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UNIVERSITY RESEARCH ...Part VIII

Department of Geography Hull University

The physical geography research team at Hull University consists of 11 members of academic staff, four research assistants and seven research students. It has probably the best infrastructural support of any such group in the country, with 11 technicians, extensive, well-equipped laboratories, a long-established research catchment and a wide range of specialist equipment, including wave and flume tanks, hardware and analogue hydrological models, XRD and XRF equipment, AA spectrophotometer, SEM, computer-linked EDM survey systems, fully equipped nearshore survey boat, a unique tropical pollen reference collection and an extensive Macintosh microcomputer LAN which is itself networked to the University ICL 3980 mainframe computer. The department was one of the pioneers of "geographical" hydrological research in the 1960s under the direction of Professor Roy Ward. Data from its Catchwater Drain experimental catchment have found their way into the research literature of at least four continents as a result of collaborative research, conducted at Hull, with visiting academics from overseas and as a result of the appointment of hydrology PhD graduates, from the department, to University posts in Europe, Africa and Australia.

In recent years the increasing emphases on sharpening research focus and on team research has led to the definition of three main research thrusts in the department of Geography, one in the area of human geography and two in the area of physical geography (Estuarine and Coastal Research; and Quaternary Science).

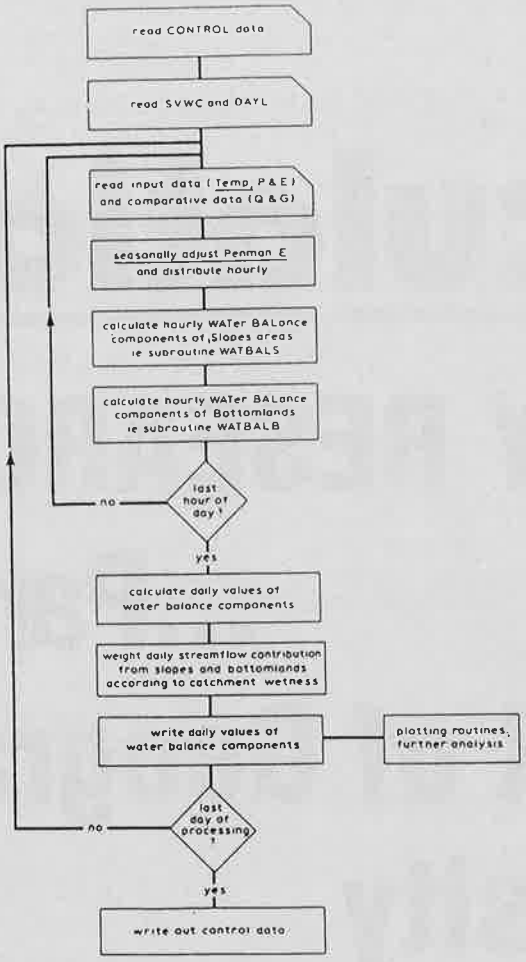
In the *Quaternary Science* group the emphasis is on the use of palynology (John Flenley), diatoms (Sarah Metcalfe) and contemporary arctic-alpine plant communities (David Watts) in the reconstruction of palaeo-environments, with strong collaborative support from the closely related work in pedology (Steve Ellis) and sedimentology (Martin Pedley and Arthur Fraser). In the *Estuarine and Coastal Research* group there is a strong emphasis upon coastal erosion and sediment transport processes (John Pethick and Jack Hardisty) and upon modelling the fresh water and polluted water inputs from river catchments into estuarine and coastal systems (Roy Ward, Roger Arnett and Dick Middleton). The work of this group contributes significantly to the rapidly expanding programme of the University's Institute of Estuarine and Coastal Studies (IECS). The Institute, which was established in 1982 to provide a focus for pure and applied research in marine, estuarine and coastal studies, has an Academic Membership which is truly interdisciplinary, ranging from chemistry to law and from applied biology to economics. a growing Associate Membership from industry and commerce, a remarkable record of attracting industrial and commercial research and contract funding; and is in the process of launching what promises to be an attractive new taught MSc course in Estuarine and Coastal Science and Management. The work of IECS has been greatly enhanced by the recent transfer, to this University, of the International Institute of Fisheries Studies. The arrival of this eight-strong team provides exciting new research opportunities both within IECS and within the Department of Geography.

Catchment hydrology

Since the early 1960s **Roy Ward** has been concerned with the theory and practice of catchment hydrology experimentation and more recently with modelling catchment hydrology. Throughout this period the Catchwater Drain experimental catchment, in the boulder clay coastal lowland of Holderness, has served as a research and teaching laboratory, as a source of data for model development, and as a stable and continuing research framework for a number of research grants and a sequence of successful research student projects.

The catchment model described in Ward (1985) is a simple accounting model, which uses an hourly operating interval to calculate the balance between precipitation and evaporation (see Fig. 1). A simple snow accumulation and melt algorithm is incorporated together with a seasonal adjustment of the

Figure 1 Flow diagram of catchment hydrology model developed for the Catchwater Drain experimental catchment in Holderness, North Humberside.



Penman estimate of potential evaporation. The model embraces the Hewlett hypothesis of runoff generation and is capable of generating satisfactory daily and hourly values of streamflow (see Fig. 2) and daily values of soil moisture and actual evaporation.

More recently, work in physical hydrology has been structured to provide a necessary input to the investigation of coastal erosion (especially in terms of the role of soil water and groundwater in the stability of clay cliffs) and of fresh water inputs to estuarine water budgets and regimes.

Catchment sediment and solute budgets

Work on source areas for sediments and solutes in the North Yorkshire Moors National Park is being continued by **Roger Arnett**, with particular interest in the relationship between soil properties and stream water quality. Sediment budgets throughout the whole of the National Park are highly variable, both spatially and temporally, and respond immediately to apparently insignificant changes in land use or vegetation cover. Erosion of the peat cover promotes high suspended organic loads, while humification and mineralisation of the peat produces significant nutrient flushes after summer storm events.

Estuarine and coastal research

The estuarine and coastal work represents a dynamic research area which has been very successful in attracting external funding. **John Pethick**'s research team has been working on several parts of the coastline of eastern England. In Essex they are working for Anglian Water on the problems of eroding salt marshes. Salt marshes provide an extremely important natural sea defence system – their vegetation cover dissipates wave energy and protects the vulnerable sea walls behind. The removal of the salt marshes will lead to sea wall erosion and, in a time of rising sea level, this could lead to extensive flooding. The team is examining the hypothesis that salt marsh erosion is not the dramatic process of large waves ripping away blocks of marsh, but rather the continuous stripping of single-grain layers of silts from the marsh surface.

Coastal erosion

Work also continues on the rapid cliff-erosion problems of the Holderness coastline. John Pethick has completed an analysis of the nearshore sediment budget, using data collected in 1985/86, which has produced some surprising results. The old idea of a southerly longshore drift removing the eroded material does not seem to be correct. Instead, it is believed that the Holderness coast has become so delicately adjusted to the wave climate of the North Sea that, for 99.9% of the time, sand on the beaches moves both north and south with no net movement in either direction. The removal of the eroded cliff material occurs during one or two major north-easterly storms during the year – the whole of the eroded sand, nearly one million tonnes, being lost in the space of a few days.

The Humber estuary

Research on the Humber estuary inevitably plays a mjaor role in the research activity of the Geography Department at Hull University. Recently two important publications have appeared: one was *A Dynamic Estuary: Man, Nature and the Humber*, to which **Philip Jones**, **John North** and John Pethick contributed, the other was *The Humber Estuary: Environmental Background*, to which these three, together with **David Symes** and Roy Ward, contributed.

Sediment dynamics

Jack Hardisty has recently joined the Department bringing a group of four PhD students and a Research Assistant from London University to strengthen the work of the estuarine and coastal team. Although his research involves the design and testing of non-linear numerical models for nearshore geomorphologies, his research on the small-scale physics of the sediment transport processes and laboratory and field instrumentation will be of particular use to the hydrologists at Hull. The group includes

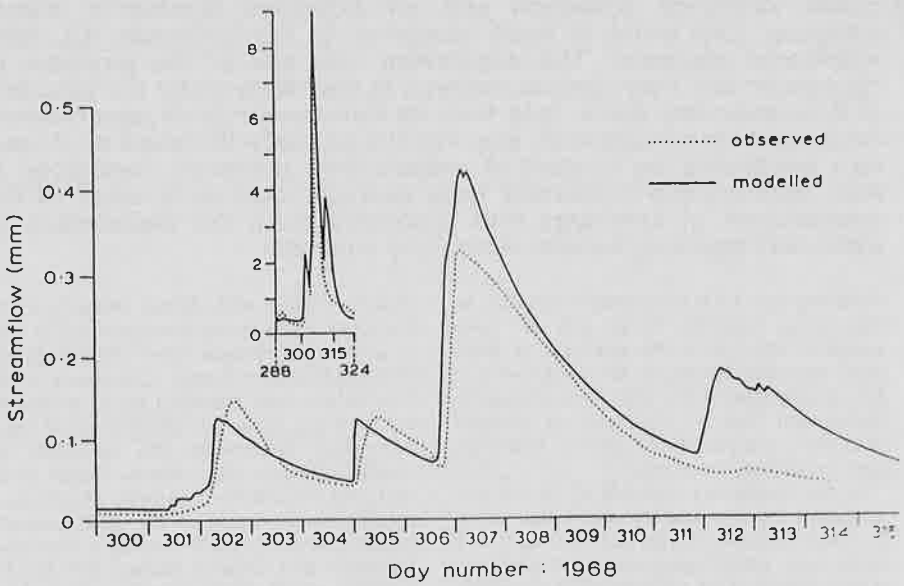


Figure 2 Observed and modelled hourly runoff hydrographs from the Catchwater Drain experimental catchment for two weeks in 1968. Inset shows hydrographs of flow aggregated to daily values for the same period.

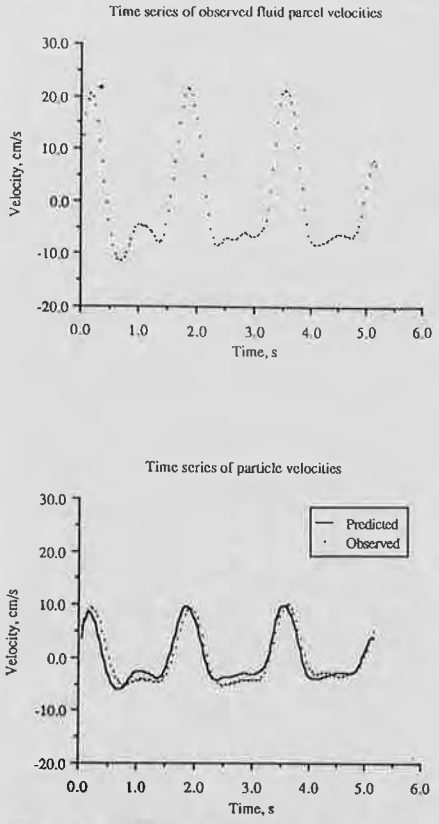


Figure 3 Despite the complex flow field that develops either because of turbulence in a river channel, or beneath waves on a beach (as shown in the upper diagram) the inclusion of acceleration terms can adequately predict the resulting movements of bed particles (lower diagram).

Jeremy Lowe who is working on an NERC grant entitled "Higher frequency acoustic measurements of bedload processes in turbulent flow" using the Hinze equations to model gravel particle dynamics in accelerating flow fields (see Fig. 3). Additionally **Richard Whitehouse**, **Arthur Evans** and **Jason Woodruffe** are all research students funded by NERC to develop and test aspects of the theoretical models for the threshold and rate of sediment transport on sloping channel beds beneath steady and unsteady flows. Although their results, together with those of **Diane Horn** on the second order wave equations, are designed to improve the predictive capability of the beach models, they will also improve sediment load estimates in terrestrial hydrological systems. The group brings an excellent range of field instrumentation from twin three component ultra-sonic current meters, capable of measuring, u′, v′ and w′ simultaneously at more than 30 Hz to the new underwater acoustic probes which are being developed to measure the bedload spectrum.

Future research

Future hydrological and related research will be specifically focussed on the further development of some of these lines of investigation. For example, a study of wave-process response to changes in sea-level, to be led by Jack Hardisty and John Pethick, is of particulr significance at a time of predicted global sea-level rises, and will involve construction of a numerical model for wave processes and erosion-accretion along wave orthogonals in both cohesive and non-cohesive sedimentary coasts. An ingenious aspect of this work will be that macro-tidal ranges in the Humber estuary will be used as an analogue for sea-level rises. Regional aspects of pollution control will be investigated by Roger Arnett, **John North** and **Derek Spooner** in a study which will concentrate on aspects of pollution control within Humberside and will examine relationships between regional development, environmental impact and public policy, including problems of cumulative and synergistic impacts and pollution transfers between media.

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ACIDIFICATION - A Scandinavian Perspective

BHS Southern Section Meeting 18 January 1989

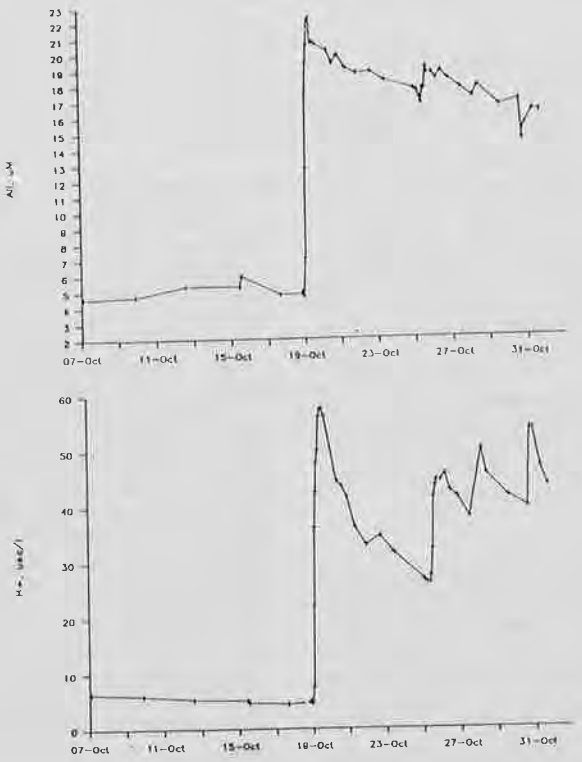
Nils Christophersen from the Norwegian Centre for Industrial Research, Oslo, who is currently spending a sabbatical year at the Institute of Hydrology, has worked in the field of surface water acidification for some 10 years and is widely known for his research into acidification models, developed initially on the Birkenes catchment in Southern Norway. During the last decade, scientific and political perceptions of acidification have changed dramatically and, at this meeting at Imperial College, Nils presented a wide-ranging review of this development, as well as highlighting current research activity.

In Norway, fish decline commenced in the 1920's and accelerated in the 1940's and 50's. By 1986 some 30,000 km^2 of Southern Norway had no fish population (Fig. 1). The connection with acid rain was not made until 1959 and the Swedish scientist **Svante Oden** formulated a fairly complete view of the problem which was presented to a UN



Figure 1 Fish status in southern Norway in 1986. Source: Norwegian Institute for Water Research (NIVA).

Figure 2 Episodic changes in streamwater chemistry at Birkenes, Autumn 1986, a) inorganic Al, b) H^+.



meeting in Stockholm in 1972. This provided the impetus to a major research effort in Scandinavia. In Norway 15 rivers are routinely monitored, seven catchments are being studied in some detail (including the acidified Birkenes catchment in Southern Norway and the pristine Hoylandet catchment in mid-Norway) and in 1986 1,000 lakes were sampled, 400 of which were first sampled in 1975/76. In a spectacular experiment, the RAIN project, a natural catchment of 1,000 m^2 has been covered, acid precipitation is intercepted and cleaned, and the resulting water is sprayed (as rain and snow) over the area to investigate recovery processes. Some of this work is currently being undertaken in collaboration with British scientists and with funding from a joint Surface Water Acidification Programme, sponsored by the CEGB and the NCB. As a result a warm relationship now exists between UK and Scandinavian researchers, although this has not always been the case. Previous criticism by CEGB scientists in the early stages of acidification research generated some hostility and was associated with the climate of Scandinavian opinion against the UK as a major polluter.

The development of scientific understanding of acidification processes has been controversial. A marked gradient in precipitation acidity over Southern Norway is associated with a corresponding gradient in surface water acidity. Is there then not a simple relationship between acid precipitation and acid runoff? Conversely, scientists such as **Professor I.T. Rosenqvist** argued strongly that terrestrial controls were dominant and that land use change is an important factor. Drawing on data from the Birkenes catchment, Nils demonstrated that the relationships are not simple. Although pH declines in response to precipitation, there is no direct relationship with hydrogen ion input; also it is enhanced Al concentrations which are responsible for fish decline. Since Al does not come from rainfall, terrestrial effects must be important (Fig. 2). The Reuss-Johnson model, considering sulphate input from rainfall as a mobile anion which interacts with catchment chemistry, provides a rational explanation for response to acid input subject to terrestrial controls.

A current area of interest is the interrelationship between hydrological flow-paths and stream response. Nils' experience of experimental studies in Norway suggests that stream response is a variable mix of water from upper soil horizons with high hydrogen ion concentration and low aluminium and water from lower horizons which has lower hydrogen ion but enhanced inorganic aluminium. Current development of the Birkenes model is focussing on this representation.

The Birkenes catchment itself now has 17 years of data, and some interesting changes are suggested by these data, namely a slight decline in sulphate and the major cations (Mg and Ca) in streamwater. This is possibly due to soil acidification but will need further consideration.

Looking to the future, Nils noted that reversibility is an issue of major scientific importance. Politically, Western Europe is now working together to reduce the problem but, for Scandinavia, the attitude of Eastern Europe is of major concern. A lesson for science has been the need to evaluate complex environmental systems. This requires flexibility of approach and a multidisciplinary background – characteristics which run counter to research training as a process of progressive specialisation!

Extensive discussion followed the presentation. Nils commented on the role of in-stream processes which he felt were secondary to soil acidification, and also expanded on the implications of a high sea salt input to the Birkenes catchment. A strong Cl input episode had acted as a tracer from which hydrological response mechanisms could be inferred.

The meeting closed with a warm vote of thanks for a stimulating and most enjoyable presentation.

S Kaemaki and H.S. Wheater
Imperial College

Weather Radar at IH

NERC's Steering Committee on the Hydrological Applications of Weather Radar hosted a one-day seminar for invited representatives from the communications industry, water authorities, government and university research departments and international organisations at the Institute of Hydrology, Wallingford on 6th April 1989.

The meeting started with a review by **Vin Collinge** (University of Lancaster) on the UK's past investment in weather radar for the water industry and – brave man – a financial evaluation of the benefits. This was followed by a contribution from **Messrs Lawler & Passarelli** (Plessey Radar and Sigmet Inc., respectively) who took us through the exciting developments in both hardware and software aspects of new systems.

Bob Moore (IH) then focussed on technical aspects of using radar to measure precipitation and how new techniques for measurement and calibration will help the water industry.

Chris Collier (Met. Office) moved on to the realms of forecasting and explained what radar has to offer now and the prospects for the future. Practical applications were then covered by **Ian Cluckie** and **John Tyson** (University of Salford and North West Water) for urban drainage problems and for rural storm hazards by **Duncan Reed** and **Lisa Stewart** (IH).

Peter Walsh (North West Water and Chairman of the NERC Radar Committee) completed the formal proceedings with a review of research needs and commercial opportunities before a free-ranging discussion ensued. Pertinent comments on the danger of the UK losing its present European lead in weather radar expertise and the need to think hard about the contribution it can make to third world problems wound up a stimulating meeting.

The full papers will be published as the next in the series of BHS Occasional Papers later this year.

New Software Release from the Institute of Hydrology

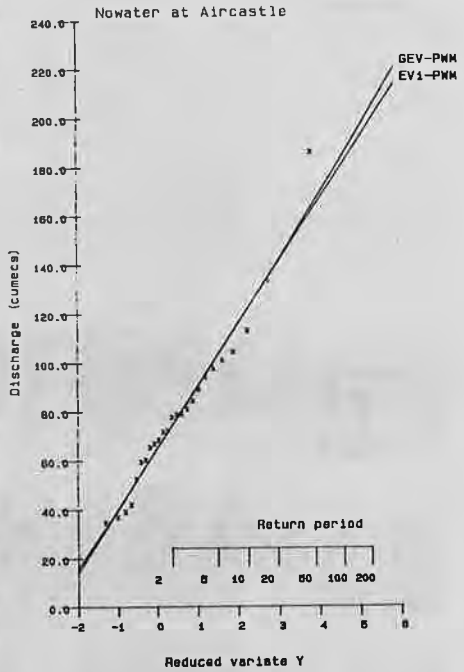
If you have ever wished you could tackle a wider range of flood frequency distributions but have never had the time to get into the details, you may well be interested in FFAP. This *Flood Frequency Analysis Package* enables you to plot and fit curves for any or all of six different probability distributions by different standard procedures.

Currently available combinations are:

Extreme Value Type 1	– by moments (MO) or maximum (ML) or probability weighted moments (PWM)
General Extreme Value	– by ML or PWM
2 Parameter Lognormal	– by MO or ML
3 Parameter Lognormal	– by MO or ML or PWM
Pearson Type 3	– by MO
Log-Pearson Type 3	– by MO

The program ranks and plots (using Gringorten positions) annual maximum series of any appropriate statistic from either file or screen entry. It will run on any microcomputer using MicroSoft MS-DOS or PC-DOS coupled to graphic facilities using GEM graphics software. Appropriate drivers for your machine come with FFAP. Printer and plotter outputs are very similar so only one is shown here. Results tables give both the fitted parameters and estimates of flood peak for any chosen return periods thus obviating the need to measure off the graph.

The package is available in a test marketed form at a discounted price of £400. This will entitle a registered user to future upgrades, the glossy manual when it is printed later in 1989 and a reasonable level of back-up support. Purchase requests or additional details from Nigel Arnell or Frank Law on 0491–38800.



Risk Assessment for Dam Safety Evaluation

BHS Southern Section Meeting 10 October 1989

It is estimated in the United States that around 3,000 high hazard dams are unsafe, mainly due to inadequately sized spillways. The cost of upgrading these dams is large: actions need to be taken but where do planners start? High priority cases need to be identified and interim solutions justified. Over 50 people came to Imperial College to hear *Professor David Bowles* of the Water Research Laboratory of Utah State University outline some recent developments in methods for evaluating dam safety.

Professor Bowles described two related methods that have recently been used by his team to assess the safety of dams across the United States. The methods – Incremental Consequence Assessment (ICA) and Risk Assessment (RA) – are fundamentally quite simple, but Professor Bowles has developed rigorous frameworks for their application and has applied them to several dams to provide information for use by their owners and regulators in making dam safety decisions. Dam safety is a function of loading (flood, earthquake, internal failure, for example), response (such as overtopping or breaching) and consequence (loss of life and property, disruption to water or power supplies, for example); the key to dam safety evaluation is to identify all the components relevant at the site of interest.

Incremental Consequence Assessment basically involves studying the various loadings at a dam and asking "what if various loading levels were to occur?" If the probable maximum flood occurred, what would happen? Would the dam break, or simply overtop? What would be the consequences of overtopping, as opposed to breach? An "incremental consequence" is simply the difference between the consequences of a given flow (or indeed seismic acceleration) with and without a particular type of failure. Professor Bowles pointed out that it is a legal issue as to whether the increment should be based instead on the "natural" or "without failure" case. Graphs can be prepared showing the consequences of different loadings under particular assumptions about failure modes, giving a quick and generalized picture of the main areas of risk. It is also possible to prepare graphs for different sectors of the community at risk. Such graphs would indicate, for example, the relative consequences of failure to the dam owner/operator and downstream communities.

However, ICA makes no reference to the likelihood of failure and different consequences. This is rectified in Risk Assessment, which attempts to assign probabilities to loadings, failure modes and consequences. The probability of incurring different consequences is estimated and, hence, the "average annual consequences" can be calculated as a measure of hazard posed by an unsafe dam. Estimating the probabilities of experiencing different loadings is relatively straightforward – it is what flood frequency analysis is all about – but estimating the probability of experiencing a particular failure type for a given loading, for example, and the probabilities of getting different consequences for a given outflow from a failed dam is not as straightforward as flood frequency analysis. An experienced multidisciplinary team is therefore used to develop appropriate estimates and an indication of the associated uncertainties based on engineering and

economic analyses, experience and judgement.

Professor Bowles illustrated the two methods using examples from several dams, including the Tongue River dam in Montana which suffered from spillway erosion at relatively low flood flows. The client had identified the strategies they wanted to compare, and Professor Bowles' team worked out both the incremental consequences and the average annual cost of the consequences from different loadings and failures. The total annual cost of a particular strategy is the sum of the annual costs of the leftover consequences and of implementing the strategy. A failure of the Tongue River dam could cause several casualties and Professor Bowles expressed the cost of different mitigation strategies in terms of the "cost-to-save-a-life" which could then be compared with the costs of other investments in public safety.

A lively discussion followed, with much debate over the assignment of notional probabilities to dam failures and probable maximum floods. In Risk Assessment, experienced professionals from both the project team and the client get together to assign not just failure mode probabilities but also bounds on their estimates, and Professor Bowles emphasized the value of experienced, interdisciplinary teams. Other questions concerned the incorporation of "intangible" aspects of risk and dam failure: these are currently receiving increasing attention in Britain.

Overall, Professor Bowles' talk gave some very interesting insights into current thinking on the thorny issue of dam safety assessment. The audience certainly came away with a deeper understanding of the key points and possible approaches, and we hope that Professor Bowles also found the comparison with British experience useful.

Nigel Arnell
Institute of Hydrology

COMPUTERISED DATABASES IN HYDROLOGY

BHS National Meeting 16 March 1989

This one-day meeting on hydrological databases was held at the British Antarctic Survey, Cambridge. The speakers described existing and proposed database systems, with key themes including:

- confusion within water authorities which are inheriting many independent and often inadequate systems
- worries over quality of data
- concern that the use of polished and complex computer packages gives undeserved credence to poor data.

The morning session was chaired by **Dr Mike Lowing** (IH) who reported the "loss" at Heathrow Airport of the day's third speaker, **Tom Poodle** (Clyde RPB). Mike considered it timely to discuss databases as the NRA is being forced to use computer systems independent of the PLC units and is now reviewing its database needs. (He also reported that BSI have been given funds by DTI to establish a new standard of hydrometric data management.)

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The opening presentation was given by **Terry Marsh** (IH) who described the National River Flow Archive held at IH and the PC-based HYDATA system. He began by reviewing the history of the national river archive and contrasted the lack of continuity in the UK, where five organisations have been responsible for the data since 1935, with Sweden's 90-year-old meteorological and hydrological institute, SMHI. Also, IH's data collection is dependent on the water authorities' perception of a proper hydrometric network, driven by regional rather than national needs.

UK rivers are miserable streams compared with the global situation, being short, shallow and with many artificial influences. This makes accuracy of measurement all the more difficult. There has been a technical revolution over the last decade with new instruments and more cost-effective data collection, but this sometimes means that data are not scrutinised. Data validation has been very important at IH, with a range of simple checks using historic and related data, supported by visual checks whereby large volumes of data can be scanned rapidly.

Terry then described HYDATA, a microcomputer-based hydrological database developed at IH. It has been used in about 30 countries overseas and is now seeing increased use in the UK. Some of its key features are its ability to handle stage-discharge relationships, its data editing and retrieval facilities, and its extended range of information handling.

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Brian Greenfield (Thames Water) began his talk on current and future practices of hydrological data processing and storage within Thames Water by taking a quick look at the breadth of data being handled; rainfall, groundwater levels, river levels and flows (representing the largest volume of work) and abstractions. Most river level and flow data are collected on solid state loggers, but there are also telemetry systems and chart and paper tape recorders. Processing of these data involves flow calculation and data editing, with visual checks becoming increasingly important with the greater use of loggers. Data are presented as tables and plots and are stored on microcomputers, a mainframe computer and on fiche.

Until 1985 hydrometric data took many different routes into a central archive of daily flows and many processed data were inaccessible except from printed copies. Thames have since developed a system whereby data sources lead into a single flow calculation and editing system, and from there into the mainframe archive.

On data archiving he said that they did not have the same success story as IH. Their Water Archive contains daily rainfall, spot flow measurements, potential evaporation, abstractions and water quality data. Standalone archives handle a variety of other information. They want a single system to cope with everything, offering a single set of retrieval options. This should be simpler for operators and generate less in-house programming. It should also provide for new features such as river network data and geographical selection criteria.

There is no clear idea as to what will happen in Thames NRA unit: will it be simpler with common aims, or more complex because of data coverage?

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The discussion which followed was led by an impromptu (or so Mike Lowing assured us!) and ethusiastic presentation by **Mr Hasan** (independent consultant) on the use of GRIPS (GRoundwater Information Processing System, an IH package) in Somalia – see this issue *Circulation*.

The more general discussion was led by **Max Beran** (IH) who contrasted Mr Hasan's happy situation with Brian Greenfield's consternation. He wondered why Thames had not chosen to use an off-the-shelf package. Brian replied that they have a wider range of data and that the real problem is the archiving, not the processing. **Jed Kennedy** (Thames Water) pleaded for an emphasis on microcomputer systems which are better suited to surviving reorganisation: this was supported by others.

John Brown (Met. Office) described the archiving of rain radar data which is proving costly and said they were now reviewing it: only some of the costs are recovered from users.

When asked about automatically derived flows, Brian Greenfield said that they were usually quite accurate. The main problems were at extreme flows but manual methods also suffered then. The use of loggers aided as tail and pressure tapping data can be synchronised accurately, something which is not possible with charts. It was hoped that Brian would publish his work so that others may learn.

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Over lunch, and at the end of the meeting a number of microcomputer systems were on display; the Mott MacDonald Group demonstrated two databases one for a hydrometric network in the Philippines, the other for Anglian Water groundwater data. IH showed HYDATA, GRIPS and a package automating the derivation of low flow statistics, whereby

the user simply identified the point of interest on a digital map of the stream network. Anglian Water and HydroLogic displayed posters, as did our hosts with an attractive illustration of the work of the British Antarctic Survey.

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Terry Evans (Mott MacDonald) chaired the afternoon session and the first speaker was **Angelo Papianou** (Anglian Water). There are many approaches to hydrological databases within the UK and this is equally true within Anglian Water. The five divisions had strong local practices with different priorities and resources – there were very few common systems. There are now three NRA areas with local operations and services, inheriting many different systems, some modern, others crude manual arrangements.

Anglian have taken stock of the existing systems and reviewed off-the-shelf packages. Also, they have considered development of purpose-written software. Many different recording devices and data sources are involved, with much information in local files and many ad hoc systems. The main message here was the need for rationalisation.

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Alison Stuck described the background to the development of microcomputer-based database systems within the Mott MacDonald Group. They are under increasing pressure to leave a working computer system at the end of overseas programmes. Generally, in the client organisations, there is a lack of competent staff with experience of using computers, so there is a need for support and training, and for tailored software. Mott MacDonald have developed a robust modular system which provides for input, processing, verification, archiving, cataloguing and analysis of data.

The emphasis is on customising the software and Alison gave two examples. In the Philippines, where an island-wide network was to be set up and run by local staff for five years, data were collected on solid-state loggers and special software interfaces were written for each device. The second example was in Lesotho where there is an established water level data network, dating from the 1960s, and comprising about 60 stations; rainfall data have been collected since the 1930s. There had been no computer facilities, so the system which was provided had digitising and data entry facilities for non-technical staff.

Alison went on to describe the benefits of a computerised system, and the importance of training, particularly of the computer manager. She also mentioned the problem of the tendency to believe in numbers when produced as computer output with an example from the Philippines of a well-presented year book which included runoff data twice as high as rainfall!

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In his talk on digitised data and geographical information systems for water data, **Roger Moore** (IH), described the technical revolution in digital mapping which has taken place. Of immediate benefit is the automatic derivation of catchment characteristics using a digital terrain model (DTM). The DTM on which IH is working is a 50-metre grid of elevation over the UK, comprising over 100 million points; software has been developed which allows for the automatic delineation of a catchment.

Roger showed a sequence of slides of the DTM for Northern Ireland (NI). The DoE (NI) asked for mean and low-flow estimates on all 20,000 stretches of river in the Province; Ordnance Survey (NI) supplied the raw map data. The slides showed how the route of water to the sea was found for any point on the DTM and how the catchment to any point could similarly be described.

Roger closed by outlining a collaborative project with ICL to develop a replacement system for the Water Archive, using techniques such as those he had demonstrated. The system is called WIS (Water Information System) and is to run on a range of computer hardware. It will include modules dealing with the River Quality Survey, Control of Pollution Act (part II) and low flow and flood estimation.

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John Andrews (Met. Office) described FLICOM (??), the standard database system supplied to Third World countries by WMO, among others; about 10 systems are being installed per year. Terry Evans noted that vast sums of money were going into supplying meteorological and climate systems, rather than hydrological ones.

Once again concern was expressed that GIS make data look better and therefore more believable. Roger Moore emphasised the importance of data checking and commented that current procedures are not faultless either.

A number of members commented on the quality of the presentations. As there exists a mechanism within BHS whereby all display material is submitted before meetings, perhaps this procedure should be strictly adhered to.

Nick Bonvoisin
Institute of Hydrology

Groundwater Information Processing System (GRIPS) - A User's Assessment

The one-day BHS meeting on 16th March at Cambridge, which discussed computerised databases in hydrology, did not include any paper based on the experience of IH databases, HYDATA and GRIPS, overseas. Except for one paper, which described the use of an in-house database of a consulting firm on an overseas project, most of the papers dwelt rather laboriously on how the UK river authorities are competing with each other in developing their own databases. As far as I know, both the IH databases are being used in many countries overseas. I think the Cambridge meeting should have provided an opportunity to overseas users to present their own assessment of these databases.

I was introduced to HYDATA in 1986 in Fiji where it was being applied in a low flow study of the Fijian rivers. I was told that IH had developed a sister software package, GRIPS, for groundwater data processing and analysis. When I moved to Somalia in 1987 on the FAO/UNDP National Water Centre (NWC) Project, my TORs included computerisation of all available groundwater data. The choice of the correct software was crucial to achieving this project output. After a detailed market survey of available software, I found that only GRIPS had the twin capability of data storage and retrieval as well as analysis. Its user-friendly design and its capacity to present data/results in myriad forms – graphs, maps, summary tables – enabled prompt publication of data without any manual "touch-ups". The NWC also developed its own logo using GRIPS.

Since the project had to train the Somali counterparts in creating a national groundwater database, it sought IH's co-operation in this regard. An IH expert (**Jon Finch**) visited Somalia for three weeks to assist the project in the intensive training of five national experts. Later, a Somali computer technician was sent to IH for two months of hands-on training in GRIPS and other IH databases.

The GRIPS 3.2 version supplied to NWC in 1987 could only handle up to 1,000 stations. When the project pointed out that it had to computerise data from over 6,000 stations, IH promptly modified GRIPS and its latest version (3.3) can, I understand, handle up to 10,000 stations. This modification will make GRIPS technically and commercially more attractive to users overseas. Since GRIPS uses the Universal Transverse Mercator (UTM) grid system for station location, it would be useful to include an algorithm to convert longitude and latitude of a station into UTM grid. Such an algorithm will eliminate the tedious task of extracting UTM grids manually. Maybe, the latest version incorporates this facility.

By June 1988 when I left Somalia, computerisation of over 2,000 stations in Southern Somalia had been completed and the computerised data were published as FAO Field Document 7 (Groundwater Data Volume 1: Southern Region). In addition, water level and quality data from a national monitoring network of 60 stations were published as Field Document 6. The computerisation of data for other regions is now in progress under the able stewardship of my successor, **Steve Pond**.

On the basis of my experience of GRIPS for a year, I would recommend it to any user in the UK or overseas. I think it is the best software available for the storage, processing, retrieval and analysis of groundwater data anywhere in the world; IH should sell it more vigorously than it does at present.

M. Riaz Hasan
Consultant FAO

The Use of Caesium Isotopes in the Study of Erosion and Sediment Transport

BHS South-West Section Meeting 11 November 1988

Some 25 participants came to the University of Exeter for a meeting which focussed on the hydrological and geomorphological applications of caesium isotope studies. These investigations have been pioneered and developed by a team of researchers in the Department of Geography led by *Professor Desmond Walling* and including *Dr Tim Quine*, *Dr Steve Bradley*, *Dave Higgitt* and *John Rowan*. The three presentations introduced the group to studies of local catchments, to investigations in a major river system outside of Devon and to work at a national scale.

In the first paper, **Des Walling** explained the basic principles which underlie the use of ^{137}Cs and went on to illustrate four different aspects of erosion and sediment transport studies where this radioactive tracer can provide useful information. He outlined the origin of ^{137}Cs as a by-product of atmospheric nuclear testing of weapons, showed the typical fallout pattern for this radioisotope since the mid 1950s and noted that the Chernobyl accident has recently added to caesium levels (both ^{137}Cs and ^{34}Cs) in some areas of Europe. The relatively long half-life (c. 30 yrs), strong fixation by clay and organic matter in the near-surface environment of the soil and the relatively easy, if somewhat time-consuming, measurement through gamma spectrometry combine to make caesium isotopes particularly useful in hydrological and geomorphological work.

"Fingerprinting" of sediment sources in drainage basins was the first application of caesium studies illustrated. Considerable quantities of suspended sediment are carried by Devon rivers during flood events but it is not immediately obvious what proportion of this is from the river channel or from the hillslope environment, nor which type of land use is susceptible to most erosion. Comparison of ^{137}Cs concentrations of flood-borne suspended material with those characteristic of river bank sediment and pasture and arable topsoils provides a means of identifying the predominant sediment sources, although account must also be taken of variations in particle size between potential source materials.

The second application was establishing rates and patterns of erosion in agricultural areas. Des explained how measurement of total ^{137}Cs activity in a large number of soil cores extracted from an individual arable field, and comparison to the background levels of ^{137}Cs content in undisturbed pasture areas, enabled zones of deposition and erosion to be identified and mapped in relation to the topography of the field (Fig. 1). Areas of soil loss and gain are respectively characterized by Cs activity which is less than and greater than background levels, and results suggested that maximum erosion is located on the spurs rather than in the hollows of the spur-hollow systems studied.

As a third illustration, ^{137}Cs data were also applied to calculate sediment budgets for individual fields and small catchments. In one example, it was shown that a gross annual erosion rate of 3.2 t ha^{-1} on the slopes of a field was offset by deposition within (2.5 t ha^{-1}) and at the base of the field or in the bounding river channel (0.41 t ha^{-1}), so that the net yield of 0.64 t ha^{-1} represented a sediment delivery ratio of only 20%.

A fourth aspect of this work being undertaken in Devon rivers relates to rates and patterns of floodplain accretion. Des Walling illlustrated this application with reference to studies undertaken in a 13 km reach of the River Culm, where continuous suspended sediment monitoring has indicated the occurrence of substantial deposition. The location and amount of accretion on the Culm floodplain is revealed by Cs activity which is greater than background levels and by a "stretching" of the ^{137}Cs profile. Results from 17 profiles suggested that the average rate of deposition over the last three decades was 1.5 mm year^{-1}, although the amount of accretion may vary from 1–4 mm year^{-1} in different parts of the floodplain. Measurement of total Cs activity in more than 100 cores has provided further information on spatial patterns of local scour as well as accretion on the floodplain and has also allowed the pattern of deposition to be evaluated in relation to micro-topographic features.

In the second presentation, **Steve Bradley** reviewed an ongoing study of how caesium isotopes produced by the Chernobyl accident are being transported and redistributed by fluvial processes in the Severn Basin. In Britain, deposition of ^{137}Cs and the shorter-lived isotope, ^{134}Cs, was governed by the pattern of rainfall during early May, 1986. Maximum fallout occurred on 3rd May and levels within the Severn Basin were highest in the headwaters but declined to negligible

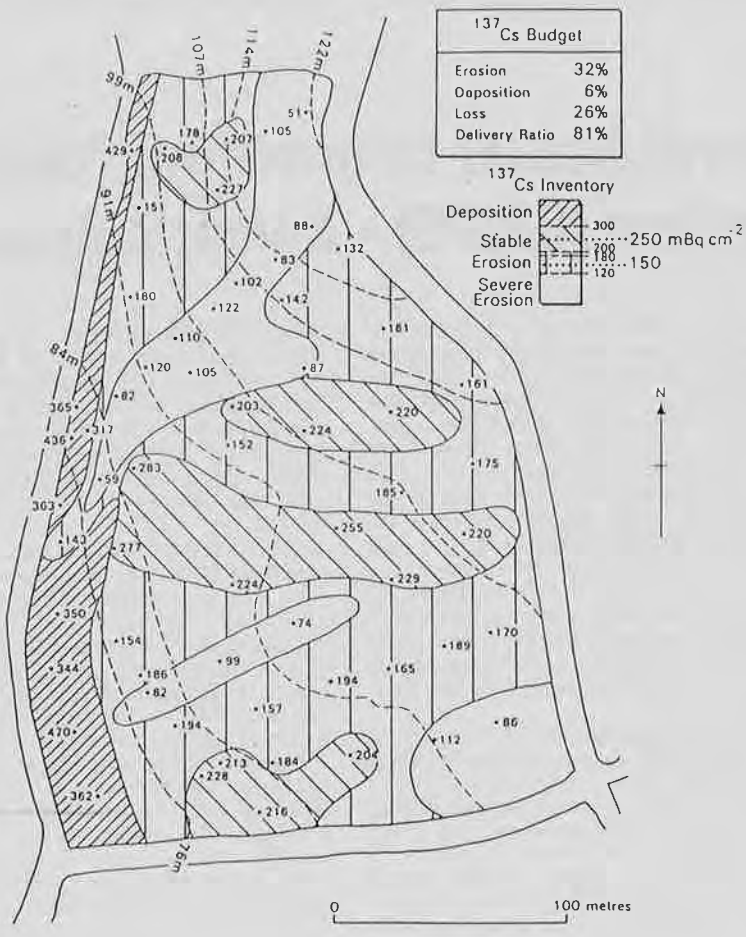


Figure 1 The spatial distribution of ^{137}Cs content of the soil profile within a cultivated field near Exeter.

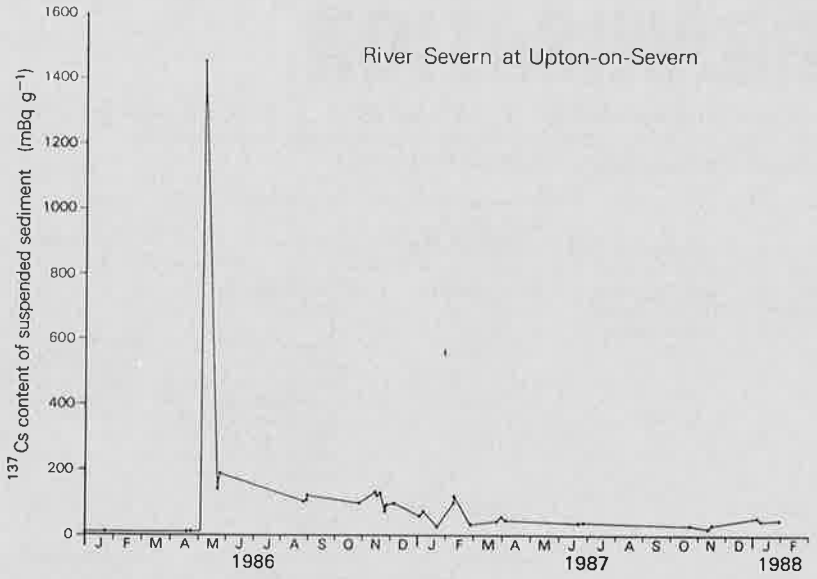


Figure 2 Temporal variation in the ^{137}Cs content of suspended sediment in the River Severn.

values in the lower reaches. A programme of flood-period suspended sediment sampling at three stations on the River Severn, initiated before the Chernobyl event, revealed an increase in particulate-associated ^{137}Cs concentrations of more than two orders of magnitude immediately following the nuclear accident; concentrations remained an order of magnitude higher by the end of 1986 and five to ten times higher in 1987 than pre-Chernobyl levels (Fig. 2).

Within the River Severn, redistribution of sediment contaminated by Cs radionuclides is a complex process which requires the contribution of "bomb" and "Chernobyl" ^{137}Cs to be separated. Steve reported the results of detailed investigations which emphasise the role of sediment remobilization in successive floods, inputs from tributaries characterized by different amounts of Chernobyl fallout and overbank deposition of fine sediments enriched in ^{137}Cs and in ^{134}Cs. Floodplain accretion of contaminated sediment is complicated, in time, by significant variation in the clay content of suspended sediment transported from flood to flood and, in space, by preferential deposition in zones close to the river channel. Future work will consider the detailed spatial patterns of Cs deposition along the floodplain of the Severn.

In the final paper, **Tim Quine** reported the use of ^{137}Cs in a study aimed at estimating the patterns and rates of soil erosion and deposition at a range of sites on arable land in Southern Britain. He explained that study sites had been selected to represent the main soil types in this part of the country but, in his presentation, he focussed on the results of investigations in Bedfordshire, Gwent and Shropshire which involved clayey, silty-clay and sandy soils respectively. At each site, soil sampling was conducted on a 20 m grid to establish the pattern of ^{137}Cs residuals from background levels, which were then mapped and showed varying relationships to field topography.

A major goal of this work has been to calibrate ^{137}Cs residuals in terms of soil erosion rates and Tim described a model which has been developed for this purpose and is in good agreement with recent Canadian calibrations. The model can also be used to evaluate soil gain as well as loss and, when applied to ^{137}Cs residual patterns derived for the study fields, it revealed localized rates of erosion and deposition of 30 and 20 t ha^{-1} year^{-1} respectively. Erosion and deposition were also used to compute sediment budgets for individual fields (Table 1) which showed net soil erosion to be relatively high on the sandy soils of Dalicott Farm, Shropshire, but relatively low on the clayey soils of Brook End Farm in Bedfordshire. Tim Quine explained that calculation of sediment erosion for the field at Fishpool Farm in Gwent was complicated by a significant input of Chernobyl ^{137}Cs and he also demonstrated the sensitivity of the erosion calibration to model parameters such as plough depth.

The three presentations stimulated lively discussion on the spatial variation in Cs inputs, Cs association with fine materials and the relative roles of wind and water erosion on arable land. The meeting finished with a visit to the Department's gamma spectrometry laboratory.

Bruce Webb
Exeter University

Table 1 *Rates of erosion and deposition for selected fields in Southern England*

	Brook End Farm Bedfordshire	Dalicott Farm Shropshire	Fishpool Farm Gwent
Gross Erosion Rate (t ha^{-1} year^{-1})	4.0	9.4	8.6
Deposition Rate (t ha^{-1} year^{-1})	1.6	1.7	4.0
Sediment Budget (% redeposition)	39%	18%	47%
Net Erosion Rate (t ha^{-1} year^{-1})	2.4	7.7	4.6

EURO-MEDITERRANEAN NETWORK

The Euro-Mediterranean network of Experimental and Representative Basins (ERB) was initiated over two years ago and now includes participants from nine countries. The network was set up in order to increase collaboration between researchers working on experimental and network basins by various means, including visits and meetings, and to compile an inventory of such basins. If you are interested in the ERB and would like your name to be added to the mailing list to receive future issues of the newsletter would you please contact:

Dr Alan Gustard
Institute of Hydrology
Crowmarsh Gifford
Wallingford
Oxon OX10 8BB
Tel: 0491–38800

REORGANISATION

With all the recent changes at the Water Authorities resulting from the creation of the NRA and PLCs, the Society is aware that many of its members are unsure who is now doing what. We are most grateful to **John Pirt**, Rivers and Regulation Division, Severn-Trent Water for collecting the names, post title and, where possible, responsibilities of key people at the NRA Units.

Organisation	*'NRA Unit' Current Name*	*Address Telephone*	*Principal Sub Offices*	*First Tier Officer Second Tier Officer★*	*Post Title*	*Responsibilities*
Anglian Water	Rivers Division	Ambury Road, Huntingdon, PE18 5NZ 0480–56181	Northern, Lincoln Central, Huntingdon Eastern, Ipswich	Mr. Peter Bullock	Regional General Manager	
				★J.A. Tellow	Regional Manager, Environmental Regulation and Fisheries	Water Resources, Fisheries, Environmental Regulation
				★C. Mason	Regional Manager, Flood Defence and Operation	Flood Defence
				★R. Hyde	Regional Manager, Finance and Common Services	
Northumbrian Water	Rivers Division	Eldon House, Gosforth, NE3 3UD 091–213–0266		Mr. Douglas Rainbow	Regional General Manager	
				★M. Colley	Environmental Water Quality Manager	Water Resources
				★P. Johnson	River Engineering Manager	Flood Defence and Operations
				★A.S. Champion	Fisheries Manager	
				★P. Darling	Business Services Manager	Legal, Finance, Administration
North West Water	NRA North West Unit	New Town House, Buttermarket Street, Warrington, WA1 2QG 0925–53999		Mr. Chris Harpley	Regional General Manager	
				★F. Brassington	Water Resources Manager	
				★J. Leeming	Environmental Quality and Water Pollution Control Manager	
				★P. Walsh	Regional Land Drainage Manager	
				★C.M. Newton	Regional Fisheries, Recreation and Conservation Manager	
				★G. Ager	Administration Manager	
				★M. Maitland	Finance Manager	
Severn-Trent Water	Rivers and Regulation Division	Sapphire East, 550 Streetsbrook Road, Solihull, B91 1QT 021–711–2324	Nottingham, Shrewsbury, Tewkesbury, (Litchfield area)	Dr. Geoffrey Mance	Divisional Manager	
				★A.C. Skinner	Regional Controller – Catchment Management	Water Resources, Catchment Regulation Groundwater
				★R.A. Bailey	Regional Controller – Flood Defence	
				★K.A. Bryon	Regional Controller – Fisheries, Conservation and Recreation	
				★G.M. Woodward	Regional Controller – Environmental Quality	
				★G. Litterick	Regional Controller – Support Services	Legal, Finance, Administration
Southern Water	NRA Division	Guildbourne House, Chatsworth Road, Worthing, BN11 1LD 0903–205252		Mr. Grainger Davies	Regional General Manager	
				★P.W. Herbertson	Resources Manager	
				★G.W. Robinson	Flood Defence Manager	
				★M.J. Beard	Environmental Protection Manager	
				★I. King	Secretary and Solicitor	
				★K.B. Hodgson	Finance Manager	
South-West Water	Rivers Division	NRA Rivers Division, Manley House, Kestrel Way, Sowton Industrial Estate, Exeter, EX2 7LQ 0392–444000		Mr. Gordon Bielby	Regional General Manager	
				★C.V.M. Davies	Environmental Protection Manager	Water Resources, Regulation, Fisheries Flood Defence Operations
				★G.E. Bull	Engineering Manager	
				★Q.L. Gray	Secretary and Solicitor	
				★D.G. Horwood	Finance Manager	
Thames Water	National Rivers Authority Division	Nugent House, Vastern Road, Reading, RG1 8DB 0734–593333		Mr. Les Jones	Regional General Manager	
				★G.W. Philips	Water Resources Control Manager	
				★S. Darby	Land Drainage and Flood Defence Manager	
				★A. Birtles	Fisheries, Recreation and Conservation Manager	
				★I.M. Adams	Environmental Quality Manager	
				★G. King	Finance and General Services Manager	

Organisation	'NRA Unit' Current Name	Address Telephone	Principal Sub Offices	First Tier Officer Second Tier Officer★	Post Title	Responsibilities
Welsh Water	Regional Rivers Division	Plas-y-Ffynnon, Cambrian Way, Brecon, Powys, LD3 7HP 0874–3181		Dr. John Stoner	Regional Manager	
				★A. Gee	Planning Manager	Water Resources
				★D. Walker	Environmental Quality Manager	
				★T. Widnall	Flood Defence Manager	
				★W. Ayton	Regional Fisheries and Conservation Manager	
				★C. Martin	Regional Solicitor	
				★W. Griffiths	Finance and Administration Manager	
Wessex Water	Rivers Division	PO Box 9, King Square, Bridgewater 0278–457333		Dr. Clive Swinnerton	Regional General Manager	
				★M. Booth	Catchment Planning Manager	Water Resources
				★D. Palmer	Catchment Control Manager	Environmental Regulation
				★B. Tinkler	Flood Defence Manager	
				★A. Barber	Fisheries, Recreation and Conservation Manager	
				★N. Reader	Finance and Support Services Manager	
Yorkshire Water	Rivers Division	21 Park Square South, Leeds, LS1 2QG 0532–440191		Mr. Ken Newham	Regional General Manager	
				★R.W.D. Franklin	Water Resources Manager	
				★B. Marsden	Flood Defence Manager	
				★A.M.C. Edwards	Environmental Manager	
				★D.J. Shillcock	Fisheries and Recreation Manager	
				★G.W. Greenlay	Secretary and Solicitor	
				★G.J. Astley	Finance Manager	

GROUNDWATER POLLUTION - Containment or Dilution and Dispersion

BHS Southern Section Meeting 7 December 1988

The common edict "out of sight ... out of mind" is certainly inappropriate when considering the initiatives currently being undertaken by consultancies, research institutions and water authorities to control and manage groundwater pollution. The British Hydrological Society's meeting on "Groundwater and the Management of Chemical Wastes", held last December, provided an opportunity to explore these initiatives and discuss the hydrological aspects of groundwater quality protection.

Willie Burgess (Dames & Moore International) presented the first paper on "Volatile organics in groundwater – an evaluation of remediation case histories". He used a number of case-study examples of groundwater contamination at industrial sites in Europe to illustrate the practical problems of assessing the extent of contamination and of deriving remedial methods. The pollutants causing the contamination at the sites were industrial organic compounds, principally trichloroethane, dichloromethane and dichloroethane. These chemicals are adsorbed to some extent by organic carbon in a soil substrate. The unsaturated zone can therefore constitute a secondary source of contamination since these organic pollutants may be flushed through with winter rainfall. Evidence for this retainment and subsequent release of contamination from the unsaturated zone was found at a site where the vulnerable chalk aquifer was overlain by 30 m of Quaternary sands and clays. Monitoring of the plume relative to the contaminant source revealed the importance of the fracture pattern of the chalk in controlling the direction of the plume. Monitoring over a longer time period produced evidence that the unsaturated zone was operating as a secondary source of contamination. In the summer months the level of contamination of dichloromethane in groundwater declined and subsequently increased with winter rainfall. It is therefore essential when deciding on remedial measures to assess not just the magnitude of loss of these substances to the groundwater system but also the partitioning of contamination between the unsaturated and the saturated zone.

Mr G. Williams (British Geological Survey) described some of the key issues in aquifer protection. He also gave details of the field and laboratory studies currently undertaken at BGS to improve the knowledge and prediction of groundwater pollutant migration. Focussing particularly on waste disposal leachate contamination, he presented the argument for and against the management options of containment and dilution and dispersion. This was a theme which was further developed by the third speaker and discussed more extensively by members during the open session of the meeting. Mr Williams suggested that it is difficult to assume complete containment of contamination with the containment option. The hazard from leachates would always be present at landfill disposal sites unless the toxicity decayed and, therefore, long term institutional control would be required. With dilution and dispersion the hazard is dispersed at low concentrations throughout the rock.

The important factor in selecting a waste disposal management option is to consider site characteristics. Mr Williams illustrated this using the decision matrix given below:

Waste type	Containment site	Contamination	
		Slow release with attenuation	Fast release no attenuation
Inert	Yes	Yes	Yes
Biodegradeable	Yes (1)	Possible (2)	No
Toxic/Persistent	?	Possible (2)	No

Options marked (1) would require a leachate removal or treatment.
Options marked (2) would require a detailed hydrogeological assessment.

At BGS the quantification of biochemical reactions in the saturated zone is being pursued using laboratory microcosm studies, controlled field tracer tests and by the investigation of existing pollutant plumes. Laboratory experiments using columns of material irrigated with leachates are revealing more information on the sorption and mobility of leachates. At Drigg in Cumbria, BGS researchers are investigating the reactions which take place between radioactive tracers and rock using conservative (^{131}I) and non conservative (^{85}Sr) tracers. They are establishing the relative rates of movement of the two types of tracers to determine retardation factors and distribution ratios. The aim is to characterise the hydraulics and geochemistry of the aquifer system and develop a mass transport model to predict the outcome of tracer tests. The results obtained indicate that there is retardation and attenuation of ^{85}Sr activity. Analysing the results using advection and dispersion equations reveals a difference between the predicted and observed outcomes. The difference occurs because of the assumption in modelling methods that the aquifer is isotropic and homogenous but in reality there is aquifer heterogenity. Mr Williams summarised by stating that it is difficult to predict the outcome of relatively simple tracer tests because of aquifer heterogenity, modelling limitations and lack of dispersion parameters. The prediction of landfill leachate movement is even more complex because the waste leachate composition may be poorly defined; large scale studies are required to define acquifer heterogenity adequately and there are complex chemical and biochemical interactions between rock, water and leachate. The assessment of the fate of chemical wastes in the subsurface remains a challenge for the hydrogeologist.

Bob Harris (Severn–Trent Water) presented a paper on the statutory controls and policy aspects of groundwater protection. Both the Control of Pollution Act (Parts I and II) and the EC Directive on dangerous substances (EC/80/68) have generated improvements in waste disposal practice. Water Authorities have also introduced Aquifer Protection Policies and, although these policies have no statutory bearing, they have been influential in promoting the disposal of wastes to less sensitive hydrological environments. Mr Harris outlined the aquifer protection policy of STW, in which four zones are defined according to the importance of the aquifer and its properties (Fig. 1). The zoning policy reflects the attitude of the Authority to development of the areas for waste disposal purposes. In zone 1 no waste disposal is permitted under normal circumstances. The areal extent of this zone is loosely based in the development of the cone of depression. Zone 2 areas coincide with the major aquifers; dilution and dispersion sites are prohibited but artificial containment remains a possibility. Zone 3 covers the minor aquifers; the zoning is designed to protect individual abstractors. There are no objectives to waste disposal in zone 4 areas although the Authority may make recommendations for the protecting of surface water. Severn–Trent scientists are obtaining more information about the presence of layers of drift material, clays and peats, and the nature of soil material in the region. This information will be used to identify the areas most at risk to maximise the protection effort.

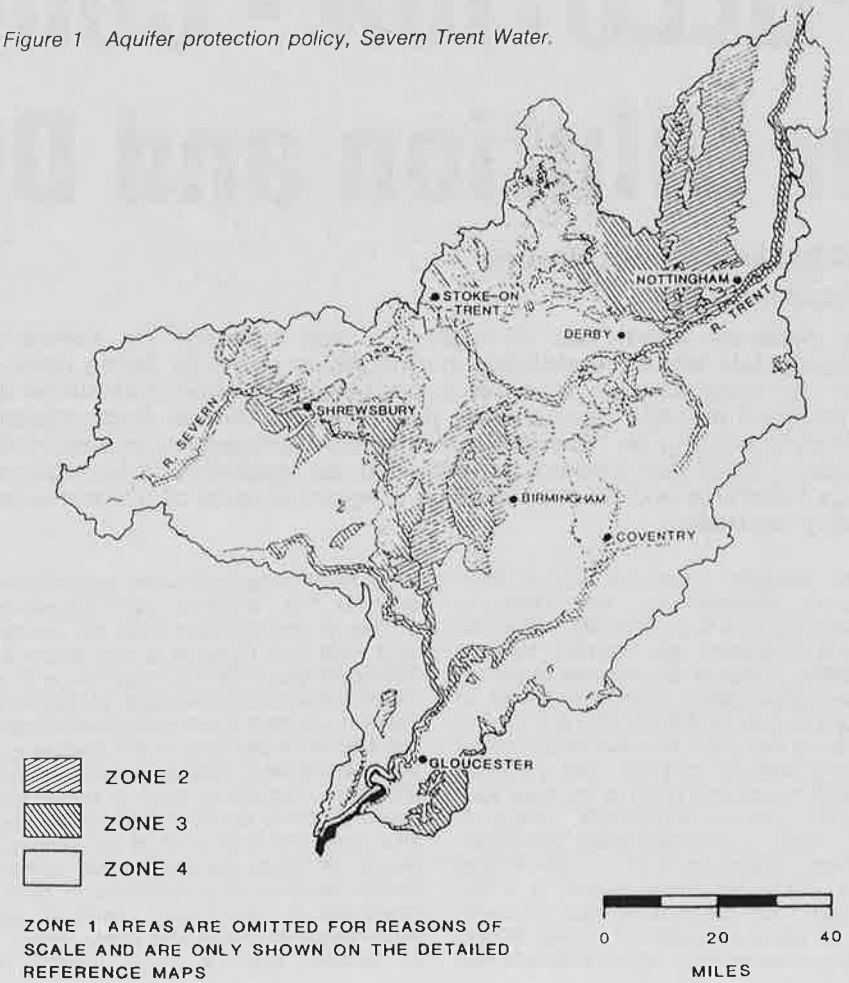
Mr Harris commented on the marked change in waste disposal practice that occurred in the past five years to a policy of containing wastes. The inability to predict attenuation mechanisms was probably one of the underlying factors in this change. Containment sites can have the benefit of enhanced gas recovery but require sophisticated engineering design, careful monitoring and measures to protect surface water resources. The containment of wastes in a dry state, utilising liners and caps, is a preferred disposal option for the Water Industry. However, problems arise at the present time because of lack of aftercare provision once the operator has handed in the licence. The Government intends to introduce additional legislation on the extension of landfill licensing into the restoration and aftercare stage with the provision for mandatory consultations with Water Authorities.

In assessing the future developments in aquifer protections, Bob Harris suggested the need to focus research on the saturated zone, in particular the assessment of plume development around old disposal sites. More research is needed on the development and use of computer models to aid prediction of contaminant movement. The active involvement of hydrogeologists with engineering design of waste disposal sites and more stringent statutory controls will improve aquifer protection.

It is interesting to note that the recent report for the Department of Environment on "Assessment of groundwater quality in England and Wales" by the consultants Sir William Halcrow and Partners, stressed the need for more funding of research into groundwater pollution. The priorities for research contained within this report echo many of the statements made by the speakers and members attending this meeting. The report also advocates a national strategy for protecting groundwater resources. This would encompass a national aquifer protection policy, tight controls around abstraction wells and a national network of monitoring points.

Kathleen Lacey
Kingston Polytechnic

Figure 1 Aquifer protection policy, Severn Trent Water.



Flood Frequency Analysis of Chalk Catchments

BHS Southern Section Meeting

14 February 1989

This meeting at Imperial College provided an interesting juxtaposition of practical and analytical approaches to flood estimation in chalk catchments.

Peter Midgley from Southern Water, illustrated the main problems of practical flood estimation in Hampshire. In addition to the striking seasonal differences in rating curves due to weed growth, the main problem for the ungauged case seems to be that of catchment area. The reasons for this are twofold. First, the hydrogeology shows that subsurface catchment area is often rather different from the surface catchment area. Second, in terms of the response to rainfall, it appears that runoff in storms arises predominantly from a perched water table in the valley-bottom alluvium and from areas of clay with flints contiguous with this alluvium. Estimated mean annual floods, based on the areas of the catchment which contribute during storms, were shown to perform rather better in the Hampshire catchments than estimates based on the entire catchment area. However, hydrologists beware: Peter also pointed out that in many cases the actual incidence of flooding in these catchments was due to the careless setting or vandalism of hatches and sluices maintained for salmon and trout fishing.

On a more national or indeed European scale, **Nigel Arnell** from the Institute of Hydrology looked again at the Flood Studies Report regional curve for chalk catchments given in Supplementary Report 4. Regional flood frequency analysis techniques were applied to 41 catchments identified by a baseflow index greater than 0.85. The results were very similr to the earlier analysis, although a number of very large floods did stand out. The UK chalk curve was also compared with that from chalk catchments in Belgium and France. The European data show a lower mean annual flood and a steeper growth curve as might be expected from the different rainfall regime. It remains to be seen whether this is an appropriate scenario for climate change over the English chalk.

Pam Naden
Institute of Hydrology

NEWS FROM MEMBERS

Association of Hydrologists of India

Mike Mansell-Moullin has sent the following notes on the Association's annual meeting in October 1988:

One of the Society's important international links is with the Association of Hydrologists of India, whose activities were described recently by **Professor Sarma** in *Circulation* (May 1988). Annual meetings are held and this one was in Visakhapatnam at the University of Andhra. The Association is based on the University's Department of Geophysics, from which Professor Sarma retired recently. Visakhapatnam is on the east coast, roughly midway between Calcutta and Madras, and is a booming city and port.

I first met Professor Sarma in India in 1987 and helped to establish the links between the two societies. Therefore it was a great pleasure for me to be invited to give a lecture at the Association's three-day meeting last October. Having some experience of the practical problems of flood estimation in the sub-continent, particularly dam spillway design floods, I chose as a title "Rare flood estimation; practice, problems, processes and the role of hydrological societies". The intention of the second part was to suggest the important role of such societies. Firstly, by identifying weaknesses in current practice, resolving what can be done to reduce them and then actively promoting the necessary actions. Secondly, by creating a widespread awareness of the advantages of modern practices in hydrology. These activities can have the additional benefit of stimulating co-operation between those practising hydrology and research workers and academics. In India, many of the former are irrigation engineers employed in Central or State Government organisations and inter-disciplinary contacts are limited, due partly to the vast size of the country.

The meetings were well-attended, provoked good discussions and were conducted in a very friendly atmosphere. The hospitality was truly excellent; each day was followed by fascinating performances of traditional music and dancing and open-air dinners under the stars. This may sound rather like a holiday brochure; if it does, apply now for details of the 1989 meeting!

The Seminar was marked by the publication of the first issue of the Association's quarterly "Journal of Applied Hydrology", which is intended to cover all aspects of the subject. Professor Sarma, the enthusiastic editor who is supported by an international Editorial Board, has set a high standard to ensure widespread interest both within and outside India.

On a personal note, having first lived in India many years ago and taken part in a variety of water resources development projects and studies since then, it was a very great honour indeed and pleasure to be made an honorary life member of the Association. In this role, I shall do all that I can to assist co-operation between the Association and the Society. Altogether, it was a memorable occasion.

New Members

We welcome the following new members to the Society:

BEDDING, N.D.	
BILGI, A.	Student
CABRA, J.S P.	Student
PEARCE, J.H.	Student
SEKULIN, A.E.	Water supply planning officer
SMITHERS, H.A. (Dr)	Self-employed consultant
	Hydrologist

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Hydraulic engineering in upland areas
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Branch 'b'
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for the design, operation and management of plans and structures for flood protection and the control of rivers and estuaries.

Branch 'c'
Land and water development
for the development of soil and water resources for agricultural and other purposes.

Branch 'd'
Experimental and computational hydraulics
for mathematical modelling and laboratory investigations in support of the design, management and construction of various hydraulic structures and works.

Branch 'e'
Port engineering
for the planning, design and construction of ports and harbours.

Branch 'f'
Coastal and offshore engineering
study of the physical properties of the sea and the coast and their influence on coastal and offshore structures.

A Postgraduate Course for Hydrologists

The course for Hydrologists is directed towards solving water-related problems of quantity, quality and availability. The growing need for guaranteed supplies of water, and protection from flooding and pollution, imposes heavy demands on hydrological scientists and engineers. Participants study the latest developments in the field and are trained in the use of new methods and techniques. Apart from the study of fundamental transport processes, the course deals with engineering hydrology, which includes aspects of analysis, planning and design.

Awards
Both courses lead to a Certificate of Attendance, Diploma or Diploma with Distinction. *Participants who have obtained the Diploma with good results can continue with the IHE M.Sc. Programme (additional duration approximately 6 months.).*

Admission requirements
For both courses a degree in civil engineering or a related field of science or engineering, with at least three years of practical experience. A good command of the English language is indispensable.

Tuition fee: 5,000 Dutch guilders.

Fellowships
Donors that can be approached for fellowships include various international organizations such as UNESCO, UNEP, UNDP, Food and Agriculture Organization (FAO), World Meteorological Organization (WMO), Commission of the European Communities (EEC), Association of Southeast Asian Nations, International Association of Ports and Harbours, etc. Furthermore, nationals coming from developing countries may apply at the Netherlands diplomatic representatives in their country.

Candidates are always advised to check first with their employer or with their own government if financing for their studies could be provided from local sources, or from training components of development project budgets.

In addition, during 1989 IHE will organize the following

Short Courses

Basics of Modelling Groundwater Flow and Contaminant Transport
from March 6-10, 1989

International Seminar on Port Management
from May 16 - June 23, 1989

Modelling Unsaturated Flow
from May 22-26, 1989

Applied Modelling of Groundwater Pollution
from October 16-20, 1989

For all courses, please contact the IHE registrar for detailed brochures, application forms and further information. Address: P.O. Box 3015, 2601 DA Delft, The Netherlands. Phone: 31-15-784466. Telex: 38099 ihe nl. Cables: Interwater Delft. Fax: 31-15-122921.
IHE in Delft also offers postgraduate courses in Sanitary Engineering, Water Quality Management, Environmental Science and Technology, Transportation and Road Engineering and can organize courses on topics in its areas of competence tailored to special needs, which can then be conducted either in Delft or overseas. IHE assists governments and universities in developing countries in designing and conducting postgraduate training courses. IHE moreover carries out research in hydraulic engineering, hydrology, sanitary engineering, water quality management and environmental management.

CEMP

CENTRE FOR ENVIRONMENTAL MANAGEMENT AND PLANNING

CEMP is a Division of Aberdeen University Research and Industrial Services (AURIS) Ltd. Since 1972 it has undertaken research, training, consultancy and the provision of environmental information services in many aspects of environmental management and impact assessment. CEMP has recently been granted the status of WHO Collaborating Centre. Consultancy and training has been undertaken for a wide range of clients including WHO, UNEP, ILO, the Department of Environment (UK), British planning authorities, public and private companies such as BP Petroleum Development Ltd and investment companies.

Services offered by CEMP include:

- Management and production of preliminary or detailed environmental impact assessments (EIAs)
- Review of environmental assessments and environmental impact statements (EISs)
- Conducting health, social, economic, ecological, visual and risk assessments
- Production of base line studies and environmental monitoring
- Environmental Audits
- Resource and Land Use Planning Studies covering topics such as upland land use management, coastal planning, forestry, conservation, fish farming and waste management
- Advice on legal and administrative aspects of environmental management and assessment
- Guidelines and methods for EIA
- Environmental Information services on all aspects of environmental management and assessment.

CEMP has access to a comprehensive information base, and well equipped environmental laboratories for analytical work, experts in Departments of the University of Aberdeen and the services of environmental experts both in the UK and abroad.

CEMP has considerable experience in organising conferences, workshops and specialised training programmes world-wide for the WHO, EEC, UNEP and national governments. In September for example, there will be an Advanced Study Institute on "Ground Water" organised with Prof. L. Canter, University of Oklahoma to be held at Hotel Il Ciocco, Castelvecchio Pascoli, Northern Tuscany, Italy.

With over 15 years practical experience of environmental management and assessment, CEMP can provide efficient services to a wide range of clients. For further information on CEMP services please contact The Executive Director, Brian, Clark, Centre for Environmental Management and Planning, 48 College Bounds, Old Aberdeen, AB9 1FX, Scotland, UK. Telephone: 0224–272480. Telex: 73458 UNIABN G. Fax: 0224–487658.

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SITUATION VACANT

HYDROLOGISTS/MATHEMATICAL MODELLERS

Due to an expanding worldwide workload we are seeking to recruit high calibre engineers/scientists/mathematicians with a background in water-related disciplines.

The hydrology section is involved in a broad spectrum of work ranging through data collection, interpretation, analysis and evaluation. Central to this work is the use of computers – both for databases and simulation models. The majority of the database systems and mathematical models have been developed entirely in-house and have been used for a wide range of applications. These applications include water resource evaluation and exploitation, river basin management, flood protection and alleviation, urban drainage and water quality modelling.

We are looking for people who are capable of working in a multi-disciplinary engineering environment who feel that they can cope with the challenges of working overseas. Ideally the candidate should have:

— a degree in engineering or related discipline
— a post-graduate degree in hydrology, hydraulic engineering or water resources
— relevant experience.

We are looking for staff with all levels of experience in both hydrology and mathematical modelling and are offering permanent career posts with excellent prospects. Successful applicants will be offered a competitive salary with generous overseas allowances.

Please reply with a CV to:

Rodger Cole
Personnel Director
Mott MacDonald Consultants
Demeter House
Station Road
Cambridge
CB1 2RS

or phone Alison Stuck on 0223–460660 for further details.

FORTHCOMING EVENTS

INTERNATIONAL ASSOCIATION for HYDRAULIC RESEARCH

1989
Programme of Activities
at
The Institution of Civil Engineers
1–7 Great George Street, London

18th May 1989.
"Stochastic hydraulics" – Professor I. Cluckie.
5 for 5.30 p.m.

2nd October 1989.
"Dambreak analysis" – Dr A.I.B. Moffat + two other speakers.
2.30 p.m.

26th October 1989.
"Sediment dynamics".
10 a.m. – 4 p.m.
AGM and Lecture
"Future trends in hydraulic engineering" – Professor Abbott.

23rd November 1989.
"Model studies for the Victoria Harbour"
10 a.m. – 4 p.m.

Courses

COLLEGE on SOIL PHYSICS
9–27 October 1989
Miramare, Trieste, Italy

The aim of the College is to provide participants with a fundamental understanding of soil physical properties and processes. Agronomic and engineering activities such as tillage, water management, soil conservation, fertilization, drainage, irrigation and erosion control require an understanding of the physical conditions and the physical processes in the soil. The College will be in part descriptive and theoretical; special attention will be given to measurement, modelling and practical interpretation and application.

The following topics will be covered:

- Soil and soil properties (intrinsic and variant)
- Soil measurement techniques
- Soil–water (infiltration, irrigation, drainage water balance)
- Spatial variability of soil physical properties
- Erosion processes (wind and water erosion)
- Soil management

The College is intended for students and

professionals with backgrounds in engineering, agricultural and environmental sciences. A working background in physics, mathematics and soils, is required. The College is open to scientists from all countries that are members of the United Nations, IAEA or UNESCO; it will be conducted in English. Participants should preferably have completed several years of study and research after a first degree. The closing date for applicants is **31 August 1989**.

Details from: Prof. G. Ghirardi, International Centre for Theoretical Physics, College on Soil Physics, P.O. Box 586, I–34100 Trieste, Italy.

Meetings

INTERNATIONAL CONFERENCE
on
RIVER FLOOD HYDRAULICS
18–20 September 1990
Wallingford, England

Hydraulics Research will hold an international conference on River Flood Hydraulics at its site in Wallingford. The aim of the conference is to link current experimental and analytical research to the needs of engineering practice. The topics selected for the conference cover areas of international research interest and practical importance with a view to providing a forum for advancing the art of river engineering.

The conference will cover the following topics.

Flood analysis and prediction
- rural and urban flood hydrology
- analysis of flow data
- rainfall run-off relationships
- joint probabilities of flooding
- impact of climatic change

Field data
- experience of historic floods
- flood discharge measurement

Hydraulics of flood flows
- interaction of main channel and flood plains
- effects of meanders
- two-stage channels
- influence of vegetation
- dam break analysis

Sediment transport and morphological effects
- sediment supply to river systems
- sediment transport rates
- cohesive and non-cohesive sediments
- graded sediments and armouring

Physical and numerical modelling
- scale effects in physical models
- comparison of numerical methods
- combined physical and numerical modelling
- application of turbulence models

Engineering design, maintenance and operation of schemes
- case studies
- post project appraisal
- flood forecasting.

Synopses of no more than 3,000 words should be submitted to the organisers as soon as possible, and no later than **31 August 1989**, on an offer of paper form. Each paper should be submitted on a separate form (photocopies are acceptable) available from the Conference Organiser. PLEASE NOTE: the language of the conference will be English and all papers must be written and presented in English. No translation facilities will be provided. Authors will be expected to attend the conference and present their papers themselves.

Manuscripts of 3,000–5,000 words in length will be required by **1 February 1990**. All papers to be presented at the conference will be bound in a Volume of Papers to be distributed to delegates prior to the conference, and they will then be made available for general sale after the conference.

A small complementary exhibition will be held during the conference where organisations can display company literature and associated material.

Further details and enquiries should be addressed to: Ms Jacqueline Watts, Conference Organiser, River Flood Hydraulics Conference, Hydraulics Research Limited, Wallingford, Oxon OX10 8BA. Telephone: 0491–35381. Telex: 848552. Fax: 0491–32233.

INTERNATIONAL & TRANSBOUNDARY WATER RESOURCES ISSUES
1–5 April 1990
Toronto, Canada

*** Call for Papers ***

Submission of abstracts is invited for this Joint Meeting of the American and Canadian Water Resources Associations. Topics as related to North American and global water issues are as follows:

The Great Lakes
- levels and flows
- water quality
- policies and programs for management
- shoreline management (erosion control)

Contaminants
- controlled, toxic, and non-toxic
- uncontrolled (spills and lakes)

Climate change (implications)
- the "greenhouse" effect
- sea level rise

Transboundary flows
- surface
- subsurface flow

The commerce of water
- market valuation (supply and waste disposal)
- nonmarket values
- cost of water

Basin management
- international
- interjurisdictional

Groundwater
- use
- recycling and disposal

North American experience in global water management
- technology transfer
- appropriate technology
- training and professional development.

Abstracts (3 copies) of approximately 250 words should be sent to either address below by **1 June 1989** and must include all authors names and their affiliation. Full mailing addresses and telephone numbers of all authors must be included on a separate sheet.

General Editor
Joint AWRA/CWRA Symposium
c/o Ken Reid, CAE
Executive Director, AWRA
5410 Grosvenor Lane, Suite 220
Bethesda. Maryland, 20814–2192, USA
Telephone: (301) 493–8600

General Editor
c/o Mr. Craig Mather
The Metropolitan Toronto and Region Conservation Authority
5 Shoreham Drive
Downsview, Ontario
Canada M3N 1S4
Telephone: (416) 661–6600

Papers will be published for distribution at the Symposium. Each author of an accepted paper should send camera-ready manuscript to the Proceedings Editor no later than **1 November 1989**.

Diary

16th June 1989
BHS National Meeting.
"Prescribed flow, abstractions and environmental protection".
Institution of Civil Engineers

4th July 1989
BHS National Meeting.
"Groundwater recharge" – joint with Hydrogeological Group of Geol. Soc. London.
Venue: Birmingham.
Contact: David Lerner, Birmingham University. Tel: 021–414–6156.

11th July 1989.
BHS South-West Section Field Meeting.
"The Rowden drainage experiment".
2.15 p.m. at IGAP, North Wyke near Okehampton.
Contact: Bruce Webb, Exeter University. Tel: 0392–263334 (futher details will be supplied to SW Section Members and other interested parties).

14th–17th August 1989
BHS National Meeting.
International Symposium on "Hydrological Applications of Weather Radar".
Venue: Salford University, Manchester.
Contact: Ian Cluckie. Tel: 061–736 5843

4th–6th September 1989.
BHS National Meeting.
"Second National Hydrology Symposium".
Venue: Ranmoor Hall, Sheffield University.
Contact: Max Beran, Institute of Hydrology.
Tel: 0491–38800.

Copy Deadline for Issue No. 23 6th July 1989

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