ISIS DISTRICT

CANEGROWERS

48 Churchill Street Childers Qld 4660
PO Box 95 Childers Qld 4660
Phone (07) 4126 1444 Fax (07) 4126 1902
Email isis@canegrowers.com.au

27 August 2010

EJ Hall
Chief Executive
Queensland Competition Authority
GPO Box 2257
BRISBANE QLD 4001

Dear John

Re: SunWater Prices Review 2011-2016
Terms of Reference
Water Pricing Options for the Bundaberg WSS

Following discussions in Childers yesterday with Mark O'Sullivan and Matthew Bradbury, I am compelled to write and express our strong views that engaging a consultant to review the Water Pricing Options for the Bundaberg WSS is a waste of time, resources and money.

CANEGROWERS Isis Limited on behalf of its 200 members does not support a change to the segments as they exist or the introduction of nodal pricing for the Bundaberg WSS.

Furthermore, we believe that neither the Premier, the Treasurer (the Ministers) nor QCA have a mandate to investigate these matters. Surely, this is a matter for the irrigators in the Bundaberg WSS scheme and one or two submissions who want nodal pricing based on electricity costs do not speak on behalf of the majority of irrigators.

It appears that it is up to us to demonstrate (prove) that the scheme was predicated on the one scheme one price principle and that is the way everyone signed up for the scheme. It is also a fact that the pricing (fees and charges) schedule for the Bundaberg WSS (attached) for the last 40 years has applied the charges on this basis.

Delving into the bowels of our filing system I have found and attached two documents that may bring about more clarity to our claim. Ironically, one of the documents was prepared for the Bundaberg and Childers region by the Bundaberg District Cane Growers Executive (now known as Bundaberg CANEGROWERS Limited) in July 1969 and the other, undated, prepared by the Bundaberg and District Irrigation Committee.

I refer to the first document, in particular, to the highlighted sections as follows –

- Foreword by Ben Anderson, Chairman Bundaberg & District Irrigation Committee;

- Comments by the then Bundaberg District Cane Growers' Executive Secretary, Kevin Pharr;
- The conclusions and the purpose of report and proposals on page 1;
- 'Establishment' on page 2;
- Estimated capital and annual costs and revenue on page 4.
- Existing assigned areas to be served 'Stage 1' on page 14.
- Part 8 'Irrigation and Ancillary Works', the extent of the Isis Irrigation System on page 21.
- Off-peak pumping and Supply to farms – Channel Systems on page 22.
- Finance for farm irrigation facilities on page 24.
- Programme of supply to farms, Annual Revenue and Water Charges from irrigation systems on page 26.
- Page 30 – "Water charges for the proposed scheme have been calculated at $10 per acre foot where water is to be delivered to the farm by the reticulation system."

It is clear from the highlighted sections of the document that the Bundaberg Irrigation Scheme was accepted and endorsed by the irrigators and constructed on the premise of channel water at the one price across the benefitted area.

The second 'undated' publication titled 'A Case for Capital Water Storage and Irrigation Works for the Lower Burnett Area, Queensland' prepared by the Bundaberg and District Irrigation Committee points to several schemes investigated (page 12). It is clear that Bundaberg and Isis growers had contemplated a range of systems but the Bundaberg and District Irrigation Committee (page 13) believed the future of the Lower Burnett area demanded a major capital works for water storage. "Certainly the people who benefit directly – the growers and the milling companies – are prepared to pay for the water supply".

Any departure from the original agreed 'one scheme one price' principle is not what the majority of Bundaberg WSS irrigators want or require.

If however, QCA was still inclined to investigate this matter then we suggest the investigation not be specific to the Bundaberg Water Supply Scheme. That way, all irrigators in SunWater Schemes have the opportunity to voice their opinion on this matter.

Trusting that you will see through the ambit claims of a few individual people, who are motivated by self interest and other purposes.

Yours faithfully

[redacted]

Wayne Stanley
MANAGER

c.c. Anna Bligh MP, Premier of Queensland
Hon. Andrew Fraser MP, Treasurer of Queensland
Hon. Stephen Robertson MP, Minister for Natural Resources, Mines & Energy

A case for capital water storage and irrigation works for the Lower Burnett Area, Queensland

Prepared by
The Bundaberg and District
Irrigation Committee
C/- Bingera Plantation,
Via BUNDABERG,
Queensland.

A CASE FOR SURFACE WATER STORAGE PROJECT

IN

THE LOWER BURNETT AREA OF QUEENSLAND

Prepared by -

The Bundaberg and District Irrigation Committee,
Bundaberg.

Members of the Committee are :-

- Canegrowers of the -

  Bingera, Fairymead, Gin Gin, Isis, Millaquin and Qunaba Mill areas.

- Sugar Milling Organisations :

  Gibson & Howes Ltd., Bingera

  Fairymead Sugar Co. Ltd.

  Gin Gin Co-operative Sugar Milling Assoc. Ltd.

  Isis Central Sugar Mill Co. Ltd.

  The Millaquin Sugar Company Ltd.

- Bundaberg City Council

- Bundaberg Harbour Board

- The Shire Councils of :

  Biggenden

  Gooburrum

  Isis

  Kolan

  Woongarra

*** *** ***

INTRODUCTION

The Lower Burnett sugar-producing area, near Bundaberg, in Queensland, is suffering from its second successive year of drought - on top of 63 years of recorded, unpredictable rainfall, much of which has been inadequate. The continuation of the drought into its second year has forced many cane-growers in the Bundaberg, Isis, and surrounding areas to the verge of bankruptcy because of the tremendous financial burden it has imposed on them.

The effect of this drought is little short of catastrophic. For example, in 1962 when sugar peaks for the six mills in the district was 189,000 tons, actual production was 285,000 tons, showing how in a normal season additional sugar could be produced. Between then and 1964, after expansion the peak grew to 271,000 tons, but actual production of sugar was 213,000 tons - the first effects of the drought.

This year, after more expansion, the peak was lifted to 335,000 tons. The best estimates of actual production provide for a dismal 190,000 tons.

Too much emphasis cannot be placed on the 1965 position in which, because of drought conditions, full advantage could not be taken of the increase in peaks and land assigned for cane-growing. In fact, estimates indicate a production of only 56.6% of the peak allocation.

...2

The effect on the income of cane-growers and milling companies can well be imagined: For 1965 alone the drop in income will be more than £7 million. However, if the drop in income for 1964, also a drought year, were added to this, the combined loss becomes tremendous.

It seems ironical that the loss of this revenue to the Lower Burnett area during these two years will most likely exceed the estimated capital cost to install the irrigation scheme which is envisaged and needed.

Many cane-growers have contributed to the multi-million pound capital outlay on clearing and preparing new land assigned for cane growing under the expansion plans adopted by the Queensland Government from the recommendations of the Sugar Committee of Enquiry which, in 1963, examined and reported on the future prospects of the sugar industry.

In addition, new growers who are given the opportunity to come into the industry to share in what, under normal conditions, would have been the sugar industry's more stable economy, are finding the drought effects particularly severe. They have also committed themselves to spending large sums of money without ever having received any of the benefits of growing cane in previous years.

An amount of £15 million has been committed to expanding the Sugar Industry in the six District Sugar Mill areas since 1962. This development must continue, notwithstanding the fact that earnings will be well down.

Generally it is recognised in the Lower Burnett Area that there will be thousands of acres of new and increased assignments on which the cane might be physically too small to harvest.

On old assignments thousands of tons of drought-ruined cane have already

...3

been destroyed. During the next two or three months this amount could possibly double or even treble, so dismal are the prospects for harvesting.

Apart from the large sums of revenue lost from ruined cane, it costs about £50 an acre to replace it, which could run into hundreds of thousands of pounds.

Throughout the Lower Burnett area, which last year produced only £9.1 million worth of sugar, compared with a possible £18 million in good seasons, cane-growers, milling companies and local authorities are unanimous that only a large-scale irrigation scheme based on new dams can solve the long-term problems of the area.

Drought relief, while greatly appreciated, offers only temporary relief and attacks the symptom and not the cause. It is probably too late for the industry to gain any relief for the 1965 season if the drought broke almost immediately.

From the surveys made in the six sugar growing districts of the Lower Burnett area it is estimated that 1,410,000 tons of cane -- only slightly more than half of the 2,250,000 tons which is the district's current cane peak -- will be crushed this year. (Under good seasonal conditions production would exceed this.) Only 190,000 tons of sugar -- little more than half of the 335,000 tons of sugar which has been allotted as mill peaks to the six mills in the area -- are expected to be produced.

In 1963, the area crushed 1,883,000 tons of cane and produced 265,000 tons of sugar. Gross sugar revenue from the Lower Burnett area, estimated this year at £9,070,000 yielded £10,214,000 in 1964 and £17,024,000 in 1963.

...4

OTHER PRIMARY INDUSTRIES, TOO :

However, the sugar industry of the Lower Burnett is not the only sinew of primary industry damaged by this lack of water.

Other types of primary industry such as grazing of stock, cotton, fruit and vegetables, grain growing, dairying and tobacco have recorded losses of many thousands of pounds. All these sectors of primary industry would benefit as much as cane growing and sugar milling from large scale irrigation.

There is latent productive capacity, both in the district fields and mills, which will be released by the establishment of large scale dams and a comprehensive district irrigation scheme.

To achieve a comparable increase in production relying on natural rainfall would require a considerable expansion of cane growing lands and mill transport systems. Obviously, the most economical means of attaining expanded production would be through irrigation. The additional advantage of stabilised production would be axiomatic.

With the capital irrigation and storage works envisaged and the water from them, Bingera, Fairymead, Isis and Millaquin could each produce 100,000 tons of sugar and Gin Gin and Qunaba could produce a combined tonnage of 100,000 tons. This would total 500,000 tons of sugar from the area compared with the total mill peaks mentioned earlier of 335,000 tons.

While the situation continues - and continue it could when the erratic rainfall pattern over the years is considered - the economic livelihood of the 42,510 people in the Lower Burnett area who depend directly or indirectly on the sugar industry is in jeopardy. Supply of water to the 23,250 people in the city of Bundaberg is also threatened.

...5

Therefore, the Bundaberg and District Irrigation Committee has prepared this document to show the current plight, the likely future plight if conditions continue, and the need for the capital water storage scheme, which would cost between £10 million and £12 million - a sum of money which might have to be provided by a Commonwealth grant to Queensland to enable the scheme to be implemented.

*** *** ***

THE CASE FOR

DAMS AND IRRIGATION

The Lower Burnett sugar producing area extends over 127,300 acres and embraces the growing and milling areas of Bingera, Fairymead, Gin Gin, Isis, Millaquin and Qunaba.

In addition, the stock grazing, small crops and other primary industries mentioned earlier are by no means unimportant and contribute quite substantially to the Lower Burnett district's economy.

The capital investment in the sugar industry in the whole area is valued at between £60 million and £70 million. Currently there are 1,530 growers and their working sons and families in the area, and about 3,200 employees on the farms and in the mills, all of whom form part of the 42,510 people in the whole of the Lower Burnett area.

While these people will be hardest hit by the effects of the drought, the whole economy of Queensland, already suffering a down-turn because of drought elsewhere in the State, and because of the Mount Isa dispute, could be a major sufferer. This embraces industries and Government utilities which supply goods and services to the area.

The reduced revenue from the area in income and company tax to the Federal Treasury will be marked.

...7

The Lower Burnett makes a very significant contribution to the tonnage of sugar Queensland exports overseas but droughts of the kind now being experienced could, unless there is some mitigation, affect Australia's efforts to be recognised as a reliable supplier. This would result in a worsening of the nation's balance of payments problems which have reached, as is well known, a crucial position.

If the industry increases its efficiency, greater sales of sugar overseas are certain, but these are developing on a long term contractual basis. This makes stabilised production essential, and in the Lower Burnett, which would be required to provide - and has the capacity to provide - part of the increased exports, it cannot be achieved without irrigation.

Commerce and industry in Bundaberg and elsewhere in Queensland, and to a lesser degree in other States, will not escape unscathed from the drop in spending power of the people in the Lower Burnett sugar area.

The wage bill alone for 1965 is estimated to be £1.6 million below what it could have been if peak production had been achieved in a normal growing season. The effects of the long drought will therefore continue to be felt in future years as well as in this year.

In an era of expansion unparalleled in the history of the Australian sugar industry, it must be of national concern that an important part of the industry, the Lower Burnett, will contribute less than its share. A worse result could be if production continued at the current low level, or dropped even further, which is possible, that the mill peaks of the six mills could be reduced because of their failure to maintain them. Additional hardship would then be heaped on the canegrowers and the mills.

Irrigation is the only answer, but it must be irrigation from large-scale capital works built with large sums of money.

... 8

Many cane farms in the area are irrigated; those in the Fairymead, Millaquin and Qunaba districts of the Lower Burnett will in fact produce the bulk of this year's cane crop for the whole area. But it is irrigation from uncertain sources of river and underground supplies, as this 1965 drought has shown.

The Burnett and Kolan Rivers have dropped to alarmingly low levels. The levels of underground water, into which many canegrowers have bored for their irrigation schemes, have fallen significantly and salt water intrusion is feared along the seaboard.

However, the majority of growers have no access to either source of water - river or underground.

SELF-HELP :

The Bundaberg and District Irrigation Committee has not been inactive in its efforts to try and help itself to solve the long term problem.

After several conferences with water conservation authorities, the members have provided £10,000 of their own money to finance the cost of bringing experts from the Snowy Mountains Hydro-Electric Authority to assist the Queensland Irrigation and Water Supply Commission in an engineering and economic survey into future water requirements and irrigation potential. However, the report will not be available until next year.

Committee members are prepared to contribute more - if it will help. But they submit that amounts such as £10,000 are like a man using his children's moneybox contents to finance the building of a large house.

Thinking about irrigation is not new in the Lower Burnett area. However, in two districts, growers have been told several times by authorities

...9

over the years that it would cost them too much in headworks on their farms to bring about complete or partial irrigation. This has, in fact, been presented to them as a deterrent.

But these growers - or many of them - would now be prepared to meet these costs if a scheme were available.

Any observer moving through the Lower Burnett area can see the stark contrast between the irrigated and non-irrigated cane and other crops. It is not exaggerating to say that it is virtually the difference between the lush green fields of Britain and the hard dry earth of Western Queensland.

Production figures tell the story succinctly. In the Gin Gin mill area alone last year, 39 growers, with either fully irrigated or partially irrigated farms, produced 39 per cent of the total crop of cane harvested in the district. The remaining 61 per cent of the crop was produced by 170 growers, none of whose farms was irrigated.

This year in Gin Gin, there are 234 growers, of whom 71 have irrigated farms. However, some of these farmers, who are depending on the river for irrigation, are either working under restricted pumping periods or unable to draw any water, because of the dangerously low level to which the Burnett River has receded.

In the Gin Gin area, the mighty Burnett has dwindled to almost the dimensions of a small creek whose body of water is scarcely moving.

In this district last year, 492 acres of cane were destroyed because it did not reach cutting standard. Of 3200 acres stood over in the hope of a better season in 1965, about one third would by now have been drought-ruined and destroyed (at a replacement cost of £50 an acre on top of the lost revenue).

...10

The cane farmers of the Lower Burnett have tried to help themselves.

However, in the Isis district, perhaps the hardest hit, self-help with individual dam schemes is inadequate in a drought and only a big scheme can provide the water. Isis growers need to be able to be part of a large capital scheme. The dams from which Isis Mill draws its water are almost completely dried up and need a permanent source of replenishment to overcome the problems drought years create.

Isis farmers say that with modern spray irrigation methods, there would be no problem irrigating the hilly country once the water was brought to the farms. It is worth pointing out that in 1964 Isis farmers cut 217,000 tons of cane - half the crop of 1963. The 1965 crop estimate is even bleaker.

What this means to the average farmer can be seen from the following comparisons. In 1964 an irrigated farm of 127 acres (when water was available) harvested 100.9 acres at 31.1 tons to the acre, making an aggregate harvest of 3143 tons. Next door, a 130 acre non-irrigated farm under the same ownership harvested only 30.9 acres at 20.2 tons to the acre - a total harvest of only 626 tons of cane.

<u>The 1965 results will show even more startling comparisons.</u>

In the Fairymead, Millaquin and Qunaba districts, growers have exploited irrigation as much as possible. In the Fairymead area, for example, the number of bores sunk into underground water supplies has increased from 12 in 1953 to 312 in 1965. However, the underground basins from which many Fairymead growers obtain water have become salty, the results of which are obvious. In the Millaquin and Qunaba districts, irrigation sprays can also be seen over large areas of cane. There are 387 pumps bringing water from underground sources

...11

but this, as indicated, is dwindling. At Qunaba 95 per cent of the farms are irrigated and 69 per cent at Millaquin.

At Bingera 85 per cent of the total crop will come from 100 growers whose farms are partially or completely irrigated out of a total of 300 growers. Many of the non-irrigated growers will this year cut no cane.

What of other primary industry?

While 1965 estimates are not available, comparisons between 1962-63 and 1963-64 are pointed.

In that period of twelve (12) months, drought caused a drop in the production of :

- Cotton from 88 tons to 16 tons - 81 per cent;
- Pastoral : value down from £640,000 to £540,000 - 16 per cent;
- Whole milk by 14 per cent.

Although irrigation has proven successful where the water is being pumped from the river or from underground sources, these sources cannot be relied upon with a continued drought causing replenishment virtually to cease.

The only reliable source is surface storage - large dams from which water can be pumped evenly throughout the Lower Burnett area.

In this regard, the following schemes are envisaged :

...12

* Kolan River - Dam in upper reaches of river and on Gin Gin Creek feeding to lower weirs on the Kolan for individual farmer pumping development.

* A major dam on the upper Burnett at Riedels Rocks, or alternatively, at Mingo Crossing for replenishment of the Bingera Weir basin and for reticulation to cane growing lands distant from the stream storages.

* Dams on the Gregory and/or Isis Rivers to service Isis canegrowing land with necessary reticulation. The Isis lands are also being investigated for service from the Upper Burnett storage.

* Recharge of the underground basins in the Gooburrum and Woongarra areas by pumping from the major Burnett storage.

* A dam on the Elliott River to service adjacent cane lands and for recharge of underground basins.

* The Irrigation & Water Supply Commission has also been requested to investigate the feasibility of utilising lower reach weirs on the Burnett in association with the major upper storage. If practicable, this would facilitate cheap reticulation of stored water to widespread areas of land merging in all Shires and the city of Bundaberg.

To depend on the rainfall in the Lower Burnett area is fatal. The erratic pattern of the rainfall since 1900 in just one district of the area, Bingera, which would be typical, is illustrated more eloquently in an attached graph (see Appendix A) than a thousand words. Figures of rainfall in other districts taken out from the so-called "wet" month of February for the last 13 years, confirm the fly-by-night nature of the rainfall.

...13

For detailed information of readers of this document, the Committee has attached a statistical rundown of vital facts showing disastrous effect of the lack of water in the Lower Burnett area.

The Committee believes that these figures and this document will convince you that the future of the Lower Burnett area demands a major capital works for water storage. Certainly the people who benefit directly - the growers and the milling companies - are prepared to pay for the water supply.

But the initial capital outlay is beyond the reach of any section of the area. The estimated cost could be at least £10 million and would be at least five times the annual appropriation of the Queensland Irrigation and Water Supply Commission.

Only a Commonwealth grant to Queensland, or the provision of low cost capital from another source, backed by the Commonwealth, can provide the means to carry out this immense task which, when completed, will benefit the Lower Burnett area and its 42,510 people and the State of Queensland, and must be a factor in assisting the overall economy of Australia.

In addition to benefits which would accrue to existing primary and small secondary industry in the Lower Burnett from wide scale irrigation, additional water will be needed to cope with problems which must face Local Authorities in the future. The city of Bundaberg could attract large new types of industry in which water is an essential requirement, while increases in population could accentuate, and indeed aggravate, the need for more and more water in the other towns located in the Lower Burnett area.

In fact, among the inquiries that the Bundaberg City Council has received

. . . 14

from potential industries, two of them, paper and chemical companies, were discouraged when they learned of the uncertainty of water supply for industry.

The paper manufacturing company spent between £4, 000 and £5, 000 on an investigation of the Bundaberg City area and was considering a site. The company said that its proposed mill would require initially six million gallons a day, which would grow to twelve million gallons a day in five years.

Imagine this when compared with the Bundaberg City's present supply of four million gallons a day.

The chemical industry proposal negotiations collapsed when the company learned that water supply would be insufficient.

The Committee emphasises that water is the key.

The success of many irrigation schemes depends on the spending of huge amounts of capital on factors other than irrigation. In developing a NEW AREA the establishment of new farms, communities, homes, community facilities and additional transport and communications call for the committal of capital far above the cost of the irrigation scheme itself.

In the Lower Burnett area the only capital to be outlayed to create a new irrigation scheme is the cost of the irrigation project. Communities, farms, machinery, milling capacity, shipping and port facilities, and proven soils ALREADY EXIST.

How prophetic then are the words of Mr. W.J.S. Sloan, Director-General,

...15

Department of Primary Industries, at the Water Research Foundation of Australia Symposium, held at Rockhampton during June, who said :

".....Because of our limited water resources, I believe we will never regret building well located irrigation schemes using suitable soils and good quality water, irrespective of what the economists say.

"If this generation does not find it economic to build large water storages, the next generation will have to do so for survival. "
(The underlining is ours.)

*** *** ***

Appendix 'B'

INFORMATION IN RESPECT TO SUGAR PRODUCTION IN THE LOWER BURNETT DISTRICT EMBRACING THE MILL AREAS OF FAIRYMEAD, MILLAQUIN, QUNABA, BINGERA, GIN GIN AND ISIS.

1. CAPITAL INVESTED IN THE INDUSTRY - Estimated £60 to £70 million.

2. POPULATION OF DISTRICT

Bundaberg City	-	25,000
Shires of Woongarra	-	4,500
Gooburrum	-	4,500
Kolan	-	2,650
Isis	-	4,000
Biggenden	-	1,860
		42,510 for District.

3. NUMBER OF EMPLOYEES:

	BINGERA	MILLAQUIN	F'MEAD.	QUNABA	ISIS	GIN GIN	TOTAL
Mills in Crushing Season		270		185	275	210	940
Mill & Plantation	410		740				1150
Contract Cane Cutters (Farmers)							800
Farmers Field Workers							300 *
							3190

4. AMOUNTS SPENT ON IMPROVEMENTS BY MILLS:

1962	66,924	66,000	78,716	35,000	156,188	53,957	457,000
1963	290,332	87,000	249,087	52,000	139,298	158,715	976,000
1964	382,001	289,000	287,795	199,000	221,693	322,169	1,701,000
1965	350,000	490,000	400,000	375,000	250,000	137,800	2,003,000
Estimate							£ 5,137,000

	BINGERA	MILLAQUIN	F'MEAD	QUNABA	ISIS	GIN GIN	TOTAL
5. RAINFALL (Inches)							
1962	58.05	58.3	57.37	59.13	35.89	44.32	
1963	40.59	47.5	37.32	38.26	31.22	32.65	
1964	25.25	40.22	33.97	36.32	29.88	36.47 (See also following page)	
6. ESTIMATED LOSS IN WAGES	370,000	240,000	210,000	80,000	500,000	190,000	1,590,000
7. NUMBER OF GROWERS 1965	344	371	185	128	268	284	1,530
8. TONS OF CANE CRUSHED							
1962	408,940	398,996	393,405	174,919	432,436	174,563	1,982,000
1963	381,000	356,930	376,031	174,442	433,760	161,065	1,883,000
1964	272,905	416,064	421,206	214,771	217,039	104,035	1,646,000
1965 Estimate	230,000	360,000	390,000	220,000	100,000	110,000	1,410,000
9. TONS OF SUGAR MANUFACTURED							
1962	58,762	57,881	56,559	25,552	61,202	25,256	285,000
1963	52,434	52,286	55,768	25,703	58,009	20,296	265,000
1964	34,028	55,681	55,613	29,431	25,730	12,428	213,000
1965 Estimate	30,000	48,200	54,500	31,000	12,500	14,000	190,000
10. GROSS SUGAR REVENUE							
1962	2,781,609	2,709,351	2,676,676	1,247,114	2,878,678	1,183,889	13,478,000
1963	3,364,886	3,356,526	3,623,446	1,634,399	3,761,340	1,283,700	17,024,000
1964	1,670,106	2,696,000	2,709,924	1,410,000	1,262,257	609,501	10,357,788
1965 Estimate at £48 per ton	1,440,000	2,300,000	2,616,000	1,480,000	562,500	672,000	9,070,000

Appendix 'C'

Appendix 'D'

THE LOWER BURNETT ERRATIC RAINFALL IN THE SO-CALLED "WET" MONTH OF FEBRUARY IN THE SIX SUGAR AREAS

RAINFALL POINTS

	BINGERA	FAIRYMEAD	GIN GIN	ISIS	MILLAQUIN	QUNABA
Feb. 1952	136	268		200	211	269
1953	493	433		1157	522	486
1954	1910	942		1588	1547	952
1955	884	1531		579	1455	2038
1956	1227	1590		1362	1785	1518
1957	281	343		1475	554	292
1958	360	873	895	1329	998	768
1959	630	909	477	641	1001	911
1960	416	785	439	390	726	772
1961	1011	1251	646	544	1185	1505
1962	424	221	518	316	307	224
1963	308	150	Not recorded	396	175	72
1964	208	420	284	276	414	601
1965	32	49	46	92	197	25

*** *** ***

SUMMARY OF REPORT
on
WATER CONSERVATION
UNDERGROUND WATER SUPPLIES
AND IRRIGATION

BUNDABERG, CHILDERS REGION

Prepared and Distributed by

BUNDABERG DISTRICT CANE GROWERS EXECUTIVE

Bundaberg, heart of a community of 45,000 people to be served by the proposed irrigation scheme.

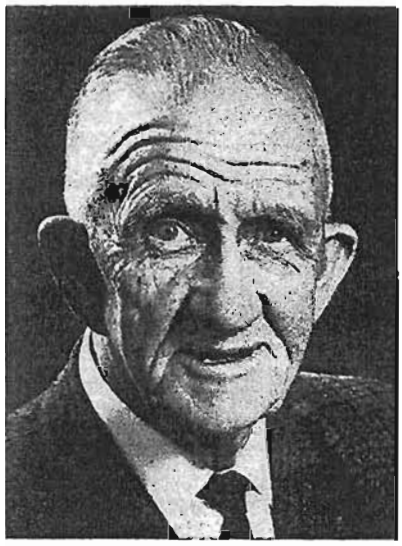
July, 1969

FOREWORD

by

BEN ANDERSON

Chairman Bundaberg & District
Irrigation Committee



This joint report compiled by the Department of Primary Industries and the Irrigation and Water Supply Commission and presented to the Ministers of the respective departments supersedes a previous report that was released in December, 1966.

The thoroughness of the survey covering the Bundaberg Region must satisfy the Lower Burnett Community as it realises upon examination how well all phases of the major irrigation scheme have been investigated and the conclusion whereby the report declares "That there is a significant degree of urgency for provision of the Stage 1 of the Bundaberg Irrigation Scheme."

The losses in sugar production because of drought since Mill Peak quotas were substantially increased in recent years is of very great concern to the region, not only because of depleted revenue but also the effect that under production could have on future mill peak quota assessments.

Under the terms of the new International Sugar Agreement and the trend of increased sugar consumption throughout the world it is reasonable to predict that the Australian sugar quota for export will be increased.

It is unlikely that Australian Mill Peak quotas will be increased in areas other than those whose production performance warrants such consideration.

The implementation of the irrigation scheme envisaged in this up-to-date report will ensure that the Bundaberg region will meet its responsibility to fill Mill Peak quotas and relieve one of Queensland's richest agricultural districts of the periodic depressions caused by drought and its consequent loss to the Australian economy.

The value of irrigation needs no proving.

In this season of 1969 where adequate water has been available, heavy crops will be harvested and the general condition of the Lower Burnett sugar crop varies according to the amount of water applied until it reaches zero on thousands of acres that have nothing to offer the mills as a result of dry conditions.

The underground source of supply is now seriously overdeveloped and in many instances even where water is plentiful the fear of salt intrusion because of low underground levels is a worry to a number of irrigationists.

The Queensland State Government has approved the Bundaberg Region Scheme and given it No. 1 Priority in its approach to the Commonwealth Government for finance to implement it. It is clear that the attitude of the Commonwealth Government towards Queensland's approach to have the scheme accepted is all important.

It was always contended that a thorough survey of the Lower Burnett Region would reveal how well suited it was to carry a major water conservation scheme and the new report excellently portrays the complete answer in the matter of its economic value.

All sections of the community are alive to the threat held over the region relative to its progress and consequently were never more united in a demand for National assistance to have the scheme carried out.

WATER in great quantities is absolutely essential for this otherwise well developed area. It is the one commodity needed to guarantee constant production and without it a rising population cannot enjoy the natural desire to develop a wonderful piece of a great Continent to the full.

Yours sincerely,

BEN ANDERSON,
Chairman Bundaberg & District Irrigation Committee.

The scheme is economically justified. The number of 1,458 assignments given security, increased efficiency and volume of production makes it unique in the State to date in the ratio of farms served to capital cost. A concerted effort to obtain the necessary finance is in progress. It is proposed that the scheme be submitted to the landholders to ascertain whether they desire it to proceed. This precis has been compiled and distributed to enable landholders to know the implications of the proposal and the possible consequences in the future without a major water storage at the present level of irrigation.

A wider distribution is planned to foster the scheme and to inform members of interested sectors of the community of the ramifications and economics of the scheme.

BUNDABERG DISTRICT CANE GROWERS' EXECUTIVE

K. F. Pharr,
SECRETARY.

TABLE OF CONTENTS

Page No.

PART 1 – SUMMARY AND CONCLUSIONS – Pages 1 to 4

CONCLUSIONS ... 1
SUMMARY:
- SECTIONS OF SCHEME ... 1
- PURPOSE OF REPORT AND PROPOSALS ... 1
- PRESENT DEVELOPMENT ... 2
- RAINFALL, DROUGHT OCCURRENCE AND EFFECTS ... 2
- PRESENT IRRIGATION ... 2
- UNDERGROUND WATER SUPPLIES:
  - Areas Irrigated from Groundwater ... 2
  - Scope and Result of Investigations ... 2
  - Proposals to Overcome Shortages ... 2
- AGRICULTURAL ASPECTS ... 2
- PROPOSED SCHEME:
  - Establishment ... 2
  - Areas to be Supplied and Water Requirements ... 3
  - Outline of Scheme ... 3
- WATER ALLOCATIONS AND CONDITIONS OF SUPPLY:
  - Supply from Irrigation Systems ... 4
  - Private Pumping from Rivers ... 4
  - Supply from Groundwater ... 4
- ESTIMATED CAPITAL AND ANNUAL COSTS AND REVENUE:
  - Construction and Development Programme ... 4
  - Annual Operation and Maintenance Costs and Revenue ... 4
- THE INDIVIDUAL FARM SITUATION ... 4

PART 2 – BUNDABERG REGION – PRESENT SITUATION – Pages 5 and 6

RAINFALL AND DROUGHT OCCURRENCE ... 5
EXISTING IRRIGATION DEVELOPMENT AND SUPPLIES ... 6
CITY OF BUNDABERG WATER SUPPLIES ... 6

PART 3 – DROUGHT EFFECTS, IRRIGATION AND OTHER WATER REQUIREMENTS – Pages 7 and 8

DROUGHT EFFECTS ... 7
OVERALL DROUGHT EFFECTS ... 8
NEED FOR ASSURING AND EXTENDING IRRIGATION ... 8
STAGE DEVELOPMENT FOR PRESENT AND FUTURE ... 8
BUNDABERG CITY WATER SUPPLIES ... 8

PART 4 – AGRICULTURAL ASPECTS – BUNDABERG REGION – Pages 9 and 10

PRESENT LAND USE ... 9
CANE VARIETIES ... 9
AGRONOMIC CONSIDERATIONS ... 9
WATER USE AND RESPONSE TO IRRIGATION:
- Measured Water Use ... 10
- Response to Irrigation ... 10
- Irrigation Yields ... 10

PART 5 – UNDERGROUND WATER SUPPLIES – Pages 11 to 13

EXTENT OF INVESTIGATIONS ... 11
EXTENT AND DEVELOPMENT OF PRESENT USE ... 11
NATURE, EXTENT AND BEHAVIOUR OF AQUIFER SYSTEM ... 11
ARTIFICIAL RECHARGE INVESTIGATIONS:
- Conclusions ... 12

PROPOSED ARRANGEMENTS TO OVERCOME SHORTAGES ... 13

PART 6 – AREAS TO BE SERVED AND WATER REQUIREMENTS – Pages 14 and 15

AREAS TO BE SUPPLIED AND WATER REQUIREMENTS ... 14

PART 7 – STORAGES – Pages 16 to 20

DESIRABILITY OF USE OF BOTH BURNETT AND KOLAN RIVERS ... 16
COMBINED OPERATION OF MONDURAN DAM AND BUCCA WEIR ... 16
KOLAN TIDAL BARRAGE 9.2m ... 16
BURNETT RIVER STORAGES:
- Kalliwa Dam ... 16
- Bundaberg Tidal Barrage ... 17
- Combined Operation Kalliwa Dam and Bundaberg Tidal Barrage ... 18
- Gayndah Weir ... 18
- Allocation of Supply from Wuruma Dam ... 18

STORAGE, SELECTION AND ARRANGEMENT:
- Arrangement for Stage I Development ... 18

INITIAL DEVELOPMENT – STAGE I ... 18

PART 8 – IRRIGATION AND ANCILLARY WORKS – Pages 21 to 24

METHOD OF SUPPLY:
- Kolan Section ... 21
- Burnett Section ... 21

OFF-PEAK PUMPING ... 22
SUPPLY TO FARMS – CHANNEL SYSTEMS:
- Point of Supply ... 22
- Measurement of Supply ... 23
- Conditions of Supply ... 23
- Water Allocations ... 23
- Use of Existing Supplies ... 23

[Continued on next page.

TABLE OF CONTENTS (continued)

Page No.

SUPPLY TO FARMS ALONG THE KOLAN AND BURNETT RIVERS:
- Right to Obtain Supply ... 24
- Measurement of Supply: ... 24
- Pumping Equipment ... 24
- Supply Arrangements ... 24

FINANCE FOR FARM IRRIGATION FACILITIES ... 24

POSSIBLE TRANSFER OF ASSIGNMENTS ... 24

PART 9 – ESTABLISHMENT CAPITAL AND ANNUAL COSTS AND DIRECT REVENUE – Pages 25 to 27

ESTABLISHMENT:
- Estimate of Capital Costs ... 25
- Construction and Development Programme ... 26
- Provision of Supply to Farms – Stage I ... 26
  Stage II ... 26
- Annual Revenue ... 26
- Water Charges from Irrigation Systems ... 26
- Water Charges for Supplies from Kolan and Burnett Rivers ... 26
- Charges to Landholders using Underground Water ... 27
- Water Charges to City of Bundaberg ... 27
- Charge to Sugar Mills ... 27

PART 10 – INCREASED PRODUCTION – Pages 28 to 31

INCREASE IN YIELD WITH IRRIGATION ... 28

IRRIGATED AREAS TO PRODUCE PRESENT PEAKS ... 28

INDIVIDUAL FARM SITUATION:
- Dryland and Irrigated Yields ... 28
- Additional Capital Requirements ... 29
- Additional Annual Costs ... 30
- Return to Use of Irrigation at Farm Level ... 30

PART 11 – BENEFITS – Page 32

CONCLUSION ... 32

SUMMARY OF BENEFITS ... 32

GLOSSARY OF TECHNICAL TERMS

Acre Foot — The volume of water which would cover an acre to a depth of one foot, equivalent to 272,250 gallons.

Cusec — One cubic foot per second, equivalent to 22,500 gallons per hour or 544,500 gallons daily.

R.L. — Reduced Level. Height above the State Datum which is approximately mean sea level.

F.S.L. — Full Supply Level as related to:

(a) Reservoir—
In the case of fixed crest structures such as Monduran Dam the full supply level is the same as spillway crest level.

(b) Channel—
The level of water when the channel is flowing at the designed discharge.

Channel — Where used in this report refers to use of constructed waterways rather than natural streams. Includes various types of construction, e.g., trapezodial concrete lined channel, trapezoidal earth channel or reinforced concrete, asbestos cement or steel pipelines.

Inverted Siphons — Pipelines used to convey water across natural drainage depressions, watercourses or streams by gravity.

Relift Areas — Areas above the level of the main channel system which can only be served by pumping from the channal system.

Aquifer — Underground formations of material permitting the movement and storage of considerable volumes of water. Aquifer materials in the Burnett-Kolan area are usually sands and gravels.

Recharge — The process whereby water from natural sources such as rainfall or stream flow is used to replenish underground water storage either by natural or artificial means.

PART 1 – SUMMARY AND CONCLUSIONS

This report supersedes a previous Report of December, 1966, which proposed a scheme to serve the Kolan Section (lands along and between the Kolan River and the Burnett River) of the Region.

CONCLUSIONS

The outstanding feature of the investigation is the need for irrigation to raise the whole efficiency and security of the Bundaberg Region sugar industry. This is essential to remove the threat of casastrophic loss with recurrence of prolonged drought periods such as 1899-1910.

If repeated under present conditions of peaks, prices and overdeveloped underground supplies, production losses exceeding $50,000,000 over the period could result, which could destroy the Bundaberg Sugar Industry.

Stage I of the scheme proposed provides the only means of stabilising this $30 million industry on which an important city and community is based, with benefit/cost ratios up to 1.96 on direct benefits which compares favourably with other schemes built or approved to date and has the additional advantages of drought mitigation and stabilised financial and social conditions in an important established region.

Increased sugar production at this stage is not excessive in relation to the time required for development.

Consideration of Stage II can be deferred until the effects of Stage I are determined and/or opportunities for further expansion of production occur.

The capital cost of $47,079,000 for Stage I is large, but the number of 1458 assignments given security, increased efficiency and volume of production make it unique in the State to date in the ratio of farms served to capital cost.

Future drought occurrence cannot be predicted but having regard to previous records, the low average rainfall, further drought in 1968-69 following 1964-65 and the behaviour of underground water levels in 1968-69, it would appear that there is a significant degree of urgency for provision of the Stage I of the Bundaberg Irrigation Scheme.

SUMMARY

SECTIONS OF SCHEME:

For the purpose of this report, the Region has been divided into two sections – Kolan and Burnett Sections.

The Kolan Section comprises the lands along the Kolan River and between that River and the Burnett River assigned to the Fairymead, Bingera and Gin Gin Mill areas.

The Burnett Section comprises the lands south of the Burnett River to and including the Isis area, which are assigned to Qunaba, Millaquin, Bingera, Gin Gin and Isis mills.

PURPOSE OF REPORT AND PROPOSALS:

The scheme is planned for provision of works in two stages and development of sugar production in three stages in which the objectives and effects are as follows:

Stage I (a):

(a) To eliminate the effects of drought on sugar production by –

(i) providing irrigation from surface water to 1,181 existing assignments with a gross area of 93,433 acres in the six mill areas, which include a number of assignments now irrigating from overused underground supplies;

(ii) reserving use of underground supplies, to assure adequate supply for 277 existing assignments with a gross area of 25,000 acres (105 assignments comprising 12,500 acres are in the Kolan Section and 172 assignments comprising 12,500 acres are in the Burnett Section).

Stage I (b):

When markets are available providing expansion of production by up to 104,450 tons of sugar per annum over present peaks (total increase Stages I (a) and I (b) 150,520 tons valued at $18,396,000) by increasing the area irrigated and harvested to 75% of existing assigned areas.

Stage II:

When further markets are available, provision of additional works to increase production by a further 166,297 tons of sugar annually (total increase Stages I and II, 316,817 tons valued at $28,197,000) by —

(i) increasing irrigation and production to 80% of existing assigned areas; and

(ii) providing irrigation and production on 80% of 33,000 acres of presently unassigned lands suitable for cane production, which could be readily served by the main channel system required for Stage I.

In addition the proposals provide for a source of surface water supply to augment the present underground supply used by the City of Bundaberg by some 5,000 acre feet per annum for Stage I and 10,000 acre feet per annum in Stage II.

Initial development of Stage I costing $8,298,000 would benefit 50% of assignments to be benefited by the complete stage.

PRESENT DEVELOPMENT:

The Bundaberg Region is Queensland's third largest sugar producing region with some 128,000 acres of assigned sugar lands held on 1,567 assignments serving six mills with an annual mill peak of 341,000 tons of sugar (16% of State peak) valued at $30,350,000 at the 1969 predicted average price of $89 per ton.

RAINFALL, DROUGHT OCCURRENCE AND EFFECTS:

The Region has the lowest average rainfall (44.3 inches) of any non-irrigated sugar producing area in the State and a high incidence of drought.

1964-65 regional shortfalls were 22% and 45%, with an aggregate value of $18,776,000. Over the last 40 years the value of average annual production deficit below peaks for all mills, taken on the basis of present peaks and a price of $89 per ton of sugar amounts to $4,432,000.

In addition, it is estimated that shortfalls result in an average annual increase in milling costs of $1,033,000 which together with losses of road transport fees and harbour dues bring the average annual direct loss due to drought to $5,561,000.

Drought in 1968-69 will again cause substantial shortfalls in Bingera, Gin Gin and Isis mill areas.

PRESENT IRRIGATION:

Use of irrigation in the region to achieve reliable and low cost production, has increased from 18,000 acres in 1961 to 47,000 acres in 1968 (35,000 acres from underground supplies and 12,000 acres from surface supplies).

Unfortunately this is based on insecure water supplies. The safe annual supply to 35,000 acres now irrigated from underground water supplies has been assessed at about 50% of the current annual use. As a result even with good recharge rainfall in 1967-68, standing water levels are currently approaching the lowest recorded in December, 1966, and include over 20,000 acres of the Qunaba Mill area with levels at or below sea level. Consequent serious threat exists of extensive salt water intrusion into this area.

The only secure supplies are those to 8,000 acres irrigated along the Burnett River, now to be supplemented from Wuruma Dam, and 1,200 acres irrigated from the Elliott River.

The $30,000,000 sugar industry in the Bundaberg Region is thus insecurely based and the provision of the proposed comprehensive irrigation scheme is the only means of ensuring its stability and improved efficiency.

UNDERGROUND WATER SUPPLIES:

AREAS IRRIGATED FROM GROUNDWATER:

Current annual use is some 52,000 to 70,000 acre feet per annum for irrigation, 3,300 acre feet for the City of Bundaberg and a further 2,000 acre feet for the three sugar mills.

SCOPE AND RESULT OF INVESTIGATIONS:

Extensive investigations of these supplies have shown that natural recharge of these supplies is from local rainfall when this exceeds 5.6 inches per month, and it is not physically or economically feasible to provide artificial recharge of underground water beds to the extent necessary to meet current requirements.

PROPOSALS TO OVERCOME SHORTAGES:

Because of the impracticability of artificial recharge it is proposed that the current shortage of underground water supply for present use be overcome by providing surface water supplies for irrigation to some 37% of the area using the supplies in the Kolan Section, and up to 50% of the area now using these supplies in the Burnett Section, prohibiting use of underground water supplies for irrigation where this surface water supply is provided, and allowing landholders in the balance of the area of groundwater availability to continue using this, within certain limits.

AGRICULTURAL ASPECTS:

Normal annual water requirements for irrigation in the Region have been assessed at an average of 1.5 acre feet per acre and in dry years, 2 acre feet per acre.

Increased production resulting from irrigation of dryland has been assessed as varying from 1.4 tons of sugar per acre from the Gin Gin Mill Area (Kolan Section) to 1.6 for the Fairymead Mill Area and 1.9 tons (14.2 tons of cane) for other areas.

On this basis, it has been further determined that the proportion of present total gross assignments necessary to be harvested to fill present mill peaks, under irrigation, would average 52% for the Bundaberg Region and vary from 36% in the Gin Gin (Burnett Section) Mill Area to 60% in the Fairymead Mill area. The present overall average area harvested is 65% of total gross assignments (50% in Gin Gin to 75% in the Fairymead and Qunaba Mill areas).

PROPOSED SCHEME:

ESTABLISHMENT:

Prior submission to landholders in the area to determine whether they desire the scheme to proceed and are prepared to meet the charges involved would be desirable.

To exercise control over the use of underground water supplies as proposed, would require the approval of an Order in Council declaring the whole area of groundwater availability "a district in which provisions of Part VII of the Water Act apply", which require the Commissioner of Irrigation to license, and fix conditions of use of water from, all bores and wells in the area.

AREAS TO BE SUPPLIED AND WATER REQUIREMENTS:

Stage I:

For Stages I(a) and I(b), these are shown in the following Table 1–I:

TABLE 1–I
AREAS TO BE SUPPLIED AND WATER REQUIREMENTS
STAGES I(a) AND I(b)

Section	No. of Assignments	Assigned Area (Acres)	Area to be Irrigated (Acres)		Annual Water Required at Storage (Acre Feet)	
			Stage I(a)	Stage I(b)	Stage I(a)	Stage I(b)
Kolan	477	89,238	20,990	29,420	58,090	81,650
Burnett	704	54,200	27,505	40,650	73,730	108,510
City of B'berg					5,000	5,000
Total Bundaberg Region	1,181	93,433	48,495	70,070	136,820	195,160

A further 277 assignments of some 25,000 acres would continue to use underground water supplies for irrigation.

Stage II:

For Stage II, these are shown as follows:

TABLE 1–II
AREAS TO BE SUPPLIED AND WATER REQUIREMENTS
STAGE II

Section	Assigned Area (Acres)	Area to be Irrigated (Acres)	Annual Water Requirements at Storage (Acre Feet)
Kolan	54,973	43,988	121,050
Burnett	71,400	57,120	152,280
City of Bundaberg			10,000
Total	126,373	101,000	283,330

OUTLINE OF SCHEME:

The overall arrangement of the scheme would be:

Stage I:

Storages:

Kolan River –		
Monduran Dam	Capacity	475,000 ac. ft.
Bucca Weir	Capacity	16,700 ac. ft.
Kolan Tidal Barrage:	Capacity	3,500 ac. ft.
Burnett River –		
Bundaberg Tidal Barrage	Capacity	18,200 ac. ft.
Gayndah Weir	Capacity	18,000 ac. ft.
Total		526,400 ac. ft.

In addition a regulated flow of 5,000 ac. ft. per annum would be provided from Wuruma Dam in the Upper Burnett catchment.

Supply in the Burnett River would also be supplemented where required by diversion from Monduran Dam through the Bingera Irrigation System.

Total normal annual yield with this arrangement is 196,000 ac. ft., but this would be subject to substantial reduction in a period similar to 1902-03.

Stage II:

Stage II development would require the construction of Kalliwa Dam on the Burnett River with a storage capacity of 440,000 acre feet, increased capacities of pumps and rising mains at most pumping stations, and extension of reticulation systems to serve additional lands.

At this stage all regulated flow from Wuruma Dam would revert to use in the Upper Burnett River.

The estimated cost to Stage II is $78,142,000.

Initial Development — Stage I:

Subject to approval for the complete Stage I to proceed, but at the risk of substantial shortages of supply during a severe drought such as 1902-03, it would be feasible to provide initial development to give early supply of surface water, and some significant reduction in level of groundwater use, thus benefiting at least 730 assignments at a capital cost of $8,298,000, by the following arrangement:

(a) Storages:

Kolan River: Bucca Weir and Kolan Tidal Barrage
Burnett River: Bundaberg Tidal Barrage and Gayndah Weir
Supply of 10,000 acre feet annual regulated flow from Wuruma Dam

(b) Available Supply:

Normal annual supply of 54,000 acre feet would be available but would be sufficient to provide 2 acre feet per acre per annum to the following —
Kolan Section: 152 assignments, 11,294 acres assigned, 67% irrigated
Burnett Section: 301 assignments, 22,435 acres assigned, 60% irrigated.

The totals of 453 assignments and 33,729 acres assigned are 38% and 36% respectively of totals to be served by complete Stage I.

In addition significant benefit would result to underground supplies continuing to be used by more than 277 assignments of 25,000 acres.

WATER ALLOCATIONS AND CONDITIONS OF SUPPLY:

These would be as follows:

Supply From Irrigation Systems:

(a) Water rights (paid for whether used or not) of 0.8 acre feet per acre of gross assigned area (18 inches per acre for 52% of the assignment irrigated or 12 inches per acre for 80% of the assignment irrigated);

(b) Sales water quota (supply in excess of water right paid for if and when used) 0.7 acre feet per acre of gross assigned area for Stage I and 0.8 acre feet per acre of gross assigned area for Stage II. Total allocation (water right plus sales) would be 2 acre feet per acre for 75% and 80% of the gross assignment irrigated.

PRIVATE PUMPING FROM RIVERS:

Water would be allocated by licenses under the Water Act with maximum allocation of 1.5 acre feet per acre of gross assigned area for Stage I and 1.6 acre feet per acre of gross assigned area for Stage II, 50% of the allocation to be paid for each year whether used or not, and the balance as used.

SUPPLY FROM GROUNDWATER:

In the area continuing to use underground water, conditions of the license would require water meters to be installed and maintained by the Irrigation Commission as part of the cost of the scheme on all irrigation pumps on bores and wells.

Maximum annual allocation of supply to any one holding, 2 acre feet on 80% of the gross assignment, and/or the actual area of crops irrigated other than sugar cane. Annual fees to be paid for 50% of the allocation, whether used or not, and the balance paid for as used.

ESTIMATED CAPITAL AND ANNUAL COSTS AND REVENUE:

CONSTRUCTION AND DEVELOPMENT PROGRAMME:

Rate of development of the scheme would depend on availability of funds. Detailed design and preparation of sufficient plans and specifications to permit construction to commence would require 1½ to 2 years.

A possible 12 year construction programme for Stage I (the minimum practicable) would enable completion of the initial development of this stage by the end of the third year. This would require a maximum expenditure of $4,500,000 in the fourth to the ninth years.

An alternative programme providing for a maximum annual expenditure of $3,000,000 would enable completion of the initial phase of Stage I in the fourth year, and completion of this Stage in 17 years.

Stage II has not been programmed.

ANNUAL OPERATION AND MAINTENANCE COSTS AND REVENUE:

Annual revenue from the scheme would be derived from the following sources, and at the charges indicated:

(a) Water Charges:

(i) From irrigation systems (water rights and sales)	$10 per ac. ft.
(ii) Private pumping from rivers	$ 3 per ac. ft.
(iii) To City of Bundaberg for surface water supplies from Bundaberg Barrage	$10 per ac. ft.
(iv) To landholders, the City of Bundaberg and Sugar Mills continuing to use underground supplies	$ 1.50 per ac. ft.

(b) Charges to six sugar mills (in addition to charges as irrigators) to provide a contribution towards the cost of the scheme – $1.00 per ton of sugar allotted as mill peak in respect of farms served by surface water and obtaining underground water from areas benefited from the project.

THE INDIVIDUAL FARM SITUATION:

Investigation of the effect of irrigation on the individual farm showed that for a typical dryland farm with 75 acres gross assignment and sugar price to farmer $60 per ton, the comparative average annual returns at Stage I(b) would be:

(a) dryland conditions – 49 acres harvested; value of cane less harvesting costs $7,000;

(b) under irrigation – 56 acres harvested; value of cane less harvesting costs $12,900; additional annual costs of irrigation $2,400; net margin in favour of irrigation over $3,000. At Stage I(a) the amount in favour of irrigation would be $1,000.

PART 2 – BUNDABERG REGION – PRESENT SITUATION

RAINFALL AND DROUGHT OCCURRENCE:

The Region has an average rainfall of 38 inches in the western section to 44 inches in the eastern or coastal part.

These average annual rainfalls are the lowest of any non-irrigated sugar producing area in the State.

By comparison in the Burdekin Delta, where average annual rainfall is similar to Bundaberg, complete irrigation of sugar cane has been considered essential for many years, and for the 5 year period, 1959 to 1963, average sugar yields in the Delta were 39% and 48% greater than the Mossman-Ingham and Bundaberg Regions, respectively.

The problem of overall inadequacy of average rainfall is aggravated in the Bundaberg Region by :

(a) relatively poor distribution throughout the growing season; and

(b) the high variability of annual rainfall from average and the uneven occurrence of below average years interspersed with periods of more favourable conditions.

High deficiencies in the important growing months, September to January, substantially affect the crops ability to achieve maximum growth during February and March.

The occurrence of two or more successive years of below average rainfall for the three centres is summarised as follows for the 70 year period, 1898-1968.

Bundaberg: Average occurrence once in 5.8 years with an average continuous duration of 3 years. Worst period 1899-1924, 19 out of 25 years below average with one period of 6 and one of 4 years.

Childers: Average occurrence once in 6.4 years with an average continuous duration of 2.8 years. Worst period 1898-1920, 16 in 21 years below average, with one period of 7 years.

Gin Gin: Average occurrence once in 5.8 years with an average continuous duration of 2.8 years. Worst periods 1899-1904, five successive years below average, and 1930-1946 with 12 in the 16 years below average.

Although future rainfall conditions cannot be predicted, a recurrence of the periods 1899-1924 at Bundaberg, 1898-1920 at Childers, and 1899-1904 and 1930-1946 at Gin Gin must be expected.

EXISTING IRRIGATION DEVELOPMENT AND SUPPLIES:

The hazards of sugar cane production under normal rainfall conditions have resulted in farmers using irrigation wherever possible and as a result the irrigated area in the Region has increased from 18,000 acres to some 47,000 acres in the last eight years.

However, limitations in both surface and underground supplies do not permit full irrigation of much of the areas. This leaves some 80,000 acres of assignments with no access to irrigation supplies at present.

Surface Water Supplies:

The area authorised to be irrigated from streams within the Region is 12,906 acres involving 286 pumps.

Bingera Weir, on the Burnett River, owned by Bingera Plantation, is the only storage on any of the streams in the Region. The weir has a capacity of 4,000 acre feet and supplies water to the Bingera Plantation and some adjoining properties.

Analysis of stream flow records on the Burnett River between 1909 and 1967 shows that flows would have been inadequate to serve the present licensed area for a considerable portion of time. This would result in little water reaching Bingera during any prolonged period of low flow, thus creating shortages of supply even with the weir storage.

For this reason it has been arranged to provide an assured flow of 5,000 acre feet per annum to the Lower Burnett area from Wuruma Dam, recently constructed in the Upper Burnett catchment.

While this will allow current licensed irrigation requirements to be met, it will not be sufficient to meet any increased demands for irrigation water. Furthermore, this supply can be utilised in the Upper Burnett area if an alternative supply can be provided in the Lower Burnett.

With the exception of the Elliott River, where stream flow is sufficient to maintain existing irrigation demand, all the other streams on which licenses have been issued suffer from periods of spasmodic and no flow and do not therefore provide a reliable source of irrigation water.

Underground Water Supplies:

Since 1960 the land irrigated from underground sources has increased from some 14,000 to 35,000 acres. The bulk of this irrigated land is to the east of the North Coast railway line in the Fairymead (Kolan Section), Millaquin and Qunaba (Burnett Section) Mill areas where, until recently, underground supplies have been adequate for irrigation purposes.

With the increased area under irrigation, the rate of extraction from these areas has increased to such an extent that it now exceeds the rate of natural replenishment. As a consequence there has been a general decline in the water table level and a reduction in the amount of water stored in the underground reservoir.

Supplies are now inadequate to meet the demand in many areas and salt water intrusions into the fresh water aquifer have commenced.

Intensive investigations by the Irrigation Commission on the possibility of artificially recharging the aquifer by water diverted from the Kolan and Burnett Rivers have proved to be impractical.

The only practical solution is to provide a proportion of the area at present dependent on underground supplies with a surface irrigation supply and so relieve the demand on the underground basin. In this way the remaining portion of the area would have an assured supply of underground water from the basin, the yield of which would be maintained permanently by the natural recharge rate.

Any surface water conservation project must therefore provide for this supply of irrigation water to the appropriate proportion of the area now using underground supplies.

CITY OF BUNDABERG WATER SUPPLIES:

The City of Bundaberg obtains its water at present from underground sources, mainly on the south side of the Burnett River.

During 1964 and 1965 there was considerable difficulty in maintaining a satisfactory supply from this source due to the fall in the water table level. This fall was a result of the high demand for irrigation water in the area east of the North Coast railway and the lack of replenishment to withstand this demand.

It is estimated that the present safe yield from the area supplying the City may only be 4,000 acre feet per annum, but even this would be in jeopardy should the continued high rate of pumping result in further lowering of the ground water table.

With the increasing demand for domestic and industrial supplies to the City, it is imperative that the present supply be supplemented from surface water sources.

PART 3 – DROUGHT EFFECTS, IRRIGATION AND OTHER WATER REQUIREMENTS

DROUGHT EFFECTS:

Sugar Production and Shortfalls on Mill Peaks 1929-1968:

In the sugar industry because of the limitations imposed on production by the institution of mill peaks and because cane is a semi-perennial crop, this threat of drought is more positive due to the fact that if peaks are rigidly adhered to it is not possible as with annual uncontrolled crops to plan high production in good years in order to cover losses in poor years.

In practice over the last 40 years the industry has accepted over-peak production from the Bundaberg mills in 117 mill years as against 121 mill years of under-peak production. Despite this almost equal distribution of over and under-peak production the average annual production deficit below peak over all mills for the 40 years has been 6.5% and for the Isis and Gin Gin mills the deficit has been 18% over the period.

By contrast in the last decade, which has seen an upsurge in irrigation development, an average annual production of 4.7% over peak has been recorded for the Bundaberg mills despite the occurrence of the severe 1964-65 drought. In this decade the two mills with limited irrigation development showed an average annual production deficit of 3.7% below peaks compared with a surplus of 8.6% for the remaining four mills.

It is clear that guaranteed production resulting from an assured supply of irrigation water would have a valuable stabilising effect on the sugar industry in the Region. Irrigation will enable all mills to reach peak in all but the catastrophic drought years and would enable them to secure over peak production in certain years as at present in order to balance deficits in other areas and thus maintain export earnings.

Hence though the following assessment of drought effects may appear to overstate the losses because no allowance is made for over peak production this in fact is not the case because of the points made in the preceding paragraph.

The average annual shortfalls for the six mills over the 40 year period, 1929-1968 are: Gin Gin 24.3%, Bingera 11.4%, Fairymead 9.8%, Qunaba 13.9%, Millaquin 8.2%, and Isis 24.8%.

In the Fairymead, Millaquin and Qunaba areas, shortfalls have been less frequent and smaller in volume and percentage of peak in the last 10 years than the preceding 30, thus reducing the long term average. This is largely the result of irrigation undertaken in these areas during the last ten years.

If over-peak production is also taken into consideration these three mills have averaged 11.1% in excess of peaks annually over the last decade. The value of irrigation and improved technology is shown by the fact that these mills averaged 2.4% below peaks in the 1949-58 decade, 0.4% below peaks in the 1939-48 decade, and 10.8% below peaks in the 1929-38 decade.

However, irrigation in these areas is almost entirely from underground water supplies, which cannot sustain the current rate of use. Under these circumstances, frequent shortages of supply must occur and in the absence of corrective action intrusion of salt water into the aquifer is expected. In the long term the average shortfalls is considered to provide a reasonable indication of future conditions in absence of an irrigation scheme.

The following sets out these average annual shortfalls applied to present peaks and evaluates these at a price of $89 per ton of sugar.

TABLE 3 – II

AVERAGE ANNUAL SHORTFALLS APPLIED TO PRESENT PEAKS

Mill	Average Annual Shortfalls %	Average Shortfalls Applied to Present Peaks (tons)	Annual Shortfalls Approximate Value of Average ($)
Gin Gin	24.3	7,800	694,000
Bingera	11.4	8,150	725,000
Fairymead	9.8	6,500	579,000
Qunaba	13.9	4,450	396,000
Millaquin	8.2	5,650	503,000
Isis	24.8	17,250	1,535,000
TOTALS		49,800	4,432,000

The value of the shortfalls for the two successive years 1964-65 at the respective average prices received reached the staggering total of $18,776,000, about 40% of the capital cost of Stage I development of the proposed irrigation project.

OVERALL DROUGHT EFFECTS:

Direct Losses:

The following evaluation of average annual drought losses is obtained:

Region Sugar Production Loss	$4,432,000
Increased Milling Costs	1,033,000
Loss of Road Transport Fees	31,800
Loss of Harbour Dues	64,700
TOTAL	$5,561,000

Secondary Effects:

Loss of production on farms has a very direct effect on other activities in or directly related to the sugar industry throughout the district.

In terms of gross value of production the sugar industry requires a higher labour force for harvesting and processing at area level than most other primary industries. Consequently, any decline in productivity as a result of drought can have severe social and economic consequences in the Region.

While these cannot be evaluated precisely in economic terms, the local effect of an average annual production loss of $4,432,000 and a loss of $18,776,000 during the 1964-65 drought is obviously high.

It has been estimated (A.N.Z. Bank) that the direct loss in wages by some 3,200 employees on farms and in mills, during the 1965 harvest season, amounted to some $3 million.

NEED FOR ASSURING AND EXTENDING IRRIGATION:

Essential Requirements:

The Region, with capital investment exceeding $120 million in the sugar industry, cannot continue to be dependent on the vagaries of rainfall for its most important industry.

The provision of an assured irrigation supply is essential to —

(a) Overcome the frequent shortfalls in mill peaks and ensure a consistent supply of sugar to markets at home and abroad.

(b) Provide growers with the means for more intensive production per acre, stable levels of income and the means to achieve lower average costs of production essential with the increased proportion of overall production for export.

(c) The full and efficient utilisation of mill facilities by maintaining mill peaks and thus ensuring low costs of production.

(d) Improve the efficiency and operation of transport and bulk handling facilities by the guaranteed supplies from irrigated lands.

(e) Prevent widespread failure of farmers, mills and local businesses that would occur with a recurrence of the 1899-1905 period of up to five or six successive years of below average rainfall.

(f) Avoid the need for assistance by State and Federal Governments in the form of drought relief.

STAGE DEVELOPMENT FOR PRESENT AND FUTURE PRODUCTION:

It would be shortsighted to provide works aimed at production of present peaks. Provision for present and possible future expanded production has been found possible in two stages of construction and three phases of production as outlined in Part 1.

World sugar consumption is increasing at the rate of some 2.0 million tons annually, and there appears no reason why the increase should not continue at this rate, i.e., some 20 million tons over the next decade. Over the next 10 years Australian consumption alone is likely to increase by some 100,000 tons.

As one of the most efficient sugar producers in the world and currently the third largest exporter, Australia must surely share in supply of increased world requirements. With limited scope for new development in many northern mill areas, provision for expansion in the Bundaberg Region appears reasonable.

BUNDABERG AND CITY WATER SUPPLY:

In Stage I of the scheme, it is proposed to provide the City with 5,000 acre feet per annum, this supply being made available at a proposed tidal barrage at 16.1m on the Burnett River. In Stage II, this amount would be increased to 10,000 acre feet per annum.

On the basis that the City can continue to draw 4,000 acre feet annually from underground supplies, this would cater for normal increase in City demand up to 1981, plus a further allowance of 2,500 acre feet per annum (almost 2 million gallons per day) for additional unforseen industrial supply.

On completion of Stage II, the 1991 requirements for normal expansion could be provided, plus an additional 4,600 acre feet per annum (almost 3.5 million gallons per day) for additional unforseen industrial requirements.

This allowance for Stage II could be reviewed when this stage is undertaken.

If required as an emergency measure, up to 2,500 acre feet per annum could be made available to the City at Bingera Weir from the assured supply that will become available once reasonable inflow occurs into Wuruma Dam.

PART 4 – AGRICULTURAL ASPECTS – BUNDABERG REGION

PRESENT LAND USE:

Bundaberg is the centre for the $32 million (1968 gross value) sugar industry based on sugar assignments located on farms within the Shires of Gooburrum, Kolan, Woongarra, Isis, Biggenden and Miriam Vale. Sugar cane is supplied to six mills located at Gin Gin, Bingera, Fairymead, Qunaba, Millaquin and Isis. These activities account for over 95% of the district income derived from agricultural production.

Other forms of agricultural production in the Bundaberg Region include tobacco growing, vegetable and fruit cropping. Such crops also rely on irrigation for their continued prosperity.

The estimated gross values for crops produced, and the acreages devoted to each of these crops in 1968 are summarised in Table 4 – I.

TABLE 4 – I – REGIONAL AGRICULTURAL PRODUCTION

Cropping Activity	Area (acres)	Estimated Gross Value of Production ($)
Sugar Cane (harvested)	90,940	32,619,000
Tobacco	825	825,000
Fresh Beans and Other Vegetables	900	441,000
Fruit Crops	380	171,000
TOTALS	93,045	34,056,000

The tobacco and vegetable growing industries are located principally in the Bundaberg, Clayton and Elliott River area where suitable soils to the extent of about 5,000 acres are available for either form of production. However, the tobacco industry is subject to quota restrictions, while any marked expansion of vegetable production for snap freezing awaits the setting up of suitable facilities at Bundaberg for processing the truck crops.

The beef and dairying industries offer little opportunity for irrigation development under the conditions, including the cost of water, likely to apply in the proposed irrigation area.

CANE VARIETIES:

Kolan Section – Varieties:

N.Co. 310 is the major variety of the district, and constitutes the principal crop favoured by irrigators.

Most other varieties produce less than 10 per cent of the total crop for any mill area in any year. An exception is Q.50 in the Bingera area which produced 20.8 per cent of the crop in 1964. However, this is largely dry land production. Varieties grown to a minor extent under irrigation are Q.47, Q.50, Q.61, Q.70, Q.71, and more recently Q.68 and H.48-3166. The production of Q.71 and Q.68 may increase but the proportion of the other varieties is expected to remain static or fall.

N.Co.310 and Q.71 have a relatively high sugar content, consequently potential sugar yield per acre for these varieties will be somewhat higher. N.Co.310 has proved an all-purpose cane and is harvested extensively throughout most of the season. On the other hand Q.71 has proved most satisfactory as an early season cane and its use is generally more restricted. The other varieties mentioned are mid-season to late-maturing varieties.

Burnett Section – Varieties:

The Isis mill area is largely non-irrigated, with the result that varieties such as C.P.29-116, Q.69 and Q.72 have been retained on non-irrigation farms solely because of their drought tolerance. None of these varieties approach N.Co.310 or Pindar in sugar content, but they are excellent varieties for coping with harsh, dry conditions. This fact in itself is ample evidence of the disadvantage which controls the economic level of production at Isis and it seems that irrigation on a large scale is necessary to overcome this disadvantage.

N.Co.310 retains its position as a major irrigation variety in the Millaquin and Qunaba district. This cane has become recognised as a variety with a high early sugar content and is well adapted to the red volcanic soils in the Woongarra district.

AGRONOMIC CONSIDERATIONS:

Field observations indicate that certain agronomic advantages may be gained from irrigation practices in frost-prone areas.

Adequate irrigation in the early summer months will promote rapid cane growth, with the result that tall stalks with a heavy canopy are present in May. This heavy canopy of leaves 6 feet or more above ground level will retard the movement of cool air along air drainage lines. In addition, the dead trash which clings to the stalks in a well grown crop affords some measure of protection to the "eyes" or nodal shoots.

The cane harvesting programme in a mill area can be adjusted by the Chief Cane Inspector to provide for early harvest of cane grown in frost-prone areas. This arrangement is more practicable when a heavy crop (with high C.C.S. promoted by irrigation in early summer) is available for harvest.

WATER USE AND RESPONSE TO IRRIGATION:

MEASURED WATER USE:

Having regard to limitations of supply in the Bundaberg area, measurements indicate a need for some 2 acre feet per acre in the drier years and an overall average of 1.5 acre feet per acre.

Yields from irrigated sugar cane are at present well below the maximum possible yields. It is apparent that provided factors such as soil nutrients, temperature, etc., are not limiting, this crop can utilise relatively large amounts of water and achieve proportionate yield responses.

RESPONSE TO IRRIGATION:

In the absence of data concerning the response of sugar cane to various quantities of applied water it has been necessary to derive these relationships from water use models established by Fitzpatrick.

A response of 1.9 tons per acre has been taken for all mill areas unless special factors are operating. Water use studies for the Gin Gin mill area indicate an average response of 1.5 tons. For the Gin Gin areas in the Kolan Section the response has been taken at 1.4 tons and for the more favoured areas in the Burnett Section the response has been taken as 1.9 tons maintaining the mill area average at 1.5 tons.

For Fairymead soils with poor internal and surface drainage, a lower response of 1.6 tons per acre has been adopted.

IRRIGATED YIELDS:

Yields with full irrigation are obtained by adding the response to irrigation to the average dryland yield for each mill area.

Dryland and irrigated yields and responses to irrigation for each mill area are as follows:

TABLE 4 – VI

RESPONSES TO IRRIGATION

Mill Area	Tons Sugar Per Acre		
	Average Dryland Yield	Full Irrigated Yield	Response to Irrigation
KOLAN SECTION			
Gin Gin	2.5	3.9	1.4
Bingera	3.1	5.0	1.9
Fairymead	3.1	4.7	1.6
BURNETT SECTION			
Millaquin	3.7	5.6	1.9
Qunaba	3.9	5.8	1.9
Isis	3.1	5.0	1.9
Bingera	3.1	5.0	1.9
Gin Gin	2.8	4.7	1.9

PART 5 – UNDERGROUND WATER SUPPLIES

EXTENT OF INVESTIGATIONS:

This section outlines the investigation of underground water supplies in the Bundaberg area, between the Kolan and Elliott Rivers.

The area covered comprises most of the Fairymead mill area in the Kolan Section and the Qunaba and Millaquin mill areas in the Burnett Section of the Region.

It does not include some underground supplies adjacent to the Gregory River in the Farnsfield (Isis mill) area from which some 800 acres are irrigated.

The rapid increase in irrigation areas and indications of substantial falls in water levels in 1960-61 and again subsequent to 1963 indicated the need to ascertain the safe available yield for the basin. The continued fall in water levels from early 1963 until the end of 1966 combined with evidence of salt water intrusion has indicated also the need to examine the possibilities of artificial recharge.

Since 1964 the investigations have been intensified.

EXTENT AND DEVELOPMENT OF PRESENT USE:

Irrigation:

Use of groundwater for irrigation of sugar cane has increased rapidly over the past eight years to a total of 35,000 acres.

Gross assigned areas for the three sugar mills are given as a total of some 54,900 acres. Thus about 65% of the gross assigned area is irrigated from groundwater supplies.

Annual use of water for irrigation purposes appears to be in the range of 1.5 to 2 feet of water per acre irrigated and the present annual irrigation use is therefore in the range of 52,000 acre feet to 70,000 acre feet.

Recent information obtained from mills in the area indicates that this water is pumped from some 900 bores with a combined output of 900 cusecs, or 20 million gallons per hour.

City of Bundaberg, Sugar Mills, Etc.:

Other annual demands for water include the Bundaberg City which currently uses approximately 3,300 acre feet and the Millaquin, Qunaba and Fairymead sugar mills which have an estimated combined use of some 2,000 acre feet.

NATURE, EXTENT AND BEHAVIOUR OF AQUIFER SYSTEM:

Source of Natural Recharge:

Before any development of the groundwater supplies took place the natural recharge entering the aquifer maintained a gradient of fresh water towards the coast sufficient to exclude the salt water. The process of natural recharge can be understood from an examination of— (a) groundwater levels; (b) river levels; (c) rainfall records.

At present water level measurements are taken at two monthly intervals in some 240 bores throughout the district, and during periods of significant rainfall measurements are taken every few days in selected key bores in the area. From each set of water level measurements a contour map of groundwater levels for the district is produced.

These contours show that the groundwater flow is directed towards the coast and also to the major drainage lines in the area, the Burnett, Elliott and Kolan Rivers, and Splitters and Yellow Waterholes Creeks. This situation, along with the fact that the Burnett and Kolan Rivers are tidal (and therefore normally salty) throughout the area of groundwater supplies shows that these two streams do not contribute fresh water to the underground beds under normal flow conditions.

Furthermore, contours of the base of the Elliott formation show that it is only in the lower fifteen miles of the Burnett River and five miles of the Kolan River where this base is below sea level. Under flood conditions when water level in these rivers might be perhaps 10 feet to 20 feet above sea level, the contribution, if any, must be small because of the short length of river in which the water level would be higher than that in the adjoining aquifer and the brief period for which these conditions occur.

Therefore, there is no doubt that local rainfall is the source of natural recharge for the area.

Water Level Behaviour:

The analysis of observations show that rises in water levels do not generally occur unless rainfall occurs in concentrations of approximately 6 inches or more per month.

When plotted on a plan of the area, the values of rise in water level for a certain rainfall adopt a definite pattern which shows that rises in water levels increase with distance from the coast. This is to be expected in a coastal basin which drains into the sea.

The examination has also revealed that the high rainfalls which were recorded at Bundaberg in January, 1967 (18.74 inches), June, 1967 (19.66 inches), January, 1968 (26.80 inches), and February, 1968 (7.73 inches) did not produce the magnitude of rise in water level that might have been expected from the previous behaviour in the period June, 1957, to March, 1968. The reason for this is probably a combination of the following factors —

(a) The comparatively long period of three years 10 months prior to January, 1967, in which no monthly rainfall greater than 5.56 inches was recorded at Bundaberg;

(b) The very low levels of the water table occurring throughout the area in December, 1966.

Need For Artificial Recharge:

An analysis conducted on the Kolan Section indicates that the "recharge rainfall" per month is the total rainfall in excess of 5.60 inches.

It can be seen that the recharge rainfall over the climatic years 1967 and 1968 is the fourth highest for any two year period since the turn of the century. However, water levels are lower now than at any time from the commencement of measurements in June, 1957, until mid 1964. No two year period from 1957 to 1964 has had as much rainfall as the years 1967 and 1968.

While it is evident that the rainfall for the three year period 1964-66 is perhaps the worst on record as far as recharge is concerned, it does not seem that the low water levels occurring towards the end of 1968 can be explained in terms of rainfall alone. It is considered that the low water levels which existed in 1967 and 1968 were caused by the high irrigation demand which existed during these years and that this demand is far in excess of the amount which can be replenished by natural recharge. It must be concluded therefore that water levels in the future will not be as responsive to rainfall as they were during the period 1957-1963 and that under the present low values of water level in the basin will not substantially improve.

From the above, it is apparent that a serious overdraft situation has developed in the area. Because of the very large volume of underground water held in storage in the sands and gravels, the most serious effects of such an overdraft situation do not evidence themselves immediately. The first sign is a reduction of water levels to below sea level in the lower areas, but if this is allowed to continue, contamination of the vast reservoir of water below sea level by movement of sea water into the water bearing horizons results. This is a most serious occurrence.

The value of safe yield for the Kolan Section is stated in the Kolan Report as being approximately 20,000 acre feet per year and based on similar behaviour in the Burnett Section under similar conditions, a safe yield of 20,000 acre feet per annum has been adopted for this area also.

Annual Use and Deficiency:

Based on an irrigation rate of 2 feet per year on areas of 18,000 acres in the Kolan Section and 20,000 acres in the Burnett Section together with an existing City and sugar mill usage of some 5,000 acre feet, the total water requirements for the two areas become: Kolan Section 36,000 acre feet; Burnett Section 45,000 acre feet.

Adopting a safe yield of 20,000 acre feet for both the Kolan and Burnett Sections, the annual supplementary water requirements for the areas for the existing level of use become: Kolan Section 16,000 acre feet; Burnett Section 25,000 acre feet.

ARTIFICIAL RECHARGE INVESTIGATIONS:

CONCLUSIONS:

Spreading Methods:

Results of the 17 spreading trials conducted on both the Kolan and Burnett Sections indicate that an overall infiltration rate of approximately ½" per day could be expected from large scale recharge by surface spreading.

In the Kolan Section an annual requirement of 16,000 acre feet could be supplied at a rate of 30 cusecs for 267 days of the year. Even allowing for absorption on a long term basis of some five cusecs in Sandy Creek and an absorption rate of five cusecs in the Waimea area, the total area required to absorb the remaining 20 cusecs at a rate of ½" per day is 1,000 acres. Because of the turbid nature and bacterial content of the recharge water, the operational area of such a scheme would need to be at least double this to allow spelling and cleaning in alternate bays. Cost of resumption of land for this purpose, together with an evaporation loss of some 5,000 acre feet per year would make this scheme economically impracticable.

The annual requirements for artificial recharge for the Burnett Section are 25,000 acre feet per year and for the same reasons as given previously for the Kolan Section, recharge by spreading is not economically feasible in this area.

Injection Methods:

The trials indicated that there would be serious long term difficulties associated with the operation of injection wells and there is very little evidence of them having been used anywhere in the world without considerable operation and maintenance costs. The most important factor is the need for a high quality recharge water and this would involve provision of a treatment works to filter and chlorinate any water supply used for recharge by injection methods.

It is estimated that a minimum of 130 injection bores each capable of operating at the high rate of 10,000 g.p.h. would be necessary to maintain a replenishment of 25,000 acre feet per annum in the Burnett Section. This estimate makes allowance for 30 standby bores to enable injection to proceed continuously while a number of bores are withdrawn from service for cleaning and reconditioning. The cost of these bores excluding distribution works is estimated to be $400,000.

The cost of reconditioning injection bores is estimated to be $65,000 per annum. In addition, it is estimated that the construction of treatment works necessary to purify the water to a standard suitable for injection would cost $1,200,000. The operation and maintenance costs of this plant, excluding debt service charges, would be some $50,000 per year which together with reconditioning of bores would amount to over $4 per acre foot of water injected, without costs of actual supply and distribution.

As excessive increases in water level would reduce the efficiency of injection bores, it is necessary that they should not be at a closer spacing than one half mile. Thus the area covered by the injection bore network would be more than 30 square miles or 19,200 acres – about 63% of the gross assigned area within the area of availability of groundwater supplies.

To supply and maintain the quality of the injection water a completely piped distribution system would be necessary to convey water from the treatment plant to the individual injection bores.

In addition it would be necessary to provide storage on the Burnett River and convey supply to the treatment plant.

From the above, it is obviously cheaper and simpler to supply surface water for irrigation direct to an appropriate area of the lands now using groundwater than to undertake artificial recharge by injection bores.

The above applies similarly to the Kolan area.

PROPOSED ARRANGEMENTS TO OVERCOME SHORTAGES:

Kolan Section:

In this area the safe yield of the underground basin would provide irrigation for 10,000 acres of cane with an annual irrigation rate of 2 feet per acre.

Assuming that within the area of available groundwater supplies the actual area irrigated is 80% of the gross assigned area then the safe yield of the basin should be capable of providing irrigation for a gross assigned area of 12,500 acres. The total gross assigned area east and south of the Moore Park road and within the area of available supplies is approximately 12,500 acres and the groundwater basin should be capable of supplying irrigation for this area as well as supplies to the Fairymead mill.

It is therefore proposed that all lands west and north of the Moore Park road be provided with irrigation from surface supplies. Following provision of such supplies, no use of groundwater supplies in this area would be permitted except for domestic and stock purposes.

All of the area east and south of the Moore Park road would be permitted to continue use of groundwater supplies to a maximum extent of 2 acre feet per acre on up to 80 per cent of gross assigned areas, or two acre feet per acre for areas actually irrigated for crops other than sugar cane.

Burnett Section:

With the same value of safe yield of 20,000 acre feet for this section a gross assigned area of 12,500 acres could be irrigated from groundwater supplies.

Use of groundwater supplies would be limited to 2 acre feet per acre on 80 per cent of the total gross assigned area of cane farms or areas actually irrigated of other crops.

This area is broadly the high lands on and around the Hummock which could not be readily commanded by gravity from the Woongarra main channel system, and along the coastal strip from Burnett Heads to Elliott Heads.

The objective of serving with surface supplies the strip of lands along the right bank of the Burnett River between Bundaberg and Burnett Heads is to reduce extraction of groundwater from this area adjacent to salt water and so minimise the potential of salt water intrusion.

It is further proposed that the City of Bundaberg continue to draw supplies up to 4,000 acre feet per annum from underground supplies.

It is proposed that all assigned lands around this area be provided with irrigation from surface supplies. Following provision of such supplies no use of groundwater supplies would be permitted except for domestic and stock requirements.

The City of Bundaberg would obtain supply in excess of 4000 acre feet per annum from surface supplies. This could be obtained immediately from Bingera Weir supplemented from Wuruma Dam or from the Bundaberg Tidal Barrage when it is built.

PART 6.—AREA TO BE SUPPLIED AND WATER REQUIREMENTS

AREA TO BE SUPPLIED AND WATER REQUIREMENTS:

As a small proportion of the current assigned lands is classified as unsuitable for irrigation, these will be considered further if it is decided to proceed with the scheme. In such case, consideration should be given to means of encouraging and facilitating transfer of assignments on unsuitable lands to suitable unassigned lands within the general project area.

In considering the areas to be supplied, as has been pointed out in Part 5, a proportion of the areas east of the North Coast Railway now using underground supplies would be provided with surface irrigation water supplies, the remainder continuing to obtain their supplies from the underground aquifer. This remaining portion is of such an area as, it is considered, could receive a satisfactory supply from the natural yield of the underground basin.

In addition some 1,200 acres now licensed to obtain supply from the Elliott River would continue to obtain supply from this source.

Existing Assigned Areas to be Served — Stage I:

The table below sets out the mill areas, the assignments to be served under Stage I of the scheme, the methods of supply and the sugar peaks.

TABLE 6 – 1 — BUNDABERG REGION

CURRENT ASSIGNED AREAS TO BE SERVED AND FARM PEAKS – STAGE I

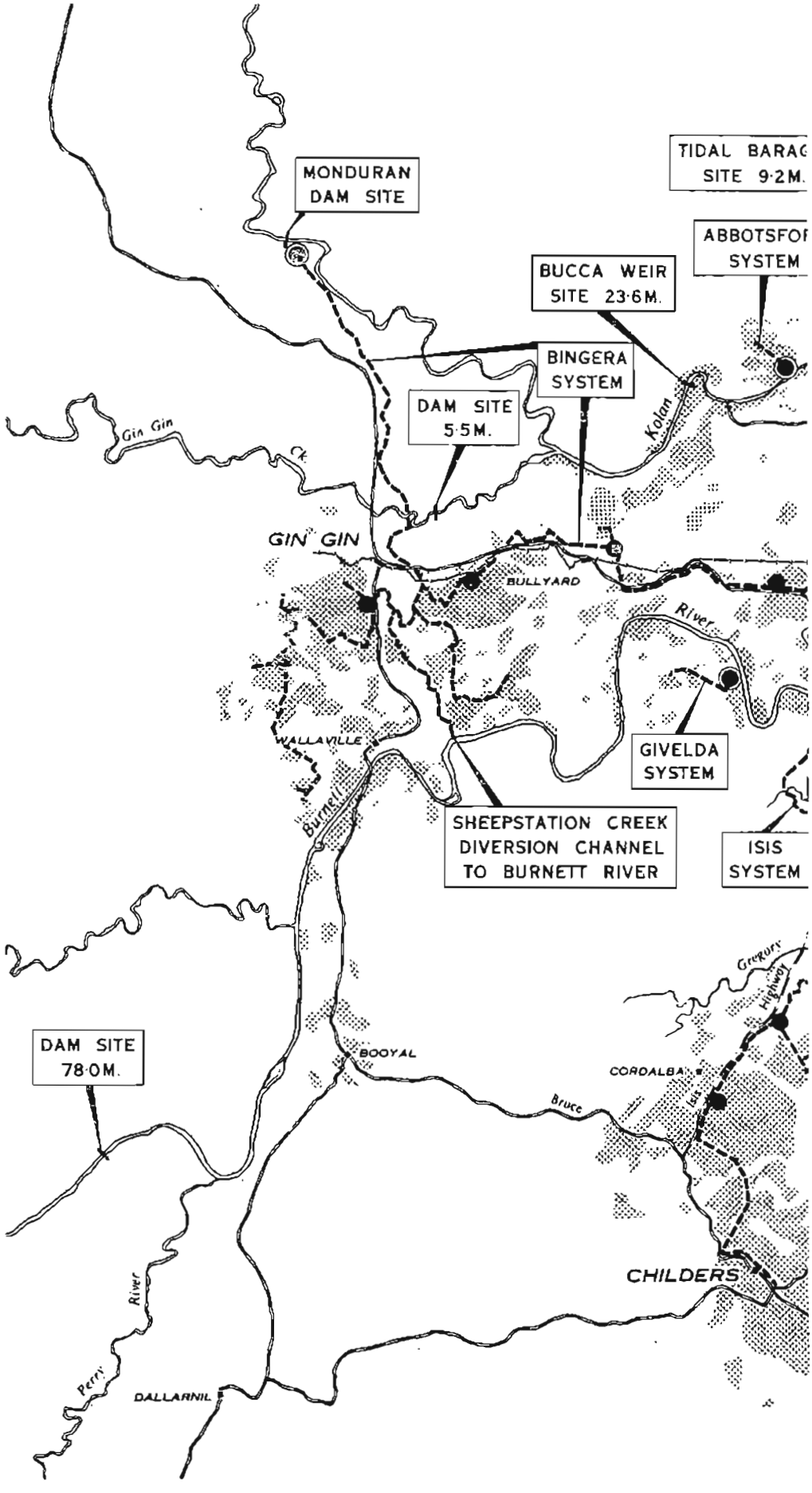
Method of Supply	Mill Area	No. of Assignments	Assigned Areas (acres)	Sugar Peaks (tons)
KOLAN SECTION:				
Pumping from Kolan River –				
(a) Private Pumping	Bingera	51	2,952	8,988
	Fairymead	5	386	703
(b) Community Scheme	Bingera	9	696	1,783
Channel Systems –				
(a) Bingera	Gin Gin	156	13,135	22,000
	Bingera	157	14,017	40,649
	Fairymead	12	787	2,470
(b) Gooburrum	Fairymead	87	7,260	20,640
TOTALS – KOLAN SECTION:	Gin Gin	156	13,135	22,000
	Bingera	217	17,665	51,420
	Fairymead	104	8,433	23,813
	All Areas	477	39,233	97,233
BURNETT SECTION:				
Pumping from Burnett River –				
(a) Private Pumping	Gin Gin	59	4,764	8,000
	Bingera	50	3,116	8,520
	Isis	25	1,700	4,200
	Millaquin	10	669	1,906
(b) Community Scheme	Bingera	15	600	1,680
Channel Systems –				
(a) Woongarra	Millaquin	247	14,361	45,094
	Qunaba	46	2,900	9,600
(b) Isis	Isis	252	26,090	64,400
TOTALS – BURNETT SECTION:	Gin Gin	59	4,764	8,000
	Bingera	65	3,716	10,200
	Millaquin	257	15,030	47,000
	Qunaba	46	2,900	9,600
	Isis	277	27,790	68,600
	All Areas	704	54,200	143,400
TOTAL – BUNDABERG REGION:		1,181	93,433	240,633

Existing and Future Assigned Areas to be Served – Stage II:

The following Table 6 – II below indicates the methods of supply to present assigned areas, possible increases in assigned area and possible future gross assignments which would be served by the Scheme in Stage II.

IRRIGATION PROJECT
BUNDABERG/CHILDERS

General Layout


MONDURAN DAM SITE
TIDAL BARAG SITE 9·2M.
ABBOTSFOR SYSTEM
BUCCA WEIR SITE 23·6M.
BINGERA SYSTEM
DAM SITE 5·5M.
Kolan
Gin Gin Ck
GIN GIN
BULLYARD
River
GIVELDA SYSTEM
WALLAVILLE
Burnett
SHEEPSTATION CREEK DIVERSION CHANNEL TO BURNETT RIVER
ISIS SYSTEM
Gregory
Highway
DAM SITE 78·0M.
BOOYAL
CORDALBA
Bruce
Hwy
CHILDERS
Perry River
DALLARNIL

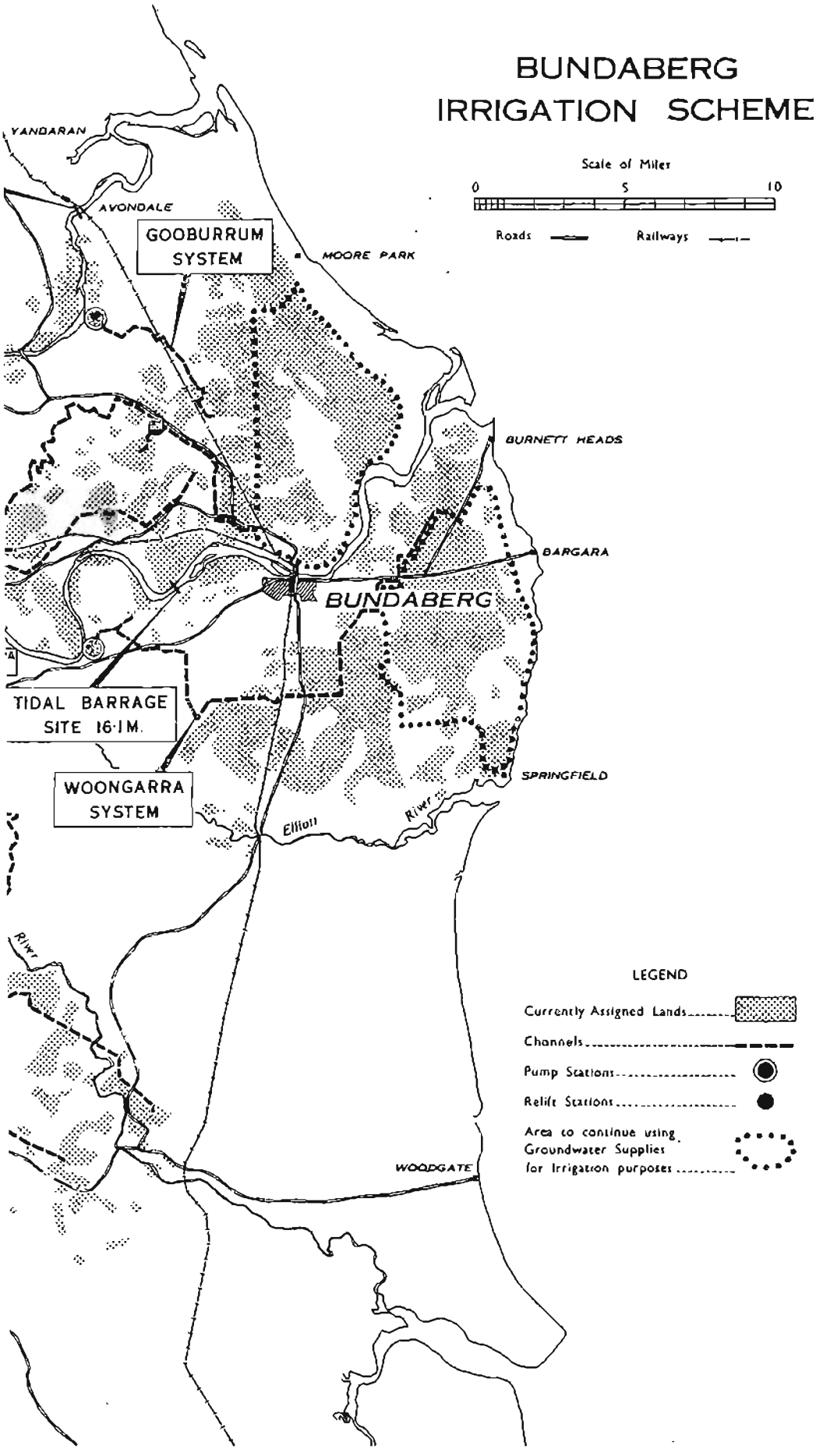

BUNDABERG
IRRIGATION SCHEME
Scale of Miles
0
5
10
Roads
Railways
YANDARAN
AVONDALE
GOOBURRUM SYSTEM
MOORE PARK
BURNETT HEADS
BARGARA
BUNDABERG
TIDAL BARRAGE SITE 16·1M.
WOONGARRA SYSTEM
SPRINGFIELD
Elliott River
River
WOODGATE
LEGEND
Currently Assigned Lands
Channels
Pump Stations
Relift Stations
Area to continue using Groundwater Supplies for Irrigation purposes

TABLE 6 – II — BUNDABERG REGION

PRESENT AND POSSIBLE FUTURE GROSS ASSIGNMENTS – STAGE II

Method of Supply	Present Assigned Areas (acres)	Possible Increases in Assigned Areas (acres)	Possible Future Gross Assignments (acres)
KOLAN SECTION:			
Pumping from Kolan River	4,034	3,220	7,254
Channel Systems	35,199	12,520	47,719
TOTALS:	39,233	15,740	54,973
BURNETT SECTION:			
Pumping from Burnett River	10,849	43,926	14,775
Channel Systems	43,351	13,274	56,625
TOTALS:	54,200	17,200	71,400

PART 7.—STORAGES

DESIRABILITY OF USE OF BOTH BURNETT AND KOLAN RIVERS:

Investigations have indicated desirability of conservation and utilisation of water from both the Burnett and Kolan Rivers to provide supply to the Bundaberg Region.

COMBINED OPERATION OF MONDURAN DAM AND BUCCA WEIR:

The Monduran Dam site is 47.5m. on the Kolan River, some 11 miles north west of Gin Gin.

Detailed estimates of costs as at February, 1969, for the dam and associated works, excluding pumping station and rising mains, amount to $8,000,000.

The Bucca Weir site is 23.6m. on the Kolan River, approximately two miles upstream of the Bucca Crossing.

Estimated cost of the structure as at February, 1969, is $1,500,000. The storage capacity is 16,700 acre feet.

Provision of the two storages and operation as a combined system would give some increases in the available yield because Bucca Weir would conserve a part of the unregulated flow from the catchment below the dam, and also part of any excess overflow or releases from the dam, thus making better use of these flows.

While the bulk of the yield from Monduran would be pumped into a main channel system serving the area between the Kolan and Burnett Rivers, a proportion would require to be released downstream to supplement downstream inflow to provide the necessary supply along the river.

The weir would therefore also act as a balancing reservoir and regulate the releases from the dam and the downstream inflows.

The annual yield of the system incorporating both Monduran Dam and Bucca Weir of 120,000 acre feet (95,000 acre feet to channel system and 25,000 acre feet along the river) would:

(a) Provide some 38,000 acre feet above the requirements of 81,650 acre feet for Stage I(b) development on the Kolan Section; and

(b) Virtually meet full requirements of Stage II development of the Kolan Section, viz., 121,050 acre feet.

The surplus available for Stage I(b) development of the Kolan Section and the relatively low cost of the Monduran Dam has formed the basis for proposal for Stage I(b) development of both the Kolan and Burnett Sections, i.e., the complete Bundaberg scheme using Monduran Dam as the only major storage.

The above yields are determined on the basis that at least 61.5% of the normal annual supply would be available during the critical period of river flows 1963-1967 and the critical drought 1899-1905.

KOLAN TIDAL BARRAGE 9.2m. - KOLAN RIVER:

This storage would have a gross capacity of some 4,000 acre feet, of which some 3,500 acre feet would be above mean sea level. The preliminary estimate of cost of this structure is $500,000.

It is proposed that the storage should not be drawn down below mean sea level to avoid the possibility of salt water pollution by seepage around the structure.

The net storage available would not significantly increase the supply available from Monduran Dam and Bucca Weir for Stage I or II development, but it would —

(a) act as a salt water barrier and so make available fresh water supplies to a number of farms at present along the upper six miles of the present tidal section of the river; and

(b) act as a balancing reservoir to assist in regulation of flows below the Bucca Weir both for use along the river and supply to the Gooburrum System.

BURNETT RIVER STORAGES:

KALLIWA DAM:

Major Storage Site:

The Snowy Mountains Authority have completed investigations on three major dam sites on the Burnett River —(a) Mingo Crossing dam site 98.5m.; (b) Paradise dam site 81.5m.; (c) Kalliwa dam site 78.0m.

The Kalliwa (78.0m.) site has been adopted as the major storage site on the Burnett River for the Stage II development of the complete Bundaberg Scheme.

Location and Access:

The location of Kalliwa Dam site is in relation to the proposed irrigation areas and the City of Bundaberg some 66 miles upstream. The name, Kalliwa, has been selected from Kalliwa Creek, a tributary joining the Burnett River just upstream of the dam site. The name is of aboriginal origin, meaning appropriately "Inland Sea".

Type of Dam:

The main factors which influenced the choice of the dam were the need to handle large floods during construction and the need to provide a spillway with a large capacity.

Both earth and rockfill, and concrete gravity dams have been considered and the type finally selected is a composite dam consisting of a mass concrete gravity section with 37 feet high spillway gates, with an adjoining earth and rockfill embankment on the right abutment. This type of structure minimises the problem of handling floods during construction and providing the necessary spillway capacity of 1,000,000 cusecs.

The main spillway would be supplemented by a secondary plug spillway through the saddle on the right bank, previously referred to, to provide an additional 500,000 cusecs capacity.

Possible Stage Development – Kalliwa Dam:

Arrangements would permit the construction of the dam in two stages, if required, the first without the spillway gates and the second involving addition of these gates with the necessary ancillary works including piers, operating deck and operating mechanisms.

Storage capacities, annual yields of the dam and estimated costs for the two possible stages are set out below:

KALLIWA DAM – CAPACITIES, YIELDS AND ESTIMATED COST – STAGE DEVELOPMENT

Height Above River Bed to Full Supply Level (feet)	Capacity (ac. ft.)	Yield (ac. ft.)	Estimated Capital Cost Total ($M)	Price Per Acre Foot of Yield ($)
Stage I: 104 (R. L. 191)	150,000	72,000	20.15	280
Stage II: 141 (R. L. 228)	440,000	150,000	24.6	164

BUNDABERG TIDAL BARRAGE, 16.1m. BURNETT RIVER:

Purpose:

Provision of a tidal barrage on the Burnett River as close as possible to the City of Bundaberg is proposed for the following reasons:

(a) Regulation of Inflow below Kalliwa Dam–
Between the Kalliwa Dam site and the proposed barrage site, there is a catchment area of some 980 square miles which yields considerable annual flows in most years.
Combined operation of Kalliwa Dam and the Tidal Barrage would increase the annual yield available from the system by some 12,000 acre feet per annum.

(b) Improvement of distribution efficiency from Kalliwa Dam and use of off peak pumping – The proposed method of supply involves release of water from Kalliwa Dam down the Burnett River for private irrigation direct from the river and to two main pumping stations operating on an off peak (12 hours per day) basis with a total capacity of 1,120 cusecs.
The provision of a substantial balancing storage below the pumping station sites would significantly improve available yield from the system.

(c) Reduction in cost of irrigation works and supply to City of Bundaberg –
The availability of fresh water in the Burnett River downstream to 16.1m (10.4 miles downstream of Bingera Weir) has the following advantages –
(i) permits supply by private pumping to a number of additional river frontage farms, instead of provision of supply from the channel system;
(ii) by permitting siting of the pumping station some 3.1 miles downstream of Bingera Weir reduces capital and operating cost of Woongarra Channel System by an equivalent capital cost of $780,000;
(iii) by permitting siting of the pumping station for Bundaberg City water supply close to the tidal barrage instead of just upstream of Bingera Weir reduces capital and operating cost of works to supply the City by an equivalent capital cost of $1,240,000.

Overall Advantages – Tidal Barrage:

The direct saving resulting from the provision of the Tidal Barrage is summarised as follows:

Equivalent capital cost of saving in Woongarra Channel System	$ 780,000
Equivalent capital cost of saving in works to supply City of Bundaberg	$1,240,000
Saving in capital cost Kalliwa Dam to provide equivalent annual yield in System	220,000
TOTAL	$2,240,000

In addition provision of essential storage to permit off-peak pumping contributes to savings of $152,000 to $874,000 annually with this arrangement.

The provision of the Tidal Barrage as part of the storage system for Stage I development also assists in providing sufficient storage for this stage with deferment of construction of Kalliwa Dam costing at least $20.15 million.

The Tidal Barrage, at an estimated cost of $1,658,000 would thus be amply justified and is proposed as part of the scheme.

Selection of Site:

The site at 16.1 miles just upstream of Tomato Island has been selected at this stage because of the best combination of desirable location and minimum cost.

Reservoir Area:

The barrage would have a total capacity of 26,000 acre feet of which 7,800 acre feet would be below R.L. 0.0 (mean sea level). It is not proposed to draw the storage level below this because of the possibility of seepage of salt water around the structure into the reservoir.

The reservoir would have a surface area of some 2,000 acres at full supply level, and extend some 26 miles up the Burnett River.

COMBINED OPERATION KALLIWA DAM AND BUNDABERG TIDAL BARRAGE:

Available Supply:

The combination of Kalliwa Dam Stage II and the Bundaberg Barrage is required to provide sufficient supply for Stage II of the Burnett Section.

GAYNDAH WEIR, 25.75m. ON BURNETT RIVER:

The yield and estimated cost for this structure are as follows:

Annual assured supply: 5,000 acre feet. Estimated capital cost: Total $1,300,000. Per acre foot of assured supply, $260.

It is proposed that this structure be built as part of Stage I development of the Bundaberg Irrigation Scheme to add to the supply that would be available from Monduran Dam, Bucca Weir on the Kolan River, Wuruma Dam and the tidal barrage on the Burnett River to meet the requirements for Stage I(b) development and to permit deferment of construction of Kalliwa Dam until Stage II development is required.

Following construction of Kalliwa Dam, the Gayndah Weir would then be available for use in the Upper Burnett River to permit full development of lands adjacent to the river in this locality.

ALLOCATION OF SUPPLY FROM WURUMA DAM:

Following construction of Wuruma Dam on the Upper Burnett catchment, which has a capacity of 150,000 acre feet and from which the assured supply along the Upper Burnett River is some 27,000 acre feet per annum, it has been arranged that 5,000 acre feet of this supply be made available to the Lower Burnett River to supplement supplies in this latter area.

Even with this provision, the existing area irrigated along the Upper Burnett some 3,500 acres could be increased to 11,500 acres.

It is proposed that, to provide sufficient water for initial development of Stage I of the Bundaberg scheme, the allocation of water to the Lower Burnett River from Wuruma Dam be increased to 10,000 acre feet per annum.

This would still allow expansion of irrigation in the Upper Burnett from some 3,500 acres to 9,000 acres.

When Stage I development is completed with supplies available from Monduran Dam, the supply from Wuruma Dam to the Lower Burnett River would be reduced to 5000 acre feet per annum.

When Kalliwa Dam is constructed for Stage II development, the whole available supply from Wuruma Dam would revert to utilisation in the Upper Burnett River.

STORAGE, SELECTION AND ARRANGEMENT:

ARRANGEMENT FOR STAGE I DEVELOPMENT:

The arrangement of storage and supply proposed for Stage I development is:

(a) Kolan River: Monduran Dam, Bucca Weir, Kolan Tidal Barrage.

(b) Burnett River: Bundaberg Tidal Barrage, Gayndah Weir, together with allocation of 5000 acre feet per annum regulated flow from Wuruma Dam for use in the Lower Burnett River.

(c) Utilisation of the surplus supply of some 38,000 acre feet from the combination of Monduran Dam and Bucca Weir over requirements for the Kolan section to supplement supplies available in the Burnett River by–

  (i) provision of Stage II pumping station capacity at Monduran Dam, and Stage II capacity for the carrier channel from the Dam to the Gin Gin area, which would give a capacity of some 150 cusecs over Stage I(b) requirements for the Bingera system, for diversion to the Burnett River.

  (ii) provision of this additional channel capacity in the main channel serving the Gin Gin-Wallaville area from Gin Gin to near the head of Sheepstation Creek, a connection from the main channel to Sheepstation Creek, and improvement of this creek channel to carry the 150 cusecs to the Burnett River.

Operation arrangements of this system would be that supplies for the Burnett section would be obtained wholly from Burnett River when flows are sufficient and until the combined storage of Gayndah Weir and the Bundaberg Tidal Barrage is drawn down to some 24,000 acre feet.

Supplies would then be diverted from Monduran Dam into the Burnett River until Burnett River flows again meet full requirements of the Burnett section.

Since this involves some anticipation of Burnett River flows some diversions to the Burnett River would prove to be unnecessary and have been taken into account in the analysis.

INITIAL DEVELOPMENT – STAGE I:

The estimated capital cost of Stage I of the scheme is some $47 million. Completion of the main scheme must therefore be a relatively long term project.

Storage and Supply Arrangement:

Provided that a decision is reached to proceed with the whole Stage I development, some advantage is to be gained by giving priority in development to an initial arrangement as follows:—

Kolan Section:

Construction of Bucca Weir and Kolan Tidal Barrage and supply to all lands along the Kolan River served by these storages.

Construction of the Gooburrum Channel System to provide surface water to any non-irrigated lands and as much as possible of the lands now utilising underground water commanded by the System.

Burnett Section:

Construction of Bundaberg Tidal Barrage, Gayndah Weir and provision of 10,000 acre feet per annum regulated supply from Wuruma Dam (after construction of Monduran Dam, the supply from Wuruma Dam would be reduced to 5,000 acre feet per annum) and supply to all riparian lands along the river below Booyal served by these storages.

Construction of as much as is necessary of the Woongarra Channel System to utilise available supplies for non-irrigated lands and as much as possible of lands now utilising underground water in the Clayton, Alloway and Thabeban districts.

Provision of initial supply of 2,500 acre feet from Tidal Barrage to Bundaberg City Council.

Detailed analysis of the water supply that would be available from this arrangement, and areas that could be supplied with the quantities available, has therefore been made.

Supply Available:

Detailed analysis of the stream flows and storage capacities has indicated that yields to be adopted from these storages under these conditions are —

(a) Kolan River: 19,500 acre feet;

(b) Burnett River: 37,000 acre feet (including 10,000 acre feet from Wuruma Dam).

It is clear that for such an interim phase of development, the possible shortage of supply would only occur with a recurrence of the critical 1902-03 period and even under these conditions substantial proportions of annual supply would still be available.

Area Served and Water Allocations:

The areas which could be served in the two sections with the yields from the storages given above have been determined allowing for annual allocation of water to farms of 2 acre feet per acre on the following proportions of total gross assignments:

(a) Kolan Section: 66.7% of total gross assignment;

(b) Burnett Section: 60% of total gross assignment.

Although allocations of water would be fixed on the above proportions of assigned areas, irrigators would be free to utilise the available water allocation on whatever area of their assignment they chose, and would be limited only in the total amount used annually.

On this basis the number of assignments served, total gross assigned areas, water allocation and areas irrigated are set out in the following table:

TABLE 7 – XII

INITIAL DEVELOPMENT STAGE I(b) – AREAS SERVED, IRRIGATED AND WATER REQUIREMENTS

Method of Supply	Mill Area	No. of Assign-ments	Assigned Area (acres)	Irrigated Area (acres)	Annual Water Require-ments (ac. ft.)
KOLAN SECTION					
Pumping from Kolan River					
(1) Private	Bingera	51	2,952	1,970	3,940
	Fairymead	5	386	258	516
(2) Community	Bingera	9	696	464	1,090
Channel Systems, Gooburrum	Fairymead	87	7,260	4,840	13,830
Totals	Bingera	60	3,648	2,434	5,030
	Fairymead	92	7,646	5,098	14,346
TOTAL KOLAN SECTION		152	11,294	7,532	19,376
BURNETT SECTION					
Pumping from Burnett River					
(1) Private	Gin Gin	59	4,764	2,860	6,370
	Bingera	51	5,562	4,045	8,990
	Isis	25	1,700	1,020	2,270
	Millaquin	10	669	401	890
(2) Community	Bingera	15	600	360	885
Channel Systems, Woongarra	Millaquin	141	9,140	5,490	15,300
Totals	Gin Gin	59	4,764	2,860	6,370
	Bingera	66	6,162	4,405	9,875
	Isis	25	1,700	1,020	2,270
	Millaquin	151	9,809	5,891	16,190
TOTAL BURNETT SECTION		301	22,435	14,176	34,705
TOTAL BUNDABERG REGION		453	33,729	21,708	54,081

Proportion of Present Areas now Using Groundwater to be Provided with Surface Water:

Some 7,260 acres total gross assignments (4840 acres irrigated) are to be served by the Gooburrum System and an annual supply of 18,800 acre feet of water would be delivered from the river (9950 acre feet delivered to farms).

This represents approximately 37% of the total gross assignment in the area presently irrigated from underground water.

This is equivalent to the area considered necessary to be 'taken off' groundwater supply and provided with surface water to enable continued safe use of groundwater by the balance of the Gooburrum area.

Some 9,140 acres total gross assignment (5,490 acres irrigated) would be served in this initial development phase by the Woongarra Channel System and an annual supply of 15,800 acre feet of water would be diverted from the river to the area (11,800 acre feet delivered to farms).

This area has approximately 27% of the total gross assignment within the area now currently using underground water for irrigation.

Although the total area ultimately proposed to be supplied with surface water and "taken off" groundwater supply for the section is proposed to be approximately 56% of the total gross assignment, the provision of this initial supply to 27% of this area with surface water supplies would provide a substantial improvement in the groundwater situation in this section.

Provision of the full Stage I development would however be necessary to fully assure adequate underground supplies under the worst natural recharge conditions.

PART 8 — IRRIGATION AND ANCILLARY WORKS

METHOD OF SUPPLY:

The method of supply to lands in the two sections would be as follows:

KOLAN SECTION:

River Supplies:

Regulation of flow in the Kolan River by releases from Monduran Dam and Bucca Weir would enable lands fronting both sides of the river upstream from the Barrage to obtain water by private pumping, with the exception of high lands upstream of Bucca crossing which would be served from the Bingera Channel System.

A small community scheme at Abbotsford would be served by pumping station at 19.2m. on the Kolan River and a piped reticulation system conveying water to some 700 acres of land within the area.

Bingera Irrigation System:

Irrigation water for individual farms in the area between the Kolan and Burnett Rivers down to the Gooburrum Irrigation System, including Bingera Plantation, but excluding other lands fronting the Burnett River, would be provided by a channel reticulation system served by the main pumping station connected to the outlet pipes in Monduran Dam.

The main pumping station would lift water into a main carrier channel 16.5 miles long, which would convey water to a saddle, 240 feet above sea level, on the south-eastern outskirts of the town of Gin Gin.

A system of main and reticulation channels would convey water by gravity to individual farms below the level of this system, generally south-west through the Gin Gin and Wallaville areas and north-east through Bullyard and Bingera down to the lands to be served from the Gooburrum Channel System in the vicinity of the North Coast Railway.

Areas above the level of the main channel system would be served by eight relift pumping stations supplying water through pipe reticulation systems to individual farms.

For Stage I development, this system would also deliver water via Sheepstation Creek to the Burnett River to supplement supplies for the Burnett Section.

Gooburrum Irrigation System:

This system would comprise a pumping station on the Kolan Barrage storage at 12.8 miles, which would lift the water into a main channel some 6.5 miles long to near Meadowvale on the North Coast Railway. This channel and a reticulation system from it, would deliver water by gravity to individual farms between the main channel and the Moore Park road, between the North Coast Railway and the Moore Park road south east to Gooburrum,and lands west of the Moore Park road to the coast. The lands to be served are generally at present using underground water supplies, but would be supplied with surface water in lieu of these.

Provision has not been made in this report for lands north-east of the Railway adjacent to the Kolan River to be supplied. If the scheme proceeds the possibility of supply to this area could be investigated.

BURNETT SECTION:

River Supplies:

Regulated flows in the Burnett River would provide irrigation supplies for lands fronting the Burnett River between Booyal and the Barrage but excluding Bingera Plantation, when complete Stage I works are provided. For initial development of Stage I, Bingera Plantation would continue to obtain water from the Burnett River.

A small community scheme in the Givelda area would be served by a central pumping station at the upper end of the Barrage storage at 36m. and a piped reticulation system to some 600 acres of lands in this area.

Isis Irrigation System:

This system would comprise a main pumpping station on the Barrage reservoir (31.5m. on the Burnett River) and would lift water to a 16.7 mile long main carrier channel terminating just south of Logging Creek on the northern edge of the Isis area adjacent to the Isis Highway.

This channel would provide supply to a few existing assignments north of the Gregory River either directly by gravity, or by individual pumping, landholders pumping from the channel to their holdings at their own expense.

Two relift pumping stations would be located at the end of the carrier channel to raise water from the channel to two higher level channel and pipe reticulation systems serving lands in the lower parts of the Isis mill area. The system of the pumping station in the Farnsfield-Goodwood areas and generally south to Stockyard Creek, would serve lands to the east and the Goodwood locality. The system would serve lands south of the pumping station in the general area Cordalba-Forest Hill, south almost to Dinner Hill.

A further relift pumping station adjacent to the Isis Highway about one mile north of Dinner Hill, would raise water from the system and raise it to a still higher level distributing system serving the highest part of the area embracing the Isis mill, Dinner Hill and Childers localities, east to Abington and Horton and south to the southern edge of the Isis area.

Woongarra Irrigation System:

This system would comprise a pumping station on the Barrage reservoir (23.4m. on the Burnett River) which would lift water into a seven mile long carrier channel to a point about 2½ miles west of Alloway. This channel and a reticulation system from it would provide supplies by gravity to all lands between the Burnett and Elliott Rivers presently

without irrigation, or using underground water except the general area of higher lands around the Hummock and the coastal lands from Burnett Heads to Elliott Heads.

Selection of the area now using groundwater to be served by surface water is based on:

(a) elevation to be such as to permit supply by gravity from the main channel, thus excluding the higher lands on and around the Hummock;

(b) the desirability of supplying a strip of the lands along the right bank of the Burnett River and as far as possible to Burnett Heads to reduce drawdown of underground water levels adjacent to salt water areas and minimise the possibility of salt water intrusion.

OFF-PEAK PUMPING

Because of the large volumes of water to be pumped and the heights to which water would have to be raised for the Gooburrum, Isis and Woongarra Irrigation Systems and hence the large sums that would be involved in pumping, and because of the lower tariffs that are available for electricity supply on off-peak hours, the possibility of arranging for pumping on an off-peak basis on these systems has been investigated.

The Bingera System has not been considered for off-peak pumping because of the relatively low average pumping head at Monduran Dam.

For the off-peak pumping system, pumps would be required to provide the full daily supply during the 12 hour period of off-peak supply (8 p.m. to 8 a.m.). This system would require:

(a) pumps and rising mains to have double the capacity of that required for 24 hour day pumping; and

(b) to maintain a continuous 24 hour supply to the irrigation systems, a balancing reservoir would be required as close as possible to the outlets of the rising mains to store water during the 12 hour pumping period so that supply could be drawn off at a constant rate during the 24 hour period.

Preliminary designs and estimates have been made to determine the additional capital cost of installations required for the off-peak pumping arrangements, as against continuous pumping, and the savings in operation costs obtained with the off-peak pumping arrangements due to the lower electricity charges.

Details of these costs for the three stages of development are as set out below:

COMPARISON OF ADDITIONAL COSTS OF INSTALLATION AND SAVINGS IN ELECTRICITY COSTS — OFF-PEAK PUMPING GOOBURRUM, BURNETT AND WOONGARRA SYSTEMS

Stage	Additional Capital Cost ($)	Additional Interest and Sinking Fund at 5½% ($)	Annual Costs Savings in Power Costs ($)	Saving Nett ($)
I(a)	2,600,000	142,500	294,800	152,300
I(b)	2,600,000	142,500	436,200	293,700
II	3,120,000	171,500	545,500	374,000

There can thus be no doubt of the advantages of using off-peak pumping in these three systems and this is therefore proposed.

SUPPLY TO FARMS – CHANNEL SYSTEMS

Point of Supply:

The reticulation system would convey water to each farm in the areas. For both main channel and relift systems, the point of supply would normally be the highest point on the farm, so that where topography would permit, supply could be distributed by surface irrigation methods over the farm without further pumping.

Where spray irrigation is likely to be required, the point of supply may not be the highest point of the farm as the requirement for spray irrigation would require pumping in any case. In these areas, the point of supply may be the point on the farm boundary as close as practicable to the most convenient point of supply for spray irrigation.

In a few cases in relift areas where the elevation of an individual farm is such as to require additional pumping head over the whole of a relift system, the point of supply may be at the lowest point of the farm and the farmer required to pump his supply to the additional height required.

Further possible exceptions would be where farms immediately adjacent to a main channel are partly or wholly above the channel level. In these cases, farmers may again be required to install their own pumping equipment to lift water from the channel to that part of the farm above channel level.

Water will generally be delivered in an open outlet and not under pressure. Farmers who utilise spray irrigation methods would be required to install their own pumping equipment to provide the necessary head to deliver water throughout the farm and operate sprinklers. Some exceptions may occur where sufficient pressure may be available at the supply point to allow the farmer to convey water by pipeline to higher land using the pipeline as a head ditch; or across an intervening depression. Pressure would not, however, be sufficient for sprinkler operation.

MEASUREMENT OF SUPPLY:

All water delivered to farms would be measured by Dethridge type meter wheels or propellor type meters installed in pipes.

Meters would be installed and maintained by the Irrigation and Water Supply Commission as part of the cost of the scheme.

CONDITIONS OF SUPPLY:

Due to the long distances from the Kolan and Burnett Rivers to the furthest point in the channel systems, it would take more than one day for water to flow from the pumping stations to the end of the system. Under these conditions, it is not possible to supply water during daylight hours only and delivery to farms must be on a continuous 24 hour basis.

Irrigators could either plan their irrigation system to operate on a 24 hour basis, which is desirable to keep down costs, or if they wish, provide a small storage on their farm into which water could be turned during the night, and irrigation systems planned to operate off the storage, on a daylight basis only.

To avoid excessive peak demands on the system, and so that deliveries from the main pumping station are maintained on a reasonably uniform basis, it would also be necessary to arrange delivery of water to farms on a roster system whereby water is supplied to irrigators in turn.

Rosters would be arranged for each irrigator to have water available for his farm for some period between five and seven days out of every 15 days. The length of these farm irrigation periods would be determined after some experience with operation of the system.

A Water Advisory Board would be established, representing irrigators in various parts of the area, to advise the Commission on detailed arrangements for water distribution.

Water Allocations:

It is necessary under the Irrigation Acts to allot "Water Rights" to land supplied from the irrigation works and it is also required that the volume allotted as a water right be paid for annually at the charge fixed whether used or not.

The purposes of this arrangement are to –

(a) Establish rights of the individual irrigator to a minimum volume of water which must be reserved for him out of the supply available; and

(b) To assure the Irrigation Authority of a minimum annual revenue to cover essential expenses to maintain the irrigation system in a state of readiness to supply water when required.

Water would be supplied in excess of the water right ("sales water") within the limit of the safe annual supply from the storage. Payment for water supplies in excess of the water right would be at the same rate as for water rights and as used.

For farms supplied by the channel system, it is proposed that the annual water right allocations and quantities of water available in excess of the water right (sales quotas) be as follows:

Water Right Allocation:

0.8 acre feet per acre of gross assigned area.

For 50% of gross assignments irrigated this would be equivalent to 1.6 acre feet (19 inches) per acre irrigated.

For 75% of gross assignment irrigated, this would be equivalent to 1.07 acre feet (12.8 inches) per acre irrigated.

For 80% of the gross assigned area, it would be equivalent to one acre foot (12 inches) per acre irrigated.

Supply Above Water Right (Sales Water):

It is proposed that the upper limit of sales water supplies in any year be equivalent to 0.7 acre feet per acre of total gross assignment for Stage I and 0.8 acre feet per acre of total gross assignment for Stage II.

This would bring the total supply available to 1.5 and 1.6 acre feet per acre of the gross assigned area for Stages I and II respectively, which would be equivalent to 2 acre feet (24 inches) per acre irrigated where this is 75% and 80% of the gross assigned area respectively.

Use of Existing Supplies:

There are some cases within the areas to be supplied by the Bingera and Isis Irrigation Systems where landholders have made provision for water supplies from bores or farm dams.

If desired by these landholders, total water allocations to such properties may be reduced by an amount equivalent to the assured annual supply from these existing facilities, with water rights being equivalent to half the adjusted allocation.

In the areas to be served by the Gooburrum and Woongarra Systems, however, because of the conditions relating to the underground aquifer and the provision of assured surface supplies, use of existing bores or wells would not be permitted, to avoid jeopardising supply to those farmers who will continue to depend on the underground aquifer for their irrigation supplies.

SUPPLY TO FARMS ALONG THE KOLAN AND BURNETT RIVERS:

Farms with frontages to the Kolan and Burnett Rivers, excepting those in the high areas which would be served from the channel system, would obtain irrigation supplies by private pumping from the river.

These supplies would be provided by natural flow in the rivers when this is available, supplemented by water released from storages down the river channel as required to maintain adequate supply for these irrigators.

Arrangements and conditions for this supply would be as follows:

RIGHT TO OBTAIN SUPPLY:

Landholders wishing to irrigate would require to obtain the right to pump water from the river by application for a license under the Water Act, as is the case at present.

The maximum annual water allocation under a license would be equivalent to 1.5 and 1.6 acre feet per acre of total gross assignment for Stages I and II respectively, equivalent to 2 acre feet (24 inches) per acre irrigated where this is 75% or 80% of the gross assigned area respectively.

A condition of the license would be that an amount of the allocation equivalent to 0.8 acre feet per acre of gross assigned land to be served would require to be paid for annually whether used or not. The balance of water used would be paid for as and when used. Total annual use would be limited to the total allocation made under the license.

MEASUREMENT OF SUPPLY:

All water diverted from the stream would be measured by a propellor type meter installed in the rising main close to the pump, the cost of installation and maintenance being met by the Irrigation and Water Supply Commission as part of the cost of the scheme.

PUMPING EQUIPMENT:

Licensees would be responsible for installing their own pumping equipment and pipelines to deliver water from the river to and throughout their holdings.

There would be no limitation on size of pumps used, provided these are reasonably related to the area to be irrigated and a practicable period to irrigate the farm.

SUPPLY ARRANGEMENTS:

Licensees would generally be permitted to pump at any time. However, when releases from storages are necessary to supplement supply in the river, notice of when they propose to pump would have to be given by licensees to the Irrigation Commission, several days in advance, to enable releases from the storage to be arranged to meet overall demands along the river.

FINANCE FOR FARM IRRIGATION FACILITIES:

The installation of farm irrigation facilities on lands not at present irrigated in the section would require a significant capital outlay by existing landholders.

All landholders served by the channel system or obtaining water by pumping from the rivers would be eligible to apply for technical and financial assistance under the Farm Water Supplies Assistance Acts in respect of these facilities.

POSSIBLE TRANSFER OF ASSIGNMENTS:

Within the Bingera Irrigation System, the Red Hills, Boundary Creek and Ferry Hills relift areas comprise a total of some 3,960 acres for which the total relift pumping heads exceed 200 feet in addition to the initial lift averaging 48 feet at Monduran Dam.

Similarly in the Isis Irrigation System the relift systems which comprise a total assigned area of 19,000 acres, involve relift pumping heads in excess of 200 feet in addition to the initial lift of 225 feet from the Burnett River.

The cost of delivering water to these areas, because of this high pumping head, would be considerable and as parts of these areas have steep slopes, some difficulty would be experienced by farmers in irrigating.

In the Booyal area, the existing sugar lands are at relatively high elevation and much of the land within this district has a generally poor soil classification. Under this scheme, this area will be provided with an allocation of irrigation water in the Burnett River, should landholders wish to pump their supplies from this source.

In addition to the areas mentioned above, there are other areas of assigned land in the region which have been classified as unsuitable for irrigation for different reasons including isolation, steep grades and shallow and eroded soils.

As there are some 33,000 acres of land, at present unassigned, classified as suitable for irrigation which would be commanded by the main channel system, it would be desirable, if the scheme proceeds, to consider ways whereby landholders in the unfavourable areas, could acquire more suitable lands in other parts of the region which could be supplied with irrigation water and to which they could be supplied with irrigation water and to which they could transfer their assignments.

Such an arrangement could significantly reduce the capital cost of works required, substantially reduce the annual cost of supply of water and improve the security of and return to individual growers.

No form of Government assistance in transfer of assignments is suggested but consideration might be given to acquisition by the Irrigation Commission of sufficient of the unassigned lands suitable for irrigation, to provide for desirable assignment transfers and subsequent sale of these lands at an appropriate value (not less than the resumption cost) to landholders willing to make transfers at their own expense.

PART 9 – ESTABLISHMENT CAPITAL AND ANNUAL COSTS AND DIRECT REVENUE

ESTABLISHMENT:

ESTIMATE OF CAPITAL COSTS:

The estimated capital costs as at February, 1969, of the works required for the two development stages are set out below:

TABLE 9–I — ESTIMATES OF CAPITAL COSTS

Item	Stage I Development ($)	Extra for Stage II Development ($)	Total Stage II ($)
STORAGES:			
Monduran Dam	8,000,000		
Bucca Weir	1,500,000		
Kolan Barrage	500,000		
Burnett Barrage	1,658,000		
Gayndah Weir	1,300,000		
Kalliwa Dam:–			
Fixed Crest		20,150,000	
Gates		4,450,000	
Totals: Storages	12,958,000	24,600,000	37,558,000
IRRIGATION AND ANCILLARY WORKS:			
Abbotsford System	155,000	131,000	
Bingera System	13,295,000	1,690,000	
Gooburrum System	1,141,000		
Givelda System	173,000	76,000	
Isis System	14,450,000	3,636,000	
Woongarra System	4,728,000	930,000	
Kolan-Burnett Channel Extension	184,000		
Totals: Irrigation and Ancillary Works	34,121,000	6,463,000	40,584,000
TOTAL COSTS:	47,079,000	31,063,000	78,142,000

INITIAL DEVELOPMENT — STAGE I:

For the full development of Stage I, the construction of Monduran Dam is essential.

However, the four year construction period of the dam would not allow early development of irrigated areas or relief of shortages of underground water supplies.

Provided overall development of Stage I is approved, there are advantages to be gained by the provision of the proposed minor stages on the Kolan and Burnett Rivers, for supply to areas which could be readily commanded by the provision of the Gooburrum, Abbotsford, Woongarra (part only) and Givelda systems, as an initial phase of development of Stage I.

The estimated capital cost for this initial development phase would be —

		$	$
Storages:			
	Bucca Weir	1,500,000	
	Kolan Tidal Barrage	500,000	
	Gayndah Weir	1,300,000	
	Bundaberg Tidal Barrage	1,658,000	4,958,000
Irrigation and Ancillary Works:			
	Gooburrum Irrigation System	970,000	
	Abbotsford Irrigation System	141,000	
	Woongarra Irrigation System	1,982,000	
	Givelda Irrigation System	143,000	
	River Supplies	104,000	3,340,000
	Total:		$8,298,000

This initial phase would serve a total of 453 farms (38%) and an assigned area of 33,729 acres or 36% of the total area to be served by the complete Stage I.

In addition this arrangement would provide significant improvement to underground water supplies, thus indirectly benefiting a further 277 assignments with 25,000 acres of gross assigned areas.

CONSTRUCTION AND DEVELOPMENT PROGRAMME:

With the frequency of below average rainfall conditions, the resulting substantial shortfalls in sugar production, and the possibility of recurrence of drought periods such as 1964-65 and the disastrous 1899-1905 period, it would be desirable to programme the works for the minimum construction and development programme for Stage I.

The actual programme of construction is more likely to depend on annual available funds than on physical limits of design and construction.

Based on a possible 12 year construction programme for Stage I, phased to complete the initial development based on the minor storages, by the end of the third year, would require maximum annual expenditure of $4,500,000 in the fourth to the ninth years.

The minimum desirable programme would be one providing for a maximum annual expenditure of $3,000,000. This would enable completion of the initial phase in the fourth year, and completion of Stage I in 17 years.

A period of 1½ to 2 years not included in the foregoing would be required for completion of sufficient detailed surveys, investigations and preparation of plans and specifications prior to commencement of construction.

PROVISION OF SUPPLY TO FARMS — STAGE I:

On the basis of a 12 year construction programme the annual progress of supply to farms in the two sections would be as set out in Table 9 – III.

TABLE 9 – 111 — PROGRAMME OF SUPPLY TO FARMS

Year	Kolan Section			Burnett Section			Total
	River Supply	Gooburrum System	Bingera System	River System	Woongarra System	Isis System	
3	65	20		87	40		212
4		67		72	101		240
5							
6							
7							
8			50			20	70
9			60		40	40	140
10			70		50	50	170
11			70		50	60	180
12			75		12	60	147
18						22	22
Totals	65	87	325	159	293	252	1181

STAGE II:

Commencement of Stage II works would be dependent on markets becoming available for the increased production which could be obtained from this Stage. No detailed programme for this stage has therefore been prepared.

The works, comprising the construction of Kalliwa Dam and additional irrigation works required under this Stage would take some six to seven years to complete.

ANNUAL REVENUE:

Annual revenue from the scheme would be derived from —

(a) Water charges for the supply from the irrigation systems for water supplied as water rights and sales of water in excess of water rights.

(b) Water charges for supplies diverted by private pumping from the Kolan and Burnett Rivers.

(c) Charges to landholders continuing to use water from underground supplies.

(d) Water charges to the City of Bundaberg for bulk supplies at the Bundaberg Barrage.

(e) Charges to the six sugar mills in addition to any charges for which they may be liable as irrigators, to provide a contribution towards an assured supply of irrigation water.

WATER CHARGES FROM IRRIGATION SYSTEMS:

Water rights would be allocated on the basis of 0.8 acre feet per acre of assigned land and additional supplies (sales water) equivalent to the volume of the water right would provide a total of 1.6 acre feet per acre of assigned land per annum. Annual payment for water rights would be required whether this quantity was used or not.

An annual charge for water rights and water sales of $10 per acre foot is proposed.

WATER CHARGES FOR SUPPLIES FROM THE KOLAN AND BURNETT RIVERS:

A maximum allocation of 1.6 acre feet per acre of assigned land would be made available to licensees diverting water from the Kolan and Burnett Rivers, at a charge of $8 per acre foot.

Licensees would be required to pay for 50% of the total allocation whether or not this quantity was used.

CHARGES TO LANDHOLDERS USING UNDERGROUND SUPPLIES:

Licenses for bores issued to landholders in the areas where use of groundwater for irrigation is to continue would include conditions allocating an annual supply per holding of 1.6 acre feet per acre of gross assignment and/or 2 acre feet per acre of crops irrigated other than sugar cane.

The license would also include a condition requiring payment of a fee for water pumped annually with 50% of the annual allocation to be paid for whether used or not.

The proposed fee is $1.50 per acre foot.

These charges would not apply to the Burnett section until completion of Monduran Dam.

WATER CHARGES TO CITY OF BUNDABERG:

A water allocation of 2,500 acre feet per annum for the initial phase of Stage I development, 5,000 acre feet per annum for Stage I and 10,000 acre feet per annum for Stage II would be made available at the Barrage to the City Council and the Council will require to provide their own pumping and reticulation facilities.

The charge proposed for this regulated supply is at the rate of $10 per acre foot for the full annual allocation per annum once supply is available from the respective stages.

CHARGE TO SUGAR MILLS:

The Central Sugar Cane Prices Board, in determining the price to be paid to cane growers for cane supplied to sugar mills, takes account of the gross income received by the Board for the sale of raw sugar in Queensland, the cost of production to the growers in supplying cane to the mill and the cost of manufacture of raw sugar as delivered to the bulk loading terminals, the net returns being distributed between the growers and mills approximately in the ratio of 2 to 1.

Because of this close integration of the industry, the sugar mills would share with the growers the advantages of increased and stable production which would result from the implementation of the irrigation proposal. It is reasonable therefore that some charge should be made to the mills, so that they share with growers the cost of providing irrigation supplies.

Several possible bases for the charge to mills have been examined but it is considered that the simplest and most satisfactory is a charge based on the sugar peaks allotted to lands, to which water will be made available from the scheme, both from the channel systems and the Kolan and Burnett Rivers and to which water will be assured from underground supplies as a result of the scheme.

The charge per ton per annum of allotted mill peak considered to provide a reasonable relationship with water charges to growers, would be $1.00 per ton of allotted peak and this annual charge is proposed.

PART 10 — INCREASED PRODUCTION

INCREASE IN YIELD WITH IRRIGATION:

Under dryland conditions in this district, a high and stable level of production appears to be unattainable. Because of the range of yields caused largely by the incidence and amount of rainfall, growers tend to plant at or near the practical harvestable limit of their total assigned acreage. When conditions are favourable some overpeak production is still possible but under drought conditions production may well be less than 50% of the sugar peak.

Theoretically, the grower could attempt to overcome the deficiency due to drought by planting still greater areas, even though this is obviously a costly procedure. However, to do this, the total assigned acreage of the dryland grower would require to be increased. Under the established structure of the sugar industry such a procedure would be of a sectional nature, both within the mill area and within the whole industry. For this reason, an alternative of this nature appears to be impracticable if the existing relativities are to be preserved. Furthermore the large acreage required to achieve present peaks under drought conditions would result in chaotic conditions of overpeak production during favourable growing seasons. The increase in gross assignments during the 1963-66 period and the development of a very favourable assigned area — mill peak ratio for the Gin Gin and Isis mills has improved but has not resolved the problem of under peak production.

Thus, within the existing gross assignments, the advent of a major irrigation scheme would have the effect of making available the area between 52% required to produce present peaks and the optimum harvest area of 80% of assignment for purposes of expansion. Similarly, it would have a similar effect in permitting production of up to 80% of future assignable and commandable land.

Although limited survey data are available on yields from present irrigated areas, there are indications that the present average irrigated yields in all areas (except where there is over development of irrigation based on underground water in the Fairymead, Millaquin and Qunaba mill areas) are about 0.6 tons below full irrigated yields.

Hence the marginal response to irrigation of current dryland areas is estimated at 1.9 tons per acre except in the Fairymead commanded area and part of the Gin Gin area where the responses are expected to be 1.6 and 1.4 tons of sugar per acre respectively. The yields from full irrigation would vary from 3.9 to 5.8 tons per acre according to soil and climatic factors but these assumed average yields are by no means the ceiling in the long term and the limitation could lie in the ability of growers to apply advances in technology. Progressive growers under favourable conditions of soils and climate are consistently achieving yields of 6.5 tons of sugar per acre.

IRRIGATED AREAS TO PRODUCE PRESENT PEAKS:

For Stage I(a), mill peaks can be achieved by full irrigation of areas less than current areas harvested. For Fairymead, Millaquin and Qunaba where areas irrigated at present are a high proportion of total area harvested, mill peaks are generally achieved except in extreme drought years. If pressure on underground water supplies is not relieved this will not hold in the long term. About 50% of the Total Gross Assignment of the above three areas is in the scheme area.

However, provision of surface supplies to growers in the scheme area now using underground supplies creates a safe supply in areas not in the scheme. Thus, assuming that present irrigated yields will decline, the production increase from the scheme, would be greater than present average production indicates and will also include an increase because the scheme has assured a safe yield in areas not covered by the scheme.

THE INDIVIDUAL FARM SITUATION:

Dryland and Irrigated Yields:

Sugar farmers along with all other businessmen are vitally interested in stabilising the productivity of their enterprise, so that they may increase their net incomes and thus ensure a maximum return on invested capital.

The individual sugar farmer in the proposed Bundaberg Irrigation Area, who would be provided with irrigation water, would have an unusual opportunity to stabilise his farm production. In addition, on a district basis, a major irrigation scheme would largely prevent and eliminate the catastrophic losses experienced by all dryland growers during both the 1964 and 1965 seasons. Farmers could expect to achieve the levels of production which are shown in Table 4 – VI on Page 10.

Some of the important advantages accruing to the farmer whose farm will be commanded by the irrigation works, are as follows:

(i) Current dryland farms, once irrigated, will produce a marginal increased return of 1.4 to 1.9 tons sugar per acre harvested in all seasons. Farms currently irrigated will have an assured supply of water for present and future needs.

(ii) Within the framework of current 1968 assignments, it will be possible to reduce the harvested area each season to an average of approximately 52% of total gross assignments with consequent cost savings due to this reduced area.

(iii) With the progressive introduction of increased farm sugar quotas, full irrigated production would return from 3.9 to 5.8 tons sugar per acre in all seasons.

(iv) Water would be available for establishing plant cane during the warm period of the year, thereby enabling the introduction of varieties with a higher sugar content. Vigorous cane with a leafy canopy results from early plantings and such cane is reported to be less susceptible to frost damage than poorly grown cane.

ADDITIONAL CAPITAL REQUIREMENTS:

Because of the topography on many of the lands throughout the Bundaberg area spray irrigation could be required on many farms. In the flatter more easterly areas surface irrigation methods would be satisfactory. Farms supplied by the channel system would usually be served at a high point on the farm. Thus, unless spray irrigation is necessary, further pumping would not be required.

To achieve efficient irrigation production, each farmer will be required to invest some additional capital, as well as providing working capital for additional irrigation costs.

Additional capital outlay is estimated on the following bases:

(a) Surface Irrigation: $24.00 per acre for grading and smoothing, construction of head ditches and furrow formation.

(b) Spray Irrigation: Cost of pumping and reticulation plant, based on plant size required to apply three inches per watering in a ten day cycle, pumping up to eighteen hours per day. Spray irrigation from the reticulated water supply, with a maximum total head of 100 feet — $120 per acre.

(c) Growers outside the main underground water areas who irrigate from bores and farm water storages would be able to continue these practices, with main supply from the reticulated system.

(d) Farms supplied from the channel system would be required to take water on a roster basis with supply being taken continuously when available. A continuous supply could introduce some problems when spray irrigation is employed and in these cases it is likely that each landholder will need to provide a smallfarm storage into which a continuous supply could be made from the channel system and water from the farm storage may be used as desired by the irrigator. A storage of 1 to 2 acre feet (¼ to ½ million gallons) would be $500 to $1,000.
capacity would generally be adequate. The estimated cost of the facility of this order

The following tables show estimated additional capital requirements for three situations, namely:

(a) additional investment on farms currently employing spray irrigation;

(b) investment on current dryland farms which will be able to use a gravity supply and employ a furrow irrigation technique;

(c) investment on current dryland farms on which a spray irrigation system will be required.

Additional investment has been calculated for three farm sizes, having total gross assignments of 60, 75 and 90 acres, respectively, and at two levels of utilisation, namely 52% of current T.G.A., being the average irrigated area estimated to meet current farm peak (Stage I(a)) and 75% of current T.G.A. representing the limit of water availability for Stage I (b).

TABLE 10–IX — ADDITIONAL CAPITAL COSTS — INDIVIDUAL FARMS STAGE I(a)

Farm Size, Present Irrigation Situation and Proposed Irrigation Method	Capital Cost Irrigation Systems or Preparation $	Farm Water Storage $	Total $
Farms with Existing Spray Irrigation			
60 acres T.G.A. 10 acres extra spray irrigation	1200	500	1700
75 acres T.G.A. 12 acres extra spray irrigation	1440	750	2190
90 acres T.G.A. 15 acres extra spray irrigation	1800	1000	2800
Current Declared Farms to be surface irrigated – land preparation ditches, etc., at $24 per acre			
60 acres T.G.A.	1440	500	1940
75 acres T.G.A.	1800	750	2550
90 acres T.G.A.	2160	1000	3160
Current Dryland Farms to be spray irrigated – Irrigation Equipment at $120 per acre			
60 acres T.G.A. (31 acres irrigated)	3720	500	4220
75 acres T.G.A. (39 acres irrigated)	4680	750	5430
90 acres T.G.A. (47 acres irrigated)	5640	1000	6640

ADDITIONAL CAPITAL COST — INDIVIDUAL FARMS STAGE I(b)

Farm Size, Present Irrigation Situation and Proposed Irrigation Method	Extra Capital Cost for Stage I (a) $	Capital Cost Irrigation Systems or Preparation $	Extra Farm Water Storage $	Total Stages I(a) and I(b) $
Farms with existing spray irrigation extra equipment at $120 per acre				
60 acres T.G.A. extra 14 acres irrigated	1700	1680	250	3630
75 acres T.G.A. extra 17 acres irrigated	2190	2040	370	4600
90 acres T.G.A. extra 20 acres irrigated	2800	2400	500	5700

[Continued next page.

Dryland Farms to be surface irrigated — all land prepared in Stage I(a)				
60 acres T.G.A.	1940	——	250	2190
75 acres T.G.A.	2550	——	370	2920
90 acres T.G.A.	3160	——	500	3660
Dryland Farms to be spray irrigated and extra equipment at $120 per acre				
60 acres T.G.A. extra 14 acres irrigated	4220	1680	250	6150
75 acres T.G.A. extra 17 acres irrigated	5430	2040	370	7840
90 acres T.G.A. extra 20 acres irrigated	6640	2400	500	9540

ADDITIONAL ANNUAL COSTS:

Water charges for the proposed scheme have been calculated at $10 per acre foot where water is to be delivered to the farm by the reticulation system.

Farm pumping costs have been assumed as follows:

From the farm water storage ex the channel system: $3 per acre foot for spray irrigation.

Repairs and maintenance have been estimated at three per cent of the initial cost of extra irrigation plant and farm water storage. Depreciation on irrigation plant has been charged at seven per cent of its original cost. Average interest on capital at six per cent of half the extra outlay has been allowed.

Examples of the range of annual operating costs which might operate on new irrigation farms in the Bundaberg area are as follows:

TABLE 10–XI — ADDITIONAL ANNUAL OPERATING COSTS — SPRAY IRRIGATION STAGE I(a) — HARVESTED AREA OF 52% T.G.A.

Farm Sizes	60 Acres T.G.A.	75 Acres T.G.A.	90 Acres T.G.A.
Harvested Areas	31 Acres $	39 Acres $	47 Acres $
Water charge at $10 per acre foot	465	585	705
Pumping cost ex farm storage	140	176	212
Repairs and maintenance	127	163	199
Depreciation on plant and dam	295	380	465
Interest on additional capital	127	163	199
Casual labour	120	180	240
Totals:	1274	1647	2020
Average cost per harvested acre	41.1	42.2	43.0

TABLE 10–XII — ADDITIONAL ANNUAL OPERATING COSTS — SPRAY IRRIGATION STAGE I(a) TO STAGE I(b) AND TOTAL AT STAGE I(b)

Farm Sizes	60 Acres T.G.A.		75 Acres T.G.A.		90 Acres T.G.A.	
Harvested Areas	I(a) to I(b) 14 Acres	Total at I(b) 45 Acres	I(a) to I(b) 17 Acres	Total at I(b) 56 Acres	I(a) to I(b) 20 Acres	Total at I(b) 67 Acres
	$	$	$	$	$	$
Water charge at $10 per acre foot	210	675	255	840	300	1005
Pumping cost ex farm storage	63	203	76	252	90	302
Repairs and maintenance	58	185	72	235	87	286
Depreciation on plant and dam	185	430	169	549	203	668
Interest on additional capital	58	185	72	235	87	286
Casual labour	60	180	90	270	120	360
Total	584	1858	734	2381	887	2907
Average cost per harvested acre	41.7	41.3	43.2	42.5	44.3	43.4

RETURN TO USE OF IRRIGATION AT FARM LEVEL:

The response to irrigation is stated elsewhere at 1.4 tons, 1.6 tons or 1.9 tons of sugar depending on location as it affects frost susceptibility, soil type, topography, etc. Assuming a c.c.s. of 13.4% and a sugar price of $89 ton the monetary values are:

1.4 tons 94 net titre sugar per acre = 10.4 tons cane at $7.90 = $82.16

1.6 tons 94 net titre sugar per acre = 11.9 tons cane at $7.90 = $94.01

1.9 tons 94 net titre sugar per acre = 14.2 tons cane at $7.90 = $112.18

The marginal returns at the individual farm level, in the case of a change from a dryland enterprise to a spray irrigation at three farm sizes and two levels of utilisation appear as follows:

TABLE 10-XIII — MARGINAL NET RETURN TO IRRIGATION PER ACRE

Area	Stage	Level of Response 1.4 tons	1.6 tons	1.9 tons
		$	$	$
60 acres T.G.A.	Stage I(a)	41.06	52.91	71.08
	Stage I(b)	40.46	52.71	70.88
75 acres T.G.A.	Stage I(a)	39.96	51.81	69.98
	Stage I(b)	39.66	51.51	69.68
90 acres T.G.A.	Stage I(a)	39.16	51.91	69.18
	Stage I(b)	38.76	51.61	68.78

Farmers in the areas currently irrigated have indicated their willingness to pay for the alternative water available in the event of the projects being undertaken in return for the opportunity of having an assured supply. Current dryland farmers have indicated their desire to participate in the scheme in order to ensure stability of output.

The transition from Stage I(a) to Stage I (b) could proceed smoothly without any marked relative increase in the cost structure at the farm level.

The following ranges of additional capital cost and additional annual operating costs and returns per farm from the current position to Stage I(b) occur:

Range of additional average capital requirement:	$3630 to $9540
Range of additional average annual operating costs (per acre)	$41.3 to $43.4
Range of additional average gross returns (per acre):	$82.16 to $112.18
Range of average surplus (per acre):	$38.76 to $70.88

The typical case taken is that of a farm with a total gross assignment of 75 acres in the Isis area. Under dryland conditions an average area of 65% of total gross assignment, namely 49 acres is assured to be harvested. With irrigation, only 52% of the total gross assignment is required to produce peak, and this is represented by 39 acres. Stage I(a) represents current peaks and Stage I(b) the production from 75% (56 acres) of total gross assignments in 1969. Comparative dryland production for Stage I(b) is calculated on 65% of total gross assignment (49 acres) this being regarded as a long-term practicable limit under dryland conditions in the Bundaberg area.

Looking at the individual farm as an entity, the comparative gross returns and net return to irrigation are summarised as follows:

TABLE 10-XIV — COMPARATIVE RETURNS FROM DRYLAND & IRRIGATED FARMS WITH TOTAL GROSS ASSIGNMENTS OF 75 ACRES — ISIS MILL AREA

	Stage I(a)		Stage I(b)	
	Dryland	Irrigated	Dryland	Irrigated
Area harvested (acres)	49	39	49	56
Average yield per acre (tons sugar) (1)	3.1	5.0	3.1	5.0
Total production (tons sugar)	151.9	195.0	151.9	280.0
Value of production to farmer at $60 per ton (2)	$9114	11700	9114	16800
Less harvesting costs at $1.85 per ton of cane (3)	$2081	2671	2081	3836
Value of production less harvesting costs	$7033	9029	7033	12964
Less Annual cost of irrigation (4)	$ —	1647	—	2381
Comparative returns	$7033	7382	7033	10583
Difference in favour of irrigation	$ —	349	—	3550
Add Cost savings due to reduced acreage—10 acres at $60 acre (5)	$ —	600	—	—
Less Cost of dryland planting of 7 acres at $60 (5)	$ —	—	—	420
Net return to irrigation at farm level	$ —	949	—	3130

Notes: (1) From Table 10–VIII

(2) Assuming that return to farmer is approximately 2/3rds of sugar price of $89 ton.

(3) As a c.c.s. of 13.4 this is equivalent to $18.7 per ton of sugar.

(4) From Tables 10–XI and 10–XII.

(5) Components: Fertilizer $30, Insecticides $6, Cane Setts $6, Fuel and Lubricants $10, Repairs and Maintenance $8.

Within the ceiling imposed by peaks, it is estimated that the harvested area of cane on each farm with irrigation will be reduced by approximately 10 acres. The alternative uses to which this land may be devoted in the event of a scheme are not further considered. At Stage I(b) of the irrigated situation, lands within the existing total gross assignments are assumed to be used to their long term practicable limit.

PART 11 – BENEFITS

The Bundaberg Irrigation Scheme has been proposed for early implementation not only because it is an economic project but also because it provides the only means of stabilising a $30 million industry based on some 1600 cane farms on which an important city and community depend.

CONCLUSION:

For a life of project of 75 years, a sugar price of $90 per ton, and an average response to irrigation of 1.7 tons per acre the Benefit Cost Ratios for 5% and 6% discount rates are 1.96 and 1.66.

If the basic data and assumptions of the scheme are accepted, then it must be concluded that the project is a sound one.

For the analysis at lower sugar prices and responses to irrigation, this conclusion still holds.

Hence on direct benefits alone the proposed scheme is economically justified and has the additional advantages of drought mitigation and stabilised financial and social conditions in an important established region.

SUMMARY OF BENEFITS:

The benefits which will result from the scheme will derive from:

1. At Stage I(a) development where present peaks would be achieved from 52% of gross assignments there would be consistent production of annual mill peaks which by elimination of past frequent shortfalls and stabilisation of the underground water supply situation, would provide an average annual increase in sugar production of 46,070 tons valued at $4.1 million.
2. The maintenance of peak production would ensure a substantial reduction in average costs of growing, milling and handling. The more consistent and increased production would ensure more efficient use of land, plant, mills, transport and other facilities, all "geared" for peak production.
3. Elimination of catastrophic losses in prolonged droughts such as in the 1899-1910 period which if reproduced at present peaks and prices could result in an industry loss estimated at over $50 million for the period.
4. Providing the opportunity for further increasing annual irrigated sugar production from assigned areas by 104,450 tons at Stage I valued at $9.296 million.
5. When market conditions permit the scheme will enable a further annual increase in irrigated sugar production (Stage I to II) of 166,297 tons valued at $14.8 million.
6. A high degree of economy inherent in expansion of production above existing peaks since it would result from:
   (a) more intensive use of existing lands;
   (b) in the second stage from intensive use of mainly undeveloped lands within the general area required to be served by the works;
   (c) more intensive use of established facilities including cane tram lines, mills, bulk handling, port, road, power and urban facilities.
7. Elimination of frequent shortfalls which by reducing supplies available for export could, in the long term, provide opportunities for other countries to take over established contracts.
8. More intensive development of rural areas further improving the environment for secondary industry development, already substantially established around Bundaberg and thus encourage further decentralisation in the State.