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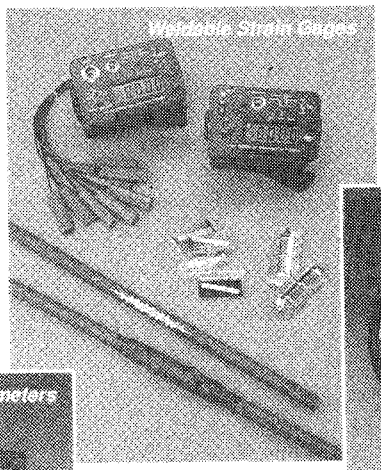
N.Z. GEOMECHANICS NEWS

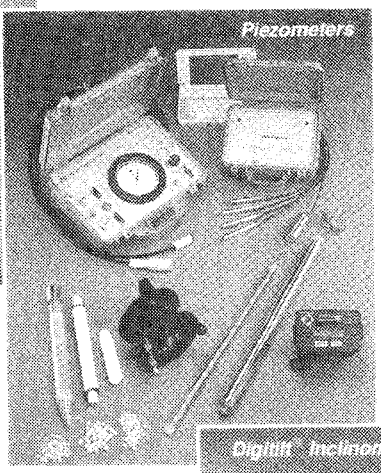
No. 41

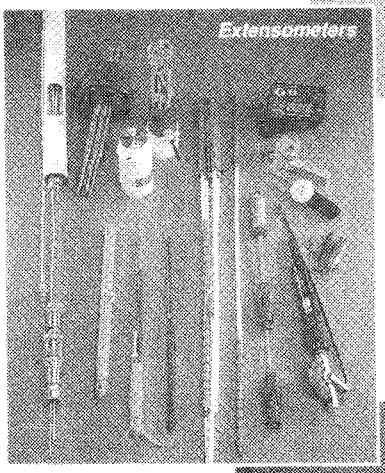
DECEMBER 1990

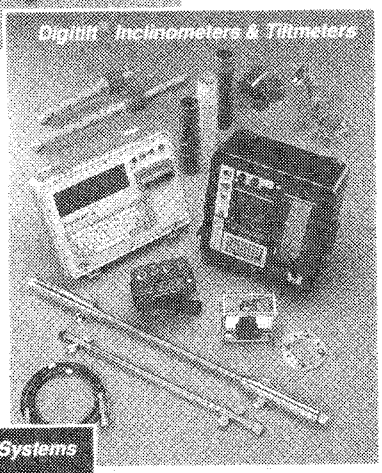
A NEWSLETTER OF THE N.Z. GEOMECHANICS SOCIETY

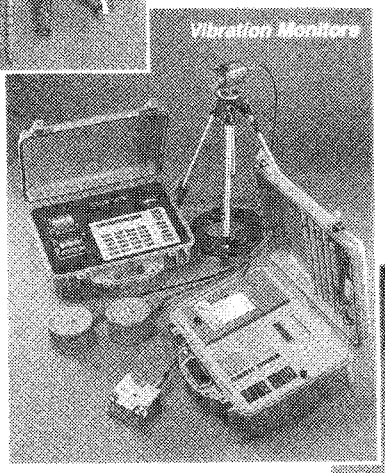
Instrumentation for Soil and Rock

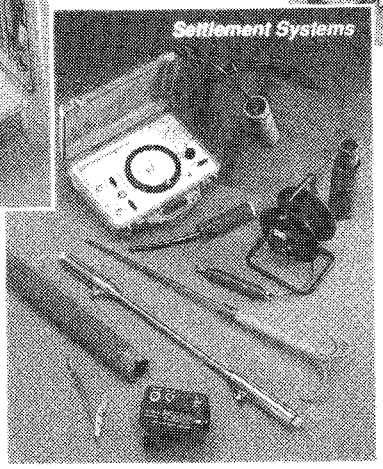












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NZ GEOMECHANICS NEWS
NO. 41, DECEMBER 1990

A NEWSLETTER OF THE NZ GEOMECHANICS SOCIETY

CONTENTS

THIS IS A REGISTERED PUBLICATION

"NZ Geomechanics News" is a newsletter issued to members of the NZ Geomechanics Society. It is designed to keep members in touch with recent developments. Authors must be consulted before papers are cited in other publications.

Persons interested in applying for membership of the Society are invited to complete the application form at the back of the newsletter. The basic annual subscription rate is $25.00 and is supplemented according to which of the international societies, namely Soil Mechanics ($10.00), Rock Mechanics ($12.00) or Engineering Geology ($25.00) the members wishes to be affiliated. Members of the Society are required to affiliate to at least one International Society.

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EDITORIAL

Since our last issue, the country has voted in a new government. This may or may not have an impact on the fortunes of our profession and members of the society but a factor of particular significance was the size of the "green" vote. We, as engineers of the earth, must be sensitive to this increasing awareness of the environment, and we can certainly have a direct influence on one of the prime components. Our recent symposium on groundwater is particularly relevant in this respect. Engineers do not have a good image in the eyes of the more extreme conservationists. But this is clearly unjustified! Most engineers, and geotechnical engineers in particular, are concerned with engineering to maximise benefit to nature and humanity. But all engineering is compromise, and some minorities may perceive an adverse impact on their own areas of interest. An adverse impact may be either economic (i.e. extra costs) or may be damage to some sector of the "environment" - but usually not both. When trying to minimise the adverse impacts, we must not confuse moral issues with environmental issues. For example, there are many against Nuclear Power and some of them may refuse to work on such a project. They would surely not be justified in this stance because it is the possible adverse environmental impacts which they abhor, not the principle. They would be contributing more to our world by saying that they will work on the project but will engineer it to minimise the environmental damage. On the other hand, what should be the response to the prospect of (say) the design of a gas chamber? That is a moral issue!

The Editor of Geomechanics News would welcome correspondence and debate on the above proposition.

Furthermore, readers are reminded that NZ Geomechanics News is a newsletter. We seek contributions of any sort for future editions. The following comments are offered to assist contributors:

- Technical contributions can include any of the following:
  - Technical papers which may, but need not necessarily be of a standard which would be required by the international journals and conferences,
  - Technical notes,
  - Comments on papers published in Geomechanics News,
  - Descriptions of geotechnical projects of special interest.
- General articles for publication may include:
  - Letters to the NZGS,
  - Letters to the Editor,
  - Articles and news of personalities.

Submission of text material in camera-ready format is not necessary though typed copy is encouraged. Diagrams and tables should be of size and quality for direct reproduction. Photographs should be good contrast black and white gloss prints and of a suitable size for mounting to magazine format. Authors and other contributors must be responsible for the integrity of their material and for permissions to publish.

Tim Sinclair
EDITOR

****

REPORT FROM THE MANAGEMENT SECRETARY

1. MEMBERSHIP

The society continues to attract an encouraging number of new members. A warm welcome to:

Donald Thomson
Phillip Glassey
Patrick Cheer
Alistair Bramley
David Stewart

We were able to correct a fault in our membership and mailing list procedures thanks to the initiative of one of our recent members. This fault affected members who joined us during 1990.

Administration of the mailing list is carried out on our behalf by IPENZ who do a marvellous job in difficult circumstances. The occasional error is unavoidable so please continue to bring these to our attention.

2. 1991 MANAGEMENT COMMITTEE

Seven nominations were received for the 1991 management committee. It was disappointing to receive insufficient nominations to warrant an election but it was reassuring to have most of last year's committee carry on. We have a busy programme next year and an experienced committee will greatly assist the smooth management of committee affairs.

The 1991 Management Committee is as follows:

Trevor Matuschka	
Graham Ramsay	
Chris Graham	
Dick Beetham	
Tim Sinclair	
Colin Newton	
Colin Newton	
John Sekula	
David Bell	Co-opted to act as convenor ISL conference
Nick Traylen	" " " ANZ "

There is no Otago/Southland representative in this list and therefore the committee is planning to co-opt a member from this area to the committee.

In addition the management committee includes two IPENZ nominees and the executive director of IPENZ. IPENZ nominees historically have provided a link between the society and IPENZ. This link is now provided by the Civil Engineering Advisory Committee, currently chaired by Professor Taylor. For this reason the management committee will shortly propose an amendment to our rules to delete the requirement for IPENZ nominees.

3. 1990 GEOMECHANICS LECTURE

Don Taylor presented the 1990 Geomechanics Lecture in four centres; Dunedin, Christchurch, Wellington and Auckland. The lecture was well receive in all venues. The lecture will be published in Geomechanics News.

Special thanks are due to Don Taylor for his efforts in the preparation and delivery of the lecture and Trevor Matuschka for his efforts in organising and publicising the event.

4. 1992 ANZ AND ISL CONFERENCES

Members will shortly receive the 2nd bulletins for these two major conferences. The ANZ conference is traditionally our largest and most important undertaking, however, in 1992 this will be followed by the International Symposium on Landslides. These conferences will attract a great deal of attention and the publicity will benefit our society. If possible, please support these conferences by preparing papers, helping with organisation and most importantly attending one or preferably both events.

5. BRANCHES

The Otago/Southland branch has been our most active branch in recent times and this region boasts the two towns with the highest number of society members per head of population, Cromwell and Arrowtown. The Clyde Dam reservoir landslides have attracted a large number of eminent visitors many of whom have been able to give an address to the "Cromwell Sub Branch". Dick Beetham has volunteered to provide regular reports on local activities for inclusion in Geomechanics News.

I closed my report for the June issue with the comment "Wrap up warm for winter". Unfortunately the June issue was delivered in spring and I received some interesting feedback. The late delivery was due mainly to the difficulty the editor had in getting copy on time. So with trepidation, I wish you all a Merry Christmas and a Happy New Year.

Chris Graham
MANAGEMENT SECRETARY

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REPORT FROM AUSTRALASIAN VICE PRESIDENT FOR ISRM

This report covers the activities of the International Society for Rock Mechanics since April 1990 and consists principally of matters considered at the Board and Council meetings which were held in Mbabane, Swaziland in September 1990.

1. It was with great regret that the death of the ISRM Secretary-General, Dr Jose Charrua Graca on August 24th was reported.

2. The recipient of the 1991 Rocha Medal was determined but the identity of the recipient must stay confidential until announced by the President.

3. Minor amendments were made to the By-Laws governing the Rocha Medal to ensure that nominations were received well before the relevant Board meeting to allow ample time for judging. Unfortunately attempts to obtain longer synopses in English for theses written in other languages were rejected by Council.

4. The recipient of the Inaugural Muller Award was decided from the three nominations put forward. Professor Evert Hoek will receive this award and give the 1st Muller Lecture in Aachen in 1991.

5. The content of the 1990 Annual Directory was discussed and it was noted that advertising revenue was down for this year. Board and council members were asked to encourage advertising for the 1991 Directory. Submission for the 1991 Directory must be with the secretariat by 31 March 1991.

6. The ISRM Meeting Guidelines were presented, discussed and finally approved.

7. The principle of forming ISRM Policy Statements was examined and it was decided to formulate drafts on the Education, Environment, Communications and Hazard Reduction for 1991.

8. A revision of ISRM Policy Statements was discussed in detail with a view to developing firm recommendations at the 1991 Board Meeting. In the meantime a 20% increase in fees was approved. This was the first increase since 1983.

9. A report of the Aachen Congress Organising Committee was provided. General discussion followed. It should be noted that 11 papers from Australia have been provisionally accepted but it is not known how many are being considered by New Zealand. Final papers are to be submitted by the end of January 1991.

10. The first European Conference on Rock Engineering or "Eurock 1" was selected as the venue for the 1991 Board and Council Meetings. This will be held in England. It may be of interest to note that the only other nomination was New Delhi.

11. It should be noted that nominations for the next ISRM Vice-President for Australasia are required six months prior to the Aachen Congress.

I.W. Johnston
VICE-PRESIDENT FOR AUSTRALASIA

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REPORT FROM THE VICE CHAIRMAN FOR ISSMFE

We have received from the President a request for nominations for the Terzaghi Oration which will be given in New Delhi in 1994.

The next Council Meeting will be held before the 10th European Conference in Florence on Sunday 26 May 1991.

The Secretary-General has enclosed terms of reference and the present list of members for the following Technical Committees:

TC1	Instrumentation, Telemetry and Data Processing
TC2	Centrifuge Testing
TC9	Geotextiles and Geosynthetics
TC24	Soil Sampling

Prof. Fredlund of TC6 Expansive Soils, has written requesting a few slides (photo's) along with a short commentary to depict the problems related to expansive soils. If anyone can help, could they contact the Vice Chairman.

A draft standard on "Evaluation of Swelling Pressure of Expansive Soil in Laboratory" has been received from TC6.

Announcements and invitations have been received from:

Seventh Int. Conf. on Expansive Soils, August 3-5 1992 to be held in Dallas, Texas

Ninth Pan American Conf. on Soil Mechanics and Foundation Engineering, August 26-30, 1991 to be held in Vina del Mar, Chile

Thirteenth Int Conf. on Soil Mechanics and Foundation Engineering, January 1994, New Delhi, India

First Young Asian Geotechnical Engineers Conference, January 1991, Bangkok, Thailand

C.J. Newton
VICE CHAIRMAN, ISSMFE

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REPORT FROM THE VICE CHAIRMAN FOR ENGINEERING GEOLOGY

1. ACTIVITIES OF THE IAEG

The Council of the IAEG met during the Sixth International Congress (of the International Association of Engineering Geology) held in Amsterdam, The Netherlands, from August 6-10, 1990. David Bell (University of Canterbury) attended the Congress and acted as the NZ Geomechanics Society representative at the proceedings.

The main decisions of the Council Meeting and General Assembly, Amsterdam were:

1.1 A new Executive Committee was elected: Ricardo Oliveira from Lisbon, Portugal, is the incoming President and John Braybrooke is the Australasian Vice-President for IAEG*.

1.2 Fees:

The annual fees have been set at:

- National group members without Bulletin 30 F.F.
- National group members with Bulletin 110 F.F.
- Individual members with Bulletin 200 F.F.
- Associate Members with Bulletin 600 F.F.

At the same time, an ad hoc group of four Members of the Executive Committee was nominated to prepare a draft introducing several levels for the annual fees based on a world-wide index (e.g. Gross National Product, Income per Capita). - i.e. the wealthier countries will be expected to pay higher fees than the poorer.

1.3 The Council wishes to publish a new list of IAEG members as soon as possible.

1.4 The Statutes of the Association have been revised (- drafts are available for anyone to see if they wish).

1.5 The 7th International Congress of the IAEG will be held in Lisbon in 1996.

1.6 The "International Decade for National Disaster Reduction". IAEG is involved in two projects presented by the International Council of Scientific Union (ICSU) as:

(i) Leader of the Project called "Instability of Megacities", and
(ii) "Landslides Hazard Mitigation".

Participation of National Groups in these studies is requested!

2. FORTHCOMING IAEG CONFERENCES

International Symposium on Urban Geology: 6-11 May in Tunisia.

Authors should send abstracts of their papers before Dec. 15, 1990. Final papers before March 15, 1991.

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* John Trudinger was the previous Australasian Vice President of IAEG. I would like officially to thank John for his efforts on behalf of the NZ Geomechanics Society and to welcome the new John.

Dick Beetham

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REGISTRATION OF ENGINEERING GEOLOGISTS - UPDATE

The Engineers Registration Act was not repeated during the last session of Parliament. Apparently time ran out and several items of "non urgent" legislation were not passed:

- What is the next step?
- Where to from here?

At present it is uncertain what stance the new Government will take on this issue. There is however, a feeling that they may tighten up the Engineering Registration Act, rather than repealing it! In this case it is imperative that we should make urgent representations to the Council of IPENZ, through the Geomechanics Society and the Civil Engineering Advisory Committee.

Presently about 25 responses have been received to the questionnaire which was included in the last (July, 1990) issue of Geomechanics News. Thank you everyone who took the trouble to respond and for those that haven't - it's not too late if you hurry!

Of these the majority have indicated that some form of "registration" of Engineering Geologists is required, with the great majority favouring membership of IPENZ. This appears to be a clear mandate for action in this direction!

Dick Beetham

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LOCAL GROUP ACTIVITIES

1. AUCKLAND BRANCH

1990 has been a busy and interesting year for the Auckland Branch.

Six formal meetings were held, along with a presentation to a seventh group meeting by Ground Engineering Ltd and Geotechnicsl Instruments Ltd.

The meetings were as follows:

Loma Prieta Earthquake

On 4 April, Professor Mick Pender spoke on the Loma Prieta Earthquake of 17 October 1989. His talk ranged widely, covering geotechnical considerations, public safety measures, post earthquake building inspections and some personal experiences.

Cone Penetrometer Testing

Wednesday, 20 June saw members present for a talk on cone penetrometer testing. Dave Jennings and his team from Works Consultancy in Hamilton discussed various aspects of site investigation using cone penetrometers, and illustrated the points raised using slides and case histories.

Software

On Wednesday, 15 August, a session was held so members could discuss and compare various geotechnical computing software packages and systems.

John Ashby, an independent consultant started the proceedings with a talk and a display on the use of spreadsheets for problem solving, with a focus on probabilistic slope stability analysis.

John Sekula of Beca Carter Hollings & Ferner Ltd (BCHF) then discussed some of the advantages and disadvantages of the software used at BCHF for slope stability analysis, laterally loaded piles, finite element analysis for pavement design and computer logging of borehole records.

Tim Sinclair of Tonkin and Taylor Ltd spoke on numerical modelling, with particular reference to applications in soil-structure interaction. Also covered was an outline of the differences between finite element and finite difference methods, with a brief summary of the strengths and weaknesses of both.

Rob Irwin of Construction Techniques spoke on the design of soil nailing reinforcement using a software package imported from Europe. Case histories were discussed, and a sample design presented.

It is hoped to repeat this session some time in the future because it is a field in which rapid advances are being made.

Ground Engineering Ltd

The only presentation of the year with a slightly commercial flavour was run by Ground Engineering Ltd and Geotechnical Instruments Ltd on 11 September.

Rob Weeks of Geotechnical Instruments Ltd spoke on piezometer construction, installation and use, with specific reference to case histories and field tests, and concluded with a brief foray into landfill gas management.

Members present enjoyed the talk, and the free beers beforehand.

Natural Hazards

The topic for the meeting held on Thursday, 4 October was "Natural Hazards".

Dr Ian Smith of the Geology Department at the University of Auckland spoke on the perils of living on a volcanic hot spot such as Auckland. His talk also touched on aspects of town planning and civil defence.

Dr Trevor Matuschka of Engineering Geology Ltd spoke on seismic tectonic hazard. He began with the tectonic seismic hazard associated with tectonic features in the Auckland Region.

The final speaker for the evening was David Burns of Worley Consultants who spoke on pipelines, in areas of slope instability. Case histories formed the body of the talk, and some interesting features of the planning and construction of pipeline routes were discussed.

Geomechanics Lecture

On 8 November, Don Taylor presented the Sixth Geomechanics Lecture, which had as its title "The Use and Mis-Use of Geotechnology in Civil Engineering"."

Don Taylor drew on his wealth of experience and, as suggested by the title, salient features of some successful and not so successful projects were discussed. The talk contained some important lessons for all people involved in the Geotechnical field and was of interest to a wide cross section of the civil engineering profession. Projects discussed included flood stop banks, piled foundations, urban development on unstable ground, caisson sinking, and hydroelectric canals in pumiceous ground.

Landfills and Groundwater

The final meeting of the year was held on 22 November as a joint meeting in conjunction with the Auckland Combined Water Group, and had as its theme, "Urban Landfills and Groundwater".

Alan Pattle of Pattle Delamore Partners spoke on the proposed Mount Wellington landfill site. Three main areas were covered, being the groundwater regime before pumping at the quarry commenced, the effect of pumping on subsurface hydrology, and some site specific groundwater requirements for the proposed landfill construction.

Wayne Russell of GCNZ Woodward Clyde then discussed the proposed Peach Hill landfill site. Specific reference was made to the effect that geology, existing faults and quarrying have on the groundwater system in existence as at 1990. The effect of the proposed landfill on the groundwater was discussed, along with some conceptual design criteria for the site.

Aidan Nelson of Earthtech Consultants Ltd spoke on the history of synthetic liners with emphasis on leachate containment. The very rapid advances made in this field in recent years were summarised, and the concepts involved in using synthetic liners to minimise leachate leakage were discussed.

Because the meeting was held jointly with the Auckland Combined Water Group (ACWG), some very interesting inter-disciplinary discussion ensued, and the meeting was rounded off with the presentation of the Ron Hicks Memorial Prize to Ian Gunn for his paper on Onsite Wastewater Disposal Systems.

Two sessions this year were joint meetings between the Auckland Branch of the New Zealand Geomechanics Society and the ACWG. Branch members were invited to attend a meeting on 12 July convened by the ACWG to hear about the Boston Effluent Outfall Project. This sort of inter-disciplinary communication can only have a positive effect for the profession.

The Branch approaches 1991 in a strong position, having had a varied and busy year, and thanks must go to the convenors of the sessions and other persons who worked hard to make it all happen so successfully.

Tony Henderson
BECA CARTER HOLLINGS & FERNER

2. WELLINGTON BRANCH

The Wellington Branch of the Geomechanics Society held a meeting on 8 August 1990 at the IPENZ rooms in Molesworth Street. Four international consultants were in the city and each gave a fifteen minute presentation at the meeting on projects with which they had been associated. The consultants were, Mr Jim Libby, Dr Don Deere, Mr Bill Swiger and Dr Reimer. Each of the consultants has a vast experience in the fields of engineering and geology which totalled in excess of 160 years. A summary of each presentation is given below.

The meeting was a combined NZGS, IPENZ Wellington Branch and NZSOLD evening and was well attended.

Dr Deere's presentation was on the Bath County, Virginia, Pumped Storage Scheme. It is the world's largest pumped storage scheme with six machines capable of 2,150 MW and is used as a peak load station.

It comprised three intakes and horizontal tunnels which bifurcate into six penstocks near the power house. The design of the pressure tunnels was unreinforced concrete except at bends and the bifurcation, with steel pressure pipes where ground cover was less than forty percent of the water head.

High strength concrete was used for the lining and as a result high heat of hydration during curing was experienced. Temperature cracks resulted and poor joints were formed at the steel and concrete connections.

During the initial filling of the tunnels, leakage into adjacent tunnels and springs on the ground surface were reported.

The drainage system was extended and a total of 1,400 drainage wells and additional piezometers were installed. Remedial grouting was also undertaken, this requiring over 90,000 bags of cement.

Upon refilling, leakage continued in large quantities. The leakage flows varied from 25 l/s in January to 75 l/s in July. The tunnel water temperatures were found to vary between 4° in January and 24° in July. It was found that the lining cracks were opening during the colder temperatures and closing as the water temperature rose. The rock at the site was found to have insitu stresses in the vertical and one horizontal direction close to the overburden pressure, but the stress in the other horizontal direction was found to be very low. Packer tests resulted in high water loses at low pressures in this one direction and it was found that when the test was concluded, all the water which was pumped into the test section was returned to the pump tank.

To avoid draining the penstocks, a robot was built to be used to inspect the penstocks. It is fitted with a video camera and capable of performing a number of tasks such as releasing dye in specific locations. This has been used to confirm leakage locations during cold weather and the reduction experienced at higher temperatures.

Mr Jim Libby spoke on the Moore Sheppard Dam in Texas. The dam was a slab and buttress dam (43 buttresses at 40' centres) which began service in 1941. It is 180' high. During a routine inspection, cracking of the spillway slabs between buttresses 15-26 was discovered. Piezometers installed beneath the spillway slab recorded a head 85% of reservoir level. The factor of safety against sliding was determined to be at unity under this condition. The lake was drawn down four metres which increased the factor of safety by 15%.

The remedial works comprised draining the foundation and adding ballast to the dam to achieve the required factors of safety. The constraints to the work consisted of no access under the spillway slab, and the tailwater level could not be lowered due to the low factors of safety.

The access upstream of the spillway slab was gained by cutting 2.4 m diameter holes through the buttresses above tailwater. Prior to the installation of the aggregate, construction debris and fine materials were removed from the flooded bays.

Relief wells, 200 mm in diameter, were installed in the foundation. One well made a direct connection with the upstream reservoir and was difficult to control. Problems were also experienced with the lake sediments migrating through the foundation and clogging the wells and reducing their effectiveness after a very short time. The upstream cutoff wall at the toe of the dam was found to be cracked and displaced 20 mm. The crack was successfully grouted under 130 metres of water head.

The works to date consisted of the placing of 93,000 t of aggregate, 146 relief wells, 132 piezometers, 16 extensometers and 10 inclinometers. The completed remedial works require the placement of 150,000 t of concrete to bring the factor of safety against sliding up to 1.75 which has been agreed, with federal agencies, as an acceptable level in this situation.

The cause of the problem has been identified as the removal of passive resistance at the toe of the dam by erosion and the lower than adopted friction angle of the foundation materials.

Dr Riemer's presentation was on the Ataturk Dam and dams downstream, in Turkey. It is a very large conventionally designed rockfill dam with a crest width of two kilometres and requiring about 85 million cubic metres of fill.

The site of the dam is in an area which has undergone extensive faulting in the past and this has created significant foundation problems for the project. The Ataturk dam is located on a karst landscape and significant problems are anticipated with the dissolvable nature of the limestone under the high lake heads.

Significant amounts of grouting and drainage drilling has been undertaken to protect the structures from uplift pressures. Lake filling has already commenced and significant leakage problems into the downstream excavations have already been observed.

Downstream of the Ataturk dam is another major dam with large active landslides on its reservoir. One landslide is currently moving at 0.5 m/yr and is currently under investigation. It is large enough to block the reservoir and also has several villages located within its boundaries.

The oldest dam in the series has a similar karst foundation and the estimated leakage loss from the dam is estimated to be 20 m^3/s with springs exiting up to 24 kilometres downstream of the site.

Dr Bill Swiger has a background with Stone and Webster in design and construction. His presentation was on the James Bay Project in northern Canada where he is on the Review Board for the second phase of the work.

The first phase of the project commenced in 1971 and was completed in 1985. It consisted of three powerhouses, with an installed capacity of 10,280 MW, and 215 dams and dykes. The project is located at the southern end of the Hudson Bay, at latitude 52°, extending 500 km to the east, with a width of 200 km in the north-south direction. In elevation it extends from sea level to 535 m at the highest lake.

The project is located geologically in the centre of the Canadian shield. The rocks are very strong granites with limited faulting. It was the centre of the ice shield during the Pleistocene and as a result of rebound, highly sensitive marine clays (activity > 500) are found up to 100 m above sea level.

There are extensive deposits of glacial tills with lesser amounts of alluvial and large quantities of rock available in the region. Dams are designed with central cores of 0.2H:1V with the core thickness 0.4H.

The overall capacity will be 15,500 MW providing one third of the North American generation capacity.

Colin Newton

3. CHRISTCHURCH BRANCH

Local branch activities this year have been dominated by the organisation of the 6th Australia New Zealand Conference on Geomechanics ("Geotechnical Risk-Identification, Evaluation and Solutions") and the 6th International Symposium on Landslides. Both these conferences are to be held in February 1992. Organising committees for both conferences have been meeting regularly for over 18 months. The ANZ Conference is

chaired by Nick Traylen of Soils & Foundations Ltd, and the ISL conference is chaired by David Bell of the University of Canterbury. The second circulars and call for papers for both conferences are now out, and workloads are becoming high. (It would be appreciated if any members who are able to assist either committee in any way could please contact the chairmen).

Other activities have included a lunch time talk (Geomechanics/Structural) by Guy Evans on the "After Effects of the Newcastle Earthquake in Australia" on 27 June and the presentation by Don Taylor on 6 November of the Geomechanics Lecture on "The Use and Misuse of Geotechnology in Civil Engineering".

Nick Traylen

4. CROMWELL GROUP

A relatively large group, numbering approximately 30 to 40 geologists and engineers, are now working at the Clyde Power Project office in Cromwell. To make the most of the collected local expertise and the visiting international experts that visit the job, Jeff Bryant has organised a series of information meetings with an invited speaker. These meetings have been held in the relaxed atmosphere of the Victoria Arms Hotel (The Top Pub) or the Project Cafeteria. The speakers so far have been:

(i) Bruce Riddols (of Riddols Consultants, Arrowtown) who talked about a recent visit he had made to Laos to investigate a hydroelectric proposal. Bruce stayed in Laos (Vientienne) for approximately a week and was able to give a first hand account of life in an interesting country which is rarely visited these days.

(ii) Graeme Fairless (of Works, Cromwell) gave a very interesting talk on life in Papua New Guinea where he lived and worked on a roading construction job for about 2 years.

(iii) Prof. David Stapleton (of NSW, Australia) spoke about a large sewerage job he had advised on in Australia. Sites for very large shafts (30 m diameter, 60 m deep) were investigated and excavated through sediments, ash and flat lying basalt flows. Due to good co-operation by the local geologists and engineers, few unexpected conditions were met during the excavation and support of the shafts.

(iv) Laurie Richards (of Golders, London) gave a very informative, and instructive talk on underground cavern (powerhouse) investigation, design and construction. The talk was liberally illustrated with examples of actual jobs on which Laurie has worked.

Dick Beetham

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PUBLICATIONS OF THE SOCIETY

The following publications of the Society are available:

(a) From the Secretary, IPENZ, P.O. Box 12-231, Wellington North:

- Proceedings of the Palmerston North Symposium "Geomechanics in Urban Planning", April 1981. Price $20.00
- "Stability of House Sites and Foundations - Advice to Prospective House and Section Owners". (Published for the Earthquake and War Damage Commission). Price $0.50.
- Proceedings of the Third Australia-New Zealand Conference on Geomechanics, Wellington, May 1980. Price $20.00 for the three volume set to members, $30.00 to non-members.
- Proceedings of the Second Australia-New Zealand Conference on Geomechanics, Brisbane, July 1975. Price $25.00
- Proceedings of the Wanganui Symposium "Using Geomechanics in Foundation Engineering", September 1972. Price $8.00 to members, $10.00 to non-members.
- Proceedings of the Alexandra Symposium "Engineering for Dams and Canals", November 1983. Price $40.00 to members, $50.00 to non-members.
- Copies of all back-issues of "New Zealand Geomechanics News", are available to members at a nominal price of 50 cents per copy plus 50 cents post and packaging per order.

Note: To reduce stocks, all the above publications costing over $10.00 will now be sold at 1/2 price - while stocks last!

(b) From Government Bookshops and the Secretary IPENZ:

- "Slope Stability in Urban Development" (DSIR Information Series No. 122). Price $2.00. (Also available from Government Bookshops).

The following publications of the Society have been sold out:

- Proceedings of the Nelson Symposium "Stability of Slopes in natural Ground", 1974.
- Proceedings of the Wellington Workshop "Lateral Earth Pressures and Retaining Wall Design", 1974.
- Proceedings of the Hamilton Symposium "Tunnelling in New Zealand", November 1977.

(c) Newer publications, also available from the Secretary, IPENZ>

- Proceedings of the Hamilton Symposium Piled Foundations for Engineering Structures, September, 1986. Price $20.00 to members, $25.00 to non-members.
- From the Institution of Engineers, Australia, Guidelines for the Provision of Geotechnical Information in Construction Contracts. A 20-page booklet. Price $10.00

Dick Beetham
PUBLICATIONS OFFICER

****

FORTHCOMING CONFERENCES

1. INSTITUTION OF PROFESSIONAL ENGINEERS NEW ZEALAND CONFERENCE AUCKLAND 10-13 FEBRUARY 1991: THEME 'CHOOSING THE FUTURE'

The Institution is holding its Annual Conference in Auckland in February 1991. This article is prepared in order to inform possible attendees of what is going to be presented and to encourage Engineers from all disciplines of Professional Engineering to attend. Full details of the Conference content and a Registration Brochure will be available in the November issue of the monthly IPENZ magazine "N.Z. Engineering" or by contacting the Conference Secretary, P.O. Box 99361, Auckland, New Zealand.

The main programme is divided into feature and technical sessions. The feature sessions include subjects such as:

- Choosing the Future: An Environment for Growth
- Hazards in Auckland
- Fire Engineering
- Information Technology
- Innovation in Engineering
- Environment and sustainable technology
- Mass public transport for Auckland
- The purpose of engineering education

The technical sessions which follow the feature sessions will run for approximately one and a half days, offering an opportunity for delegates to review quality technical papers, presenting state of the art technical knowledge and information on subjects across the full spectrum of engineering activity.

Site visits of significant local engineering projects, an evening dinner and an interesting and varied alternative programme for companions has been prepared.

Prior to the conference the Engineers for Social Responsibility is holding its annual conference for one day. Subsequent to the conference a two-day course on"Environmental Management for practising Engineers" is also available.

Of particular interest to geotechnical engineers and engineering geologists will be the paper by Dr L.D. Wesley and S.Y. Chan entitled "Dispersivity of Volcanic Ash Soil" and the feature session on "Hazards in Auckland". The paper by Wesley and Chan presents some interesting results from recent research which indicates that ash soils are no more dispersive than other soils with similar plasticity.

The feature session on Hazards in Auckland includes the effect of natural hazards (e.g.volcano, cyclone and earthquake) on engineered structures. Other papers of interest include refuse landfill engineering, soil gas surveying, geotextiles in pavement maintenance and what to do with unsealed roads.

2. CONFERENCE DIARY

1991

March 11-15
University of Missouri-Rolla, USA. Second International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics.

March 19-21
Paris, France. International Conference on Deep Foundations.

April 7-12
Stresa, Italy. Fourth International Conference on Piling and Deep Foundations.

April 15-19
Isle of Wight, UK. International Conference on Slope Stability Engineering.

May 12-18
Houston, Texas, USA. Fourth International Symposium on Land Subsidence.

May 27-June 1
Florence, Italy. 10th ISSMFE European Regional Conference

June 3-7
Mexico City. Sixth International Conference on Applications of Statistics and Probability in Civil Engineering.

June 10-12
Boulder, Colorado, USA. ASCE Geotechnical Engineering Congress.

June 13-14
Boulder, Colorado, USA. International Conference: Centrifuge '91.

August 26-30
Vina del Mar, Chile. IX Panamerican Conference on Soil Mechanics and Foundation Engineering.

September 9-11
Oslo, Norway. 3rd International Symposium on Field Measurements in Geomechanics.

September 10-12
Beijing, China. Sixth International Symposium on Ground Freezing.

September 16-20
Aachen, FRG. International Congress on Rock Mechanics.

September 23-27
Maseru, Lesotho. 10th ISSMFE African Regional Conference.

December 9-13
Bangkok, Thailand. 9th ISSMFE Asian Regional Conference.

1992

February 3-7
Christchurch, New Zealand. 6th ANZ Conference on Geomechanics.

February 10-14
Christchurch, New Zealand. 6th Int. Sym. on Landslides.

February 25-28
New Orleans, USA. Specialty Conference on Grouting, Soil Improvement and Geosynthetics.

May 10-16
Rostock, GDR. 3rd Baltic Conference on Soil Mechanics and Foundation Engineering.

May 28-31
Aalborg, Denmark, NGM-92. XIth Nordic Geotechnical Meeting

1993

August 23-26
Kingston, Canada. International Congress on Mine Design.

1994

January 5-10
New Delhi, India. XIII International Conference on Soil Mechanics and Foundation Engineering.

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CASE HISTORY PREDICTIONS - CALL FOR SUBMISSIONS

1992 Australia New Zealand Conference on Geomechanics

One of the highlights of 5th ANZ Conference held in Sydney in 1988 was the series of case history prediction sessions. This involved the provision of site data from investigation drilling,laboratory testing, etc. to the participants, from which they had to predict such things as pile capacities, settlements of structures, slope failures, and insitu stresses. The results of the predictions were then compared with actual measured data.Submissions are invited from interested groups and companies for the full running of one or more case history prediction sessions, on behalf of the Geomechanics Society. This will involve provision of full data, instrumentation and monitoring, document preparation, assessment of prediction, reporting to the conference and preparation of a paper summarising the prediction exercise, for publication following the conference. Obviously, results and data previously published are not suitable. Information is available from the special edition of the Australian Geomechanics Magazine, issued following the 1988 Conference. Further enquiries can be directed to the Chairman of the conference organising committee. A show of interest is required by January 31, 1991.

Nick Traylen
Chairman, 6th ANZ Conference
C/ Soils & Foundations Ltd
P.O. Box 451 CHRISTCHURCH

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ISL1992
CHRISTCHURCH

SIXTH INTERNATIONAL SYMPOSIUM ON LANDSLIDES
SIXIEME SYMPOSIUM INTERNATIONAL SUR LES GLISSEMENTS DE TERRAIN

10-14 February 1992, Christchurch, New Zealand

REMINDER

Themes:

G.1	Landslide Investigations	**S.1**	Seismicity and Landslides
G.2	Stability Analysis Techniques	**S.2**	Landslides and Reservoirs
G.3	Stabilization and Remedial Works	**S.3**	Open-pit Mine Slopes
G.4	Landslide Hazard Assessment	**S.4**	Slope Instability in Tropical Areas
G.5	Monitoring and Instrumentation	**S.5**	Landslides in Australasia

Abstracts: Due by 31 December 1990

Bulletin 2: Copies now available from

- National Group Secretaries of ISSMFE, IAEG & ISRM
- ISL Secretariat Fax: (64 3) 790-175
- Symposium Convenor Fax: (64 3) 642-999

Symposium Convenor:

David H Bell
Geology Department
University of Canterbury Christchurch, New Zealand.
Phone (64-3) 642-717 or 667-001

Please send all enquiries to:

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ARTICLES AND TECHNICAL PAPERS

CRIB RETAINING WALLS - USE OF MANUFACTURERS' DESIGN CHARTS

N.J. Traylen, Soils & Foundations, Christchurch

A comparison has been made between MOW design charts for crib walls and those supplied by some manufacturers.

It has been noted in the past that MOW design charts give conservative results when compared with some manufacturers' recommendations. From research into the methods that each party uses to calculate stability, it has been found that the MOW charts are in fact correct, and the manufacturers' charts can be dangerously unconservative for many cases.

These findings have been backed up by the recent failure and collapse of a large concrete crib retaining wall which, when analysed using MOW charts was found to be inadequate, but was 'safe' according to manufacturers' charts.

The problem is in the calculation of the magnitude of the thrust from earth pressure, and its point of application on the wall.

With reference to the accompanying diagram (Fig 1), the two manufacturers (incorrectly) calculate earth pressure based on the dimension Hr, which is what the earth pressure would be if the front of the retaining wall was actually the same height as the cut face of the soil - this is only the case if the backfill to the wall is horizontal, or if any headslope begins at the rear of the wall, not the front. (See Figures 1 & 2).

The earth pressure should be calculated based on Hr + b as shown. For a steep headslope, this value is significantly higher than Hr. The resulting active earth pressure is proportional to the square of this figure, thus large differences in earth pressures soon arise from any significant headslope.

The problem is then compounded by the calculation of the overturning moment to the wall. The point of application of the force is generally assumed to be ⅓ of the height of cut, which is multiplied by the earth pressure - thus the overturning moment (on which the stability of the wall is based) is proportional to the cube of the value assumed for the cut face height. A small difference in the assumed cut height can therefore lead to a large difference in the calculated overturning moment and consequently the final design of the wall. (See Fig 3).

Assuming a wall with the following dimensions:

$B = 1.22$ m
$\beta = 14°$
$H\omega = 3.0$ m

A comparison of active earth thrusts and lever arms for calculation of overturning moments for the MOW method and the manufacturers' method gives the following results:

Headslope Angle	Active Thrust Ratio (MOW/Manufacturers)	Lever Arm (MOW/Man.)	Overturning Moment (MOW/Man.)
0	1.0	1.0	1.0
5	1.07	1.03	1.10
10	1.15	1.07	1.23
15	1.23	1.11	1.37
20	1.33	1.15	1.53
25	1.44	1.20	1.73

From this it can be seen that a wall based on some manufacturers' design charts can be using design moments which are dangerously underestimated. The final column is indicative of the actual reduction in factor of safety from that assumed in some manufacturers' design charts.

Further to this, the manufacturers use a Factor of Safety against overturning of 1.5, whereas the MOW recommend 2.0, as is normal practice. This gives rise to even larger disparities in final design sizes derived when using the two different approaches.

Conclusion

Obviously when specifying a crib wall, it pays to run through a brief design check yourself, as opposed to using the design charts supplied by the manufacturer. This is especially important if an appreciable headslope exists on the proposed wall, or if surcharge or vehicle loading is expected.

Note: Since the original writing of this note in December 1989, at least one of the manufacturers has changed his design charts to eliminate the errors outlined above.

N.J. Traylen

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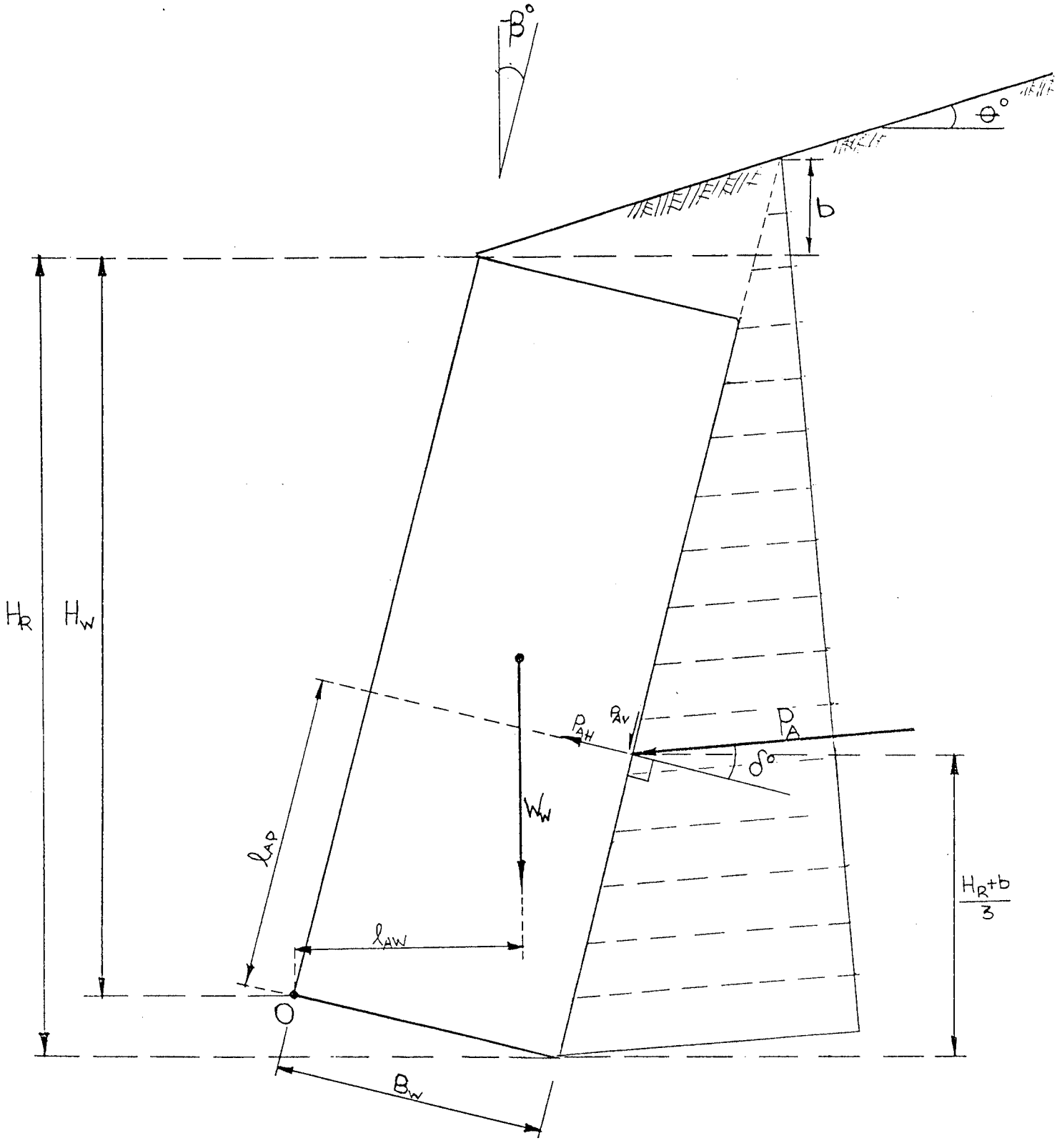


FIGURE 1: FORCES AND DIMENSIONS USED IN CRIB WALL DESIGN

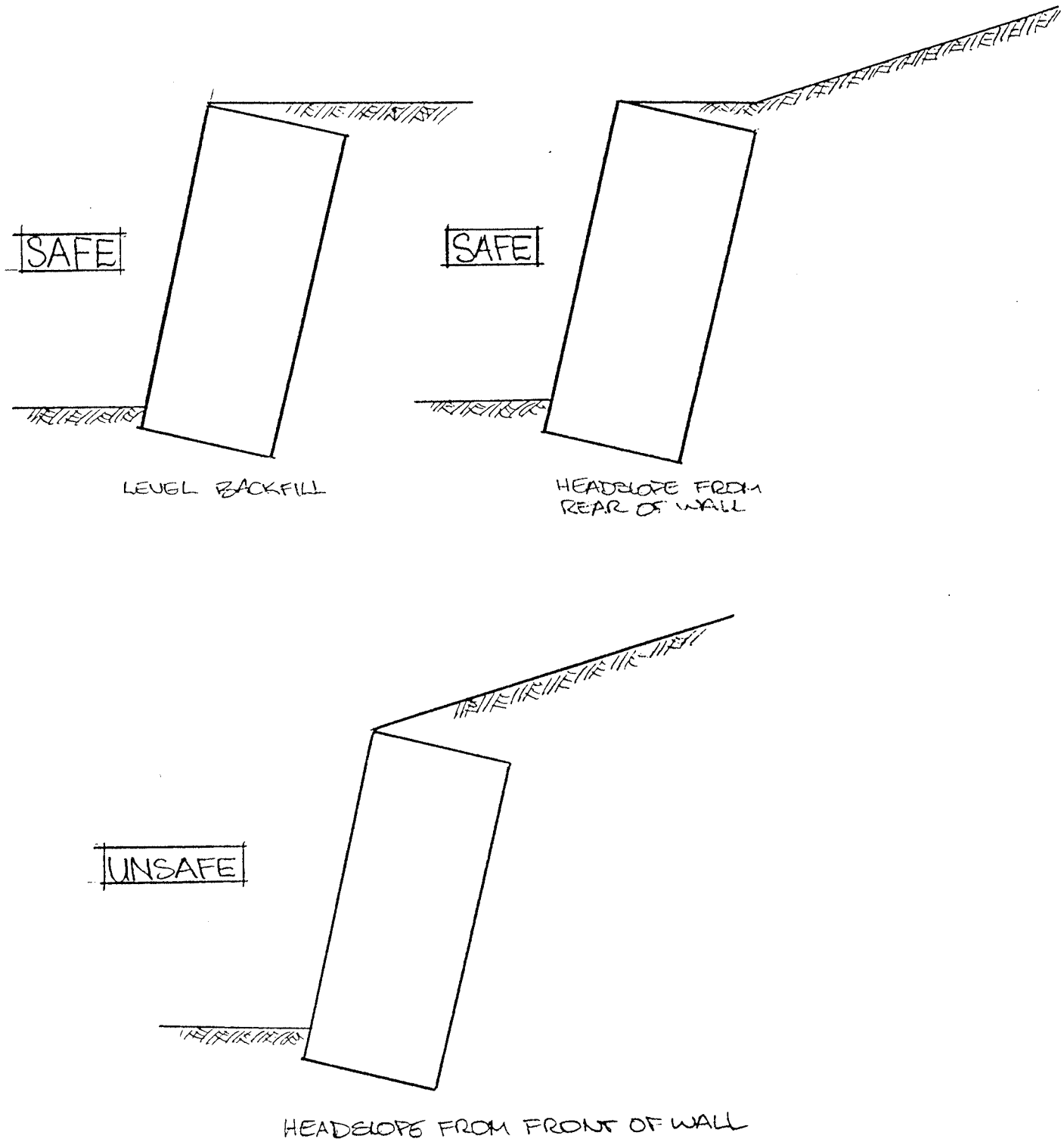


FIGURE 2: SAFE AND UNSAFE SITUATIONS WHEN MANUFACTURERS' DESIGN CHARTS

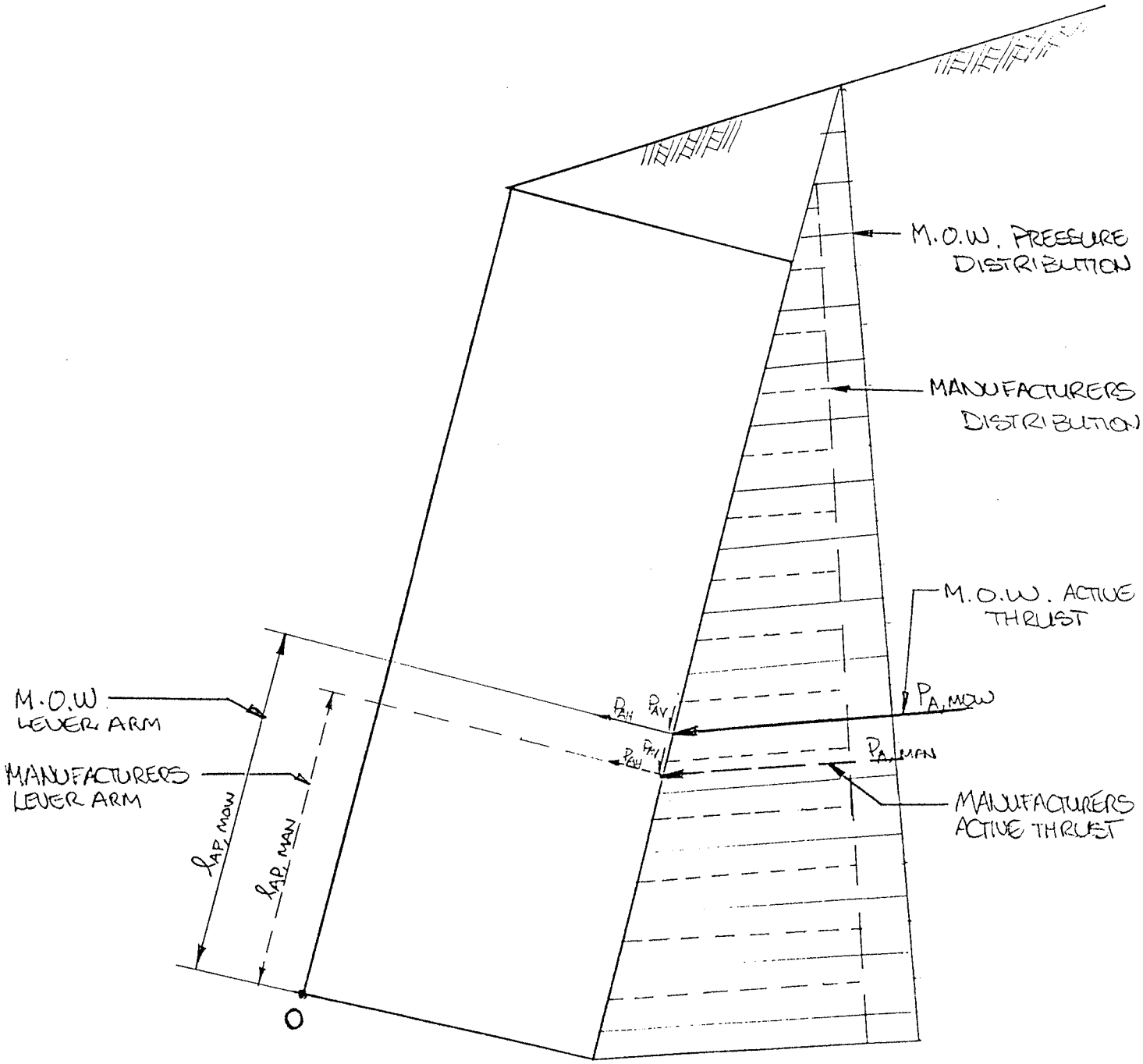


FIGURE 3: COMPARISON OF PRESSURE DISTRIBUTIONS, ACTIVE THRUSTS AND LEVER ARMS FOR M.O.W. AND MANUFACTURERS' DESIGN METHODS

THE ROLE OF THE ENGINEERING GEOLOGIST IN URBAN DEVELOPMENT

David H. Bell, Senior Lecturer in Engineering Geology,
University of Canterbury, Christchurch

Note: This paper was first presented at the 1990 IPENZ Conference in Wellington, and is reproduced here by kind permission of IPENZ

ABSTRACT

The need for engineering geology data input is widely accepted in the fields of urban planning and development, both in New Zealand and overseas. Close analogies exist with conventional site investigation programmes for hazard evaluation and/or foundation assessment, with site-specific engineering geology data appropriate to the development stage. Because engineering geologists do not have any form of registration, however, some territorial local authorities have been reluctant to accept their specialist advice on planning or development matters. More than 10 years' involvement with urban development in various parts of the South Island has clearly demonstrated the relevance of the engineering geology approach, and a number of local and regional authorities now insist on such an evaluation prior to planning or building permit approval in site-specific cases. The need for close co-operation between practising civil engineers and engineering geologists in urban development matters has also been demonstrated, and some form of registration or certification of engineering geologists is strongly advocated.

INTRODUCTION

"Engineering geology is the application of the geological sciences to the location, design, construction, operation and maintenance of engineering works. Its prime concerns are with site foundations (the "geological model" is quantified by soil or rock mechanics techniques) and with active processes (earthquakes; volcanic eruptions; landslides; etc.) which may represent hazards to the structure during its design life" (Bell, 1979, p.20). The relevance of engineering geology to urban development was highlighted by the Commission of Inquiry into the Abbotsford Landslip Disaster, where it was concluded that "... both professions, engineering and geology, should collaborate and suggest guidelines to their members on the use of both engineering and geological skills on major civil engineering works. Such consultations would considerably reduce the chances of another Abbotsford" (C.O.I., 1980, p.180).

Although it is most unlikely that the Abbotsford Landslip would have been predicted by either engineering geology appraisal or even by a full site investigation programme, it is nevertheless true that Abbotsford highlighted the need for improved geotechnical input into residential subdivision of land. Territorial authorities accepted this need, in part from their own potential liability for inadequate site evaluation, and various forms of "stability certification" were required. In recent years some Councils have attempted to transfer all liability to the subdivider or his professional advisers, although the obligation to ensure adequate site evaluation (and not just in terms of landslip hazards) must remain with the administering authority.

ENGINEERING GEOLOGY APPROACH

From close involvement with residential subdivision of land since 1980, especially in Queenstown and Christchurch, an engineering geology investigation methodology has been developed which is based on air-photo interpretation, engineering geological mapping, exposure logging, and limited geotechnical testing where appropriate (Bell & Pettinga, 1985). This approach has parallels with the feasibility, design, construction and maintenance stages of conventional site investigations (Bell & Pettinga, 1984), and the data input is varied depending on the investigation objectives. The suggested range of engineering geology investigations and associated geotechnical data inputs are summarised in Table 1, and appropriate mapping scales are also indicated. It is stressed that this engineering geology approach differs significantly from the Urban Land Use Capability (ULUC) survey (Jessen 1987), and serious reservations are held about the applicability of the latter method especially at the more detailed (Concept/Scheme Plan) stages of land subdivision and development. A detailed assessment of urban development practices in New Zealand is given by Bell (1987), and examples of engineering geology data input are given by Bell & Pettinga (1985): selected case studies are briefly reviewed in the following sections.

SELECTED QUEENSTOWN EXAMPLES

Residential development in the Queenstown area is mostly confined to steeper (10° - 25° +) schist bedrock slopes which are overlain by glacial tills and locally by beach and/or fan gravels. As a result of litigation and submissions in 1980-81 (Bell & Pettinga, 1985), the local authority adopted a by-law that requires for land zoned R4 in the District Scheme "... the submission of an Engineering Geology Plan at a scale of not less than 1:2,000 prepared by a person qualified in Engineering Geology...". The plan, and the accompanying report, are concerned with foundation conditions and site-specific hazards which must be evaluated prior to residential subdivision approval. This ordinance has operated satisfactorily since 1981, and examples of early engineering geology data input methods are shown in Figs 1 & 2 (from Bell & Pettinga, 1985).

In addition to routine evaluation of residential subdivisions at the Concept Plan stage of development, engineering geology data input has also been required at the Scheme Plan stage in certain cases. In addition, it is not uncommon for specific foundations (by a registered engineer) to be recommended for steep sites which have "topographic" (or other) constraints to their development. Control of water, both surface and subsurface, has proved to be the most important consideration in the Queenstown urban area, with of course due attention to "routine" engineering matters such as batter design/stability and fill compaction. A more recent example of current practice is the approval for condominium development behind the Shotover Resort Hotel (Fig 3). The site is located on the toe of an extremely large (c.$10^9 m^3$) landslide complex, and development approval was granted after engineering geology assessment, subject to the dwellings being relocatable.

SELECTED CHRISTCHURCH EXAMPLES

Residential development in Christchurch has taken place in areas at risk from flooding by either the Waimakariri River or the Heathcote River, whilst urban expansion onto the Port Hills has involved slope stability hazards in both volcanic bedrock and the overlying loessial soils. Tunnel-gully development has long been recognised as a development constraint in parts of Christchurch (see Bell, 1983, for example), whilst more recently potential rockfall hazards have been

Table 1

ENGINEERING GEOLOGY DATA INPUT FOR URBAN DEVELOPMENT IN NEW ZEALAND

Planning Stage[1]	Engineering Geology[2] Investigation Objectives	Typical Map Scales	Geotechnical Data[3]
A. REGIONAL SCHEME	1. Identification of "regional" hazards such as floodplains and "active" fault traces 2. Mapping of bedrock and surficial geology	1:100,000 ↓ 1:25,000	Characterisation of lithologies and identification of "problem" soil types; assessment of resources (e.g. aggregate availability and long-term requirements)
B. DISTRICT SCHEME	1. Engineering geological and/or pedological mapping, with limited excavation logging 2. Identification and investigation of "local" hazards (e.g. landslides)	1:10,000 ↓ 1:5,000	Geotechnical characterisation of mapping units as required for land-use zoning decisions; specific evaluation of tectonic and hydrologic hazards
C. SUBDIVISION CONCEPT PLAN	1. Engineering geological site mapping and subsurface investigations 2. Interpretative risk assessment and/or planning guidelines	1:2,000 ↓ 1:1,000	Limited testing (e.g. plasticity/grainsize) to indicate general characteristics of site materials; hazard avoidance or mitigation measures
D. SUBDIVISION SCHEME PLANS	1. Detailed site investigation of specific areas identified at Concept Plan stage 2. Engineering geological mapping and logging to meet any "local" authority requirements	1:1,000 ↓ 1:500	Additional geotechnical testing to verify design and/or construction feasibility as required; investigation of specific features to facilitate stage E
E. SUBDIVISION DESIGN AND CONSTRUCTION	1. Confirmation of mapped geology 2. Additional investigation as required	1:500 ↓ 1:50	Detailed investigations for design of cut and fill batters if required; control of earthworks
F. SECTION DEVELOPMENT AND HOUSE CONSTRUCTION	Engineering geological investigations only if required (A → E should prevent site "problems")	1:200 ↓ 1:50	Site specific testing for foundations if required; control of earthworks, drainage, etc

NOTES: 1) Planning stages follow from existing legislative framework (Table 3).

2) Engineering geology investigation methods include air-photo interpretation and relevant mapping and logging techniques.

3) Geotechnical design investigation requirements may vary considerably within individual urban areas.

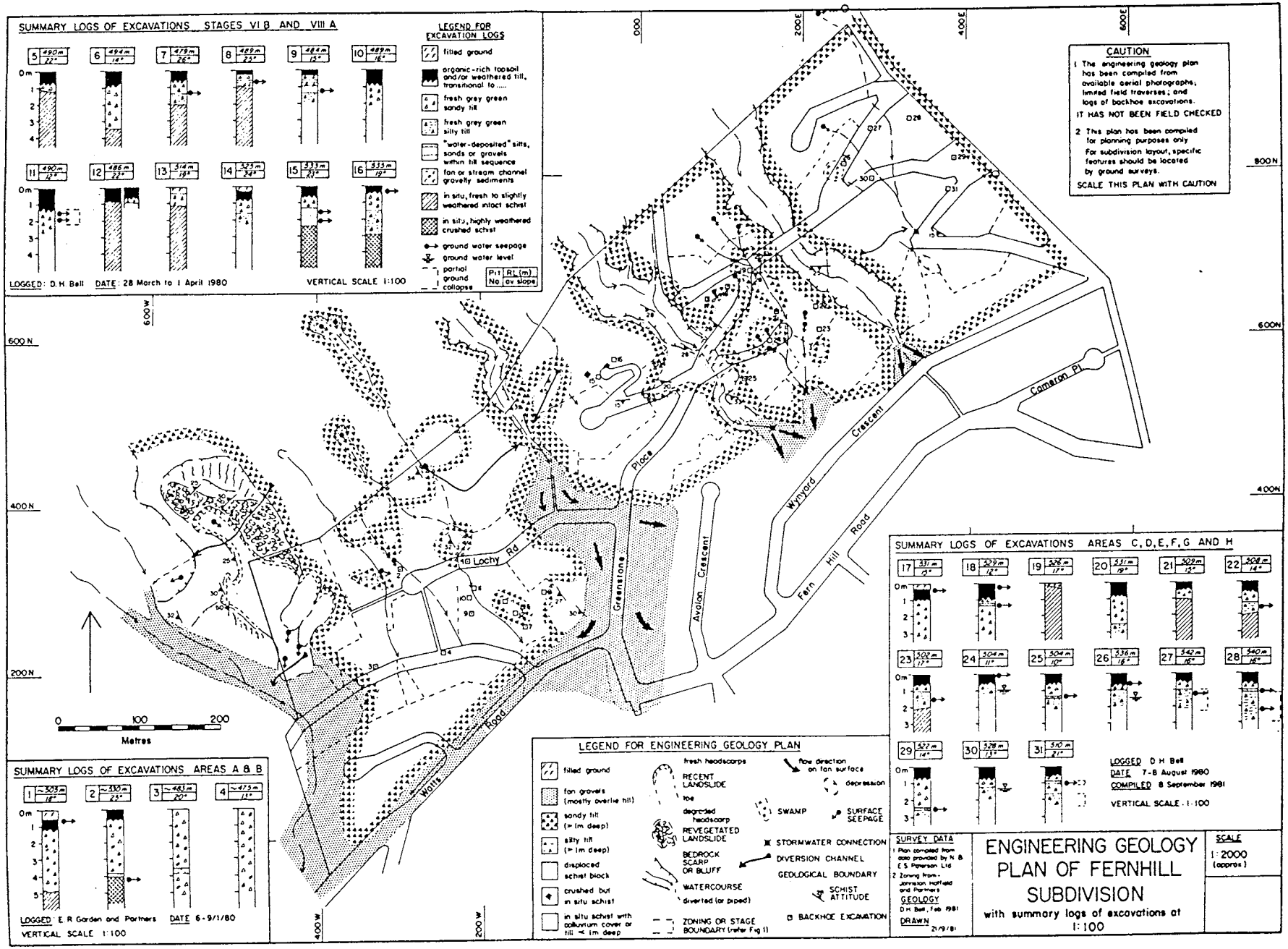


FIG 1 Engineering geology plan for subdivision assessment, Queenstown

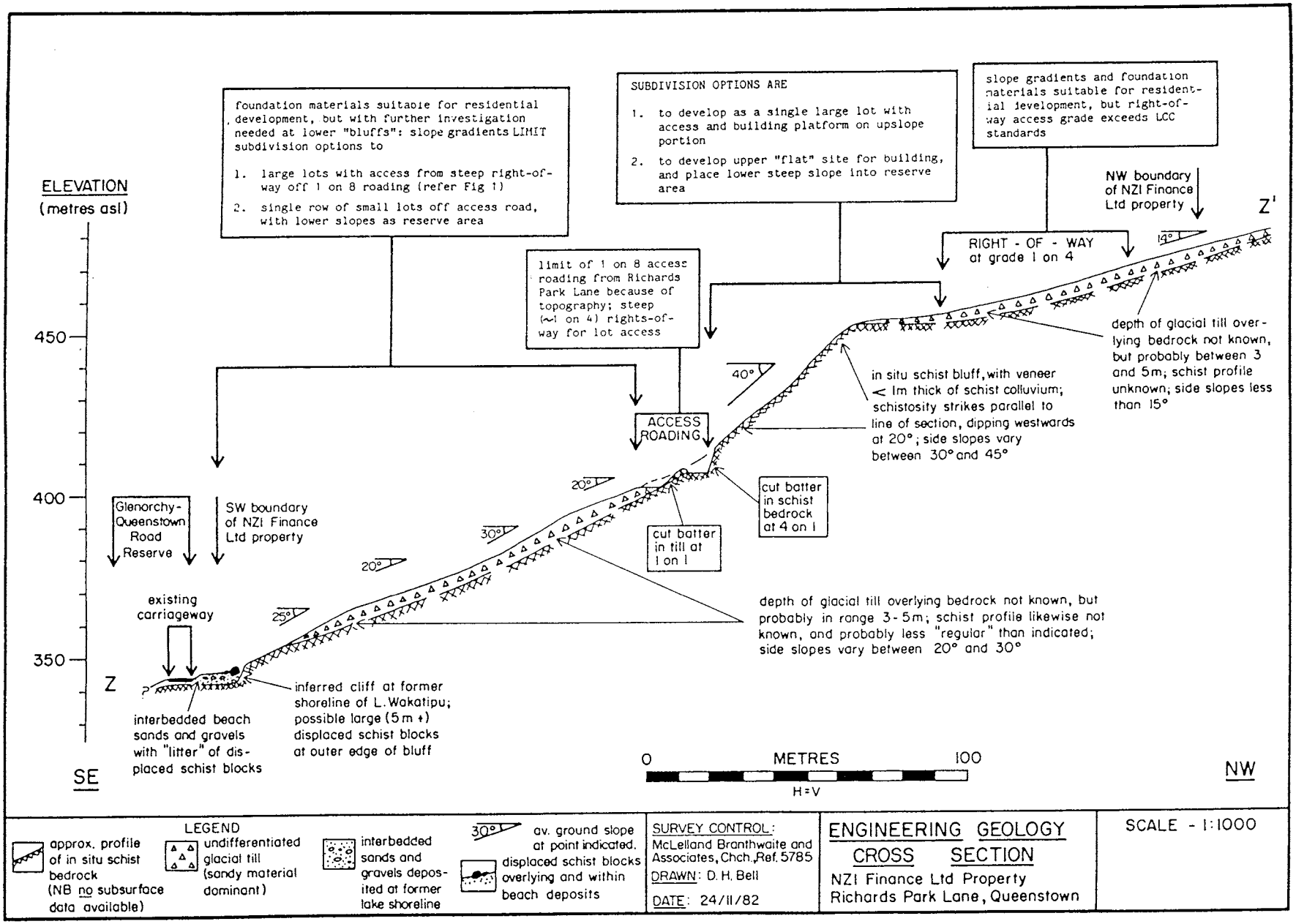


FIG 2 Schematic engineering geology section for Concept stage assessment, Queenstown

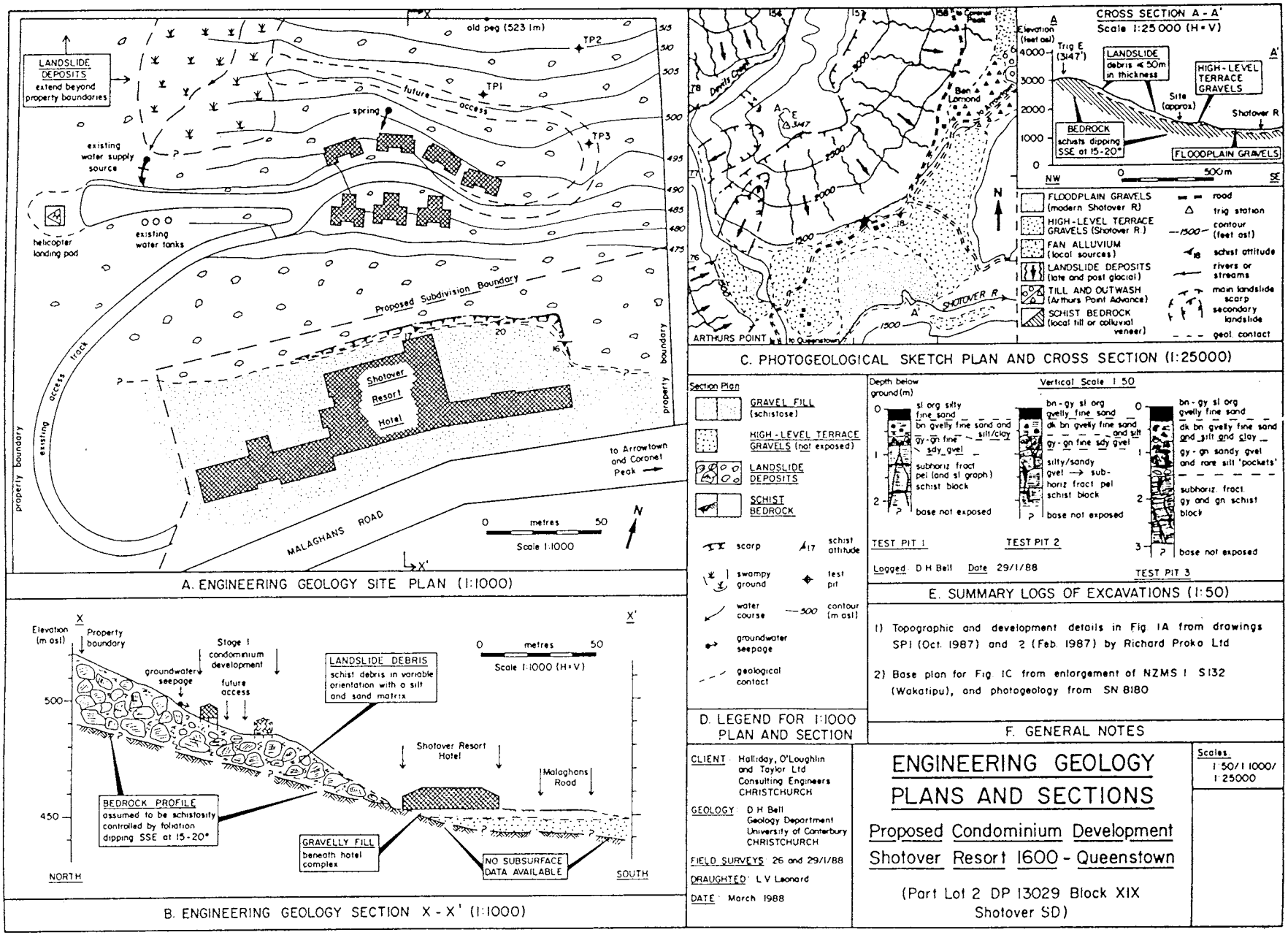


FIG 3 Engineering geology data base for proposed development evaluation, Queenstown

highlighted. In areas where potential slope stability hazards have been identified, the territorial local authorities have required engineering geology evaluation prior to development approval. In other cases, engineering consultants have obtained specialist advice, typically where dispersive soils are present or where stabilisation of volcanic bedrock is necessary.

Selected examples of engineering geology practice in the Christchurch area have been reviewed by Bell & Pettinga (1985), and once again the methodology is essentially the same as that described earlier. Figure 4 provides an example of site mapping for 3 building lots to verify the existence of suitable building platforms prior to development approval, whilst Fig 5 illustrates the approach used to provide pre-construction site data for a local engineering consultant. The cost-effectiveness of the engineering geology approach has been repeatedly demonstrated, and the availability of aerial photograph sets which date back to 1940 has provided a particularly valuable data base.

PROFESSIONAL IMPLICATIONS

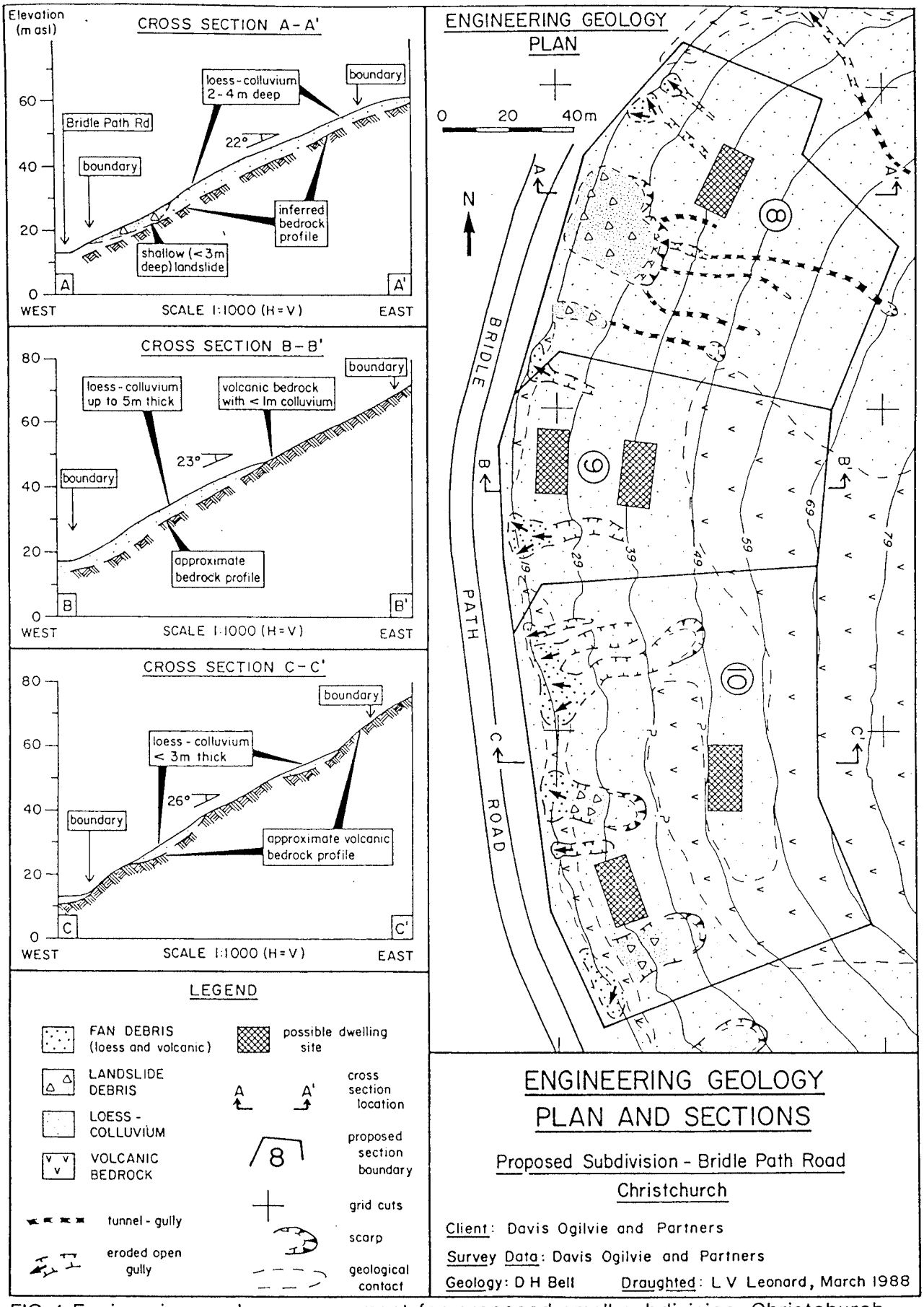
It is clear from the preceding discussion and examples that engineering geology data input is routinely required by at least some territorial local authorities. The absence of professional registration or certification requirements for engineering geologists has not so far been a cause for concern (unlike some parts of Auckland, for example), and there is a clear recognition that engineering geology data input is necessary for sound urban development. Long term, however, the uneven application of development standards by different local authorities and the increasing attempt to transfer liability to the professional adviser must necessitate some form of professional status (by registration or certification) for the practising engineering geologist. In Christchurch recently, for example, both the engineering geologist and the civil engineer concerned were each required by Council to certify the stability and suitability of a particular site for residential development. This would not have been possible without substantial professional indemnity insurance by both advisers, and reflects the changing residential development procedures being pursued by at least some local authorities and their legal advisers.

CONCLUSIONS

1. Although it is technically feasible to build on most sites, some risks are judged unacceptable and therefore hazardous areas need to be identified and excluded from residential development. Engineering geology data input at the Regional and District Scheme stages is an appropriate method of hazard identification and evaluation, although it is not widely used at present.

2. For subdivision of residential land at the Concept and Scheme Plan Stages, engineering geology assessment is considered to be a most appropriate and cost-effective method of hazard/foundation evaluation. Whilst prior identification of major hazards is certainly advocated, there are commonly geotechnical constraints to the proposed development which must still be addressed.

3. If the preceding stages of development have been carried out satisfactorily there should be only limited requirement for engineering geology data input (as part of specific foundation design, for example) at the Building Permit Stage. Remedial measures at existing sites may, however, still be required and here there is an obvious need for engineering geology information.



ENGINEERING GEOLOGY PLAN AND SECTIONS

Proposed Subdivision - Bridle Path Road
Christchurch

Client: Davis Ogilvie and Partners

Survey Data: Davis Ogilvie and Partners

Geology: D H Bell Draughted: L V Leonard, March 1988

FIG 4 Engineering geology assessment for proposed small subdivision, Christchurch

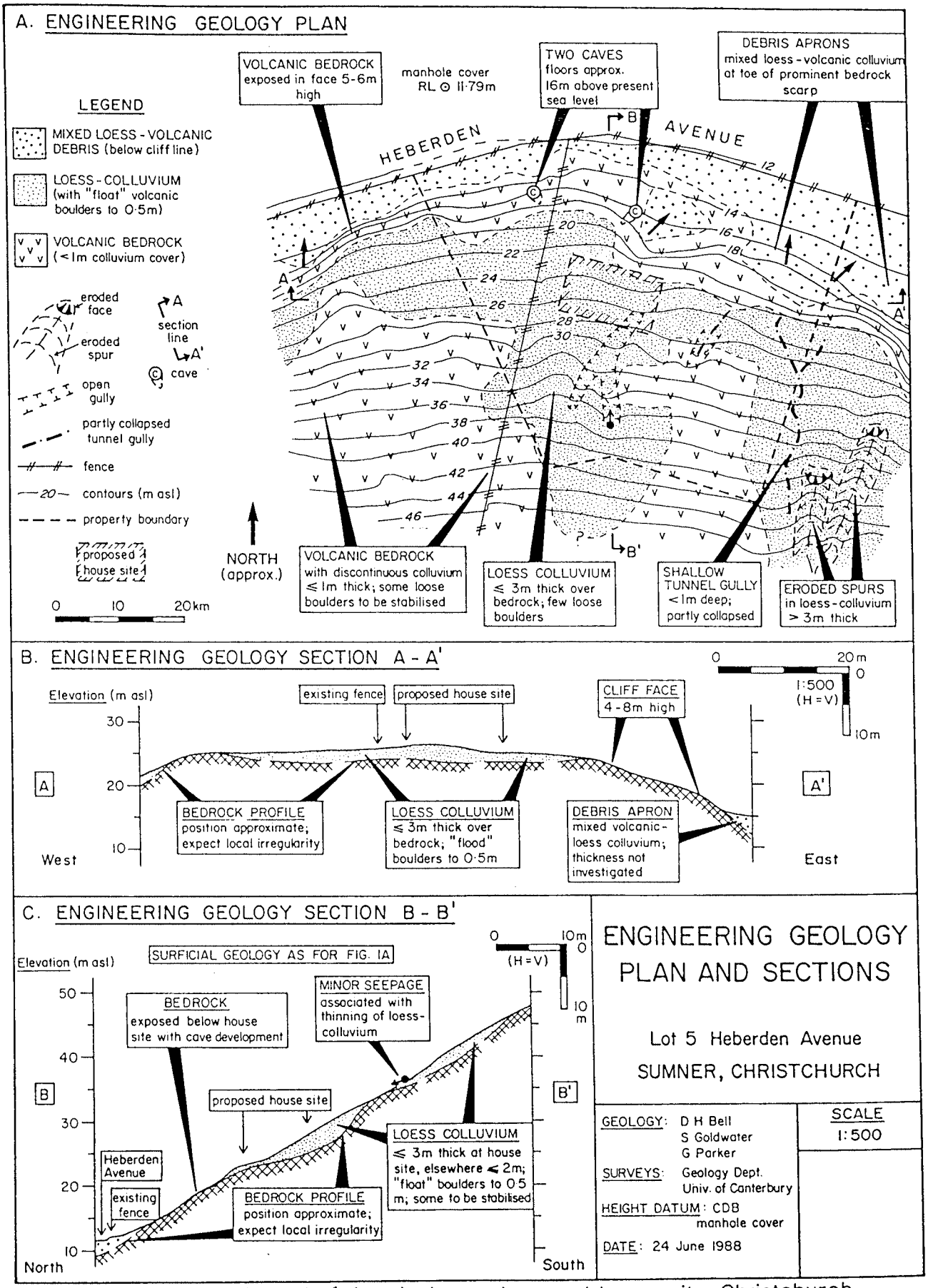


FIG 5 Engineering geology data for single sections and house site, Christchurch

4. There are obvious professional implications that derive from an acceptance of engineering geology data input into residential development, most notably the need for some form of registration or certification of practising engineering geologists. There is no doubt that engineering geology expertise is relevant to sound urban planning and development, and this must be accepted both by local authorities and by other practising professionals.

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REPORT AND DISCUSSION:

GROUNDWATER AND SEEPAGE SYMPOSIUM AUCKLAND, 24-25 MAY, 1990

A most successful symposium was held at the University of Auckland, attended by 112 registrants from engineering and geological consultants, contractors, universities, local authorities and Government departments.

The keynote address was given by Dr David K. Todd, who operates his own consulting firm specialising in the planning, development, management and protection of groundwater, from Berkeley, California. Dr Todd also holds the position of Professor of Civil Engineering, Emeritus at the University of California, Berkeley where he has taught for many years. He has published numerous papers and is the author of six books, one of which is a longstanding internationally recognised text on Groundwater Hydrology. His address was entitled "The Groundwater Quality Industry" and provided an excellent start to the Symposium in which he discussed how environmental concerns have stimulated development of the groundwater industry, actions and problems associated with groundwater contamination and the challenges created by this new industry. His address included reference to many projects he had personally been involved with.

A total of 27 papers were presented covering seven general themes. On the first day, following the keynote address, the general themes covered were:

- Hydrogeology Review and Solutions to Groundwater Problems
- Field Investigations and Interpretations
- Construction Dewatering

The first day was concluded by the Symposium dinner, including an after dinner speech by current All Black, Alan Whetton.

On the second day, the general themes covered were:

- Seepage Problems in Natural Ground
- Embankment Seepage
- Groundwater Contamination
- Disposal of Wastes by Ground Soakage

The wide variety of papers presented indicated just how diverse the field of groundwater has become. The papers and presentations were of a high standard with a nice balance between theory and case histories. Of special interest were the papers dealing with groundwater contamination which indicated that as with other parts of the World, there is a strong awareness of the importance of protection to our natural resources, of which groundwater is one of the most important. This will create new challenges for geologists, engineers and scientists involved in groundwater problems. There have been many advances in groundwater technology in the last two decades and it is important that we make use of them in our professional capacity.

All who attended the Symposium will have benefited from the sharing of knowledge and experiences, both from the papers and during information discussions. The Symposium brought together people throughout New Zealand, from a wide variety of backgrounds, and has hopefully stimulated a greater awareness of the importance of groundwater and how we can use and control it for our long-term benefit.

I would like to thank the authors whose quality contributions were significant in the success of the Symposium, and also the enthusiastic participation by all those who attended. Proceedings of the Symposium are available from IPENZ at a cost of $25 to members and $40 to non-members. A summary of the discussions follows in this issue of Geomechanics News. Those that assisted with transcribing and editing the discussion were:

L.D. Wesley	: University of Auckland
P. Brown	: GCNZ Woodward Clyde Ltd
D. Carter	: Beca Carter Hollings and Ferner Ltd
T. Matuschka	: Engineering Geology Ltd

Trevor Matuschka

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DISCUSSION
GROUNDWATER AND SEEPAGE SYMPOSIUM

AUCKLAND, MAY 1990

The following discussions refer to the above conference for which the Proceedings have been published by IPENZ as Proceedings of Technical Groups Volume 16, Issue 1(a), ISSN 0111-9532.

The written summary has been transcribed from tapes of the spoken discussion. At time,s names of contributors, words, grammar and punctuation are not clear on the tapes and, inevitably, the transcriptions will contain instances where the true intentions of the speaker have not been reflected accurately. Contributors are encouraged to write to Geomechanics News to put right any such instances or to continue the discussion in print.

DISCUSSION SESSION I - HYDROGEOLOGY REVIEW AND SOLUTIONS TO GROUNDWATER FLOW PROBLEMS

Chairman: Prof. M Pender, University of Auckland

THE NATURE, OCCURRENCE AND ENGINEERING SIGNIFICANCE OF GROUNDWATER :

D.H. Bell, University of Canterbury

Q: Dr C. J. Graham, Barrett Fuller and Partners Ltd

With regards to Figure 7 on the last page of your paper could you please explain in greater detail how you use groundwater chemistry to fingerprint water and determine its source?

Reply: David Bell

This is a very broad question. The purpose of the diagram was to identify several of the techniques currently in use. It is very difficult to accurately fingerprint water and thus identify its source as the salinity of the water is also a function of the soils through which it has flowed. For example, at the moment we have a material which has been precipitating in a Novaflow line which has been placed in front of a retaining wall. The precipitate has been determined to be calcium carbonate and we are currently trying to determine its source. It may be that the calcium is from a concrete source and the carbonation induced by naturally occurring atmospheric carbon dioxide.

THE SOLUTION OF SEEPAGE PROBLEMS :

L.D. Wesley, University of Auckland

Q. Dr. D. Elder, Soils & Foundations, Christchurch

In your paper you gave a comparison between a hand-drawn flownet and a computer analysis which indicated a difference of only 10 per cent, which most practitioners would think is very good considering the other variables associated with such computations. In my experience the problem is often in determining what happens at the boundaries. In your Huntly example you showed the difference in the flownet when you used a vertical line source, which was the river, and a horizontal line source near the ground surface. Could you comment on the effects of the boundaries and what errors were associated with the different approaches.

Reply: L. D. Wesley, University of Auckland

When you have a phreatic surface you have real difficulty in using hand sketching. In the Huntly example both flownets were hand-drawn but it is generally a tedious exercise to determine the position of the phreatic surface in unconfined situations. In this example the flownet is not sensitive to the position of the free surface but in many other practical situations it is. My view is that hand sketching is fine provided you are in a uniform material and flow is confined. For situations with a phreatic surface or more than one material then it becomes extremely difficult to come up with reliable solutions using hand sketching.

Q. Dr Chris Graham, Barrett Fuller and Partners Ltd

How well did the field observations taken during installation of the caissons compare with your modelling?

Reply: L. D. Wesley, University of Auckland

It was hard to make a direct comparison as they altered the situation somewhat, by pumping water back into the chamber at the same rate as it was being removed. This technique prevented piping from occurring except in the immediate vicinity of the suction head.

Q. Aiden Nelson, Earthtech Consulting Ltd

How did you decide that the computer solution was more correct than the hand solution i.e. do the present groundwater programs give us better results?

Reply: L. D. Wesley

Unfortunately my knowledge of the formulation of computer programs is somewhat limited, therefore I am not the ideal person to judge their accuracy.

As an aside, the accuracy of a computer program is dependent upon the size of mesh selected. For example, if you halve the space or the time step the error is reduced by a factor of four.

Q. David Jennings, Works Consultancy Services

How accurately did the axi-symetric flownet model flow into the square chamber?

Reply: L. D. Wesley, University of Auckland

The axi-symetric net would produce a much better solution than the hand solution. However, the axi-symetric was developed for circular chambers and the chamber itself was actually square, therefore you have problems at the corner points i.e. the program computes high gradients which may be too high.

CALCULATING SEEPAGE FLOW WITH A FREE SURFACE : SOME OLD METHODS AND SOME NEW ONES

J. D. Fenton, University of Auckland

Q. Michael Pender, University of Auckland

You made the remark that the approximate method used to determine surface flow through the dam had some defects. You further explained that the Dupuit approximation gave the exact value for flow into a well. How bad is the approximation when this method is used to estimate flow through a dam?

Reply: John Fenton

This point was addressed by Harr in his method of fragments. Harr suggests that you can use the Dupuit approximation whenever you are computing flow in the central portion of a dam where you essentially have free surface flow over a horizontal bed.

I am personally skeptical however of the ability of the Dupuit approximation to model flow through a dam principally because it does appear to be very good in approximating the upper boundary condition. As discussed on Page 34, a simple quadratic approximation gave excellent agreement when computing flow over a batter up to a slope of 1.1. This indicates that the head variation in the vertical is not constant as assumed by Dupuit but shows marked quadratic variation. Therefore I believe it would be both worthwhile and interesting to examine the accuracy of the Dupuit approximation for such problems.

Tam Larkin will discuss the use of the Dupuit approximation in greater detail, later in this conference.

DISCUSSION SESSION II
FIELD INVESTIGATIONS AND INTERPRETATIONS

Chairman: T. J. E. Sinclair, Tonkin & Taylor Ltd

MAKING SENSE OF PERMEABILITY TESTING

A. P. Kortegast, Tonkin & Taylor Ltd

Q. W. Brown, Brown & Thomson Consulting Engineers

When selecting tests to determine permeability, there is some confusion as to whether inflow tests are preferred to outflow tests. Doesn't it depend on whether you are looking at permeability for putting water into the aquifer or taking it out? In most of the problems I deal with we are putting water into the aquifer rather than taking from it.

Reply: A. P. Kortegast

I would prefer the outflow test where the water is coming out of the formation into the hole simply to eliminate errors which can arise from drill cuttings at the base of the hole and dirty water in the hole. If you do a falling head test (i.e. inflow test) you tend to force suspended solids or sediments into the sides of the hole, which can lead to inaccuracy. Even with a recharge well, you still want to know, as accurately as possible, what the formation permeability is. It is important when constructing a recharge well, when drilling, to take care to avoid skin effects which could effect well performance.

PLANNING AND DESIGNING A GROUNDWATER PROGRAMME

W. J. Russell, GCNZ Consultants Ltd

Q. A. Nelson, Earthtech Consulting Ltd

The focus of groundwater hydrology appears to be moving from a technical arena into a legal arena. We spend two-thirds of our budget protecting ourselves legally instead of usefully spending that looking at the complexity of the groundwater problem. Is this trend likely to continue? Is it something that we want to continue, and if not is there anything we can do about it?

Reply: W. J. Russell

If you are going to take groundwater or dispose of waste where it will emanate into groundwater or water sources, then you require water rights. Immediately you need to comply with statutory requirements. Hydrogeology is concerned with water. Water issues are currently under the Water and Soil Conservation Act. The only hydrogeology problems that don't normally come under this Act are dewatering and depressurisation. I'm not sure what the full implications of the Resource Management Law Reform will be. Whether it will be simpler I'm not certain. My first read of it suggests it won't, so I can't see us getting away from a large legal input at the moment.

Peter Callander, Canterbury Regional Council

What is the appropriate duration of pumping tests, particularly problems with long-term pumping tests? What is the appropriate weighting you put in your analysis to the transmissivity data and the lag time data? What is the applicability of using those results for long-term drawdown calculations as opposed to perhaps using transmissivities determined from flowmeter analyses.

Reply : W. J. Russell

In carrying out a pumping test there are two things you are looking at. One is the aquifer parameters, transmissivity and storativity. More importantly in the long-term test you are looking for aquifer boundaries and you really should continue a pumping test for sufficient time so that you can detect important boundaries that may affect the long term. If you don't see a change in boundary conditions after 1-2 months of pumping, provided that you are pumping at or greater than you intend to pump in the long term, you have some confidence that any boundary that may appear after that time will have limited impact on your resource. In a long-term pumping test you are looking at boundaries, and in a short-term pumping test you are looking for aquifer parameters.

Q. P. Callander, Canterbury Regional Council

Following on, what about the applicability of using those parameters from a pumping test for long term calculations as opposed to perhaps parameters from a flownet analysis that has been calibrated in a model.

Reply: W. J. Russell

That's where some judgement is required. For a long-term pumping test, provided the influence of the pumping has extended out over a large part of the aquifer, you can have confidence in what is going on in a large part of the aquifer. If after a long time you are only seeing a small influence on the aquifer, the confidence that you apply to that result is correspondingly less. Flow net analyses also require permeability as input, and you have to obtain it from somewhere. For example, from published results for particular types of material or from pumping tests. It comes down to the objective of your program.

Q. Dr D. Elder, Soils & Foundations Ltd

What is significant in terms of additional drawdown in groundwater level around the bore which is abstracting water at a level at which it can only just get the water that is available?

Reply: W. J. Russell

I don't think water level or changing water level is the means to determine the impact of pumping from one well on another. I think that it is really whether pumping from one well affects the production from another.

OHINEWAI OPEN-CAST GROUNDWATER PUMPING TEST

I.M. Parton and M. L. Plested, Worley Consultants Ltd
(Presented by M. L. Plested)

Q. P. Kelsey, Earthtech Consulting Ltd

I did some work at Huntly East mine where there was 1 m of settlement at the surface associated with some inflows into the mine workings. Investigation indicated the presence of some highly compressible fine grained ash units at the base of the Whangamarino and I was wondering if they extended up into the Ohinewai area.

Reply: M. L. Plested

I can't recall seeing any such materials at the site.

Q. P. Kelsey, Earthtech Consulting Ltd

You had a maximum of 8 m of drawdown with your long-term pump test. I wonder if a drawdown of that magnitude would in fact realise the full settlement capacity of the Tauranga Group materials when you consider the reconsolidation pressures within the Tauranga Group itself?

Reply: M. L. Plested

It is possible that you are correct that it would realise the full settlement potential, but we were only pumping for 41 days and then we had to recover. We had certain restrictions placed on us under the terms of the water rights which restricted the amount of pumping and the amount of settlement which was tolerable. Consequently we couldn't explore the long-term effects because we didn't reach steady-state conditions.

Q. C. Newton, Works Project Services

Did you have any monitoring devices on your Ohinewai piezometers at all?

Reply: M. L. Plested

Yes, we developed an in-house system with a readout. It was a DC power supplied LCD system which energised the transducer itself and once it had stabilised, which took about a minute to allow the element to heat up in the transducer, we could then get a very stable reading. The transducers themselves also had a gas bleed to the surface so they were atmosphere transducers. that was very handy because we found that we were unsure if some of the installations were producing believable results. We connected a suction pump to the gas venting line on each transducer and were able to generate a pressure differential at the head. Knowing how much pressure we were applying we could determine the output characteristics of the transducer and that it was still working satisfactorily.

Q. D. Scott, DSIR

You commented that you regarded the river as a constant head value, but the drawdown contours suggested it wasn't. Did you resolve this?

Reply: M. L. Plested

We measured about 100 mm of drawdown about 100-200 m from the Waikato River. I'm not a hydrologist myself, but in terms of the model it was satisfactory to assume it was a constant head source or a recharge source.

Q. A. P. Kortegast, Tonkin & Taylor Ltd

Have you done any computations of the final inflows to the boxcut and what were they?

Reply: M. L. Plested

No, we didn't do that. It would have been done in Germany as part of the mine model.

Q. Dr. D. Elder, Soils and Foundations Ltd

I was involved in a laboratory study using electric strain gauge transducers using 20-30 transducers over a 5 year period continuously and became aware that we had long-term problems. We carried out long-term calibration tests which indicated about 20 per cent had zero drift which became unacceptable after about 6 months (an error of about 10 per cent of full-scale deflection). They were high quality transducers and I warn that is just one problem.

Reply: M. L. Plested

At Ohinewai we carried out zero drift tests before they were installed. We also carried out recalibration tests immediately prior to installation. We did experience some zero drift problems with some of the transducers.

Comment: M. Mitchell, Consulting Geotechnical Engineer

Slope Indicator Company (SINCO) only recommend the electrical strain gauge type for short-term pump tests rather than for long-term embankment monitoring.

THE APPLICATION OF INSTRUMENTATION TO GROUNDWATER MONITORING

M. T. Mitchell, Consulting Geotechnical Engineer

Q. P. Millar, Tonkin & Taylor Ltd

Could you comment on the reliability and accuracy of instrumentation you were talking about.

Reply: M. T. Mitchell

There is a need for redundancy in instrumentation. It is a well known fact in any instrumentation programme you will lose 10-20 per cent of your instruments within the first year or so. This may be due to mismanagement at the ground surface or because of other effects following drilling. As far as reliability goes, the vibrating wire piezometer had a bad reputation for a while because of the technique that was being used but that seems to have been overcome now. The electrical strain gauge system was in vogue for a while but the difficulty of working with electricity out in the field has been a problem. With the pneumatic piezometer you seem to lose about 10 per cent per year. The observation well is reliable and I guess that is why we tend to use them.

Q. Anonymous

We have heard about the different types of piezometers, how real is the perceived perception time delay.

Reply: Panel

One panel member noted that he had used 50 mm standpipes in very low permeability material and the response time was several years.

There are several quite good graphs in the literature which show response times versus permeability and soil types.

Unfortunately none of the panel had any personal experience regarding the difference in delay times for different types of piezometers.

DISCUSSION SESSION III - CONSTRUCTION DEWATERING

Chairman: T. Matuschka, Engineering Geology Ltd

CONSTRUCTION DEWATERING

G. J. Kendall, Brian Perry Ltd
(presented by A. Orange)

Q. Dr John Buckeridge, Carrington Polytechnic

You noted that the water chemistry aspects of long term construction dewatering had been taken into account. How was this done?

Reply: A. Orange

Unfortunately I am unable to answer this question from first hand experience principally because of the relatively short time that I was personally involved in the dewatering. On this job, however, what you would investigate for example is the types of materials used in the wellpoints and the frequency of flushing.

Q. K. Anderson, Southland Regional Council

Has ground freezing been used as a method of dewatering in New Zealand?

Reply: A. Orange

No, we have not used ground freezing in New Zealand.

Q. Keith Anderson, Southland Regional Council

Would you like to make some comment on the various stages of construction of the continuous pipeline shown in your slides?

Reply: A. Orange

Basically, you hook up the header line into 50 metre lengths and we have one pump serving each 50 metres but in the header line itself we have various valves and takeoff points back to the pump. This enables us to get all our wellpoints set up ahead of the line and close off sections as we go. Once we have installed the pipe and backfilled the trench we open the system up to the water and pull the heads out, so you have continuous headers so that you can achieve control and isolate certain sections of the line.

NEAR-SURFACE GROUNDWATER HYDROLOGY AND EXCAVATION DEWATERING IN CHRISTCHURCH

D. Elder and I. McCahon, Soils and Foundations Ltd

Q. Wayne Brown, Brown and Thomson

Did you consider using a top down construction system?

Reply: Don McG. Elder

Yes, we examined this system and it was the preferred option. However, it created a number of problems for the structural engineer, in particular the potential deflections in the systems during construction and the time that would be required. The site was also very narrow (i.e. 60 m long by 20 m wide) which would have made it difficult to get construction equipment down through the floor.

Q. Nigel Fitch, Riley Consultants Ltd

You mentioned that you expected settlements up to 35 mm at the site in Christchurch. Where were these settlements expected and what sort of effects did they have on the neighbouring buildings?

Reply: Don McG. Elder

The settlements were estimated to be 25-30 mm. They were estimated to occur underneath the strip footings along the boundary of the adjacent buildings. Fortunately, the adjacent buildings where these settlements would have occurred were owned by the same client, i.e. Telecom.

The building under which the maximum settlements were expected to occur was not deemed to be of historical value. Therefore some cracking of the structure was accepted by the client.

Q. Ian Thompson, Carryer and Associates

How much design did you perform on the dewatering holes and was there any attempt to avoid the problems with ingress of sand into the wells by matching the well screens with the sediment that was being dewatered?

Reply: Don McG. Elder

Yes, a lot of analysis was performed. We first analysed the site as a large hole in the ground and computed total inflows and drawdown on a regional basis. We then used 2 dimensional flownets to examine each area of particular interest.

In answer to the second part of your question, we recommended wedge wire screens as we felt that they were well matched to the sediment and would have prevented migration of the sand that was in the area.

In the wells that did cause problems the Contractor had elected to use slotted pipe.

Q. Trevor Matuschka, Engineering Geology Ltd

Does the Telecom building have a permanent dewatering system and if so, what is its nature.

Reply: Don McG. Elder

No, the building has not been designed with a permanent dewatering system. The present system can be switched off when construction has reached the third floor level. The basement itself is being sealed.

DISCUSSION SESSION IV - SEEPAGE PROBLEMS IN NATURAL GROUND

Chairman: N. S. Luxford, Babbage Partners Ltd

MONOWAI MINE REDEVELOPMENT : PREDICTION OF GROUNDWATER INFLOWS

I. M. Parton and M. L. Plested, Worley Consultants Ltd (presented by M. L. Plested)

Q. J. Hadfield, Waikato Regional Council

Given the nature of the assumptions you made on the permeability in the Monowai mine, what sort of calibrations did you do to the finite difference model and what kind of sensitivity analysis did you carry out?

Reply: M. L. Plested

What we did was, having developed the model itself, we tried the model with a range of permeabilities in it and investigated the effect that had an outflow from the model once it had reached steady-state. We then compared that with observations of outflow from the reef and inspection of the surface of the ridge in which the reef was located. The range of permeability values considered were based upon our experience of the nature of the materials encountered in the boreholes and a review of results from previous studies in a similar environment.

SUBSURFACE EROSION AND SEEPAGE IN BANKS PENINSULA LOESS

M. D. Yetton, Soils and Foundations Ltd

Q. J. Sekula, Beca Carter Hollings and Ferner Ltd.

In work I was involved with in Hongkong we found a correlation between grading and erosion potential and in particular the importance of gap grading. Did you find this with your work? Did you find what controlled the preferred direction of development of the underground erosion tunnels?

Reply: M. D. Yetton

Loess within its relatively narrow size range of coarse clay to fine sands is very smoothly graded because of its aeolian origin and you don't get a gap graded situation. Gap grading doesn't seem to be a factor with loess, although it may be with other materials. I know that subsurface erosion does occur in colluviums in the Southern Alps in places, and they are gap graded.

The pattern of erosion in plan view appears to be haphazard, but I suspect that originally it develops along fissuring within the soil and as long as there is a downslope component to a particular desiccation crack the tunnel will develop. So we find in plan view that the tunnels zig-zag across the slope and its typically dendritic with one outlet and multiple inlets. This makes investigation very difficult. The outlet and inlet points may be easily located but in between it is extremely difficult to assess and the only really good way to find out is to get in and dig. Trenches can be cut across it, although that is not possible in many cases.

Comment: L. D. Wesley, University of Auckland

I would like to commend Mr Yetton for his comments about the pinhole dispersion test and I think a lot of people would agree with them. The 'Sherard' use of the term dispersion does seem to have distorted the way one ought to evaluate what is happening. I would have a slight reluctance to try to devise any alternative standard method of interpreting the test. I would prefer to have the technician actually report what happens or do the test myself. I'm thinking of some extreme situations where some soils swell and rates of flow will decrease although dispersion and erosion are going on e.g. bentonite. You need to be aware of what is going on in the test.

Comment: P. Jackson, Far North District Council

When I was with Works in Dunedin we had experience in the Maniototo Irrigation Scheme with sink holes and under-runs. We found that the subsurface radar was a useful technique for picking up under-runs and we found that the natural cracking system formed the basis for the under-runs. We also found a significant difference between distilled and tap water when doing pinhole dispersion tests.

Q. P. Hawker, Consulting Engineer, Gisborne

Is there any concern that erosion could take place along the grout used to fill the erosion channels and the adjacent soil?

Reply: M. D. Yetton

That is the big danger and that is why it is important to work out where the water is coming from. In this case we were able to do that and intercept it at other places. In addition, Novaflo was pulled through the cavity first so there is still drainage and the permeability of the slurry is at least a couple of orders of magnitude higher than the surrounding loess. Consequently, it would have no problem handling natural seepage flows. I would caution about using grout without understanding the source of seepage and all seepage paths, otherwise it could be a recipe for disaster.

Q. P. Callander, Canterbury Regional Council

Did you look at the mineralogy of the clays within the loess? Are there any active clay minerals in loess which might affect their erodability?

Reply: M. D. Yetton

Loess contains about 15 per cent clay fraction. There may be 2-5 per cent feldspsar and quartz produced by glacial crushing. However, the bulk of the clay fraction is illite or montmorillinite. Illites are not particularly active.

Q. T. Phipps, Northland Regional Council

I wondered if tree roots may have contributed to erosion of the loess?

Reply: M. D. Yetton

I have seen tunnels along decomposed tree roots which have been feeders to larger tunnels. I don't think the trees start the erosion. However, after the erosion has begun and once the erosion path is under the tree then tree roots, spider holes, desiccation roots etc are going to be little drains down into the original erosion tunnel. Trees in fact generally reduce desiccation in soil and even out the range of moisture content, and so they are beneficial to preventing tunnel erosion.

GROUND STABILISATION WITH COUNTERFORT DRAINS - DESIGN, INSTALLATION AND MONITORING OF DRAWDOWN PERFORMANCE

N. Fitch, Riley Consultants Ltd

Q. Andrew Du Fresne, Infiltrol

Did you use continual monitoring on your boreholes to get the results on Figure 3?

Reply: Nigel Fitch, Riley Consultants Ltd

What we actually used were peak level indicators. We had some small PVC tubes with a hole at the top which allows water in and small coloured beds which float up when in the water. So when we anticipated a certain area within the borehole where the water would rise, we put a whole lot of these beads on a weighted string at that zone and dropped it in, and in a day or two after the rain peaked, we came out and checked just exactly how high the water did get.

Q. Andrew Du Fresne, Infiltrol

Did you give any consideration to using filter cloth right around trench and if you didn't use it, what was the reason?

Reply: Nigel Fitch, Riley Consultants Ltd

Yes, filter cloth was used on that job. First of all, the stand pipes were wrapped in filter cloth to prevent clogging and secondly we used filter cloth only in the bottom of the pipe. We looked into trying to wrap the whole trenches with filter cloth, which of course is the ideal solution. However, when you've got a 7-metre deep trench which is going to collapse in twenty minutes and you're trying to get the cloth down into it, and you only have about 6 metres of it open at any one stage, it becomes rather difficult.

Q. Graham Ramsey, Beca Carter Hollings & Ferner

In constructing a facility which is required to operate through the life of a development, have you given any consideration to the long term, and by this I mean maybe 20-50 years performance? Is there any record or check whereby current and future owners are aware that they are actually sitting on a piece of land which is suitable for use as a result of some engineering? Is there any provision made on the council records or client list to show this engineering has taken place?

Reply: Nigel Fitch, Riley Consultants Ltd

In the example given in the paper and in several other recent projects we've worked on, there has been a restriction on the title that first of all development had not been allowed until it had been proven that the drainage was successful and secondly, it had been warning future owners to the location of these drains. The councils usually require that the outfalls be located where they can be monitored and the drain locations are very carefully surveyed so that if necessary the upper end can be dug out to flush out the drain if there is ever a problem in the pipe itself.

Comment: (unknown)

In terms of what might be coming in the future with the new N.Z. Building Code, with any house there should be occupancy certificates issued for properties on some regular basis which could be a very effective means of monitoring installations and insuring they are checked out on a regular basis so that the safety of the site is insured. It seems to me that it is a bit of a limitation in terms of those activities at the moment.

Q. Wayne Brown, Consultant

Regarding the use of the drains where there's an element of risk during construction and an even more major failure, how do you compare that to the alternative of just drilling a series of holes?

Reply: Nigel Fitch, Riley Consultants

In most cases where we had used counterfort drains the site geometry has been such that horizontally drilled pipes would not have worked. It wasn't at a suitable outlet area either at a small dip or something to drill through or any other area where a hole could have been dug to get deep enough into where we thought the water was being carried.

Q. Mark Mitchell, Hamilton

I would like to make a comment on the long-term performance of counterfort drains. There is a potential for algae growth within the drains itself, and I'd just emphasise the fact that you do need to be able to flush the pipes out with a high pressure jet.

Reply: Nigel Fitch, Riley Consultants

At the upper end of our trenches we tend to slope the pipe up and finish it about a metre and have that spot well surveyed in so we know exactly where it is and can get to it later.

Q. Anonymous

You say that you preferred a certain material in your trench. Would you not be concerned with migration of sediment into the trench itself if you used just that material as opposed to say an even graded GAP25?

Reply: Nigel Fitch, Riley Consultants

In practice a GAP20 or 25 plots up similar to the F2 grading. If you go through a full analysis looking at the actual soil and getting down to the size of the slot in the pipe, you usually find that you need two filter mediums to comply with D60 over D15 ratios. However, when you've got a trench 7 metres deep which is going to collapse in twenty minutes, it is a bit difficult to try and get your materials and layers vertically straight across the trench, so you have to compromise somewhere.

EFFECT OF GROUNDWATER ON STRENGTH OF LOESS

S. Goldwater, University of Canterbury (presenter)
D. McG. Elder and M. H. Yetton, Soils and Foundations Ltd
D. G. Bell, University of Canterbury

Q. Prof. M. Pender, University of Auckland

Figures 2-5 of your paper have contours of strength obtained with a hand shear vane on a diagram with dry density on the vertical axis and water content on the horizontal axis. If I understand correctly you compacted the samples at these various conditions and used the vane to obtain a measure of the strength. I'm wondering what happens in-situ when the moisture content changes. If the moisture content increase (i.e. move to the right on your diagram) does the strength follow the contours, or is it something different altogether?

Reply: S. Goldwater

We tried that, but the loess samples didn't saturate completely. So we haven't really evaluated that effect.

Comment: Prof. M. Pender, University of Auckland

It occurs to me that in practice this may be of interest. I would also like to make the comment that the notation used in your diagrams Su refers to undrained shear strength. I would prefer to use an alternative notation for the vane strength shown on the diagrams. The samples are not saturated and although the vane is a measure of strength, it is not strictly speaking undrained strength as this only applies to saturated soils. It is a pedantic point of view but in teaching the subject it is the sort of clarification we need to have.

DISCUSSION SESSION V - EMBANKMENT SEEPAGE

Chairman: P. Riley, Riley Consultants Ltd

CONTROL OF ARTESIAN PRESSURES BENEATH THE PATEA DAM

D. V. Toan, Beca Carter Hollings and Ferner Ltd

Q. Anonymous

The layer of sand across the valley was a fairly variable material and your sub-section is two-dimensional straight through the centre of the dam. The cutoff trench was cut across the base presumably only where the layer could be reached. Was that sufficient to completely cutoff that sand or was there seepage around the end? Did that layer extend under the dam giving you recharge which could have perhaps explained the higher values?

Reply: D.V. Toan, Beca Carter Holling and Ferner Ltd

No, the geologists' interpretation was that the same layer was definitely a valley infill deposit and that the underlying dense clay material was continuous from below the sand layers and up the sides of the valley and I think the borehole certainly confirmed that. This is in contrast to the situation at Patea where that sand layer in fact extended for 100 kilometres in either direction and so no cutoffs possible there.

Q. N. S. Luxford, Babbage

At Patea, between the natural ground between the reservoir and the manmade dam, what work went into the investigations particularly relating to the seepage through it? I noticed you put what looked like horizontal drains there. What protection around those drains did you put in?

Reply: D. V. Toan, Beca Carter Holling and Ferner Ltd

The investigation through the ridge between the lake and the downstream side was carried out by mainly geological survey of the exposed face which was exposed on both sides of the ridge for quite some distance. There were a few bores put in, but one thing that we did not realise, was the existence of some relief cracks that existed not parallel to the face but at some angle to the face. In the past when the river was much lower, 20 metres or so, this caused some quite interesting gothic caverns, which are quite large, all infilled with debris.

Of course the postulation is that if we found them in the dam site, where else are they? We did find another one which was intercepted by some of our drains. Those drains were flowing at 4-5 times the rate of the other drains. Because of that concentrated flow we were concerned about erosion internally in that joint so we grouted that up. It was a hair-raising exercise to try and grout just behind the face at high pressure and to lift the grout up high enough to seal that area. It worked and all the drain groups are flowing fairly evenly showing that the regime is now even rather than uneven with one joint forming a drain. The behaviour of that bank since the time of construction has been now well looked at and it seems to be behaving all right. The sandstone itself is not subject to piping.

Q. N. Luxford, Babbage

What protection around those horizontal drains did you provide?

Reply: D. V. Toan, Beca Carter Holling and Ferner Ltd.

The horizontal drains are embedded in, for a certain distance, a collar of concrete. They're also slotted inside with an internal filtered drain which has to be replaced every so often because of fungal deposits which are toxic.

Q. Mark Yetton, Soils and Foundations

I'm intrigued by the hissing that you heard. I wonder is this common in rock material with seepage under pressure? The other place you'd expect to hear about it is in tunnels.

Reply: D. V. Toan, Beca Carter Holling and Ferner Ltd.

The total amount of flow over that fairly narrow width of limerock is around about 70 litres a minute, so it's not a high amount. The shaft which we were trying to intercept the joint was around manhole size. We found the joint and grouted it. But right around the face on the upstream side, there is movement of water as it seeps downwards. We were happy enough to leave the situation but kept under a tight review all the time.

DISCUSSION SESSION VI - GROUNDWATER CONTAMINATION

Chairman: Prof. D. K. Todd, David Keith Todd Consulting Engineers

UNDERGROUND HYDROCARBON SPILLAGE - A CASE HISTORY ON INVESTIGATION, REMEDIATION AND RISK EVALUATION

A. G. Kroon, Shell Oil New Zealand Ltd (Presenter)
P. E. Brown, GCNZ Consultants Ltd

Q. D. Jennings, Works Consultancy Services

You mentioned that the velocity of the aquifer was about 2.4 m/day. That should mean that in the 18 months since discovery of the event the travel distance would be about 1200 m. I wonder if you have any information about how far the movement has occurred?

Reply: A. G. Kroon

Yes, we have observation wells at 1 km and 1.5 km from the site. We have just started detecting a trace of contamination at about 1 km from the site. The expected time for water to reach the supply well is about 3½ years.

Q. J. Hadfield, Waikato Regional Council

I am interested in refined products (petroleum). How much change occurs with time after a spill? In other words, how much degradation occurs, both physically and chemically? And what affect does this have?

Reply: A. G. Kroon

There is a major change, due to base separation. This gives a major change, especially in the lighter compounds like gasoline; this will change the immiscible phase and the dissolved components that flow on from that. That certainly is a major factor which has to be taken into account. Individual components will break down at different rates.

Q. P. Jacobsen, Far North District Council

What standards are the petroleum industry using to identify leaks?

Reply: A. G. Kroon

Well, that's a pretty hot topic at the moment. All I can say is that we are trying to do something about this, along with other authorities. But we are trying to prevent leaks at the source, rather than put the ambulance at the bottom of the cliff.

Q. Soeng Kong

As a resident of Wellington my question is, what is the present monitoring system?

Reply: A. G. Kroon

The present monitoring that is going on is regular sampling of water, and anything that might be contained in the bores we have in place. I think we have 8 boreholes in place. Results from tests are referred to the regional council at 3 monthly intervals. We consult with the council to determine what ongoing action is required.

Q. Soeng Kong

Can you tell us the spacing of the monitoring wells?

Reply: A. G. Kroon

The nearest well is about 13 m from the spill site, the next one is about 50 m away, and then 500 m, 1 km and 1.5 km.

Q. C. Tipler, Lincoln University

You mentioned biological degradation. Can you tell us any more about this? Is it significant?

Reply: A. G. Kroon

That's not something we've really tried to analyse. It is occurring, that's about all we can say. We are trying to get information on it just by watching what happens at the boreholes downstream.

SYNTHETIC LINERS - THE ULTIMATE SOLUTION?

A. H. Nelson, Earthech Consulting Ltd

Q. P. Riley, Riley Consultants Ltd

I was interested in the Kettleman Hills failure which involved sliding of refuse on a synthetic liner. The manufacturers have said that they can now provide roughened surfaces, i.e. textured surfaces to increase the friction angle. Do you have any experience of this?

Reply: A. H. Nelson

Yes, evidence to date suggests that where the artificial material is used to cap the landfill, that is where the stress is very small, the textured surface does help. Beneath the landfill, where the stress is high, it doesn't appear to have much effect, and you are back to the same friction angles as with smooth material. The texture has little effect, though testing has been very limited.

THE USE OF RISK ASSESSMENT IN EVALUATING THE HYDROGEOLOGICAL ASPECTS OF A HYDROCARBON SPILL

P. E. Brown, GCNZ Consultants Ltd (presenter)
S. Wood, GCNZ Consultants Ltd

Q. M. Yetton, Soils and Foundations Ltd

My question relates to petroleum products. Is there no resistivity method which can be used to trace these things? If you are using boreholes, it seemed to me there might be some way resistivity could be used.

Reply: P. E. Brown

Well, in urban areas, there is a real problem with resistivity because there are too many other things causing interference - too many blurred wires and pipes etc. It is seldom that a site suitable or ideal for resistivity is found. Also you would have to have a pretty substantial leak for resistivity to be effective. Soil gas monitoring is considered the most effective.

Q. L. D. Wesley, University of Auckland

On the question of risk assessment, I understand the basic points are identifying the hazard and the risk of it occurring, and then evaluating the consequences if it does in fact occur. Is there a real possibility that some hazards or risks will simply not be identified, and this will invalidate the study?

Reply: P. E. Brown

Well yes, that is a possibility. The way to avoid it is to make use of a wide range of people from different disciplines. People from different backgrounds will identify different risks, and in this way the likelihood of failing to identify some hazards is minimised.

DISCUSSION SESSION VII - DISPOSAL OF WASTES BY GROUND SOAKAGE

Chairman: G. Leggett, Beca Carter Hollings and Ferner Ltd

THE ROLE OF EVAPO-TRANSPIRATION SEEPAGE (ETS) IN ON-SITE WASTEWATER DISPOSAL FROM HOUSEHOLDS AND INSTITUTIONS

I. W. Gunn, University of Auckland

Q. Paul Jacobson, Far North District Council

How good is U.V. treatment of sewerage? A section size is mentioned of 5000 m^2. How does it compare with your recommended design procedure?

Reply: Ian Gunn, University of Auckland

It is acknowledged that organisms can be activated by U.V. light disinfection. Evidence shows damage can be repaired once activation is left.

Second part of question - 5,000 m^2 quoted incorrectly. Section size set at what you require and I'm not in favour of setting blanket sizes. Projects are set at what is required which may be a mixture of sizes.

Q. Cliff Tipler, Agricultural Engineering Institute, Lincoln

How does your ETS system fare with nutrient removal and bacterial fill?

Reply: Ian Gunn, University of Auckland

The ETS system was initially designed with a completely sealed bed and plastic liner. However in New Zealand's rainy climates one can't avoid the system filling up with liquid so total (TET) is used i.e. poor sub-soil, build seal-bed with overflow and bed with 2 weeks detention time in gravel spaces. This provides nutrient uptake into plant matter composted on site and then bacterial die-off in 2-weeks detention time. Other option is to use 600-700 mm sand above natural ground then filtered into water. Top soil is planted on top to assist evapo-transpiration. The Taupo area has PET (partial evapotranspiration), which is a sealed bed with sealed base and no sides where the effluent comes down and infiltrates sideways over the width of the trench. DSIR investigations 6-7 years ago showed very high nutrient removal system due to nitrification and anaerobic denitrification in that system which protects ground water table.

Microbiologists will endeavour to argue viruses need to be knocked on head straight away. The fact is viruses don't kill people. Engineering has more down-to-earth attitude. Waste into the ground does control spread of disease, however, this is not accepted by the Microbiologists.

EFFLUENT DISPOSAL SYSTEMS - A LOCAL AUTHORITY VIEW

R. J. Lorden, North Shore City Council (presenter)
L. G. Scott, North Shore City Council

Q. Peter Ollivier, TSE Group

Could you comment on how well the disposal systems are operating in Mansfield?

Reply: R. Lorden, North Shore City Council

Failure figures were based on a survey in 1975 and the purpose of the survey was to determine the size of problems to enable better design systems. Hopefully what's at Mansfield is better. Engineers agree better soils are obtained by building mounds over swampy areas to allow more development. The subdivision is only two and half to three years old. However, home-owners appreciate leaflets explaining white ventilation vents and what they're for. It is important for people to understand the operation and maintenance requirements of the systems.

COMPUTER MODELLING OF SEEPAGE FLOW TO STUDY THE ENVIRONMENTAL EFFECTS OF DISPOSAL OF SEPTIC TANK EFFLUENT BY DEEP SOAKAGE IN ENVIRONMENTALLY SENSITIVE AREAS

D. Jamieson, GCNZ Woodward Clyde Consultants Ltd
N. V. Mark-Brown, GCNZ Woodward Clyde Consultants Ltd (Presenter)

Q. Hugh Fendall, Consultant

You mentioned when doing deep water soakage tests, they were good and may be adopted. However, the figure given when you spoke was much higher than the figure used when doing the final analysis. Please explain.

Reply: Nigel Mark-Brown, GCNZ Consultants

The permeability values mentioned were from soakage tests in the very highly weathered material in the upper mantle. Permeability values used in the model were from pump tests in deeper bores and representative of the whole aquifer.

Q. Hugh Fendall, Consultant

I would presume that you would get much more lateral spreading than what the model showed?

Reply: Nigel Mark-Brown, GCNZ Consultants

Yes.

URBAN STORMWATER DISPOSAL BY GROUND SOAKAGE

K. C. D. Oldham, Auckland City Council (Presenter)
C. A .Manley, Auckland City Council

Q. Andrew Du Fresne, Infittrol

Extra costs not considered include the effect of seepage into the sewage system and the temptation to use sewage for stormwater disposal due to the cost and unsatisfactory performance of soakholes. Could you comment?

Reply: K. Oldham, Auckland City Council

I agree it is a problem.

A PRELIMINARY STUDY OF EFFLUENT DISPOSAL INTO A WEATHERED GREYWACKE AQUIFER, AND ASSOCIATED IMPACTS, OTEHEI BAY, URUPUKAPUKA ISLAND, BAY OF ISLANDS

P. I. Kelsey, Earthtech Consulting Ltd (presenter)
M. R. Lane, Murray North Ltd

Q. Tony Phibbs, ARC

Your calculation of injection capacity was based on permeability and pump tests using clean water. Do you think characteristics of effluent/nutrients/solids could change that?

Reply: Phil Kelsey, Consultant

The critical thing was back flushing would be used to reduce sedimentation and biological activity.

Q. Wayne Brown, Brown and Thomson, Consulting Engineers

Did you consider pumping the treated effluent into the ocean?

Reply: Phil Kelsey, Consultant

The developer had certain rights to extra groundwater from different bays but ocean effluent disposal would have required consent from the Department of Conservation.

ERRATA

GROUNDWATER AND SEEPAGE SYMPOSIUM
AUCKLAND, MAY 1990

The following list of references was omitted from the paper at the above symposium entitled:

"The Nature, Occurrence and Engineering Significance of Groundwater" by D. H. Bell, University of Canterbury."

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Sixth Australia - New Zealand Conference on Geomechanics

GEOTECHNICAL RISK - IDENTIFICATION EVALUATION AND SOLUTIONS
CHRISTCHURCH, NEW ZEALAND. FEBRUARY 3 - 7 1992

SECOND ANNOUNCEMENT AND CALL FOR PAPERS

Organised by the New Zealand Geomechanics Society, a technical group of IPENZ, in association with the Australian Geomechanics Society, with financial support from the New Zealand Earthquake and War Damage Commission, and endorsed by ISSMFE, IAEG and ISRM.

EQC

EARTHQUAKE AND WAR DAMAGE COMMISSION

INTERNATIONAL SYMPOSIUM ON LANDSLIDES

The Sixth I.S.L. will be held in Christchurch during the following week, February 10 - 14 1992, with a combined field trip to Central Otago over the intervening weekend.

QUEENSTOWN FIELD SEMINAR

A trip to Central Otago will take place between the 7th and 9th of February, centred around the exciting resort town of Queenstown, New Zealand's most popular tourist destination. The trip will be of technical interest, with visits to observe large landslides in the schist derived terrain of the area, and an inspection of the geotechnical aspects of hydroelectric developments in the Clutha Valley. There will also be organised social events, and many recreational activities will be available.

DEADLINES

Submit Abstract:	31 January 1991
Preliminary Acceptance:	15 March 1991
Registration Brochure:	31 July 1991
Submit Full Paper:	31 August 1991
Early Registration:	30 November 1991

NOTE: **The Deadline for Full Papers will be strictly adhered to.**

FURTHER INFORMATION

Information requests or enquiries should be addressed to:

Nick Traylen
Chairman
6th ANZ Conference
Soils and Foundations Ltd
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POSTAGE

Nick Traylen
Chairman
6th ANZ Conference
Soils and Foundations Ltd
P.O. Box 451
Christchurch
New Zealand

OBJECT

This four-yearly meeting of the New Zealand and Australian Geomechanics Societies is aimed at providing a forum for geotechnical engineers, geologists, researchers and others active in the field to present and discuss their work.

VENUE

The Conference will be held at the University of Canterbury, about ten minutes from the city centre. Christchurch is the largest city in the South Island, with a population of about 350,000. It is central to all the major scenic attractions in the South Island for those wishing to extend their stay. Accommodation will be available at local hotels, motels, guest houses and University halls of residence.

LANGUAGE

English

TECHNICAL PROGRAMME

The Conference Theme is "**Geotechnical Risk - Identification, Evaluation and Solutions**". This is consistent with the 1990's being designated "The International Decade for Natural Hazard Reduction".

Specific Sessions for the conference include:

Seismic Hazard, Earth Dams and Embankments, Slope Stability, Aspects of Mining and Tunnelling, Probabilistic Methods, Professional and Legal Aspects, Foundations. A full technical programme will be included in the Registration Brochure, which will be released in July 1991.

KEYNOTE SPEAKER

Professor James K Mitchell, who is the Edward G. and John R. Cahill Professor of Engineering at the University of California, Berkeley, will be giving the keynote address at the Conference. He will speak on the conference theme, with particular reference to the Loma Prieta Earthquake.

FIELD TRIPS AND SOCIAL PROGRAMME

One day of the Conference will be occupied by field trips of both geotechnical and scenic interest. In addition to a half day local field trip of interesting engineering sites around the city of Christchurch, we will offer a choice of one day trips to either Akaroa or Hanmer. The Akaroa trip will look at active slope processes in the loess soils of Banks Peninsula. Hanmer provides an opportunity to visit sites of active faulting and both the trips include social activities.

TECHNICAL EXHIBITS

A technical exhibition run at the Conference will allow either single day exhibiting or continuous exhibits throughout the week. More information is available from the Conference Chairman.

PROCEEDINGS AND PAPER PRESENTATION

A bound copy of proceedings will be available at the Conference. To maximise the number of papers which can be accepted, theme session reporters will summarise papers for general discussion. Individual author presentation will be available at poster sessions.

CALL FOR PAPERS

Papers are invited on the topic of Geotechnical Risk - Identification, Evaluation and Solutions.

The deadline for abstracts has been extended, due to programming refinement, to 31 January 1991. Abstracts should be of no more than 300 words, preferably on a single A4 sheet, with a statement of relevance to the Conference Theme.

PRELIMINARY REGISTRATION FORM

☐ I intend to participate in the Conference

☐ I enclose an abstract

☐ We are interested in exhibiting

☐ I intend to participate in the Queenstown Field Seminar

☐ I wish to receive pre/post conference tour information

☐ I confirm my previous indication of interest

Name _____

Position _____

Organisation _____

Address _____

Telephone _____

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No. of accompanying persons _____

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APPLICATION FOR MEMBERSHIP
of
New Zealand Geomechanics Society

A TECHNICAL GROUP OF THE INSTITUTION OF
PROFESSIONAL ENGINEERS OF NEW ZEALAND

The Secretary
The Institution of Professional Engineers of New Zealand
P O Box 12-241
WELLINGTON

I believe myself to be a proper person to be a member of the N.Z. Geomechanics Society and do hereby promise that, in the event of my admission, I will be governed by the Rules of the Society for the time being in force or as they may hereafter be amended and that I will promote the objects of the Society as far as may be in my power.

I hereby apply for membership of the N.Z. Geomechanics Society and supply the following details:

NAME: _____(in full in block letters, surname last)

PERMANENT ADDRESS: _____

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QUALIFICATIONS AND EXPERIENCE: _____

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NAME OF PRESENT EMPLOYER: _____

NATURE OF DUTIES: _____

Affiliation to International Societies: (All members are required to be affiliated to at least one Society, and applicants are to indicate below the Society/ies to which they wish to affiliate).

I wish to affiliate to:

International Society for Soil Mechanics for Foundation Engineering	(ISSMFE) Yes/No	($10.00)
International Society for Rock Mechanics	(ISRM) Yes/No	($12.00)
International Association of Engineering Geology	(IAEG) Yes/No	($10.00)
	(with Bulletin)	($25.00)

SIGNATURE OF APPLICANT: _____

DATE: ____/____ /19 ____

NB: Affiliation Fees are in addition to the basic Geomechanics Society membership fee of $25.00 which is reduced to $21.00 if member of IPENZ.

PLEASE DO NOT SEND FEES WITH THIS APPLICATION. AN ACCOUNT WILL BE SENT ON YOUR ACCEPTANCE INTO THE SOCIETY.

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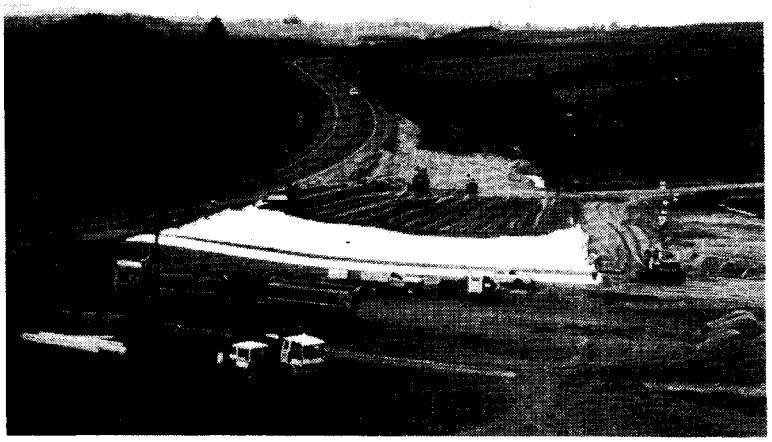

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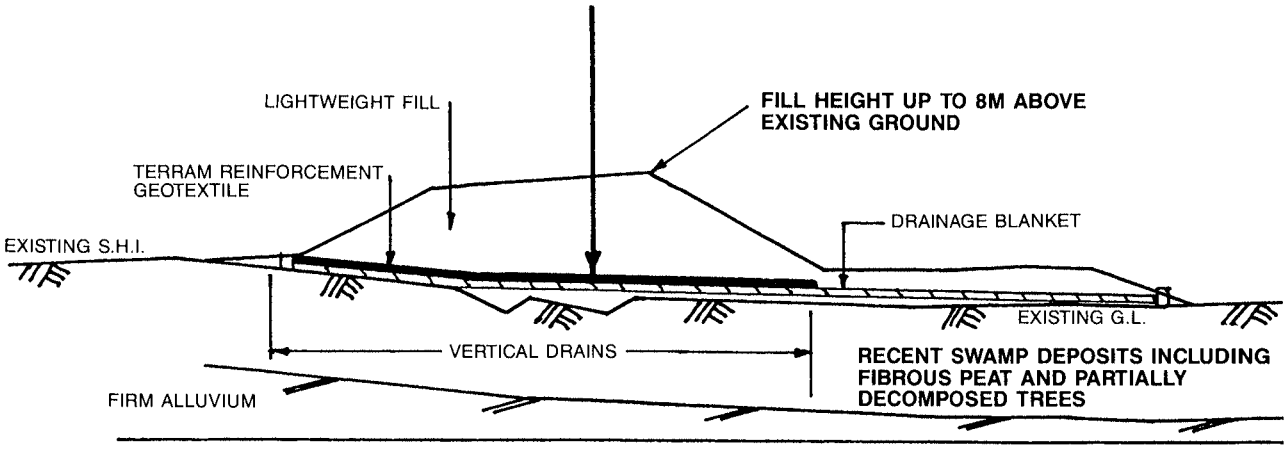

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