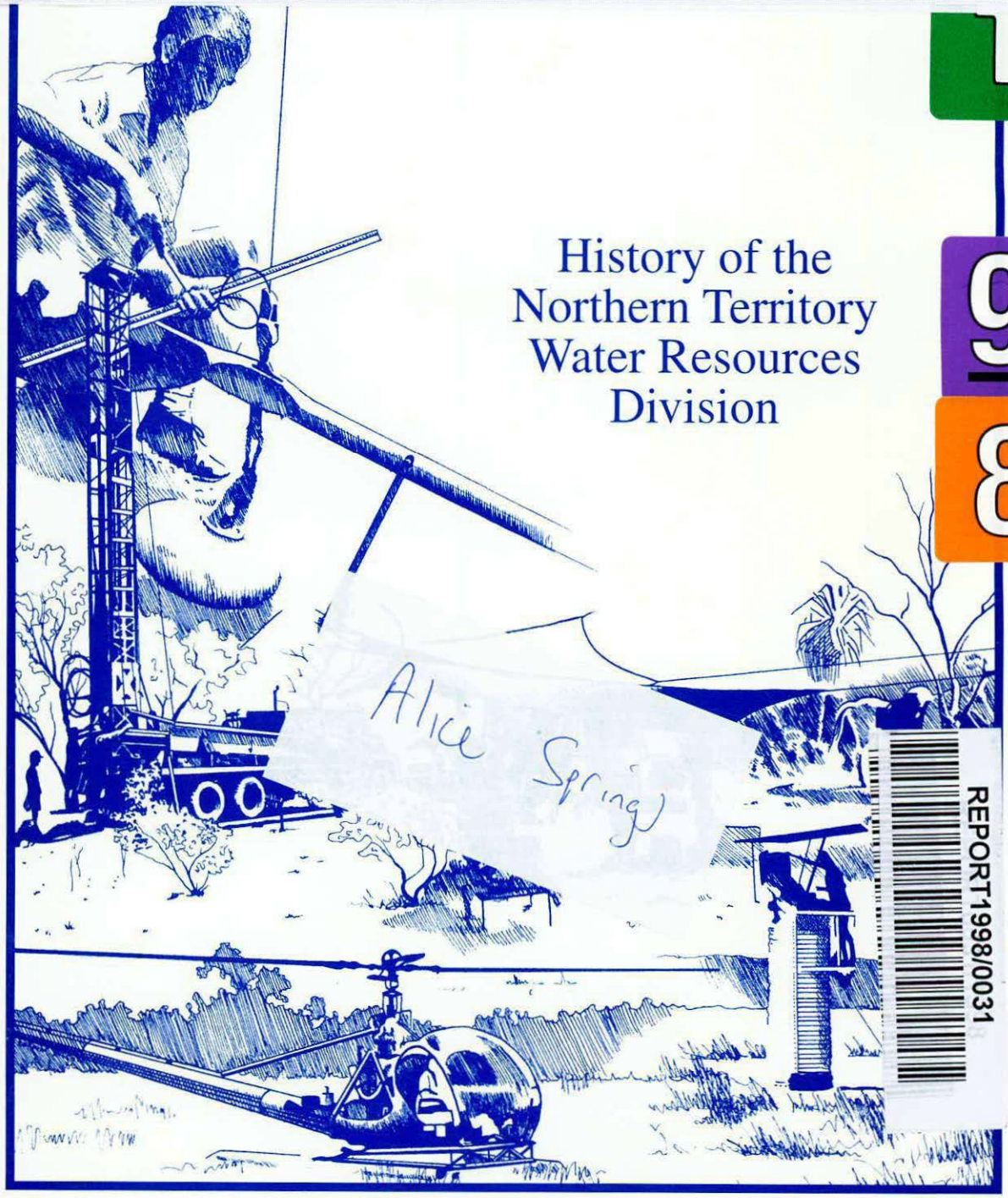
NRETA REFERENCE REPORT - TECHNICAL - INTERNAL - History of the Northern Territory Water Resources Division



Thank you to Kerrin Bullock who designed and sketched our front cover.

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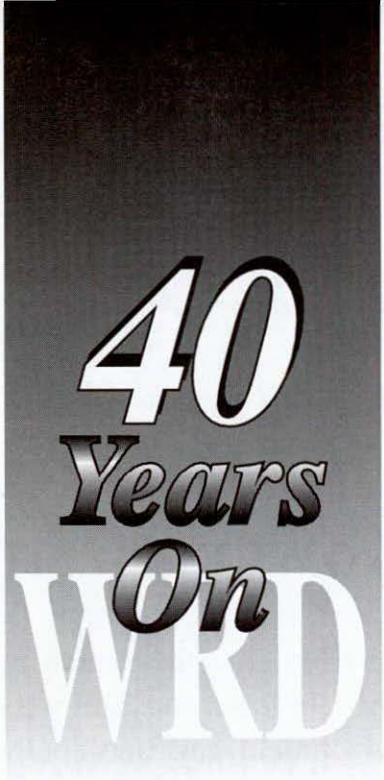


WATER RESOURCES 40 YEARS ON

History of the
Northern Territory
Water Resources Division

ACKNOWLEDGEMENTS

With the support of senior management in both the Power and Water Authority and the Department of Lands Planning and Environment, this booklet eventuated. It was collated and edited entirely by Water Resources Division staff in particular, the Water Resources History Committee (under the chairmanship of Jon Lawrie) who volunteered their time to research and write the Division's history before it was "lost".

This book would not have been possible without co-operation from a wide spectrum of past and present staff, other individuals and organisations who provided valuable information and comment.

The authors are indebted to all those who were involved, in particular, those who contributed printed and oral material. Unfortunately, it has only been possible to incorporate a fraction of this material.

FOREWORD

This booklet records the history of the Water Resources Division (WRD) and its predecessors since formation of the Water Use Branch of the Northern Territory Administration in 1955.

It consists of a four part chronological sequence of factual information, events, and activities of WRD, in each of the four decades of its existence and a further small part forecasting the future.

The role and direction of the Division has changed significantly over this 40 year period in response to the development needs of the Northern Territory, and the evolution of government administration.

In the early years, emphasis was very much about obtaining information on the Territory's water resource and on the development of water supplies. This emphasis continued through the 1960s and 1970s with expanding data collection networks, and programs to install safe water supplies to all communities throughout the Northern Territory.

Cyclone Tracy in 1974 resulted in a decentralised restructuring of the Division, and Self Government in 1978 imposed new administrative disciplines and an injection of energy to get things done without interference from Canberra.

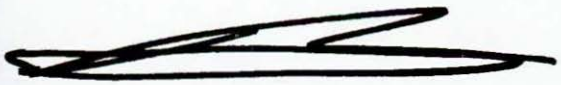
The 1980s saw the commencement of real change in the water industry throughout Australia. Community expectations for the environment and social justice increased, Commonwealth funding support for water resource assessment was cut, and global funding to the Northern Territory diminished in real terms. Recognition of the need for integrated natural resource management within catchments led to institutional policy and program changes. Water quality management, in particular, became a national issue. Several national and local enquires and reviews into the water industry were conducted during the later part of the 1980s and early 1990s.

A combination of the above factors, and recommendations reported by the various enquiries, have resulted in major changes in direction within the water industry. This change is continuing today, and at an increasing pace. The above matters are not dealt with in any depth in the booklet but have had a profound impact on the shape and role of the Division, and its future.

Since the early 1980s, the Division has downsized and redirected priorities towards management of the resource, most recently in regard to allocation and environmental water quality protection. The future will see further emphasis on policy development and regulation. During this period, there has been considerable institutional change in the water industry and WRD has successively been part of Transport and Works, Mines and Energy, Northern Territory Water Authority, Power and Water Authority, and most recently transferred to the Department of Lands, Planning and Environment on 1 October 1996.

WRD has weathered a lot of change but this booklet does not attempt to rationalise the strategic influences which have been imposed on it. Whilst many of the Division's experiences over the years have been uncomfortable, the resilience and loyalty of staff and the identity of the Division has in fact been strengthened as a result.

"Water Resources" is recognised in the most remote corners of the Territory and its staff are respected for their expertise and dedication. This booklet is full of facts and activities, but above all, it is about people - the people (past and present) of WRD who have contributed so much to the development of the Northern Territory.



The Hon. Mick Palmer MLA
Minister for Lands, Planning and Environment

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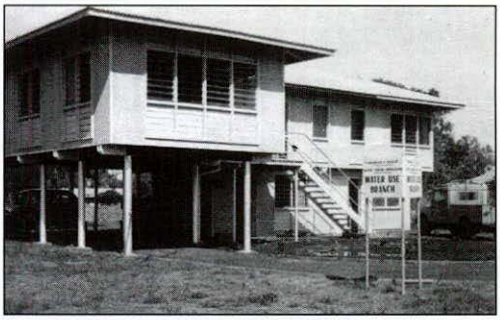
WATER RESOURCES DIVISION

THE FIRST DECADE: 1955-1964

Expanding Responsibilities and Capabilities

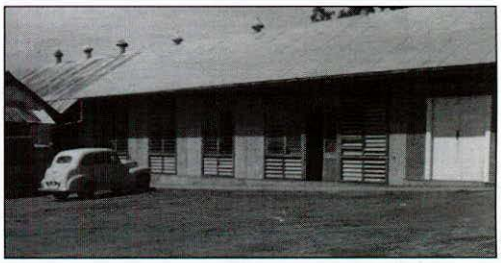
The Water Use Branch (as it was first called) of the Northern Territory Administration was established in 1955 for the purposes of surveying and investigating the water resources of the Territory, a field in which previously, there had been little activity.



Water Use Branch, Cavenagh Street, Darwin 1955

The first Director, Mr Noel Eden was appointed in October 1955, but until early in 1957, had no staff to assist him. At this stage, water resources work was carried out by a wide range of agencies outside the newly formed Branch :

- *Agriculture Branch*
  Drilling on farming lots
- *Animal Industry Branch*
  Stock Route bores, water quality testing (Alice Springs)
- *Mines Branch/Bureau of Mineral Resources*
  Geophysical surveys, bore siting, investigation drilling
- *Lands and Survey Branch*
  Survey and levelling
- *Department of Works (Alice Springs)*
  Town basin drilling investigation
- *Department of Works (Darwin)*
  Rice growing hydrographic investigations, sub coastal plains mapping, stream gauging network.



Townyard and office, Hydro Section, 1955-1967

The development of the Branch was initially slow. Until mid 1957, staffing consisted only of the Director, one administration officer and one draftsman - both temporary! In addition to this small workforce, staff from the Stream Gauging Section of the Commonwealth Department of Works (CDW) - including Jon Lawrie who would go on to become the longest serving officer (to 1995), carried out work on behalf of the Director from the "Town Yard".

In these early formative years, the Director's office was a residential house in Cavenagh Street, with the hydrographic staff operating out of the "Town Yard" office (now occupied by the Harbour View building) and using the CDW Workshop at $2^{1/2}$ mile as a depot.

Darwin Hydro Section, Wood Street, 1963

Water Use Branch, Cnr Cavenagh, McLachlan & Woods Streets 1959

Depot, Winnellie Showgrounds

"Enterprise Bargaining" for resolving conflict between workers in these days was usually carried out "up behind the tank after work hours". No minutes were kept. (T Espie on Depot in Alice)

In January 1958, the Stream Gauging Section transferred from the CDW to the Water Use Branch. Later in the same year, the first Senior Engineer Planning, George Mason and the first Senior Engineer Underground Water, Mark Bracewell, were appointed. Mike Brennan became the first technical employee of the Underground Water Section. Another officer, Rink Van der Velde, (who is still serving), joined the Branch in this year, bringing the total to thirty-two staff employed in the three sections of the Branch - Hydrographic (surface water), Underground Water (drilling & bore testing) and Planning (water quality, survey etc)

In 1959, Water Use Branch officially became Water Resources Branch. In January 1959, the Branch relocated to a new building on the block bounded by Cavenagh, McLachlan and Woods Streets. This area also housed the Branches of Agriculture, Animal Industry, Lands & Survey and Mines amongst others. An additional old building in the area behind the Lands & Survey Branch office was occupied by the Hydrographic staff from June 1960 (this site is now occupied by the Seventh Day Adventist Church and Tracy Lodge). The first Senior Engineer Hydrographic, Phil Purich was appointed and more staff were employed as activities grew. Jim Hawthorn commenced with Groundwater Section - initially in Bore Testing and later became the first Drilling Superintendent. Also at this time, the Winnellie Depot (now part of the showgrounds) was established in Darwin. The area set aside for the new Depot was previously used as a World War II army camp and consisted of ex-army buildings and Sidney Williams huts. Consequently, these buildings required considerable modifications to convert them into a suitable laboratory, workshop and store area.

Staff numbers had grown to eighty-two by June 1959 and the Branch opened its first office in Alice Springs with two temporary staff from Darwin - Mike Brennan and Bob Hamilton sharing a small part of the Heenan's Building with Lands Department at the corner of Todd Street and Gregory Terrace. Four wooden sheds at the base of Billy Goat Hill, shared with the Department of Mines, were quickly established as the Branch's depot in Alice Springs.

Frank Eggington was appointed as first District Engineer at Alice Springs in May 1960. This was followed by the appointment of Groundwater Engineer Cec Forbes, which together with additional staff and temporary transfers from Darwin resulted in a large increase in groundwater activities. Don Kneebone was appointed with responsibility for maintaining survey standards. Design and drafting output increased with an additional four drafting positions.

During 1961 and 1962, Water Resources Branch staffing had increased to 126, comprising nineteen professionals, thirty-four technical, eight drafting, twelve clerical and fifty-three industrial positions. Also during this period, Alice Springs office relocated to opposite the "Residency" in Parsons Street and the depot transferred to a site through Heavitree Gap below Mt Blatherskite.

In Darwin, the laboratory moved from Cavenagh Street to the Winnellie Depot in a modified Sidney Williams hut. By the end of 1964, the Depot was operating as a complete workshop under newly appointed Depot Manager, Rudi Bruppacher. Expansion of Branch activities continued to the end of the first decade of operations with an increase in staffing levels to 172 by the end of 1965, by which time a depot had also been established in Katherine.

Working without air-conditioning was difficult. Jon Lawrie describes some of the problems encountered; "*draftsmen sweated on top of their drawings and our office had a whopping big fan nearly 3 foot high. It was a real blaster. You had to anchor everything down to stop it flying off the desk*". Such conditions were experienced within the complex of buildings between Cavenagh and Woods Streets, which housed Mines, Agriculture, Land & Survey, Finance, Projects, Welfare and Animal Industry Branches and Water Resources Branch. The situation had come under the notice of a Parliamentary Committee which called the working conditions "*indescribable*".

Twice a week hand/sweat towels were issued (Hank Ten Haghuis on Cavenagh St office)

Legislation

The Rice Development Agreement Ordinance was passed in 1956 whereby government assistance in investigations to aid rice growing at Humpty Doo and other areas would be provided. The Director was active on the Rice Advisory and Agricultural Development Committees.

Amendments to the Control of Waters Ordinance 1959 provided for the registration of water drillers, and the submission of drillers' bore reports and strata samples. The drillers' bore reports were an Australian first which resulted in the Northern Territory developing one of the best databanks of groundwater and hydrogeological information which is still used today. Also under the Ordinance, the Director was delegated an additional function - control of the removal of sand and gravel from the bed and banks of watercourses and lakes.

"I fully agree that a proper stocktaking of water resources by competent engineers and geologists is becoming an urgent necessity, and the lack of information on the subject is already hampering the rice projects"
H.C. Barclay, Director of Lands to Government Secretary, 14 April 1954.

The Water Supplies Development Ordinance (WSDO) commenced in March 1961 with the Director being appointed the Commissioner for Water Development.

The Ordinance provided Government payment for non productive bores and/or loans to landholders who wished to develop water resources on their property. This Government assistance with bore development later became known as the "dud bore scheme". The Branch's workload increased dramatically as a result of it. Through this activity, groundwater drilling was conducted in areas of the Territory where it would not normally have been undertaken. As a result, the Branch's knowledge of the Territory's groundwater resources expanded rapidly. In the first two years, the Branch received applications for advice and assistance for 289 bores.

Drilling a bore under the "dud bore scheme"

Amendments to the Control of Waters Ordinance and Regulations in May 1962 provided better regulation of licensing, control of works in water courses and rights of entry to land.

In the final two years of this first decade, there were policy initiatives at the Federal level which greatly influenced the subsequent operations of the Branch. Firstly, the Australian Water Resources Council (AWRC) was formed in 1962, with the Director appointed as a member of the Standing Committee and Branch representatives appointed to the Groundwater and Surface Water Technical Committees. Secondly, the Federal Water Resources Assistance Program (FWRAP) commenced in 1964 which signalled an increased commitment to surface water and groundwater resource investigations which was to continue initially for ten years, but in fact continued for twenty years.

Surface Water Assessment

Some of the major climatic events of the first decade were :

- Severe flooding of the Humpty Doo rice fields in 1955/56 and 1956/57
- Major flooding in March 1957 of the Katherine and Daly Rivers-Katherine township was flooded and the Daly River Mission evacuated
- Severe flooding in April 1959 at Tortilla Flats
- Major flood in April 1963 on the lower Roper River
- In contrast, rainfall for 1964/65 in Alice Springs was the lowest since 1901/02.

Helicopters used in hut construction at Katherine Gorge 1958

Hydrographic Work

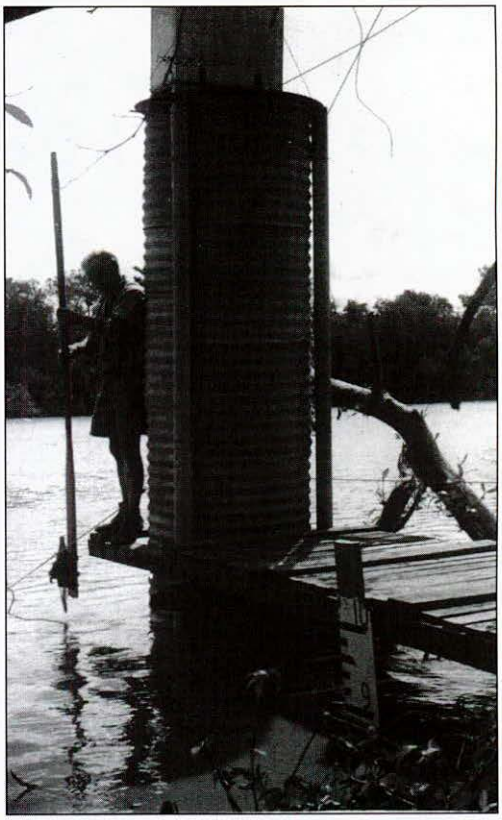
Innovations in transportation were necessary in the early years of Branch work:

- A tractor with rear wheel "paddles" and towing a 4 wheel trailer was trialled for wet season off road access.

Helicopter operations for hydrographic work commenced in the 1957/58 wet with subsequent utilisation increasing each year as the gauging station network expanded. Initial primary use of the helicopter (fitted with floats) was on the sub-coastal flood plains. Two hundred and forty-five hours were flown in a chartered Bell 47G helicopter during the 1959/60 wet season. In 1960, the helicopter was used to transport men and materials into Katherine Gorge to construct a hut and stream gauging traveller spanning the gorge. The helicopter was similarly used in 1964 for constructing two gauging stations in the Arnhem Land escarpment (above Jim Jim Falls and on the Liverpool River).

- 'Operation Horse Lift' in 1958/59, saw horses being trialled for the first time. Horses rather than vehicles were considered more suitable for this project because of the oncoming wet season and the confined area needed to be covered. For two and a half weeks on horseback, Jon Lawrie and Wally Clark carried out streamflow measurements in the Mary and Adelaide River catchments from Shady Camp to Tortilla Flats. Jon said *"we had to battle pelting rain, sandflies and mosquitoes, our saddle gear broke and we were stranded by floods for ten days at Marrakai Homestead. Thank goodness it only lasted one year. The trial was not a success"*.

- In 1960/61, two 3 ton trucks were fitted out for gauging large streams from high level railway bridges. A railway trolley on loan from the Commonwealth Railways was similarly fitted for use off the Darwin River rail bridge.



Sampling at Middle Point, Adelaide River 1955

"Operation Horse Lift", Jon Lawrie

Adelaide River Plains, Beatrice Hill, late 1950's, Rink Van der Velde

Causeway from Olympic Bridge-Beatrice Lagoon Holder Adams and Rob Lawrie

- By 1962/63 Hydrographic Section field crews operating the gauging station network had acquired five vehicles for construction and work maintenance, and eight vehicles for operations.

- A jet boat was used for the first time in 1962/63 for flood gauging, however the boat was underpowered and did not perform as well as a 14ft aluminium dingy with an outboard motor.

From 1955/56, hydrographic activities concentrated on potential rice growing areas within the Adelaide and Mary River Basins. Five gauging stations were established within the Daly River basin during this period. Investigations relating to potential rice areas expanded further east to the floodplains of the Wildman, and the West and South Alligator Rivers. Interest in the Upper Adelaide River area intensified with the establishment of the Tortilla Flats experimental rice farm.

By January 1958, there were fifty-eight stream gauging stations and nine pluviometers. Thirteen of the gauging stations were instrumented, the balance being read daily by local residents including police, mission personnel and local government departmental officers who were paid the princely sum of £1 per month to carry out this service.

Development of a Territory wide network of gauging stations proceeded as staffing levels increased. From 1958 to 1961, a number of gauging stations equipped with long term water level recorders were established in the southern region (in the Todd, Finke and Georgina River Basins). Stations were also established in the "Top End" within the Finniss, Daly, Victoria and Roper River catchments.

Special purpose stations were combined where possible with long term network stations. These special purpose stations were established to collect streamflow data for future bridge or causeway design, potential irrigation, water supplies, flood forecasting and pollution monitoring.

Approximately ninety gauging stations were equipped with long term recorders by 1962/63. During that year, a major works program encompassed the construction of new stations, maintenance, stream gauging operations, hydrologic analysis and planning and investigation. Six pluviometers were installed in the Darwin River catchment for studies relating to Darwin's future water supply. Wet season camps were manned (for streamflow measurement relating volume to height) at Acacia Gap (Manton River), Darwin River (RAAF quarry), Adelaide River township, Katherine, Victoria River Downs and on the East Baines River on Auvergne Station.

In 1963/64, collection of streamflow data for the design of low level road crossings for the Beef Road Scheme in the northwest of the Territory commenced. Also during this year, new gauging stations were established on Groote Eylandt (in readiness for manganese mining), Gove Peninsula (bauxite mining) and mission water supply, and at the European Launcher Development Organisation (ELDO) tracking station (water supply).

Network expansion continued in 1964/65 which included new stations in Arnhem Land, Victoria River basin area, Daly River plains, the McArthur River and the Fitzmaurice River.

The emphasis on hydrographic work during this first decade was on data collection and network expansion. Processing of field data was a manual operation and done on an "as needs" basis. The backlog of unprocessed hydrographic charts and data was increasing rapidly towards the end of the decade at which time 110 instrumented gauge stations and recording rain gauges were in operation. This backlog of unprocessed data remained unresolved until the introduction of computers into the Branch.

Humpty Doo - flooded drilling cable tool rig - February 1956

Water Supply Investigations

The Planning Section commenced in 1958 with preliminary surveys of towns, railways, missions and settlements to collect data on existing and potential water supply and irrigation requirements.

Within the first two years of this program, field parties visited 141 agricultural properties in the Darwin-Daly-Katherine region and a further twenty-five in Alice Springs, noting crops and watering installations. Existing and potential water resources were also inspected at four missions and seven settlements.

In the 1960s, we went bush for two months or more at a time, all for the princely sum of $1.35 a day in allowances. Our camping gear consisted of billy cans and camp ovens, a swag cover, a 25mm straw mattress and some blankets. No fridges, no stoves, no beds. Nothing has changed! (anonymous)

Investigations for these relatively small scale water supplies for missions, settlements and private irrigation developments continued for another two years. Towards the end of this period, emphasis shifted to potentially larger schemes.

An evaporation study, using cetyl alcohol, commenced on Manton Dam during the early 1960's. Other major field activities included an investigation for a proposed irrigation project on Elsey Station. Also investigation for augmentation of Darwin's water supply was carried out that involved survey work for contouring of the catchment area, reservoir and a potential dam site on the Darwin River were completed.

Planning Section activities focused mainly on the "Top End". By 1962/63 various reconnaissance surveys had been carried out using helicopters. This method proved to be cost effective. In the final two years of this decade, activities concentrated on surface water supply investigations within major catchments, and Water Supply Development Ordinance requests.

Providing a water supply to the Bathurst Island Mission

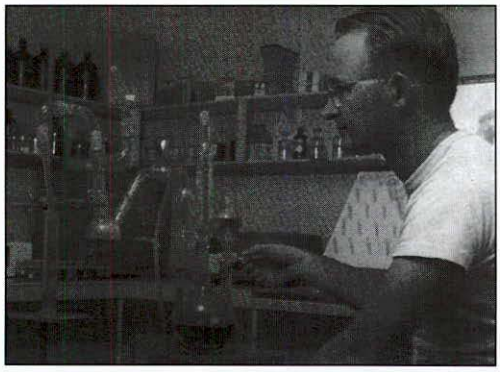
By the end of the decade, survey and design of irrigation works included three pilot farms at Tortilla Flats, and government experimental farms at Humpty Doo and Tortilla Flats. This work covered irrigation and drainage channels, levee banks, inverted siphons, culverts and a drop structure.

In addition, agricultural surface water supply investigations had been carried out in the southern region for White Gums Dairy, Tempe Downs Station, Bushy Park and at a national park dam site.

Water Quality Work

From as early as 1956 in Darwin, the Director himself carried out chemical analysis of water quality from various sources. The WRB office in Cavenagh Street housed the "laboratory" for this work, with some work being carried out in a "portable" lab - the back of a Landrover!

Two years later, Planning Section had taken over the Branch's small laboratory which was then capable of basic water and soil analysis. Numerous field water quality measurements were made and water samples taken and analysed from the Humpty Doo rice areas. The routine monthly program included five sampling points from Darwin's reticulation system and numerous other sites.



Water Use Branch Laboratory - Winnellie

By 1962, the Branch had established sampling points in the Finniss River for water quality monitoring on effluent emanating from the Rum Jungle Mine.

It was not until 1963 that the Branch had fully established its laboratory at the Winnellie Depot. From 1963 onwards, regular sampling and testing of water supplies on missions and settlements was carried out, including bacteriological analyses.

By the end of the first decade, chemical and bacteriological analyses had expanded to include:

- all mission and settlement water supplies ;
- water supplies of public/commercial establishments on the Stuart Highway from Darwin to Alice Springs;
- transformer oils and boiler waters (for the Department of Housing and Construction - responsible for electricity supply);
- soil samples in connection with rice projects on the Adelaide River and at Humpty Doo; and
- water samples from all new bores.

Early camps were in tents, no fridges so lots of tinned dog and roo. (M Brennan)

Groundwater Work

At its inception, Water Use Branch relied on other agencies for technical and professional support in groundwater investigations. The need for the Branch to establish capabilities in this area of work was recognised.

In 1956, the Director initiated the purchase of two bore test units. Within the following two years, the Branch was operating its first drilling rigs under the supervision of the Branch's first driller, Tom Cheney. A Southern Cross cable tool rig (WRB Rig No 1) was transferred from the Agriculture Branch. The second WRB rig, also a Southern Cross was purchased new.

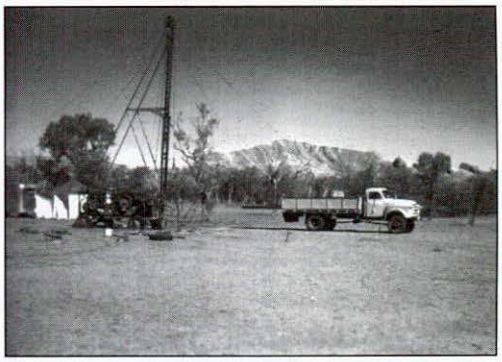
Camp kitchen, Papunya 1959
Bruno Bordato & Max Rotondi

By the end of 1959, a third drilling rig - a Horwood Bagshaw 500 quick drop cable tool - was transferred from Welfare Branch at Warrabri, NT for Branch use in Alice Springs.

Initially, the Branch had no trucks and had to borrow one every time a drilling rig had to be moved. Vastly overloaded Landrovers were much the norm!

Rig No I was taken out of service with the arrival of the first portable rotary drilling rigs for the Territory - a Failing WWI model, rated for 500' of 12" hole, an EDECO MkVI exploration rig in 1959, followed in 1960 by a Winter Weiss Porta Drill 501 and an EDECO MkVII scout rig.

In 1960, three Hydromaster percussion drill rigs operated by Commonwealth Department of Works came under the control of Water Resources Branch.



Rig 3, Mt Liebig, Haasts Bluff 1959

Trucks were unheard of and the loads carried by Landrovers had to be seen to be believed. (M Brennan)

Marrakai on route to Connellans Camp, 1958

The driller had to be his own mechanic, doctor, cook and often his only companion for long periods (T Espie)

Investigations in the Centre

Tennant Creek

In 1957, the Branch requested the Bureau of Mineral Resources (BMR) to undertake a geophysical survey of the Cabbage Gum Basin area near Tennant Creek. This survey confirmed the presence of sub-artesian water. Use of geophysical surveys proved their value on this project, and subsequently hastened the assessment of potential water supply in many areas.

Tennant Creek received its first public water supply system in 1963 from the Cabbage Gum ground water basin south of the town, and later the system expanded to include water from the Kelly Well basin, further still to the south. Until then, the major source of water supply was situated six miles from the town centre. Domestic and stock water supplies were obtained from three tanks fed by bores that had been originally drilled for the telegraph line. Until 1963, the expensive process of transporting water into the town was undertaken.

Alice Springs

Groundwater investigations by WRB in Alice Springs commenced in 1958. For many years, Alice Springs obtained water from the groundwater source known as the Town Basin. Due to the depletion of this source, concerns were being raised about the sustainability of the town water supply.

From 1962 to 1964, the Alice Springs water supply investigation concentrated on the Mereenie Sandstone aquifer approximately ten miles south of town. Rig No 10, working double shifts, drilled eighteen bores totalling 9597 feet. Following bore tests, specifications were prepared for three production bores each 1000 feet deep. Construction was then supervised by the Commonwealth Department of Works.

Throughout 1963 and 1964, activities concentrated on the development of two new production bores (P3 and P4), followed by bore tests of eight days and ten days duration respectively. Both bores required casing and screen modifications before development and satisfactory pumping tests were achieved. A total of nineteen investigation holes were drilled to complete Stage 2 of the overall project which secured a new water supply for Alice Springs.

By 1960, the effects of the drought in Central Australia were felt, and the plight of a station owner highlighted this: "*we have put down 5 bores, only one of which has been successful. The area is suffering severe drought conditions, having had no appreciable rain in 20 months*".

Drought relief drilling took place from 1960 to 1963 with six of the eight rigs in the southern region engaged on this effort, mainly drilling bores for cattle stations.

A Territory first occurred when Mark Bracewell directed a bore constructed at Haasts Bluff to be screened instead of slotted in order to extract water from the drift sand.

Groundwater work was also undertaken at the following locations in Central Australia:-

- Phillipson stock route
- Willowra, Amoonguna, Yuendumu, Warrabri settlements,
- Alice Springs farms area, Petermann Ranges, Bushy Park, Kulgera township, Ehrenberg Ranges and Barrow Creek

We learnt never to shirk hard heavy work, we learnt to fix something if it broke, we learnt to think long and with an open mind on a problem. Early private drillers also taught us to have faith in our own ability and they taught us to deal with others in a manner that ensures one few enemies and loyal clients (T Espie on what was learnt from early private drillers)

Top End Investigations

Top End groundwater investigations commenced in 1958, with some of the earliest work carried out on Darwin Peninsula, the Pine Creek area, Beswick and Katherine.

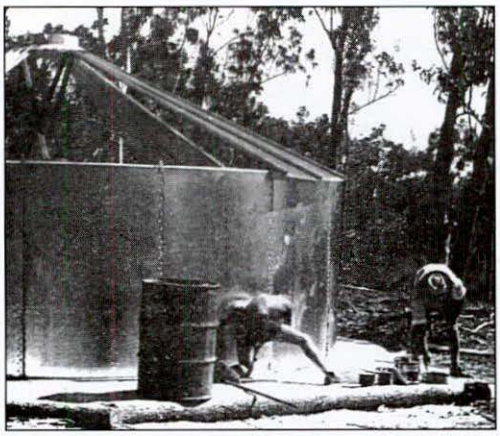
Geophysical resistivity measurements were used successfully in 1959 for location of a bore site for the CSIRO Coastal Plains Research Station at Humpty Doo. Testing the bore with a newly acquired Ornell test unit indicated the existence of a previously unknown major aquifer.

Fred Smith and Bob Jones were acting in a boisterous manner in the Adelaide River Pub when a policeman asked Fred his name. Fred told him his name is Fred Smith. The policeman retorted to Bob "and I suppose your name is Bob Jones?"

Drilling at Berry Springs and at Humpty Doo over the next few years revealed the presence of dolomitic limestone with an associated large water supply. With this discovery came the realisation of the difficulties of stabilising a borehole in a dolomitic limestone aquifer.

In 1962, testing of the quality and quantity of spring flow in the McMinns Lagoon area suggested the presence of a dolomitic limestone aquifer, and therefore a possible potable groundwater supply for Darwin. It was the beginning of investigations that are still continuing today and now providing for part of the water supply for Darwin, the rural population and a significant horticultural industry.

Ingenuity, independence and the remote and inaccessible places they lived made them pioneers in many ways (T Espie on Murray Robinson, Jim Yateman, Bob Lindon - memorable men from the 50's to 70's)



Installing a 10,000 gallon water tank at Bathurst Island

Other groundwater investigation and development work included :

- Drilling and testing at Roper, Hermannsburg and Rose River missions, Snake Bay, Hooker Creek and Delissaville settlements.
- Nine investigation bores were drilled at the Airstrip Plateau on Gove Peninsula - followed by one production well and four observation bores to evaluate behaviour of the aquifer.
- Water supply bores were established at Adelaide River township and in the bed of the Katherine River at Notts Crossing, Groote Eylandt, Bathurst and Melville Islands and Cox Peninsula.
- Construction bores were established for Tindal Airstrip.
- Stock bores were established at Beatrice Hill, Tortilla Flats and CSIRO Katherine.
- Two artesian bores producing 100gph and 1100gph respectively were drilled at Borroloola.
- 24 hour pump tests were conducted at Port Keats, Beatrice Hill, Naylors Bore, Katherine Experimental Farm and Research Station.
- Preliminary work began on a study of groundwater in the Daly Basin in 1962/63.
- Geological reports were prepared for the missions and settlements at Bathurst, Croker, Goulburn, Millingimbi and Elcho Islands, and at Garden Point, Paru, Maningrida and Umbakumba

WATER RESOURCES DIVISION

THE SECOND DECADE : 1965-1974

Organisation, Staff and Premises

The end of an era was reached with the retirement of Mr R N Eden from the Directorship in December 1966. Robert Noel Eden had been the Director of the Branch from its inception in 1955 until his retirement. Initially, Mr Eden had no staff under his control but this situation had changed at the time of his retirement, when WRB staff numbered 207. Some key events for the Branch during this decade included its involvement in the Uranium Province Project (Alligator Rivers), the Ord River and Pilot Farm Schemes (Tortilla Flats and Humpty Doo rice farms).

In 1967, the Branch's Chemical Analyses Section moved to share East Point Laboratory with the Mines Branch. Another major move for WRB was in 1968 when it relocated from a non airconditioned office to the luxury of an air-conditioned one - the Vogliotti Building in Mitchell Street.

On 1 July 1968 the Mines Branch and the Water Resources Branch merged as one organisation to be called the "Mines and Water Resources Branch". This association continued for approximately three years until Water Resources became a separate entity again.

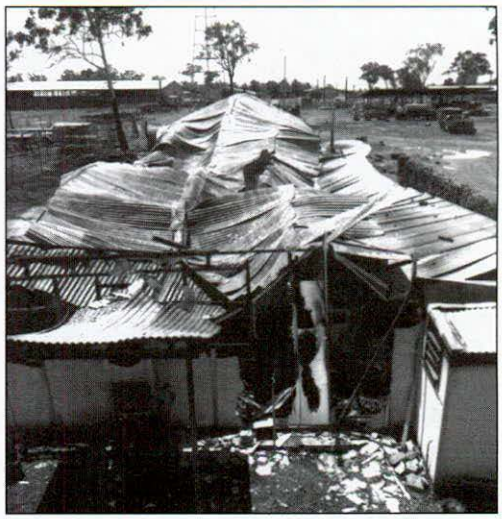
The Alice Springs office moved from Parsons Street to the old Hartley Street school in 1969. By 1971, seven Depot staff were employed in Alice Springs and 1973 saw regional hydrographic staff appointed.

In the course of field duties, many WRB staff experienced helicopter incidents, vehicle accidents and general injuries. One outstanding achievement was in 1966, when hydrographer Lew Matthews was awarded the British Empire Medal (the highest civilian award for bravery) for the rescue of a pilot from a burning helicopter in the Darwin River area. The helicopter, while coming in to land, had flown into power lines.

Darwin staff levels increased in the Laboratory, Investigations and Data Processing Sections by 1971. The Winnellie Depot now employed twenty staff and in 1972, a Darwin groundwater monitoring section was formed.

The offices were airconditioned and the pubs weren't - where do we drink now? (Rob Roos)

We wanted to expand our depot but were unable to source funds. We pulled down two houses in Gap Road and used the materials for our renovations.
We needed an additional welder, so we purchased the parts and our bush mechanic built it. There were occasional delays in getting the equipment onto the assets register. (G Ride)



The Microbiology Laboratory, Winnellie Depot after the fire 1973

On Christmas Eve 1973, a fire destroyed the Microbiology Laboratory at the Winnellie Depot resulting in a temporary relocation to the Forestry Building at Berrimah. Staff were able to resume operations two weeks later.

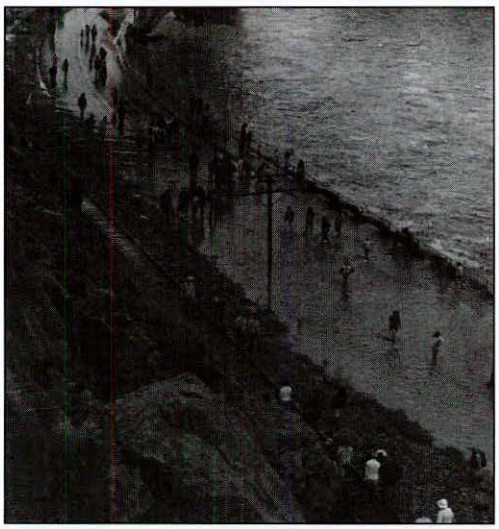
The Microbiology Laboratory, Winnellie Depot after the fire 1973

Disaster struck again with Cyclone Tracy on Christmas Eve 1974 which rendered the Darwin office (Vogliotti Building) untenable. Some staff departed and never returned, many others were subsequently relocated to Alice Springs, Canberra (data processing), Katherine and Gove. The seventeen staff who transferred to Katherine initially settled with their families in construction camp housing at Tindal air strip. They purchased materials, much of which came from Rum Jungle, and built an office and depot at the Victoria Highway enabling regional field operations to commence from Katherine.

The Head Office function was relocated to the Forestry Building at Berrimah. The regional dispersion of staff from Darwin as a result of Cyclone Tracy had a long term impact on the overall organisation and operation of the Branch.

One unfortunate incident to marr this decade was a fatality in 1971/72, when an Alice Springs employee, Bob Hamilton disappeared, presumed drowned in Jay Creek whilst on a gauging trip. His body was never recovered.

Hydrology



Flooding of Todd River at Heavitree Gap (1974)

Some of the main climatic events of this decade were: - The 1973/74 wet season produced major flooding in all areas of the Northern Territory (except Arnhem Land). Extensive flooding prevailed in the Alice Springs area from November 1973 through to April 1974. The Todd River flowed for many months, and a field crew was marooned at Docker River and eventually flown out.

In January 1974, Darwin recorded 29 inches (741mm) of rain, the average being 14 inches (350mm). Top End weather for the 1974/75 wet season was influenced by Cyclones Selma, Amelia and Tracy (which resulted in one of the wettest "Wets" on record) and by cyclonic formed tropical depressions in March and April.

- Darwin River Dam was completed in 1972 and filled for the first time when the spillway flowed from March 1974 through to May 1974.
- Heavy rainfall in the Alice/Barkly and Roper/Katherine areas was experienced during September and October 1974.

At Newcastle Waters, water flowed over the Stuart Highway causeway for 122 days in 1974, eighty-two days in 1975 and fifty-eight days in 1976. For much of this time, depth was in excess of one metre. A new causeway was built in 1977-78. In fact, the 1974/75 wet season precipitated a major program of road upgrades and bridge building throughout northern Australia and the Northern Territory in particular.

Hydrographic Work

Great emphasis was placed on gathering stream flow information to calibrate gauging stations. Early in the decade, one wet season gauging program targeted thirty-seven stations across twelve river basins from the Ord River to the McArthur River.

Sediment runoff plots at Gove and in the Adelaide River catchment were in operation during 1968/69. The plots were an attempt to establish the rainfall - runoff - erosion relationship. Stream sediment studies were also undertaken at Walsh Creek in the VRD area. This was to assess soil losses due to cattle grazing.

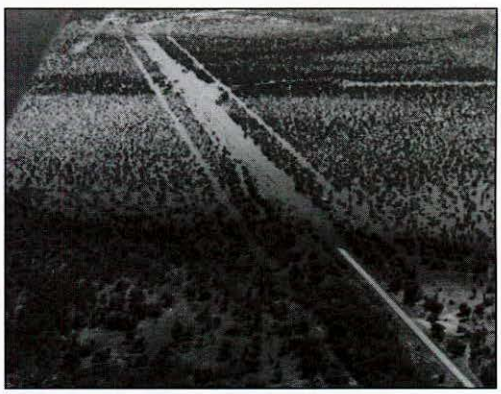
During this decade, the surface water monitoring network expanded considerably. Gauging stations were now located throughout the Top End, including the Victoria River and Daly River Basin, Melville Island, in the Adelaide River Basin, Liverpool River (Arnhem Land) Roper River and in the southern region. By 1967, operational gauging stations numbered 191.

During 1967 and 1968 the stream gauge station network throughout Arnhem Land extended to include stations on the Cadell, Blyth, Goyder and Clyde Rivers. The following year saw new stations constructed at another thirty-two sites. Pluviometers were operating in nine river catchments for catchment studies and at twelve other locations.

In 1971, a tide-gauge was constructed at Groote Eylandt. Eleven stations were constructed in the southern region, and eleven stations and seven pluviometers were installed for the Keep River investigation.

Pluviometers were installed and flow measurements taken during 1972 for the Tipperary sorghum enterprise. A gauging station was established on the Magela Plains outflow and stations were installed for what was to eventually become the Uranium Province investigation. In 1973, further gauging stations and pluviometers were erected in the Darwin River Dam catchment and for the Scott Creek agricultural development, west of Katherine (with Agriculture Branch assistance).

The Newcastle Waters flood in 1974



The Newcastle Waters Flood in 1974 (Stuart Highway)

There wasn't a place in the Territory where we went, which we thought was inaccessible, that we didn't come across empty beer bottles. We used to get paint lids and use them as markers - nailing them high in trees so we could see them early in the Dry over the spear grass (Col Beard)

A recorder tower at South Alligator River

Hydrology staff in the early 1970s

The gauging station network expanded in the Gulf Area with the construction of stations on the Limmen Bight River, Looking Glass Creek (representative basin project of the AWRC), and the Clyde River which has the tallest (78 ft/24m) recorder tower built in the Northern Territory. These stations were part of the investigation related to the McArthur River Mine project. Pluviometers were installed in the Finniss River catchment, and a gauging station and three catchment pluviometers were installed for a McKinley River damsite investigation. By the end of the decade, the gauging station network had 245 instrumented stations and eighty pluviometers.

Project work during 1966/67 included investigations for the Ord River project, Mt Bundey Road crossing, Adelaide River bridge, and tidal movements on Darwin Harbour and Melville Bay on Gove Peninsula for the NT Port Authority. Darwin Harbour tidal velocities were measured for cable laying across to Cox Peninsula for the Radio Australia Overseas Transmission Station, while the Melville Bay measurements were required for shipping purposes.

In 1969, Manton Dam was selected as part of a National Evaporation Study in order to establish a more accurate method of forecasting evaporation from lakes and reservoirs throughout Australia. One raft and two land mounted meteorological stations were constructed and weekly visits were maintained. Regular water temperature profile surveys and meteorological readings of the dam were carried out until 1972.

A siphon operated tide gauge was developed in-house during 1969 and 1970 to overcome the site problems of tidal movement and mangrove mud which prevented the construction of a conventional tide gauge. This was installed at Middle Arm on Darwin Harbour. A submersible recorder structure, believed to be the first of its kind in Australia, was designed in-house and built on the Victoria River for highway design purposes. A tide gauge had been installed on Centre Island (in the Gulf of Carpentaria) in 1972 for the investigation into the McArthur River Mine development and shipping of ore. (This mine eventually opened in 1995).

Disruptions due to Cyclone Tracy in the 1974/75 wet season produced delays in gauging work. Another disruption to gauging work was caused by Cyclone Amelia in April 1975, when recording structures at Tin Camp Creek and Goomadeer River in Arnhem Land were inundated and sheared off at ground level.

Water Supply Investigations

Survey and design work for irrigation of the Humpty Doo (CSIRO) and Tortilla Flats Pilot Farms was undertaken during 1965 and 1966. WRB was involved in the design of the irrigation structures (channels, levees, banks etc). Other survey levelling activities included Adelaide River dam site (Warrai) and various capacity and grid surveys on other dam sites were finalised.

In 1966, the Lower Daly irrigation investigation was started with the construction of a thirty-eight kilometre road from Woolianna to the area. A survey benchmark network was setup and completed in 1967. The hydrographic gauge station network in the whole of the Lower Daly area was also surveyed into the same datum.

WRB's Keep River basecamp

In 1969/70, a report on the feasibility of irrigating the Keep River Plains and Weaber Plains (NT) from the Ord River was produced. As a result, in 1970 a major investigation of the Keep River area commenced. The Keep River project continued until 1974 and work included level surveys over more than 250 sq kilometres (100 sq miles) of black soil plain, the installation and monitoring of some half a dozen groundwater monitoring bores and operation of a stream gauging network on both sides of the NT/WA border. A major field camp accommodating up to thirty personnel was built along with an all weather air-strip now seen on base topographic maps for the area as Kneebone Airstrip. The Air-strip is named after the Senior Technical Officer (Don Kneebone) who was in charge of the early establishment stages of this major project.

Water Quality

During this decade the Branch operated three laboratories: East Point for chemical analysis; Alice Springs and Winnellie conducted bacteriological analysis only, while Water Quality Section in Darwin did all the sampling Territory wide for bacteriological and chemical analysis.

Field setup for water analysis at Middle Point during Adelaide River salinity tests

A major investigation for the East Point Laboratory involved studying chemical pollution of rivers in the Northern Territory near mine sites. The Mary River near Moline Mine, the South Alligator River near El Sherana, and the Finniss River near the Rum Jungle Mine were studied. Studies at Finniss River showed sulphide ore contamination which led to a monitoring program involving three organisations: Territory Enterprises Pty Ltd (TEP), Australian Atomic Energy Commission (AAEC) and Water Resources Branch. This project became known as the Rum Jungle TAW Monitoring Project.

Following public health concerns about sewage outfalls, regular sampling for bacteriological testing of the Darwin foreshores was undertaken as part of a Darwin Harbour Pollution Study.

Inside the Water Quality laboratory

Monitoring of Darwin's water supply for the Department of Health indicated that the bacteriological water quality did not meet World Health Organisation (WHO) guidelines. Chlorination of the water supply was implemented (on advice from WRB), with a subsequent improvement in the bacteriological water quality to match the good chemical quality of the water. Similar investigations led to many missions and settlements receiving chlorinators and soda ash units, after bacteriological or chemical tests.

A requirement of bacteriological testing is that samples be processed within a maximum of 24 hours of sampling to achieve a valid result. As the Territory is vast with many roads not sealed, this requirement was, and still is, difficult to meet. The Water Quality Section tried many different methods to meet the deadlines required and made many breakneck journeys to outback airstrips to meet mail planes, etc. The ingenuity of the Section resulted in the mobile bacteriological lab being set up in the back of a panel van. While the mobile laboratory meant the samples were processed quickly, problems with "dust-proofing" and sterilising proved too difficult, and subsequently the mobile lab was abandoned.

Alice Springs was running out of water (G Ride)

On the road, Adelaide River

Groundwater Work

Groundwater activities increased during the early part of the decade, mainly due to the provision of the ***Water Supplies Development Ordinance*** (WSDO). The Ordinance allowed applicants to apply for advice on bore construction and obtain reimbursement of costs for unsuccessful drilling.

This proved very popular with landholders and during 1965/66, twenty-eight applications for advice covering sixty-six bores were received. Since the introduction of the WSDO in 1961, this made a total of 265 applications covering 527 bores.

The production bores for Alice Springs water supply were completed by 1966 (including P5 to 863ft/263m and P6 to 1871ft/570m). A report concluded that the Mereenie aquifer was capable of supplying water that would meet the needs of Alice Springs at least for the next twenty years. Both these bores were tested at 15,000gph (19 L/s). By 1967, fifteen permanent observation bores were used to monitor the Mereenie aquifer.

By 1967, groundwater equipment operated by WRB included twelve drilling rigs, three bore test units, ancillary and geophysical equipment. By the end of the decade, two new drilling rigs (WRD No 20 for Alice Springs and WRD 21 - Portadrill 10TKT - for Darwin) had been purchased and three older drilling rigs had been disposed of.

Darwin water supply investigations at McMinns continued throughout the decade. A fifteen day pump test was conducted on M31 production bore, (on average, a major pump test takes two days). Water supplies for Darwin were augmented by 1969, with the siting and drilling of production bores by WRD. An additional thirty-two investigation bores were drilled in the McMinns area during 1971 and 1972.

Papunya No.3 Bruno Bordato, Bob Hamilton Max Rotondi

Investigations in the Centre

The Kelly Well Basin was investigated in 1965 to determine whether there was a sufficient water supply to augment the Cabbage Gum Basin (Tennant Creek water supply). Investigation drilling commenced in December 1965, and by March 1966, fifty-two bores had been drilled with a total footage of 6,989ft (2130m). By 1969, water supplies for Tennant Creek were augmented with the siting and drilling of additional production bores.

The search for a reliable water supply for the tourist industry in the Ayers Rock area resulted in thirty-four bores drilled between 1966 and 1969, with further drilling continuing until 1971.

An investigation in the Ti Tree area commenced in 1966 with an initial eighty-one investigation bores drilled. Three production bores were subsequently drilled during 1969.

To assist community development, investigation and production bores were drilled at Papunya, Warrabri, Mt Barkly, Areyonga, Hermannsburg, Santa Teresa Mission, Pine Valley and the Dulcie/Sandown area.

Flow testing at McMinns Lagoon - Bore 31

Arnhem Land Camp near Goyder River Colin Beard August 1970

We had a very enthusiastic team, first class drilling equipment (for the period), miles of work, and no money but more than anybody else. Our approach was often unorthodox, but we achieved many objectives by being resourceful. (G Ride)

Top End Investigations

A drilling program at Arnhem Land coastal missions and settlements began during this decade at Maningrida, Elcho Island, Rose River, Goulburn River, Croker Island, Millingimbi, Umbakumba, Numbulwar and Snake Bay. Previously, water supplies for these communities were obtained from surface water or shallow soaks with many of these supplies being polluted with animal and vegetation matter.

On Gove Peninsula, an investigation of the groundwater resources was undertaken in 1965 to ascertain the groundwater availability. It was proposed to develop a bauxite mine on the Peninsula. The mine (NABALCO) still operates today.

Due to ongoing water supply problems at Oenpelli, additional bores were drilled in 1969. However continuing water shortages initiated further investigation and drilling of production bores continued through to 1974.

The Daly Basin groundwater investigation progressed throughout the decade with four investigation bores drilled in the Tipperary area. One bore was drilled to 1385ft (422m) and was free flowing (artesian) at 200 gph (.25 L/s). Drilling was also undertaken in the Claravale area and one deep hole had been drilled near the King River on the Victoria Highway. This bore commenced in May 1970 and was completed in November 1970 with drilling delayed for two months because of the failure of the main drill cable at a depth of 1640ft (500m). At final depth, 2245ft (684.3m), the bore was free flowing at 7920 gph (10 L/s) at a temperature of 50°C.

The role of the drilling and bore test crews diversified briefly during the Cyclone Tracy clean-up. As it was crucial that a safe form of sewerage disposal be established, the major work carried out was drilling toilet pits in school grounds.

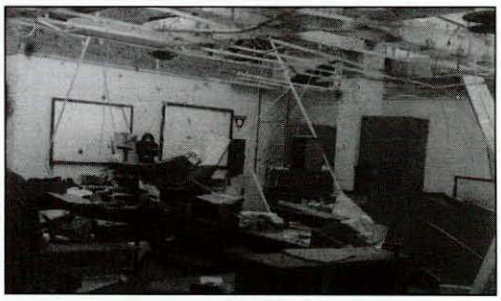
Other activities included:

- four bores at Borroloola for the store/hotel, two houses and the racetrack;
- two production bores on Gove Peninsula for the European Launcher Development Organisation Tracking Station (ELDO) project;
- testing of five bores at Francis Creek iron ore mine.

CYCLONE TRACY

"The Vogliotti Building was quite a mess and we pushed all the rubbish out down the stairwell and through the window in my office".
Norm Watson

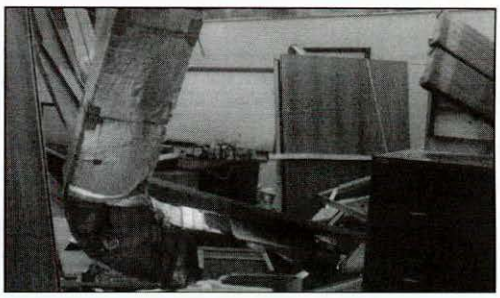
"The wind started blowing and everybody said: well, fill the bath up with water. Make sure you've got plenty of water. Shut yourself in the bathroom because that's the place to be. Then it started blowing all the way around because the roof had come off there".
Peter Trenchard



Head Office, the Vogliotti Building, Mitchell Street after Cyclone Tracy

"Apart from drying out charts and trying to get our records recovered and back into reasonable shape, the main task was to track down where all our people were".
Norm Watson

"Because the main supply to Darwin (a steel pipe right through) was damaged, the Water Resources put taps on. So most people used to go there for a shower if they wanted one in those days".
Peter Trenchard



Head Office, the Vogliotti Building, Mitchell Street after Cyclone Tracy

"When I see those two Water Resources sheds (at the showgrounds), I just start to think of everything else that went down there. That was rebuilt by Water Resources personnel and that was pretty good".
George Edwards

Taking a shower from the water main, Stuart Highway

Water Resources Depot, Winnellie Showgrounds before "Tracy"

WATER RESOURCES DIVISION

THE THIRD DECADE: 1975-1984

Origanisation, Staff, Premises and Legislation

Two years after Cyclone Tracy, WRB was situated in various offices throughout Darwin - the AMP, Jape and Royal Globe Buildings in Cavenagh Street, the Vogliotti Building in Mitchell Street (opposite the Hooker Building), the Winnellie Depot (showgrounds) and laboratories at East Point and Bishop Street. A large number of groundwater staff were transferred to Alice Springs including the Principal Groundwater Engineer after the cyclone. The Bacteriological Laboratory (previously at the Forestry Building near CSIRO), moved to Bishop Street.

Some ex-railway staff joined the Drilling Section as a result of the closure of the Commonwealth Railway between Darwin and Larrimah in 1976. By 1977, the structure of WRB comprised the separate sections of Project Investigations, Hydrographic, Water Quality and Pollution, Laboratories, Groundwater Operations, Groundwater Assessment, Groundwater Basin Management, Rural Advisory Service and Administration.

The Katherine Depot was upgraded in 1976 when two ex Tindal RAAF houses were installed as office accommodation. East Point Laboratory moved to 2 1/2 mile for six months to allow repairs to the buildings at East Point .

In 1977, with the Northern Territory's pending move towards constitutional reform and self government, the function and organisational structure of the various authorities involved in water resources activities in the Northern Territory were reviewed by the Assistant Director, Bob Morrison.

The review concluded that: *"there is a strong case for the creation of a single water and sewerage authority in the Territory, to take account of all phases of water resources planning and development, and related matters. This should be done as soon as possible."*

Royal Globe Building (now Carpentaria House)

As we went into the seventies, the barnstorming approach "Territory style" subsided somewhat. (Hank Ten Haghuis)

Jape Plaza

from left: Don Mitchell, Hugh Wand, Bob Morrison, Norm Watson, Mike Green.

The Laboratory at Bishop Street

The Winnellie Depot (Showgrounds)

With the commencement of self-government on 1 July 1978, the role of the WRB was transferred as the Investigations Branch of the Water Division of the Northern Territory Department of Works. The Department also incorporated the sewerage, roads and public works functions. All permanent and temporary WRB employees were compulsory transferred to the NT Public Service. This move provided better working conditions including the benefit of superannuation for WRD blue collar workers. Norm Watson was appointed Chief Engineer, Investigations and Robert (Bob) Morrison was appointed Director of the Water Division, a position he held until 1981.

In 1978, the Bacteriological Laboratory in Bishop Street amalgamated with the Department of Works, Water and Wastewater Laboratory at the 2½ Mile Depot.

After much trial and error to remove a major algae bloom of *Botryococcus Braunii* at Darwin River Dam, a limnologist was ultimately appointed and subsequently a Limnology Section was created within the 2½ Mile Laboratory. Later in July 1979, a geophysics section commenced.

During 1978, under recommendations of the Fox Report, the Environment Section formed to administer investigations within the Uranium Province. An Environmental Laboratory was established to monitor the effect of any mining on the environment in the Uranium Province area (Alligator Rivers project). This Laboratory was initially to be established in Jabiru, but due to problems with supply of chemicals and gases and the perceived 'remoteness' of Jabiru to southern appointees, the Laboratory was initially housed at Bishop Street before moving to the old Health Clinic in the Nightcliff shopping centre (now a police station). The Environmental Section also included surfacewater and groundwater employees and staff numbers in this section rose to forty-eight during this period.

In 1979, the Investigation Branch staff (WRD) numbered 315, with 239 in Darwin including forty-three staff at Winnellie Depot. Fifty-nine were located in Alice Springs and seventeen in Katherine.

In 1980, a Water Control District was declared in the Alice Springs area to control development and exploitation of the groundwater resource. Later in 1980, the Alice Springs office relocated to Brown's Building (now the Central Land Council office) on the Stuart Highway.

In 1980, Binnie International (Aust) Pty Ltd. was contracted to "review all matters relating to the assessment, development, control and management of water resources and if appropriate, recommend modifications to the organisation and responsibilities of the agencies carrying out the function". The Binnie Report recommended that the Water Division be divided into three branches: Resource Investigation; Water Supply and Sewerage; and Finance and Administration. It also stressed that a cost effective system be implemented to "properly reflect costs of all schemes and projects".

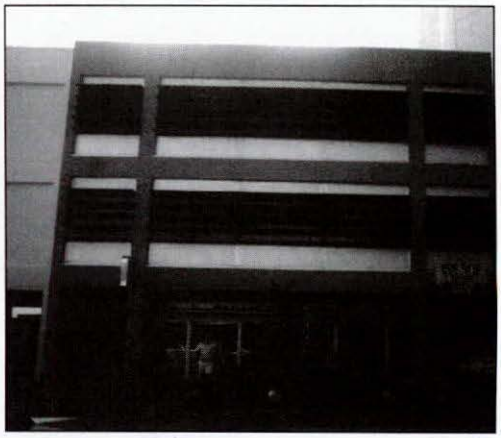
In 1982, the Investigations Branch underwent a major re-organisation which took effect over the ensuing year. As a result, WRD staff and its functions changed significantly:

- transfer of twelve survey and six drafting positions to the Department of Lands and Housing;
- air monitoring function transferred to Department of Health;
- mineral assay/geochemistry function transferred to Department of Mines and Energy;
- plant maintenance was transferred to Plant Branch of Transport and Works; and
- Winnellie Depot transferred to the $2^{1/2}$ Mile complex.

Staff numbers had been reduced to 177 by the end of the re-organisation. Reductions occurred in depot staff, hydro construction and drilling and bore test Alice Springs; and the Water Division retained responsibility for assessment and planning functions.

During the financial year of 1980/81, a review of the Federal Water Resources Assessment Program (FWRAP) by the Australian Water Resources Council (AWRC) reported that the surface water program had successfully met its 1964 objectives. Originally FWRAP's objectives were to operate for ten years but in fact, it continued for twenty years. The NWRAP also resulted in 70% of Australia's groundwater information being made available in an accessible format. The Australian Water Resources Council recommendations were that: "the revised program must be an ongoing priority with funding on a five year rolling basis; and the existing groundwater data on major sedimentary basins should be evaluated and low density monitoring of all aquifer types should continue".

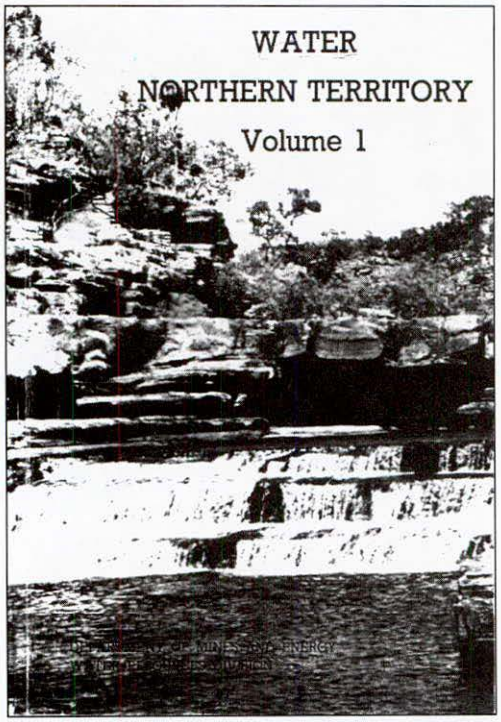
In the early 1980s, the Federal Government began to reduce the level of subsidy to the Northern Territory and these cuts flowed to Water Division activities.



Vogliotti Building

Darwin River Dam (where algae bloom was removed)

The Investigations Branch had been operating since 1959 under the ***Control of Waters Act*** and the ***Water Supplies Development Act*** In 1983, the NT Government Cabinet approved the drafting of new legislation; the ***Water Act,*** for uranium reasons this was not enacted until 1992.



Front cover - "Water Northern Territory: Volume 1"

With the Northern Territory Government's announcement of new administrative arrangements on 21 December 1984, the Resource Investigations Branch of the Water Division (T&W) was transferred and renamed the Water Resources Division of the Department of Mines and Energy. The re-organisation of WRD saw 265 staff transferred to the Department of Mines and Energy.

Other Water Resources Division Activities

Public awareness campaigns began in the Darwin rural area in 1982. The main focus was on the protection of the rural water resources. Information was provided on the Darwin Rural Water Control District and the need for bore construction permits (which now came under legislation). To encourage interest, WRD offered free water sampling, bacteriological analysis and advice on water supply.

In 1983/84, WRD prepared submissions on water rights and access to potential water supply areas on Aboriginal land claims for Finniss River, Katherine Gorge area, Tennant Creek area and Roper Bar.

In 1985, "Water Northern Territory, Volume 1 - an 'atlas' of the NT's Water Resources" was published. This study was initiated following the release of the Commonwealth report "Water 2000 : A Perspective on Water Resources to the Year 2000" . The document was an inventory of the Northern Territory's surface and ground water resources and identified existing and future problems in relation to management of water resources.

A more cost effective policy on work undertaken for external clients was initiated. The policy aimed to charge external clients, including other government departments for work done by WRD. As a result, most government departments reviewed their requirements for WRD to undertake particular water supply investigations on their behalf.

Hydrology

There was a period of high rainfall from 1973 to 1977. This saw the highest previously recorded flood levels being exceeded at more than 114 gauging stations, and more than twenty gauge station recording structures inundated.

March 1976 produced widespread flooding in western Arnhem, Daly, Katherine, Roper and Victoria River districts with prolonged flooding occurring in the Katherine, King and Daly Rivers. The Victoria Highway was flooded by the King River for 3 1/2 weeks in March 1976. During this wet season, the flooding of the Ranken River closed the Barkly Highway for a period of three weeks, as did the James River.

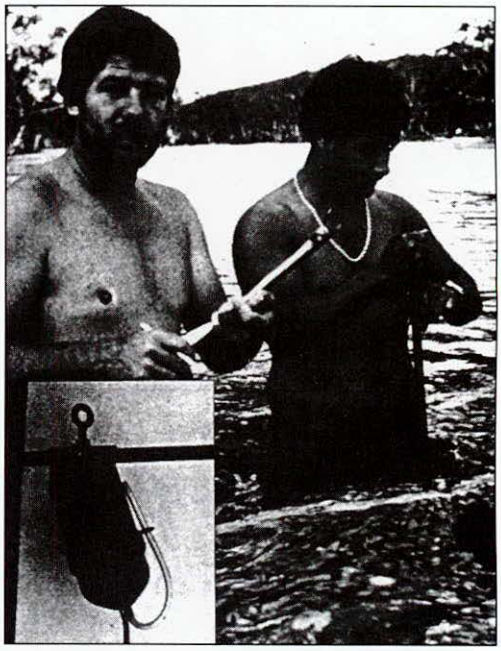
Darwin experienced a record seasonal rainfall total in 1976/77 of 2196mm (a record which was broken in the 1994/95 Wet Season). March 1977 produced the highest March rainfall on record for the Darwin/Daly district.

Darwin itself recorded the highest rainfall total on record for any single month with 1013.5mm recorded. The heavy rainfall saw widespread flooding in the lower Daly River area and the evacuation of many residents. Record flooding was documented at the Adelaide, Finniss, Fish, Bradshaw, upper Flora, Palm, Laurie and Fitzmaurice Rivers. Flooding at Dorisvale Homestead (Bradshaw River) exceeded previous recordings by three metres, totally destroying the Dorisvale Homestead and resulting in the tragic drowning of four adults and two children.

In March 1984, Cyclones Kathy and Ferdinand, and later Cyclone Gretel in April 1985, produced heavy rainfall in the Top End. The Katherine River reached a peak of 17.3m - the highest level for twenty-seven years. Flooding in the Katherine and Daly Rivers saw WRD become active in providing Emergency Services with flood forecasts.

Cyclone Kathy in 1984 in the Gulf of Carpentaria destroyed the tidal recorder on Centre Island, and caused a tidal surge in which many dugong and turtles were washed inland and became stranded several kilometres from the sea. At Borroloola, WRD's office (a two story hut) was blown away. Later, flooding from the west Arnhem area to the Victoria River Downs area was caused by the arrival of Cyclone Gretel in April 1985.

Flooding was experienced in the Alice Springs area in December 1975 and continued until February 1976. Record rains in the Alice Springs district during February 1977, resulted in the flooded Finke River closing the Stuart Highway for some time. In addition, the Highway at Newcastle Waters was impassable for five days.



Eric Salmia & George Tongia (Hydrology) collecting sediment samples from the Todd River on a cold Sunday morning. (insert: the sampling device)

Rig crews started by camping under their trucks and hydro staff spent the entire wet season, without a break in temporary huts. (anonymous)

Hydrographic Work

Eighty pluviometers had been established in the Northern Territory by 1976, with the total monitoring network divided into nine areas operated by two men per area. By 1984, the monitoring network consisted of ninety-seven pluviometers and 226 instrumented gauge stations including six tidal sites.

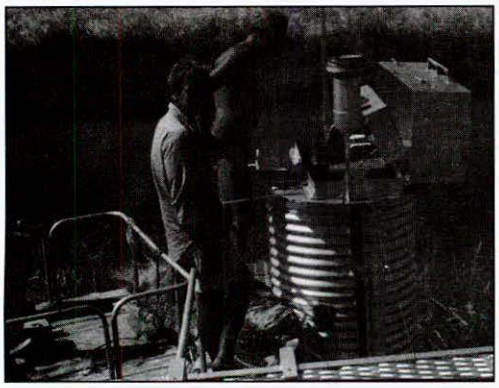
Marking the navigation channel in preparation of the arrival of the barge with their drilling rig at Umbakumba. Left to right: Bill Clarke, Roman Chaloupka, Jimmy Gallager, Bill Lloyd, Mal Williams

During the decade, a marine hydrographic survey and charting was completed for the barge and shipping approach to Milingimbi. A tide gauge was installed and a 5km hydrographic survey undertaken to chart and mark the Umbakumba (Groote Eylandt) shipping approach to the jetty. A hydrographic survey was undertaken to establish barge approaches to Numbulwah. Navigation markers (NAVAIDS) were installed at Milingimbi, Cadel Strait (Elcho Island), the entrance to Buckingham River (Lake Evella) and Medina Inlet (Bathurst Island).

Major survey levelling work was carried out in 1978 and 1979 in association with projects in the Uranium Province and also at Daly River, Katherine bores, Peppimenarti, Amadeus Basin, Hooker Creek, Elizabeth River, Oenpelli, Tennant Creek and Kulgera.

There is not one community, cattle station or project in the NT which has not benefited from our expertise and sweat over the past 25 years. (anonymous)

During 1981 and 1982, three gauging stations and a meteorological station were established for the Rum Jungle rehabilitation project. Full time monitoring during periods of flow of the East Finniss River commenced from the 1982/83 wet season under the Rum Jungle Rehabilitation Agreement with the Commonwealth, and continued until the termination of the Agreement in August 1988. A reduced level of monitoring continued thereafter.



Gauging operations by air-boat Magela Plains outflow Hydrographers Rob Roos & J Wood

The hydrographic network in the Uranium Province increased from twenty-nine gauging stations and nine pluviometers in 1975 to thirty-eight gauging stations and twenty-one pluviometers 1978. Of these, the Magela Creek system (with a catchment of 1435 square kilometres) had nineteen gauging stations and nine pluviometers. This made it the most intense hydrographic network coverage in the Northern Territory.

Following the Federal Government's prevention of the Todd River Telegraph Station site becoming a recreation lake, investigations of several other possible dam sites in the Alice Springs area were undertaken. Two potential sites considered were Emily and Jay Creeks. However, due to the lack of funding, a recreation lake did not proceed.

A Palmerston Urban Hydrology Study commenced in 1983 in conjunction with Roads Division and the Palmerston Development Authority. The objective was to establish an urban gauging station network of four gauging stations and eight pluviometers in the Darwin and Palmerston regions (Palmerston, Corneys Creek, Karama & Moil). The network provided the data necessary to assess urban drainage design methods and their suitability to develop an empirical base of design parameters.

Other activities during the decade included the Darwin Harbour pollution survey, Uranium Province project (funded to $1.82M in 1982), Finniss River pollution investigation, McArthur River development, and flooding assessments for the Adelaide River township, Daly River crossing, Katherine, Newcastle Waters and Timber Creek. Investigations were also carried out for Leanyer Sewerage Ponds, the Lower Daly River flood warning system, together with various flood plain mapping, hydrological design studies, and water supply development investigations.

Gauging the volume of water flowing down the Fitzmaurice River.
Gordon Hargraves & Roman Chaloupka

Water Quality

The Limnological Section of the 2 1/2 Mile Laboratory became involved in the control of *Mimosa Pigra* within the catchments of Darwin River and Manton Dams from the early 1980s.

The advertising spiel for a hydrographer job certainly sounded great - money, travel, exotic places; just like the Navy. (Rob Roos)

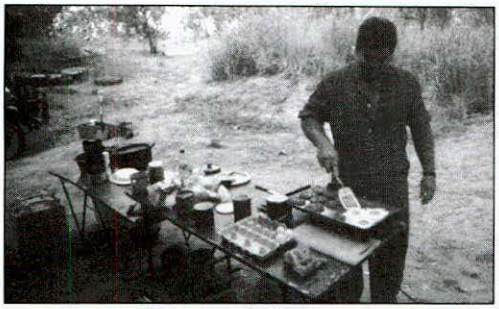
The East Point Laboratory (EPL) was primarily involved in the chemical analysis of drinking water throughout the Northern Territory. Staff upgraded most instruments in this decade to make the analysis more automated. A special Clean Air Laboratory was built at EPL to house an Inductively Coupled Plasma Spectrophotometer (ICP). This needed very sophisticated equipment: distilled water airconditioners; lab coats and overshoes; airlocks and sticky mats to trap dust particles in the air. Power and water supplies were unstable and unreliable to the EPL. This problem was amplified when a lightning strike destroyed the power supply. After this, the ICP became unserviceable.

The Clean Air Laboratory was used extensively for the analysis of the Rum Jungle Mine rehabilitation work late in the third decade.

Dave Miller

The Environmental Laboratory, established as a result of recommendations of the Fox Report, had to validate new methods since environmental monitoring of the Uranium Province was considered to be vitally important. Existing methods were not precise enough for the analytical levels required.

By 1985, all three laboratories of WRD in Darwin were National Association of Testing Authorities (NATA) accredited. Since the Branch was operating three separate laboratories in the Darwin region, approaches were made to the Palmerston Development Authority to build a combined facility at Palmerston (site of the present University). The proposal for a combined laboratory lapsed due to the high cost of construction. Subsequently, the possibility of privatising one, or all three laboratories was considered. However, this did not eventuate.

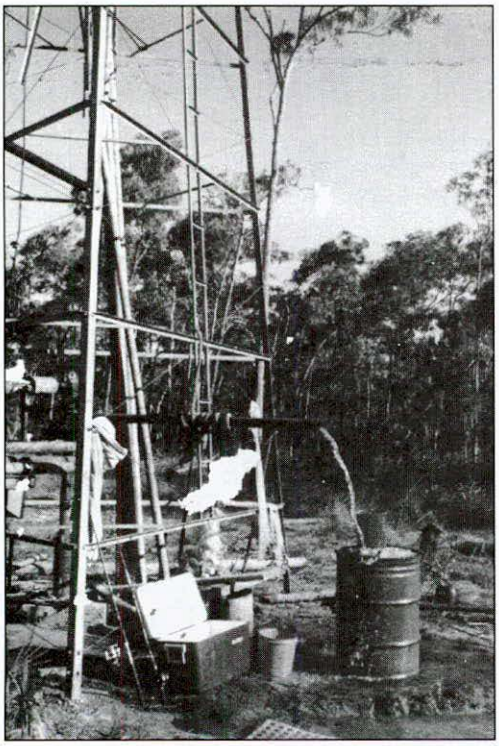


Camp cook - Allan Wade

During this decade, the Water Quality Section took on a more diverse role than just that of sampling. The Section began interpreting results, producing reports and initiating programs. It became involved in pollution responses and the establishment of the baseline water quality data of previously unsampled rivers.

Groundwater

The major groundwater projects for 1978 included the Uranium Province, Darwin rural area, McMinns groundwater, Cox Peninsula, Oenpelli water supply, groundwater potential in Wave Hill/Buchanan Highway area, Gove water supply, and investigation drilling along the proposed route for the Alice Springs/Darwin railway.



Pump testing a bore

Groundwater investigations were carried out for the new Yulara Tourist Village situated at Ayers Rock with the establishment of production bores in 1978. An increase in water demand from the village saw further production bores constructed during 1979 and 1980.

Other new projects included the Jabiru, Alice Springs-Mereenie, Tennant Creek and Yulara water supplies and water supply assessment at Goulburn Island, Millingimbi, Peppimenarti, Ti-Tree, Kulgera and Gove.

Throughout 1982 and 1983, groundwater supplies were developed at fifteen remote Aboriginal communities located in the Arnhem and Alice Springs regions. Investigations at Oenpelli failed to locate a new groundwater source.

Sixty technical projects commenced in 1984, the main two being the Wildman River Station (cashew nut plantation) and Kings Canyon Resort Groundwater Investigation for a proposed major tourist development.

In 1979, drilling rig No 22, believed to be the first TH60 unit sold in Australia, was purchased followed by Rig No 23 (an RO300). These rigs are still in service today. In addition, three 10 Ton and one 5 Ton Smeal cranes were purchased for bore test operations and mounted on MAN trucks.

Towards the end of the decade, under the "Buy Australian Made" policy, an order for drill rig (No 24) was placed with Bourne Pty Ltd in Brisbane for delivery in 1985/86. Subsequently, the two older rigs (Nos 18 & 20) were 'mothballed'.

It could be considered that bore drilling reached its peak during this decade. During one year, mid-decade, 230 bores were drilled while in the final year, this figure had risen to 401, which included eighty-seven constructed under contract.

Our cook, Bruno Bordato, had been sent to get the tucker for the ten days we were to be out on a field trip. But Bruno had an aversion to being cook, so he kept it simple. We had baked beans for breakfast, baked beans for lunch and baked beans for dinner. Subsequently, he was known as "the bucket bean bastard". (Mark Bracewell)

WATER RESOURCES DIVISION

THE FOURTH DECADE: 1985-1994

Origanisation, Staff, Premises and Legislation

In August 1985, the "Temple Review" into the organisation of the water sector was commissioned. This review subsequently produced a report titled "Report on the Establishment of a Water Authority for the Northern Territory". Chapter Five of the report comments: *"from the early 1960's the water function seems to have undergone a disproportionate number of changes. Reviewing the history of how these services have been administered is illuminating. The impression is gained that there has been some doubt as to what to do with them, and consequently there has been more than an average tendency to move the pieces around".*

The most significant event for Water Resources Division in this decade was its move to a Water Authority, followed closely by another departmental amalgamation to form the Power and Water Authority.

Cabinet defined WRD's role as a service organisation in August 1988 following the proposals in the Clegg Report which included a recommendation that all work should be undertaken on a commercial basis. This report, and the Estimates Review Committee (ERC) in 1991, resulted in dramatic alterations to internal organisation and significant reduction in staff numbers.

Major changes also resulted from the Commonwealth decision (20 August 1986) to cease financial assistance for assessment functions under the Federal Water Resources Assistance Program (FWRAP). The surface water hydrometric network was effectively halved and staffing reduced by thirty positions. Some staff departures were of long-term employees such as Snowy Klose and Hank Ten Haghuis who had a combined service of 50 years. Cossie Blyth another long-term employee of twenty years also departed from Alice Springs.

We trained hard, but it seemed that every time we were beginning to form up into teams, we would be re-organised. I was to learn later in life that we tend to meet any new situation by re-organising, and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralisation. (Calus Petronius, AD 66)

Water Resources Management Committee from left: Fred Barlow, Maria Prukner, Mike Lawton, Jackie Stanger, Peter McDonald, Bill Stall, Ian Smith, Bruce Thatcher, Norm Watson, Peter Jolly

The new Alligator Rivers Unit was established in 1985 within the Department of Mines and Energy, and twelve WRD staff were transferred to this new unit. On 19 March 1987, new administrative arrangements saw the transfer of water resources responsibilities from the Department of Mines and Energy to the Northern Territory Water Authority (NTWA) which had formed earlier in January 1987.

Sasco House, now Palm Court

On 1 July 1987, the NTWA and the Northern Territory Electricity Commission merged to form the Power and Water Authority (PAWA). Water Resources Division became part of the Water Directorate of PAWA. The objective of the merger was to: "*provide efficient and effective power and water services to consumers; generate a real rate of return on its assets and promote commercial development of the NT's natural gas reserves*". The Minister for PAWA was the Hon Barry Coulter MLA and the first Chairman of the Authority was Mr Ray McHenry.

Northern Territory Public Service staff (NTPS) (including WRD) who transferred to PAWA were given a two year period of leave without pay from the NTPS which expired on 30 June 1989. Staff not electing to return to the NTPS were then automatically transferred to PAWA. Among those who elected to return to the NTPS were Technical Services Branch Head, Peter Garone and Driller, Ian Broughton. A staff member who left during the year was Hydrology Branch head, John Verhoeven.

2½ Mile Lab

In 1989, the three laboratories (previously located at East Point, Nightcliff and 2½ Mile) were amalgamated in the one refurbished building at 2½ Mile. The Water Quality Section was also relocated from Sasco House (Cavenagh Street). National Association of Testing Authorities (NATA) accreditation was reaffirmed for the combined laboratory. Following the Bruce Fryer Report of 1994, the Laboratory and Assessments Sections were combined to form the Water Quality Branch.

Dani Lloyd & Kate Gowland (NT Waterwatch Co-ordinator) at the Water Exploration Trail, Marlows Lagoon Palmerston 1994

Two federally funded programs; Waterwatch and Monitoring River Health commenced in the NT in 1994 and are currently administered within the Water Quality Branch. Waterwatch is a program designed to encourage community participation by monitoring water quality and raising community awareness of the natural environment.

The Monitoring River Health Programme is based on the collection of water samples and aquatic macroinvertebrates (shrimps, insect larvae, worms snails etc.) from undisturbed and disturbed river sites. These "waterbugs" are sensitive to environmental changes and therefore changes in the waterbug communities can be used to assess the health of rivers.

In 1991, the WRD Darwin head office was reorganised to the 1st floor of Sasco House (now Palm Court). Previously, WRD occupied most of Sasco House.

Further organisational changes within WRD began in April 1991 as a result of the ERC decisions. WRD staffing numbers were reduced by 35% to a level of 110 to be achieved over a two year period. Sections specifically affected were Drilling, Bore Testing and the Laboratories. Internal restructuring was necessary and the laboratory function reverted to an analytical and limited advisory role.

In September 1992, the Alice Springs depot was relocated to premises leased by Gorey and Cole Drillers.

Temporary drilling rig staff were employed for the 1992 season in order to supplement the two Darwin crews which were reduced by the ERC redundancies. This seasonal employment for drilling and bore testing crews still continues. Further internal restructuring saw the creation of the new position of Drill/Test Pump Manager which was filled by a long standing employee, Jon Lawrie.

Northern drilling operations were shifted to Katherine in April 1993. The 2 1/2 Mile Depot field staff and equipment were relocated to Tannadice Street Depot, Winnellie in 1994, while the Laboratory, Water Quality Section, Geophysics and Inventory Instrument Workshop remained at 2 1/2 Mile.

In 1991, after many years of community and government consultation, construction of a flood mitigation dam for Alice Springs commenced. Water Resources Division provided considerable data and advice on matters related to the Alice Springs Flood Mitigation Dam.

The central area of Alice Springs is flood prone, with approximately one quarter of the town including the central business district on land below the 1% (100) year probability flood level. Loss of lives and substantial property damage have occurred from floods over the last decade or so, and the potential for much larger floods exists.

Vincent and Lorraine Fulton of the Minyerri Community (Hodgson Downs) assisting Rod Metcalf (Monitoring River Health Officer) on Arnold River, December 1994

Collecting data at Howard River for Monitoring River Health. Rodney Metcalf and Jane Suggit, 1995

2 1/2 Mile Depot (now moved to Tannadice Street)

Tannadice Street Depot, Winnellie

The NT Government approved construction of a flood mitigation dam at Junction Waterhole, 9km north of Alice Springs on 27 November 1990. Construction work at the dam site began in January 1991. On 26 March 1991, the Federal Minister for Aboriginal Affairs, the Hon. Robert Tickner MP, issued a stop work order at the request of the Central Land Council, and the construction authority certificate for the dam was withdrawn by the Aboriginal Areas Protection Authority. On 15 May 1992, based on the advice contained in a report produced by Mr John Halden Wootten AC QC, the Federal Minister issued a declaration prohibiting all work on the site except rehabilitation and pastoral activities for a period of twenty years.

The ***Water Act*** was passed by the Northern Territory Legislative Assembly in 1992. "NT Water", a strategic plan for the management of the NT water resources, was drafted and made available for community comment.

Jon and Val Lawrie at Jon's retirement, October 1995

Following implementation of the ***Water Act,*** appointments were made to the Water Resources Review Panel and the Drillers Qualifications Advisory Committee. The first Northern Territory Driller Licences under the ***Water Act*** were issued in February 1995.

The Council of Australian Governments (COAG) recommendation of separation of regulatory functions from utility organisations led to the matter being considered by Cabinet, which decided the function was to remain within PAWA.

The Winnellie Depot Manager, Hans Fischer, retired in July 1993 after 25 years with WRD. On 26 October 1995, WRD's longest serving staff member, Jon Lawrie retired after 39 years of service. Jon's comment on retirement was : "the early years were an exciting period of Territory development going hand in hand with the investigation of the water resources necessary to sustain that development, but much is still to be done on water resources assessment, development and management in the NT".

Divisional staff were shocked to learn in 1995, of the murder of Ron Marks near Alice Springs. Ron had previously retired in May 1992 after seventeen years with the Division.

Planning/General

In 1992, the water resources data base development progressed considerably with the installation of HYDSYS surface water software, a VAX3100 computer installation in Darwin, and backup facilities in Alice Springs, including ten new and upgraded personal computers. Data processing capabilities were further enhanced with the addition of HYDSYS software modules for water quality and groundwater.

Throughout 1993 and 1994, consolidation in the use of the up-to-date geographic information and data management systems continued. This system enabled an improved integration of related water quality, groundwater and surface water data. Most of the recorded data of the Northern Territory's water resources became available for wider use.

Fred's Pass Show

Detriment submissions were prepared for various land claims in 1992 and 1993 the main issue being vulnerability of waterways (bed and banks).

The National Landcare Program (NLP) commenced on 1 July 1993. This program was an amalgamation of the previous Federal Water Resources Assistance Program (FWRAP), the Soil Conservation Assistance Program and other community based funding programs. Under the NLP, approximately $700,000 of Commonwealth financial assistance was received in the first year (1993/94) .

Implementation of the National Water Quality Management Strategy (NTWQMS) into the Northern Territory commenced in 1993. The Strategy is part of the national program for ecologically sustainable development and aims to deliver a nationally consistent approach to water quality management.

The Strategy allows all stakeholders to become involved in deciding their preferred or Beneficial Uses for natural water bodies. The Beneficial Uses form the basis of action plans which are designed to manage water quality while allowing for local conditions and the needs of the local community.

In May 1993, a monthly newsletter "Waterwise" detailing WRD activities was born and continues to be distributed widely. Preparation of the historical document "Water Resources - 40 years On : The History of Northern Territory Water Resources Division", commenced in 1995 to mark the 40th anniversary of WRD activities and achievements since its inception in 1955.

School children learning about water bugs at the Water Exploration Trail, Marlows Lagoon, Palmerston, 1996

Flood gauging at Finke River, South Stuart Highway, Dave Evans

The Division participated in National Water Week in 1993, 1994 and 1995 with a number of displays and activities aimed at focusing community attention on the use and care of the NT's water resources. As well as static displays in Darwin and Alice Springs, hands-on field days were held for school children at Rapid Creek in 1993 and 1994, and at Marlows Lagoon in 1995. Alice Springs Water Resources conducted a Borefield Open Day in 1995. The high profile of the Division as a water resource manager still continues to be promoted by the Rural Advisory staff through its displays at the Katherine and Fred's Pass shows.

Surface Water Assessment

Some climatic events of note in the fourth decade were :-

- In 1985/86, seasonal rainfall throughout the NT was generally well below average with the Katherine River recording its lowest wet season peak level in 25 years. Sixty percent of gauging stations in the southern region recorded nil flow for the year.

- Flooding in Alice Springs on 30 March 1988 was assessed as a 1 in 50 year event. Major flooding also occurred at Hermannsburg with the highest level on record for the Finke River and the Hugh River south of Alice Springs.

All sorts of people became hydrographers. In the field, crews included Australians, Dutch, Poles, Germans, British, Irish, Welsh, Checks, Kenyans. They all had a wanderlust, and a love for the job. (Rob Roos)

- High rainfall in January and February 1991 produced minor flooding in the Todd River, record flooding of the Victoria River at Coolibah, of the Dry River (tributary of the King River), Daly Waters Creek and Rapid Creek in Darwin.

- Record rain in January 1995 produced some of the highest river levels on record in the Katherine-Pine Creek area. The Fergusson River rose to 13.2m (3.5m higher than the previous record). Other peak levels occurred on the Mary River (Kakadu Highway), Harriet Creek and McAddens Creek.

- Darwin's 1994/95 Wet Season produced the highest annual rainfall on record.

Hydrographic Work

The monitoring of river flows and rainfall for BHP and the NT Government at Coronation Hill area started in 1985 and continued until 1990. BHP funded the installation of monitoring stations in the South Alligator River catchment in order to collect data for the Environmental Impact Statement for Coronation Hill. The mining of Coronation Hill never eventuated.

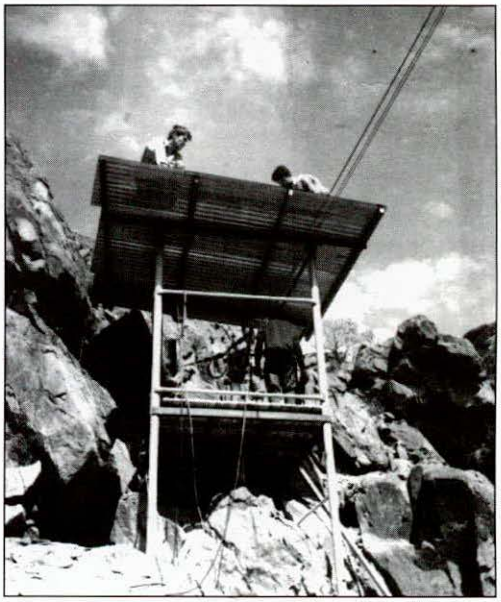
Stage 1 of a flood warning system for Alice Springs was developed and began operation in the 1985/86 wet season. Upgraded flood warning systems for the Katherine and Daly Rivers were successfully tested over the 1986/87 Wet Season. During the same time, a prototype long term recording evaporimeter was developed and tested in response to project requirements.

Flood volume gauging measurements were obtained at Cooper Creek, Victoria River, Daly Waters Creek, Newcastle Creek and Dry River during the 1990/91 wet season. Flood forecasting was implemented for the Daly River, and advice on flooding was provided for Timber Creek. The Alice Springs floodwarning equipment proved unreliable and has since been upgraded. In addition, a lightning strike at Katherine Gorge destroyed the flood warning equipment and the associated Telecom line. Both had to be replaced. In 1994, the Edith River reached a new peak level higher than the recorder tower which was knocked over by the flood waters.

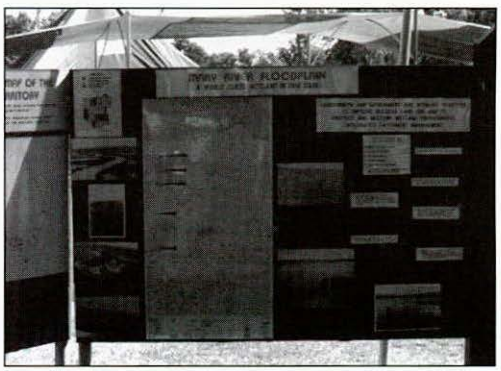
Floodplain maps for Borroloola, the rural area downstream of Katherine, and the Kakadu Highway flood hydrology study were finalised in 1988. Later, further floodplain mapping was completed for Undoolya Valley in the Alice Springs area, and the Finniss River.

Data from the Palmerston Urban Drainage Study which started in 1983, indentified the need to upgrade the tropical urban drainage design criteria.

Tidal data from five sites in the Northern Territory was provided to the Royal Australian Navy Hydrographic Service in 1990. In the following year, tidal flow measurements were taken on the lower Mary River. Salinity surveys, tidal and flood gaugings, sediment sampling and aerial inspections of tidally inundated areas from Shady Camp barrage on the Mary River were completed. Telemetry systems for flood warning were established on the Victoria River and an Argos Satellite transmitter was installed on the Wickham River.



Constructing a traveller hut on Todd River



Mary River Floodplain Display

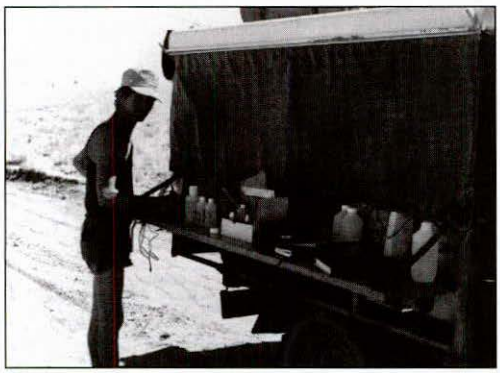
Investigations for Katherine's future water supply started during 1991. McAdden's Damsites 3 and 6 and Dorothy Damsites 1 and 2 were investigated. A possible pumped storage scheme to supply Pine Creek from Copperfield Creek and Renison Dam was considered.

Obtaining a water sample from a local bore

Installation of electronic data loggers in the field commenced in 1989. Data loggers were tested at the Fort Hill Wharf Tide Gauge prior to deployment to field stations. During 1992 and 1993, analogue recorders previously used for rainfall and river height measurement were replaced by solid state data loggers at sixty gauge stations, and by early 1994, 50% of all analogue recorders in the NT had been replaced with solid state data loggers.

After wide consultation with NT Government Departments, industry and other stakeholders, a Northern Territory surface water data collection network review was completed in 1994. The Australian National Rail was provided with extensive data for bridge design purposes on seven river crossings between Katherine and Darwin.

Katherine River dry season storage capacities were determined over a 40km depth of the river.



Bill Stall fluoride testing in his portable lab

Water Quality

Throughout 1985 and 1986, monitoring for the Rum Jungle Rehabilitation Project continued. The total project expenditure had reached $18.3M by 30 June 1986. Following its disbandment in June 1986, responsibility for finalisation of earthworks contracts, maintenance programs, ongoing environmental monitoring and production of the final project report reverted to WRD.

Responsibility for the rehabilitated Rum Jungle Mine site was subsequently transferred to the Conservation Commission of the Northern Territory in December 1988, and monitoring by WRD continued at a reduced level.

Water quality monitoring and sampling of reticulated water supplies and recreational water bodies for public health purposes required the continuous operation of fourteen sampling runs on a repetitive basis varying from weekly to monthly throughout the year.

During the 1987/88 financial year, a consolidated report on bacteriological water quality of water supplies of towns, settlements and roadhouses across the Northern Territory was completed by Laboratory staff. Attention was drawn to a significant level of non-compliance with National Health and Medical Research Council/Australian Water Resources Council drinking water quality guidelines - particularly in respect of sampling requirements.

Monitoring continued in the Uranium Province and the Coronation Hill area.

The years 1988 and 1989 saw field work on the limnology of Darwin River Dam and Manton Dam, with the aim of preserving the quality of Darwin's water supply being undertaken. Also, helicopter and ground spraying was carried out to control *mimosa pigra.*

Automatic water samplers operated during the wet season for the Rapid Creek/Airport study, for inflows to Darwin water supply dams and for specific urban drains.

Between October 1990 and November 1991, regular sampling for monitoring Darwin Harbour water quality began. A review of the monitoring program for the Rum Jungle Rehabilitation Project was also undertaken. Limnological monitoring and interpretation to aid reservoir management continued for Darwin River Dam and Manton Dam.

Water quality monitoring instrumentation, including the construction of two flumes in 1992, and one in 1993 were established on request of CSIRO at the Kapalga Research Station (CSIRO). This was to assess variance in water quality rainfall run-off and sediment erosion between burnt and unburnt catchments.

Water quality projects now involved a multi-disciplinary approach including consultation with a wide range of interest groups such as Greening Australia, Landcare organisations, Conservation Commission, landowners and the community.

Noel Gibbons water sampling near Glen Helen

Ready for field work
(Rig, 2 MAN trucks & 2 4 X wheel drives)

No development occurs without a suitable and guaranteed water supply be that for mining, pastoral, manufacture, agriculture, aquaculture or the general population. (Rob Roos)

Groundwater

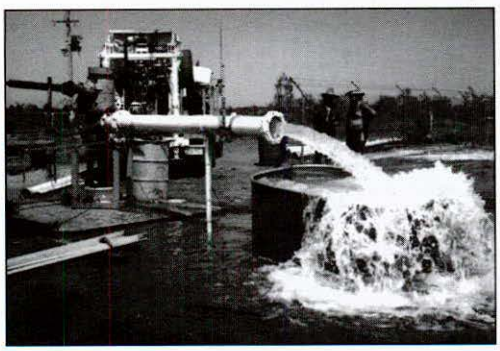
Approximately thirty-three of the projects undertaken during 1985 and 1986 were completed and reported. Under the WSDA - Rural Advisory Scheme - of sixty-eight bores drilled in the Northern region, 75% were successful and of 131 drilled in the Southern region, 47%. Bores were also drilled for client Departments under the Government Production Bore Drilling Program.

We were bogged in this! Warren Archard

In the southern region, the Department of Community Development (responsible for Aboriginal communities) was the major client. Bores were also drilled for the Conservation Commission for parks at Finke, Arltunga and Trephina Gorges.

During 1986 and 1987, projects for assessment, development and planning town water supplies of Darwin, Alice Springs, Tennant Creek, Jabiru and Adelaide River were conducted. A further twenty-one project reports and forty bore completion reports were documented. Investigation into water resources for a potential cashew plantation at Wildman River, and for a date palm irrigation project in the Deep Well area south of Alice Springs was undertaken. A high yielding bore was completed at Pine Hill for the table grape industry. Further high yielding irrigation bores were developed near Katherine. Groundwater investigations for Aboriginal communities and outstations continued with detailed studies for Borroloola, Wurruwi (Goulburn Island), Yarralin, Santa Teresa and Peppimenarti undertaken.

These courses are the first of their kind in Australia. (anonymous)



Test pumping a bore at Nabalco, Craig Hodgson.

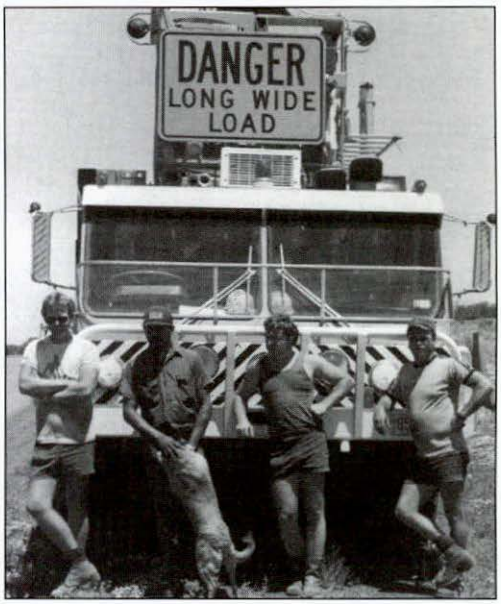
By mid 1987, there were approximately 20,000 registered bores in the Northern Territory. Bore testing was completed at fifty-four locations with 122 bores tested and developed with flow rates from 0.5 l/s to 100 l/s. In addition, 1148 bores were also monitored and sampled on a regular basis at sixty-two locations. Bores drilled under WSDA achieved a 65% success rate in the northern region, and 50% in the southern region.

Groundwater technical staff commenced a two year Certificate on Groundwater Management. This was conducted in conjunction with the Darwin Institute of Technology and the Australian Drilling Industry Training Committee. The bulk of the course content was compiled by WRD, which also conducted the first module. The second module was later held at the Darwin Institute of Technology in 1986. In Alice Springs, Stage 1 of the Groundwater Technology Course was conducted for sixteen southern region staff in January 1988. This was followed by Stage 2 in February/March 1988.

Twenty-nine project reports and thirty-five bore completion reports were finalised during 1987 and 1988.

Comments were invited in October 1987 regarding thirteen specific settlements conducting their own groundwater monitoring measurements. Other focus was on Cabinet's "New Initiatives Program" aimed at assisting mining development. As a result of the program, three regional water resource assessment projects located at Koongarra, Pine Creek region and in the Tanami/Granites area commenced.

In 1989, three replacement MAN trucks were purchased. These proved to be the last heavy vehicle replacements for the decade. Throughout 1989 and 1990, major maintenance was required on the Bourne rig (No 24). Because of ongoing problems the rig was later sold in 1992. In 1991, the PAWA Board deferred a bid of $0.7M for the replacement of a sixteen year old drill rig. Submissions for the adoption of a forward heavy plant and equipment replacement program continued to flounder, and the issue of plant replacement is still unresolved in 1995.



The Bourne Rig 2000 and Alice Springs field crew. From left: John Marne, Ian McMasters, John King, Noel Gibbons

Throughout 1990 and 1991, sixty-eight projects worth $3M were undertaken. Approximately 50% of the work was for Aboriginal communities and outstations. Projects included activities in Kakadu and East Arnhem, Adelaide River, Wadeye, Victoria Highway, Baniyala, Bremer Island, Elcho Island, Manbullo, Mt Liebig, Inyalinga, Laramba and the Alice Springs Town basin.

Field investigations for small scale water supplies at forty remote communities were completed in 1990/91 and major borefield rehabilitation works undertaken at Roe Creek in Alice Springs. Overall, projects totalling nearly $3.5M were undertaken for external clients during this decade.

The "Dud Bore Scheme" which commenced in 1961 under the ***Water Supplies Development Ordinance***, which provided Government payment for non productive bores and/or loans to landholders, was abolished in 1992.

A cut in Government capital works programs during 1992 resulted in a reduction of drilling activities for both Government and the private sector. However, WRD rigs successfully drilled ninety-six bores and completed field investigations for small scale water supplies at forty-three remote locations.

Bore drilling work increased during 1993 to reach a total of 101 bores with seventy-two being pump-tested. During 1995, No.22 Rig was utilised for 143 drilling days while No.23 Rig achieved 154 drilling days. This number of production days in the field had never previously been achieved by WRD.

"I guess you could say that anything that had a engine and could transport Water Resources personnel faster and safer was tried". (Rob Roos)

Bogged at Belyuen Island Steve Heriot

Mick Verma contemplating an artesian bore

Other WRD activities included resource assessments in the Darwin, Auvergne, Wave Hill and Larrimah regions. Investigations of recharge/discharge mechanisms in areas of regional significance were made at Howard East, Lake Woods, Kelly Well, Kintore and Katherine. Assessments were undertaken to meet specific development requirements in Alice Springs, agricultural development sites near Katherine, Roper River, Beswick, East Alligator, Kintore, Willowra, Larrimah, Glen Helen, West Mereenie Loop Road, Port Keats area and Wave Hill areas.

The "Period Drilling Contract" finished in 1994 after 20 years of operation. Under this contract, specific contractors were tendered to drill bores throughout the Northern Territory for Government Departments. The tendering process is now open to all NT licenced drilling contractors.

By the end of 1995, registered bore number 30,000 had been logged.

Investigations in the Centre

Throughout 1987 and 1988, new production bores were drilled at Roe Creek borefield, and rehabilitation was conducted on three existing bores. A major 'fishing' job taking many months over Production Bore P24 in the Roe Creek borefield at Alice Springs proved successful. An accident by a contractor equipping the bore necessitated the retrieval of a pump, tools, damaged screens and reconstruction of the 227m deep bore. On line production was later achieved at 120 l/s.

In September 1988, Drill Rig 24 was used at Roe Creek in Alice Springs to deepen an investigation bore from 356m to 619m. This investigation was part of an ongoing assessment for Alice Springs water supply.

Around this time, water supplies for the Department of Transport & Works (DTW) road works were provided in the southern region, and the Tennant Creek borefield model was successfully established, calibrated and verified. The following year focused on water supply drilling for the Yulara community.

Top End Investigations

Projects completed during 1987 and 1988 included :-

- Test pumping of bores for Jabiru water supply;
- A groundwater evaluation culminating in the construction of eight production bores on South Goulburn Island. This project commenced in 1985 but was disrupted by accidental intrusion of a sacred site by a member of the drilling crew and further work was abandoned;
- Arnhem Land drilling program proceeded including three bores of 10l/s each at Maningrida to meet expected demand to the year 2000; and
- Emergency bores were drilled at Swim Creek and Carmoor Plains for buffalo drought relief.

In 1990, water supplies for the Department of Transport & Works were provided on the Gove road. The Jabiru water supply investigation located suitable groundwater reserves. At Smith Point on the Coburg Peninsula, water supply was secured with seven low yield production bores completed and tested. Assessment and drilling of five high yielding investigation bores was undertaken for a private enterprise in the Katherine area.

Site assessment was undertaken to test water supplies for the Victoria Highway upgrading in 1990. Also the first hydrogeological map of the Pine Creek mining region was produced. This was followed later by maps of the Granites/Tanami and Helen Springs areas. Groundwater drilling and bore testing client jobs continued and focused on island and Arnhem Land communities. Other clients included Conservation Commission of the NT, Department of Transport and Works and Department of Primary Industry and Fisheries, various primary producers and organisations. All client jobs contracted to the private sector were supervised by WRD. Other groundwater activities included work in the following localities - Lajamanu, South West Island, East Arnhem outstations, Howard East, Manbullo, Sanderson High School, Territory Wildlife Park, Humpty Doo Golf Club, Litchfield and Kakadu Parks.

To this day, our staff still live in swags in the bush, cut access tracks, winch rigs up beaches. It is a bit easier than it used to be, but we still do not have tea ladies serving us coffee and bickies. (anonymous)

Ord River Development Scheme

In 1992, a contract to McRobert Contracting Service (Port Hedland, WA), was let for downhole colour video logging of bores at Belyuen, Gunn Point, Nguiu (Bathurst Island), Nanambu Creek, Milikapiti, Adelaide River, Pine Creek, Howard East Borefield and along the Carpentaria Highway. The videos were used to determine the condition of the steel casing and screens and of the rehabilitation procedures. This period also saw major borefield rehabilitation works undertaken at Nabalco's borefield on Gove Peninsula. In the following year, two production bores were completed for Nabalco.

Throughout 1994, community water supply drilling was conducted at Bathurst Island - Ranku, Wollogorang, East Alligator and Yulara South. Also, in Arnhem Land, a community and outstation drilling program recommenced after a lapse of two years.

The Keep River Plains Hydrogeological evaluation was reported in 1995 as part of the investigation into an extension of the Ord River irrigation scheme. Also, drilling for Darwin Rural Area Investigation Stage 2 was completed and an extensive investigation was undertaken for the Oenpelli water supply.

WATER RESOURCES DIVISION

THE NEXT DECADE

The challenges ahead

The last decade has been one of considerable change but the next one will bring even more changes.

The Council of Australia Governments (COAG) Water Reform Agenda will be the driver for ongoing restructuring in the water industry and will be a significant factor in steering the direction of the Water Resources Division in the years ahead.

The process of organisational and cultural adjustment is happening right now. Transfer of the Water Resources Division from the Power and Water Authority to the Department of Lands, Planning and Environment was a fundamental first step in this process. As a result, the management of water resources will be increasingly integrated with management of other natural resources and linked to the broader land use and land development agenda. In addition, the community is becoming progressively more involved in planning and decision making through both informal and formal processes (eg. Water Advisory Committees). This trend will intensify.

The trend towards smaller Government, concentrating on core business, will apply equally to the Water Resources Division. Not only will the private sector be increasingly called on for consulting and contracting services but the Division will work collaboratively with the private sector to assist it in further developing its capabilities.

The explosion in information technology will have a significant impact on the way business is done. Remote area data collection will move towards satellite communication having major impact on field operations.

As the horticulture and aquaculture industries gather pace so too will the demand for information on water availability and its management. Opportunities for broad acre irrigation will also call on inputs from the Division and the Ord River Stage 2 extension into the Northern Territory will become a reality in the next decade.

As the demands for water increase, particularly in the rural sector, competition for the available resource, between either competing sectoral uses or between individual users will also increase. A more comprehensive approach to water allocation is a core component of the COAG reforms and some very important work will be undertaken in the next couple of years to develop the policy framework, criteria, and methodologies for systems of water allocation based on bulk allocation, individual entitlements in the form of property rights, and mechanisms for trading in water. The needs of the environment will be recognised in this process and the whole framework has to be underpinned by substantial legislative change.

Any community involvement will be fundamental in this process. Conflicts in competition for water will however inevitably occur, and it is the Division's role to resolve these through conciliation and where necessary regulatory controls.

The Division's role in water quality management will also intensify as development proceeds. The focus on Darwin Harbour will increase and could well provide a national case study on the integrated approach to catchment planning and water quality management.

The COAG reforms also place a strong emphasis on cost recovery and user pays philosophy. Whilst urban users are being progressively educated to the real costs of water services and moving towards meeting these costs, this approach still has a long way to go in the rural sector. The examination of resource management costs and a strategy to move towards cost recovery is on the agenda. It will be a slow process which will need to be underpinned by ongoing consultation and education.

The Division is currently in transition. The 40 years past have had a major focus on locating and developing urban and community supplies. Contribution to the growth and health of the Territory population has been enormous. What many may call the "good old days", are now past. The pioneering image of Water Resources, along with the early surveyors, road builders, welfare workers, etc., will gradually fade. The Territory owes them a debt however, and perhaps this booklet, in some small way, will help to keep that image alive.

The future is presenting a whole new set of challenges, some of which are outlined above. The new leaders are now emerging and will no doubt lead the Division with the same level of distinction it has earned in the past. The future lifestyle of all Territorians will be dependent on their success.

APPENDIX 1

GENERAL ABBREVIATIONS AND DESCRIPTIONS

AAEC	Australian Atomic Energy Commission
AIB	Agriculture Industry Branch
ATV	All Terrain Vehicle
AWRC	Australian Water Resources Council
CCNT	Conservation Commission of the Northern Territory
CDW	Commonwealth Department of Works
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DME	Department of Mines and Energy
DPIF	Department of Primary Industry and Fisheries
DTD	Darwin Town Datum
DTW	Department of Transport and Works
ELDO	European Launching Development Organisation
ERC	Estimates Review Committee
FWRAP	Federal Water Resources Assistance Program
NATA	National Association of Testing Authorities
NTEC	Northern Territory Electricity Commission
NTPS	Northern Territory Public Service
NTWA	Northern Territory Water Authority
NTWQMS	Northern Territory Water Quality Management Strategy
PAWA	Power and Water Authority
TAW	a combination of three organisations which were involved in the Rum Jungle Mine Rehabilitation project - Territory Enterprises, Australian Atomic Energy Commission, Department of Transport and Works.
TEP	Territory Enterprise Pty. Ltd.
VRD	Victoria River District
WHO	World Health Organisation
WRB	Water Resources Branch
WRD	Water Resources Division
WSDA	Water Supply Development Act
WSDO	Water Supplies Development Ordinance

Uranium Province area in the Alligator Rivers region which includes various mines sites such as Ranger Uranium Mine at Jabiru, Jabiluka, Koongara and Nabarlek

Sidney Williams Huts - Small, hot, one roomed huts with corrugated iron walls and roof. Floors consisted of a cement slab and louvered windows

APPENDIX 2

TECHNICAL ABBREVIATIONS

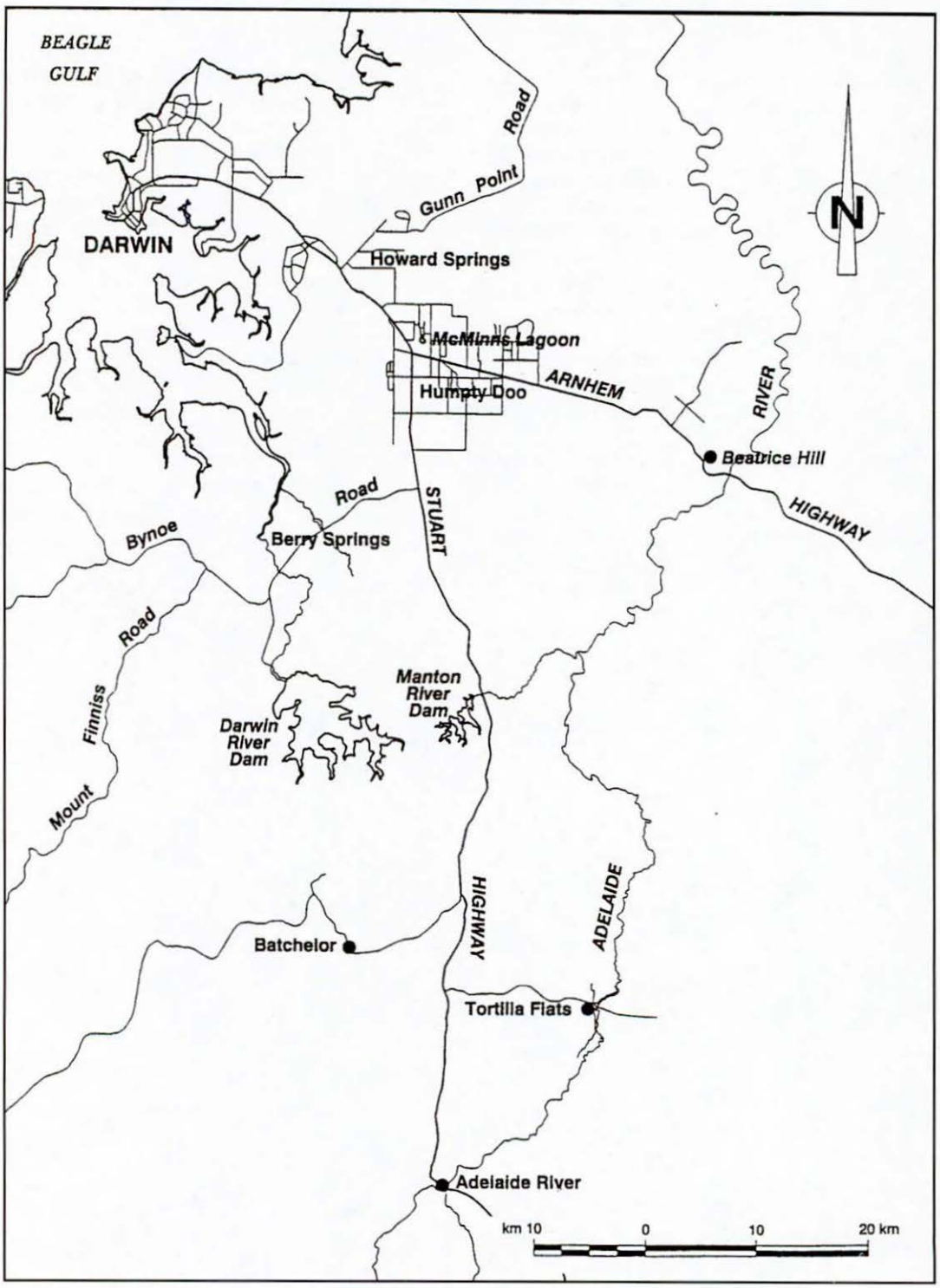
analogue recorders	chart recorders used before digital (computer) recorders and data loggers
aquifer	A geological formation, group of, or part thereof capable of transmitting and yielding significant quantities of water
benchmark	a survey level reference point
board of survey	process by which capital items are written off
bore return	a drillers bore report that details construction, depth, formation, aquifers struck and eventual yield
bore strata samples	soil or rock samples collected whilst drilling
culverts/inverted siphons	pipes under roads
dolomitic limestone -	this type of rock usually indicates the presence of a large water aquifer
drop structure	a structure in irrigation channel to reduce velocity and control erosion
evaporation study	to study the rate of water evaporation
evaporimeter	instrument that measures and records water evaporation
gauging stations	to record the water level in a river agains time
grid survey	method of survey to find the contour of the land
inductively coupled plasma spectrometer (ICP)	a laboratory instrumer used to simultaneousl measure the amounts of metal ions in water (eg. sodium and copper).
investigation bore	bore drilled to assess strata or potential water supply
l/s	litres per second
tidal/navigation markers	a device placed at entrances into tidal creeks and inlets to indicate safe access
observation bore	used to monitor water level responses when other bores are pumpe and for seasonal variations
pilot farms	farms established to investigate viability o crops and appropriate farming methods
pluviometers	recording rain gauges
production bore	a bore equipped, teste and suitable for water supply

APPENDIX 2

TECHNICAL ABBREVIATIONS Cont.

radium/radon testing rig	usually called "radon rig". A scientific instrument used for measuring amounts of radon gas produced in a sample. Radon is a product of Radium 226, a radioactive element which can be found in water
recharge	how the groundwater supply is naturally replenished by rain etc.
recording structures	recording the water level in a river
resistivity measurements	measurement of the electrical properties of the ground
sediment run-off plots	small area of land used for erosion studies
solid state data loggers	electronic devices used to record data (temperature, depth, rainfall etc.)
sorghum	a tropical cereal grass
stream gauging traveller	cable from which flow measurements can be made
survey levelling	to bring different points into a common level eg. sea level.
tide gauge	used to record tidal levels

DARWIN AND SURROUNDS



NORTHERN TERRITORY