DEPARTMENT OF MINES
SOUTH AUSTRALIA

THE GREAT ARTESIAN BASIN IN SOUTH AUSTRALIA

REHABILITATION OF UNCONTROLLED FLOWING WELLS

REPORT NO. 2

by

W.R.P. BOUCAUT

CHIEF GEOLOGIST, SERVICES

and

J.C. BEAL

GEOLOGIST

ENGINEERING DIVISION

30th November, 1977.

Rept.Bk.No. 77/140
G.S. No. 5959
D.M. No. 175/77

CONTENTS

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ABSTRACT

The rehabilitation of all flowing wells penetrating the Great Artesian Basin in South Australia will take approximately seven years to complete at an estimated cost of $700,000.

The funds available to the Mines Department will allow rehabilitation during the current financial year of fourteen wells at a cost of $56,000.

Rehabilitation of Nunns, Angus, McEwin, and Welcome wells will be completed in such a manner as to allow as far as possible for a controlled flow for preservation of existing wetlands, and the associated ecological systems. Other wells in the current programme will be shut off or controlled for stock watering where required.

INTRODUCTION

The previous Report (Boucaut and Beal, 1977) explained the extent of the problem, the need for remedial action, and the tecnhiques to be used. It also proposed an initial programme of well rehabilitation. The proposed ecological study has now been carried out by officers of the Department for the Environment (Appendix 2) of the wetlands associated with flowing wells on the western margin of the Great Artesian Basin to determine the environmental effects should these flows be stopped.

WELLS ALREADY REHABILITATED BY THE DEPARTMENT OF MINES

Three deep flowing wells were rehabilitated in 1969. The wells are known as Mount Dutton, Honeymoon and Beresford and their location is shown in Figure 1.

A further 30 shallow flowing wells were recently rehabilitated in September/October, 1977. These were drilled by oil exploration companies

carrying out seismic surveys several years ago, north west of Nilpinna station. Their location is also shown in Figure 1.

ENVIRONMENTAL CONSIDERATIONS

An officer from the Department for the Environment inspected flowing wells which the Department of Mines proposesto rehabilitate (Fig. 2), and four wells were considered to require regulation to maintain the present associated wetlands. These wells are known as McEwins, Nunn's, Angas, and Welcome (Appendix 2).

REHABILITATION PROGRAMME AND FUNDING

It is anticipated that most wells which have intersected pressure water from the Basin will require some form of rehabilitation. The location of all known such wells is shown on Figure 4. The full rehabilitation programme is estimated to take 7 years to complete (assuming 6 months work possible per year) at a total cost of $700,000 (1977 costs). Such an estimate is necessarily very approximate because it is impossible to foresee individual well problems. Rehabilitation of the deeper wells, away from the edge of the basin, will pose technical problems which will no doubt take time and money to overcome. However, expertise gained during work on the shallower wells should help in successfully rehabilitating all the wells.

During rehabilitation work proposed during the current financial year priority will be given to the rehabilitation of the fourteen flowing bores in the grids H3 and H4 (Fig. 2). This includes Nunns, Angas, McEwin and Welcome wells. Because these latter 4 wells are to be rehabilitated so as to allow a regulated flow they will require routine maintenance, and a permanent access causeway will be necessary for each well. It is proposed that the Department of Mines construct the causeway and additionally the fences which will be required to keep stock out of the wetlands. The estimated cost of rehabilitation of these fourteen wells is $56,000. This work will be carried out during the latter months

of this financial year and Departmental funds are available for this work.

For further rehabilitation work it would be preferable if some 6 months could be spent each year in the area with an estimated expenditure of $100,000 per year. This would be the most efficient and hence economical approach as establishment costs are a significant part of the total cost, and would be kept to a minimum by carrying out as much work as possible during each field trip. However under the present financial allocation to this Department it would be possible to make available only about one half of the required $100,000 per year required to meet the proposed programme.

All wells, where possible, will be completed to allow for the required controlled flow for wetland preservation or for stock watering purposes as requested by individual property owners. However it should be stressed that technical problems in individual holes may make this impossible, and the flow may have to be completely shut off.

MOUND SPRINGS

The location of mound springs is shown on Figure 3. Controlling of free flowing wells is likely to result in increased flows from these springs.

CURRENT LEGISLATIVE PROVISIONS

Under the Water Resources Act 1976 a permit is required for all new wells and no well penetrating the Great Artesian Basin can be drilled unless by a Class II driller whose licence has been suitably endorsed. He is obliged to observe rigid standards of well completion.

In addition, under the Act, where the Minister is satisfied that wastage or undue depletion of any waters is occurring the owner or occupier of the land can be directed to control or stop the flow.

SUMMARY AND CONCLUSIONS

To date three wells (1969) and thirty seismic shot holes (1977) have been rehabilitated in the Great Artesian Basin in South Australia (Figure 1).

An estimate of seven years work at a cost of $700,000 has been made to complete the rehabilitation of all flowing wells on the western margin of the Basin. However, Departmental funds would not be sufficient to complete the work in the time proposed. This would lead to increased total costs.

The proposed programme for 1977/78 financial year as described in Report No. 1 (Boucaut and Beal 1977) is estimated to cost $56,000. Funds are available for this work.

Ecological studies of the area have shown that Nunns, Angas, McEwin and Welcome wells provide valuable aquatic habitats and it is recommended that, where technically feasible, these wells be rehabilitated and regulated so as to support the existing wetlands.

The wetlands should be fenced and stock watered outside the fence. Permanent access to each well head is necessary for future maintenance.

W.R.P. BOUCAUT
CHIEF GEOLOGIST SERVICES

J.C. BEAL
GEOLOGIST

REFERENCES

Boucaut, W.R.P., and Beal, J.C., 1977: Great Artesian Basin in South Australia, Importance of Rehabilitation of Uncontrolled Flowing Wells. S. Aust. Dept. Mines report 77/109 (unpublished).

APPENDIX 1

Cementing off Flowing Shot Holes - Old Nilpinna Area

TO THE CHIEF DRILLING & MECHANICAL ENGINEER:

Ref. Flowing Seismic Holes - Nilpinna Station
Cementing Operations

The current programme of cementing off flowing shot holes for Delhi, Department of Mines and Shell in the old Nilpinna area has been completed. Of the twenty(20) wells reported by Williams (rept. Bk. No. 74/229) eighteen(18) have either been cemented off (15) or completed as controlled flowing wells (3). Two wells (5 and 6) (locality plan 741076) were not attempted and are possibly springs. In addition a further twelve(12) holes were located and cemented off and an attempt was made to cement off Shell SDA 13, which although unsuccessful due to lack of enough cementing capacity the flow has been restricted.

Details of holes located and cemented are as follows:-

Pexa PYH Line

11 holes cemented off
2 holes completed as flowing wells
2 additional holes are dry.

Pexa PYC Line

4 holes cemented off
1 hole completed as a flowing well
1 additional hole located but damp only

Mines Dept. TX Line

7 holes cemented off
9 additional holes located but damp only
8 additional holes located are dry

Mines Dept. TY/Pexa PYI Line

5 holes cemented off
1 hole located but damp only
1 hole attempted cementing off but unsuccessful
2 holes located but are dry

Shell SDA 13

Flow limited after unsuccessful cementing attempt. Lack of cement on site prevented further action. The flow of this well was estimated at 30 l/sec. prior to cementing and is possibly limited to 10-15 l/second now.

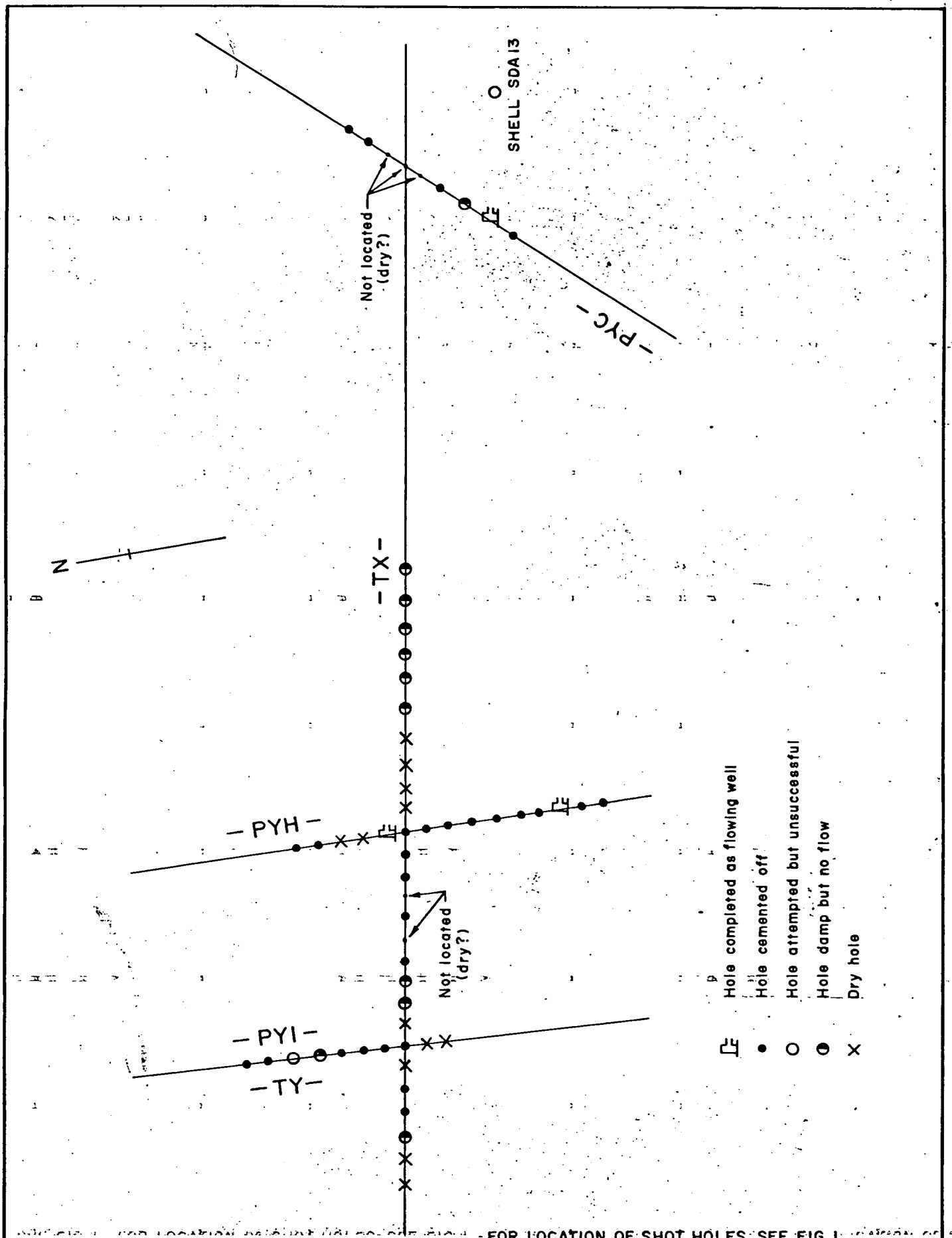
Further work is required in the area with special attention required to reported flowing wells on the Departmental TY/TZ intersection. The possibility of flows ~~emigrating~~ from the reported damp holes also exists in the future. Additional flowing wells are also suspected on the PYC line extensions, the eastern extension of the TX line and the PYJ line in the south. A field examination of these areas is required to locate and assess these lines.

A total of 700 sacks of cement were used during the cementing operations.

The attached sketch plan attempts to locate the holes cemented off and completed as flowing wells with damp and dry holes located.

D.K. LOCK
ENGINEER

DKL:MKG
11/10/77



FOR LOCATION OF SHOT HOLES SEE FIG. 1

	DEPARTMENT OF MINES—SOUTH AUSTRALIA	SCALE: —
COMPILED: W. R. P. B.	GREAT ARTESIAN BASIN	DATE: NOV. 77
DRN: M. W. CKD.	SEISMIC SHOT HOLES — OLD NILPINNA AREA	PLAN NUMBER: S 13142

APPENDIX 2

Report from the Department for the Environment

Report from the Curator of Birds

Report from the Curator of Fishes

MINUTES forming ENCLOSURE to DE No. 3471 19 77

TO THE DIRECTOR, DEPARTMENT OF MINES:

Proposed Rehabilitation of Artesian Bores

A list has been forwarded to this Department showing artesian bores proposed for rehabilitation by the Department of Mines. The Department for the Environment is concerned that some of those bores may be providing valuable habitats for aquatic flora and fauna and may therefore warrant some form of preservation.

Most of the bores listed were inspected by officers of my Department on 30th September and 1st October, 1977. Their report is enclosed for your consideration.

In summary:

1. The swamps associated with Angas, Nunn's, McEwin's and Welcome Bores are considered to be worthy of preservation.

2. Capping of the other bores inspected is not opposed.

P.C. Cornish

P.C. Cornish,
ACTING DIRECTOR
DEPARTMENT FOR THE ENVIRONMENT

11/11/77
SL/mp

NOTED
Director of Mines

TO THE SENIOR ENVIRONMENTAL OFFICER (PROJECTS):

Inspection of Artesian Bores Nominated for Capping

SUMMARY:

The Department of Mines proposes to cap several bores in the far north of South Australia in order to provide some protection for the state's artesian water supplies, which are showing signs of depletion. The Department for the Environment considers that some of the bores may provide valuable wetlands in the area and may therefore warrant some form of preservation.

In order to assess this situation, most of the bores nominated for capping were inspected on 30/9/77, and 1/10/77. As a result of those inspections it is concluded that:

1. Capping of Blyth, Milne, Levi, Umbum, Sunny Creek, Strangways and Trig Bores is not opposed.

2. Nunn's, Angas and McEwin's Bores provide valuable aquatic habitats and should be preserved as much as possible.

3. As a secondary priority, the swamp at Welcome Bore should also be protected.

(Margaret Creek, Lethbridge and Nancy's Bores were not inspected).

BACKGROUND:

The South Australian Department of Mines is concerned at the possible depletion of the State's artesian water supply because of the uncontrolled flows from several artesian bores in the far north. Therefore, as a means of conserving the artesian supplies, the Mines Department has proposed that a number of bores should be capped.

i.e.;

Blyth	Bore
Milne	"
Levi	"
Umbum	"
Sunny Creek	"
Nancy's	"
Nunn's	"
Strangways	"
Angas	"
Trig	"
Welcome	"
McEwin	"
Margaret Creek	"
Lethbridge	"

While acknowledging that the action proposed by the Mines Department has a sound basis, the Department for the Environment considers that some of the bores may have become valuable habitats for aquatic flora and fauna. Such bores may have partially replaced as inland wetlands some of the mound springs in the area, the flows from many of which have substantially decreased in recent years. The Department for the Environment therefore proposes that any ecologically valuable swamps created by the bores should be preserved as much as is possible - e.g., by controlling, but not halting, the artesian flow.

In order that specific Departmental recommendations on this matter could be prepared, most of the bores in question were inspected on 30 September, and 1 October, 1977, by Technical Officer V. Potezny and Environmental Officer S. Lewis.

FIELD OBSERVATIONS AND DISCUSSION:

1. Blyth Bore

A relatively small area of boggy ground approximately 50 metres in diameter. The area has been substantially disturbed by cattle.

Aquatic vegetation: predominantly Juncus sp. (rush) with some Phragmites communis (common reed) both grazed almost to ground level.

Fauna: two white-faced herons (Ardea novaehollandiae).

Bore Flow: slight.

Comment: little ecological significance.

2. Milne Bore

As for 1. above - a small area of boggy ground greatly disturbed by the intrusion of cattle.

Aquatic vegetation: sparse Juncus.

Bore Flow: slight.

Comment: little ecological significance.

3. Levi Bore

The bore itself is fenced within an enclosure of 30 to 40 sq m, with a trough outside. In total, about 100 sq m have been affected by the bore, but the area outside the fence has been heavily disturbed by cattle.

Aquatic vegetation: some Juncus, grazed to ground level.

Bore Flow: very slight.

Comment: little ecological significance.

4. Umbum Bore

A relatively extensive area of swamp covering possibly 2 to 3 ha. Most of the area substantially disturbed by cattle, with the presence of several carcases indicating bogging.

Aquatic vegetation: some Juncus, much heavily grazed.

Fauna: possibly 200 to 300 birds in area, predominantly banded stilts (Cladorhynchus leucocephalus).

Bore Flow: relatively strong.

Comment: It is possible that, given the continuation of the present artesian flow and protection of the area from cattle, the Umbum Bore Swamp could develop into an area of some value. However, the following factors should be considered:

- the bulk of the area consists of boggy ground together with small, very shallow pools. Two points follow from this:

  (i) the area supports a relatively low diversity of aquatic flora and fauna;

  (ii) any reduction of bore flow would substantially reduce the area of swamp.

- protection from cattle would require fencing, which would involve some expense and regular up-keep.

Therefore it is considered that the effort and expense required to preserve the Umbum Bore Swamp could probably not be justified.

5. Sunny Creek Bore

Small area of relatively open boggy ground; heavy cattle pressure.

Bore Flow: moderate.

Comment: little ecological significance.

6. Nancy's Bore:

Not inspected - an attempt at following the access track from the Sunny Creek Bore proved unsuccessful.

7. Nunn's Bore

Extensive swamp of approximately 2 to 3 ha, consisting largely of open water of apparently reasonable depth. Relatively rich in aquatic life. Heavy grazing pressure - 7 carcases were observed to be bogged in one small section of the swamp.

Aquatic vegetation: Phragmites communis on boundary of swamp.

Fauna: yabbies (Cherax destructor) and other crustaceans, insects and birds (including 20 to 30 pelicans, Pelecanus conspicillatus) all common.

Bore Flow: slight. It was apparent that the level of the swamp had decreased significantly, by about 0.5m, during the previous 2 to 3 years.

Comment: Despite the substantial adverse impact of cattle upon the area, the Nunn's bore swamp is considered to form one of the most valuable wetlands in the area. There is little doubt that this value would be further increased by the exclusion of cattle through the fencing of the swamp and provision of a trough outside the fence - which would also alleviate the problem of cattle becoming bogged in the swamp.

It is apparent that at least the current bore flow is required in order to maintain the swamp at its present level. In fact, in view of the recent reduction of pool level, it is probable that the present flow is insufficient to maintain the level.

It is recommended that:

(i) Nunn's Bore Swamp is of sufficient environmental value to warrant preservation.

(ii) The Swamp should be protected from cattle (and cattle protected from the Swamp) by the provision of fencing and a trough outside of the fence.

(iii) The outflow from the bore should be maintained at at least the present level. (This does not imply that controls should not be implemented to ensure that flows do not exceed the current level).

8. Strangways Bore

Small fenced area immediately adjacent to the Strangways Railway Siding. Some cattle intrusion, resulting in boggy conditions and heavily grazed vegetation.

Aquatic vegetation: some Phragmites communis.

Bore Flow: very slight.

Comment: little ecological significance.

9. Angas Bore

Approximately 2 ha of swamp including about 1 ha of open water. Heavy cattle pressure with several bogged carcases.

Aquatic vegetation: some Phragmites communis and Juncus sp., both heavily grazed.

Fauna: approximately 100 ducks, 30 pelicans, 50 banded stilts and numerous other birds.

Bore Flow: slight.

Comment: it is considered that the Angas Bore Swamp is in the same category as the Nunn's bore swamp; i.e. it is a valuable wetland which would be worthy of preservation if it could be protected from cattle intrusion. It is again pointed out that the fencing of the swamp and provision of an outside trough would also be of benefit to the cattle, by eliminating the problem of bogging.

From the environmental viewpoint, it is desirable that the present level of the swamp be maintained. It is therefore recommended that the present low outflow from Angas Bore should be allowed to continue.

10. Trig Bore

Very small patch of boggy ground, greatly disturbed by cattle intrusion.

Bore Flow: very slight.

Comment: no ecological significance.

11. Welcome Bore

Large swampy area of 6 to 10 ha, supporting probably hundreds of birds, predominantly ducks and banded stilts. Substantial disturbance by cattle.

Aquatic vegetation: little vegetative cover, heavily grazed.

Fauna: birds as described above.

Bore Flow: slight to moderate.

Comment: From the abundance of birds in the area, it is apparent that the Welcome Bore Swamp is serving a valuable environmental function and therefore that some consideration should be given to its preservation.

However, because of the very shallow nature of the swamp, it is likely that any significant reduction of bore flow would substantially reduce the area of swamp, thus greatly reducing its ecological value. It is relevant to note at this point that the area of the Welcome Bore Swamp has increased substantially in the past 2 or 3 years - suggesting that flows from the bore are subject to wide fluctuations. It is also possible that a continuation of the present flow rate may be unacceptable to the Mines Department.

In summary, the Welcome Bore ~~Spring~~ Swamp would constitute a valuable wetland if the present bore flow could be maintained and if the area could be fenced to exclude cattle. However, the swamp's preservation is regarded as a lower priority than the preservation of wetlands at Nunn's, Angas or McEwin's bores.

12. McEwin's Bore

Large swamp covering 6 to 10 ha and including 0.5 to 1.0 ha of open water. Whole area substantially disturbed by cattle and horses.

Aquatic vegetation: Phragmites communis common, with some Juncus sp.

Fauna: abundant birdlife, predominantly banded stilts, Cladorhynchus leucocephalus.

7/...

Bore Flow: strong (1.5m "gusher" from the vertical pipe), though slightly less than 1974 observation.

Comment: McEwin's Bore is considered, from the environmental viewpoint, to be one of the most important "permanent" wetlands in the area and its preservation is therefore considered to be highly desirable. The value of the area would be further increased by the provision of fencing.

For all of the swamps recommended for preservation there arises a central problem; i.e., what is the minimum bore outflow required to maintain a reasonably viable area of swamp? This problem is probably most critical at McEwin's Bore, since this has by far the strongest flow of all the bores inspected; i.e., it presents the largest drain on artesian supplies. Thus it may be regarded as the bore for which some control of outflow is most urgently required. The effects of a significant flow reduction upon the swamp are unclear. However, because of the generally shallow nature of the swamp it is considered likely that there would be a substantial reduction in the area of the wetland with a corresponding reduction in its ecological value.

It is therefore acknowledged that a substantial proportion of the McEwin's Bore Swamp may have to be sacrificed in the long-term interest of the artesian water supply. Nevertheless, it is recommended that as much as possible of the area should be preserved as swamp and thus that some acceptable compromise should be sought between the interests of the wetland habitat and those of the artesian supplies.

13. Margaret Creek Bore

Could not be located.

14. Lethbridge Bore

No access track to Lethbridge Bore could be located.

CONCLUSIONS:

It is concluded that most of the bores inspected are of little or no value as habitats for aquatic flora and fauna. In general, the bores have relatively low flows which have created swampy or boggy conditions within a very small area. Such areas are regularly visited by cattle, which have created severe disturbance through their grazing upon aquatic vegetation and physical activity in general.

However, as noted earlier, there are four bores which are providing valuable wetland habitats; i.e., Nunn's, Angas, McEwin's and Welcome Bores. All four bores contain both areas of open water and beds of reeds and rushes. It should be noted that, while the regions of open water provide feeding grounds for several bird species, the reedbeds are equally valuable in providing shelter and nesting areas. It is therefore concluded that every effort should be made to preserve the swamps associated with these bores. This conclusion has the support of the South Australian Museum, whose studies have indicated that the four bores in question are providing valuable habitats for aquatic fauna. In particular, the Desert Goby, Chlamydogobius eremius, which is endemic to inland Australia, has been recorded in some numbers in the Nunn's bore swamp.

RECOMMENDATIONS:

1. Capping of the following bores is not opposed:

Blyth	Bore
Milne	"
Levi	"
Umbum	"
Sunny Creek	"
Strangways	"
Trig	"

2. The swamps associated with Nunn's Bore and Angas Bore should be preserved and upgraded; i.e., by allowing the bore outflows to remain at about their present levels and by fencing the areas to afford protection from cattle and to protect cattle from becoming bogged.

3. Every effort should be made to preserve the McEwin's Bore Swamp, or at least a portion thereof, as a viable wetland habitat. It is acknowledged that some control of bore outflows may be necessary.

4. The preservation of swamp at Welcome Bore is desirable but is regarded as a lower priority than 2 and 3 above.

S. Lewis
ENVIRONMENTAL OFFICER

V. Potezny
TECHNICAL OFFICER

SL:GK
4/11/77

To the Acting Chief Environmental Officer

Report re ... environmental ... & ... Strategy

Agreed ... 10th Nov.

MEMORANDUM

TO: Director FROM: Curator of Birds

SUBJECT: Species of birds frequenting boredrain and moundspring swamps. DATE: 20th April, 1977

All species of birds that frequent the boredrain and moundspring swamps are nomadic, at least within the Lake Eyre drainage. They fall into two groups:

1. Species that use the reedbeds for nesting and shelter:

   Porzana fluminea Spotted Crake
   P. pusilla Baillon's (Marsh) Crake
   P. tabuensis Spotless Crake
   Gallirallus philippensis Banded Landrail
   Gallinula ventralis Black-tailed Native Hen
   Porphyrio porphyrio Purple Swamphen
   Tyto capensis Grass Owl
   Legalurus gramineus Little Grassbird
   Acrocephalus stentoreus Clamorous Reedwarbler
   Ephthianura crocea Yellow Chat

2. Species that feed mainly or wholly on Rattus villosissimus, Long-haired Rat, which itself is strongly tied to artesian swamps and undergoes huge population explosions in good seasons:

   Elanus scriptus Letter-winged Kite
   Milvus migrans Black Kite
   Tyto alba Barn Owl.
   (T. capensis of list 1 also feeds on this rat)

Of the above species, Gallinula ventralis and Elanus scriptus have the Great Artesian Basin as their centre of distribution because of their dependence, primary or secondary, on the artesian swamps. All the other species occur extensively elsewhere, though the Great Artesian Basin carries good populations of them. They can only have benefitted from the boredrain swamps put down since the 1890's, and although they are all nomadic, any reduction in the number of boredrain swamps will reduce the amount of habitat that they can occupy within the Basin. Considering that the Yellow Chat was formally reported in the Basin only in 1972 and the Grass Owl in 1975, there is probably quite a bit more work for ornithologists to do in these artesian swamps.

I should certainly like to be kept informed of developments here.

.....

Shane Parker
CURATOR OF BIRDS

SP:dlr

MEMORANDUM

TO: Director DATE: 7th April, 1977

FROM: Curator of Fishes

SUBJECT: Coward Springs and other Central Australian bores.

In respect of the proposed control of flowing wells in the Central Australian region, it should be pointed out that artesian bores sunk since European settlement have, in many instances, formed successful habitats and refuges for endemic fauna, notably fish and birds.

Although, such habitats are artificial, they undoubtedly have facilitated and improved the survival prospect of this fauna, counteracting to some extent the increasing pressure to which they are subject from mans "development" of the region, as well as adverse natural factors.

For example, manyof the artesian mound springs which undoubtedly constituted original and natural habitats for this fauna have become uninhabitable for a variety of reasons - either because of reduced flow (presumably due in part to the bores themselves, and partly to their own self-destructive development i.e. by forming excessive flow heads) or because of the destructive effect of converging cattle.

Accordingly, I recommend that any programme of bore/well rehabilitation be approached with caution. I assume that "rehabilitation" implies anything from total blocking-off of bore shafts, to the installation of regulating valves. The latter would, I suggest, be a far more prudent technique.

In any event, any such programme should be selective. Some bores, for example, could well be permanently cut-off without presumably any significant impact on the regions biota - certainly the sub-artesian bores in which water is pumped up by windmill, usually into concrete tanks or turkey dams, would fall into this catogory. Such latter habitats are rarely inhabited, even when there is overflow onto the ground surface.

In any event, where such bores have been totally abandoned, there is rarely any flow anyway, simply because the pumping machinery has broken down through negligence.

On the other hand, survival of certain "key" artesian bores, which currently feed extensive swamp areas waterholes and streams, which clearly constitute major habitats, should be ensured, although their flows might well be regulated or cut back to advantage without significant harm. One such bore is the one at Coward Springs railway siding, which is of special significance in that it is the type locality of one of the regions endemic fish (Chlamydogobius eremius). Formerly, this bore fed a very extensive swamp area supporting large numbers of water wading-birds (checklists available). Since attempts were made to cut this bore off nearly ten years ago, the flow has reduced greatly, reducing the swamp to a fraction of its former size, although sufficient seepage continues to maintain a small body of water. This is one bore which I feel could be opened up again, but on a regulated basis.

Other little used bores whose continued survival could well be considered vital in the present context include some of those alongside the Birdsville Track, Munna bore (south east of William Creek), Johnson's No. 3 bore (western edge of Lake Eyre North) and other remote ones. I do not suggest that all such bores be maintained but that a selected, dispersed and representative number be so, perhaps on a reduced or regulated flow basis.

I appreciate that unless some cut-back in artesian flow is effected that the whole system may eventually fail. Nevertheless, I consider "control" of flows will, overall, be more advantageous than total "cut-off".

Finally, I suggest that Mr. S.A. Parker also be invited to comment on this subject. (i.e. re bird life)

C.J.M.G.

CJMG/jm

C.J.M. GLOVER,
CURATOR GRADE II.

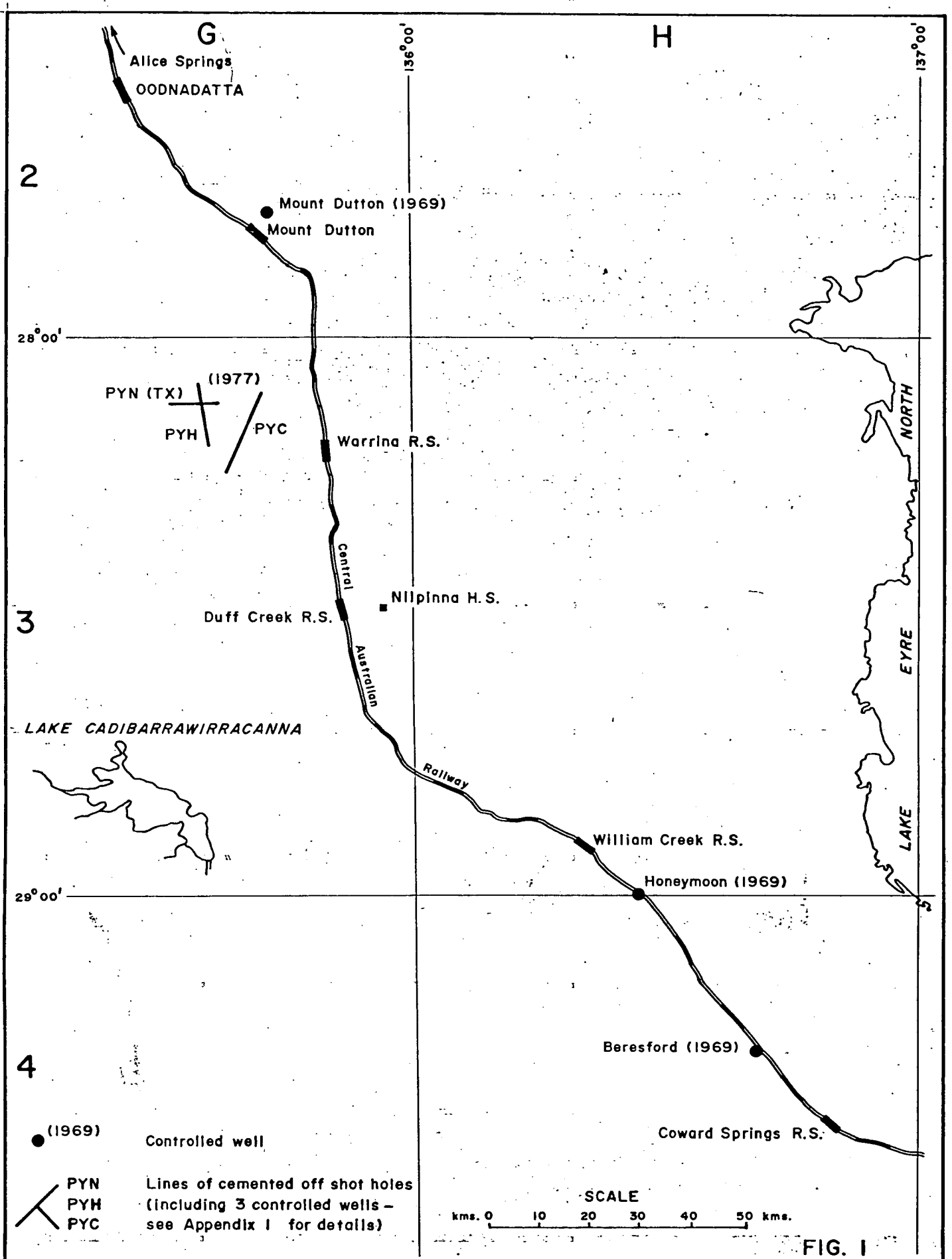


FIG. 1

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COMPILED: W.R.P.B.	GREAT ARTESIAN BASIN	DATE: NOV. '77
DRN: M.W. CKD.	LOCATION OF REHABILITATED WELLS	PLAN NUMBER: S 13139

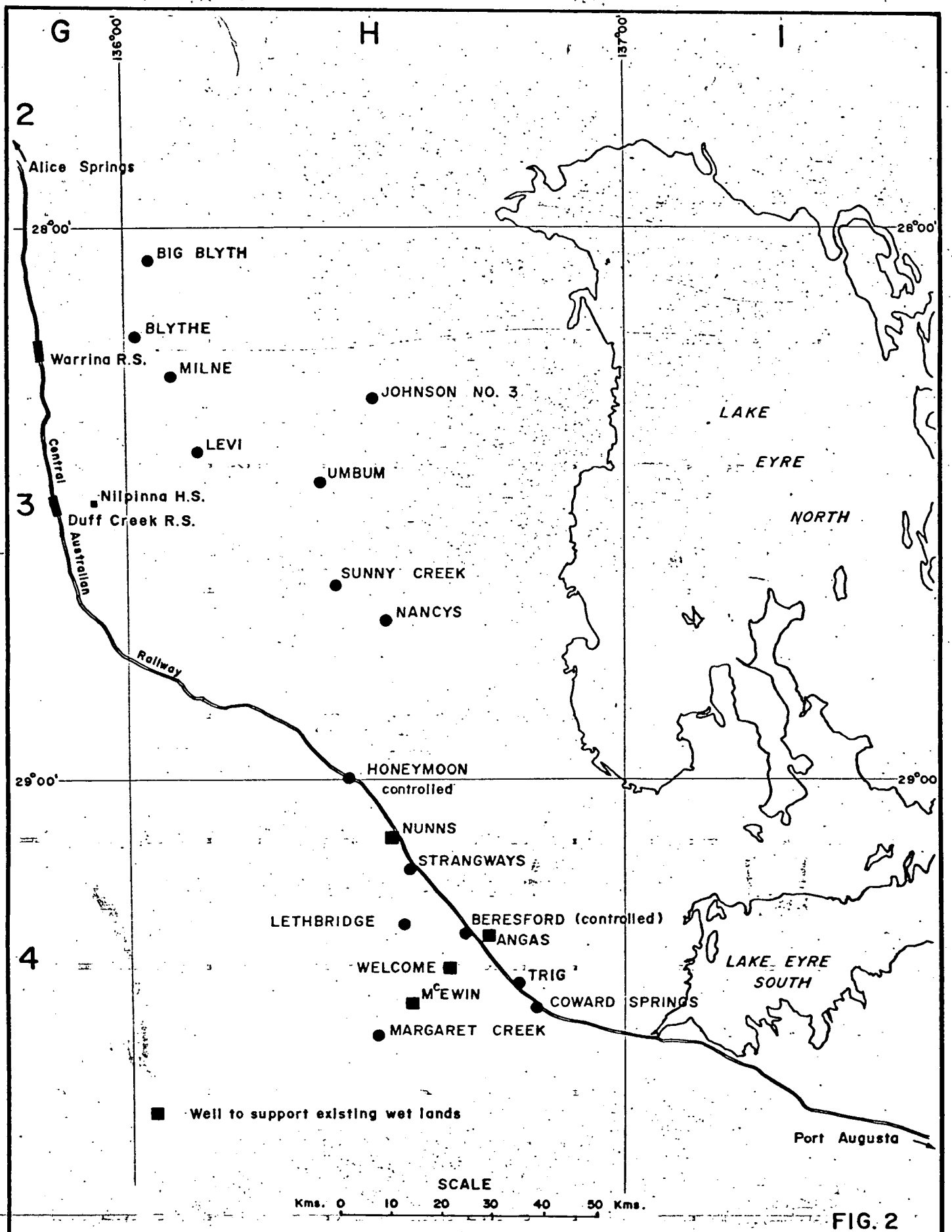

FIG. 2

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale : 1:1000000
Compiled : W.R.P.B.	GREAT ARTESIAN BASIN	Date : NOV.'77
Drn. M.W. | Ckd	LOCATION OF WELLS TO BE REHABILITATED	Drg. No. S 13140

750—8.74 F332 O

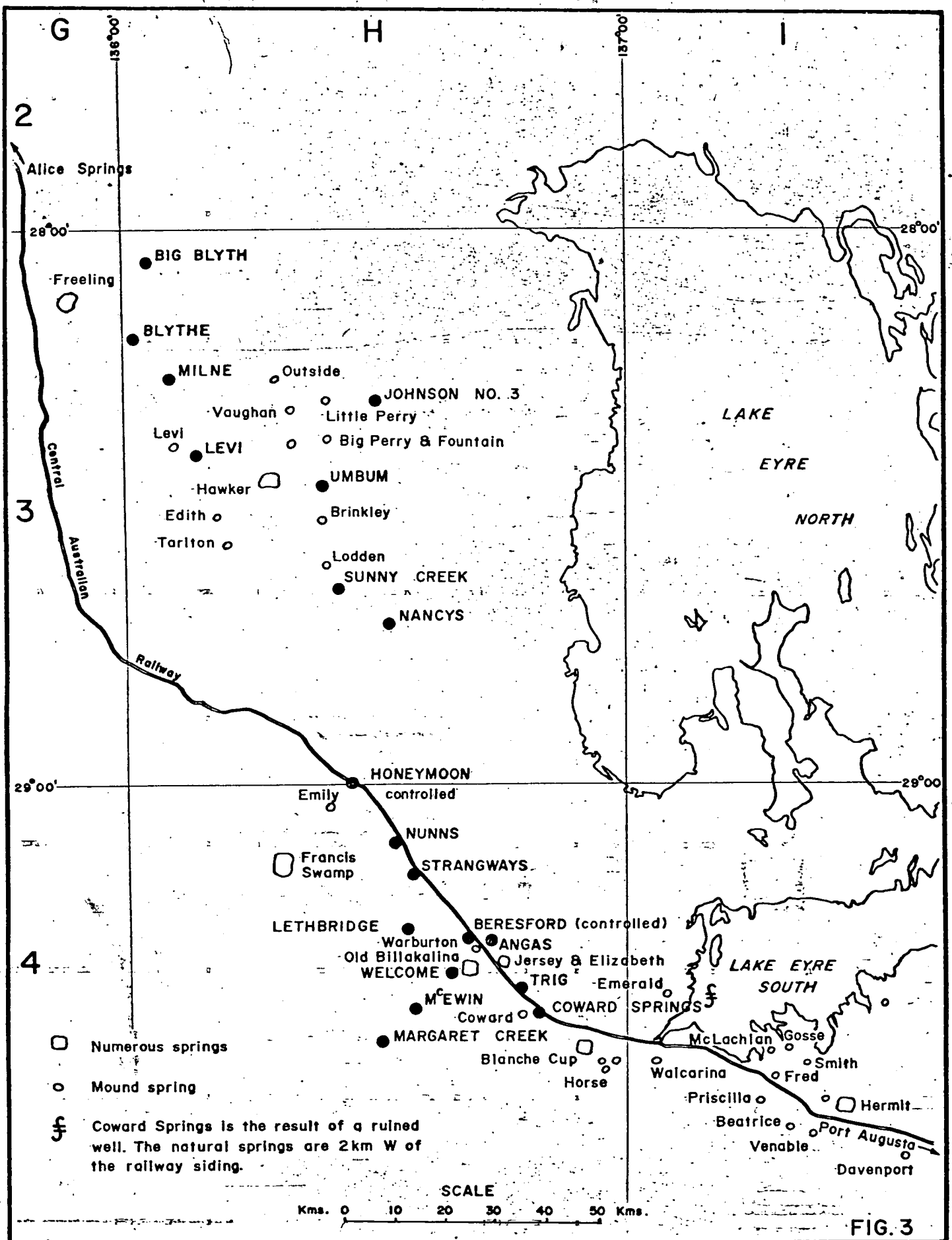

FIG. 3

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale : 1:1000000
Compiled : W.R.P.B.	GREAT ARTESIAN BASIN	Date : NOV. '77
Drn. M.W. | Ckd	LOCATION OF FLOWING WELLS AND MOUND SPRINGS	Drg. No. S13141

750-8.74 F332 O

135° 136° 137° 138° 139° 140° 141°

G H I J K L

QUEENSLAND

26° 27° 28° 29° 30° 31° 32°

1 2 3 4 5

SOUTH AUSTRALIA

SIMPSON DESERT

LAKE EYRE NORTH

LAKE EYRE SOUTH

LAKE TORRENS

LAKE FROME

LAKE GREGORY

LAKE EVERARD

LAKE HART

LAKE YOUNGHUSBAND

LAKE LABYRINTH

LAKE HARRIS

LAKE CADIBARRAWIRRACANNA

LAKE PATRICIA

LAKE BLANCHE

LAKE CALLABONNA

GOYDER LAGOON

MADIGAN GULF

BELT BAY

HALLIGAN BAY

ALBERGA RIVER

WIRE CREEK

MACUMBA

ALBERGA

FINKE RIVER

MACUMBA RIVER

MARALINGA

MARALINGA FLOOD PLAIN

MANEROO RIVER

MARALINGA RIVER

MARALINGA CREEK

MARALINGA CREEK NORTH

MARALINGA CREEK SOUTH

MARALINGA CREEK EAST

MARALINGA CREEK WEST

MARALINGA CREEK NORTH EAST

MARALINGA CREEK SOUTH EAST

MARALINGA CREEK NORTH WEST

MARALINGA CREEK SOUTH WEST

MARALINGA CREEK NORTH EAST

MARALINGA CREEK SOUTH EAST

MARALINGA CREEK NORTH WEST

MARALINGA CREEK SOUTH WEST

ALLINGA

PURNIE No.1

WITCHERRIE No.1 (OIL)

JUNCTION

MEMORY

APPIRINNA

STEVENSON

MT. SARAH

HORSESHOE

SNAKE CREEK

ALBERGA

MACUMBA

BROWNS CREEK

WIRE CREEK

OODNADATTA

DUCKHOLE

WATSON CREEK

PEECHARMURRANNA

STATION HOMESTEAD

WONDILLINA

MT. DUTTON

CADNAOWIE

OCHENDEN

TOONDINA No.1

TOONDINA No.2

COOTABARCOOLIA

WOOD DUCK

WILD DOG CREEK

BIG BLYTH

PEAKE

RASPBERRY CK.

ONE TREE

5 MILE

BLYTH

1 MILE

NILPINNA

MILNE

EDWARDS CK.

JOHNSON No.3

LEVI

3 SPRINGS

UMBUM

HOPE CK.

WILLOW

SUNNY CREEK

NANCYS

WILLIAM CK.

HONEYMOON

NEW ANNA CK.

NUNNS

STRANGWAYS

JACKBOOT

LETHBRIDGE

BERESFORD

ANGAS

ONE TREE

WELCOME

TRIG

COWARD SPRINGS

McEWIN

MARGARET CK.

EMERALD SPRINGS

CURDIMURKA

SMITHS

LAKE LETTIE 3

LAKE LETTIE 2

MORRIS CK.

MORRIS

PETERS

LAKE HARRY

MARION

CHARLES ANGAS

LAKE LETTIE

COORYANNA

CLAYTON DAM

LAKE BILLY

BRANSONS

STEPHENS PONDS 2

FINNISS

BOPEECHEE

NEW YEARS GIFT

BULL PADDOCK

ALBERRIE CK.

BEATRICE

VENABLE

DAVENPORT SPRINGS

HERGOTT SP.

MARREE No.2

MARREE No.1

ABDUL

WELL CK.

CLARKS

TWO MILE

COOLONG

STEPHENS PONDS 1,3

JUNCTION

PANDIE BURRA (OIL)

GOYDER LAGOON

MT. GASON

PUTHERA

MARROO HILL

LAKE HOWITT

MIRRA MITTA

KALLADEINA

POONARUNNA

MUNGERANIE

MULKA

KOPPERAMANNA No.2

KOPPERAMANNA No.1

CANNUWAUKANINNA

PEACHAWARINNA

DULKANINNA

SINCLAIR

COORYANINNA

JEWELLERY CK.

TROUDANINNA

CHAPPALANNA

TOONKETCHEN

CLAYTON

TARKANINNA

YARRA HILL

NICK O' TIME

MONTECOLLINA

METEOR

MURNPEOWIE

LAKE CROSSING

PETERMORRA

DEANS LOOKOUT

QUART POT

JUNCTION

PATCHAWARRA

INNAMINCKA No.1

MERRIMELIA (OIL)

DULLINGARI (OIL)

OLD TILCHA

TILCHA

WOOLATCHIE

COONANNA

YANDAMA

BOUNDARY

MULOOWURTINA

COONEE CK.

COOTABARLOW 1

COOTABARLOW 3

ANBOOLA

CURRAWORRA

LAKESIDE

GLENMANYIE 1

GLENMANYIE 2

BLACK OAK

FORTVILLE No.3

Leigh Creek

DOG FENCE

FIG. 4

	DEPARTMENT OF MINES—SOUTH AUSTRALIA	SCALE: 1:1000000
COMPILED:	GREAT ARTESIAN BASIN	DATE: Nov. 1977
DRN: R.H. CKD.	LOCATION OF WELLS INTERSECTING PRESSURE WATER	PLAN NUMBER: 70—58