drains and ducts).*

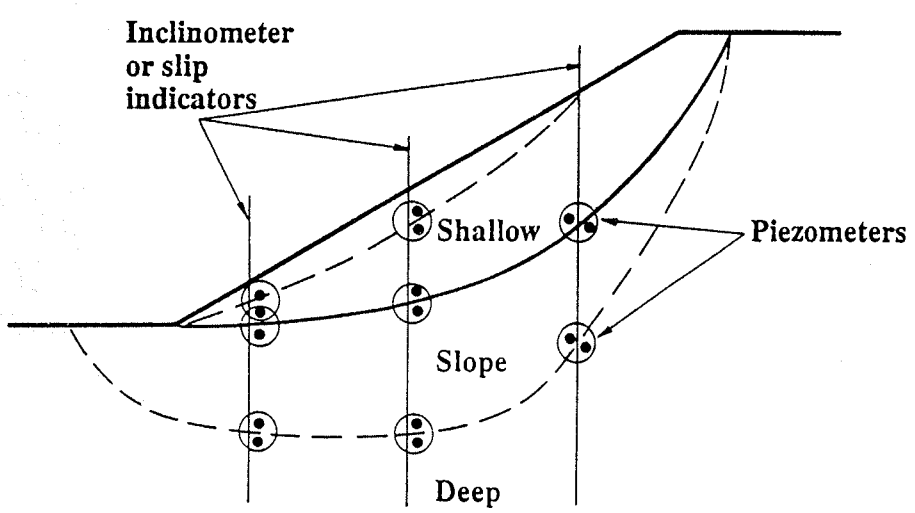


Figure 3 *Investigating slope failure mechanisms and associated pore water pressures*

Flow naturalisation using hydrological models

BHS National Meeting
Institution of Civil Engineers
17th March 1994

About 60 members attended this national meeting, organised by *Alan Gustard* (Institute of Hydrology), to look at a variety of flow naturalisation issues, with particular reference to archiving systems and data requirements. The first session, on "national perspectives", was chaired by *Nigel Fawthrop* (NRA Anglian Region), and the second, on "case studies", by *Sue Walker* (NRA North West Region).

Terry Marsh (Institute of Hydrology) presented the first of the seven papers, looking at the role of the National River Flow Archive. He speculated on the potential role of flow naturalisation as a means of reducing political conflict, citing examples worldwide.

International and regional basin management plans required naturalised flows to provide an equitable basis upon which to plan development strategies. Less than 20 per cent of the gauging stations in the UK measure what are considered natural flow regimes, a low figure in international terms. He described the virtual collapse of daily naturalised flow data collection in the UK during the 1970s. The findings of a report compiled by the Natural Flow Data Group some 15 years ago remain highly relevant today. These include the need for a selection of "benchmark" naturalised flow records.

Summing up, Terry suggested that documentation, and the need to archive formally, to update routinely and to provide information to users on how naturalised data were derived were vitally important to increase the utility of the associated gauged flows throughout the UK.

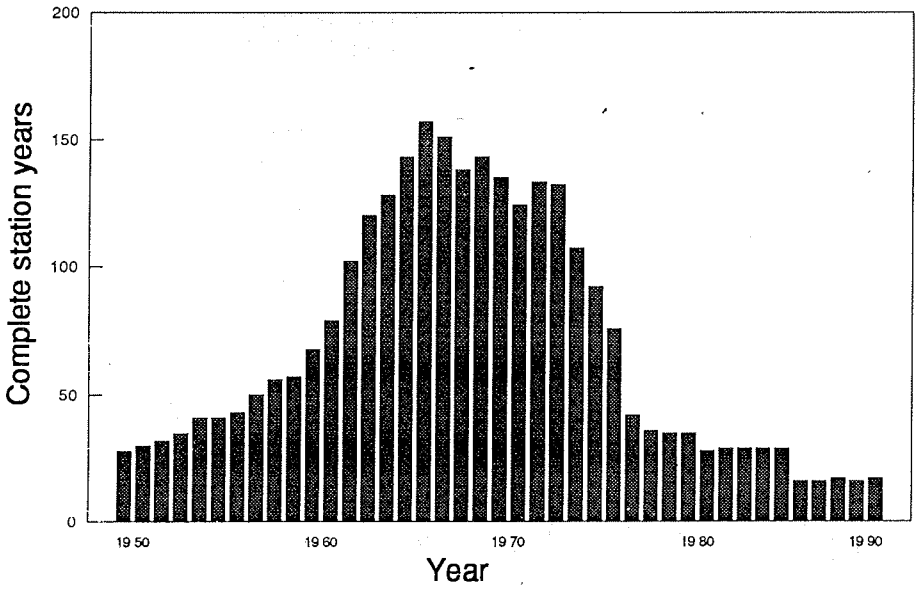
Continuing the theme of good archiving practice, **John Mawdsley** (NRA Northumbria Yorkshire Region) outlined the development of the NRA's proposed Water Archive and Monitoring System (WAMS), describing its main structure and aims together with the timetable for its implementation. Current NRA data archiving involves separate databases for river flows, licensed abstractions and discharges, with each of the regions having its own methods, a legacy of Water Authority days. The aim is to standardise facilities and procedures using WAMS and the National Abstraction Licence Database (NALD): this should facilitate the naturalisation of flows.

Discussion followed about whether WAMS would constitute a national database, with one region being able to access a different area's data. John said that each region would have its own hardware to start with, but they could expect to be linked eventually. In response to a query from **Andy Bullock** (Institute of Hydrology) about whether the timetable for WAMS included encoding all abstraction data, John replied that all computerised data should be loaded within the timescale, but paper archived data would be incorporated at a later date. He was not aware of any current national perspective on a flow naturalisation network, a topic brought up by Terry Marsh.

A coach breakdown had delayed one of the speakers, so **Paul Webster** (University of Birmingham) jumped up the order of presentations. His paper concerned a case study in South Africa, outlining the methodology involved in flow naturalisation and denaturalisation on a basin scale, including lumping reservoir response. Like all the presenters, he stressed the need for good quality data, not only for recorded flows but also for all major abstractions and discharges. The detailed databases of South Africa's reservoirs were impressive. Paul pointed out that it was important to get the large abstractors' values correct as 'Pareto rules OK!' — returned discharges were small and numerous.

In the discussion, **Frank Law** (Institute of Hydrology) cited the example of Vyrnwy reservoir where short-term negative daily runoffs could be produced by strong winds uplake; setting negatives to zero would distort the water balance in such cases. He asked if irrigation drainage returns could be estimated where naturalisation initially suggested negative flows because of their omission: Paul thought this was not realistic on a basin scale.

The discussion session which followed provided interesting observations on what should constitute naturalisation. **Mike Law** (NRA Northumbria Yorkshire Region) noted that there had been no mention of land-use changes and asked whether this should be addressed. Terry Marsh responded that the Working Group on Natural Flow Data had concluded that land-use changes were difficult to quantify and should be addressed by specific research investigations. Frank Law added that if land-use changes were incorporated into naturalisation,



Monthly naturalised flows stored on the National River Flow Archive, 1950–1990

then accompanying land drainage changes should be as well, noting the results from the Institute of Hydrology's study catchment at Coalburn, Cumbria.

The discussion then moved on to the naturalised flow network in the UK. Terry Marsh stated that in 1979, 60 per cent of daily naturalised flows from rivers in Essex were archived, but once this became apparent the Water Authority drastically reduced its commitment to naturalisation! He added that there were very few daily series currently received into the National River Flow Archive, but there was a larger number of records with monthly adjustments. Nigel Fawthrop asked about managerial responsibility and routine naturalisation; Terry said that the best way forward was to identify catchments to be naturalised and to ensure that adjustments to the gauged records were undertaken routinely. John Mawdsley affirmed that data within WAMS would be available to external users. Replying to **Ian Littlewood** (Institute of Hydrology), he briefly outlined the quality control procedures that will be integrated into the system: most of these would be within flow processing, checking that the data were continuous and sensible.

After lunch Sue Walker took the chair. **Ron Manley** (consultant) reviewed the development of HYSIM (HYdrological SImulation Model), with particular reference to recent developments of the package, making it PC-based and more user-friendly. He pointed out the modular structure of the package, which facilitates modification when required. He felt it was necessary, given the current pattern of water usage, to naturalise only in "simulation mode" those flows that would have occurred historically. He ended by likening the development of HYSIM to stages in the life-cycle of a butterfly: during the 1970s it was a caterpillar, working but consuming large amounts of energy; by the 1980s it was a chrysalis, alive but dormant, whilst with the recent development work in the 1990s it had emerged like a butterfly, "beautiful and elegant".

John Hall (Binnie and Partners) described the procedures used to naturalise flows on three rivers in the Essex region for input into the NRA's water resources model of the Ely-Ouse-Essex rivers system. Threshold criteria were set to limit the number of artificial influences considered: 80 of the 669 abstraction licences (the top 98 per cent by volume, agreeing with Paul Webster's earlier view on Pareto) and 29 of the 129 discharge consents were analysed. Net abstractions were estimated according to source and return factors, whilst discharges were estimated from consent data. A daily flow record was synthesised for downstream locations on each river using this information.

He concluded that data availability was the key factor. Whilst abstraction information was generally adequate, more data were needed on point releases into the system, with spot measurements generally the only available source of data. Nigel Fawthrop had previously commented on the need to monitor sewage treatment works' releases: some in the Anglian region were now recording and archiving their discharges.

The last two presentations were double acts: **Terry Newman** and **Richard Symonds** (NRA South Western Region) reviewed the effect of groundwater abstractions on three limestone rivers in Wessex. Three different integrated catchment models were used to assess changes in the flow regime due to abstractions. In addition, the Physical HABitat SIMulation (PHABSIM) approach was used to produce habitat duration curves to assess the effect of groundwater management on the biological component of the rivers.

Terry stressed that the results highlighted the uncertainties regarding the safe yield of aquifers that did not severely effect river flows; Richard added that flow augmentation from groundwater in these cases provided only partial mitigation. For two of the rivers in the study, the Allen and the Malmesbury Avon, regular observations made by knowledgeable members of the public led to an opinion of the acceptable flow for each river. Results indicated that this was close to the naturalised Q95 flow.

The final paper brought together two Andys from the Institute of Hydrology, **Andy Bullock** and **Andy Young**, presenting a paper on artificial influences on low flows. Andy Bullock introduced the idea of a "Low Flow Estimation Cube", where the three dimensions of the cube represent gauged/ungauged flows, time series/statistics and natural/artificial flows. He noted that the NRA used up to the equivalent of 2½ staff in estimating low flow statistics at ungauged sites. He showed that 80 per cent of all the 17 000 river stretches in the former NRA Yorkshire Region possess Q95 values below 0.01 m^3s^{-1}, but they are represented by less than 5 per cent of the gauging stations: this raises questions about the attention given to modelling time-series flows from gauged catchments. He described eight key steps in estimating artificially influenced low flows, including identifying and quantifying upstream artificial influences to produce a monthly profile of these influences and combining these with gauged flow statistics. Andy Young then gave a demonstration of Micro LOW FLOWS version 2, producing estimated artificial and natural flow duration curves for several ungauged sites.

A lively discussion session began with Mike Law asking Andy Bullock about possible future links between Micro LOW FLOWS and the NRA's WAMS and NALD. Andy said that it is essential for this to happen in the future, since it would ease the loading of large amounts of data from different formats, which is now necessary. He added that it was possible to bulk-load data onto Micro LOW FLOWS, although **Nigel Fawthrop** said that his Anglian region had experienced some difficulties formatting the data correctly for this loading operation.

Richard Symonds responded to Paul Webster's query on comparisons between the different models employed in their Wessex study, saying that they would not have chosen to use different models for each catchment: comparisons between the models would be difficult as the catchments were all different. Terry Newman answered Nigel Fawthrop's question on the use of "observers" to consider acceptable flows: he noted that these people did produce remarkably consistent views in a given season, but in 1992 they accepted a lower flow than in 1993, probably because 1992 was drier.

Sue Walker asked whether it was a limitation of Micro LOW FLOWS that it assumed that any individual abstractor behaved in the same way as the whole population of abstractors with respect to the proportion of the licence taken up. Andy Bullock admitted that this was so, but he stressed that the most important aspect was improving upon the rather provisional uptake and seasonal variation factors. Andy Young added that the simulated abstraction data within the package is always over-ridden by actual data when the latter have been loaded.

Frank Law added a historical perspective to John Hall's Essex rivers naturalisation process. He noted that it was strange that although gauging on the Lee was started in the 1880s, continuous gaugings in Essex generally did not start until 1928, and were first published in the South Essex Water Bill transcript that year. Flow measurements were originally taken on Sundays, when the water was ponded upstream to provide power for the mills downstream during the week. He asked John to comment on the effect of milling and navigation and whether these had been considered. John replied that it was very difficult to integrate ungauged artificial influences into naturalised flow data.

In response to **Alan Gustard**'s query about the most likely source of errors in their study, Terry Newman opined that hydrological modelling had a considerable advantage over ecological modelling, as it was better served by extensive and relatively precise databases. The collection of hydrological data was more affordable than the equivalent requirement for ecological parameters.

Although he had only just arrived in Britain after a transatlantic flight,

Norman Crawford, the author of the Stanford Watershed Model and now of Hydrocomp Inc., gave the meeting a western US perspective, stating that the term "stable flow series" might be more appropriate there: because river regimes are so artificial, there is less emphasis on natural flows. He and Ron Manley agreed that the effectiveness of a hydrological model in simulating conditions was generally proportional to the sophistication of the model. Ron felt that simple models may be satisfactory initially, but they were less extendable and less flexible than those with more development. Terry Newman said that in his view it was important to assess the degree of change that has occurred in the rivers of England and Wales over the past generation, as the general public tended to react more strongly to an observed change than to an historical fact.

In her conclusion, Sue Walker repeated the importance of good quality base data, particularly gauged flows, in this increasingly modelled world, but financial restraint and spending justifications were threatening this. She wound up the proceedings by thanking the presenters of papers and all those who had attended the meeting. In particular Sue thanked Alan Gustard for arranging such a successful and stimulating meeting. The pre-circulation of abstracts by **Karen Irving** (Institute of Hydrology) had been a great help: copies are available from her at £10 including post and packaging, payable to the Institute of Hydrology.

Stephen Loader
Institute of Hydrology

Register of consultants

Following the success of the register of independent consultants in hydrology, included for the first time in the *Members' Handbook* last year, we are about to update it at the same time as members' details. To qualify for inclusion you must be truly independent and not employed on a full-time basis by any firm. An annual fee of £10 is charged for including a member's details in the register.

Consultants already registered will shortly receive a form to re-register. Any member who wishes to register for the first time should send full details by *30th June 1994* (text should match the format of last year's register), together with their cheque for £10, to

Rod Hawnt, BHS Hon. Treasurer, c/o Hydro-Logic Ltd, The Annexe, West Lodge, Rainbow Street, Leominster, Herefordshire, HR6 8DQ.

Inter-agency Research Committee on Hydrological Use of Weather Radar

Priority topics for radar hydrometeorological research

In March 1992 the Natural Environment Research Council's Steering Committee on Hydrological Application of Weather Radar produced a report proposing a UK strategy for Radar Hydrometeorological Research during the 1990s. The purpose of this report was to identify the needs and the opportunities presented by the availability of weather radar data for basic research. Applications of weather radar, particularly to flood forecasting, are already well advanced and they are in operational use within the National Rivers Authority.

The Inter-agency Research Committee on Hydrological Use of Weather Radar (which replaces the NERC Committee) has reviewed the topics identified in the strategy report. These are presented under the headings of Basic and Applied Research for four themes. NERC has established a special topic area for HYREX (HYdrological Radar EXperiment) to undertake fundamental research in two main areas: one is the science of weather radar as a remote sensing device, the other is an investigation of the precipitation process and its link with run-off response. HYREX Projects and similar topics are labelled (H) and the first-priority topics are listed below. Further information, including a brief description of these topics and the list of second-priority topics, is given in the First Report of the Committee which is available from its Secretary, **Roger Austin** at the Institute of Hydrology, Wallingford, UK.

First Priority Research Topics

Basic Research

A. Processes

B. Measurement
1. Bright band.
2. Vertical pointing radar and cloud physical model reflectivity profile studies. (H)
3. Combined weather radar and satellite systems for global rainfall measurement.

C. Modelling and Forecasting
1. Development of distributed grid-based rainfall-runoff models for flow forecasting.
2. Radar based rainfall forecasts for use in flow forecasting models. (H)
3. Time and space discretisation of weather radar for flow forecasting.
4. Radar and satellite data for global scale modelling.
5. Radar, GIS and digital terrain models to investigate hydrological regimes.
6. Radar, areal rainfall estimation and flood forecasting.

D. Data Analysis
1. Use of radar for design storm estimation.
2. Climatology of short period rainfall.

Applied Research

A. Processes

B. Measurement
1. Bright band.
4. The radar/raingauge representatives problem. (H)

C. Modelling and Forecasting
1. Development of distributed grid-based rainfall-runoff models for flow forecasting.
2. Radar based rainfall forecasts for use in flow forecasting models. (H)
7. Calibration of weather radar within flood forecasting models.
8. The use of weather radar in forecasting flows at ungauged sites.

D. Data Analysis
1. Use of radar for design storm estimation.
3. Probable maximum precipitation.

It never rains but it pours

A couple of years ago it was reported[1] that a sizeable upward trend had been detected in the mean annual flow of rivers in the west of Scotland. It was argued then that this was having a beneficial effect on some pollution levels by increasing the available dilution for effluent discharges. It was also suggested that the rather simplistic approach of the national five-year summary of water quality was inadequate, since this type of effect was not eliminated. Of course, at the same time, the opposite end of the country in southern and eastern England was suffering increasing deficiencies of runoff, and therefore reduced dilution.

The drought in these parts of England may have finished, but Figure 1 shows that the upward trend of runoff in western Scotland is continuing. The mean annual flow in the River Clyde at Daldowie (grid reference NS 672 616) has increased by an astonishing (60 ±12)% over the 25 years from 1969 to 1993. Statistical analysis using Kendall's tau test indicates the presence of this trend at the 99.99% significance level.

Rainfall figures, for example from West Browncastle (NS 622 432) in the hills of the mid-catchment, confirm that annual totals have risen by (50 ±15)% for the winter half of the year (October-March) with the trend confirmed at 99.9% significance, while in the summer half-year the increase has only been (28 ±18)% at 95% significance.

It is likely to be purely coincidental that global warming climate models[2] suggest an increase in westerly-type airflow over Scotland, with an associated enhancement of rainfall, particularly in winter and particularly over western hills. Certainly the magnitude and rapidity of the observed increase greatly exceeds the predictions of the models. It would seem probable that the trend is only temporary and that eventually a compensating reversal will occur. Similar, though less exaggerated, fluctuations appear to have occurred in the past[3].

References

1. Curran, J.C. and Robertson, M., 1991. Water quality implications of an observed trend of rainfall and runoff, *J. Inst. Wat. & Env. Manage.* **5**, 419-424.
2. Rowntree, P.R., Murphy, J.M. and Mitchell, J.F.B., 1993. Climatic change and future rainfall predictions, *J. Inst. Wat. & Env. Manage.* **7**, 464-470.
3. Water Research Centre, 1990. Climatic change and its potential effect on UK water resources, *Report No. PRS 2467-M.*

James C. Curran
East Kilbride

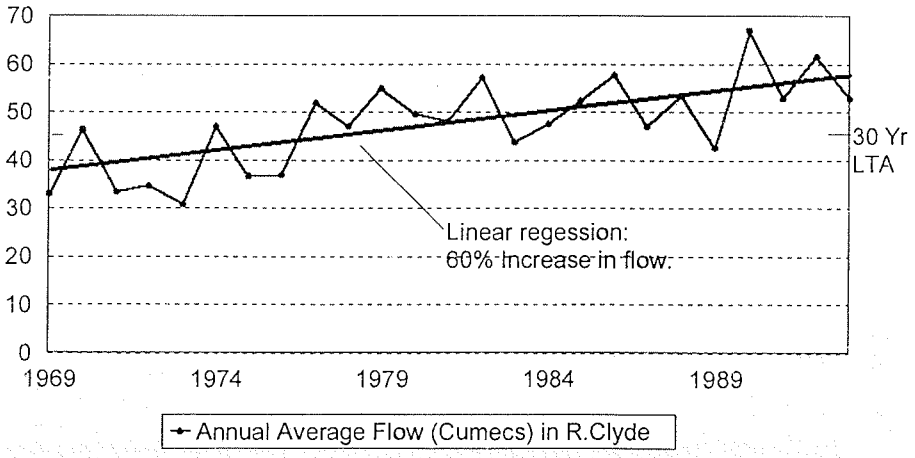


***Figure 1** 25-year trend in the flow of the River Clyde*

CPD — what does it mean for you?

CPD is a term which is often heard at the moment, but many readers may not be sure what it means.

The proposed definition of Continuing Professional Development for the Engineering profession is: "The systematic maintenance, improvement and broadening of knowledge and skill and the development of personal qualities necessary for the execution of professional and technical duties throughout the practitioner's working life."

Many engineering Institutions, and indeed many other professions, are currently establishing policies for CPD. A key issue is whether CPD should be voluntary or obligatory: to what extent should policies prescribe or control, rather than enable and encourage, CPD action by members? What happens if a member does not meet the 'requirements' laid down?

The Engineering Council is drawing up a framework for CPD, together with the Institutions. This will indicate the activities which Institutions should carry out to help their members meet CPD standards, detailed in a model Code of Practice. From some future date the Institutions will expect members to follow the CPD code.

It therefore seems certain that all hydrologists who are also Institution members will in time be required to undertake CPD. What does this involve? Current requirements of Institutions vary between 20 and 50 hours per year and can include:

- project work
- short courses
- attendance at conferences / meetings
- writing papers
- private study and reading
- in-house training
- involvement in community schemes.

This is a very wide range of activities, and may sound very vague and unstructured to those brought up on the ICE's "Chilver Days". More detailed guidelines will be needed about how time spent on these activities can qualify as CPD. Meanwhile, some Institutions, e.g. the Royal Town Planning Institute (RTPI), include in their Code of Professional Conduct a requirement to provide a written account of CPD on request.

The message is that we should all get into the habit of recording any activities which may be classified as CPD. It is worth noting that members of the RTPI found that 'events' were easier to record than other forms such as structured reading.

Finally....

It may even be possible to be paid for achieving your CPD requirements in an unusual fashion. As a Territorial Army Royal Engineers Officer "everything you study and practice whilst training will enable you to work with and motivate people under severe pressure — under fire, when they are harassed or wounded, when communications break down or when they are hungry, freezing and have not slept for days!" — (Conditions only slightly more severe than in today's workplace.) It's nice to know someone appreciates the pressures of survival in the current climate!

This material has been culled from ICE and Engineering Council material. We will continue to bring you further information on CPD as the situation becomes clearer. In the meantime please let us have your views and experiences.

Hilary Smithers

News from Members

Midlands Section news

Congratulations are due to **James Greenhalgh** on two counts. In February he presented a paper at the Dr Jenkins Memorial Competition run by the East and West Midlands branches of IWEM. He was awarded second prize for his paper "A comparison of flood flow prediction methods on the Afon Tywi", which described his investigations as part of his MSc degree studies at the University of Birmingham.

James has been engaged on temporary work with the University of Birmingham and the National Rivers Authority (North West Region). Now he is due to take up a permanent post with Peter Brett & Associates in Reading, where he will be working on hydrological and hydraulic modelling. We wish him well in his new appointment.

End of Enda's term at EGS

Professor Enda O'Connell stepped down as Vice-President (Hydrology) of the European Geophysical Society during the EGS General Assembly in Grenoble. His place has been taken by **Professor Philip O'Kane** of University College, Cork. **George Vachaud** from Grenoble, the new President, paid tribute to Enda's efforts during his three-year term of office. Mainly because of Enda's commitment and enthusiasm, the profile of hydrology within EGS has increased significantly: there is a Hydrological Section, and the subject now accounts for 16% of all papers presented to the EGS meeting.

It is a sign of this higher profile that George Vachaud has been elected EGS President, the first hydrologist ever to hold this office.

News from Imperial College

Professor Howard Wheater is pleased to announce the appointment of **Paul Whitehead** (Institute of Hydrology) as Visiting Professor at Imperial College, London. The appointment strengthens links that Paul has had with the College for many years, through post-graduate teaching and collaborative research; Paul is now contributing a full module on *Water Quality Modelling and Magic* to the Hydrology MSc.

Dr Adrian Butler has been appointed Lecturer in Groundwater Hydrology. **Paul Johnston** has moved to Trinity College, Dublin, but continues to teach at Imperial as a Visiting Lecturer. **Bruce Beck** has become Professor and Eminent Scientist at the University of Georgia at Athens, USA, but continues to work on joint research programmes at Imperial as a Visiting Professor. Bruce's lectureship has been advertised: watch this space for further developments!

Award for hydrological work

Congratulations to **Dr Tim Burt** (Oxford University) who has recently been awarded the Royal Geographical Society's *Cuthbert Peek* award for his contributions to hydrological research.

CHALLENGING OPPORTUNITIES
in Water Resources Management & Monitoring Consultancy

Hydro-Logic are expanding their consultancy activities in the area of Water Resources Management and Monitoring and require well-qualified and experienced personnel to undertake a wide range of projects mainly based in the UK but with some opportunity for short overseas trips. Applications are invited for two positions from individuals with an engineering background with suitable qualifications who have experience in most of the following areas :

Engineering Hydrologist
- Flood and drought analysis
- Water resource systems modelling
- Rainfall-runoff & water balance studies
- Design of flow gauge structures
- Borehole drilling and pump-testing
- Environmental impact assessment

Engineering Technician
- Design of hydrometric installations
- Preparation of contract specifications
- Supervison of siteworks
- Flow gauging and land surveying
- Instrumentation and telemetry
- AUTOCAD or similar software

Applicants should also have a strong interest in computer applications and be prepared to assist with technical support and training of our range of commercial software packages. Positions will be based in either Reading or Leominster. Salary is negotiable but will be commensurate with qualifications and experience.

Please apply in writing enclosing a CV to :
Rod Hawnt, Hydro-Logic Ltd, The Annexe, West Lodge, Rainbow St., LEOMINSTER, Hereford & Worcester, HR6 8DQ.

HYDRO LOGIC

Chartered Meteorologists

Congratulations to the following BHS members who have successfully passed through the Royal Meteorological Society's accreditation scheme and are now Chartered Meteorologists (CMet): **Prof. Chris Collier** (Metstar Consultants Ltd), **Dr James Curra**n (Clyde River Purification Board), **James Dent** (independent consultant) and **Dr James Milford** (University of Reading). We look forward to announcing many more in future.

New Members

We welcome the following members to the Society:

Adjei, N.A.	Birmingham
Beatty, M.H.	Newcastle under Lyme
Brown, A.G.	Dept of Geography, University of Leicester
Burton, A.	Dept of Civil Engineering, University of Newcastle upon Tyne
Cornford, D.	School of Geography, University of Birmingham
Couperthwaite, J.S.	Kingsheath, Birmingham
Spence, B.	Old Coulsdon, Surrey
Sutherland, D.C.	Ampthill, Bedfordshire
Walker, C.L.	Lindfield, West Sussex
Wood, P.J.	Selly Oak, Birmingham

Catchment ecosystem research and freshwater management — a 'feasibility and scoping study'

Some readers may be aware of an initiative to examine present approaches to the management of river catchment ecosystems in Britain. The initiative grew out of the scientific meeting held in March 1993 at Leicester on 'The Ecological Basis for River Management'. It became apparent there that we needed to look hard at whether environmental researchers were satisfying the information needs of catchment managers, and whether managers were making decisions from a sound enough base of scientific knowledge.

Since then, a series of seminars and meetings has been held between the National Rivers Authority, the National Environmental Research Council, representatives of the Country Agencies for conservation, the Freshwater Biological Association and academics from a range of environmental disciplines. These and other agencies have now commissioned a 'feasibility and scoping study' with the objective of examining how the relationship between scientific research and catchment management can be improved.

As part of this project we aim to:

- identify *research programmes* presently being carried out in the UK and overseas, which relate at some scale to catchment management
- review present *scientific knowledge* of catchment ecosystems and the application of such knowledge to catchment management and conservation,
- review present approaches by statutory and non-statutory bodies to *catchment planning*,
- identify areas where potential exists for achieving significant improvements in efficiency and effectiveness of catchment management, and
- make recommendations as to how such improvements might best be achieved.

We are seeking to make contact with as many people as possible who are involved in catchment research and/or management, so that any recommendations we make may reflect the views of this community.

Any readers who would be interested in providing some input to our study should write to Dr Judith Hutchinson, School of Biological Sciences, Queen Mary and Westfield College, University of London, Mile End Road, London, E1 4NS, UK.

Alastair Ferguson (NRA Anglian Region)
Alan Hildrew (QMWC, London)
Steve Ormerod (University of Wales, Cardiff)
Geoff Petts (University of Birmingham)

Papers wanted for ICE Journal

Members with papers in preparation on water resources topics should note that the Editor of the re-vamped ICE Proceedings *Water, Maritime and Energy Journal* is very keen to include more articles on hydrology. So, all you members with manuscripts in gestation, this could be the very outlet you've been searching for.

Book review: next time

Apologies to **Mike Knowles**: his book review will be in the next *Circulation*.

Education and Training News

We understand that the ICE has significantly — and positively! — changed their position on the validity of Geography (and other similar subjects) as an appropriate first degree for those seeking Chartered Engineer status. This news is being followed up by the BHS E&T Subcommittee. Watch this space!

New NERC Centre for Ecology & Hydrology

Organisational changes within the Natural Environment Research Council have just been announced, which aim to allow the Council to develop its science to meet user needs, the philosophy advocated in the recent Government White Paper. Two new interdisciplinary Centres have been set up to manage in-house research in the marine and the terrestrial/freshwater sectors.

The new Centre for Ecology and Hydrology (CEH) will include IH plus the Institutes of Terrestrial Ecology, Freshwater Ecology and Virology & Environmental Microbiology. The Acting Director of the CEH is **Brian Wilkinson**, still based at Wallingford for the time being; IH's Assistant Director, **Tony Debney**, will take over at the top of IH. Both these appointments took effect from *16 May 1994*.

The President's piece

Presidential life continues to be busy but very rewarding: I get the opportunity to meet a large number of BHS members as I travel around the country.

I was particularly pleased to be invited to the Post-graduate Symposium at Birmingham: I have a strong personal commitment to young members and their education and training. I was anxious to find out from the young members who attended what they wanted from BHS and they were very insistent that they wanted a Postgrad Symposium to take place next year.

They saw that BHS was unique in providing this sort of opportunity for young hydrologists and appreciated being able to present papers (for many, their first opportunity) before a supportive audience. The informal networking outside the paper session was also welcomed. Nearly 50 young members attended, which is getting to the limit of what is manageable in the informal style which we favour — this is especially pleasing as a few years ago we had to cancel a Postgrad Symposium because of a lack of interest.

Following the Symposium, the baton has been handed on from **Paul Webster** to **Kevin Tilford**, who has already started preparing for another Postgrad Symposium at Salford next Spring. Contact Kevin if you have any suggestions about its activities or organisation.

During discussions in Birmingham, it became clear that the networking, and just finding out who was working in allied research areas or who was using particular software packages, was a very important part of the Symposium. In order to build on this, the Main Committee is investigating whether BHS can set up an 'electronic wall' on E-Mail to allow this sort of information to be exchanged on an ongoing basis. If this is not feasible, we will see whether we can use *Circulation* in the same way.

Building on our commitment to younger members, we are now in a position to act on the change in Statutes agreed at the last AGM which specifically allows the election of a Young Member to the Main Committee. Nomination papers accompany this issue of *Circulation*. Any young member who has ideas about how BHS can meet their needs is encouraged to stand. We old stagers need your help!

We are also seeking nominations for the President Elect, Hon. Secretary and two Ordinary Members of the Main Committee. The only qualifications needed are plenty of energy and enthusiasm and a commitment to helping BHS and its members.

The Main Committee is anxious that BHS continues to expand its status as the voice of hydrology for the UK in international affairs. In this respect, I was pleased in April to attend the International Hydrology Programme (IHP) National Committee meeting and renew my friendship with **Andras Szöllözi-Nagy**, Director of Water Sciences at UNESCO. Those who went to Cardiff will remember well his lively contribution to the Symposium (both inside and outside the lecture hall!). I was especially pleased that BHS has been asked to become the main focus for the dissemination of information about IHP to hydrologists in Britain. There is a separate article on IHP and its relationship with BHS elsewhere (page 17). I am discussing with Andras how BHS may take further initiatives in IHP.

Still on the international front, I was delighted that **Jim McCulloch** (in his role as the BHS roving ambassador overseas) was invited to Budapest by the Hungarian Hydrological Society. Jim gave a presentation on BHS and we have agreed to maintain relations with the Hungarian Society, through an exchange of newsletters and by providing points of contact for our members visiting each other's country.

In April, I attended the EGS meeting in Grenoble as BHS President. I was delighted with the reception which BHS received. Our relationship with EGS was consolidated through discussions with **George Vachaud** (new President of EGS, and a hydrologist), **Enda O'Connell** (outgoing Vice President of the Hydrological Section) and **Philip O'Kane** (new Vice President of the Hydrological Section). Philip hopes to join us at the Heriot-Watt Symposium next year, as George will unfortunately not be available. I also had the opportunity to have preliminary discussions with **Fred Spilhaus** of the American Geophysical Union, who I was already scheduled to meet, having been invited to the AGU Convocation of Presidents in Washington in May.

Finally turning to the home front, discussions with IWEM are still continuing. The view developing is that there is currently no need to formally "Associate" with IWEM in the same way that we are Associated with IH and ICE. Instead, the opportunity will be taken to collaborate on issues such as Education and Training, publications and meetings. Further detailed discussions are planned for July, after which a further report will appear in *Circulation*.

Susan Walker

Jim McCulloch meets the Hungarian Hydrological Society

Jim McCulloch, Chairman of BHS's International Liaison Sub-Committee, visited the Hungarian Hydrological Society from 5th to 7th April. He also spent a day at VITUKI, the Hungarian equivalent of IH & WRc, where there is a fabulous new water quality laboratory donated by the EC, including tritium and Carbon-14 and many other facilities: it must be the best equipped in Eastern Europe!

On 7th April, he met the President of the Hungarian Hydrological Society and was presented, formally, with the Hungarian newsletter and the technical publications of the HHS, the documents from their 75th anniversary celebrations (partly in English) and a commemorative medal. He explained that *Circulation* is the only regular BHS publication, but he promised to set up an exchange of newsletters and to try to send proceedings of our Biennial Symposia as they are available.

All the Hungarian society's papers are in Hungarian, with only a brief abstract in English. Jim pointed out the language difficulty and was assured that for a serious user the HHS might have *one* paper per volume translated into English. Jim, for his part, suggested that any paper of merit should be offered to an English language journal such as *Journal of Hydrology*, provided that it satisfied the journal's normal reviewing standards.

The HHS is keen to secure links with Western agencies (if only because of the anticipated financial support from the West for such linkages). They would like to persuade British hydrologists to take up membership of the Hungarian Society, but Jim thought that he would be hard pressed to nominate even four people who could understand the Hungarian hydrological literature and would be interested in joining their Society.

Jim gave a lecture on BHS, and British hydrology in general, including the history of the BHS and Britain's contribution to hydrology as a science.

The meeting finished with Jim formally presenting a BHS tie to the HHS President. It was apparently accepted with approval, with the comment that it was rather lighter to carry than literature!

The International Hydrology Programme

Introduction

The International Hydrology Programme (IHP) forms part of the natural sciences sector of UNESCO. Together with the ecological and marine sciences, it belongs to the environment programme. The IHP is the successor to the International Hydrological Decade (1965-1974); it is executed in six-year phases, with the main emphasis of the programme and the individual projects changing in each phase. The IHP's annual budget is 2.43 million US dollars (1992/93 prices), plus 8.6 million US dollars allocated to the water division of UNESCO.

Organisation

The IHP is planned, executed, coordinated and monitored at global, regional, sub-regional and national levels. National committees have been set up for the IHP, and although the UK is no longer a member of UNESCO, a Memorandum of Understanding has allowed the formation of a UK Committee for IHP in order that the UK hydrological community can contribute to and receive feedback from IHP. Indeed, the FRIEND project, to which the Institute of Hydrology is a major contributor (see *Circulation 41*, page 9), is a key element of the current IHP.

The UK Committee for IHP meets once a year and communicates by correspondence at other times. It is chaired by **Brian Wilkinson**, Director of IH, and comprises representatives from IH, DOE, MAFF, the Scottish and Welsh Offices, DOE (Northern Ireland), the NRA, the Association of RPBs (Scotland), ODA and the Met Office, as well as the BHS President.

IHP - IV Programme

The fourth programme of IHP concludes in December 1995. There are three main sub-programmes, into which are incorporated sub-themes as listed below:

Sub-Programme H: Hydrological research in a changing environment

- Interfaces between atmosphere/land/water
- Relationship between climate variability and hydrological systems
- Changes in water quality through the hydrological cycle
- The role of snow and ice in the global water cycle
- Hydrological problems of specific regions.

Sub-Programme M: Managing water resources for sustainable development

- Methodologies for water resource assessment and hydrological design
- Scientific and technical water related information and documentation systems
- Evaluation of social and environmental aspects of freshwater systems and prediction of the impact of human activities
- Integrated water resource development and investigation of risk-based decision making
- Hydrologic and water management aspects of international water resource systems

Sub-Programme E: Education, training and the transfer of knowledge and public information

- Education and training of technicians
- University courses
- Post-graduate training
- Continuing education for post-graduates
- Public information

IHP-V

A draft consultation document is being debated which outlines proposed themes for the next Programme, IHP-V, which will commence in January 1996. This will be put to the UNESCO Council in February 1995 and will be subject to final approval at the General Conference in October 1995. The philosophy will be to have fewer projects but more detailed work within each project than in IHP-IV. The principal themes will be

- Processes at the global scale
- Regional studies
- Knowledge and information transfer

The UK Committee of IHP is coordinating a response to the draft document.

UK IHP Committee Meeting, 19th April 1994

Dr Andras Szöllözi-Nagy, Director of Water Sciences Division of UNESCO, addressed the meeting of the UK National Committee on 19th April and gave an update on progress within IHP.

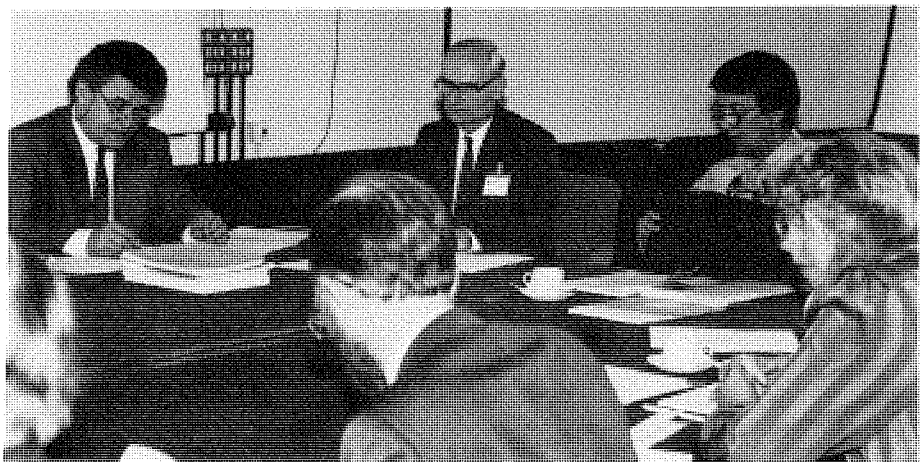
It was clear from the discussions during the meeting that information on IHP is not being adequately disseminated to the UK hydrological community. UNESCO publishes a large number of technical monographs and reports on hydrological subjects, many of which are available free of charge. There is also an IHP Newsletter, published several times a year.

It was agreed at the meeting that BHS, through Circulation, is ideally placed to disseminate information to UK hydrologists. It was therefore agreed that occasional articles on IHP would appear in *Circulation*, a list would be published annually giving details of new hydrological publications available from UNESCO, and key items from the IHP newsletter would be reprinted in *Circulation*.

Brian Wilkinson kindly agreed that BHS members will be able to consult IHP reports and technical documents held in the library at the Institute of Hydrology. Further information will appear in a future edition of *Circulation*. BHS would consider whether there were further initiatives which could help to disseminate information on IHP activities and also support the UK contribution to IHP.

In the meantime, any members wishing to obtain further information on UNESCO IHP publications and activities should write to UNESCO, Division of Water Sciences, IHP, 1 rue Miollis, 75352 Paris Cedex 15.

Telephone: +33-145-684002,
Facsimile: +33-145-675869.



The UK IHP National Committee meeting on 19th April at the Institute of Hydrology

BHS and the Parliamentary and Scientific Committee

The Parliamentary and Scientific Committee (P&SC) comprises members of both Houses of Parliament and the European Parliament, as well as representatives of scientific and technical institutions, industrial organisations, science-based companies and universities. The Committee's objectives are:

- to provide Members of both Houses of Parliament with authoritative scientific information in connection with debates;
- to take appropriate action through Parliamentary channels to reinforce the views expressed by members on matters of public interest and legislation, especially for financing scientific and technological research, education and development, and to ensure that proper regard is taken of the scientific point of view;
- to provide its members and other approved subscribers with a regular summary of the scientific and technological matters dealt with in Parliament.

As at 31st December the P&SC had the following membership: 80 Peers, 97 MPs, 17 MEPs, 12 Honorary and Life members, 133 Scientific and Technical Organisations, 76 Associate Member Companies and Undertakings and 62 Universities.

Committee meetings are generally held in the early evening at the Houses of Parliament, approximately monthly. In addition visits are arranged, although these are often restricted to Members of Parliament.

The idea that BHS should join as a Scientific and Technical Organisation was prompted by the P&SC meeting held to discuss "Water Resources and Drought". This resulted in the publication by the Parliamentary Office of Science and Technology (POST) of Report No. 10, "Dealing with Droughts: Environmental and Technical Aspects of Water Shortages" (February 1993, Price £15).

Sections of this report covered The Current Situation, Environmental Aspects, Future Demand and Supply, and Issues and Options. Drawing on inputs from a wide variety of organisations, it is an impressive document in terms of presentation and clarity, and is to be recommended for the balanced view given to the issues. In May 1993 POST published their Report No. 12, entitled "Drinking Water Quality".

Five or six times a year, the P&SC itself publishes the journal "Science in Parliament", which is sent to members. It records details of science-related legislation and debates in the UK and EC Parliaments, but it also has articles on scientific and technological advances as well as policy issues.

The decision that BHS should join the P&SC was taken at the Main Committee meeting on 14th April 1993: the current **BHS President** and **Tim Wyatt** were nominated to represent the Society. Copies of "Science in Parliament" are being reviewed by our two representatives before being lodged with **Celia Kirby** at IH, where they will be available for consultation by BHS members.

To gain an understanding of the workings of the P&SC, the BHS representatives attended the meeting on 14th December 1993 at which "The Case for a British Baccalaureate — an alternative to A-levels" was discussed. The invited speakers were **Sir Gordon Higginson** (Vice-Chancellor, University of Southampton) and **Dr Eric Anderson** (Headmaster of Eton College).

The presentation and following discussion were of a high standard. Arguments were made both for maintaining the more specialised A-level examinations and for adopting the broader-based 'continental' system. A major point to emerge was that the A-level system was established at a time when only some 10% of school leavers went on to university, whereas the aim now was to reach 40% by the end of the century. Any replacement should threrefore be viewed in the wider context of educational attainment and vocational qualifications.

It would be interesting to know the views of BHS members on this subject, given the wide range of undergraduate courses now followed by those who eventually become hydrologists. Also whether the wider range of subjects that have to be offered for a Baccalaureate, including foreign languages, gives continental graduates a significant advantage when working outside their native country.

In these days of 'career politicians', it was reassuring to hear the opinions of MPs who had experience of teaching both A-level and Baccalaureate courses; less comforting was to hear representatives of the universities voicing concern at a reduction in 'academic rigour' amongst scientific undergraduates. Conversely, it was made clear that candidates offering high levels of achievement in either the International or European Baccalaureate were considered very favourably when applying to UK universities. Finally the point was made that the Scottish system of Higher Level examinations already represents a *de facto* British Baccalaureate. However, this is allied to a four-year Honours degree course at Scottish universities and would have similar implications for course lengths if adopted nationally.

Given its very broad remit, it is inevitable that many of the issues addressed by the P&SC will be of only marginal interest to BHS members. Accordingly, BHS's membership will be regularly reviewed by the Main Committee, and reports on issues thought to be of particular interest will be published in *Circulation*.

Tim Wyatt

Forthcoming publications

BHS Occasional Paper No. 3, *Assessment of Drought Severity*, is now available. It arose from the BHS Loughborough workshop in 1993 and was compiled and edited by **John Mawdsley**, **Geoff Petts** and **Susan Walker**. Copies may be ordered from Louise Picton at the ICE (address on back page) at £5 each.

To be published soon is the Research Strategy document, *Sustainability in a changing world: the key role of hydrology*, prepared by **Frank Law**, **Howard Wheater** and the R & D sub-committee.

Occasional paper No. 4 will be the *Hydrologist's Workbook*, compiled by **Ron Manley** (see Circulation 38); No. 5 is to be based on papers accepted for the meeting on 9th January 1995 on *Weather Radar and its Application*.

Postgraduate Symposium

The Fourth BHS Postgraduate Symposium took place from 29th to 31st March at the University of Birmingham. Fifty delegates attended; about half of them were accommodated in one of the University Halls of Residence.

The Symposium was a most enjoyable affair, with a full programme of activities including over 20 presentations by the delegates. There was a visit to the University of Wolverhampton's experimental site at Hilton Park, and evening entertainment provided by **Frank Law** (Institute of Hydrology) and **Geoff Petts** (University of Birmingham).

At the end of the final session, BHS President **Sue Walker** presented an award to **Paul Wood** for the best presentation, entitled "Low flows and recovery of macro-invertebrates in a chalk stream". There will be a full report in the next *Circulation*.

Paul Webster

Travel grants

Grants in the range £75-£100 are available to help members with the cost of attending meetings (see *Circulation 38*). The scheme is open to anyone, but is intended mainly to help students or younger members whose travelling expenses are not met by an employer.

Please apply to the Hon. Secretary (**Richard Harpin**), including details of the meeting, whether a paper or discussion is to be presented, the total costs and benefits of attendance, brief details of your financial situation, your background and your aspirations in hydrology. A brief supporting letter from a supervisor is also required.

Successful applicants are expected to produce a short report of their experiences in attending the meeting.

New Reading publication

The Centre for Agricultural Strategy at the University of Reading has published CAS Paper 29, *Water services and agriculture: key issues and strategic options.* This comprises the papers presented to the conference held at the ICE on 14th December 1993 and supported by the Foundation for Water Research, NRA, WRc, Thames Water plc and Zeneca Agrochemicals.

Key issues of concern to the water and agricultural industries were identified and discussed, leading to an examination of the options and strategies for the future.

Copies may be ordered (price £20 including postage) from Mrs Janet Cheshire, Centre for Agricultural Strategy, University of Reading, 1 Earley Gate, Reading, RG6 2AT (Tel. 0734 318152, Fax 0734 353423)

Book reviews

The pile of review copies of hydrological books is growing again. Reviewers are sent a complimentary copy of a new book and then write a review of it for *Circulation*. New volunteers are always welcome: let me know your area(s) of interest and I shall add your name to my select list of reviewers.

I have received books on a wide range of topics in hydrology and would like to publish at least a page of reviews in the next issue of *Circulation*.

John Griffin

FORTHCOMING EVENTS

Meetings

International Conference on
WETLAND MANAGEMENT
ICE, London
1-3 June 1994

Wetlands, from a small harbour to a large mangrove swamp, require comprehensive management based on interdisciplinary skills: hydrology, hydraulics, environmental planning, engineering, ecology, geomorphology. Presentations and poster papers will cover the threats to wetlands, the processes involved, ecology and water quality, land-use changes and management solutions.

The conference is co-sponsored by IWEM, ASCE, IAHR, NRA and others. The fee, including visits and proceedings, is £300 (including VAT and the proceedings volume), with a lower rate for a second delegate; there is also a greatly reduced stand-by rate for students, unemployed and retired ICE members by telephoning *7 days* before the event.

For further information contact the Conference Office, ICE, 1 Great George Street, London SW1P 3AA (Tel.: 071 839 9805, Fax: 071 233 1743).

British-Irish Conference on
THE BALANCE OF WATER — PRESENT AND FUTURE
Dublin
7-9 September 1994

This is a joint meeting of the Agricultural Meteorology Group of Ireland and the Royal Meteorological Society's Agricultural Meteorology Group, to be held at Trinity College, Dublin. The conference will reassess the accuracy of the components of the overall water balance — precipitation, evaporation and runoff — and look at problems of estimating and measuring them. International experts, practitioners and young scientists will focus on hydrology and agricultural meteorology and discuss how to meet the needs of users of hydrological data. The conference fee is £90, including lunches and the Proceedings volume. College accommodation is available (£99) and low-cost flights from Luton have been arranged.

For further information contact Dr J A Clark, Secretary, Royal Met. Soc. Agricultural Meteorology Group, University of Nottingham, Sutton Bonington, Loughborough, LE12 5RD (Tel: 0602 516254).

Two meetings on
GLOBAL CONTINENTAL PALÆOHYDROLOGY
Southampton
9-12 September 1994
& London
13 September 1994

GLOCOPH '94 is the first international meeting of the INQUA Commission on Global Continental Palæohydrology. It will focus on the last 20 000 years and will be held at the University of Southampton from 9 to 12 September.

On the following day a meeting on *Global continental changes: the context of palæohydrology* will be held at the Geological Society, Burlington House, London. Jointly organised by the BGRG and the INQUA Commission, this will discuss impacts of global environmental change on the hydrological cycle and the contribution palæohydrology can make in predicting these changes. Keynote papers will cover modelling future water balance and climate, changes in the global water budget, glaciated areas and the carbon cycle.

Further information may be obtained from Julia Branson, GeoData Institute, University of Southampton, SO9 5NH (Fax: 0703 592849; E-mail: j.branson@soton.uk.ac).

International Conference on
INTEGRATED RIVER BASIN DEVELOPMENT
Wallingford
13-16 September 1994

With increasing world population and higher aspirations, managing sustainable natural water resources is vital for the health of people and their environment. This conference will bring the professional expertise of scientists and engineers, planners and administrators together to debate appropriate techniques of river basin development. It is organised jointly by HR Wallingford and the Institute of Hydrology and sponsored by BHS, IAHS, IAHR, ODA and NRA. The full conference fee for BHS members, including the volume of

papers, refreshments, lunches, technical visit and conference dinner, is £564 (including VAT). The reduced fee for academics and research students is £352.50. College accommodation in Oxford has been arranged (£150) and there is a day's post-conference tour of the River Kennet, run by the NRA Thames Region, for £40 (including an extra night's accommodation).

For further information contact the conference organiser, Jacqueline Watts, HR Wallingford Ltd, Howbery Park, Crowmarsh Gifford, Wallingford, Oxon, OX10 8BA (Fax: 0491 832233).

Fifth ERB General Assembly and Conference on ASSESSMENT OF HYDROLOGICAL TEMPORAL VARIABILITY AND CHANGES
Barcelona, Spain
26-30 September 1994

The 5th biennial conference of the European Network of Experimental and Representative Basins (ERB) will focus on the use of ERB in analysing temporal variability of spatial differences in hydrological phenomena. Contributions are invited, especially on monitoring and modelling of seasonal and long-term hydrological fluctuations, land-use and climate change. Papers will be available at the beginning of the meeting and refereed papers will then be published in a special issue of *Acta Geologica Hispanica*. There is still space for a few more contributions to the poster session; there will also be two field trips to ERB sites in Spain.

For further information contact Dr Mark Robinson, Institute of Hydrology (Tel: 0491 838800).

First international conference on LIVING WITH WATER
Amsterdam, The Netherlands
26-29 September 1994

This international conference on integrated water resources management is organised by the International Association on Water Quality and sponsored by IAHS and the UN's ECE amongst others. The fee is Dfl 850, including free admission to the 15th AQUATECH trade exhibition on water technology, running alongside it. There will be 10 invited papers, 28 selected papers and many posters: preprints will be available at the beginning of the conference. There is a choice of six technical excursions.

For further information contact the Conference Secretariat, Buerweg 51, 1861 CH Bergen (nh), The Netherlands (Fax: +31-2208-99040).

Diary

*6th July 1994 **(note revised date)***
BHS Midlands Section /BWB
"Hydrology of canals" — field visit
Venue: Birmingham
Contact: Paul Webster, Dept of Civil Engineering, University of Birmingham, Birmingham, B15 2TT *(Tel: 021 414 5055, Fax: 021 414 3675)*

7th September 1994
BHS Annual General Meeting
"Environmental impact and the hydrological cycle"
Venue: ICE, 1-7 Great George St, London
Time: 10.30 (coffee from 10.00) to 16.45
Contact: Dr Richard Harpin, Halcrow, Burderop Park, Swindon, Wiltshire *(Tel: 0793 812479)*

29th September 1994
British Soil-Water Physics Group
"Scaling problems in soil-water physics"
Venue: ADAS, Cambridge
Contact: Dr A C Armstrong, ADAS Soil & Water Research Centre, Anstey Hall, Maris Lane, Trumpington, Cambridge, CB2 2LF

16th September 1994
Welsh Hydrological Group
Annual General Meeting
Contact: Linda Aucott, NRA South Western Region, Rivers House, East Quay, Bridgwater, Somerset *(Tel: 0278 457333, Fax: 0278 662153)*

4th October 1994
Hazards Forum / BHS
"Contingency plans for UK droughts"
Venue: ICE, 1-7 Great George St, London
Contact: Frank Law, Institute of Hydrology, Wallingford *(Tel: 0491 838800)*

5th October 1994
BHS Pennines Section
Site visit to the Tees Barrage
Time: 2.00 p.m.
Contact: Elizabeth Kaar, NRA North West, P.O. Box 12, Knutsford Road, Warrington, Cheshire *(Tel.: 0925 53999)*

14th October 1994
Scottish Hydrological Group
"Land-use/climate impact on river flows"
Venue: City Mills Hotel, Perth
Contact: Dr D J Gilvear, Dept of Environ. Science, Stirling University, FK9 4LA *(Tel: 0786 467845; Fax 0786 467843)*

2nd November 1994
BHS Pennines Section
"Low flow management"
Venue: University of Huddersfield
Time: 2.00 p.m.
Contact: Elizabeth Kaar (*address above*)

16th November 1994
BHS National Meeting
"Techniques in water resources analysis"
Venue: University of Newcastle
Contact: Tim Wyatt, Power & Water Systems Ltd, Henley on Thames, Oxon *(Tel: 0491 578860, Fax: 0491 410780).*

9th January 1995
BHS National Meeting / NERC
"Weather radar and its application"
Venue: ICE, 1-7 Great George St, London
Contact: Dr Kevin Tilford, Dept of Civil Engineering, University of Salford *(Tel: 061 745 5000)*

22nd February 1995
BHS Pennines Section
"Flood prediction and warning"
Venue: University of Salford
Time: 2.00 p.m.
Contact: Elizabeth Kaar (*address above*)

28th March 1995
BHS National Meeting / Geol. Soc.
"Modelling river/aquifer interactions"
Venue: Burlington House, London
Contact: Dr Paul Younger, Dept of Civil Engineering, University of Newcastle upon Tyne, NE 1 7RU *(Tel: 091 222 7942)*

17th May 1995
BHS Pennines Section
AGM followed by technical meeting on
"Rainfall modelling"
Venue: University of Lancaster
Contact: Elizabeth Kaar (*address above*)

4th – 7th September 1995
5th National Hydrology Symposium
(see circular enclosed with this issue)

Copy Deadline for Issue No. 43 9th July 1994

Circulation is the quarterly newsletter of the British Hydrological Society. It is issued free to members, but is also available on an annual subscription of £19. All enquiries concerning membership should be made to Louise Picton, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Telephone 071 839 9836. Please address all other correspondence to the Editor, John Griffin, Institute of Hydrology, Wallingford, OX10 8BB. Telephone: 0491 838800 extension 2395. Fax: 0491 832256.
Circulation is produced by the **Institute of Hydrology** and indexed in *Geosystems: Hydrotitles* and *GeoArchive*.