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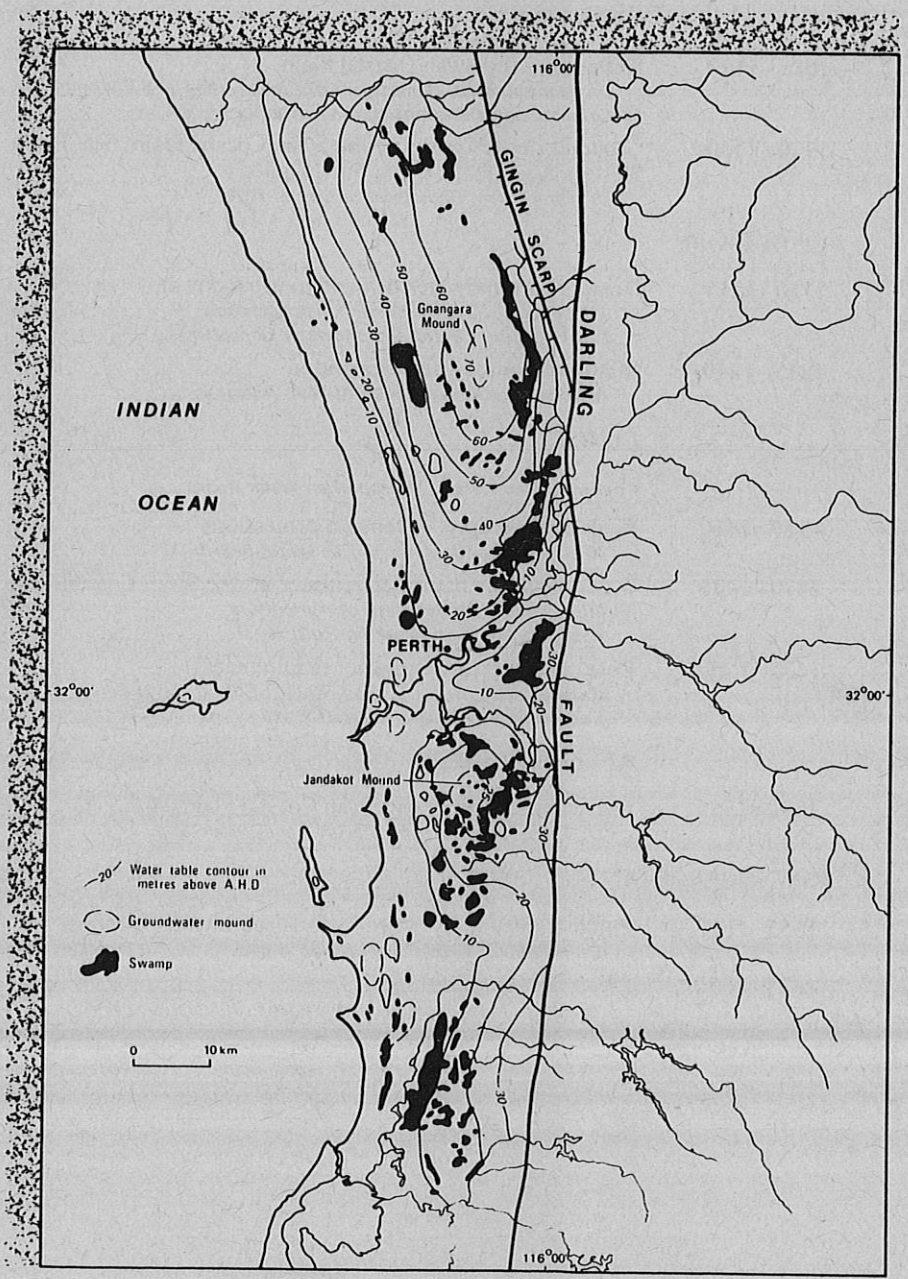
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

The Groundwater Resources of the Swan Coastal Plain 1981

A Public Symposium at the University of Western Australia, May 21st and 22nd, 1981.

ABSTRACTS



the Swan Coastal Plain

Thursday May 21 **Chairman:**
Brian Whelan, CSIRO Division of Land Resources Management

0900–0920 **OFFICIAL OPENING**
Sir Charles Court

0920–0930 **Outline of Symposium Format**
Brian Whelan

THE RESOURCE

0930–0955 **Perth Water Supply – The role of groundwater resources**
Maurice Caldwell, Metropolitan Water Board.

0955–1025 **Groundwater resources of the Swan Coastal Plain, near Perth, Western Australia. I. Unconfined aquifers.**
Dr. Tony Allen, Geological Survey of W.A.

MORNING TEA

1055–1120 **Wetlands of the Swan Coastal Plain**
Dr. Jenny Arnold, Department of Conservation and Environment
Colin Saunders, National Parks Authority of W.A.

1120–1150 **Groundwater resources of the Swan Coastal Plain, near Perth, Western Australia. II. Confined aquifers.**
Dr. Tony Allen, Geological Survey of W.A.

THE DEMAND

1150–1215 **Domestic groundwater demand in urban Perth.**
John Farrell, National Waterwell Association,
Paul Whincup, Layton Groundwater Consultants.

1215–1240 **Industrial groundwater demand.**
Peter Booth, Confederation of W.A. Industry.

LUNCH

Chairman: *Ken Kelsall, Metropolitan Water Board.*

1345–1410 **Perth water supply – Demand projections**
Maurice Caldwell, Metropolitan Water Board.

1410–1435 **Water requirements for agriculture on the Swan Coastal Plain**
Mike Hawson, Department of Agriculture,
Ken Cole, Department of Agriculture.

1435–1500 **Local authority groundwater requirements**
Russell Candy, Geoff Dutton, Robert Elliott, David Porter,
Local Government Engineers of W.A.

AFTERNOON TEA

1530–1555 **Native vegetation of the Swan Coastal Plain, W.A.**
Dr. Libby Heddle, E.M. Mattiska and Associates.

CONSEQUENCE OF USE

1555–1625 **Public water supply schemes and groundwater response**
Chris Pollett, Metropolitan Water Board.

1625–1650 **Effects of urbanization**
Don McFarlane, Geology Department, University of W.A.

Friday May 22 — Chairman: *Barry A. Carbon, Alcoa, Australia.*

0900–0925 — Effect of groundwater use by industry at Kwinana.
Kevin Haselgrove, Alcoa Australia.

POTENTIAL POLLUTION

0925–0955 — Nature of groundwater pollution and description of some sources of pollution.
Steve La Brooy, Dr. Peter Newman, School of Environmental and Life Sciences, Murdoch University.

0955–1020 — The influence of sanitary land-fill on groundwater quality at Hertha Road, Stirling
Trevor Bestow, Geological Survey of W.A.

MORNING TEA

1050–1115 — Bacterial and nutrient transmission through sand: a field study in groundwater pollution from a septic tank in Perth, Western Australia.
Brian Whelan, CSIRO Division of Land Resources Management,
Bill Parker, Department of Microbiology, University of W.A.

1115–1140 — Industrial groundwater pollution in the Kwinana–Owen Anchorage area
Paul Whincup, Richard Barnes, Layton Groundwater Consultants.

1140–1205 — Groundwater recharge with primary and secondary effluents
Dr. Goen Ho, School of Environmental and Life Sciences, Murdoch University.

MANAGEMENT POLICIES

1205–1235 — Legal and administrative control of groundwater in the Swan Coastal Plain
Peter Johnston, Faculty of Law, University of W.A.

LUNCH

Chairman: *Dr. Baden Clegg, Department of Civil Engineering, University of W.A.*

1345–1410 — The role of the Metropolitan Water Board in the management of the groundwater resource
Ian O'Hara, Metropolitan Water Board.

1410–1435 — The role of the Public Works Department in the management of the groundwater resource
John Abbott, Public Works Department.

1435–1500 — Striking a balance
Geoff Savage, W.A. Branch, Australian Institute of Health Surveyors.

AFTERNOON TEA

1530–1555 — Groundwaters management – Must there be conflict?
Dr. Duncan Macpherson, Dr. David Bennett, CSIRO Division of Land Resources Management.

1555–1620 — Investment in bores: Underground water usage from a household perspective
Dr. Geoff Syme, Steve Kantola, CSIRO Division of Land Resources Management,
Dr. Dirk Ditwiler, School of Social Inquiry, Murdoch University.

1620–1650 — Identifying and resolving conflicts
Dr. Henry Schapper, Dept. of Agricultural Economics, University of W.A.

1650–1700 — Closing Remarks.
Dr. Baden Clegg, Chairman, W.A. State Committee, Water Research Foundation of Australia.

PERTH WATER SUPPLY - THE ROLE OF GROUNDWATER RESOURCES

M.J. CALDWELL

Senior Engineer, Forward Planning and Computing Section

MWB

ABSTRACT

This paper briefly traces the historical role of groundwater in the development of Perth's water supply and reviews the merits of developing groundwater resources up to the end of the century vis-a-vis alternative sources of supply.

In order to give a proper perspective to the future role of groundwater resources, the MWB's current approach to long range water resource planning is outlined.

Research into the complex hydrological and ecological mechanisms which govern the environment of the Swan coastal plain is an important component of the overall planning process. The results of ongoing studies by the MWB and others will lead to the development of more refined management strategies for multipurpose use of our groundwater resources.

It is suggested that competent resource management will enable resolution of the various interests competing for use of the groundwater. This is a primary objective of MWB planning.

GROUNDWATER RESOURCES OF THE SWAN COASTAL PLAIN, NEAR PERTH, WESTERN AUSTRALIA

A.D. Allen, M.Sc., Ph.D., senior geologist,
Hydrogeology Division, Geological Survey
of Western Australia

ABSTRACT

The Swan Coastal Plain near Perth is underlain by the Perth Basin containing Permian to Quaternary sediments about 13 000 m thick. Fresh groundwater (<1000 mg/L TDS) occurs in the upper 1000 m of sediments. The main aquifers are the 'superficial formations' (Pliocene - Quaternary), Leederville Formation (E. Cretaceous), and Yarragadee Formation (E - M Jurassic). The 'superficial formations' form an unconfined aquifer which has a net annual average recharge of about 11.5% of rainfall equivalent to about 350 x 10^6 m^3. The Leederville and Yarragadee Formations are confined aquifers with restricted intake areas. Annual recharge is about 75 x 10^6 m^3 and 48 x 10^6 m^3 respectively. A simplified water balance indicates that present estimates are of the correct magnitude but require further verification, and that there is scope for further abstraction. The ultimate groundwater yield will be established by experience and will also depend on the methods and policies for groundwater abstraction.

WETLANDS OF THE SWAN COASTAL PLAIN

Jennifer Arnold, Department of Conservation and Environment

Colin Sanders, National Parks Authority of Western Australia

Abstract: Wetland-related issues raised in the 1976 Symposium are reviewed. At that time, wetlands were seen on the one hand as competitors for the groundwater resource, and on the other as vital components of the natural environment. The extent of the existing wetland resource on the Swan Coastal Plain is discussed in relation to some of the factors which have shaped it; none of the wetlands has escaped the impact of European settlement.

A measure of protection is afforded to many wetlands by reserves managed by Government agencies and, in the urban context, by regional planning. The planning process has proved less effective in providing a mechanism to recognise and protect important environmental resources in privately-owned land in rural areas.

Various views of the values of wetlands are discussed. The view of wetlands as competitors for a groundwater resource or as sources of insect pests and other nuisances is contrasted with more positive perceptions. Positive contributions of wetlands to the urban setting include landscape amenity and places for passive recreation.

The importance of urban wetlands for conservation is very great. Because of the impact on wetlands in rural areas of salination and drainage, urban lakes are significant drought refuges for water birds, and this function may become even more important with further development in the south-west of the State.

The question of how to reconcile conservation needs and open space amenity values in the urban setting is raised. There is seen to be a mismatch at present which may be attributed in part to the public view of what a city lake should be and in part to a lag in translating research findings into practical management strategies.

A brief outline is given of the broad range of research efforts recently completed or in progress which will improve the understanding of local wetlands.

Despite the impacts of changing land use over the last 150 years, a large and diverse array of wetlands remains on the Swan Coastal Plain. The merit of protecting wetlands is highlighted by *The Darling System Western Australia: Proposals by Parks and Reserves** currently before the public. Strong efforts should be made to develop practical management strategies and to provide adequate funding and facilities for proper care of this resource.

**The Darling System western Australia: Proposals for Parks and Reserves*. The System 6 Study Report. Report No 8. Department of Conservation and Environment, Perth 1981.

URBAN GROUNDWATER DEMANDS

John Farrell, Principal of Farrell Consultants,
Irrigation and Reticulation Consultant Engineers;
Past President, W.A. Branch, National Waterwells
Association of Australia

This topic relates to the demand made on the underground water aquifers by domestic consumers who utilise this water source for home requirements, specifically lawn and garden irrigation.

It will outline the background which leads Western Australians to consume almost 50% more water than the Australian average with the growth of an industry that is virtually unique in this country to Perth.

The demand in growth pattern of consumption will be outlined and how that relates to the water restrictions effected in the summers of 1979 and 1980 and the change in the method of charging for scheme water by the Metropolitan Water Supply.

The method of well and bore construction will be described together with details of the various items of equipment used, covering screens, bore casings, pumping units, etc. It will be shown the radical effect that recent dry seasons, particularly those years on restrictions, have had on the industry and the consumer.

In summary, we will analyse future trends and make a recommendation as to expanded Government involvement and legislation to regulate and control undoubtedly our greatest resource and provide stability and direction for an important industry.

INDUSTRIAL GROUNDWATER DEMAND ON THE SWAN COASTAL PLAIN

ABSTRACT

There is little formally documented information available to provide information on Industrial groundwater demand. Many industries do have their own records and can provide accurate details on their water balance. Other industrial users do not have detailed information available and it does not seem that there is any central overall coordination or recording of information for all industrial consumers of water. This paper provides some background to the information that is available and broadly summarises this to indicate demand, use and recycling aspects, noting the figures that are available.

THE AUTHOR

Peter F. Booth, B.E., C.Eng., F.I.E.Aust., F.I.Mech., Chief Executive and Principal Engineer, P.F. Booth and Partners Pty. Ltd., Consulting Engineers. (Previously Corporate head of Engineering for Mt. Newman Mining Co. Pty. Limited.)

PERTH WATER SUPPLY - DEMAND PROJECTIONS

M.J. CALDWELL

Senior Engineer Forward Planning and Computing Section

MWB

ABSTRACT

The paper describes the method currently used to estimate long range quantitative demands for water and presents the results of studies carried out to date by the Board's water resources planning team.

The projected total annual demands for water in each year up to the year 1999/2000 are listed, together with the expected contributions required from groundwater resources to meet these needs.

ABSTRACT

AGRICULTURAL GROUND WATER DEMAND

K.S. Cole and M.G. Hawson
Western Australian Department of Agriculture

Agricultural development on the Swan Coastal Plain near Perth has centred mainly on the production of fresh vegetables, the planting of vines for fruit and wine production and limited areas of fruit trees such as citrus. Some dairying was practised on the summer damp areas. More recently, lucerne, poultry and pig production and horses for racing, trotting and pleasure riding have added to the diversification of activity in this region.

The nursery industry has increased also with more emphasis on the production of native plants and vegetable seedlings.

Although the climate of this area may appear unsuited for many agricultural activities, the abundance of large volumes of water at shallow depths supplies essential water for crops and animals. Overhead sprinklers are used mainly for the application of irrigation water and this aids also in cooling the crops during the long hot summer.

It is estimated that agriculture uses about 24m m^3 of water on the Swan Coastal Plain. The vegetable industry is by far the largest consumer with 41 per cent of the total volume.

Production of vegetables has not kept up with population demand leading to the importation of many lines from eastern States and overseas.

It is expected that the overall future demand for water for agriculture will tend to increase slowly, although there will be changes within each industry.

LOCAL AUTHORITY GROUND WATER USAGE

Robert W. Elliott
Russell I. Candy
Geoffrey F. Dutton
David E. Porter
Local Government Engineers Association of W.A.

ABSTRACT

A survey covering ground water usage by Local Authorities in the Perth Region was undertaken and information collected on ground water usage, areas requiring research and projected demand.

Local Authorities within the study area utilise approximately 35 million kilolitres of ground water per annum and of this 96% is used for the reticulation of 2795 ha. of Public Open Space. Ground water is used for this purpose due to its availability and relative low cost in comparison with water from the Minister's mains.

The utilisation of groundwater for reticulation purposes is not without its difficulties however, and Local Authorities are confronted with a number of problems that affect the ease and economy of water recovery and use. The majority of ground water contains iron which in addition to causing unsightly stains, also affects plant growth. Aggressive water is another problem encountered in some areas, which has resulted in considerable expense due to the short life of pumping equipment. These and other problem areas discussed still require considerable research and development work.

There is considerable demand from residents to improve recreation facilities and this often involves the installation of reticulation systems. Local Authorities have estimated that their usage of ground water will increase by 30% over the next ten years.

NATIVE VEGETATION ON THE NORTHERN SWAN COASTAL PLAIN, WESTERN AUSTRALIA

Dr. E.M. Heddle
E.M. Mattiska and Associates

ABSTRACT

The population of Perth is currently dependent upon an integrated water supply system from underground water on the coastal plain and surface water on the Darling Plateau. The recent series of below average annual rainfall years, the driest on record for Perth, has placed even greater demands upon these resources. In view of the increasing recognition of the need to conserve representative flora and fauna, a series of studies was initiated, by a range of organisations, to monitor the influence of the withdrawal of underground water on the native vegetation. The difficulty in predicting such an influence is dependent upon the ability to understand these plant communities and their relationships with existing environmental conditions. On the northern Swan Coastal Plain earlier work by Havel delineated the main determinants. Recent work by Heddle, in conjunction with the Metropolitan Water Board and the Forests Department, attempts to delineate the reaction of the native plant communities to fluctuations in environmental conditions, particularly water stress. Results support earlier predictions, by other workers, on the likely influence of a water stress situation.

PUBLIC WATER SUPPLY SCHEMES AND GROUNDWATER RESPONSE

C G POLLETT
ENGINEER, METROPOLITAN WATER BOARD

ABSTRACT

Pumping of groundwater from Swan Coastal Plain aquifers by the Metropolitan Water Board's public supply wellfields induces a water level response which has important implications for groundwater planning and management. The size and extent of the response is determined by aquifer properties, recharge conditions and pumping rates. The prediction and assessment of the response, whilst complicated by the presence of other hydrologic changes, is a fundamental consideration in the planning, design and management of wellfields. The MWB has accordingly undertaken groundwater monitoring and modelling, and studies of wetland hydrogeology and native vegetation. The abstraction of shallow groundwater by wellfields has produced a smaller water table drawdown than predicted because of greater leakage than anticipated from sedimentary layers above those from which water is drawn. This result is favourable for wetland and flora conservation and for other shallow groundwater users. The response of the groundwater system to pumping, rainfall variations, and land use changes is being evaluated by a combination of long term groundwater monitoring, modelling studies, aquifer testing and water balance investigations.

THE EFFECTS OF URBANISATION ON GROUNDWATER LEVELS AND CHEMISTRY IN PERTH, WESTERN AUSTRALIA.

by D.J. McFarlane
Post-Graduate Research Student,
Geology Department,
University of Western Australia

ABSTRACT

Urbanisation disturbs the long term equilibrium achieved by the unconfined aquifer. Following clearing and urbanisation, three factors contribute to a rise in the water table - decreased transpiration and interception of rainfall by vegetation, the addition of imported waters by septic systems and irrigation, and increased recharge from shedding areas. Evidence is presented to indicate the importance of the latter factor relative to the other two. Two factors tend to oppose the rise in the water table - the removal of water by bores and flood mitigation drains. The final equilibrium will depend upon a number of factors, the most notable being housing density, the quantity of water extracted by bores and the type of sewerage and drainage system adopted. Housing density affects both the amount of concentrated recharge that occurs and the area requiring irrigation (and often the proportion of this area being watered with groundwater). The quantity of water extracted by bores depends upon socio-economic factors, the imposition of water, restrictions and block size. The type of sewerage and drainage system adopted depends upon State and Local Government policies.

As urbanisation changes the inputs and outputs of the hydrologic cycle it has the potential to change the chemistry of the groundwater. Mechanisms are outlined whereby groundwater salinity, iron content and hardness may be changed in urban areas.

EFFECTS OF GROUND WATER USE BY INDUSTRY AT KWINANA

Kevin D. Haselgrove
Alcoa, Australia.

ABSTRACT

The shallow, unconfined ground water on the coastal strip is an ideal water resource for the industries at Kwinana. Because of the high aquifer transmissivity the water can be extracted cheaply and without environmental effects due to draw-down. The water would otherwise discharge into Cockburn Sound.

Alcoa has a network of bores monitoring the saline interface and any movement is imperceptible. The industries appear to be pumping at about the safe limit of abstraction. If local saline intrusion problems occur, remedial action can be taken, such as to widen the well fields. The saline wedge presents no threat to ground water users to the east of the industrial strip at present levels of abstraction.

NATURE OF GROUNDWATER POLLUTION AND DESCRIPTION OF SOME SOURCES OF POLLUTION

S.R. La Brooy

Tutor in Environmental Engineering, Murdoch University

ABSTRACT

Our sandy soils are highly porous so able to soak up the bulk of the precipitation that falls on them, to give an unconfined aquifer at shallow depth. Undesirable liquids or soluble materials in contact with the soil can only be prevented from reaching the groundwater if they are fixed in the soil by chemical reaction, biological action or ion exchange. The potential for this depends on the particular soil type. Quindalup sand has some attenuation possibilities from its calcium carbonate content. Spearwood sand has a clay fraction that can fix some pollutants, but Bassendean sand is virtually useless, being almost pure silica. Peaty swamp soil, alluvial and gravel areas can achieve greater attenuation if there is sufficient depth of soil above the water table. Limestone areas are generally even worse than the sands, as their highly fissured nature provides an easy path to the groundwater. Thus pollution control has to rely mainly on prevention.

Our pollution problems are still localised and arise from a slow build up of nutrients and toxic non-biodegradable chemicals. Fortunately natural levels of nutrients in the groundwater are low. However, even if serious problems are not observed yet, there is no room for complacency. It may take decades for aquifers to be rendered useless for water supply, and even longer to reverse the situation. A number of management questions may be posed:

1) Mining and large industrial waste disposal ponds have all the technology available but are still inadequate in eliminating pollution - does this mean we should build no more of them?

2) Agriculture and market gardens - is the slow build up of nutrients reaching the stage where farmers should have their use of fertilisers controlled?

3) Medium and small scale industries ' back yard' disposal - has this reached the stage where much tighter requirements are needed, such as a centralised disposal system?

4) Domestic septic tanks, urban run off, sewage recharge and sanitary landfill - is there a real problem in nutrients, chemicals, bacteria and viruses?

THE HERTHA ROAD SANITARY LAND-FILL SITE AND ITS INFLUENCE ON GROUNDWATER

TREVOR T. BESTOW

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA
PERTH AUSTRALIA

ABSTRACT

A major sanitary land-fill situated on the site of a former swamp in the City of Stirling has been the subject of detailed hydrochemical study. Seven sets of boreholes have been used to periodically recover pumped samples from within the land-fill and the underlying regional groundwater system over a period of six years. Study of the tracer variance in time and place shows that the components of the pollution plume fall into two groups: those due to natural evaporative concentration of the accession from rainfall and which are essentially stable with respect to time; and those which originate within the introduced land-fill and show variance in both time and place. All components exhibit marked differences in ionic mobility in response to the control exercised by peat, which together with dilution in the main aquifer, brings tracer concentrations down to acceptable levels at nearby pumping boreholes.

BACTERIAL AND NUTRIENT TRANSMISSION THROUGH SAND: A FIELD STUDY IN GROUNDWATER POLLUTION FROM A SEPTIC TANK IN PERTH, WESTERN AUSTRALIA

Brian Whelan, CSIRO, Division of Land Resources Management
Bill Parker, Dept. of Microbiology, University of W.A.

ABSTRACT

A two month survey of bacterial and tracer dye (Rhodamine Wt) transmission from an operating domestic septic tank system in Bassendean sand was undertaken. The area has a high water table and large open drains.

The extent faecal coliforms (FC), nitrogen, phosphorus and tracer dye from the leach drain travelled was assessed by means of small observation wells installed in the garden and subsequent soil-profile analysis. Results showed that FC organisms were able to reach the water table in the direction of the water table gradient.

Soil profile analysis indicated that the soil beneath the septic tank end of the 9 m leach drain was saturated with percolating effluent, providing a continuum of water from the leach drain to the groundwater. As a consequence, the soil profile was anaerobic. At the other end of the leach drain the soil profile was unsaturated and aerobic. The soil aeration status controlled the form of nitrogen in the soil water and consequently the soil pH. Nitrogen and phosphorus were only detected in those observation wells close to the leach drain.

These results indicate that the levels of both bacteria and chemicals are potentially serious where septic tank systems are installed in areas of high water table and coarse sands with minimal clay.

INDUSTRIAL GROUNDWATER POLLUTION, KWINANA - OWEN ANCHORAGE

by

P. Whincup[1] and R.G. Barnes[2]

ABSTRACT

Kwinana - Owen Anchorage, the largest of more than 20 industrial areas within the Perth Metropolitan Region, occupies the coastal strip between Fremantle and Rockingham.

Groundwater quality in the shallow sand and limestone aquifer of this area was examined by the Cockburn Sound Study Group in 1979, resulting in the detection of widespread industrial pollution.

A diverse range of acids, alkalis, herbicides, heavy metals and nutrients is present in the water table aquifer of this part of the Swan Coastal Plain.

Groundwater pollution occurs as a result of intentional discharge to soak pits and injection wells or accidental spillage of effluents, process liquors and chemicals onto the land.

Many of the pollutants migrate towards and possibly into the ocean, resulting in an increase in the concentration of pollutants in Cockburn Sound. Others, entering the aquifer further inland become so diluted as to be relatively unobjectionable. Still others, such as caustic soda and petroleum products, have a commercial value and are actively recovered.

Detection and monitoring of industrial groundwater pollution requires a sound understanding of the prevailing hydrogeological regime. If proper investigative proceedures are not pursued, the presence of polluted groundwater may remain undetected.

The costs incurred to date with respect to the installation of groundwater monitoring and pollution recovery systems at Kwinana is estimated to be about $6 million with an annual operating expenditure of about $500,000.

1. Principal, Layton Groundwater Consultants

2. Senior Hydrogeologist, Layton Groundwater Consultants

GROUNDWATER RECHARGE WITH PRIMARY AND SECONDARY EFFLUENTS

Goen E. Ho
Senior Lecturer in Environmental Engineering
School of Environmental and Life Sciences
Murdoch University, Murdoch 6150

SUMMARY

The disposal of effluents from wastewater treatment plants has met with increasing difficulty as the effluents are viewed to be contributing to potential pollution from nutrients (nitrogen and phosphorus) and pathogenic micro-organisms. The effluents can also be considered, suitably treated, as a reliable source of water for agricultural and industrial purposes.

In this paper the case for re-using effluents via soil filtration and groundwater recharge is examined. Advantages and disadvantages are considered in relation to recharging primary and secondary effluents on the Swan Coastal Plain, taking into account control of pollution, availability of renovated water, land-use requirement, suitability of the Swan Coastal Plain and its soils, control of odour and groundwater mounding, and the status of groundwater recharge technology. Two case studies are presented : an inland treatment plant producing secondary effluent and a coastal treatment plant producing primary effluent.

It is concluded that water re-use via groundwater recharge on the Swan Coastal Plain warrants further investigation.

LEGAL AND ADMINISTRATIVE CONTROL OF GROUNDWATER IN THE SWAN COASTAL PLAIN

Peter Johnston
Faculty of Law, University of W.A.

This paper concentrates on the legal framework under which the relevant government authorities, the Metropolitan Water Supply, Sewerage and Drainage Board, and the Public Works Department, regulate the withdrawal of groundwater by consumers, in some cases acquire the resource for supply purposes, and generally preserve the quality of the water.

In pointing to the separate administrative schemes carried out under two different Acts, the paper questions whether a single uniform Act is desirable.

Because many of the provisions relating to control of these matters depend on executive discretion, particular instances are mentioned where it might be questioned whether there is sufficient external control of apparently unfettered discretions.

The question of possible amendment is also posed with respect to provisions which are ambiguous and hence unclear in their reach, especially where private rights of existing users are potentially affected. One key example concerns the payment of compensation for loss of existing equities in groundwater usage.

Given the increased scope for conflict arising from future competition for a possibly diminishing resource, the final section of the paper raises for consideration a general issue whether the legislation should be reformulated so as to make more explicit the goals and priorities of ground water management to which it is addressed, rather than leaving these simply to executive determination. Particular concepts such as statutory management plans drawn from United States examples are put forward as a basis for further exploration.

THE ROLE OF THE METROPOLITAN WATER BOARD IN THE MANAGEMENT OF THE GROUNDWATER RESOURCES

I.J. O'Hara
Assistant Chief Engineer, M.W.B.

ABSTRACT

The paper discusses various aspects of the matter of groundwater management as the author perceives them to concern the M.W.B.

What is seen as being the present groundwater "scene" in the Region is brefly described.

Some likely future management needs are outlined; it is predicted that there will be a growing demand to institute some form of management control to allocate groundwater resources amongst users in those areas where no regulatory controls on groundwater abstraction apply and which are then affected by overdrawing of the aquifer.

THE ROLE OF THE PUBLIC WORKS DEPARTMENT IN MANAGEMENT OF THE GROUNDWATER RESOURCE

J S ABBOTT, B.E , F.I.E.AUST
ASSISTANT DIRECTOR OF ENGINEERING

The Public Works Department has only a peripheral role in management of the groundwater resource on the Swan Coastal Plain: The Metropolitan Water Supply, Sewerage and Drainage Board has the major responsibility in this area. The Department is however responsible for controlling extraction by landholders of artesian water throughout the area and extraction of non-artesian water and prevention of pollution of groundwater in specified parts of the area.

The paper outlines the provisions of the Rights in Water and Irrigation Act which provide the legislative basis for the Departments control and describes the policies followed by the Department in regulating the usage of artesian and non-artesian water.

The provisions of the Act relating to the prevention of pollution of groundwater introduced in 1976 are described and the actions taken since then to license discharge of factory effluents outlined.

The administrative arrangements which operate between the Public Works Department and the Metropolitan Water Supply, Sewerage and Drainage Board with respect to the above functions are also outlined.

STRIKING A BALANCE

Geoff W. Savage

President, Australian Institute Health Surveyors (W.A. Division)

Pollution of ground water has long been a by product of mans activities and results from industry, government, agriculture and residential activitles.

The Health Surveyors legal and ethical responsibility in the overall field of Public Health is in the preventive area of Environmental Health. The component words - Health - Environment - Prevention signify his professional commitment to the protection and promotion of the health and well being of the community, and the environment in which the community lives and works.

The very nature of the Health Surveyors involvement requires professional judgment and responsibility which is necessary when "striking a balance" between proposed developments and protection of the environment.

Ground water contamination can occur through inadequate household effluent disposal techniques, improper industrial waste disposal, landfill solid waste disposal and bulk liquid waste disposal methods.

Landfill sites which are located, constructed and maintained in accordance with good engineering and public health practice will not adversely affect the quality of ground or surface water. Those that are not, however, may pose serious hazards.

The field of solid waste and bulk liquid waste disposal is moving rapidly towards a more sophisticated level where a great deal of technical information is required. The only way this type of information can become available is to gain it through practice and research. Maybe an organization such as the C.S.I.R.O. can assist.

To assist in the prevention of ground water pollution from on-site effluent disposal systems in low lying high water table areas - policies need to change. Priority must be given to servicing these potentially hazardous areas with deep sewers before worrying about areas which can adequately cope with disposal systems.

If the theory and design of ground water protection systems are to work in practice, quality control of construction and operation in the field is a necessity. Health Surveyors will continue to work towards improvements in the field of Waste Management and Effluent Disposal. However a growing concern is the knowledge that almost all of the on site effluent disposal systems established in high water table or impervious soil areas are polluting our sub-soil water.

Hopefully with co-ordination, planning and research we can eliminate potential areas of ground water pollution.

GROUNDWATER MANAGEMENT - MUST THERE BE CONFLICT?

D. BENNETT and D.K. MACPHERSON
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ABSTRACT

The groundwater of the Swan Coastal Plain has two important features which are hard to take explicit account of in any management plan: - uncertainty and conflict. Uncertainty comes from stochastic variation in rainfall and the long time lags between cause and effect in groundwater flow. There is also uncertainty about population growth and the demand for water and the use of wetlands.

Conflict arises because of the different uses that people have for the water and because the groundwater is a "commons". This means that the joint effect of each user's rational usage can be destruction of the resource unless there is cooperation. Uncertainty can increase conflict by allowing greater differences of opinion about the effects of management procedures.

The easiest strategy for resolving these problems is the use of professional judgement, rather than explicit designation of objectives and step-by-step explanation of decisions. Signs that this strategy is being used are such phrases as 'common sense', 'balanced appraisal' and 'treat each case on its merits'.

Professional judgement is indispensable. However, there are dangers if it is substituted too often for the explicit justification of decisions and for the involvement of the public in them. Water managers may lose touch with the population they serve. The scope for rational dialogue may decrease. The potential for conflict may increase. Justification and involvement are the main alternatives to confrontation between managers and users. Without the chance to help design an open agenda of management alternatives, users can only achieve their ends by manipulating power and influence. Where the resource is of critical importance, such manipulation strains the fabric of society.

INVESTMENT IN PRIVATE BORES: UNDERGROUND WATER USAGE FROM A HOUSEHOLD PERSPECTIVE

By

G.J. Syme and S.J. Kantola
CSIRO Division of Land Resources Management,
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ABSTRACT

The major response of Perth householders to the drought and subsequent water restrictions of 1977/78 was investment in bores to guarantee water supplied for private gardens. In the 1976 symposium on "Groundwater Resources of the Coastal Plain" Cameron stated that demand management was required in Perth, and that householders wasted water on their lawns and gardens. He suggested that water policy should concentrate on the concept of the value of the use of water, in order to prevent waste.

This paper examines Cameron's claim with reference to relevant recent research, the growth of bores, the economics of bore investment and, finally, the relationship between attitudes towards water, garden use and home ownership. The paper concludes that a continuing and substantial future demand for bores may be expected in Perth, and provides evidence that bore investment should be interpreted in terms of the financial and aesthetic value of the garden for the home owner. Finally, we suggest ways of developing social policy with respect to domestic underground water use.

NOTES

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