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The Waters Under the Earth

Fortunately for Queensland much of it overlies aquifers, the water from which permitted the nineteenth century growth of the pastoral industry and the continued existence of many rural communities. The supply, however, is not inexhaustible.

Large parts of Queensland have been entirely dependent on underground water throughout their history. Without the Great Artesian Basin, the pastoral industry of the west simply could not have existed. Without aquifers to tap, many regional areas of Queensland would not have been able to develop industries. Without reliable sub-surface storages, many towns would have been unable to provide urban water supplies. In particularly fortunate circumstances such as occurred at Birdsville, the town bore provided hot and cold (after cooling) reticulated water and power generated from a Pelton wheel.¹

Up to 1.4 million megalitres of underground water are extracted in Queensland each year² – as the old diviners would say, more water than you can poke a stick at. Up until the Burdekin Falls Dam was constructed in the late 1980s, groundwater use in Queensland exceeded the use of surface water.³

The value of underground water has long been recognised from the time when Henderson and his staff devoted so much energy to its production and management. Yet, to some extent, groundwater has been treated as the poor cousin, even to the extent that the Branch responsible for it has been widely known as ‘Sleepy Hollow’.

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Certainly, the activity has never bathed in the glamour attached to design and construction. Yet groundwater can only be managed through a combination of high technology, incorporating complex mathematical analysis and sophisticated technical equipment, and sweat, blood and tears expended by field officers who wrestle with hostile natural and human elements.

When the new Commission was formed, it was only natural that a branch would be set up to deal with underground water and with the stock route facilities that were so dependent on it. And it was only natural that George Brown would continue to be the man in charge of the Artesian and Stock Water Supply Branch. George had served time in the west in the old Sub-Department, having been District Engineer in Winton and St George. He was regarded as an extremely reliable officer who issued



Artesian Water and Stock Supplies Branch Staff 1956
(Back row) Bill Bellion (draftsman), Ned Colclough (Snr Clerk),
CH Lancaster (draftsman), Mark Westerman (draftsman), Alan
McConville (Snr Draftsman), Harold Guy (foreman), Les McArthur (Works
supervisor), Fred Barlow (engineer) (Middle row) Alan Bird (engineer),
Andrew McNee (clerk), Rupert George (clerk), John O'Brien (cadet)
Bonnie Naylor (clerk typist) (Front row) George Pearce (Snr Engineer),
Denise Gorring (clerk typist), Nick Carter (engineer)

clear and concise instructions with enough information to do the job. Both George Pearce and Bernie Credlin held him in very high regard. George Brown was the father of artesian water schemes and was tremendously respected in the bush. His knowledge of the Great Artesian Basin was remarkable and his establishment of Artesian Bore Water Supply Areas an enormously beneficial undertaking. His memorandum writing was a model to young engineers in the extent of the information combined with brevity.⁴ It was considered to be nothing short of tragic when George Brown died in office in 1955.

In the early post-war years, sub-artesian groundwater investigations were part of Water Resources Branch's responsibilities under the direction of FJ 'Father' Calvert, renowned for the length of ash drooping and dropping from his perpetual hand-rolled cigarette. While the scale of operations was modest compared with that of later years, steady progress was made with the investigation of mostly coastal deltas using basic cable-tool rigs and army surplus trucks.⁵

As early as 1947, the Government was interested in the tourist potential of the Barrier Reef islands. Charlie Ogilvie was given the task of investigating some sites, assisted by a young Alan Wickham. After an eight hour launch trip from Gladstone to Heron Island in mountainous seas, it took only half an hour with a shovel and 'Ogie's' test kit to discover a 'freshwater lens' was saltier than the ocean!⁶ 'Ogie' also explored the supplies available for tourism on Hinchinbrook Island with Alan Wickham assisting and on Torres Strait Islands with Nev Weller as his offsider.

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In 1949, CE Parkinson was sidelined to the position of Director of Stock Watering Facilities and until his retirement administered the control of the Great Artesian Basin and the investigation, design and construction of stock route watering facilities. In 1939, the Queensland Government set up an investigation into the Great Artesian Basin⁷ under the Chairmanship of JR Kemp.⁸ Professor 'Freddie' Whitehouse and Charlie Ogilvie were technical advisers to the Committee.⁹ The work was interrupted by the war and a report was not presented to Parliament until 1954. It provided an important collation of the state of knowledge of the Queensland portion of the basin. In relation to uncontrolled and leaking bores, it concluded that stringent conservation measures were not required. Parkinson, a member of the committee, disagreed strongly and submitted a dissenting minority report.¹⁰ The minority report was fully considered by the majority which adhered to its original conclusions and recommendations.¹¹

Winifred Hossack was the Secretary of the Artesian Committee. She had a Master of Science degree and had been known during the war as 'Winnie the War Widow'. She had been an aide to Sir John Kemp who was Co-Ordinator General and head of the Allied Works Council. Winifred had been very active and efficient in preparing all his reports, Cabinet submissions and other material, and was held in high regard within the Public Service.¹²

Following George Brown's death, George Pearce was appointed as Senior Engineer Artesian and Stock Water Supplies. George Pearce was universally liked and admired for his professionalism, humanity and wisdom. Just a few tales will illustrate George's approach to life and work.

Len Ritchings was supervising a drilling contract in the Flinders River-Julia Creek area. The contractor, Hellier, didn't mind a drop of the amber fluid and, for a few days, he wasn't working. So Len rang George Pearce, demanding that he be sacked. George asked, "What day is it, Len?" He said, "It's Friday, Mr Pearce." So George said, "Well you go back to Longreach, Len, and have a rest and come back on Monday. Time heals many things." On Monday, Hellier was sober and they got on with the contract.¹³

George Pearce often said most people have about 45 years of working life. The first 15 are learning, the second 15 they're doing things and the last 15 they're just passing information on.

George obviously had a good eye for a likely recruit. John Hillier had joined the Commission as a cadet and then decided to study science part-time. After two years he decided it would be better to go full-time and applied for a scholarship. He was invited to front a Public Service Board selection panel, of which George Pearce was a member. John was later told that George had said that he wasn't having anybody else,

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so John got the scholarship. At the time, John was driving a taxi part-time, studying part-time and working full-time. When George offered him a scholarship at half salary he also told John that going to university would knock his standard of living around. So he said, "John, if they're prepared to give you half, I think I'll push them a bit more." He got him full salary, the first person in the public service to get that.¹⁴

Randall Cox had worked during a vacation with the Department of Primary Industries, and because he liked skin diving had thought he might like to study Marine Geology. He applied for a scholarship and a panel, which included George Pearce, offered him the simple choice of Maths with Main Roads or Geology with the Commission.¹⁵

Bill Huxley also joined the Commission, straight from school, as a cadet in 1968. After a year, he asked Mike McEniery about the chances of getting a scholarship. McEniery said it would have to be in Geology and George Pearce pointed him in the right direction.¹⁶ All these men were to prove worthy of George's belief in them.

In 1958, Jack O'Shea, who was then working in Surface Water Branch, was sent down into New South Wales to have a look at their organisation and procedures of the underground water section. In his 1959, report his main conclusion was, "We need more money." That must have happened, because the groundwater section blossomed in the next decade or so.¹⁷ Indeed, the 1960s were a decade of growth, but so were the 1970s and 1980s.

Because of the expected changes to the Commonwealth contributions to water resources assessment proposed by the Department of National Development before Arthur McCutchan joined it, the shallow groundwater activities of Water Resources Branch were combined with the artesian sections to form one branch.¹⁸ Arthur McCutchan was highly intelligent and a very hard worker. For a time he was personal assistant to Commissioner, Tom Lang. Arthur was awarded a Fulbright Scholarship while with the Commission and visited USA under its terms.¹⁹

Arthur McCutchan was a very decent and high principled person. Some thought him a 'wouser' and somewhat unworldly. Bernie Credlin suspects he was not always good at selecting employees, and some of his staff pulled the wool over his eyes at times but there were occasions when he came out on top. On one occasion two young engineers were down from the bush for a couple of days. They went out for a quick bite of lunch and got waylaid. They returned to the office, each with a pie which they furtively nibbled at the table they shared until one of them began to hiccup. Arthur arrived at their table and made the observation: "It must have been the oysters, it couldn't have been the beer." As Senior Engineer in charge of Water

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Resources and then Surface Water Branches, and later Chief Investigation Engineer, Arthur was very much responsible for putting surface and underground water assessment on a scientific and systematic basis. Some of the praise levelled at staff for the advances in mathematical modelling of surface and groundwater systems and groundwater hydraulics should be shared with McCutchan. He left the Commission in 1966 to join the Commonwealth Department of National Resources as its Deputy Director.²⁰

Col Hazel graduated and joined the Groundwater section in 1962. Don McPherson, Ron Belcher, Phil Whitmee, Hector Macdonald, Tommy Lord, Eric Webb and Bill Siller were prominent members of the team. In due course Darryl Hooper and Dave Schmiede joined as advisory cadets. Darryl left to drive a taxi but Dave is still working diligently in his original career.

There was a degree of movement from 'the bush' to Brisbane and vice versa. Col Hazel went to Longreach for three years, Bernie Credlin came to Brisbane from St George in 1964 and Mike McEniery came to Brisbane via Bundaberg and the Water Conservation and Irrigation Commission in NSW. Henry Shannon resigned in protest at the flooding of the bent-wing bat caves by Glenlyon Dam. Henry believed that groundwater studies in the area showed there was plenty of groundwater and the dam couldn't be justified.²¹ Jeff Lloyd transferred from Brisbane to Rockhampton in 1973 (swapping with Bruce Pearce) and has remained there since, later being joined by Bill Legg. Col Cooney went to Longreach as District Engineer and eventually returned to become the resident expert in Bore Water Areas and Stock Route facilities (even after his retirement). John Palmer succeeded him at Longreach but didn't return. Dave Free similarly moved to Toowoomba while Dave Munro, Randall Cox and later Bob Ellis transferred in from Townsville. Leon Leech went to Ayr and later, because no further promotion was available in his field, moved into management at St George.²² Rob Lait went to Mareeba while Dave Dempster remained 'in the cold', simply moving from Biloela to Toowoomba and then Bundaberg. Keith Bedford, Linda Foster, Stuart Wade and Jerome Arunakumaren remained in Brisbane. Vivienne McNeil didn't leave Brisbane but took time out to have her family.

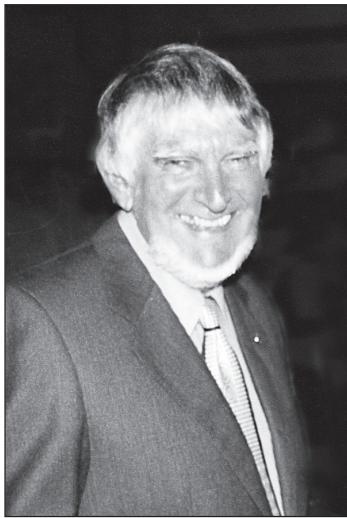
Noel Eden joined the Commission in 1935. He served as District Engineer in St George and worked on the mathematics of artesian flow. He moved to the Northern Territory where, as Director of Water Resources, he oversaw the establishment and operation of the Water Resources Branch and was among the Territory's top public servants. He even acted as Administrator during a visit by the Queen. He returned to the Commission in 1966 for a few years.

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Bill Day came on a promotion from Irrigation Branch and Alec Vitte came in from Charleville. Links between Head Office and the regions were maintained through conferences and workshops, and gradually telephone, fax and finally email became more available. While some attempts were made to transfer more groundwater staff to the Regions, it was realised that a critical mass was essential.²³

The drafting group also experienced a constant turnover because of the rotation scheme. But the supervisors stayed on. The original senior draftsman was Alan McConville. He was balding and, because he couldn't grow a moustache, painted one on with an eyebrow pencil.²⁴ One morning, cadet Bevan Faulkner was short of shirts so wore a red polo shirt. Alan let him know in no uncertain fashion that there was to be no recurrence of such aberrant behaviour. Draftsmen were expected to wear white shirts and ties.

Bill Bellion became Supervising Draftsman in 1970 and remained there for about 13 years. His staff did terrible things to his cigarettes and were always trying to organise lectures by Dr Carlton and Mr Tooth.²⁵ Eric Davis, a long-serving stalwart, succeeded Bill before surprising everyone by moving to Ayr.



John O'Shea

Having risen to the exalted rank of Executive Engineer, Jack O'Shea looked around and saw how many Executive Engineers there were, and how few Senior Engineers there were, and began to get a little restless! He also had a daughter who got asthma very badly in Brisbane, to the point where the O'Shea family just had a one-way ticket to the Chermside Chest Hospital. His local medico said, "I can't treat her any more." A job as Foundation Head of Agricultural and Civil Engineering at the newly formed QIT Darling Downs (as it was then) was advertised. So Jack applied but didn't hear a thing. The job was readvertised and he reapplied. This time he got summonsed by Mr Haigh who sat him down and said, "Why do you want to leave the Commission?" Jack replied "Probably the main family reason is that my daughter gets asthma", to which Fred responded, "I wasn't aware of your daughter getting asthma. So I will not stand in your way this time." So obviously there was a little network going.²⁶ But Jack managed to leave and to change his name (to John)! He did come back and spend a

sabbatical with the Commission in 1985 doing a follow-up study on the Burdekin Delta. He wrote a paper titled *Burdekin Revisited* from the then television serial (and earlier Evelyn Waugh book) *Brideshead Revisited*.²⁷

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Similarly, Hector Macdonald had to apply for a job as Executive Engineer in Harbours and Marine Department twice before Fred would release him. It is tempting, but in the end idle, to speculate on what would have happened to Hector (and the Commission) if he had not left. By contrast, Fred was generous to others including Bernie Credlin with advice on their future prospects.²⁸

In 1971, Ken Carmichael retired and George Pearce succeeded him as Chief Engineer Rivers and Streams. Bernie Credlin became Senior Engineer Underground Water and Bill Sharp moved from Rivers and Streams to be 2IC. Bernie took a great interest in his staff but was also very careful to try to eliminate mistakes. On one occasion he said to Ian Pullar, "What on earth did you do that for?" Ian responded, "That's called initiative if you like it. If you don't, it's stupidity."

Within the year, Bernie had been promoted to Chief Investigation Engineer. Bill Sharp became SEUW with Alec Vitte as his deputy. One classical day, Bill Sharp went over to the Cecil for a beer at lunch time. Peter Gilbey upset the barmaid and she refused to serve him. Bill said, "If you're not careful, I'll take all my staff and drink somewhere else."²⁹ He had a great collection of stories that would keep people entertained and he could vary the stories depending on the audience. On one occasion something had happened in Groundwater and Fred sent down for Bill. He wasn't there so Fred asked for Bernie, the previous incumbent. Bernie wasn't there so he sent for George, the one before that, and reprimanded him. If he wanted to abuse someone, Fred always would.³⁰

In 1977, Bill went to Rivers and Streams as Chief, Alec Vitte became SEUW and Bill Day his deputy. Alec Vitte's family were White Russians. His ancestors, who were then named de Witt, migrated from the Netherlands to Czarist Russia where they achieved success. When the Bolshevik revolution occurred, the family fled east through Vladivostok and China, eventually migrating to Australia.

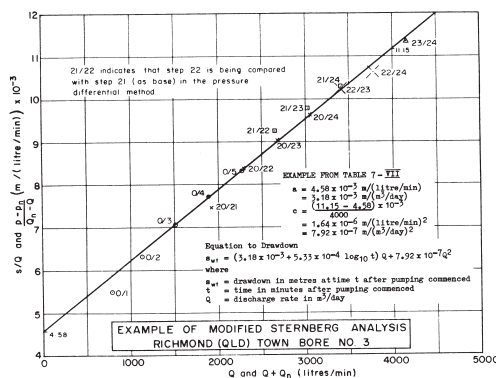
Alec was a very conscientious and co-operative leader who simply got on with the job with a minimum of fuss. Those who saw him as being a conservative, totally dedicated public servant were probably somewhat surprised when he used all his accumulated leave to effectively retire about six months before his sixtieth birthday, the then minimum retiring age, and then to grow a beard!

Col Hazel left the Branch in 1979 to join Forward Planning. Warren Lane, after apparently having made the Darling Downs groundwater management his life's assignment, left the Branch for Irrigation in 1977. Col Hazel returned to Groundwater as Senior Engineer in 1983, following Alec Vitte's retirement. In 1985 Groundwater and Surface Water Branches were amalgamated as Water Resources Division with

John Ward as Director. Col Hazel succeeded him in 1987. The reduction in divisions following the integration of the Commission into DPI saw Lee Rogers appointed as Director of Water Resources Assessment Division with Col as his deputy. At the abolition of the Commission in 1995, Col Hazel elected to take an early retirement and the rest, as they say, is history. The functions of Groundwater Branch that relate to assessment were transferred to the Resource Sciences Centre at Indooroopilly and the management functions to Resource Management.

Groundwater Branch traditionally differed from its sister branch, Surface Water, in that the latter was responsible only for assessment, whereas Groundwater, until its latter stages, was concerned with both assessment and management.

Assessment itself involved two major components: the capacity of individual bores and the ability of an aquifer system to provide an ongoing supply of water. Both of these facets of assessment involved a combination of raw strength and intellectual muscle.



Sternberg bore analysis sheet

The individual bores problem required drilling and/or testing. More will be said later about those who undertook these tasks, but there can be no question that they required a deal of stamina and dedication. An artesian bore, several thousand feet deep, could take several months to drill under often very trying conditions. Bore testing was no picnic either. After initial setting up of the test, readings have to be taken at the bore site and in a number of observation bores at intervals over the period of the test – seven days, or, in the abbreviated version, 24 hours – not exactly conducive to a good night's uninterrupted sleep. While he was in Longreach,

Col Hazel developed the modified Sternberg test, derived from work done in the United States of America. The analysis of the pump test was incredibly tedious before the advent of the personal computer, as multiple calculations had to be made manually using seven-figure logarithms. John Hillier reports having taken three days to analyse one modified Sternberg test by hand. This was speeded up somewhat by the introduction of standard times for measurements so that the logarithms would not need to be looked up every time.

The analysis of the bore tests enabled the calculation of a number of important factors: the yield of the bore (in gallons per hour or, later, litres per second), the transmissivity (the ability of the aquifer to transmit water), and the storativity (the

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ability of the aquifer to store water in the pore space). Even the layman knows that a tight clay layer of earth has no ability to transmit water, but sand and gravel are quite porous and can hold and release water readily. While he was stationed in Longreach, Col Hazel acquired a piece of sandstone and fashioned it into a bowl, so that he could demonstrate at lectures and talks how sandstone could store and transmit water.

These parameters are important in the analysis of aquifer systems. Whereas dams (which also store water) have an infinite transmissivity and 100% storativity, aquifers have much smaller values for these parameters as the water has to fit into, and move through, the pore space. Basin-wide investigations need to examine variation in these properties over a wide area and hence require a substantial number of bores, bore tests and observations.

Further work on the hydraulics of bore flow was carried out by Warren Lane during the 1970s as part of his Master's thesis. He experimented in the laboratories at Rocklea with simulated bore flow in a container of prepared aquifer material.

It has been claimed that the strength of the Groundwater Branch lay in the fact that Engineers and hydrogeologists worked side by side.³¹ Certainly another strength was the calibre of the hydrogeologists and the fact that they stayed on for so long, growing with the job and serving in all sorts of conditions. Even though Randall Cox bemoans the fact that their training was solely in technical matters, ill-preparing them to cope with resource management issues, they manfully tackled the problems as they came along, not only keeping pace with technological developments, but often leading the way. The contribution made by such people as Nev McTaggart, Dave Munro, Bruce Pearce, Dave Dempster, Dave Free, Jeff Lloyd, Rob Lait and others is immeasurable.

Perhaps the best known (and greatest character) was Mike McEniery. Mike served in Rockhampton and Bundaberg before he resigned and took up a job with WC&IC in NSW. In due course, he returned to the Commission and was the senior hydrogeologist in Brisbane for many years. He was not always liked, but was always respected. In his early days he was brash but a very good worker, working heart and soul for the Commission in all hours.³² He delighted in 'taking the mickey' out of engineers, being one of those who asked new recruits to get the Charleville Harbour Master's file. (Such a file was actually listed in the Register, but the contents were a furphy).

A farmer from Mundubbera had been pestering Fred Haigh for water out of Mundubbera Weir for his orchard. All Fred could do was offer some groundwater advice. So Mike McEniery and Bernie Credlin went and recommended some sites

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for wells that were partially successful. When they were leaving, the farmer gave them three cases of oranges for Fred, Mike and Bernie. They went back to the office and reported to Fred to give him his case of oranges. Fred hit the roof and told Bernie to take them away. Cyril Young (the Commissioner's driver) told Bernie that Fred's standard practice was to give such goods to charity.³³

Mike McEniery's wife Ros contracted a seriously debilitating illness in 1974, possibly brought on by the trauma of the flooding of her parents' home. She underwent years of treatment including a visit to Lourdes. Mike's delight when she was pronounced cured in 1989 was infectious. But within a short space of time he was diagnosed as having multiple myeloma and died shortly after.



John Hillier

The mantle of 'dean of hydrogeology' passed to the broad shoulders of John Hillier. In due course John was promoted to a rank equivalent to the old Senior Engineer Underground Water, an achievement which would have been impossible in the earlier engineer-dominated era. He has seen tremendous changes in technology where the overriding factor is the effort made and the loyalty shown.³⁴

Of course every man in the street knows that if you want to find a water supply, the last person you would send for would be a hydrogeologist. You'd send for a water diviner, at the very least to verify what the geologist had to say for himself.

According to John O'Shea, *one of the frustrating things that Commission geologists have found is if some farmer wanted a bore site selected, they'd go out, select one scientifically and put a peg in the ground. They knew only too well that within a day or two of them leaving, a water diviner would be engaged to come and check whether this peg was in the right place or not. The water diviner would pull out his forked stick and walk around, and it would move up and down, and the water diviner would shift this peg about a metre and claim, of course, that he was the one who discovered the water supply. This was a little bit frustrating, so Wally Roman, a geologist allocated to the Rockhampton and Ayr District Offices in the 1950s, decided he would counter-attack this. He used to carry a really high-pitched whistle, and he'd go to the farmer's place and he'd say, "Well, this looks good. I'll just try it out with the whistle." He'd blow, "Whooooo," and say, "No, no, I'm not getting the right vibes with that." So he'd walk around a bit further. He put on this act to convince the farmers that he had some sophisticated technique of*

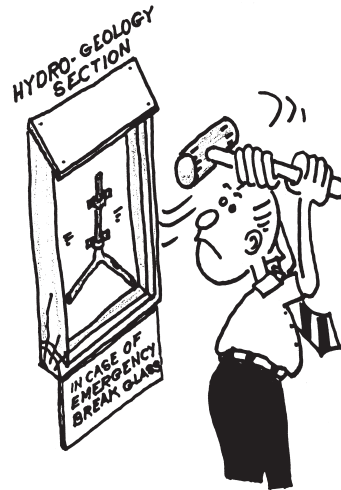
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*checking whether the water was there, and how much there was, with this whistle.*³⁵
Wally's frequent letters to Head Office about diviners were known as 'Epistles from the Romans'.³⁶

In previous times, the Government had sensibly recognised the ability of dowzers and, under Partridge, the Commission had actually appointed a Government Water Finder named JH Bestman. He had operated in the Callide Valley with apparent success. But in that area the aquifers are fairly wide-spread and even random selection of a site would almost certainly have found water.³⁷

One year in the 1960s Minister Harold Richter came to the annual dinner dance. Jack O'Shea was the President of the Social Club and the Minister asked him what he thought of water divining. Jack didn't know what to say because he didn't know what the Minister thought. Fortunately the Minister went on, *"Let me tell you a story first. I had a property in the Brisbane Valley and there was a water diviner in the area, so I invited him over and asked him to divine me a bore. So the diviner walked over the paddock and eventually marked the definite spot. So I asked him to divine another spot over the bill and he went off. While he was away, I moved the marker about 200 feet and when the diviner came back I asked him to check the spot. He walked over the paddock and, yes, that was the exact spot."*³⁸

There are many examples of successful water diviners (John Palmer's father among them), but there is a high correlation between success and knowledge of the area. Take a diviner away from his patch, and his success rate usually plunges.³⁹



Cartoon by Vince Folkman

For many years, the Water Conservation and Irrigation Commission (NSW) kept records on success rates for divined bores and ones selected by departmental geologists. As dowzers usually have an intimate knowledge of their localities whereas Government officers are usually from farther afield, the former might be expected to produce superior results. Such, however, was not the case – the Government won the competition hands down.⁴⁰ There are undoubtedly many charlatans out there.⁴¹

The Australian, in about 1972, carried an article titled *It would be funny ... if it weren't so sad*, written by a Bob Connolly of Glebe, NSW, who described an experiment conducted by James Randi of the Sceptics Society. *Twelve diviners were selected from the hundreds who responded to invitations to prove their powers. All*

*12 agreed beforehand that the test was well designed . . . On a field, 10 pipes were laid under the ground. Water could be directed along any of the 10 and the diviner was asked to walk across the pipes and determine which one contained the water ... all day the 12 diviners performed their magic. Each of them walked across the 10 pipes on 10 different runs. Each time they went across, water was flowing through a different pipe. Each time the rods miraculously spoke their message. Except the diviners were wrong – hopelessly, incontrovertibly wrong ... The overall result was one out of 10 – entirely consistent with chance.*⁴²

One Commission driller attempted to convert Alan Wickham to divining but failed when Alan took control of the stronger of the two branches of the forked stick instead of the weaker one.⁴³ There's a file on water divining that has a lot of material.⁴⁴ Lots of things were useful in divining – even a handsaw. They even used to catch criminals by using divining.⁴⁵

Bernie Credlin recalls *an interesting experience in Fred Haigh's day. The Royal National Association held a symposium before the Exhibition to teach landholders about water on the farm. We had people like Dave Morwood to tell them about the services available under the Farm Water Supplies Assistance Act. Fred Haigh fully supported Commission involvement until he found no geologist would be present but there would be a diviner from Dirranbandi. He withdrew his technical staff. The President went to the Premier so our staff had to go. So Fred called me up and told me I was to go there and use technical arguments to make it difficult for the diviner. I couldn't get the microphone to ask the question until I actually took it from an official. My question was why when farmers wanted help with agriculture they went to an agronomist, when they wanted help with stock they went to a veterinarian, but when they wanted help with water they go to a charlatan? The President said, "That's the worst question I ever heard." And I got no answer. Queensland Country Life gave great publicity to the symposium but ignored my question. It gave prominence to the diviner who undertook to go to the Arcadia Valley, an area notorious for the lack of underground water, and find water. When he found 80 sites this was proclaimed in Queensland Country Life. When the Commission found that 79 of the sites were duds, Bernie wrote to Queensland Country Life and asked them to give the same prominence to this as they had to the article. Ultimately a tiny article appeared on about Page 7.*⁴⁶

No matter how bore sites are selected, they have to be drilled, developed and tested. This has traditionally been done by a combination of government employees and private contractors. Contract drillers have been required to have a current drillers licence if they are operating within a proclaimed area. (Under the *Water Resources Act*, regulations for groundwater use are specified in those areas

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where the Act requires them to apply. Not all of Queensland has been proclaimed as areas where the Act applies. One notable exception is most of the Lockyer Valley.) In order to ensure that holes are drilled in accordance with the conditions of their licences, the Commission employs Boring Inspectors and Boring Supervisors. To say that drillers and boring staff are remarkable men would be more than something of an understatement.

The Commission was blessed with an abundance of extremely competent drillers such as John Dickson, Charlie Wimhurst, John Svensson and others whose stories are included here. Not only were they good plant operators, but they had great ability to cope with hostile conditions including drought and flood. In the early days they even had to cut wood to burn as motive power. Just a few stories will have to suffice.

Matt Tallon (the same family as Don, the Queensland wicket-keeper) was drilling a bore for farmer Dahl near The Hummock in Bundaberg, starting in an existing well to save on drilling and casing costs. The farmer's plan was to clamp the casing at the well bottom and disconnect the string above that and he volunteered to go down the well to do it. The casing line was occupied holding the casing and the drill line was operating a pump to keep the well dry, so Dahl was gently lowered on the sand line, using the clutch. The task completed, Dahl had to be brought up at several hundred feet a minute past two great steel beams. The slightest error of judgement could have resulted in tragic head smashing. But Matt did it without blinking an eyelid. When Matt was in a really tough situation, he'd tie a stick to the levers and stand clear. So he was cautious but he pushed the plant to the limit. He was a superb plant operator.⁴⁷



Cable tool drilling rig

Matt Tallon had a favourite story about oil drilling in Queensland in the 1930s involving an entrepreneur who poured oil down a bore Matt was drilling just prior to a visit by a prominent cleric who was financing the drilling. The traces of oil were designed to convince the cleric that a gusher was imminent and more investment would be prudent.⁴⁸

John Hillier and Bill Johnstone once caught up with Roy Long drilling in the Nogoa River for a construction water supply on a freezing cold day. He had been swinging on the crank handle for ages with no success. He'd even lit a little fire to warm it up. Eventually, electric starters were incorporated into the rigs.⁴⁹

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Kevin Fox liked a few beers. At 10 p.m. Foxie would order a six pack or a carton and follow you into the shower, still talking. He'd just be finishing the carton off at 3 a.m. But he was never seen to miss work once. Arguably he was the best driller the Commission had.⁵⁰

There was a hard and miserable drilling project in the Border Rivers in 1985, using a cable tool rig as well as the rotary rig because the rotary couldn't handle the big boulders. The cable tool driller was a guy called Cec Malone who had been around for years. He had Coke bottle glasses. He'd boil up a billy of tea in the morning and drink it all day as it got colder and colder. One day he dropped a spanner and as he was feeling around for it, John Hillier said, "Are your eyes that bad?" He said, "Do you want to test me? Drop a sixpence down the hole and I'll pick it up for you." He was so experienced, he didn't need eyes.⁵¹

Kevin Brown was an extremely resourceful man who was happy to be posted to one site for a period of time. This enabled him to set up a proper camp with a vegetable garden, a milking cow and perhaps the odd pig or sheep. He told Head Office that he had engaged a local offsider,⁵² but whenever a superior officer arrived on site, there was no offsider to be seen. Instead, his wife Audrey was on hand to provide a cup of tea and a chat. As Audrey herself explained, she knew the job much better than any green local recruit and was perfectly competent.⁵³ Nobody could truthfully testify otherwise. *They brought their kids up in tents and they're salt of the earth. Every five or six weeks he would arrive at Rocklea, hollering, "Eh boys," with a ute load of pumpkins, cabbages and the like.*⁵⁴

Many of the drillers went on to become Boring Inspectors and were pretty tough men. Wally Stevenson at St George was an artesian driller who became a Boring Inspector and Supervisor. He was a most remarkable man (see Chapter 2). Ken Kennedy is his grandson. Wally told a story of a driller who went to drill a deep bore and the first thing he did was plant an orange tree. They sacked him because they reckoned he'd decided to stay there for a couple of years!⁵⁵

One night Don Beattie and Wally were in the Australia Hotel in Miles after dinner *when an old driller by the name of Abe Moy walked in, full as anything, and sat in front of the fire. Suddenly, he pulled out a cigarette, and he reached into the fire with his fingers, pulled out a red hot coal, picked it up, lit his cigarette, and said, "Gee, that was hot!" Some of these drillers were pretty tough characters!*⁵⁶ Abe claimed outstanding divining skills like suspending a watch over a 1:250 000 map on the verandah of his Miles home to select bore sites in the far west.⁵⁷

THE WATERS UNDER THE EARTH

A legend among Boring Inspectors is Dick Hurn. Dick had little formal education, although he did have nine months boarding at the convent school in Blackall and a year at Nudgee College. At his request the nuns in Longreach taught him to type and he was the only Boring Inspector who always submitted his reports typed up.⁵⁸ He was a great bushman, having grown up on a property in a family of 12. His skills were invaluable in many circumstances, such as when Dick saved Paddy Carr's life. Paddy's car had broken down and he had walked away from it. Dick sat on the bonnet of a car while Bill Day drove and tracked him down when he was close to death.⁵⁹

Dick Hurn had wanted to become a Boring Inspector and Ken Jones asked if he had any experience. So Dick went and worked on bores between Bedourie and Birdsville for a couple of years and then came back and got the job.⁶⁰ It was typical of Dick that he would go to such lengths to achieve an ambition.⁶¹

Together with Harry Flint, Dick Hurn did a lot of work in the St George district advising new settlers in the Brigalow Scheme.⁶² They were busy with bore remeasurement work and contract supervision as well as assisting the Bureau of Mineral Resources with their artesian bore logging programme.

Dick had high regard for authority and rules were meant to be obeyed. He could well have been the model for the 'humble and obedient servant' of yesteryear. One day Dick was driving George Pearce to the back of beyond when he stopped the car. George enquired why they had stopped and Dick responded, "It's the thousand miles, Mr Pearce. I've got to change the oil." He'd known the service would fall due during the trip and had come prepared. Nothing George said about "approximately every thousand miles" could convince Dick to disobey an instruction from Head Office and George waited while the oil was changed.⁶³

In about 1971, two transparencies of bore cementing diagrams were put through the dye-line machine in Head Office backwards. Peter Cochrane thought this was too good an opportunity and sent the mirror image diagrams to Dick Hurn (who was then located in Toowoomba) with a memo over the (forged) signature of BL Credlin, Senior Engineer Underground Water, saying "Enclosed please find copies of HPARG and HPARGOMON for use in Bore Decementing. A backward-reading stop watch will be forwarded soon." Dick was certain his trusted friend, Bernie, would never pull his leg but didn't know how to deal with it. He was observed surreptitiously looking at the drawings from time to time and shaking his head.⁶⁴

Max Dean grew up in the west. When he was about nine he was driving his father's mail truck around Stonehenge. He had to get down off the seat under the dashboard so he could push the clutch in. Dick Hurn recalls that *you could just see*

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*Maxie's head over the windscreen driving the Hudson car. Col Hazel was once waiting for some equipment to come to Longreach. There were two trains a week and it hadn't arrived on either, so I was ranting and raving in the back room. Maxie said, "Hold it, Father. This is the land of wait-a-while. If it doesn't come today, it'll come on the next train or maybe the one after."*⁶⁵

One day Col Hazel was driving (he never let anyone else take the wheel) with Max to the Diamantina Lakes and he said, "We'll stop at the Moyan pub for lunch." Max said, "We'll be too late." They travelled on for an hour or so and Col reckoned they were only about 20 miles away. "We'll stop there, Max," he said and again was told, "We'll be too late." Col said, "What do you mean?" At this point Max let on, "It burnt down 20 years ago."

Another time Col was with him in the Channel Country during a bad drought and asked, "What's the worst drought you've ever had, Max?" "We've only ever had one." "When was that?" "Same bastard," he said, "it just goes on and on."

Jack Rasmussen was another Boring Inspector. He was only 51 when he died but he looked about 80. The sun in the west dries people out dreadfully.⁶⁶ Kenny Jones also died young, as did his son Trevor, who was a hydrologist in Bundaberg when he died.

Eric Kusay, Boring Inspector of Longreach, made Tom Fenwick look positively svelte. He got to the stage he couldn't fit in the cabin of a Toyota. Then Toyota brought in tilt steering wheels and he could get back in again and they sent him back into the field.⁶⁷ Maurie Watts, who joined the Department in the 1950s, worked for many years in Longreach before transferring to Rockhampton. He lived under canvas for months on end constructing stock route facilities using gangs of migrants. He used to drill holes to a depth of 25 feet using a hand auger.⁶⁸

Maurie Heness was the youngest of three brothers who were Boring Inspectors with the Commission. Maurie and Aub joined at the same time, in Longreach and Charleville respectively. Ross joined two years later and followed after Maurie into his various postings. Maurie grew up in the bush but considered that Max knew the west better than he did. Maurie had extensive experience in deep drilling in the west and in shallow alluvium from his training on the east coast, one of the few with both.

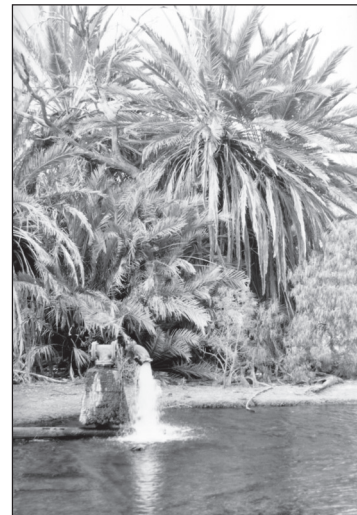
In the Channel Country out the back of Birdsville, at a place called Adria Downs, there's a big old artesian bore flowing with very hot water. A team of three went to measure the flow. They diverted the water across a sandhill, but it was difficult to open a drain because it kept filling back in. The fellow from the Coast went in to try

THE WATERS UNDER THE EARTH

*to remove the gauge board, and he was standing there in the sandbill and you could see his feet just going down like that. The top of the gumboot was getting closer and closer to the water. Max Dean and Maurie Heness grabbed hold of him and pulled him out. It was close.*⁶⁹

Max Dean told Maurie Heness that Dick was off work for a fair while after he slipped into a drain and the water came over the top of the gumboots. They had to cut the gumboots off him and apparently it tore all the skin off his feet. That used to happen.⁷⁰

Life wasn't all beer and skittles for wives either, as illustrated by a tale told by Maurie Heness. *When we first went to Longreach, accommodation wasn't real easy, and we were only able to rent a pretty ordinary flat. I had only been there a couple of months when I had to go on this field trip that involved everywhere round the place – Julia Creek, Burketown, Mt Isa, Hughenden – so it was about five weeks away. I packed up the gear, and it might have been Gerry Smith I was with or Jack Rasmussen. "Hooray, dear," to my wife, and away I went. About five weeks later I arrived back, walked in through the front door with my port full of dirty clothes to get washed and said, "Hello, love. How have you been while I was away?" She said, "How the bloody hell do you think I've been while you were away?" I thought, "Gawd, she's a bit cranky. She's not very pleased to see me home." Anyway, I found out that while I was away, they didn't know where to contact us, and she'd got sick in the flat. We had one boy about three at the time, and after two or three days when she couldn't get out of bed, the little bloke decided that he had better do something, so he went over to the next door neighbour. The neighbour came over and had a bit of a look at her and she didn't know what to do, so she rang where I worked, and she finished up contacting Col Hazel. Col Hazel didn't know what to do, either, because he didn't know where we were. We had no two-way radio, no nothing. He knew that my Mum and Dad were semi-retired out in Boulia, so he got in touch with them, because my wife had to go to hospital. They came in from Boulia and looked after the little bloke and lived in the flat while Jill went into the hospital – she had pneumonia, I think, from memory. After a period of time she got okay, so they said, "Well, you're right now, Jill. We'll go back to Boulia." So they packed up and went back to Boulia, and about four days later I arrived home and said, "How're you goin', love?"⁷¹*



Flowing bore and bore pool

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One of the Boring Inspectors with whom Maurie shared a lot of experiences was Gerry Smith, who, with his brother Daryl, served the Commission in a number of locations. He was certainly a well-known and popular figure amongst farmers on the Darling Downs. Another popular figure in his own area was the inimitable Doug Neilsen. No landowner in his district would have been prepared to proceed with the construction of a production bore without the blessing of Doug. John Hillier and others did a land and water survey in the Callide in 1974 and stayed at the pub in Biloela for seven weeks. The publican claimed Doug Neilsen was his best customer and would put more money through the bar than anyone else. He'd never seen him drunk, but he was so consistent. He would come in every night have three or four beers, go home for dinner, come back and have three or four beers, buy a six pack and go home. And, of course, he was never unfit for duty.⁷² Pat Ruming and Jim Murray were two experienced wages people who specialised in land and water surveys in the Callide, Monto and Darling Downs areas. John Kennedy, Bob Whittington, John Young, Denis Russell and Perry Goebbels can also take their place with pride.

Back in Head Office, there was a Superintendent of Boring (SOB) who, with some assistance, managed the boring staff (task, not characteristic). Reg Williams held the position until he resigned to set up his own enterprise. Mention has been made of borescreens which held aquifer material back from falling into bores and allowed water to flow. The market had been cornered by Edward Johnson Co of USA. When Reg saw this, he said, "We can do this in Australia." So they engaged a company and, without breaching copyright, they had a cast made. Instead of these rods being individual rods, they had a cast body on which they machined a spiral groove, and then laid V-shaped wire in that groove. Reflecting Reg's name, the product was called 'Willscreen'. These were obviously much cheaper than the overseas equivalent. *The only catch was that the early ones were welded to the body only at the top and the bottom, so if one of these things broke it just went like a coiled spring – TWANG! You'd have bits of screen everywhere. So they introduced a little spot welding mechanism. They also had a lot of electrolytic problems because he was mixing up two different metals – cast bronze with steel – but eventually he sorted it out reasonably well.*⁷³ Willscreens were later replaced by Surecreens, the groundwater staff assisting with the design.

Charlie Howard became SOB, a well-liked, achieving man. Charlie was always cheerful and philosophical. It was his candid opinion that "More trouble is caused by this, that and the other than by anything else."⁷⁴ Jimmy Hawthorne and then Harry Rowland were his principal offsidiers.

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Harry loved to travel around to see the men on the job and to help them. As *Aquarius* reported:

*There once was a boring old coot
Who drove all around in his ute.
Would you believe it,
He never would leave it,
'Cause his cute little ute was so beaut.*

When Charlie retired, a very experienced man with a lot of knowledge was brought down from Rockhampton to replace him – Bill Johnstone. Bill was a very straight-down-the-middle bloke with high moral standards.⁷⁵ In the year that *Piping Lane* won the cup he was supervising drilling in Bauhinia Shire and he knew that Col Hazel, Ian Pullar and Bruce Pearce would be calling in. So he rigged up a most elaborate aerial so that they could hear the Cup on the radio.⁷⁶ Always very obliging, was Bill. Once Bill was concerned about doing something and confided in Sam McCall that he thought he might get into hot water. “Don’t worry about getting into hot water,” said Sam. “Even the hot water around here’s lukewarm.”⁷⁷

Jim Kurts came from Toowoomba to replace Harry Rowland. Jimmy also does a bit of drilling around the Fassifern Valley, where he lives.

In due course, Bill Johnstone retired and Barry Gibson succeeded him. He still occupies the position.

Staff recruitment procedures and higher standards of education have brought about a major change in the type of sub-professional officer. It is unlikely that in today’s climate many drovers (Dick Hurn), mail-truck drivers (Max Dean) or well-drillers (Bill Johnstone) would be appointed, despite their obvious natural skills.⁷⁸

In order to maximise the benefits of the Great Artesian Basin, the Government introduced a programme to encourage landholders to distribute bore water to as many properties as possible and thus avoid a wasteful proliferation of expensive bores. The *Water Act* made it possible for them to legally form a Bore Water Area administered by a Bore Water Board. They would get together, decide to drill a bore and then construct bore drains. In some cases they took over existing bores and levied themselves and the area that would benefit and they managed their own affairs. In most cases, the funds to drill the bores and build the drains were guaranteed by the Crown, so there was a Government representative on the Board. Some Areas got into financial trouble and the Government became the Board through the local District Engineer.⁷⁹

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Boring School Charleville 1971

(Back row) Max Dean, Ross Heness, Aub Heness, Peter Kelly, Jim Ole, Barry Rogers (partly obscured) John Kennedy, Harry Plint (Middle row) Barry Gibson, Freddie Gifford, Alf Castles, Maurie Watts, Jim Kurtz, Keith Hendrickson, Daryl Smith, Mike Ware (Front row) Col Hazel, Maurie Heness, Len Ritchings, Charlie Wimburst, Peter Cochrane, Bill Johnstone, Bernie Credlin, Charlie Howard

As at June 1974, there were 60 Areas serving more than 1.8 million hectares through 3,735 kilometres of drains.⁸⁰ The St George district had more than half the bore trusts in Queensland and many of them were operated by the Commission.⁸¹ One property near Bollon is supplied by five different Bore Water Supply Areas plus its own private bore. In theory, the BWAs finished at the NSW border, but in reality they continued on. The drain maintenance on

the NSW side was paid for directly to the delving contractor and not to the Board.⁸² (Delving is the term applied to the mechanical cleaning and realigning of the drains.)

As Warren Hutton said at a public meeting in Theodore in 1995, “Whisky’s for drinking and water’s for fighting over.” According to Gerry Harth, there were constant fights over water and constant theft. If you put a dead sheep in the start of your neighbour’s drain, the water would go along your drain instead of your neighbour’s.⁸³ Gerry Harth recalls that *during the dry times there was always thieving of water and diversion of the bore drains. Every Board had at least one meeting a year. At one meeting a man got up and stated that if any bastard touched his bore drain water again, he’d shoot him. They believed him so it never happened again. People put glass window panes in the divisors (structures to divide the flow into separate drains) because they were hard to see. You could only find them if you physically got in and hit them. There were polythene pipelines underground from one drain to another. New drains disappeared mysteriously. If bore drains died back in summer, there were accusations of theft that had to be dealt with diplomatically. Some of the landholders were descended from the original settlers and thought they owned everything.*⁸⁴

These disputes were a constant trial for Commission staff. The mild-mannered Bill Johnstone from Blackall/Longreach was a reluctant but highly effective calming agent (and sometimes an enforcer) when tempers looked like fraying.⁸⁵

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Even without fights, the administration of Bore Water Areas could be hazardous. Greg Claydon and John Dickson went to a BWA meeting north-west of Surat. There had been quite a lot of rain and they were coming back just on dark and they decided to go and have a look at an old bore that was really serving no one any longer. They got bogged. About midnight, they got on to a local property owner who got Gerry Harth to come and rescue them.⁸⁶ On a previous occasion, Bernie Credlin and Mick Moore walked twenty-five miles through the latter part of the night, arriving in St George about lunch time on Good Friday, after having been offered a lift about half a mile out of town. Once Bernie and George Symonds were bogged in black soil and were clearing the mud from the wheel arches by hand. One got a handful of very angry brown snake. Both snake and mud-cleanser survived.⁸⁷

Because water is delivered from bores via earthen drains, the losses are extreme, particularly in summer when evaporation rates are high. In addition, many of the bores are very old and leak or have no effective headworks to control flow. Thus, of all the water discharged from bores in the Great Artesian Basin, less than 10% of it is actually used.

Whilst the 1954 Report did not recommend any remedial action in Queensland, NSW commenced a programme of rehabilitation of uncontrolled bores in 1952.⁸⁸ A formal programme commenced in Queensland only in 1989, largely at the instigation of Col Hazel and after a special committee had been established in 1987. Prior to this, the Commission had encouraged owners to recondition their bores, with no charge for technical assistance or supervision.⁸⁹ The main impediment to the formal programme, as is often the case, had been funding arrangements. Eventually, an agreement was reached where the Commonwealth and State Governments would each contribute 40% of the cost and the owner 20%. The first bore reconditioned as a trial was the Euthella bore near Richmond. Local history had it that the casing had been blown out of the bore in the 1930s. John Hillier logged it in 1986 or 1987 with Phil McNamara and Mike McEniery. It had a pond about 5 acres in area with a sandy bottom and about 41°C - you could have set up a tourist resort there. It had been set up with 6", 8" and 10" casing but logging found no 6" anywhere; the only part of the 8" was the casing shoe and the 10" had gaps of up to 2 metres. It was decided to use this to try out some techniques so six or eight Boring Inspectors were assembled. The first thing was to pump out the pool. It took two to three weeks to do the full job. One day, Bruce Keogh wandered down the bore drain



Bore drain delving

and found *a four foot freshwater croc that had made his home there. Bruce put it in a bag and brought it back to camp to show the boys, who were duly impressed.*⁹⁰

Phil McNamara was the driving force on the bore rehabilitation programme. He had been a clerk in Longreach but he admired the Boring staff so much he went out and worked on a drilling rig, then bought his own rig and came back as a Boring Inspector. Col Hazel believes he was probably the most intelligent BI. He died in office but his contribution mustn't be forgotten.⁹¹



Headworks on reconditioned bore

Gerry Harth kicked off the rehabilitation programme in St George. There were many arguments with Longreach about whether St George should be included, with only 43 uncontrolled bores in the whole area. The owner of one of the first bores to be rehabilitated rang to say come and have a look at the bore because it was flowing again for the first time in 15 years. A downhole camera was put down the bore first, showing up what looked like holes in the casing. But the river had flowed over the bore, filling it with debris and silt and there were sticks and gum leaves sticking out of the rusted casing. They cemented it off and produced a healthy flow and enough pressure to push it through pipes all over his property instead of using drains.⁹²

Some of the bores are over 100 years old so there is quite a lot of reconditioning required. Some of the older owners didn't like replacing the bore drains because they reckoned it resulted in the stock congregating in one place, creating dust bowls and downgrading the quality of the fleeces. But often the drains ran through a corner of the paddock and watered only part of it. With reticulation, they could water the whole paddock and also control the feral pigs and goats. There is now a good acceptance of the programme. Probably two-thirds of the bores have been rehabilitated. Because all the bore drains are interconnected you can't replace the drains from one bore in isolation, but you need a proper programme and do the whole lot in one go.⁹³

As well as reconditioning bores, the Commission encouraged replacement of the inefficient drains with (more costly) pipes. The rehabilitation programme is ongoing but must be considered a success.

The 1960s and 1970s were a time of major investigations and assessments to determine how much water could be extracted from the various groundwater basins.⁹⁴ In the 1960s, there were up to 17 cable-tool rigs, owned by the Commission and private contractors, working throughout Queensland, drilling exploration holes.⁹⁵

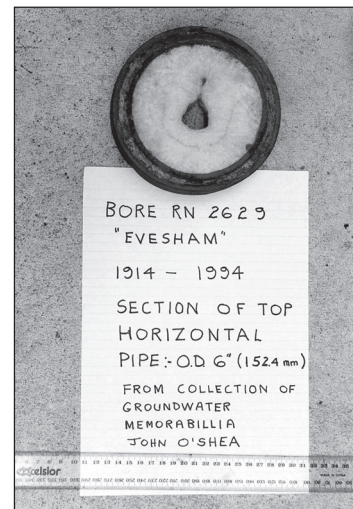
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This period marked a greatly accelerated programme of investigations throughout Australia. The progress was highlighted by two landmark publications of the AWRC: *Groundwater Resources of Australia* in 1975 and *A Review of Australia's Water Resources*, 1975 in 1976.⁹⁶

Some of the investigations were carried out on behalf of industry. For example, the Commission undertook an investigation to supply groundwater to the new Weipa bauxite mine. Assistant Commissioner Harry Hiley and Jack O'Shea went to look at the potential water supply. *We expected pretty primitive accommodation at Weipa, sleeping under canvas. But Comalco had American connections and Weipa was absolutely amazing. There was a transportable but made out of aluminium with fridges, a complimentary bar, and the whole box and dice. Not at all primitive conditions but treatment as VIP visitors. What is more, it was probably the easiest assignment of the lot, because there are fantastic groundwater supplies in that Weipa Peninsula. The mining venture itself was like taking candy from a baby. If you went into a test pit and ran your finger along, you would dislodge at least a kilogram of pesolites, and that's what they were mining. You just had to shovel it out and take it off.*⁹⁷

Jack O'Shea was also involved in investigating brine deposits at Port Alma, just south of Rockhampton, for ICI. The brine was twice as salty as the sea, and if it was pumped up on to the ground, it evaporated and salt crystallised quickly. Jack carried out the pump tests on numerous bores and analysed the tests to determine the pump rate. ICI would immediately ring the Ornell Pump Company in Sydney, and they would design a pump for that particular bore. One of the offshoots of the investigation was that, after the ICI field had been going for a while, the Taxation Commissioner said that, because the brine was very possibly a renewable resource, this was not a mining venture and was not eligible for taxation advantages. There was a big court case, ICI-v-The Taxation Commissioner, held before the High Court of Australia. Jack was relieved of his duties at the Commission to go into court every day and just sit there without saying a word to anyone other than the learned Counsel for ICI who were actually arguing the case. In 1972, long after Jack had left the Commission, the finding was in favour of ICI.⁹⁸

The Commission's investigations were wide-ranging, covering a substantial part of Queensland. Areas under investigation included the Lockyer Valley, the Burdekin, Bundaberg, Condamine, Mackay, the Bowen Basin, the Isaacs Basin and the Flinders



Calcareous deposits in Evesham Bore

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River area.⁹⁹ A huge amount of data was collected by numerous field trips, some into remote and dangerous areas. Many of these were extremely memorable for the participants.

In 1973, the Commonwealth Government allocated money for the investigation of the groundwater resources of the Burdekin Basin, including the Belyando-Suttor Area. As *Aquarius* of July-September 1973 reported, three geological parties were sent out.

*There is movement at the Suttor, for the word had got around
That the Feds had lots of loot to give away –
(Not including salaries, some sixteen thousand pounds) –
So all the cracks have gathered for the fray.
Seven brave hydrologists have come from near and far
To muster up in Clermont two by two;
For geologists love mapping what the wild bush features are
And the drillers wait to hear what they must do.

There is Hillier who leads the band from Clermont through the scrub
And Darryl Hooper shares his driving load;
And Jones has come from Longreach with a fridge to hold the grub
He shares with bearded Ellis on the road.
And Cox from up the Burdekin will come and lend a hand
When Huxley's had enough of country life
While Schmiede keeps a drink for him, conveniently canned,
A solace for a man without a wife.**

* Randall Cox had recently announced his engagement

John Hillier described the exploits. *During the Burdekin appraisal in the Cape–Campaspe area, there were two people to a car and you'd camp out for two or three nights and then come back to town and have more beer than is healthy and then go back out again. Everyone had guns to protect themselves against the wild pigs that were rampant. Darryl Hooper decided to get the bounty on the snouts. So every pig he shot, he cut off the snout and the tail. The locals were happy for this to happen every time he saw a pig. But after a few days, they began to smell, so the interwoven snouts and tails were banished to the roof of the vehicle. Somewhere on the road to Charters Towers, the chock-a-block sample bag full of snouts and tails fell off and he never collected the bounty.*¹⁰⁰

One morning Bob Ellis was fast asleep in his bunk when Trevor Jones woke up and saw a huge brown snake headed towards Bob. He let go with both barrels of the shot gun and Bob rose vertically from the bunk with eyes as wide as fried eggs. There's a photograph of Bob holding the snake, measuring 6'3".¹⁰¹

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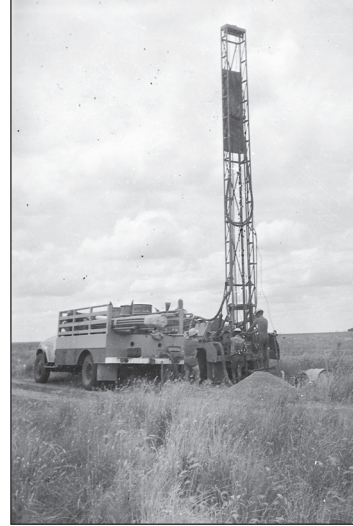
The vehicles weren't really made for the rough conditions. The old Willy's jeep got stuck in the middle of a sand bed in the Belyando with broken leaf springs.¹⁰² It was pretty isolated and certainly didn't comply with modern safety requirements. There could be one person in a vehicle 60 kilometres or so from the nearest habitation without a radio. And there would have been no medical kits as standard equipment. Modern standards indicate huge changes in attitudes.¹⁰³ For a time field staff used panel vans as they could sleep in them. A big change came with the advent of the Toyota Hilux and more reasonably priced four-wheel drives. While these were seldom used in four-wheel drive mode, they had the clearance to traverse the ruts in unmade roads.¹⁰⁴

Cable tool rigs were used for investigation bores because, although they were slow, they produced excellent strata samples. Rotary drills were considered to pose too great a risk of contamination of the strata and strata samples. They were also considered likely to seal off the water-bearing layers with mud. The first time the Commission used a rotary rig was in the early 1960s in the central Burnett. In 1974, the Commission purchased its own rotary rig. *Aquarius*¹⁰⁵ reported the pride of Superintendent of Boring, Charlie Howard, at the acquisition of his new toy:

*A boring old chap, name of Howard,
Had dreams which have suddenly flowered;
He's gone up in Rotary –
Not that common old coterie;
His set-up is much higher powered.*

It had been decided that rotary rigs could be used in conjunction with electric loggers. The logging equipment, all valves, was in the back of a Land Rover. The whole back was filled up with the equipment. Before you could actually do any logging you had to hop up and replace the broken valves and push the others back in. But some good logs were obtained.¹⁰⁶

Birdsville Town Bore was the first deep bore drilled by a rotary rig. They drilled it with mud, found the aquifer layers, cemented in the outer casing at the top, drilled right to the bottom and filled it with mud. They lowered the inner string and set up the lead seal between the two strings and congratulated themselves. They lowered the stems about 600 metres or so and started to lift out some of the mud. Slowly the pressure took over and the casing started to rise out of the hole. They ran for their lives as the casing came about a metre and a half out of the hole – just through expansion of the steel as the water was almost boiling and the casing was over 1,200 metres long.¹⁰⁷



Mayhew rotary drill rig

In 1971, the Technical Committee on Underground Water of the Australian Water Resources Council had decided that a research project on strata sampling was highly desirable. Bernie Credlin, Queensland's representative on TCUW, had volunteered the Commission's services in undertaking the research and had earmarked Hector Macdonald for the task. But Hector foiled those plans by changing departments. Bernie offered the task to a new member of the Branch, Ian Pullar. In due course, *A Review of the Literature and Current Australian Practice on Downhole Sampling Procedures* was published (March 1972).

When Alec Vitte was Shire Engineer at Longreach, his construction gang had been drilling foundations for a new bridge using a large diameter auger. The rig encountered a seam of loose gravel which the auger was unable to lift. A long thin foreman volunteered to be lowered barefoot on a rope and to pick up the gravel with his toes and deposit it into a billy also lowered on a rope. Ian Pullar proposed to include 'a man with prehensile toes' as one of the methods of downhole sampling. The Project Manager, Bernie Credlin, while initially supporting this notion, thought better of it.¹⁰⁸

The NSW representative on TCUW was Bill Williamson, probably the pre-eminent hydrogeologist of Australia and foundation President of the Institute of Australian Hydrogeologists (IAH). He was slightly older than Bernie. On one occasion Bill and Bernie Credlin were in Bangkok when Bill (who was tall and slim in contrast to Bernie's shorter and more thickset physique) was approached by a pimp at 7 p.m. offering to provide him with a woman now his father was going to bed.¹⁰⁹

There have been a few criticisms, particularly from the computer buffs, of the fact that exploratory drilling used lines across the alluvium. In an alluvial valley there was commonly a line of bores, then five or six miles to another line of bores, and nothing in between. Of course, what the modellers didn't realise is that you've got to drill on public roads. If you're doing investigation drilling, you've just got to accept what's there and work around it.¹¹⁰

Jack O'Shea recalls *when doing investigations in the Callide Valley, one of the staff found – a well-known fact now but not at the time – that once you remove the trees from an area, you get a rise in the groundwater table. Each little tree is a pump. The Callide Valley had been a fairly treed area when it was opened up for settlement after World War I. Some wells had been dug, and when the trees were cleared there was a very sharp rise in the groundwater table. It came up 10 metres or something in that order. That meant, of course, that these wells, instead of just being domestic wells, were able to be used for irrigation. Gradually, the early wells were replaced by screened bores and that really developed the Callide Valley in the way it is now, where there's a lot of irrigation going on. But the irrigation is basically replacing the trees that were using that water before. Plants and trees keep the water table down.*¹¹¹

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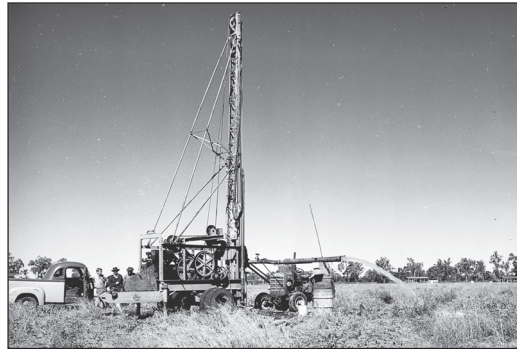
The other oddity in the Callide Valley was that in the process of building Callide Dam the alluvium of Callide Creek was cut off and the quantity of groundwater that was flowing down the Callide Creek was greatly reduced, and compensation water had to be provided. Callide Dam was built for the power station but no rain fell and here was a great big dam, a power station and no water! *Fred Haigh had to eat humble pie, come down to the groundwater section and say, "Can you guys put down a few bores upstream of the dam and supply the power station?" So the power station was supplied from bores behind an empty dam for a number of years and the groundwater guys felt entitled to smirk!*¹¹²

Investigations were not confined to determining how much water could be extracted from an aquifer system. They also took up the challenge of finding ways to augment the existing supplies by promoting artificial recharge.

The first attempts to promote artificial recharge were in the Burdekin Delta. Jack O'Shea was a prime mover in the project which was conducted in conjunction with the South Burdekin and North Burdekin Water Boards. George Symonds, who had retired as Senior Engineer Project Planning, came back to work part-time at the Commission, and was allocated to Water Resources Branch. He worked with Jack and later told him that Fred Haigh pulled him aside one day and said, "George, are you sure this Burdekin Delta recharge thing is going to work?" So George had to say, "Yes, I am sure as I can possibly be that it will work. No worries."¹¹³

And work indeed it did. From its commencement in 1965 to this day, the Boards divert water from the Burdekin River to recharge areas where it disappears into the ground to supplement the groundwater. Some effort is required to settle the water and to clean the intake beds, but it is all remarkably straightforward, as Bill Day, who worked closely with the Boards, can attest. This was a big step forward.¹¹⁴ The spectacular success here made results elsewhere sometimes appear to be a failure.¹¹⁵

Despite extensive experiments in the Bundaberg area, in which Hector Macdonald and Peter Bevin had a major role, there was no success. John Harvey was involved in the trials, throwing up sand banks in the bed of the Kolan River. *Water was actually transferred all the way from the Kolan River to Moore Park for recharge trials, and it worked. Contractors piped water from the Elliott River to a potential recharge area that sounded like a mighty fine recharge area – Clay-ton. It was found that*



Pump testing a bore in the Callide Valley 1974

*the algae in the water clogged the injection bores. So a sand filter was tried, but the same thing happened. The only place anything good happened was a place called, oddly enough (and equally rarely), Sandy Creek.*¹¹⁶ At least there was a possible solution for Bundaberg – substitution of surface water for groundwater.

George Symonds also did some very good work in the Callide Valley to identify the areas of highest recharge. But the recharge weirs were built on the best recharge sites and the silty water clogged them up. Later, when more was known about the recharge, open structures with drop boards to let the first dirty flow through would have been constructed.¹¹⁷ It is probable that recharge would be increased by blowing up the recharge weirs. As it is, the weirs have been cleaned out several times with limited success.¹¹⁸



*Recharge investigations
in the Condamine area 1979*

The Three Moon Creek at Monto was predicated on releases from the proposed Cania Dam being recharged to the aquifers. Extensive studies were carried out on possible recharge areas by Adrian McNeil (Brisbane) assisted by Alan Potter (Biloela District Office), using resistivity probes. These studies involved a number of occasions on which vehicles got bogged in the sticky black clays and Alan Potter had the opportunity to demonstrate his skill at mud-sliding in chains. At the end of the studies, Col Hazel and Ian Pullar went to see Commissioner Fred Haigh to explain that these modern scientific studies had proven conclusively that the Youlambie Flats, north of Monto, were not conducive to recharge. Fred said, “The channel will recharge at half a cusec per mile” and could not be persuaded to a different view by any scientific evidence. So the field staff, particularly Alan Potter and Kevin Brown, constructed a diversion weir on Three Moon Creek and a production bore half way down the diversion channel. Measuring weirs were set up along the channel and water was diverted. It disappeared into the ground at almost exactly half a cusec per mile as predicted by Fred!¹¹⁹

It was abundantly clear that, as the water levels on the Darling Downs were steadily declining through the 1970s, something needed to be done about the water supply. New surface storages in addition to Leslie Dam did not appear to be feasible, so artificial recharge was investigated despite the deep and extensive black clay beds. Warren Lane (who Kevin Brown dubbed ‘The Little Master’) was responsible for the trials which included injection bores (unsuccessful) and recharge beds. Water was diverted to the North Branch of the Condamine River, but there was no recharge. Backhoes were employed to excavate through the clays to the sandy aquifer material

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and the trenches were backfilled with clean, sandy material. Harry Plint and Kevin Brown spent many a long day ensuring that all was ship-shape before water was again diverted. In no time the intake beds were sealed by a film of the black clay.¹²⁰

Considerably more success was achieved in the Lockyer Valley where again Warren Lane had a hand. Several weirs had been constructed as surface storages during the 1940s (O'Reilly, Brightview, Wilson and Jordan weirs) and these had been observed to have resulted in a local elevation of the water table. During the 1970s, a number of weirs were constructed specifically to promote recharge, and these were followed in the late 1980s by more. The Lockyer Valley is now virtually wall-to-wall weirs. In the early 1990s, funds were made available through a special programme for the cleaning of the intake beds of these weirs. They have been quite successful, but because of the small storage capacity and the intermittent streamflow, the benefit has been limited. The three off-stream storages, Atkinson Dam, Bill Gunn Dam and Clarendon Dam, are able to make releases to effect some recharge. There are no sites for further surface water development, so the Lockyer Valley will have to depend on management and trading to optimise its water use.

Data collection was, of course, neither a one-off event, nor an end in itself. Officers were required to make periodic visits to the observation bores and read water levels. And the measurements, apart from being recorded, had to be analysed. The joys of analysing pump tests manually have already been touched upon. The mathematics are not simple either, relying on similarities with electrical and heat flow.¹²¹ The analysis of aquifers is orders of magnitude greater. Yet, as aquifer systems become more and more stressed, the need for accurate analysis of their yield becomes more and more imperative.

The Australian Water Resources Council (AWRC) recognised the problems and the Technical Committee on Underground Water (TCUW) thought that national standards could be improved by holding Groundwater Schools. The first was held in 1965 where Bill Williamson (of Water Conservation and Irrigation Commission, NSW) delivered the majority of the lectures, with support from other Australian experts. Phil Whitmee and Hector Macdonald were the Queensland attendees. Mike McEniery did not attend the School, but once it was over he came down on a sortie from Bundaberg and stole Hector's lecture notes, claiming they were Commission property.¹²²

In 1967, TCUW organised to bring an American expert Stan Lohman from the US Geological Survey to Australia to conduct the two-week-long Groundwater School, again in Adelaide. Jack O'Shea, Bruce Pearce and Col Hazel attended. Stan Lohman was an outstanding lecturer, who gave a wonderful set of notes on groundwater hydrology and new insights into groundwater.¹²³

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In 1970, AWRC brought JG Ferris from USA to conduct the Groundwater School. Again, this was held in Adelaide, the home of Schools for many more years to come. These were held over two weeks and a weekend tour of the wineries was absolutely compulsory.

During their educational McLaren Vale tour, the 1972 delegates were told a tale of wonderful resourcefulness. Some time before, a research project was being conducted on the groundwaters of the area and the Atomic Energy Commission was engaged to date water samples by measuring their tritium levels. (Because of radioactive decay, older waters will have lower concentrations of tritium, a radioactive isotope of water). While the scientists could measure the radioactivity, they needed a calibration curve using data from samples of water of known age. But where to get such samples? Someone realised that this was a wine growing district, wine is mostly water and, best of all, wine is accurately dated. So they prevailed upon the vintners to provide them with some appropriate samples – the older the better – for scientific analysis. Each test required only a thimbleful of wine, and you couldn't throw the rest down the sink, could you?¹²⁴

By 1972, TCUW decided Australia should have more input to the Groundwater Schools. Bernie Credlin, as a member of TCUW, volunteered Col Hazel to deliver more and more lectures. He eventually went with a thick volume of lecture notes that he had prepared. He gave 13 hours of lectures. At the end, Eugene 'Dris' O'Driscoll (from WA Mines Department) said that he'd looked at the notes and wondered who Hazel thought he was. But he soon realised how good they were.¹²⁵ The notes have continued to be used ever since with only slight modification.



Col Hazel

Attendees came to the Groundwater Schools from every State in Australia – professional people from government departments and consultants – and some from overseas.¹²⁶

Randall Cox was nominated to attend from Queensland so he applied for permission to fly from Townsville to Adelaide. At the time, virtually no one other than very senior officers was allowed to fly, so the application went to the Commissioner, Frank Learmonth. Frank annotated the application *Train travel is good* and did not approve it. Eventually, after it was pointed out to Frank just how long it took to travel to Adelaide by train, he relented and Randall was allowed to fly from Brisbane, but he had to train from Townsville. The rationale was that this train fare remained within Queensland Government coffers, but the extended journey would benefit foreign States, so the airlines might as well get the money!¹²⁷

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The fact that Schools are still held demonstrates that they are considered good and fill a niche.¹²⁸ They deal mostly with modelling now so the notes are more background to help modellers understand the principles they are applying.¹²⁹

By the mid 1970s, computer technology had advanced to the stage that water authorities could seriously contemplate attempts to model aquifer behaviour. A number of research institutions began to build models. One of the trial areas for a joint analysis by CSIRO and the Capricornia University was the Callide Valley.

Up until 1974 the Commission had undertaken its analyses by hand, and a tedious business it was despite attempts to develop labour-saving short cuts. When calculators first became available they cost about \$150 for what, despite huge escalations in CPI, would cost about \$25 today. To buy one required authorisation from the Assistant Commissioner and, more dauntingly, from Supply Officer Garney Johnson.¹³⁰ In 1974 Warren Lane devised the first flow model for computer analysis and this was a huge advance. The Branch was very fortunate that at that time it had amongst its ranks one Jonathon Leon Henry, son of Leon de Witt Henry, who was still serving the Department of Local Government with distinction. Jon's ambition in life was for Leon to be known as 'Jon's father' instead of him continuing with the appellation of 'Leon's Lad'.

Jon Henry, with the blessing of enlightened management, set about developing a general lumped-parameter model. Although the methodology had been around for some time and employed by hand calculations, there was doubt about whether a model could be devised. When Randall Cox was starting his Master's degree in Townsville in the mid-1970s, he spoke to Professor Bill Lacey, who said, *"Now look, these computers might be all right for massaging the front end and back end of the sums you need to do but you're always going to need resistance-capacitor networks to do the real number crunching in the middle. I don't think you should waste your time with that."*¹³¹ This smacks of the bureaucrat who closed the US Patent Attorney's Office towards the end of the nineteenth century because "everything had been invented".



Jon Henry

Jon Henry pushed the technology forward with his groundwater modelling in the 1970s and early 1980s. He was a very bright young engineer who was invariably 'right' and would brook no argument. Anyone who disagreed was invariably wrong. His work was well beyond his time. Modelling in the other States was designed to

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show that modelling worked, as funding was available for that.¹³² By contrast, Queensland concentrated on the practical side.¹³³

The difficulties of modelling groundwater were pointed out in *Aquarius*¹³⁴ in the following poem:

*Some observations on the flow of water through anisotropic
porous media and the disparity between theoretical
and practical behaviour of the fluid*

*Groundwater
Doesn't do
What it oughter.*

For all the technical know-how, the work was not easy. The Bundaberg model was commenced in 1977. Recently, in a shed at the back of Indooroopilly, John Hillier's staff found huge tables of data that had been drawn up – the sort of thing you now do on a spreadsheet. John was reminded that it had taken more than 18 months to tabulate the data on the Woongarra model. He had gone to Bernie Credlin and said, "I don't know if we're getting anywhere. Why don't we give it away?" And, typically, Bernie had said, "Get back and get to work."¹³⁵

It was good advice. The Branch got back to work and developed the models that are employed, though with some refinement, today. In the early stages of the development of the Bundaberg model, to help with the visualisation of the physical dimension, Cadet Darryl Hooper set out the strata with sticks, under the direction of engineer Bill Perry, who was also the Commission photographer.¹³⁶ Every bore in Bundaberg was represented by a stick with the different strata shown in coloured tape. The area would have been at least four metres square. You could look through and see sea level and where the aquifers and channels were. Nowadays we try to do it with computers. They laid out the whole of the Isaacs on aerial photographs and picked all the bore lines.¹³⁷

In the old Construction Branch days, Bill Perry was the butt of many practical jokes by people like Garney Johnson and Ed Penny. Bill lived at Woody Point, grabbed a pool vehicle whenever he could and carried a leather embossed IWSC 'port', all to impress the neighbours. He never opened the port. With the aid of Rocklea Workshops, Garney and Co. had several sheets of steel cut to the inside dimensions of the port and each day added one to the contents. Bill was built like a sparrow from Belsen and after several days, he had a massive list to starboard as the additional mass took its toll on his physique.¹³⁸

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Modelling wasn't the only area in which the technology changed. Mention has already been made of the change from cable tool drilling to rotary drilling and electric logging. During the era of the cable tool rig there were no such things as down-the-hole logging tools or cameras. If something had to be fished out of a bore hole, drillers had to improvise tools sometimes using impressions from plasticine or wax. Now cameras provide all the information.¹³⁹

Drilling rigs themselves have improved. The rigs didn't always have the facility for cementing in the casing and bores leaked up the outside. The Euthella Bore lasted only 12 years before it blew up.¹⁴⁰ A whole range of technological developments has occurred, including logging tools and surface exploration tools such as resistivity and (to a limited extent in groundwater work) seismicity. Exploration tools borne by aircraft and satellites have also been utilised to map groundwater areas and groundwater use. Bruce Pearce has experimented with the MICROBRIAN system (from Micro Barrier Reef Image Analysis) as an analysis tool. Satellite images collected in different wave bands can be manipulated and combined digitally to display scenes in false colour. These can be used to detect a range of landscape features such as areas inundated (and therefore saturated) by recent floods, or various crops (including illicit marijuana plots inside rainforest canopies).¹⁴¹

The management and manipulation of data has itself been subject to considerable technological change. In 1974, the Branch embarked upon its first attempt to computerise the huge amount of bore data that had been collected over the years. The old bore data had actually been put on to sequential tapes in 1969, but in 1974 Bob Kay was seconded from the drafting section to set up a system with some help. As *Aquarius*¹⁴² reported:

*They've hired some lasses to cater
For data which daily grows greater.
But their vital statistics,
Or so say these mystics,
Are purely additional data.*

Everybody, including Alec Vitte and Bill Day, used to spend two mornings a week filling in cards – the old 80 column variety. It later went on to a database system in about 1978 when Bill Eastgate was there, which was a significant step forward. The Western Australia Department of Mines only put their data on to a computer system in about 1998. All the models were run on the PDP 10 mainframe computer at the University of Queensland and stayed on that until it got too expensive. The Department was by far the biggest customer. The system was then moved to the Burroughs system¹⁴³ and later to a PC based system.

The ultimate purpose of all of these activities was, of course, management of the resource. In the current jargon, the resource must be managed sustainably. The Commission is empowered under the *Water Act* to issue licences to water users. To do this, the Commission always tried to calculate the yield of bores and aquifer systems and manage to these. They didn't always get it right, but they tried.¹⁴⁴

Administrative staff were allocated to assist in the management. Martin Murphy was responsible for keeping the Great Artesian Basin register and calculating the annual decline in yields. He didn't always have sufficient data because it was impossible to measure all the bores at once, so he assumed that it declined at 3% per annum and wrote up his register accordingly. As data became available, it was shown that the decline was, in fact, 3%.¹⁴⁵ Martin was a conscientious, much-liked character, fond of a game of bowls in his own time and a good chat in the boss's. He was something of a father figure to the young officers of all stations.

Jack Curry was the water quality clerk, with responsibility for the processing of the numerous samples to the Government Chemical Laboratories and of the results from there to the appropriate destination. Jack was a real character, argumentative when he'd had a drink. He came to the Commission after he retired from the army. Years of repetitious work in the peacetime army inured Jack to the boredom of his job and, with the attention to detail drummed into him, he did an excellent job. Among the many well-performed Branch Clerks was Graham Deighton. Alan Bugeja was a young fellow eager to learn, who later moved to Property on a permanent basis. There were some excellent typists including Kathy Cleary, Colleen Cull (Ryan) and Jan Hemming (Wilke).

Andy McNee was very proud of his Scottish heritage and was extremely conscientious about his tasks, one of which was to ensure that private drillers complied with their licence conditions and submitted the logs of the bores they drilled. One day, Detective Sergeant Bischoff came into the office with a bag of blue shale wanting to know at what depth it would have been found in a bore near Hungerford. A driller known as Pelican had hired a 60-year-old offsider named Bill Groves, who had gone missing. Pelican claimed he had decamped, but the local policeman had insisted he run the sand line down the bore. This revealed that rather than pay him the £160 he owed him, Pelican had hit Groves on the back of the neck, cremated him and thrown him down the bore hole. The file copy of Andy McNee's letter demanding the bore logs, addressed to Pelican at Boggo Road Gaol, shows just how conscientious he was.¹⁴⁶