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NEWSLETTER

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IAH-AUSTRALIA PRESIDENT'S MESSAGE

It is now just over three years since the Water Down Under conference was held in Adelaide (November, 1994), when Queensland took over the running of the Australian Chapter of IAH. These years have been ones of considerable work, especially in regard to updating the membership lists to a computer based format, tracking down lost members and attempting to get subscriptions up to date, and producing the newsletter.

We have had continued growth in new membership which is very pleasing. Total members on our list now exceeds 400. However, this growth is countered somewhat by the number of members who are not financial. Many do not realise that they are not up to date, but it is easy to pay late one year and miss paying for the next. A letter to each member who has fees outstanding is being prepared and will explain the situation. We hope to get this all sorted out before handing over the National Executive to the next controlling body. Being current in fees is now an important issue due to the cost involved in producing and mailing the international Hydrogeology Journal, which comes with membership. Because of the interest in this journal from the new year it will go from four to six issues per year.

Sorting out the financial status of each member is now of further importance as the IAH rules were changed at the General Assembly in Beijing in 1996 to require that "membership fees be paid in the year in which they are due. Members are reminded that their membership will be suspended if fees are overdue; this is necessary to contain IAH costs and give an efficient service to the majority of members who pay their fees year by year" (IAH News & Information, Issue C16, November 1997).

There has been much changed in groundwater matters in Australia over these last three years, especially in the structure of State Government (and Federal) organisations. I don't think any have remained unchanged. Similarly, consultancy firms have changed structure, merged, been taken over or redirected their activities. Staff movement has been quite significant, not only within each state but between states. It all goes to show that even in our small part of the world nothing stays the same for long. There is, however, with all of this reorganisation of who is doing what, an increasing awareness of the role and importance of groundwater in Australia. This awareness is also quite apparent in neighbouring countries, in both the Pacific and the southeast Asian region.

I hope to catch up with many members and to be able to discuss these changes at the IAH-Australia Sustainable Solutions conference in Melbourne next February.

This is the last issue of the newsletter which will be produced by our faithful editor Dr Mal Cox. I thank him for all his efforts in this often thankless task. It is the means by which we keep in touch and the IAH would not be as cohesive without it.

Merry Christmas and a happy New Year to all.

John Hillier
President IAH-Australia

Items for Newsletter

This will be the last formal Newsletter from Queensland and this unworthy editor. Members will be contacted in the future by some combination of mail, email and fax with information about future Newsletter and the editor's address.

I would like to thank those people who contributed to the Newsletter, that helped greatly. It did not quite make quarterly status, but I managed to get out 3 in 1995, 4 in 1996 and to just squeeze in 3 in 1997. I also thank Eilish Lalor, Administrative Officer of School of Natural Resource Sciences, for processing the always rushed invoices and accounts for printing of the Newsletter.

Seasons Greetings and the Very Best for 1998

Malcolm Cox
IAH Newsletter Editor

NEWS FROM THE STATES AND TERRITORIES

NEW SOUTH WALES

Local Branch News

NSW Branch of IAH held the annual students night on October 15th. The students night was in fact the inaugural W.H. Williamson Lectures Night in recognition of the contributions made by Bill Williamson to the advancement of the science. Many may recall Bill's pivotal and perhaps pioneering role with the NSW Water Resources Commission and his commitment to strategic planning and development of the state's groundwater resources over a 'lifetime' career. He is currently documenting the history of groundwater in Australia and hopes to publish in the near future. Perhaps a hint of memoirs!

Two students provided excellent presentations to a large attendance:

Boyd Dent:
Do cemeteries pollute ?

Boyd is currently monitoring, testing and consolidating findings from studies of cemeteries in most States of Australia. In view of the high level of response to the study it has been possible to access a wide range of hydrogeological and soil conditions together with climate, cemetery practice and cultural aspects. Boyd provided excellent slide coverage of many of the study sites and framed the problems of scale in evaluating the local hydrogeological regimes. The study has yet to be finalised but should provide benchmark information for future planning.

Shane Schofield:

The origin of sodium bicarbonate waters from the Ballimore region, central NSW.

Effervescent soda water has been known in groundwater water in the Ballimore area, near Dubbo since early this century and for many years was bottled for the Sydney market. Whilst undertaking field mapping of the stratigraphy of the Ballimore area, Wayne's attention was drawn to these waters and their likely origin. He provided some very interesting ideas about the origin of the sodium bicarbonate which characterises these waters.

The evening was a resounding success and reflects the continuing popularity of the IAH bimonthly meetings. Students were awarded a prize of \$50.

Interstate members are always welcome at our main venue, The Rugby Club located near Circular Quay. Dates and topics will be published in the next Newsletter.

The last meeting for the year was held at UTS on Broadway on Tuesday 2nd December.

Topic: Management of coastal groundwater aquifer systems. Ian Acworth

QUEENSLAND

Queensland Branch News

The last meeting for 1997 of the Queensland Branch was held on 11th November 1997 at Queensland University of Technology. The speaker was Jeff Thrupp of Douglas and Partners Brisbane Office. This was an extremely well prepared and presented talk. It was well attended and sparked a great deal of discussion.

Jeff Thrupp

The dewatering and extension of the Dolphin Cove Lagoon Habitat at Seaworld on the Gold Coast.

Dolphin Cove Lagoon Habitat is the largest natural dolphin lagoon habitat created at a marine park. Due to cost and aesthetic considerations, the proposed dolphin lagoons construction involved a non-traditional dewatering/re-injection method in place of the traditional methods of diaphragm wall/sheet piling and dredging. To construct the lagoon via the sheet piling method would have involved divers working under water which would have been expensive and time consuming. Therefore Douglas and Partners produced a groundwater model to demonstrate the feasibility of using dewatering and re-injection to construct the lagoons. The system then had to be designed to ensure that disturbance of the watertable would not cause subsidence of Seaworld Nara Resort or water level changes in the existing dolphin ponds. Areas of interest covered during the talk included production of a groundwater model, dewatering/re-injection system design and groundwater monitoring during the construction phase. The project was completed on time for the Boxing Day rush and at a much lower cost.

Christmas Party

This year the current National President John Hillier and his lovely wife Bernie graciously provided their home as the venue for our annual Christmas Bash. There was a good roll up of Members, Friends, Partners and Offspring from as far afield as St George. All attendees enjoyed ample quantities of food and drink, though I don't know what the neighbours thought when a couple of hundred empty stubbies were carted away clinking loudly in the early morning. On behalf of all the party goers I would like to thank John and especially Bernie for the all their efforts in preparation of the food and for allowing us to invade their home.

Linda Foster
Secretary
Queensland Branch



GENERAL NEWS

Data Structures for Core Groundwater Data in Australia

Do you sometimes get groundwater data where you don't know what half the codes mean?

Are you tired of massaging different data formats from different sources into your groundwater database, before you start on the real work?

When someone asks for your groundwater data, do you give it in a format that they can handle?

Are you establishing a groundwater database, but do not know where to start?

The National Groundwater Committee, with funding from the National Landcare Program, has initiated a project to address these issues. This has led to the recent establishment of a working group to define standards for core groundwater data in Australia.

Understandably, the main groundwater data providers in Australia have established database structures to suit their particular functions and priorities. Likewise, users have set up their particular databases. Data interchange between provider and user is hampered by the current multitude of exchange formats and structures. A generic data transfer standard would bridge the gap between user and provider.

The establishment of standards has many advantages:

- (i) Increased productivity in terms of data access and analysis
- (ii) The possibility of misinterpretation decreases as data is uniformly structured, defined and documented.
- (iii) Proper metadata (data about data) gives the supplier an opportunity to describe the reliability and limitations placed on the dataset.
- (iv) Financial savings will be realised when common data structures allow organisations to share the development costs of support software. The pooling of resources will allow the current rapid technological advances to be realised by a larger audience.

In other disciplines, the cost savings associated with introducing standards-based information management have been significant. The work of the Petrotechnical Open Software Consortium (POSC) is the classic example. Their business model estimates that the adoption of POSC standards has led to a reduction in oil production costs by US\$1-3 per barrel. This may not appear to be much, but when applied to the 1996 Australian production figures amounts to an annual saving of over US\$400 million!

The project will be investigating structures relating to borehole data (location, construction, water levels, chemistry, etc) as well GIS-based spatially mapped datasets (groundwater salinity, aquifer yield, potentiometric contours, etc.) The final product will be a set of guidelines for the storage of groundwater data. This will include standard definitions of core datasets, a database structure for source borehole data, data types and attributes for GIS-base mapping, metadata standards and data transfer formats.

The working group is interested in your perspective on these issues. For further information, contact:

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HYDROGEOLOGY OF THE GREAT ARTESIAN BASIN MAP AT SCALE 1 : 2 500 000

The map - Hydrogeology of the Great Artesian Basin - at scale 1 : 2 500 000 by M.A. Habermehl and J.E. Lau (Australian Geological Survey Organisation) summarises the hydrogeology and artesian groundwater resources of the Great Artesian Basin and is the result of extensive studies in the Basin by the Australian Geological Survey Organisation (and its predecessor the Bureau of Mineral Resources, Geology and Geophysics).

The map - Hydrogeology of the Great Artesian Basin - at scale 1 : 2 500 000 is the first map of the whole of the Great Artesian Basin. The map was completed by AGSO and was printed during November 1997. It was released during a formal launch by Senator W.R. Parer, Minister for Resources and Energy at a Meeting of the Great Artesian Basin Consultative Council in Canberra on 24 November 1997. Part of the funding for the preparation of the map was provided by the National Landcare Program, administered by the Commonwealth Department of Primary Industries and Energy.

The hydrogeological map comprises the main map, five side maps, a cross-section, a hydrostratigraphic correlation table, five smaller maps and a text summary of the main aspects of the hydrogeology of the Great Artesian Basin.

The main part of the map sheet - Hydrogeology of the Great Artesian Basin - at scale 1 : 2 500 000 is a solid geology map of the sedimentary sequence of the Great Artesian Basin, including Triassic, Jurassic and Cretaceous lithostratigraphic units. Tertiary and Quaternary units are not shown. The map has been compiled and digitised from 160 geological map sheets at scale 1 : 250 000, the general reconnaissance scale geological maps in Australia. These maps were prepared during the 1950s to 1990s, though they are predominantly from the 1960s and early 1970s. The compilation for the present map at scale 1 : 2 500 000 was generalised, and some lithostratigraphic units were combined to suit the scale of the map.

The main map shows the significant aquifers and confining beds, faults, structure contours of the base of the Rolling Downs Group (the main Cretaceous confining sequence), which is equivalent to the top of the main artesian aquifer sequence in the Lower Cretaceous - Jurassic sedimentary sequence. It also shows structure contours (ie. the depths) of the base of the Great Artesian Basin or top of the hydrogeological basement, topographic contours, potentiometric surface contours for the main Lower Cretaceous - Jurassic aquifer, regional groundwater flow directions, locations of flowing artesian springs, boundaries of flowing artesian conditions, total dissolved solids contours, artesian groundwater temperatures, isotope ages or residence times of the artesian groundwater, industrial borefields, pipelines, desalination and geothermal power plants, oil and gas fields and mines using and/or producing artesian groundwater.

Some of the hydrogeological map parameters including the potentiometric surface contours, regional groundwater flow directions, total dissolved solids contours, artesian groundwater temperatures and isotope ages or residence times of the artesian groundwater mainly refer to the upper aquifers in the Lower Cretaceous - Jurassic sedimentary sequence, the Cadna-owie Formation, Hooray, Pilliga and Algebuckina Sandstones, and Gilbert River Formation and their equivalents. These aquifers are the most widespread and the most exploited sources of artesian groundwater. The majority of the flowing artesian waterbores in the Great Artesian Basin obtain their groundwater from these aquifers.

A correlation table shows the hydrostratigraphy and lithostratigraphy of the Great Artesian Basin and its constituent sedimentary basins.

The cross-section from NE to SW follows a major regional groundwater flowline through the Basin, and is compiled from data from waterbores and petroleum exploration wells.

Five inset maps show rainfall, evaporation, runoff and topography, hydrogeological setting in terms of geological basins and fractured rock provinces, depth to basement, extent and boundaries of aquifers and confining beds, total dissolved solids contours, hydrochemical composition of the artesian groundwater and drawdown of the potentiometric surface levels for the period 1880 - 1970.

Five smaller maps show the locations of flowing artesian waterbores, non-flowing artesian waterbores, wire-line logged waterbores (logs acquired by AGSO) and petroleum exploration wells, and the location of the Great Artesian Basin.

The hydrogeology of the Great Artesian Basin is summarised in a block of text printed on the main map.

Copies of the map are for sale at:

Australian Geological Survey Organisation (AGSO) Sales Centre
GPO Box 378
Canberra, ACT, 2601
Australia
phone 02 - 6249 9519
fax 02 - 6249 9982
email sales@agso.gov.au

The price of the map is \$ 25.00

Bibliographic reference of the map :

M.A. Habermehl & J.E. Lau, 1997

Hydrogeology of the Great Artesian Basin, Australia (map at scale 1 : 2 500 000)

Australian Geological Survey Organisation, Canberra ISBN 0 642 27305 7



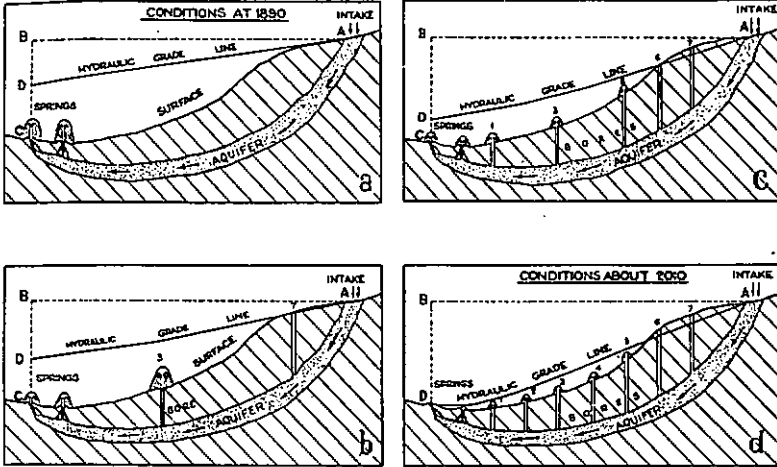
In the past, community and industrial wastes in the Perth region were often disposed of in sandy depressions with no impervious barrier and in wetlands. Fortunately, this practice is no longer permitted. However, there is some evidence that small local groundwater pollution has occurred



The circulation of water in the cycle is relatively rapid, except where the water occurs as groundwater. Groundwater may take hundreds to tens of thousands of years to return to the sea.

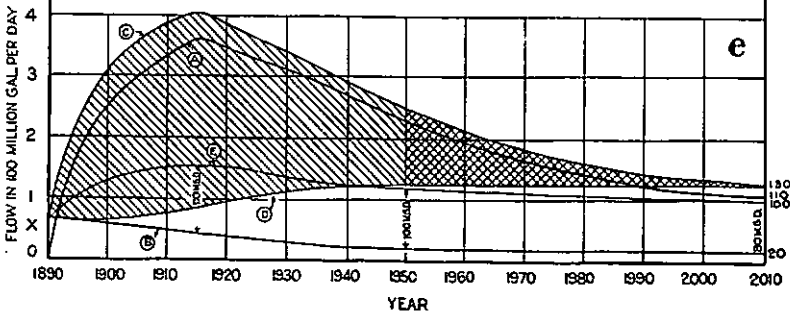
VOLUMETRIC HISTORY OF ARTESIAN BASIN IN QUEENSLAND

CROSS SECTIONS OF TYPICAL ARTESIAN BASIN SHOWING
THE HYDRAULIC CONDITIONS OBTAINING AT SUCCESSIVE STAGES OF DEVELOPMENT.



VOLUMETRIC HISTORY

PARTICULARS.	VOLUME OF WATER (MILLION ACRE- FEET)		
	1890-1950	1950-2010	TOTAL
A DISCHARGE FROM FLOWING BORES.	22.6	12.3	34.9
B OTHER DEMANDS ON THE AQUIFERS, INCLUDING SPRINGS, BORDER LEAKAGES AND PUMPED SUPPLIES.	3.2	1.6	4.8
C=A+B TOTAL DISCHARGE FROM AQUIFERS.	25.8	13.9	39.7
D ACTUAL RECHARGE.	7.5	10.1	17.6
E RECHARGE NECESSARY FOR DRAINS, SPRINGS, PUMPS, AND BORDER LEAKAGES	10.9	8.6	19.5
C-E DISCHARGE IN EXCESS OF MINIMUM REQUIREMENTS	14.9	5.9	20.2
C-D WITHDRAWN FROM ELASTIC STORAGE: SHOWN. 	18.3	3.8	22.1



From a 1954 report "Artesian Water Supplies in Queensland" by the
Department of the Co-ordinator-General of Public Works, Queensland

These projections are rather interesting

An early groundwater investigation

Colin Laing

In 1952 I was stationed at the Kaitake Regional office of the New Zealand Geological Survey. Kaitake was then a small town north of Auckland with a population of 3000. They were short of water despite their low per capita consumption possibly because of the high beer consumption.

The Borough Council had engaged a water diviner who, attended by the mayor in full robes and chain, had determined that an 8 feet wide stream of pure water lay at shallow depth under the town. In desperation the Council's consulting engineer came to us.

My investigation showed the town was located on the side of a gentle basalt cone which lay on impermeable indurated Mesozoic sediments. The present water supply was a number of springs coming out at the base of the basalt. Allowing for evapo-transpiration there was a balance between annual rainfall and annual flow from the springs.

There were 2 bores near the line of the supposed stream. One had been developed by explosives and was used to dispose of septic tank effluent from the post office building. The other was used by the local fish shop to dispose of waste fat.

To counter the divining I made a vertical magnetometer survey of the town which showed a possible buried valley up dip and well away from the supposed stream, but any bore there would have only drawn on stored water.

My report was not well received and I was threatened to be run out of town. They drilled the bore on the diviner's site unsuccessfully and had to accept their consulting engineer's solution of a pipeline from nearby Lake Omapere.

FLUOR DANIEL GTI AUSTRALIA WELCOMES JIM ROUSE

James Rouse is an internationally recognised expert in the behaviour of heavy metals and radionuclides in the saturated and vadose zones. Mr Rouse has specialised in the in-situ contamination control of such material, with over 50 publications on the subject. He is the principal inventor of a technology for the in-situ fixation of chromium in soil and groundwater.

Mr Rouse is a Principal Scientist with over 35 years of relevant experience, both with Federal pollution-control agencies and with consultant organisations serving industry, including mining, electropolating and wood-treating, throughout the United States, Canada and Australia. Jim can be contacted in Fluor Daniel GTI's Brisbane office on 07 3252 5711.

If you have any other enquiries please call Sue Hart, Project Management Assistant

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UNESCO/IHP Groundwater investigations, Lifuka Island, Tonga

SOUTH PACIFIC
APPLIED GEOSCIENCE COMMISSION

This newsletter is published by the
SOPAC Secretariat

Field work in support of one of the two approved UNESCO/IHP projects: "Groundwater Pollution Study, Tonga" was carried out from 28 April to 6 May 1996, on Lifuka Island in the Ha'apai group. The aim of this project is to develop more appropriate guidelines for the safe siting and spacing between pollution sources and groundwater supply facilities. The project is designed to measure travel times and the decay rates of faecal contamination indicators (e.g. faecal coliforms) through the soil profile in the groundwater between sanitation (e.g. latrines) and nearby water supply (e.g. wells) facilities.

Most people on Lifuka are being supplied water by a public system of water drawn from wells placed between villages and the centre of the island. The rest of the population get their water from rainwater catchments. The water from the private wells is being used for non-potable activities such as washing. However, during extended dry spells, when rainwater catchment tanks run dry, the use of the wells increases.

The survey on Lifuka consisted of:

- surveying of wells and monitoring of water levels during severe tidal phases;
- measuring the degree of coliform contamination in private wells;
- preparing plans of the layout of wells and toilet facilities.

- dye tracing and monitoring experiments; and
- investigating the social aspects of water supply and sanitation through the use of questionnaires and personal interviews.

Based on the field work, preliminary results and conclusions are summarised below:

That all private wells were shown to be contaminated in the bacteriological investigation. There are forty privately-owned wells. Ms Bellatrix Tapealava, Tonga Water Board, confirmed during initial discussions that higher levels of total and faecal coliform bacteria counts were found in samples from wells in densely populated areas, and the lowest were found in wells located in remote areas.

Sketching layout plans for the wells and their location relative to potential contamination sources. It was discovered that while a well and a toilet facility were usually the furthest apart on a single property, the next property's toilet facility would sometimes be located very close to the water source of the adjacent property. It seems to suggest that future siting of wells and toilet facilities needed to be planned and co-ordinated at the village or community level.

The investigation of the social aspects showed that while people generally located their toilets far from their houses and kitchens, they based this in physical considerations, such as

smell for example. The concept of groundwater contamination from toilet facilities was not clear to people and therefore never a consideration when determining a site for a toilet.

A church convention was scheduled for Lifuka in the week following the groundwater investigations. This convention could have easily doubled the population on Lifuka, placing considerable stress on both water supplies and sanitation facilities. To alleviate this stress a higher pumping rate pump was installed in one of the public water supply system, which increased the risk of the water becoming salty in a shorter time due to overpumping the groundwater lens. Notably, during the week prior to the convention when people from all over Tonga started to arrive, there was an increase in diarrhoea cases in the hospital.

The reports and results of this project will be finalised after the second half of the required surveys have been conducted in September.

Ulla Mogensen, the SOPAC engineer who was involved in this work and brought you this report wrapped up a year at SOPAC with this activity (more on that next issue).§

Projects to improve water and sanitation conditions on small islands

The UNESCO Pacific hydrological working group met for three days at the SOPAC Secretariat in Suva from 22 to 24 April 1996, to discuss three projects that should improve water and sanitation conditions on small islands.

One study will investigate the safe distance to locate a water well from a toilet discharge. All too often households will pollute their own well water supply by locating their toilet too close to well. An international research team will be carrying out field work and conducting community surveys next week in Tonga (see report on opposite page).

The second project which began in August in Kiribati was to investigate the amount of rainfall that actually enters the

ground to flow into underground aquifers. Little was known about the safe amount of water to be taken from groundwater lenses without introducing salt water into them. This study will enable engineers to maximise the safe removal of freshwater from groundwater lenses without endangering them.

A third study was discussed with scientists preparing a proposal to assess the social and environmental effects of logging methods on watershed areas including lagoon and reef systems using remote sensing and biological monitoring.

The Commonwealth Secretariat also agreed to provide two on-the-job

training fellowships for each study and the WASP group at SOPAC would fund another two.

The results of the research projects will not only assist the countries in which the studies were carried out but any small island with similar conditions.

Other areas of research identified by the group for future funding include rainwater catchment systems and coral island groundwater modeling. The development of closer links with International water-related organisations and the use of appropriate sanitation systems were also discussed. §

Ed Burke

Geochemical Flush/Fix Immobilises Metals Below Tailings Sites

James V Rouse
Fluor Daniel GTI, Brisbane

During the first generation of uranium milling in the 1940s and 1950s, tailings were often placed in the closest natural basin, with little thought to effects on underlying groundwater. Similar attitudes were common with respect to acid-producing mine waste. The result was a number of heavy metal and radionuclide groundwater contamination sites.

Removal or capping of the waste material does not address the continuing contamination source formed by mobile metal salts in the soil and bedrock under the facilities. One such uranium tailing site in North America is now being remedied by Fluor Daniel GTI through a program of geochemical flushing and fixation. For almost 20 years, the mill had disposed tailings into unlined ponds formed by blocking existing drainage channels. The tailings were subsequently moved to a double-lined impoundment; however, a reservoir of uranium and molybdenum salts remained in the fractured bedrock underlying the old disposal area. These salts served as a continuing source of metal contamination to groundwater due to leaching by infiltrating precipitation. If not addressed, it would take hundreds of years for these salts to have been adequately flushed or fixed by natural attenuation.

The regulatory bodies issued an order requiring the flushing of the salts by the injection of fresh water. Testing by another consultant demonstrated that this approach would have required several decades. Recognising the limitations of the water flush approach, Fluor Daniel GTI recommended coupling flushing with an innovation in-situ geochemical fixation process, which is expected to reduce the metals concentrations to acceptable levels within 5 years and permanently restore water quality.

In-situ geochemical fixation introduces a non-toxic chemical reductant into the subsurface in the flushing solution. When the uranium and molybdenum react with the reductant, residual salts are chemically altered to less-soluble minerals. As a result, the metals are permanently 'fixed' in the bedrock, and no longer serve as a source of contamination.

To demonstrate the effectiveness of in-situ flushing and fixation at the tailings disposal site, Fluor Daniel GTI developed and implemented a pilot testing program. The project team first evaluated various chemical reductants through laboratory testing, and selected a non-toxic polysulfide solution. Fluor Daniel GTI has subsequently applied for a US patent on the use of polysulfide for in-situ metals fixation.

In a pilot test, an infiltration test pit was constructed and the subsurface below and adjacent to the pit instrumented with clusters of pressure/vacuum lysimeters and piezometers to allow monitoring of water quality in the vadose and saturated zones. Reductant solution was added to the 10 square metre infiltration pit at a rate of only 2000 litres per day. Within three months the uranium and molybdenum concentrations in the groundwater declined by 86 and 71 percent respectively, with even greater declines in the concentrations of vadose zone fluid. Six months after the end of the infiltration test, there was no evidence of uranium or molybdenum remobilisation, proving the permanence of the remedy.

Based on these test results, Fluor Daniel GTI successfully negotiated with the regulatory authorities to implement an alternative remedy. The project team designed a system of 14 infiltration cells to remediate the first 4 hectares of the highest metals concentration. The area will be expanded in a leap frog approach as areas are remediated, recognising limitations formed by water supply. The estimated time for remediation of the entire 60 hectare area is estimated to be less than 5 years.

Fluor Daniel GTI implemented the final remedy in less than 1 year, from concept through testing, design, and construction start. The system is currently operating and nearing completing of the first 14 cells.

Two members of the project team are currently located in the Fluor Daniel GTI office in Brisbane. For additional information, contact
Jim V. Rouse: tel: (07) 3252 5711 email: briadmin@gta.com.au

Australian Drilling Manual

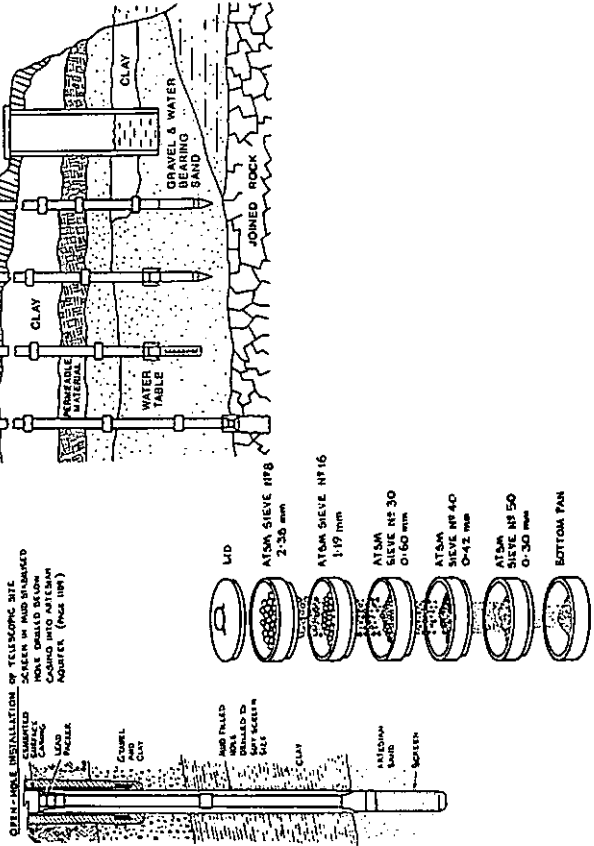
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 PO Box 1545
 Macquarie Centre
 NSW 2113
 AUSTRALIA

Phone: (02) 887 1077
 Fax: (02) 888 2078

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SOFTWARE

GAEA Environmental Engineering Ltd Software Demos

We take pleasure in announcing the opening of our new web site at:
<http://www.osha.igs.net/~gaea>

At this site you will find information and free demos for the following software:

WinLoG - This program can be used to quickly and easily create, edit, and print all types of borehole logs. Formatting for each log is controlled by a template, which can be easily changed.

POLLUTEv6 - This program can be used for fast, accurate, and comprehensive contaminant migration analysis. The program implements a "one and half dimensional" solution to the advection-dispersion equation.

MIGRATEv9 - Using this software contaminant transport from multiple sources, either at the surface or buried, can be modeled quickly and accurately in two dimensions.

Please browse this site, we would appreciate your comments and suggestions.

Michael Fraser
GAEA Environmental Engineering Ltd.
44 Canadian Oaks Drive, Whitby, Ontario
Tel: (905) 725-4487 Fax: (905) 725-9657 E-Mail: gaea@osha.igs.net

Parallel PEST

Watermark Computing would like to announce the arrival of Parallel PEST, a version of PEST that can distribute model runs across a PC network of the type found in just about any office environment.

Parallel PEST is a version of the model-independent parameter optimizer, PEST. Because PEST communicates with a model through the model's own input and output files, PEST can be used in the calibration of any existing model. It implements a particularly robust variant of the Gauss Marquardt Levenberg technique, running a model as many times as it needs to until the fit between selected model outputs and corresponding field data is reduced to a minimum in the weighted least squares sense. It achieves this fit by adjusting selected model inputs/parameters as identified on one or more input files.

PARALLEL PEST allows a PEST user to distribute model runs across a PC network. This reduces overall PEST optimization time enormously, making it possible to calibrate large and complex models for which application of nonlinear parameter estimation techniques would have hitherto been considered impossible.

For more information on PEST and Parallel PEST see the following web pages, which include descriptions and an example of the use of Parallel PEST in calibrating a complex recharge/groundwater model:-

www.ozemail.com.au/~wcomp

Dr. John Doherty
Watermark Numerical Computing
336 Cliveden Avenue
Corinda 4075

Phone: +61 7 3779 1664
Email: jdoherty@gjl.com.au

Geology of Australia

Mark Warne, School of Earth Sciences, La Trobe University
mwarne@mojave.la.robe.edu.au

Geology of Australia is an introduction to earth sciences and a comprehensive illustrated guide to the geology of Australia.

Facilities and capabilities of the package

This hypermedia package consists of two CD-ROMs. The package is essentially a digital text book. The content is organised into six sections as follows: 1. Introduction to Earth Sciences; 2. Minerals and Resources; 3. Topographical and Geological Maps; 4. Geological Time; 5. Principle Geological Features; and 6. Geological Atlas. Each of these sections is divided into a number of subsections. For instance the introduction to Earth Sciences section is subdivided into forty-three topics each of which has a number of accessible screens ("electronic cards") which are portrayed on the computer screen as a sequence of labelled files. These can be individually selected by clicking on file labels. Most screens consist of text and images. Highlighted key words in the text can be selected for additional information. Images can be individually selected to give an expanded view of diagrams and photographs as well as additional information in the form of text notes. Navigation from one topic to another within this particular section is facilitated by scrollable text boxes listing related topics to the selected topic in view on the computer screen. Other sections include video, digital gazetteer and some simple interactive maps and graphics. Operational and image design varies between sections.

System Requirements

IBM-compatible PC (486 or higher), *Microsoft Windows 3.1* or higher supporting 640x480, 256-colour SVGA, 4Mb RAM, 6Mb free hard disk space, Mouse, CD-ROM drive, sound card and speakers or headphones.

Ease of use

Once installed the program is easy to use as it adopts a mostly conventional hypermedia approach which includes "buttons", "scroll bars", "drag bars" or "hot text" to navigate through aspects of the program.

Suitability for use in teaching

This software is suitable for a self-paced, theoretical, learning program for students on introductory geology, although it does not have a stand-alone teaching and learning structure. The program has a number of additional resources such as digital Geological Atlas that may be usefully compiled into a broader teaching materials framework of a conventional course on Introductory Geology.

Area of application and intended users

Clearly this program does not substitute for an Introductory Geology course that is designed as the initial part of an university undergraduate program leading to the training of professional geologists as it is not suitable for teaching students practical or field skills. However the program may be used as a part substitute for theoretical aspects of lectures on Introductory Geology. The program would be especially useful for non-professional geoscientific oriented education programs at a senior secondary school or first year university level.

Coverage of material

The computer program gives an acceptable coverage of topics common to lecture programs for Introductory Geology courses, although aspects of Structural Geology are under-represented.

Accuracy

The information provided in this software package is scientifically accurate.

Overall evaluation

The teaching resource materials of this software are extensive and most teachers of Introductory Geology courses would find the content of these CD-ROMs a helpful adjunct to their courses. At the current price of \$99.00 the product is very good value.

Geology of Australia is available from:
CD Vision
83 Beatrice St
Balgowlah Heights, NSW 2093
Tel: (02) 9948 5540
email: visioncd@ozemail.com.au

TRAINING AND SUPPORT

SPONSORSHIP OF IAH MEMBERS

Lindsay Furness

After a lengthy process, the Australian National Chapter is now about to sponsor members in neighbouring countries. This has come about through the wishes of members to take an interest in members of the hydrogeology fraternity in our near-neighbour countries of the south Pacific and south-east Asia.

Until this move by the National Committee, the IAH Secretariat in the UK has managed all sponsorship arrangements, as applicants interested in obtaining sponsorship contacted IAH directly or were referred by individuals or National Committees. The IAH secretariat welcomed the proposal for the Australian National Committee to focus on its neighbours.

The National Committee established a sub-committee to investigate the mechanism for attracting applicants and guidelines for the selection of candidates. The initial focus on south-east Asia and the south Pacific identified a difficulty with drawing a boundary of influence and would possibly have found far more applicants than our donations would support. Therefore, it was decided to concentrate initially on the south Pacific and, as funds permitted, move to the Indian Ocean states and south-east Asia.

For the first group of candidates to be sponsored, advice was sought from the South Pacific Applied Geoscience Commission (SOPAC). Most countries of the region contained one or two hydrogeologists, with the exceptions of Vanuatu, Solomon Islands, PNG and Fiji.

Sponsorship will be guaranteed for a minimum period of three years, unless the candidate volunteers to resign or moves out of the field of hydrogeology. Preference will be given to persons actually practicing in the field of hydrogeology and they will be encouraged to distribute materials provided by IAH to other persons in their country, through placement in libraries. The newsletter is to be sent regularly to these people and we would like individual members or State Committees to correspond directly with them.

The people invited received a welcoming letter for the president of the IAH Australian National Committee and were asked to regularly communicate, to describe themselves and their work. These letters will be published through the Newsletter. The follow list contains the names of members for sponsorship under these arrangements. Sponsorship will commence in 1998 and be supported by IAH Australia for a period of three years.

Mr Malakai Finau
Hydrogeologist, Mineral Resources Department
SUVA, FIJI

Mr Christopher Ioan, Hydrogeologist, Department of Geology, Mines and Water Resources
PORT VILA VANUATU

Mrs Baranika Kamaie, Hydrogeologist, Ministry of Works and Energy
TARAWA KIRIBATI

Ms Elizabeth Michael, Geological Survey of Papua New Guinea
PORT MORESBY PAPUA NEW GUINEA

Mr Ben Parakoti, Director of Water Works, Ministry of Works, Environmental and Physical Planning, RAROTONGA COOK ISLANDS

Mr Amataga Penaia, Headworks Engineer, Western Samoa Water Authority
APIA WESTERN SAMOA

Mr Donn Tolia, Director of Geology, Ministry of Energy, Water and Minerals
HONIARA SOLOMON ISLANDS

CONFERENCES

1997 CMTW MEETING BATH UK

Some 43 people attended the meeting of the Commission on Mineral & Thermal Water of the IAH at Bath, UK from 4 to 8 October 1997. Bath has a thermal spring which has been utilised since pre-Roman times. By the 1980's it was highly polluted and dangerous to use. As part of the restoration of the Roman Baths, Dr Geoff Kellaway considering the spring was related to a major fracture system, had an angle hole drilled tapping the unpolluted spring water at 500 metres below the surface.

Dr Roger Rolls at the meeting also gave the history of the curative effects of the water from the 300 year records of the Bath Hospital. Dr Ann Heywood reported on research she was doing indicating that bathing in the hot water removed lead from the body. An amusing sidelight of the history was that in the 17th century spectators used to throw things at the bathers, including sometimes dogs and cats! This was before the sedate bathing seen in the Jane Austen films.

Other matters dealt with at the meeting included descriptions of 2 hot rock projects one at Cornwall, the other at Southampton. Both, despite expensive fracturing programs, had permeability problems. I mentioned the use of explosives for fracturing originally in US oilfields but more recently by Mirko Riha in Victoria.

There were papers presented on thermal springs in Hungary, Slovakia, Slovenia, Portugal and Germany. As part of a continuing study on carbon dioxide which the CMTW is conducting I delivered a paper on the origin of bicarbonate in the Great Artesian Basin, referring the relationship between bicarbonate and dissolved carbon dioxide.

As part of the proceedings there were several bus trips particularly to 2 deep limestone quarries which were thought to possibly affect the Bath Spring.

It was decided, after a rash offer by me some years ago to hold the next meeting in Australia. This will be in Ballarat from 4 to 8 October 1998, followed by a bus trip of 6 days to the mound springs at Marree.

A.C.M.Laing and Associates
Consultant Geologists

phone 07 3202 7064
fax 07 3202 7748

POSTAL ADDRESS
3319 Moggill Road
Belberrine Q4070
AUSTRALIA

Meeting of Commission on Mineral & Thermal Water of IAH
at Ballarat University 20 to 24 September 1998, followed by
a 5 day field trip to Flinders Range and Great Artesian Basin
mound springs. Details Rien Habermehl fax 06 249 9970 or Colin
Laing fax 07 3202 7748, or phone 07 3202 7064.

**INTERNATIONAL ASSOCIATION
OF HYDROGEOLOGISTS
INTERNATIONAL GROUNDWATER
CONFERENCE
1998**

Groundwater is a critical resource both globally and in the Australian environment. Adequate protection and management of this resource is critical to ensure its sustainability into the twenty-first century. Through a series of talks, discussions and workshops the conference will be striving for the sustainable use of groundwater resources through their protection and management.

Specific issues to be addressed include the investigation and management of groundwater in salt-affected areas and at contaminated sites, groundwater pollution prevention and the interrelationship between groundwater and the environment.

Hydrogeologists in Victoria have been active in all of these areas, and Melbourne is well placed in terms of the number of investigators and access to field sites.



**International Association
of Hydrogeologists**
AUSTRALIAN NATIONAL CHAPTER

Further enquiries may be made by contacting:

CONVENTION & INCENTIVE SERVICES
Level 2, 370 Glenhuntly Road
Elsternwick VIC 3185
Australia

Tel: +61-3-9523 8290 Fax: +61-3-9528 4046
E-mail: cis@ozemail.com.au

**GROUNDWATER:
SUSTAINABLE
SOLUTIONS**

**University of Melbourne
Melbourne, AUSTRALIA
8-13 February, 1998**

Topics for papers and poster presentations will include:

Salinisation

- Dryland salinisation
- Irrigation salinisation
- Effectiveness of control measures

Groundwater Contamination - Causes, Effects, and Management

- Diffuse pollution
- Contaminated sites
- Landfill disposal
- Groundwater remediation
- Waste water disposal
- Mining

Groundwater - Surface Water Interaction

- Wetlands
- Eutrophication
- Stream baseflow
- Catchment management

Urban Hydrology

Groundwater Sustainability and Planning

- Groundwater resource abuse and management
- Changing demands for groundwater
- Impacts of government downsizing and privatisation
- Groundwater monitoring and reassessment

11th Queensland Hydrology Symposium

10 - 11 February 1998
Griffith University

CALL FOR PAPERS

The Water Panel of the Institution of Engineers, Australia, Queensland Division is organising the 10th Queensland Hydrology Symposium which will be held over two days at Griffith University on 10 - 11 February 1998. It is proposed that those objectives and traditions informally established by the previous symposia be continued so as to encourage an informative exchange covering a broad range of hydrological topics.

Proposals are invited for papers in all areas of hydrology, including: agriculture; forestry; soil conservation; salinity problems; meteorology; water supply; flood control; groundwater; catchment yield; field techniques; computer modelling; automatic recorders; and research reports.

As in previous symposia Authors are requested to prepare one page abstracts - full papers are not required. Symposium proceedings will only contain these documents. It is proposed to allocate 15 minutes for presentations and 5 minutes discussion. This format has been adopted so as to encourage concise and to-the-point presentations, with ample opportunity for discussion. The symposium will include the Queensland Hydrological Games with a prize for the winners, and a presentation for the best paper in the symposium.

The registration fee will be \$180 for two days attendance or \$110 for single day attendance; and one half of these amounts for full-time students. This will include printed abstracts, lunches, morning and afternoon teas, and the symposium dinner with two days registration.

**The deadline for receipt of ABSTRACTS will be Wednesday
31 December, 1997**

Preference will be given to earlier submissions for inclusion in the programme.

Proposed Titles and Abstracts should be sent to:

*Mr John Stasyshyn
The Institution of Engineers, Australia
Queensland Division
447 Upper Edward Street
BRISBANE QLD 4000
or phone (07) 3832 3749*

Enquiries should be directed to the above address or:

Dr John Macintosh (07) 3374 3055

Mr Terry Malone (07) 3864 8839

A requirement of NPER-3 and NEAR requires Engineers and Associates to continuously update their engineering expertise. Attendance at this Symposium would contribute to the continuing education of Engineers/Associates and hence employers should recommend their engineering staff to attend this and other Technical Presentations organised by the Institution.

**INTERNATIONAL ASSOCIATION
OF HYDROGEOLOGISTS**

XXIX CONGRESS 1999

**HYDROGEOLOGY
AND LAND USE
MANAGEMENT**

**Slovak Committee of IAH
Slovak Association
of Hydrogeologists
Bratislava, Slovak Republic
6 - 10 September 1999**

Venue and date

The congress will be held in the Congress
Centre in Bratislava - capital of Slovakia,
from 6 - 10 September 1999.

Registration Fees

The registration fee will be about 530 USD
which will include one copy of the Congress pro-
ceedings.

Marian Fendek
Geological Survey of Slovak Republic
Mlynska dolina 1
817 04 Bratislava
Slovakia

Telephone: +421 7 370 5355

Telefax: +421 7 371 940

E-mail: IAHCONGR@GSSR.SK

Main Congress Topics

1. Legislation concerning exploitation and protection of groundwater.
2. Hydrogeological and hydrogeochemical maps and information systems.
3. Groundwater resources and environmental aspects of the exploitation of these resources.
4. Relationships between construction works and groundwater.
5. Contamination, protection and treatment of groundwater.
6. Groundwater and human health.
7. Mineral and geothermal waters.
8. Groundwater and education.
9. Groundwater and mining.

BNR 3 CONFERENCE

BIOLOGICAL NUTRIENT REMOVAL

Convention Centre, Brisbane, Australia
30 November - 4 December 1997

Biological Nutrient Removal (BNR) technology presents major environmental benefits in the treatment of wastewater, a \$5 billion industry in Australia alone. Natural biological organisms are used to purify wastewater and remove the nutrients of nitrogen and phosphorus, instead of traditional industrial chemicals. As such, BNR is an effective method of removing wastewater nutrients that are responsible for blue green algae outbreaks.

PROCEEDINGS

Published 1997 by

Australian Water & Wastewater Association Incorporated
ARBN 054 253 066

PO Box 388, Artarmon NSW 2064
Telephone +61 2 9413 1288 Facsimile +61 2 9413 1047

in association with

International Association on Water Quality

KEYNOTE SPEAKERS

Difficulties and Developments in Biological Nutrient Removal Technology and Modelling

Education, Training and Technology Transfer: Are These the Same as Wisdom, Knowledge and Information Retrieval?

G Ekama

M Wentzel

K Lindrea

SESSION 1 - MICROBIOLOGY-BIOLOGY OF BNR PROCESSES

SESSION 2 - BNR BIOSOLIDS MANAGEMENT

SESSION 3 - MODELLING AND SIMULATION

SESSION 4 - OPERATIONAL EXPERIENCES

SESSION 5 - OPTIMISATION AND RETROFITTING

SESSION 6 - ALTERNATIVE METHODS AND STRATEGIES

BNR is good for the environment and cost effective. As a result, it is one of the fastest growing technical areas in pollution control and treatment of wastewater in the world. There are now 27 Australian plants using BNR technology, with a particularly high concentration of plants in south east Queensland.

Selwyn McFaul
Chairman, BNR3 Organising Committee
Ph: 07 3244 9600

**MEMBERS MOVEMENTS
and
NEW ADDRESSES**

NEW MEMBERS

We are pleased to welcome the following new members recently accepted into the IAH.
Congratulations.

Mr J Bean	QLD	Mr E Briese	QLD
Ms K Ivkovic	ACT	Mr N Jones	NSW
Mrs C Kennedy	WA	Mr J Keys	QLD
Mr S Kumarapeli	VIC	Mr D Larsen	QLD
Mr D McKibbin	NSW	Mr R Neivandt	QLD
Mr A Newman	QLD	Mr M Pillai	VIC
Mrs M Preda	QLD	Ms P Severn	WA
Mr S Vhora	NSW	Mr S Wright	WA

IAH BADGES

The secretary Robert Ellis, still has some international IAH metal pin badges.

This attractive badge is now available for only \$5.00.

This badge will identify you as a member of IAH International.

You will look and feel more distinguished when you wear it.



**PLEASE BE SURE YOUR FEES AND
ADDRESS/CONTACTS
ARE UP TO DATE**

**if not soon you will stop receiving
Hydrogeology Journal**