COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record No. 1968 / 106

Government Members Mining and National Development Committees Fact Finding Tour July 21st - 28th 1968

Compiled by

G.F. Clarke, N.O. Jones and K.H. Smith

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CONTENTS

INFORMATION PAPERS

TOWNSVILLE

COPPER REFINERIES LTD

COAL DEPOSITS OF CENTRAL QUEENSLAND

EMERALD IRRIGATION PROJECT

PAMPHLET AND MAPS*

THE MINERAL INDUSTRY IN THE NORTHERN TERRITORY

MINERAL DEPOSITS - MAP AND NOTES - ATLAS OF AUSTRALIAN RESOURCES

SHELL ROAD MAP WESTERN AUSTRALIA (NORTHERN)

TOPOGRAPHIC MAP OF NORTHERN TERRITORY SHOWING MINERAL DEPOSITS

* Not reproduced in this record.

III

GOVERNMENT MEMBERS MINING AND NATIONAL DEVELOPMENT COMMITTEES

FACT FINDING TOUR JULY 21ST - 28TH, 1968

compiled by

G. F. CLARKE N. O. JONES K. H. SMITH

RECORD 1968/106

INTRODUCTION

During the period 21st - 28th July, 1968, a party comprising sixteen members of parliament from the Commonwealth Government Members Mining and National Development Committees, and seventeen representatives of Industry, the Public Service and the Australian Broadcasting Commission toured some of the mining and developmental areas in Western Australia, Northern Territory and Queensland.

The Chairman of the Government Members Mining Committee Dr. M. G. Mackay asked the Director of B.M.R. for assistance in organising the tour. Mr. G. F. Clarke was nominated as the Bureau representative to work in co-operation with Mr. Dugald Munro, Secretary of the Government Members National Development Committee.

Organising the tour involved the choice of a suitable route and itinerary, negotiations with state and local government authorities and mining companies, arranging accommodation, transport (other than the charter of the aircraft which was arranged by the Transport Officer of Parliament House), and the preparation of briefing notes comprising a tour guide, information papers covering the centres visited, a pamphlet "The Mineral Industry in the Northern Territory" and maps.

Preparation of the briefing notes was a co-operative effort by officers of the Department of National Development in Northern Division, Water Power and Geographic Branch and the Bureau. The paper "Burdekin Delta Replenishment Scheme" was contributed by the Irrigation and Water Supply Commission Queensland.

Brochures were provided by the Departments of Industrial Development of Western Australia and Queensland, and these, together with the material listed in the contents were distributed to members of the party at the start of the tour. Mining companies and local authorities provided additional material as the tour progressed.

The aircraft, in which the party travelled throughout the tour, was a Fokker Friendship F27 chartered from T.A.A. Seating capacity of the aircraft was thirtysix.

The leader of the tour was Dr. M. G. Mackay.

Note: The times given throughout this record are the actual times recorded during the tour and differ in some cases from those given in the original document.

IV

ITINERARY

Members have been asked to join the Charter Aircraft a TAA Friendship at Melbourne on Sunday morning 21st July for the flight to Perth, where the tour officially commences.

Depart Melbourne by air	10.30 a.m.	Sunday 21st July
Arrive Adelaide	11.55 a.m.	" " "
Depart Adelaide	12.30 p.m.	" " "
Arrive Forrest	3.20 p.m.	" " "
Depart Forrest	3.50 p.m.	" " "
Arrive Perth	5.55 p.m.	" " "

Overnight accommodation at Travelodge Motel, 54 Terrace Road, Perth

Depart Perth by air *	7.30 a.m.	Monday 22nd July
Arrive Esperance	9.20 a.m.	" " "

Agricultural developments, port facilities etc.

Overnight accommodation at Highway Motel

Depart Esperance by air	7.45 a.m.	Tuesday 23rd July
Arrive Kalgoorlie	8.45 a.m.	" " "
Depart Kalgoorlie by bus	9.00 a.m.	" " "
Arrive Kambalda	10.00 a.m.	" " "

Nickel operations - Western Mining Corp.

Depart Kambalda	2.00 p.m.	" " "
Arrive Kalgoorlie	3.00 p.m.	" " "

Tour of Golden Mile

Overnight accommodation at Highway Motel

Depart Kalgoorlie by air	7.30 a.m.	Wednesday 24th July

Fly over Mt. Newman, Mt. Tom Price

Arrive Onslow (refuel)	11.25 a.m.	" " "
Depart Onslow	11.55 a.m.	" " "
Arrive Barrow Island	12.20 p.m.	" " "

Oil operations - W.A.P.E.T.

Depart Barrow Island by air	2.25 p.m.	" " "
Arrive Dampier	3.00 p.m.	" " "

1. Iron ore handling facilities
2. Pelletising Plant
3. Desalination Plant - Hamersley Iron

Depart Dampier by air	5.30 p.m.	Wednesday 24th July
Arrive Port Hedland	6.05 p.m.	" " "

Overnight accommodation at Walkabout Motel

Depart Port Hedland by air	8.25 a.m.	Thursday 25th July

Fly over Mt. Goldsworthy, Cape Keraudren, Mt. Sydney

Arrive Derby (refuel)	11.15 a.m.	" " "
Depart Derby	11.45 a.m.	" " "
Arrive Kununurra	1.30 p.m.	" " "

Ord River Project

Overnight accommodation at Kununurra Motel, Ord River Motel and Hostel

Depart Kununurra by air	7.15 a.m.	Friday 26th July

Fly over Tipperary

Arrive Tennant Creek	12.40 a.m.	" " "

Copper and gold operations - Peko Mines, Australian Development

Depart Tennant Creek by air	4.00 p.m.	" " "
Arrive Mt. Isa	6.10 p.m.	" " "

Overnight accommodation at Inland Motel, Barkly Hotel

Depart Mt. Isa by air *	7.20 a.m.	Saturday 27th July

Fly over Duchess

Arrive Ayr	10.30 a.m.	" " "

Burdekin Delta

Depart Ayr by air	4.45 p.m.	" " "
Arrive Townsville	5.15 p.m.	" " "

Overnight accommodation at Reef Motel

Depart Townsville by air	9.45 a.m.	Sunday 28th July
Arrive Charters Towers	10.15 a.m.	" " "

Greenvale Nickel

Depart Charters Towers by air	12.00 noon	" " "
Arrive Clermont	1.05 p.m.	" " "

Blair Athol Coal Pty. Ltd.

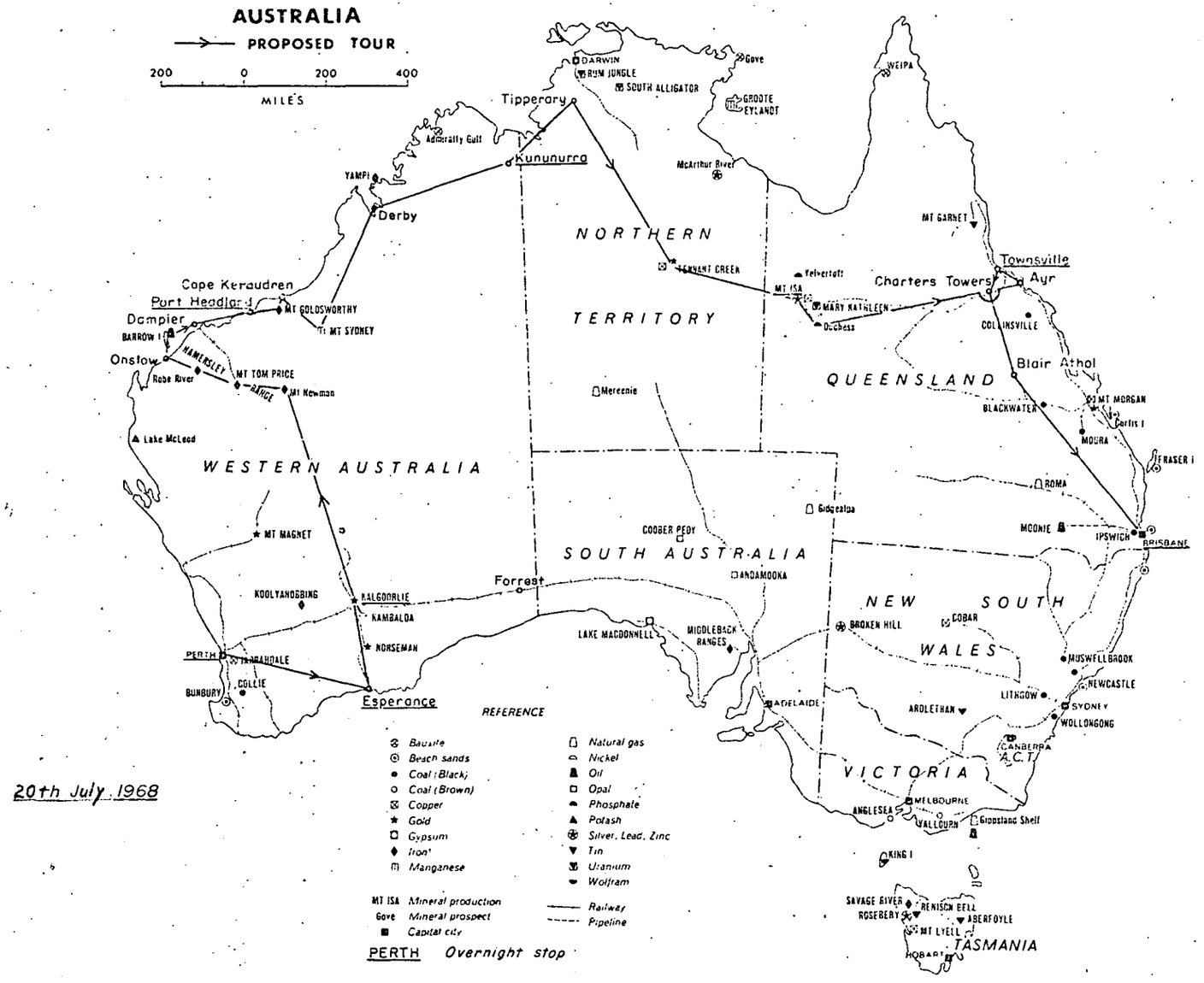
Depart Clermont by air	4.00 p.m.	" " "
Arrive Brisbane	6.10 p.m.	" " "

Overnight accommodation at Tower Mill Motel

<u>End of Tour</u>

* Breakfast in aircraft

<u>NOTE</u>: The aircraft will be leaving Brisbane 9.00 a.m. on 29th July flying via Sydney to Melbourne arriving there at 1.50 p.m.



20th July 1968

List of Members on Tour - July 21st - 28th 1968

M. G. Mackay	-	M.P. for Evans (N.S.W.)
R. H. Whittorn	-	M.P. for Balaclava (Vic.)
A. A. Street	-	M.P. for Corangamite (Vic.)
R. C. Katter	-	M.P. for Kennedy (Qld.)
J. A. Pettitt	-	M.P. for Hume (N.S.W.)
A. A. Armstrong	-	M.P. for Riverina (N.S.W.)
E. H. St. John	-	M.P. for Warringha (N.S.W.)
I. B. E. Wilson	-	M.P. for Sturt (S.A.)
Hon. W. C. Haworth	-	M.P. for Isaacs (Vic.)
A. W. Jarman	-	M.P. for Deakin (Vic.)
D. Cameron	-	M.P. for Griffith (Qld.)
S. E. Calder	-	M.P. for Northern Territory
H. B. Turner	-	M.P. for Bradfield (N.S.W.)
J. Corbett	-	M.P. for Maranoa (Qld.)
R. S. King	-	M.P. for Wimmera (Vic.)
D. R. Munro	-	M.P. for Eden-Monaro (N.S.W.)
G. F. Clarke	-	Bureau of Mineral Resources
E. Dean	-	Press Secretary to the Minister for National Development
R. H. J. Thompson	-	Assistant Secretary, Department of National Development
L. Meredith	-	A.B.C. Representative
I. Walton	-	Industrial Observer W. King Yuell & Co.
J. Bruce	-	Public Servant N.S.W.
W. Quigley	-	Company Director } Hutchinson and
K. Hutchinson	-	Company Director } Quigley Pty Ltd.
N. Williamson	-	Cattle Breeder representing Williamson Bros.
W. Marr	-	Stock Broker (Syd.)
W. Holloway	-	Civil Engineering
N. L. Hain	-	Hain & Co. Retailers & Builders Suppliers
P. G. Doyle	-	Cooma Company Director
D. Baldry	-	Grazier of Wallendbeen N.S.W.
L. J. Bell	-	Associated Rural Industries Ltd.
K. Horler	-	Executive Director APEA
P. Solomon	-	Consulting Geologist
F. Greenwood	-	Dept. of the North West (W.A.)
P. Brand	-	Dept. of Industrial Development (W.A.)

TOUR GUIDE

The following notes have been prepared to brief members of the tour. Where more detailed information has been thought necessary separate papers have been prepared. These are appended and are referred to in the text.

For convenience, an itinerary and map of the route have been prepared as separate documents, however a detailed itinerary for each day is given in these notes.

The Western Australian and Queensland Departments of Industrial Development have provided literature to cover the tour of W.A. and Queensland. Members will find the literature on their seat in the aircraft.

The aircraft will leave Essendon airport at 10.30 a.m. on 21st July and fly via Adelaide and Forrest to Perth where the tour will commence.

Sunday 21st July Melbourne to Perth

10.30 a.m. Depart Essendon
11.55 a.m. Arrive Adelaide - refuel
12.30 p.m. Depart Adelaide
3.20 p.m. Arrive Forrest - refuel
3.50 p.m. Depart Forrest
5.55 p.m. Arrive Perth - The Hon. C. W. M. Court, O.B.E., Minister for Industrial Development and the North-West, will meet the party at 6.10 p.m. in the VIP Room at the Perth airport. Transport to motel provided by T.A.A. Overnight accommodation has been arranged at the Travelodge Motel, 54 Terrace Road, Perth.

Monday 22nd July Perth to Esperance

7.00 a.m. Depart Motel for Perth airport - transport provided by T.A.A.
7.30 a.m. Depart Perth - breakfast in aircraft.
9.20 a.m. Arrive Esperance. The party will be met at the airport by Mr. J. F. Cameron, Shire Clerk who has arranged a tour of the Gibson Research Station (O.I.C. Mr. Fox) an Australian farm, and the town. Mr. J. F. Parkin, District Officer of the Department of Agriculture will assist in the tour.

Overnight accommodation has been arranged at the Highway Motel.

Western Australia is enjoying an era of prosperity and development which has been described as rapidly removing the 'imbalance between the State and the Eastern States' and it is claimed that it is maintaining a faster rate of expansion than Australia as a whole. In the period 1959 to 1968 the total private capital injected into the State economy has been in excess of $1,800,000,000 and it has been estimated that in the next three years a further $1,400,000,000 will be invested.

For details of the developments in the State, Members are referred to the pamphlet "Western Australia" and to the excellent map it contains. Basic facts on W.A. are contained in this pamphlet.

It may be possible, immediately after take off, to see the bauxite mining operation of Western Aluminium N.L. at Jarrahdale. Bauxite is railed 29 miles from Jarrahdale to the alumina refinery at Kwinana. Western Aluminium is expanding the capacity of the refinery from about 410,000 to 830,000 metric tons to come into operation in the second half of 1969. Production of alumina was over 405,000 tons for the 12 months ending December, 1967.

After leaving Perth the aircraft will fly over some of the richest wheat and sheep producing areas of Western Australia before passing Ravensthorpe, a small mining town of about 800 people, located about 100 miles west of Esperance. Mining activities at Ravensthorpe are mainly carried out by the Ravensthorpe Copper Mine N.L. In the year ended June, 1967 the Company milled 57,071 tons of ore for 3276 tons of concentrate averaging about 23% copper, 7.79 dwts of gold and 1.5 ozs of silver. The concentrates are shipped through the port of Esperance to Japan.

Esperance is the centre of a large land development scheme and is one of the fastest rural growth areas in Australia. Agricultural scientists believe that within 20 years it could become a major agricultural region of the Commonwealth. It is also the port for the shipment of copper concentrates from Ravensthorpe and nickel concentrates from Kambalda.

The town has a population of about 2700, and the surrounding Shire, which covers a little over 11,000 square miles, has a population of about 4900. The area contains about 2.5 million acres of heath plain country on the southern seaboard with a rainfall of 16 - 28 inches. To the north it merges into about 4.0 million acres of mallee country with a rainfall of 13 - 16 inches. It is currently carrying about 900,000 sheep and 28,000 head of cattle.

Esperance was first settled in 1864 by the Dempster Brothers who drove 500 sheep and 200 horses overland from Northam, 60 miles east of Perth, but it was not until 1893 that the town and port were established following the discovery of gold in 1892 at Coolgardia. Its importance as a port for Coolgardie waned with the completion of the Kalgoorlie - Perth railway in 1897.

The completion of the railway line from Coolgardie to Esperance in 1927 and the development of farming in the mallee area to the north brought some prosperity to Esperance in the decade following World War I. This prosperity was shortlived with the failure of the wheat farms in the 1930's.

In 1949 the W.A. Department of Agriculture established a research station at Gibson 18 miles north of Esperance. It was here that research workers soon discovered what could be done by the use of trace elements, superphosphate, subclover, and modern farming techniques.

The land at Esperance is mainly light sand overlying gravel and clay at varying depths. The surface is slightly undulating and almost treeless making it relatively easy to clear. Experiments at Gibson show that the soils of the Esperance Plain are deficient in zinc copper and phosphorus, and nitrogen levels in virgin soil are low.

In 1956 the W.A. Government gave American promoter Allen T. Chase (who was also associated with the Humpty Doo rice project in the Northern Territory) an option over 1.5 million acres, but agricultural development in this instance failed because the methods recommended by the Research Station were not followed.

The growth of the Esperance region has been remarkable. In 1953 there were 130 farms in the area. By March 1961 this had grown to 347 farms and today there are over 650. Much of the expansion has been due to the activities of the Esperance Land and Development Co., a consortium of American Factors Associates Ltd and Arcturus Investment and Development Ltd. Under a 1960 agreement with the W.A. Government, the Company can develop 1.45 million acres of the Esperance Plain. The land is being subdivided into holdings of about 2000 acres. The Company has the right to retain half the land it develops and the remainder has to be sold. Over the last four years the Company has sold about 100 blocks.

The W.A. Government has a Conditional Purchase Scheme whereby a settler is allotted a holding of 2000 - 3500 acres at $1 to $2 an acre over

20 - 25 years. Esperance land costs about $40 an acre to develop to the stage where it can carry three sheep to the acre.

Under an agreement with the W.A. Government which provided financial assistance, the Esperance Fertiliser Works was established in 1964 at a cost of $3.1 million to supply fertilisers to the area.

The American television personality Art Linkletter has a 22,000 acre property 40 miles east of Esperance. He is reported to have spent $2.0 million in developing the property and hopes to get a 20% return on his investment.

A paper on Esperance is appended.

Tuesday 23rd July Esperance to Kalgoorlie

6.30 a.m. Breakfast

7.00 a.m. Depart Motel for airport

7.45 a.m. Depart Esperance

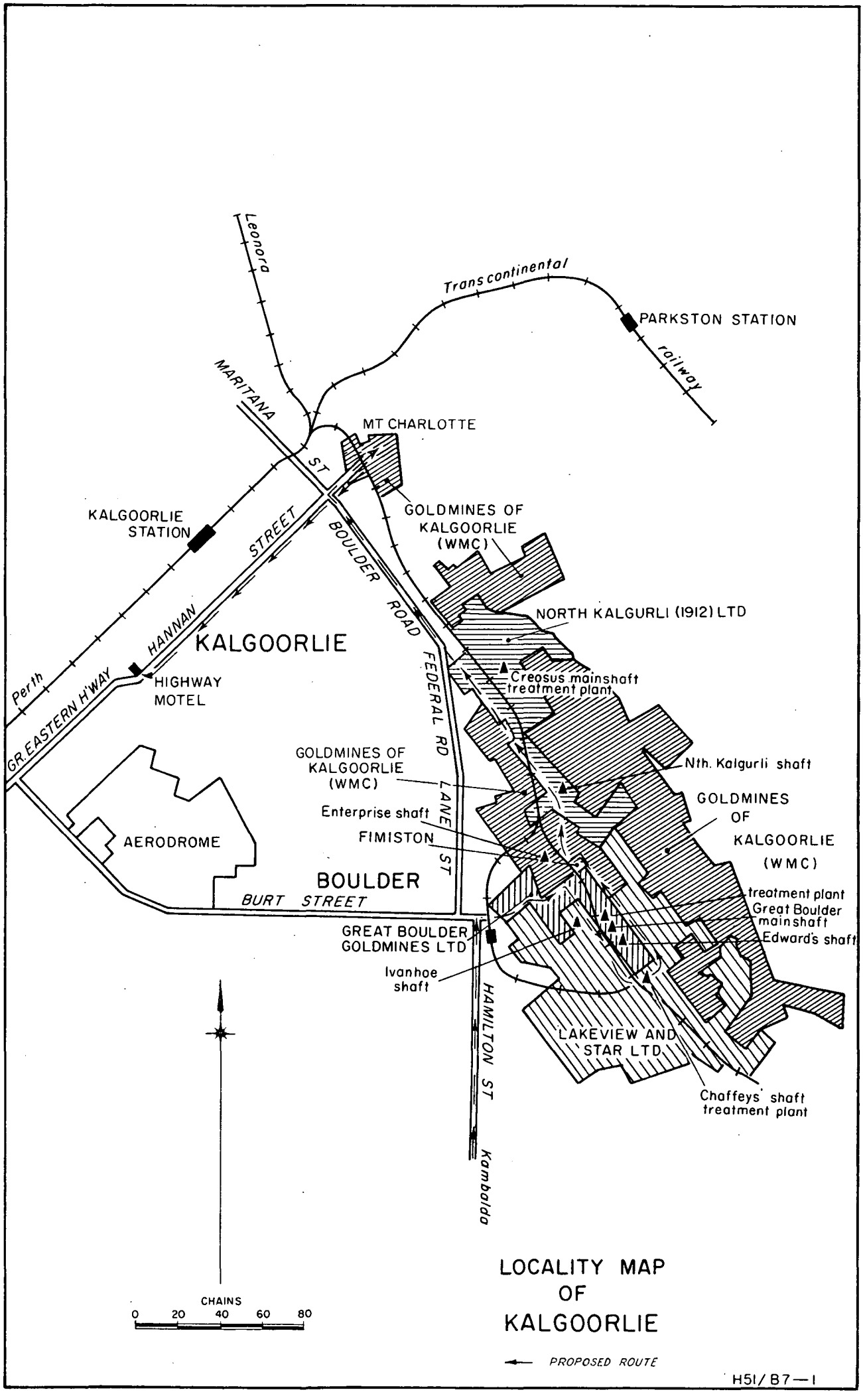
8.45 a.m. Arrive Kalgoorlie. The party will be met at the airport by Mr. Jim Lissiman of Western Mining Corporation who will accompany members to Kambalda. The bus will leave Kalgoorlie at 9.00 a.m. and return to Kalgoorlie at 3.00 p.m. Lunch is being provided by W.M.C. at the Kambalda Club at 12.30 p.m. After returning to Kalgoorlie the party will tour the Golden Mile. (See map attached).

A civic reception has been arranged by the Mayor Cr L. A. Alman in the Banquet Room of the Town Hall at 8.15 p.m. The Town Clerk is Mr. Doug Morrison.

Overnight accommodation has been arranged at the Highway Motel.

On the flight from Esperance to Kalgoorlie the aircraft will pass over Norseman and Kambalda. Norseman is a gold and pyrite mining centre on the southern end of Lake Cowan, a large salt lake.

Norseman Gold Mines N.L. produced pyrite from the Iron King Mine which can be seen about 4 miles south of the town. Production for 1967 was 58,653 tons (containing 26,678 tons sulphur) valued F.O.R. at $875,665. The pyrite concentrate is railed to fertiliser works in Perth where it is roasted for the production of sulphuric acid. Contracts with CSBP and Farmers Ltd, and Cresco Fertilisers Ltd lapsed at the end of 1967 because the companies pre-


Leonora
Transcontinental
railway
PARKSTON STATION
MARITANA ST
MT CHARLOTTE
KALGOORLIE STATION
STREET
HANNAN
BOULDER ROAD
GOLDMINES OF KALGOORLIE (WMC)
NORTH KALGURLI (1912) LTD
KALGOORLIE
Perth
GR. EASTERN HWAY
HIGHWAY MOTEL
Creosus mainshaft
treatment plant
FEDERAL RD
LANE ST
GOLDMINES OF KALGOORLIE (WMC)
Nth. Kalgurli shaft
Enterprise shaft
FIMISTON
GOLDMINES OF KALGOORLIE (WMC)
AERODROME
BOULDER
BURT STREET
treatment plant
Great Boulder mainshaft
Edward's shaft
GREAT BOULDER GOLDMINES LTD
Ivanhoe shaft
HAMILTON ST
LAKEVIEW AND STAR LTD
Chaffeys shaft
treatment plant
Kambalda
CHAINS
0 20 40 60 80
LOCALITY MAP OF KALGOORLIE
PROPOSED ROUTE
H51/B7—1

ferred elemental sulphur to pyrites. The Minister for Trade and Industry announced on 4th March, 1968 the adoption of a Tariff Board recommendation that the Government could best discharge its obligation (incurred when the Government actively encouraged the use of indigenous sulphur bearing materials) by a grant of $385,000 to Norseman Gold Mines.

It is understood that the company received a further contract for 15,000 tons of pyrites and that this was fulfilled at the end of June, 1968. It was reported in the press recently (6.7.68) that the Iron King Mine had closed down.

The principal gold producer is Central Norseman Gold Mines N.L., a subsidiary of Western Mining Corporation. Production for the year ended June 1967 was 186,963 tons of ore for 91,033 ozs of gold and 78,150 ozs of silver, equivalent to 9.74 dwts of gold and 8.36 dwts of silver per ton. This production came from two mines, the Phoenix and the Princess Royal. The Phoenix Mine and dump can be seen immediately to the east of the town and a head frame of the Princess Royal can be seen further to the north east. Reserves were estimated to be 529,000 tons averaging 10dwts gold at 27th June 1967.

The settlement of Widgiemooltha is situated on the southern shore of Lake Lefroy, another large salt lake, and Kambalda is on the north-west shore of the lake. Both these towns should be visible from the aircraft, and are referred to in the paper on Kambalda appended to this text.

Norseman Gold Mines have an agreement with Sumitomo Shoji Kaisha Ltd to investigate the possibility of harvesting salt from Lake Lefroy for export to Japan. Plans are for export to commence late in 1968 at a rate of 200,000 tons annually rising to 500,000 tons by 1970. The salt will be railed to Esperance for export.

1968 is the 75th Anniversary of the discovery of gold at Kalgoorlie by Paddy Hannan in 1893. A statue was erected in his honour in Hannan Street in 1929. The W.A. Department of Industrial Development has produced a pamphlet entitled "The Golden Mile 1893-1968" and a copy can be found in the literature provided.

The twin cities of Kalgoorlie and Boulder straddle the Golden Mile, an area about two miles long and half a mile wide, which has proved to be one of the richest gold mining areas in the world.

Gold production in W.A. has declined from 802,860 ozs in 1963 to 626,961 ozs in 1966; (production for 9 months to September, 1967 was 427,000 ozs.), but despite the difficulty of producing a fixed price commodity under the burden of rising costs, the gold mining industry has, by efficient management and co-operation of both Commonwealth and State Governments, continued to contribute about $18 million worth of gold a year to the State's economy.

The State produces between 70-80% of the Nation's gold.

Amendments to the Gold Mining Industry Assistance Act 1954 received assent in Federal Parliament on 2nd June 1965, and the operation of the Act was extended for a further five years from 30th June 1965. Under the amended Act, subsidy is paid to large producers, on gold produced on or after 1st July 1965, at the rate of three quarters of the excess of the average cost of production over $27 per fine ounce, with a maximum subsidy of $8 per fine ounce. A producer whose output is more than 500 ounces per annum may elect to be treated as a small producer, in which case the subsidy rate payable on total deliveries is $6 per fine ounce, reduced by one cent for each fine ounce by which deliveries exceed 500 fine ounces. The subsidy payable to small producers whose annual deliveries do not exceed 500 fine ounces is $6 per fine ounce. Premiums received by producers from the sale of gold overseas by the Gold Producers' Association Limited are offset against subsidy payments.

A large producer will be able to include in his costs for subsidy purposes one-half of the costs incurred in approved exploratory diamond drilling elsewhere than in his mining property. The criterion for approval will be whether diamond drilling, if it results in the discovery of gold-bearing minerals of payable grade, would contribute to the continued production of gold-bearing minerals in, or in the vicinity of, an existing gold-mining area.

PRODUCTION OF GOLD IN WESTERN AUSTRALIA 1966

Company	Location	Tons treated	Gold produced (fine oz)	Average no. of men employed
Central Norseman Gold Corp. N.L.	Norseman	188,647	98,992	296
Golf Mines of Kalgoorlie (Aust.) Ltd	Fimiston and Kalgoorlie	849,953	158,136	810
Great Boulder Gold Mines Ltd	Fimiston	360,417	83,129	613
Hill 50 Gold Mine N.L.	Mt. Magnet	156,859	41,201	190
Lake View & Star Ltd	Fimiston	644,625	148,130	830
Moonlight Wiluna Gold Mines Ltd	Mt. Ida	24,910	9,697	62
North Kalgurli (1912) Ltd	Fimiston	364,140	70,108	462
Sundry Producers		29,465	17,729	790
	Totals	2,619,016	627,052	4,053

Source: Chamber of Mines of Western Australia.

Treatment of gold ores in Australia follows the conventional practice of crushing to the required degree of fineness and recovery of the gold by amalgamation or cyanidation, or a combination of both processes. At Kalgoorlie, where part of the gold is associated with sulphides, a gold-bearing pyritic concentrate is obtained by flotation, the concentrate is roasted, and the gold is recovered by cyanidation. The tailings from the flotation plant may be cyanided. In recent years, part of the concentrate has been despatched to Fremantle, where sulphur from the roaster gases is used for the production of sulphuric acid, and the roasted concentrate cyanided. Amalgam and gold slimes from cyanide extraction are treated at the various plants to produce gold bullion, which at some mines may be partly refined before despatch to the Perth Mint and other refiners. Accumulated gold-bearing matter and slags are sent to public analysts or to base metal smelters for treatment.

Interest in the search for gold is being maintained by companies in the eastern goldfields. Exploration is directed towards location of concealed ore bodies and involves fairly large scale diamond drilling.

Wednesday 24th July Kalgoorlie to Port Hedland

6.30 a.m.	Depart Motel for airport
7.30 a.m.	Depart Kalgoorlie. Breakfast in aircraft - fly over Mt. Newman and Tom Price.
11.25 a.m.	Arrive Onslow - Refuelling stop only
11.55 a.m.	Depart Onslow
12.20 p.m.	Arrive Barrow Island - a tour of the oil installations on the island has been arranged by WAPET. Lunch will be provided in the company mess.
2.25 p.m.	Depart Barrow Island
3.00 p.m.	Arrive Dampier. The party will be met by Brig. Donald R. Jackson, Manager for Liaison, Hamersley Iron Pty Ltd who has arranged a tour of the company's installations.
5.30 p.m.	Depart Dampier.
6.05 p.m.	Arrive Port Hedland - transport to Motel by T.A.A. Arrangements have been made by the W.A. Department of Industrial Development for Mr. John C. Tozer, Assistant to the Administrator of the North West to address members during the evening. The Shire President Mr. Angus Richardson may also be present.

Overnight accommodation has been arranged at the Walkabout Motel.

On the flight from Kalgoorlie to Onslow the aircraft will detour to fly over Mt Newman and Mt Tom Price. These two centres are situated in an iron province where reserves of iron ore have been estimated at 15,000 million tons. By comparison the known reserves of iron ore in Australia in 1960 were of the order of 360 million tons. The lifting of the embargo on the export of iron ore led to the remarkable change in the reserve position, and Western Australia emerged as one of the largest sources of high grade iron ore in the Western world.

The W.A. Government has entered into agreements which require the companies to accept major community responsibilities in return for the right of access to the ore. Companies are called on to build towns, railways, ports, and roads wherever required, and provide where possible for the development of processing industries.

Mt Newman is the name of the townsite for the iron ore project of the Mount Newman Consortium at Mount Whaleback in the Ophthalmia Ranges. The mine is about 265 miles south of Port Hedland and has reserves of 345 million tons (64% Fe). The Consortium has contracts to supply Japanese steel mills with 100 million tons of iron ore over 15 years commencing in 1969. Value of the contracts is $777 million. In addition Broken Hill Proprietary Ltd will purchase 66.5 million tons of ore over 20 years commencing in 1970 for its own iron and steel making operation. Population of the town is expected to reach 2800 by 1975. Further details of reported additional contracts are given in the paper "Mt Newman Mining" which is appended.

Tom Price is the name of the town for the operation of Hamersley Iron Pty Ltd at Mt Tom Price. The mine is 179 miles south east of Dampier and has reserves of 500 million tons (64% Fe). The company has contracts extending to 1982 to supply about 156 million tons of iron ore and pellets to steel mills in Japan, Britain and Europe. Total value of the contracts are estimated to be in excess of $1100 million. Dampier is the port for Mt Tom Price and the first shipment of ore to Japan was made from there in August 1966.

A paper on Hamersley Iron Pty Ltd is appended.

After leaving Tom Price the aircraft will fly to Onslow to refuel before flying to Barrow Island.

Onslow is situated on Beadon Bay and is about 890 miles by road from Perth. The town serves the expanding wool industry of the Ashburton and is the nearest port to Barrow Island.

A paper on the discovery and development of Barrow Island oil field is appended.

From Barrow Island the aircraft will fly to Dampier.

Dampier is the port for the mining operation of Hamersley Iron Pty Ltd at Tom Price and is the site of a pellet plant which came into production in March of this year. The plant is the largest of its type in the world and is capable of producing 2 million tons of iron pellets a year.

Hamersley Iron Pty Ltd has installed two desalination units to supply water for domestic use, ore treatment, and shipping requirements. Each of the units produce daily 200,000 gallons of fresh water from sea water. The high salt content is removed from the sea water by flash evaporation. A feature of the installation is the use of waste heat from the exhaust gases of the diesel engines in the power station.

A solar salt project is being established at Dampier by Dampier Salt Ltd to produce a reported 650,000 tons salt annually by 1970.

Separate papers on Dampier and Port Dampier (King Bay) are appended.

The aircraft will leave Dampier late in the afternoon for the short flight to Port Hedland. On the way it will pass over Cape Lambert which is the proposed port site for Cliffs Western Australian Mining Co. project at Mt Enid in the Robe River area. The principal share holders of this company are Cleveland Cliffs Iron Co. 51%, Mitsui and Co. 35%, Garrick Agnew Pty Ltd 7½%. The mine site is approximately 90 miles south of Cape Lambert and reserves are estimated to be 3000 million tons (56% Fe) of limonitic ores. The Company's proposal for development includes a rail link to Cape Lambert where a port and pellet plant will be established. The project will involve an estimated expenditure of $70 million. Cliffs Western Australian held a 71.4 million ton contract for pellets but this was cancelled and the company is negotiating a new larger contract for pellets and a contract for the sale of iron ore fines. Figures reported in September 1967 were 87.5 million tons of pellets and 50.50 million tons of fines.

If a contract of this order is finalised it would be the largest export contract for iron ore made by an Australian company and would boost the total quantity to be exported to about 500 million tons valued at above $4,000 million f.o.b.

Development of Cape Lambert to serve the Robe River area will enhance the prospects of the Roebourne District. The town of Roebourne is situated on the North West Coast Highway about 13 miles south of Port Sampson. The latter is the port for Roebourne and should be visible from the aircraft. The main industry of the area is sheep farming. Roebourne has a permanent population of about 160.

Port Hedland is the port and administrative centre of the Pilbara region and also the port for the Mt Newman operations. It is 1214 miles by the coastal highway from Perth. The town is built on a small island accessible by a tow mile causeway. Its population is in the vicinity of 3000 and is increasing rapidly. Plans were announced in May 1967 to build a new town a few miles inland beyond the tidal flats to absorb the impact on Port Hedland of the $200 million Mt Newman project. Both towns are expected to have a population of 12,000 by 1980.

A paper on Port Hedland is appended.

Produce shipped through the port includes wool, sheep, and minerals. Current mineral development projects in the area include iron ore mining at Mt Goldsworthy and Mt. Whaleback. It is estimated that by 1980 the port will handle at least 30 million tons of cargo a year. Manganese is also shipped through the port. The principal producers are Mt Sydney Manganese Pty Ltd operating at Woodie Woodie and Westralian Ores Pty Ltd operating in the Mt Cooke area. Production of manganese ore in W.A. for 12 months ending December 1967 was 183,837 tons of which 130,600 tons was produced in the Pilbara Goldfield. The remaining 53,237 tons was produced by Westralian Ores and Broken Hill Pty Ltd from the Peak Hill Goldfield to the south.

The Leslie Salt Co. of San Francisco is constructing a solar salt plant at Port Hedland. Exports of salt are expected to begin at an initial rate of 475,000 tons in 1969 rising to 1 million tons per annum upon completion of the plant. Subject to demand, plans are in hand to expand the plant to produce 2 million tons per annum by 1975. Estimated cost is $7 million.

$17,100,000 will be spent by the Main Roads Department to complete the realignment and sealing of the north coast highway from Carnarvon to Port Hedland by 1975.

The Public Works Department has provided $2,394,000 for the construction of a land backed berth which is scheduled for completion in 1969.

Another project which is scheduled for completion in 1970 is a broadband communication system between Perth, Carnarvon, and Port Hedland which is being installed by the P.M.G. Department at a cost of $120 million.

Thursday 25th July Port Hedland to Kununurra

7.00 a.m.	Breakfast
7.45 a.m.	Depart Motel for airport
8.25 a.m.	Depart Port Hedland - Fly over Mt Goldsworthy, Cape Kirauden and Mt Sydney.
11.15 a.m.	Arrive Derby - refuelling stop
11.45 a.m.	Depart Derby. Lunch in aircraft
1.30 p.m.	Arrive Kununurra. The party will be met by Mr. Neil Kenworthy, District Engineer and Mr. Dennis O'Brien, Public Relations Officer of the Public Works Department. A tour has been arranged to include a cotton farm, a

cotton ginnery, the Kimberley Research Station, and the town.

Overnight accommodation has been arranged at Kununurra Motel, Ord River Motel and the Hotel.

On the flight from Port Hedland to Derby the aircraft will detour over Mt. Goldsworthy, Cape Kiraudren, and Mt Sydney.

Mt. Goldsworthy is the centre of the iron mining operations of Goldsworthy Mining Pty Ltd. The mine is about 70 miles by rail from Port Hedland and has reserves of 65 million tons (54-64% Fe). The company has contracts to supply 31 million tons of lump ore and fines to Japan extending to 1979. Ore is transported by standard guage railway, built by the company, to a stockpile on Finucane Island at Port Hedland, from where it is shipped to Japan.

A separate paper on Mt Goldsworthy is appended.

Cape Kirauden is the proposed site of a port for Sentinel Mining Co.'s iron ore operations at Nimingarra about 100 miles east of Port Hedland. The company has been given an extension to 30th June 1968 to supply details of proposed developments of the deposits at Nimingarra.

A separate paper on Sentinel Mining is appended.

From Cape Kirauden the aircraft will divert to the Mt Sydney area to give members the opportunity of seeing from the air the open cut mining operations of Mt Sydney Manganese Pty Ltd in the Woodie Woodie area. Manganese ore is mined by contractors and sent by road to Port Hedland.

Further to the south similar operations are carried out by Westralian Ores Pty Ltd. Westralian Ores is the operating company of Bell Bros. Ltd, an earth moving and cartage contractor of Perth. The ore is sent by road to Port Hedland for shipment.

Production by Mt Sydney for 12 months ending December 1967 was 59,610 tons, and by Westralian Ores at Mt Cooke 70,990 tons.

After leaving Mt Sydney the aircraft will fly across the Canning Basin to Derby. The Canning Basin is held by WAPET outright or under farmout agreement. A progress report by the W.A. Government 1959-68 states that WAPET plans to spend $17,000,000 on oil exploration in W.A. during 1968, of

which $11,000,000 will be spent on drilling about 85 wells. Total expenditure to the end of 1968 by the four companies participating in WAPET will be $120 million.

The Bureau of Mineral Resources will carry out a reconnaissance marine surface gravity, magnetic, and seismic survey over the continental shelf offshore from the Canning Basin during the period August to November of this year. The survey is a continuation of a programme commenced by the Bureau on the shelf area of the Timor Sea in 1965, to obtain basic geological and geophysical data to assist in the search for minerals.

On the flight to Derby it may be possible to see the town of Broome to the west of the flight path.

Broome is the centre of W.A.'s mother of pearl shell industry and also the site of one of the most modern and up to date meatworks in Australia. Built at a cost of $4 million the latter employs 30 men permanently and another 70 during the killing season when 30-35,000 head of cattle are processed.

Population of the town is about 1500 but in years gone by up to 3000 men were employed on the 450 luggers which operated out of Broome. Few luggers are now in operation. The town has a new deep water jetty 2700 feet long which gives ships a minimum of 32 feet of water at low tide.

Developing and upgrading roads in the north have been a boon to the development of Broome.

The aircraft will stop at Derby for thirty minutes to refuel.

Derby is the principal port and commercial centre of the West Kimberley District. It is 1460 miles by road from Perth and has a population of about 1500. A meatworks for processing cattle provides the basis for the town's growing prosperity. A $900,000 beef road from Glenroy to Derby has assisted the development of beef processing.

A $2,000,000 steel and concrete jetty was completed in 1965 to provide port facilities for shipping including exports of live cattle.

Mr. H. L. McGuigan the Administrator of the North West resides at Derby.

In 1964 the Western Australian Cabinet established The North West Planning Authority, the main functions of which are to assess the resources and potential development of the area north of the 26th parallel, and to examine projects which lend themselves to development by the State or Commonwealth or both. The Director of Engineering of the Public Works Department (Mr. John Parker) is chairman of the Authority and members are the Under Treasurer, Director of Agriculture, Commissioner of Main Roads, Surveyor General and the Administrator of the North West. The name of the authority has since been changed to "North-West Planning and Co-ordinating Authority".

The State Government has been given valuable financial assistance by the Commonwealth to develop its northern areas. This applies particularly to the Ord River project, beef roads, and the development of the Wyndham Derby and Broome ports.

From Derby the aircraft will fly across the Kimberley to Kununurra.

In the seven year period to June 1968 approximately $20,000,000 has been allocated by the Commonwealth and State for the upgrading of Kimberley beef roads to enable large scale transport of cattle to meatworks at Broome, Derby, and Wyndham. The Commonwealth has provided $9,900,000 of this amount and in November 1967 announced a $9,500,000 extension to the programme. The Kimberley region accounts for more than 50% of the cattle in the State and offers considerable potential for future development of the beef export industry.

The region has been geologically mapped by joint parties from the Bureau of Mineral Resources and the W.A. Geological Survey and this has greatly increased the interest of exploration companies in the mineral potential of the area.

Extensive testing of bauxite deposits in the Admiralty Gulf area has been carried out by United States Metals Refining Company (a subsidiary of American Metal Climax Inc,). If adequate reserves are established and a firm decision made to proceed, an alumina plant, town, and port will be built.

Iron ore deposits are being worked by Dampier Mining Co., a subsidiary of the Broken Hill Proprietary Ltd at Koolan and Cockatoo Island in Yampi Sound. Production for the 12 months to December 1967 was 1,538,000 tons from Koolan and 678,000 tons from Cockatoo Island.

Kununurra is the administrative and commercial centre for the Ord River Scheme and is located about 2 miles from the diversion dam. Through its main tributaries the Ord River drains a 17,000 square mile catchment on which monsoonal rains can fall at the rate of up to 12 inches in 24 hours. Average annual flow of the river is approximately 2,400,000 acre feet or 650,000,000 gallons.

The first stage of the Ord project involving the construction of a diversion dam and channel system to provide irrigation facilities for the development of 26,000 acres was completed in 1963, at a cost of $12.08 million. In that year about 1400 acres were planted to cotton by the first five commercial growers. This year about 30 farms each of approximately 650 acres are in operation and about 12,000 acres were planted to cotton.

Sorghum is an alternative crop and shows economic promise, especially in view of the strong demand building up in Japan.

The Commonwealth Government recently announced its support for stage 2 of the Ord project with the provision of financial assistance to the State of W.A. of just over $48,000,000. The assistance is being provided on the basis of a non repayable grant ($20.9 million) for the construction of the dam and an interest bearing loan ($27.25 million) for associated irrigation works.

Stage 2 comprises a major storage dam on the Ord River about 30 miles up stream from the diversion dam, and associated irrigation works to supply water for the development of a further 150,000 acres of which 100,000 acres lies in W.A. Storage capacity of the dam will be about 4.6 million acre feet.

The commercial possibilities of a number of other crops and tropical pastures are being investigated at the Kimberley Research Station on the Ord River. The station has been jointly financed and staffed by the Commonwealth and Western Australian Governments since its establishment in 1946.

Separate papers on Kununurra, the Ord Scheme, and the Kimberley Research Station are appended.

Wyndham is the only port for the East Kimberley area and is 66 miles northwest of Kununurra. It has a population of about 900 which rises to about 1200 from May to September when the Wyndham Meat Works is in operation. About 35,000 head of Kimberley cattle are processed annually. Further beef road improvements are expected to increase the throughput of the meatworks.

Friday 26th July	Kununurra to Mt Isa
6.15 a.m.	Breakfast
6.45 a.m.	Depart Motel for airport
7.15 a.m.	Depart Kununurra. Fly over Tipperary.
12.40 a.m.	Arrive Tennant Creek. The party will be met by Mr. R. E. White, General Manager of Peko-Mines, and taken on a tour of the Peko Plant, Juno Mine, and Warrego Mine. To conserve time a sandwich lunch will be provided during the tour.
4.00 p.m.	Depart Tennant Creek
6.10 p.m.	Arrive Mt. Isa. The party will be met at the airport by officials of Mt. Isa Mines. A dinner has been organised by Mt. Isa Mines.

Accommodation has been arranged at the Inland Motel and the Barkly Hotel.

On the flight from Kununurra to Tennant Creek the aircraft will divert to the north to fly over Tipperary Station. This station covers 3500 square miles and was purchased by the Tipperary Land Corporation in 1967 to produce sorghum, mainly for the expanding Japanese market.

A paper on Tipperary is appended.

A geological party from the Bureau of Mineral Resources is currently completing the regional mapping of the Victoria River area in the Northern Teritory. Use is being made of helicopters and the party is camped near Fitzroy Station on the Victoria River. The geological activities of the Bureau on the continent are mainly confined to the area north of the 26th Parallel and to date about 75% of the area has been mapped at a scale of 1:250,000.

Between the Ord Region and Katherine (situated about 220 miles south of Darwin on the Stuart Highway) a system of beef roads has been constructed under the 1961-66 Beef Roads Programme. For a detailed treatment of beef roads, members are referred to the paper "Beef Road Scheme", a copy of which is appended. This paper is already familiar to M.P.'s and contains a map outlining the future beef road programme in W.A., the N.T., and Queensland.

Improvement of roads, stock routes, and harbour facilities in the North has greatly assisted the beef industry to increase the rate of turn-off from existing numbers, largely by reducing the age of turnoff.

The only centre to be visited (apart from the fly over of Tipperary) in the Northern Territory is Tennant Creek. A separate paper with a locality map of Tennant Creek is appended.

Outstanding developments of recent years in the N.T. include harbour extensions, forestry, and the expansion of mining activities. Additional berthage and cargo handling facilities have been provided in Darwin at a cost of over $4 million.

In 1966 the Minister for Territories announced a four year development programme which included increasing the rate of establishing soft wood plantation from 350 acres per year to 1000 acres per year by 1969-70.

Mineral developments include the iron ore operations at Francis Creek and Mt Bundey. The Francis Creek Iron Mining Corporation has a contract to export 4 million tons of ore to Japan over 8 years. Morgan Mining and Industrial Co. Pty Ltd has a contract to export 1.4 million tons of ore to Japan, from Mt Bundey over a period of 7 years.

Plans are in hand for the development of the Gove bauxite deposits by Nabalco Pty Ltd. Reserves are estimated to be of the order of 160 million tons and the company proposes to construct an alumina refinery at Gove with an initial annual capacity of 500,000 tons. Early estimates of the cost of the project were about $100 million but because of the inaccessibility and isolation of the area this initial cost was revised to about $200 million. A recent report in the Financial Review based on an announcement by Alusiusse put the figure in excess of $300 million. The project is expected to employ 800 people and to support a population of 3000 in a new township at Gove.

In December 1967 the then Minister for Territories Mr. C. E. Barnes invited companies to submit proposals for the further exploration and possible development of a lead-zinc prospect at Woodcutters near Rum Jungle which was discovered by the Bureau of Mineral Resources in the course of an exploration programme for uranium. The area offered for release comprises about 360 acres covering the known occurrence of the mineralisation.

Production of manganese ore from Groote Eylandt has increased from 123,000 tons in 1966 to about 365,000 tons in 1967. A little over a third of this was exported overseas and the remainder shipped to Bell Bay and Newcastle for the production of ferro-manganese and silico-manganese.

The flight path to Tennant Creek crosses the Murranji Track which runs from Newcastle Waters to Top Springs. It may not be possible to see Newcastle Waters from the aircraft but Lake Woods to the south of Newcastle Waters should be clearly visible on the port side. The Murranji Track was pioneered by cattlemen moving cattle from Queensland to the Kimberley area, and it eventually became one of the main routes for moving cattle from the Victoria River District. Its use has declined in recent years with the development of beef roads and the construction of meatworks at Katherine and Darwin. These latter developments are probably the biggest boost the cattle industry in the northern part of the Northern Territory has had in its struggle for survival.

The main geographic feature to be seen as the aircraft approaches Tennant Creek is the Ashburton Ranges which run south from LakeWoods.

From Tennant Creek to Mt Isa the flight line lies slightly south of the Barkly Highway which was built as an emergency measure in World War II but has since been of vital importance in permitting all-weather road transport across the Barkly Tableland. The first part of the flight after leaving the mining field is over virtually unoccupied, spinifex-covered, sand country but further east the plane will fly over the treeless grasslands of the Barkly Tableland. This 60,000 square mile grassland, growing on the black soils overlying a very extensive limestone belt, is still developing as a major beef cattle area.

Near the eastern margin of the limestone belt, near and north of Yelvertoft, several mining companies are testing phosphate deposits. The deposits so far discovered in this area are smaller and/or of lower grade than those near Duchess. Prospecting is continuing. This area is only half the distance from possible port sites on the Gulf of Carpentaria and transport costs will be a major factor as to whether and when Australian phosphate deposits will be developed. A paper on Phosphate Rock in Australia is appended.

The town and mine of Mt Isa are situated in the valley of the Leichhardt River, about 600 miles west of Townsville. The town has a population of 18,000 which is expected to increase to 23,000 by 1972. It is the administrative capital of a large area of north-west Queensland, and besides its mining activities a considerable cattle trade provides some diversity to its economy. More than 100,000 cattle a year arrive in Mt Isa via the beef roads for transport by rail to meatworks on the east coast.

1968 is the 45th anniversary of the chance discovery of silver-lead mineralisation at Mt Isa by John Campbell Miles while on a journey from Duchess to Darwin.

Mt. Isa Mines was formed in 1924 but it was not until 1931 that production of silver-lead began. During the war years the company switched from lead to copper production at the request of the Federal Government and within two years was the leading producer of copper in Australia. By 1953 the company was treating both copper and lead-silver-zinc ores producing lead bullion, blister copper, and zinc concentrates.

In 1956 the company launched an expansion programme which by 1967 had cost over $130 million lifting ore treatment capacity 16,000 tons a day. The programme included the construction of a 17,500 million gallon dam, Lake Moondarra; extensions to the copper smelter to increase the capacity to 100,000 tons of blister copper a year; construction of the K57 shaft at a cost of $11 million, construction of the No. 2 concentrates at a cost of $16.8 million to increase sulphide ore milling capacity by 5400 tons a day, construction and expansion of the copper refinery in Townsville. Complementary to the expansion programme of Mt Isa Mines was the rehabilitation of the Townsville-Mt Isa railway. The Commonwealth Government provided financial assistance for the project by way of $34.5 million loan to the Queensland Government which was two-thirds of the total cost of the project.

Ore reserves at Mt Isa at 30th June 1967 were -

<u>Copper</u> -	Primary ore 42 million tons	3.2% copper
	Secondary ore 1.5 million tons	3.8% copper
<u>Silver-Lead-Zinc</u> -	Primary ore 32 million tons	5.4% oz Silver, 7.4% Lead, 5.6% Zinc

Secondary ore 0.6 million tons 2.0 ozs Silver,
5.5% Lead

Production for 12 months to 30th June 1968 is reported as -

86330 tons crude lead (1966-67 62,900 tons)
47800 tons blister copper (1966-67 52,090 tons)
95244 tons zinc concentrates (1966-67 68,184 tons)

A paper on Mt Isa is appended.

The Mary Kathleen Uranium Mine owned by Mary Kathleen Uranium Ltd (51% CRA) is situated about 30 miles due east of Mt Isa. Mining for uranium ceased in November 1963 following the completion of an $80 million contract for the sale of uranium oxide. Production between 1958 and 1963 was of the order of 750 tons of uranium oxide a year. At the end of 1963 indicated and possible ore reserves were reported to be 7672 short tons of uranium oxide.

When the mine was in operation the population of Mary Kathleen was over 1,000 including about 200 families. The community is now reduced to about 30 families who are maintaining the plant and the town pending re-opening of the mine. The company has been carrying out a programme of exploration work in the area, including diamond drilling, and this is proceeding.

Other occurrences of uranium in the Mt Isa area include Anderson's Lode about 9 miles north-east of Mt Isa, and the Skal deposits about 21 miles north of Mt Isa, both of which are owned by Kathleen Investments (Aust.) Ltd which also has an interest in Mary Kathleen Uranium Ltd. Ore reserves of Anderson's Lode are reported to be 2280 short tons of uranium oxide and of the Skal deposit to be 660 short tons of uranium oxide.

Export of uranium oxide has always been subject to control by the Commonwealth Government, but in April 1967 the Minister for National Development announced an easing of the restrictions to permit export under certain conditions. This was done to encourage exploration to establish new reserves and to conserve known uranium resources for future essential needs.

Saturday 27th July Mt. Isa - Townsville

6.45 a.m.	Depart Motel for airport
7.20 a.m.	Depart Mt. Isa - breakfast in aircraft Fly over phosphate deposits at Duchess
10.30 a.m.	Arrive Ayr - Members will be met at the airport and taken on a tour of the Burdekin Delta. Lunch has been arranged.
4.45 p.m.	Depart Ayr
5.15 p.m.	Arrive Townsville - transport to motel provided by TAA.

Accommodation has been arranged at the Reef Motel where a Buffet Dinner will be held for members to meet local authorities.

On the flight from Mt. Isa to Ayr the aircraft will detour to the south to fly over the phosphate deposits near Duchess. These deposits are about 70 miles south-south-east of Mt. Isa and about 20 miles south of the town of Duchess.

Exploration for phosphate in the Duchess area can be directly attributed to suggestions made by Dr Sheldon, a specialist from the U.S. Geological Survey whose visit to Australia in 1965-66 was arranged by the Bureau of Mineral Resources to assist the search for phosphate. Following up Sheldon's recommendations, Bureau and company geologists in February 1966 found phosphatic sediments in samples from the Black Mountain Bore, 85 miles south of Duchess. Within a very short period Mines Exploration Pty. Ltd., a subsidiary of Broken Hill South Ltd discovered the phosphate deposits in the area where these sediments cropped out about 20 miles south of Duchess.

The discovery of this deposit is a good example of effective co-operation between Government agencies and private enterprise. The former provided regional geological maps, fundamental data and ideas to assist mining companies to delineate prospective areas and formations to which their exploration skills could best be applied.

The deposits, although containing thin beds of high-grade phosphorite, up to 37% P_2O_5, bulk about 22% P_2O_5 over economic widths ranging up to 60 feet and are thus of medium grade. Detailed information on reserves is not available but it is apparent that reserves will be at least of the order of hundreds of millions of tons. Beneficiation of the medium-grade ore is

practicable. Feasibility studies to investigate exploitation are in progress by the company, the main problems stem from the isolation of the deposits which are some 300 miles south of the Gulf of Carpentaria and 550 miles from the established port of Townsville. It may be difficult to find export markets in competition with foreign phosphate deposits that are more favourably located for the use of cheap sea transport.

Australian domestic production of phosphate has been small (12,000 tons in 1967, all from South Australia). Phosphate imports in 1967 were 3,265,000 tons. Total shipments from Nauru and Ocean Island in the Pacific Ocean and Christmas Island in the Indian Ocean increased from 2,217,000 tons (67.5 percent of the total) in 1966 to 2,417,000 tons (74.0 percent of the total) in 1967.

A separate paper on Phosphate Rock in Australia is appended.

From Duchess the aircraft will fly over the Cloncurry District before crossing the northern part of the Great Artesian Basin.

Cloncurry is within the Cloncurry and Mt Isa gold and Mineral Field which covers an area of about 22,000 square miles. The town is the seat of local government and the centre of communication.

The inauguration of an airmail service to Cloncurry in 1922 by Qantas marked the beginning of air communication. Today more than 200 radio transceiver sets give direct communication with Cloncurry to people scattered throughout north-western Queensland and adjacent areas.

The Great Artesian Basin is the largest sedimentary basin in Australia and one of the largest in the world. It covers an area of 670,000 square miles of which about 430,000 square miles is in Queensland. There are about 18,000 recorded water bores in the Basin and 12,000 of these are in Queensland.

Underground water storages have the great advantage that they are less subject to evaporation losses than surface storages. This is particularly important in arid areas where the loss from the surface by evaporation is very high. The Great Artesian Basin is an excellent example of the conservation of water resources underground.

The first flowing bore was drilled near Bourke N.S.W. in 1880 and development of the basin followed rapidly. The peak discharge from the basin was estimated at 350 million gallons per day in 1915.

Soon after it became apparent that the discharge of flowing bores from the basin was decreasing, and systematic studies of the basin were carried out to determine the available water resources and to design a system for controlling the use of the water. The authority in this field in Queensland is the Irrigation and Water Supply Commission. In 1954 it was estimated that the safe permanent yield of the basin was about 110 million gallons per day. In most areas the water is suitable for domestic and stock use but is generally unsuitable for irrigation.

The Burdekin Delta, lies approximately 50 miles south-east of Townsville. The surface of the delta rises gently from the coastal fringe of sand dunes and swamps to 70 feet above sea level at The Rocks where the Burdekin River enters the delta 20 miles upstream from the coast. The gentle topography and deep, light-textured loamy soils have permitted the development of the district as one of the principal sugar cane-growing areas in Queensland. The principal towns on the delta are Ayr and Brandon, north of the river, and Home Hill, to the south. The combined population of these towns is about 12,000 (1963) out of 17,000 people in the 2,000 square miles in Ayr Shire.

Sugar cane was first produced commercially in the area in 1883 and by 1920 approximately 6000 acres were planted to cane. The area planted then increased substantially to 31,000 acres in 1940. The assigned area for cane production is now 71,000 acres. The cane is crushed at mills on the delta and the raw sugar is shipped from Townsville to the refineries.

The mean annual rainfall at Ayr is 43 inches but most of the rain falls in the five months December-April. The annual rainfall has ranged from less than 10 to almost 100 inches. Cane production benefits greatly from irrigation. Irrigation commenced well over half a century ago and in recent years virtually all the crop has been irrigated. The estimated water requirement is now 260,000 acre-feet per annum.

Because of the unreliability of the uncontrolled flow in the Burdekin River and the cost of distributing water pumped from the river virtually all the irrigation water has been pumped from the groundwater resource. Bores and wells yielding 300-1000 gallons per minute from depths less than 100 feet are common in the delta area. Except for the seaward fringe of the delta most of the groundwater is of suitable quality for irrigation of sugar cane. Groundwater withdrawals from the Burdekin Delta exceed those from any other area of comparable size in Australia and are comparable to the discharge

from the Queensland portion of the Great Artesian Basin, which has an area of more than 400,000 square miles. Nevertheless, development of groundwater in the delta is still at a modest scale compared to many overseas groundwater basins.

The heavy pumpage of groundwater for irrigation use has, in several recent dry years, exceeded the rate at which the groundwater is naturally replenished from rainfall and river flow. The extra water has been supplied from groundwater storage leading to a marked decline in water levels. In some areas of heavy pumpage in the southern part of the delta groundwater levels in February 1964 fell as much as 4 feet below sea level. It is necessary to keep the freshwater levels 2-3 feet above sea level if instrusion of sea water into the freshwater aquifer is to be prevented. Concerned at this danger the Irrigation and Water Supply Commission, aided by other State and Commonwealth authorities, made detailed investigations of the hydrology of the area as a result of which it was decided that artificial recharge of the groundwater aquifer would be the most economic way of ensuring the continuity of irrigation water supplies. Notes on the Burdekin Delta replenishment scheme, provided by the Queensland Irrigation and Water Supply Commission, are attached.

The city of Townsville is the second most populous city in Queensland, having a population in the vicinity of 60,000 people. It is the main seaport for northern Queensland and is the site of a $16 million (cost to June, 1967) copper refinery with a capacity of 92,000 tons per annum operated by Copper Refineries Ltd a subsidiary of Mt Isa Mines.

Papers on Townsville and Copper Refineries Ltd are appended.

The construction of a copper refinery, development of a new army base which is the largest construction project undertaken by the Army in Australia since World War II, and the establishment of a university college, have had a profound effect on the development of the city.

Many manufacturers are being attracted to Townsville. The major secondary industries in terms of workforce and volume of production are sugar cane crushing, copper refining, slaughtering and meat processing and cement manufacture. The largest employer among the manufactures is Copper Refineries Ltd.

It is a major tourist centre and each year many tourists are attracted to Magnetic Island about 6 miles offshore.

Sunday 28th July — Townsville to Brisbane

9.00 a.m.	Depart Motel for airport - transport provided by TAA.
9.45 a.m.	Depart Townsville
10.15 a.m.	Arrive Charters Towers. The party will be met by Cr Arthur Titley, Mayor of Charters Towers, Mr. Peter MacDougall, Town Clerk, Cr Harry Clarke, Chairman of Dalyrmple Shire and Mr. Doug Fairbank, Shire Clerk.
12.00 noon	Depart Charters Towers
1.05 p.m.	Arrive Clermont. The party will be met by Cr Ian Bennett Chairman of Belyando Shire and Mr. Peter Lawrence, Shire Clerk. The Shire Council has arranged lunch, and is providing transport for a tour of the Blair Athol coal field.
4.00 p.m.	Depart Clermont
6.10 p.m.	Arrive Brisbane - transport to Motel provided by TAA.

Accommodation has been arranged at the Tower Mill Motel.

After leaving Townsville the aircraft will fly to Charters Towers about 85 miles inland.

Before the turn of the century Charters Towers was an important gold mining centre. Gold was first discovered there in 1872 and in the period 1891-1896 the Charters Towers goldfield became one of the most productive in Australia. Today the city is an important education centre and the heart of a large cattle raising district.

To the north of Charters Towers near Greenvale, Metals Exploration N.L. is investigating a deposit of weathered serpentine containing nickel. The company reported in February 1967 that it had agreed to investigate the deposits with Freeport of Australia Ltd under a joint venture arrangement whereby each company would provide 50 percent of the finance. Completion of a drilling programme at Greenvale outlined a deposit of approximately 800 acres containing 45 million tons of lateritic nickel ore averaging 1.55% nickel and 0.11% cobalt. The zone of nickel enrichment averaged 30 feet in thickness and lay beneath a 20 feet thick cover of overburden containing nickel in amounts less than one percent. It is understood that metallurgical and feasibility studies of the deposit are continuing.

A paper on the coal deposits of central Queensland is appended.

Members will visit the Blair Athol coalfield, an open cut operation which is worked jointly by Blair Athol Open-Cut Collieries Ltd and Blair Athol Coal and Timber Co.

The field is west of the main coal areas of Queensland. In 1966 reserves were estimated to be about 266 million tons of which 222 million tons had been proved. The coal is a bituminous non-coking coal with a fairly high calorific value and low ash content. It is suitable for use as a steaming coal and for general purposes, but due to the lack of demand for large tonnages of this type of coal production has been small. In 1966 it was 77,000 tons and in 1967 76,000 tons. The coal is supplied to various local power stations and industrial plants.

Conzinc Rio Tinto of Australia announced recently that its take over bid for the two companies working the field had been successful.

On the flight from Clermont to Brisbane the aircraft will fly to the east of Emerald. A paper entitled "Notes on Emerald Irrigation Project Queensland" is appended.

In the Fitzroy River Basin near Rockhampton the Commonwealth is providing assistant to Queensland under the Brigalow Lands Development Act 1962-1967 for the development of brigalow lands. The act provides for Commonwealth assistance up to a maximum of $23 million in the form of interest bearing loans to finance State expenditure on specified works. The main purpose of the scheme is to increase the production of beef cattle by subdividing large existing holdings into smaller blocks, which when developed under pastures can carry a greatly increased number of cattle. Some of the blocks are allotted to existing landholders, some are sold at auction and the remainder are offered through ballot.

In a recent statement (1.7.68) the Premier of Queensland stated that the scheme has now proved itself as one of the most successful land settlement schemes in Australia and is bringing rapid development to part of Queensland's brigalow areas, which represents one of the largest regions of underdeveloped fertile land in Australia. Expenditure to date is of the order of $11 million.

Northern Division
June, 1968

ESPERANCE

Esperance was named in 1792 by the French explorer D'Entrecasteaux after one of the ships of his fleet. From then on it was largely unused, although in the 19th century, Middle Island, about 80 miles east of Esperance was a base for sealers operating in southern waters.

The area was first settled in 1864. The port of Esperance came into being in 1893 as a port for the Coolgardie goldfields and the population reached 1,200 by 1897. However with the completion of the Perth-Kalgoorlie railway in 1897, the importance of the town began to wane. Initially, although the Kalgoorlie trade was lost the Norseman trade remained; but with the completion of the railway line from Coolgardie to Norseman, in 1909, even this trade was lost and Esperance rapidly decayed.

The development of wheat farming in the "mallee" country brought another brief period of prosperity to the town. The railway was extended to Norseman in 1927, and Esperance became the wheat port for the mallee. With the failure of wheat farming in the mallee the town again regressed.

Agricultural development of the area was slow despite the enthusiasm of a few landholders, and Esperance persisted largely as a holiday resort for residents of the Goldfields. However, there was some settlement along the short rivers such as the Dalyup, where more fertile soils occurred, and on one or two areas on the plain.

Between 1916 and 1948 a number of individuals carried out crop and pasture experiments on their properties and demonstrated the potential of the area.

The modern era of development commenced with a visit to Esperance by the then Minister of Agriculture in October 1948. Experimental work was carried out on a private property, in 1948-49 and the decision was taken to establish a Research Station in the area.

The Esperance Downs Research Station was established in 1949 to investigate the potential of the area and to develop the best methods of farming the coastal plain.

By 1956/57, about 1,100 acres of pasture had been established and the Station was carrying 2,000 sheep. The area under crop or pasture is now over 1,800 acres and there are 4,000 sheep and over 100 cattle. Each year more than 200 acres are sown to cereals or linseed, and over 6,000 trees have been planted.

Although still not fully developed, the Station is carrying out numerous trials and demonstrations with the object of developing more intensive land use in the Esperance area.

Most of the experimental work is carried out on the Research Station, but it has been necessary for some work to be carried out on the properties of local farmers.

There have been failures as well as successes in the area. The most spectacular failure was that of the American Chase Syndicate in 1957-58. This group entered into an agreement to develop 1½ million acres in the Esperance area. The 1957 planting failed, due to poor planting techniques and an unfavourable season, and the company did not go on with development. Although this failure was a setback to the district, the widespread publicity associated with the scheme was of ultimate benefit to the region.

In 1960, the Chase agreement was taken over by another group, Esperance Land and Development Company, which is developing land along orthodox lines. By 1967 this company had planted 164,641 acres.

The area being developed lies between the south coast and the 18-inch rainfall isohyet, and extending from 20 miles west of Hopetoun to the coast south of Israelite Bay.

The coastal plain consists of a fringe of coastal limestones and sand, averaging two to three miles in width and rising abruptly to a plain with an elevation of from 200 to 600 feet above sea level. In some areas the coastal limestone is less than a mile wide, particularly to the east of Esperance.

The elevated plain is gently undulating and slopes towards the coast. It consists of a variable depth of Miocene sediments overlying the Precambrian granite shield. The country to the west of the Esperance-Norseman road is more broken than that to the east.

These sediments have been weathered to form the major soil types found on the plain; grey siliceous sands overlying gravel, gravelly clay or clay subsoils. The depth of sand is variable and pasture development is easier where the sand is less than 24 inches deep.

Significant areas of sand deeper than 36 in. occur on which pasture establishment is difficult. On the other hand, large areas are found where the surface soils are gravelly sands or clay. Where clay occurs on the surface a gilgai microrelief is found on waterlogged areas.

Soils with gravel on the surface are more extensive to the north and west of the area while those with clay within 3 inches of the surface are more extensive to the north and east.

Free lime is found in many subsoil clays; this is common to the west of the Lort River and east o. Boyadup. In most places where lime occurs it is found one foot down into the clay.

Where drainage channels or rivers have exposed the country rock, a gneissic granite is exposed by the erosion of from 30 to 50 feet of overlying material. This rock gives rise to brown sandy loams or loamy sands on which is found a woodland vegetation quite distinct from the heath association of the plain.

The relatively even spread of rainfall over the May to October period, coupled with lower evaporation, a flat topography and impermeable subsoil gives the Esperance area a longer growing season than would be expected from the annual rainfall figures.

Only limited rainfall records are available except in the vicinity of Esperance and along the Esperance-Norseman railway line. Many of the stations have only short records.

The isohyets run roughly parallel to the coast except over the western quarter where they turn towards the coast. There is no very wet period in winter. This is demonstrated by data from Park Farm where, although the monthly rainfall for May to September is over 2½ in., the highest monthly rainfall is less than 3½ in.

Although rainfall falls off rapidly to the north a great deal of the country within 20 miles of the coast has a rainfall of 20 in. or more. However, on the western side of the region the 29-inch isohyet crosses the coast between Hopetoun and the rabbit-proof fence.

The area receives significant falls of rain in the period from November to April. All parts receive at 6 in. during this period and the part immediately to the east of Esperance Bay receives an average of 7 in.

Temperatures in autumn and spring are favourable for active crop growth and even in winter the temperatures permit significant growth.

Frosts are infrequent in the coastal areas, averaging only two a year at Esperance, but the average increases inland.

Summer temperatures are generally mild and the mean maximum temperature for February ranges from 77°F near the coast to 80°F to the north of the area. Periods of hot weather do occur and the highest reading recorded at Esperance is 117°F.

The Esperance area is suited to the production of pastures and the raising of stock, particularly sheep for wool and cattle for beef.

In the development stage sheep are run, primarily for wool, with the introduction of fat lambs and beef cattle. The facilities available and relative returns will determine the relative importance of the various forms of stock management.

As the fertility of the soils is built up cash crops will become an important part of the farm practice. However the returns per acre need to be high to pay for the loss of production associated with ploughing up an area of highly productive pasture supporting high stocking rates.

Rain during the harvesting season can be a problem and often there are only short periods during each day when harvesting is possible with machines other than "all crop" headers.

Also, experience has shown that fungal root rots of wheat, and to a lesser extent barley, are a serious problem in some years when these crops are sown on clover ley. The root rots and other diseases limit the suitability of the area, at present, for cereal varieties now being planted.

At present, oats appears to be the best cash crop on clover ley. Linseed yields well but market prospects at the moment are doubtful. Either of these crops can be followed by wheat or barley, which give good returns in all but wet years, provided nitrogen fertiliser is applied.

So far, there is no evidence that the annual subterranean clover - Wimmera rye grass pastures need renovation to maintain their species composition. At Esperance Downs Research Station the oldest paddock, which was sown in 1950, still has an excellent species composition even though it has not been renovated since it was sown.

Development of the scrub plain to carry excellent subterranean clover pasture is relatively easy provided three simple basic principles are followed. These are:

(a) The depth of sand on the selected area should not be more than 3 ft and preferably less than 2 ft.

(b) Land preparation should be thorough.

(c) Fertiliser application over the first five years should be adequate.

Areas where the surface sand is deeper than 3 ft. should be avoided.

Experimental work has shown that all soils in the area should be treated with copper and zinc. Some soils are also showing a deficiency of molybdenum.

Superphosphate is essential and should be applied at 150 lb. per acre for the first six years, after which the rate of application can be reduced to 112 lb per acre.

Over most of the area it is necessary to sink dams to obtain adequate summer water supplies for stock.

Roaded catchments are necessary in much of the country receiving 20 in. of rain or less and in some of the higher rainfall areas. Areas where clay is within 8 in. to 12 in. of the surface can usually be found and roading is not a major expense. Clay of good water holding quality and depth (to 12 ft) is usually readily found, though near some of the creeks and rivers, shallow clay layers (less than 10 ft) can make site selection difficult.

Underground water is too saline for stock use over most of the area. However, within the area enclosed by a line drawn from Mt. Hawes, to Gibson, to Dalyup, to Barkers Inlet, good quality underground water can usually be found, although even in this area it is not certain.

KAMBALDA NICKEL

Kambalda is situated about 30 miles south-south-east of Kalgoorlie on the northern shore of Lake Lefroy. Access is by road from Kalgoorlie or Widgiemooltha (see map attached).

In 1947 prospectors John Morgan and George Cowcill collected specimens in the Kambalda area which were thought to contain copper. An analysis of these specimens made by the Kalgoorlie School of Mines in 1954 showed the presence of nickel but no copper. The assay report stated inter alia "In view of the meagre Australian Resources and the relatively high price it might be worthwhile to explore the extent of the occurrence and submit a sample for nickel assay".

It was ten years later that the partners sent the specimens to Western Mining Corporation, where their potential was immediately recognised by the Chief Geologist Ray Woodall.

Western Mining Corporation undertook a mapping and sampling programme which found many surface indications of nickel mineralisation. Subsequent geophysical and geochemical surveys located a site for the first diamond drill hole in December, 1965.

The discovery of a high grade nickel sulphide orebody at Kambalda was announced in April, 1966. In May, 1967 the Corporation announced that further intersections of nickel ore had been made during drilling operations in the Paris-St. Ives area south of Lake Lefroy.

The ore is a pyrrhotite-chalcopyrite-pentlandite association and reserves in the Kambalda-St. Ives area are of the order of 9.3m tons averaging 3.8% nickel.

Production of concentrates from Kambalda commenced in June, 1967 and for the 28 weeks ending 9th January, 1968 was 15,101 tons (13.03% Ni, 1.66%Cu).

The Corporation has signed contracts with Sumitomo Metal Mining Co. Ltd of Japan for the sale of nickel sulphide concentrates (nickel content 40,000 tons) for delivery over 10 years from September, 1967, and it has also made arrangements to ship concentrates to Sherritt Gordon Mines Ltd., Canada, for refining. It is reported that these shipments will be at an annual rate of 10,000 tons (1500 tons nickel) for 3 years from August, 1967.

The Corporation signed an agreement with the Western Australian Government in January, 1968 to erect a nickel refinery at Kwinana W.A. having an annual capacity of 15,000 tons. A sum of $45m was agreed upon for the

construction of the refinery and the expansion of mining facilities at Kambalda. Production of ore is being increased and is expected to reach about 800,000 tons per year by 1970.

The design of the refinery is at an advanced stage and construction is expected to commence in July, 1968. The refinery is scheduled to commence production in 1970. An ammoniacal leach process similar to that used by Sherritt Gordon Mines Ltd. Canada is planned for use in the Kwinana refinery.

Other terms of the agreement include the continuation of investigations into the feasibility of establishing a nickel smelter at Kambalda or Kalgoorlie. If a smelter is erected the royalty rate of 2% of value of contained nickel in ore mined at Kambalda will be extended from the first 5 years of operation to 10 years. The Corporation has been granted extended rights for nickel exploration at Kambalda until 1975, subject to the surrender of portions of the reserve at intervals. The agreement also provides for the Corporation to contribute to the cost of expanding the goldfields water mains to provide a reliable supply to the Kambalda operation. The Corporation will provide its own ore-trucks in which the State Railways will haul nickel ore from Kambalda to the refinery.

Kambalda township is reported to have a population of about 250 people with a work force of 80 to 100. By 1970/71 the town is expected to grow to 2500 and have a work force of 800-1000 men.

Although Western Mining Corporation Ltd. is the only nickel producer in Australia to date, promising exploration results have been obtained from several other prospects in the Kalgoorlie-Kambalda area.

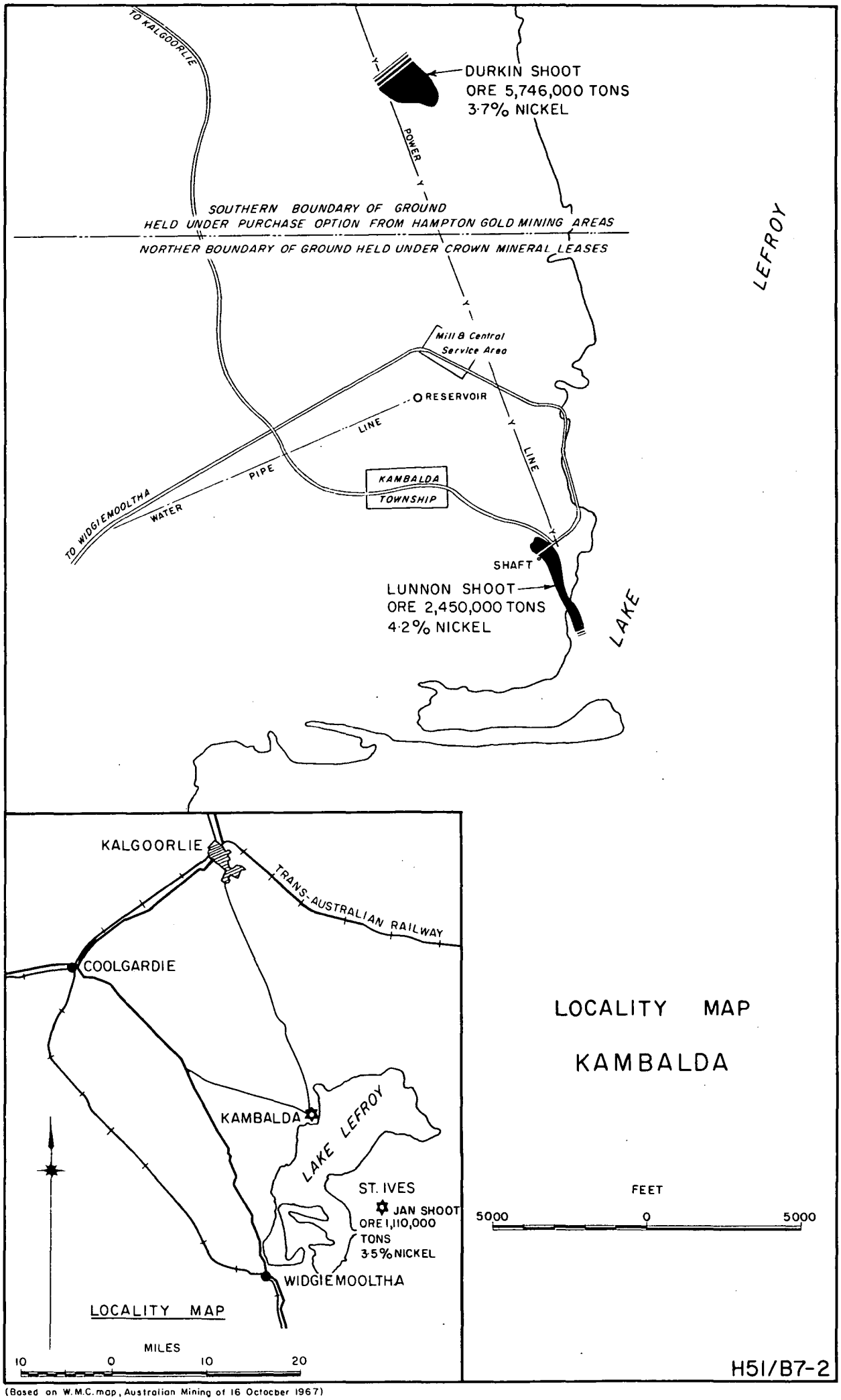
The intersection of nickel sulphide and copper mineralization in a drillhole at Widgiemooltha, 50 miles south of Kalgoorlie was announced in May, 1967 by Anaconda Inc. and Conzinc Rio Tinto of Australia Ltd. during a joint exploration programme. After additional drilling the Partnership advised in March 1968 that nickel sulphide mineralization had been found to occur over a more extensive area and in May further advised that nickel sulphide mineralization assaying 4-11% Ni over a 1000 feet length and 4-10 feet width had also been located near Higginsville, 18 miles south of Widgiemooltha. The prospect at Higginsville is shared by a partnership of Anaconda Inc., Conzinc Rio Tinto of Australia Ltd.and New Broken Hill Consolidated Ltd. At Widgiemooltha drilling had intersected nickel sulphide mineralization in 14 drill holes and had indicated mineralization over a length of 350 feet by 35 feet which averaged 1 percent nickel and minor copper.

Favourable drilling results were obtained by Great Boulder Gold Mines Ltd. at the end of 1967 during an exploration programme for nickel mineralization at Mount Martin W.A., 25 miles south-south-east of Kalgoorlie. Directors stated in October, 1967 that a drill hole had intersected sulphide mineralization which averaged 8.10% nickel in one 6 feet long section. Other drilling by the company at Mount Martin had shown sections assaying up to 3.99% nickel. In February, 1968 Great Boulder Gold Mines Ltd. and North Kalgurli (1912) Ltd. jointly secured mineral claims at Scotia 35 miles north west of Kalgoorlie which had formerly been held by the Jones Prospecting Syndicate. Fourteen shallow drill holes (deepest 64 feet) had indicated grades of 2.54% nickel and 0.34% copper along a contact 170 feet long. In June a deeper drill hole confirmed these grades after intersecting a total of 19.5 feet of ore which assayed 2.8% nickel and 0.18% copper.

In April, 1968 Metals Exploration N.L. disclosed that it had intersected high grade nickel sulphide mineralization in a drillhole at its Nepean prospect 15 miles south of Coolgardie. A 50 percent interest in this area is held by Freeport of Australia Ltd. Following further intersections of sulphide ore assaying up to 15.7% Ni, Metals Exploration advised that it would make no further statements of results until the extent of mineralization had been determined.

At the end of May, 1968 there were 58 companies and prospecting groups holding nickel tenements in the Kalgoorlie area.

The long term outlook for nickel is encouraging. The current short supply is likely to persist to the early 1970's. Australian requirements are currently about 3000 tons per annum and will probably be about 3500 tons in 1970. This will leave about 11,000 tons of metal for export if the proposed refinery at Kwinana achieves full production in 1970. A market should be available in a non-communist world production estimated to be 400,000 tons in 1970 and 660,000 tons in 1975.



(Based on W.M.C. map, Australian Mining of 16 October 1967)

Northern Division

June, 1968.

MT. NEWMAN MINING

Owners		
	Pilbara Iron Pty. Ltd.	30%
	Dampier Mining Ltd.	30%
	Amax Iron Ore Corporation	25%
	Mitsui-C Itoh Iron Pty. Ltd.	10%
	Seltrust Iron Ore Ltd.	5%

In turn these companies are owned as follows:

(1) Pilbara Iron Pty. Ltd. -

Colonial Sugar Refining	68%
Australian Mutual Provident Society	23.81%
Mutual Life and Citizens Assurance Co. Ltd.	5.59%
Colonial Mutual Life Assurance Society Ltd.	2.6%
National Mutual Life Association of Australia	
United Insurance Co. Ltd.	

(2) Dampier Mining Ltd. -

Broken Hill Pty. Ltd.	100%

(3) Amax Iron Ore Corporation -

American Metal Climax Inc.	100%

(4) Mitsui C Itoh Iron Pty. Ltd. -

Mitsui and Co. Ltd.	70%
C Itoh and Co. Ltd.	30%

(5) Seltrust Iron Ore Ltd. -

Selection Trust Ltd.	100%

The actual operating company Mt. Newman Mining Ltd. is a wholly owned subsidiary of B.H.P. The other major partners in the venture (Amax and C.S.R.) have options to acquire shares in the management company after 5 years.

C Itoh and Company is the Japanese liaison trading company associated with the project.

AMAX is responsible for the development of markets for Mt. Newman iron ore outside Australia, including the United States and Europe.

C.S.R. is responsible for the co-ordination of matters in Australia and liaison with the Commonwealth Government.

Direction of the Project is vested in a 10-man operating committee. Amax Iron has four representatives; Dampier and Pilbara Iron each have three representatives. For the first five years the chairman will be nominated by Amax Iron, and thereafter by Pilbara Iron and Dampier.

Location of Operations

The Mt Newman leases are some 250 miles to the south of Port Hedland. The iron ore deposits cover an area of 758 square miles, and the main orebody is the three-mile long, 750 foot high ridge known as Mt Whaleback. This is ten miles south east of Mt Newman, the highest peak in the Ophthalmia Range.

Mt Whaleback is in the "Mt. Newman" Reserve, which covers part of the eastern end of the Ophthalmia Ranges. To the north-west is the "Weeli Wolli" Reserve covering deposits in the extreme eastern end of the Hamersley Range, around Weeli Wolli Spring. To the south of this reserve is the "Pamelia Range" Reserve, centred on Pamelia Hill, just north of the Ophthalmias.

At Mt. Whaleback, which is an isolated ridge some 19,000 ft. long, 5,500 ft wide and rising to 750 ft above the surrounding plain, outcropping ore was discovered in 1957 by prospector Stan Hilditch. The ore assayed at 68.8% iron content. In 1963-64, a seven-months drilling programme was carried out, which indicated the presence of at least 216 million tons of hematite ore averaging 64.6% iron. Subsequent drilling and mapping has proven the presence of 345 millions tons of 64% plus hematite ore, with a phosphorus content of 0.04%. Project geologists have inferred a total potential within Mt. Whaleback of better than 1,000 million tons of high grade ore; which would make Mt. Whaleback one of the largest single deposits of hematite ore in the world.

Other Mt Newman deposits have yet to be drilled, but present indications are that high grade iron ore deposits held by Mt. Newman Mining are amongst the largest in the world.

Commitment to Western Australian Government

Expenditure: The company's agreement calls for minimum expenditure of $156 million firstly for export of ore, then for upgrading before export, and finally for steel making. The company's announced plans indicate that capital expenditure will exceed that required in the agreement.

Mount Newman is committed to submitting a scheme for secondary processing by 1979, and to construction of a $16 million plant, with an initial capacity of 500,000 tons within the next three years. By 1982 it will be expected to lift this capacity to 2 million tons unless the company can utilise a less expensive but at least equally satisfactory method of processing than any present known to either party.

The company is also committed to submitting a proposal by 1992 for the establishment of an $80 million integrated iron and steel industry, capable ultimately of producing 1 million tons of steel annually.

Initial capacity by 1994 would be 250,000 tons of steel, building up by the end of the century to a million tons.

Royalties: Shipping ore: 7½% on f.o.b. value for lump (minimum 60 cents per ton)
3¾% on f.o.b. value for fines (minimum 30 cents per ton)
Locally used ore: 15 cents per ton.

Total royalties payable by the company on contracts current at April 1967 are of the order of $A52m.

Capital Expenditure

Original estimate of company expenditure has been substantially increased. Believed to be in excess of $A200 million.

Employment

Construction: 1,800 - 250 by June 1967.
- 1,000 by October, 1967.
- 3,000 by April, 1967

Permanent: At mine 560
At port 120

Port

Establishment expenditure $A16 million ($A14 million expected on dredging).

Capacity for 68,000 ton ore carriers initially with plans for port expansion to take 100,000 ton vessels.

Extensions to the State owned general cargo wharf have been completed to the stage where ships of 15-20,000 tons can berth alongside and unload heavy cargoes.

The dredging contract for the harbour and approaches involves moving at least 10 million cubic yards of bottom to give a 37 foot deep channel starting seven miles out to sea; a 34 foot deep channel inside the harbour; an 1,800 foot wide turning basin, with a depth of 25 feet; and a berth 2,050 feet long, 200 feet wide and 56 feet deep. The Mt Newman partners are negotiating with Goldsworthy Mining Ltd regarding the dredging of the approach channel, which must be widened to 600 feet.

Port and Loading Facilities

The iron ore loading berth is located on Nelson Point, Port Hedland. Initially the 2,000 foot long pier will be sufficient to berth one 68,000 ton vessel at a time. As shipments build up the docking and loading facilities will be improved.

About 180 acres of mangrove swamp are being reclaimed for the

stockpile area. The stockpile will hold about 1,500,000 tons of ore.

The ore loader is being constructed by the Ishikawajima-Harima Heavy Industries Company of Japan and it should be delivered to Port Hedland in October of this year. The machine is claimed to be the world's largest iron ore loader, and has a capacity of 9,500 tons an hour.

When the ore arrives at Port Hedland it will be emptied from railroad cars by a rotary car dumper, which has a capacity of 6,000 tons an hour and can accommodate two freight cars at a time. The ore is then transferred to an adjacent stockpile, before being crushed, screened and moved onto a belt conveyor leading to a stacker system, from which the ore is finally delivered to different product stockpiles and ore blending piles.

The ore reclaiming system from product stockpiles will be by two bucketwheel reclaimers that will each feed conveyor belts leading to the travelling shiploader.

The Mine

Production will be up to 10,000 tons a day, initially, rising to 40,000 tons a day within five years.

The surfaced haulage road is being cut on a 7 per cent grade to the top of the east end of Mt. Whaleback, where benching has been started. The 50 foot benches are being cut at several levels, with an overall pit slope of 45 degrees to permit production at several levels simultaneously.

The benches will be percussion-drilled with 20cm. holes and blasted with explosives. One will be loaded by 10 cubic yard electric shovels into 75-ton trucks and hauled to primary crushers at the foot of Mt. Whaleback.

The two-stage crushing and screening plant will have a capacity of 4,000 tons/hour.

There will be a 310 foot loadout tunnel, about 20 feet in diameter, with ten power-operated loading chutes under a 30,000 ton crushed ore pile. Trains will pass through the tunnel and ore will be loaded through chutes into railcars.

Mining operations will be geared to the production of two products, lump ore and fines, to meet requirements of the Japanese and B.H.P. contracts.

Railway

Between Port Hedland and Mt. Whaleback, a 265-mile, heavy duty, standard gauge line is under construction. When completed, it will be the largest non-government railway project in Australia. The estimated cost of the railway is $40-50 million, and it is due for completion in February, 1968. Track-laying is proceeding at a rapid rate and has now passed the half-way mark.

When the railway is completed, there will be 19 miles of sidings, spurs and yard tracks. The track will require 60,000 tons of rail (132 lb. to the yard) 14,000 tons of anchor plates, and 870,000 sleepers.

Trains of up to 135 freight cars, each carrying 90 tons of ore, will be hauled by three 3,500 h.p. diesel locomotives. The trains will be loaded with up to 12,000 tons of ore in less than an hour, and will be able to travel to Port Hedland and back within 24 hours.

Power

The Port Hedland power station will have four 2,300 kilowatt units.

The power station at the mine site will have four 2,300 kilowatt units and one 1,100 kilowatt unit.

The buildings at each site will use filtered air, under pressure, to exclude dust.

Ore Sales

The Mt Newman consortium has an initial 15-year contract with Japanese steel interests for the supply of 100,000,000 tons of iron ore.

The first shipment to Japan will begin in April 1969, and will rise from 3,000,000 to 7,500,000 tons a year, within four years.

The ratio of lump ores to fines will be 65:35. and the Fe content 64 per cent for lump and 62 per cent for fines

Reported price

(f.o.b. in U.S.$ per long ton)			(f.o.b. in U.S. cents per Fe unit)		
Size	30 x 6mm	9.37	Size	30 x 6mm	14.64
	100 x 6mm	9.16		100 x 6mm	14.31
	Fines	7.48		Fines	11.6875

These prices will operate for ten years. It is reported that prices during the 11th and 12th years be re-negotiated, and in case no agreement is reached between both sides the prices for the first ten years shall apply to the shipments during the 11th and 12th years. Prices for the 13th to 15 years will be negotiated between the parties, with the prices to be fixed within 10% decrease or increase from the previous year.

Recent newspaper reports indicate that Amax has been conducting negotiations for the sale of a further 40,000,000 tons of Mt Newman ore to the Japanese steel industry over 10 years, commencing in 1970. The contract ore would be made up of equal parts of lump ore and fines. The suggested shipment

rates were reported to be 1 million tons in 1969, 1-1.5 million tons in 1970, and 1.5-2 million tons in 1971, 3 million tons in 1972, 4 million tons in 1973 and 4 million tons a year thereafter.

However, there are other reports that Amax is attempting to negotiate a three-year contract for the supply of iron ore to Japan, until negotiations can be finalised on a longer term contract. Japanese press reports state that the proposed shipment rates under the short term contract would be 1 million tons for 1969, 1-1.5 million tons for 1970, and 1.5-2 million tons for 1971.

In addition to supplying ore to Japanese steel mills, Mt. Newman also has a contract to supply Broken Hill Proprietary Ltd. with 66.5 million tons of ore between 1970 and 1990. Shipments of ore under this contract will rise from 500,000 tons in 1970 to 4 million tons in 1974, and continuing at this rate.

Press reports of 4th July, 1968, indicate that the Company has signed three new contracts to supply an additional 8.5 million tons of iron ore to Japan. The contracts are worth approximately $US50 million.

The first of the contracts is for the supply of 5 million tons of low grade ore to Kobe steel over ten years. The second contract is for 1 million tons of low grade ore to Kawasaki. The remaining contract is for the supply of 2.5 million tons of high grade iron ore to eight Japanese steel mills in 1969-70.

NORTHERN DIVISION

JUNE 1968

HAMERSLEY IRON PTY. LTD.

Owners — Conzinc Riotinto of Australia Pty. Ltd. (C.R.A.) (54%) and Kaiser Steel Corporation (U.S.) (Kaiser) (36%)
Direct Australian shareholding 10%
Australian equity also through 15% Australian holding in C.R.A.
Marubeni-Iida and Mitsubishi are the Japanese liaison trading companies involved.

Location of Operations

The mine site is at Mt. Tom Price in the Hamersley Ranges; 182 miles by rail from Dampier, and 30 miles south of Hamersley Station Homestead. The port and pellet plant are at Dampier, formerly King Bay.

Reserves

The company holds mining tenements over some 2,700 square miles, of which the present mining lease is 298 square miles.

Hamersley Iron holds estimated reserves of some 3,000 million tons of hematite ore (60-64%Fe), of which a considerable amount has an Fe content of up to 69%. The company also has additional reserves of limonite, totalling about 1,500 million tons (50-55% Fe). Mt. Tom Price is the principal orebody on the company's leases, and contains an estimated 500 million tons of high grade hematite (64% Fe). It ranks as one of the richest single deposits of iron ore in the world.

The Mt. Tom Price hematite deposit extends for more than four miles. It ranges up to 4,000 ft. in width but averages about 2,000 ft. The bulk of the orebody occurs as a folded sheet, averaging 150-200 feet in thickness, and is composed of beds of hematite alternating with thinner beds of ferruginous shale. In the central section of the deposit, maximum thickness of the high grade ore so far intersected by diamond drilling is 350 feet. The maximum depth to which the ore has been shown to extend is 420 feet.

Commitment to the W.A. Government

(1) Expenditure

On 30th July, 1963, Hamersley Iron signed an agreement with the Government of Western Australia by which it undertook to develop its iron ore

holdings in four linked stages. In return the company would receive iron ore search rights, mineral leases, and land grants as required in each stage. The four stages and the company's obligations are:

(a) Investigation - The company must spend not less than $1,000,000 on preliminary investigations of the iron deposits and necessary infrastructure associated with mining and shipment of ore.

(b) Export - The company must spend not less than $60,000,000 within three years of the date of the agreement on mining, transport, port facilities, etc., to enable the shipment of ore to commence at an annual rate of not less than 1,000,000 tons. The company must construct the railway, necessary roads, wharf and channel dredging. In addition, the company undertook to provide housing, services, schools, airstrips and recreational facilities.

(c) Processing - The company must submit proposals to the Government, within ten years of beginning exports for the investment of at least $16,000,000 on a secondary processing plant, with a capacity of 2 million tons a year, within seven years.

(d) Steel - The company to submit complete plans within 20 years of beginning iron ore exports for an integrated iron and steel industry, requiring an investment of at least $80,000,000, with production to begin within five years of submitting plans. The initial capacity to be 500,000 tons of pig iron, foundry iron or steel, of which not less than half is to be steel; rising to a capacity of not less than 1,000,000 tons of steel within six years of beginning production.

The company has already exceeded the required expenditure for Stages a, b, and c, but has until 1987 to submit plans for an integrated iron and steel industry.

Royalties

On direct shipping lump ores not used locally, the company will pay a royalty of 7½% of the f.o.b. value or 60c. per ton, whichever is the greater. On fine ore for export it is 3¾% of the f.o.b. value or 30c a ton, whichever is the greater. On iron ore concentrates (pellets), and on locally used ore, the royalty is 15c. a ton. Revenue on all other ore is 7½% of f.o.b. value.

Finance

In March, 1967, the authorised capital of the Company was increased to $60 million by the creation of 29,500,000 shares of $2 each and the whole of the share capital was then sub-divided into shares of 50 cents each. In the same month a total of 88,933,320 ordinary shares were subscribed for in cash by C.R.A. Ltd. (53,359,992 shares) and Kaiser Steel Corporation (35,573,328 shares) and the amount of $44,466,660 already advanced to the Company by these shareholders was applied in paying up these shares in full.

In May 1967, the issued capital was increased to $50 million by the issue to the public of 10 million shares of 50 cents each at $2.50 per share. Following the issue, the shares of the company were listed on all Australian Stock Exchanges. The premium of $20 million from the share issue was transferred to a share Premium Account.

North American banks have arranged to provide loan facilities, to a maximum of $US120 million. At the 31st December, 1967 there was an outstanding balance of $A109,053,488. Under the terms of the agreement the loans are repayable in United States dollars. The company has pledged all of its shareholdings in Hamersley Iron Pty. Ltd. as security for the above-mentioned loans by the North American banks.

The consolidated profit of the company for the year 1967 amounted to $9,364,484 after providing $3,040,000 for future taxation and $7,259,649 for depreciation. Under the terms of the credit agreement with the North American banks restrictions are placed upon Hamersley Iron Pty. Ltd. regarding the payment of dividends, with the result that it will be 1970 before the shareholders receive a dividend.

Employment

At the end of 1967 the total number of employees at Dampier and Tom Price was 745. The labour turnover continues to be high, although terminations among married employees are generally low. In order to encourage a more stable workforce, the company plans to provide family housing for up to 80 per cent of its employees.

DAMPIER (KING BAY)

Port

Export Wharf

Stage 1- completed. Ore carriers to 65,000 d.w.t. at all times and to 100,000 tons on the tide. A 104,500 ton bulk carrier has loaded 90,222

tons of ore at this wharf. Using one shiploader, the annual ore export capacity is 13 million tons - assuming that the average carrier is 40,000 d.w.t.

Stage 2

Lengthening the approach channel, and deepening it to 46 feet, is now being undertaken. This will allow 100,000 d.w.t. carriers to use the port on a regular basis, without tidal restriction.

Hamersley's current expansion plans include extension of the present wharf by 1,000 feet to cater for an increase in export capacity beyond the present loading limit.

Another ship loader may be installed, or separate loading facilities built on an island about one mile offshore. The new plan would entail construction of a conveyor system to carry ore across the bay for a new stockpile on the island, and it is likely that a new wharf would probably have to be built.

Import Wharf

The rock-fill service wharf is used for handling fuel oil and general cargo. The 210 foot long "T" head has a depth alongside of 27 feet.

Shipping Stockpile

575,000 tons total capacity, live capacity 250,000 tons.

Water

At Dampier water is obtained from two sources. Water from Miaree Pool in the Maitland River, some 20 miles away, is pumped to Dampier and gravitated to the town and port installations from a storage tank. Miaree Pool is half a mile long and contains about 20 million gallons when full. However, as this supply was considered adequate for a maximum daily consumption of 50,000 gallons - only enough for the requirements of a township of 160 people and uses associated with the export of lump ore - the company decided to use waste heat from Dampier B power station to distil seawater. Two desalination units, each capable of turning out more than 200,000 gallons a day. Company officials estimate that the cost of the distilled water is about 50 cents a thousand gallons. (c.f. Canberra, around 20 cents a thousand gallons). The cost of the installations was $750,000.

Power

At Dampier, major loads on the electrical system are of an intermittent nature because of the high unloading and loading rates of the ore handling system. The A power station, installed to serve the lump ore export project and township, is equipped with three 2,660 kVA generators and two 525 kVA generators.

Dampier B power station is located adjacent to the A station. Power is generated by seven Mirrlees/Brush alternator sets with a total capacity of 30 megawatts. The engines use the same low grade heavy residual oil as is used in the pellet plant.

Due to the increasing demand for electric power following rapid expansion at Dampier it has now been decided to install a 60 megawatt steam power station at Dampier. Future heavy demands for power can be met more economically by steam turbo-generation than by a multiplicity of diesel generating sets. It is anticipated that a substantial amount of waste heat will be available for the generation of steam from the proposed metal agglomerates plant.

Four of the existing diesel sets at Dampier will be transferred progressively to Tom Price and four retained as a start-up facility and reserve capacity for the proposed steam station.

Ore Handling

The 100 ton ore wagons are shunted to a rotary inverting unloader manufactured and installed by Hitachi of Japan which handles two wagons at a time. The complete operation of unloading takes 45 seconds. The two wagons are slowed down by air-operated breaking shoes which operate by pressing the wagon wheels against the railway lines. The wagon rolls into the unloader where the wheels are gripped by a further set of breaking shoes and heavy steel arm-type clamps descend on the tops of the trucks holding them to the rails. The whole device is then rotated through about 170° by electric motors driving the prominent ring gear on either end of the unloader. The ore falls into a concrete bin below the unloader. The wagons are then righted, the break shoes and clamps released and the next 2 loaded wagons shunt the now empty ones out of the unloader. The empty wagons roll down slope and then up an incline across the set of points which they automatically change on their passing. They are halted by the incline and then under gravity travel back over the changed set of points down a gravity line

for a mile or so where they are collected into a train for the return to Mt. Tom Price.

From the concrete ore bin below the unloader, the ore is reclaimed by a tunnelled conveyor belt. From this belt the ore may take several different paths:-

1. Direct to the shiploader bypassing the screening plant on the shipping wharf.
2. Direct to the screening plant on the shipping wharf with the sized ore going to the shiploader or the stockpiler and the fines going either to a stockpile or shiploader or a stockpile in both cases, i.e. the sized and fine ores are kept separate regardless of the destination of the sized ore (only one size goes to the shiploader at one time).
3. The ore may go direct to the stockpiler and be stored on a particular stockpile.

The conveyor belting in all cases is of Japanese manufacture and consists of $\frac{1}{4}$ inch steel wire reinforcing with $\frac{1}{4}$ inch gaps encased with vulcanised rubber.

Stockpiler

The stockpiler is electrically operated and railmounted, using a continuous conveyor belt passing ore to a boom conveyor. It was manufactured by Hitachi of Japan.

The recovery from the stockpile is by two tunnel reclaim conveyors which can pass ore through or bypass the shipping wharf screening plant to the shiploader. A sampling unit is installed just after the screening plant.

Shiploader

The shiploader is railmounted electrically driven with a travel of 1600 feet. The loading complex can handle 6000 tons per hour and for short periods is capable of surges up to 7500 tons per hour.

Pellet Plant

Hamersley's Pellet Plant was officially commissioned in March, 1968.

The plant, which will produce two million tons of specification pellets annually, is the largest single unit of its kind in the world.

The Hamersley plant is not designed to upgrade ore, but to agglomerate the high grade fines from Mt. Tom Price.

Each of the three large ball mills is 38 ft 6 in. long by 14 ft. in diameter and contains over 250 tons of steel grinding balls. The fines, together with one per cent by weight of limesand are ground in the dry state.

The ground ore is conveyed to six balling discs, which are rotating inclined discs 19 ft. in diameter. Water is sprayed on to the ore on the discs, and the rotary action forms the moistened ore into strong balls of roughly half-inch diameter.

The newly-formed "green-balls are then conveyed to the indurating machine, or furnace, for heat treatment through successive stages of drying, pre-heating, firing (to 2,400°F) and finally cooled. The cooled pellets are then screened to remove oversized or undersized pellets and are then conveyed to a 200,000 ton stockpile.

Pellets are recovered from the stockpile by gravity loading and transported to the ship by the normal bulk loading equipment.

The limesand, for the pellet mix, is mined at Hearson's Cove, about five miles from the plant.

The fuel used in the plant is low grade heavy residual oil.

Metallised Agglomerates

Hamersley has decided in principle to go ahead with plans to develop a metallised agglomerate plant at Dampier. Final decision is dependent on availability of markets and finance.

The product which Hamersley hopes to manufacture at Dampier will be a uniformly sized and chemically consistent material of high metallic iron content. Initially it is believed that the product will be used to advantage in existing electric arc and basic-oxygen type furnaces, as well as foundry cupolas. The availability of this new raw material in quantity will encourage world steelmakers to adopt new lower-cost techniques.

RAILWAY

The heavy duty 182 mile railway between Mt. Tom Price and Dampier is of standard 4 ft 8½ ins. gauge. The track consists of rails weighing 119 lb/yard laid on 9 in. wide sleepers set at 3,250 to a mile.

The line drops from a height of 2,450 feet at the mine terminal to 65 feet above sea level at the Dampier loading terminal.

The maximum grade for loaded trains is 0.33%, and for unloaded trains is 2%.

Ore is transported in cars of 100 tons capacity, and three diesel locomotives are required to haul the trains carrying up to 20,000 tons from Tom Price to Dampier.

The return trip to Dampier takes about 12 hours, leaving 12 hours for loading, unloading and train maintenance.

The present rolling stock consists of 9 diesel-electric locomotives and over 380 one hundred ton ore cars. Four A.E. Goodwin Locomotives (3600 h.p.) are due to be delivered in October, 1968. By May, 1969, 680 one hundred ton ore cars will be in service.

MT. TOM PRICE

Production

The total tonnage mined during 1967 amounted to 9,345,000 tons, including 6,541,000 tons of ore delivered to the primary crusher. Tonnages of lump ore, fine ore and low grade ore delivered to the load-out stockpile were 3,876,000, 1,065,000 and 323,000 tons respectively.

The company plans to increase output from 5 to 15 million tons of ore and pellets per annum and it is planned to complete this in two stages, first to 10 million tons by June this year and then to 15 million tons in the last quarter of 1969.

The open cut mine is being developed to meet the increasing demand for ore. A second 12 cubic yard shovel with its complement of seven 100 ton trucks came into operation in the latter half of 1967.

The primary crusher, capable of crushing 3,300 tons of ore an hour, is to be duplicated and the capacity of the secondary and tertiary crushers and screening plant is being doubled. The load-out stockpile has been extended.

A beneficiator plant will commence operations in September, 1968. This plant will have an initial annual capacity of 7.2 million tons and will remove low grade fines with a relatively high shale content from run-of-mine ore up-grading the regular fine ore product by some two or three percent iron.

Mining

The mine is an opencut with 40 to 50 feet benches. The haul road is 100 feet wide with a maximum grade of 8%.

Mining is carried out using QM5 Quarry Master drills, drilling nine inch diameter blast holes. The smaller CM2 Ingersoll Rand drills are also used for three inch diamond blast holes for bench work etc. The explosive used is a slurried mix of an aqueous nitrate solution and a dry mix containing essentially aluminium powder.

The main shovels are diesel-electric 191 Marion 12 cubic yard shovels with a rated capacity 1,000 yards per hour. Small shovels, 111 Marion $4\frac{1}{2}$ yard, are also used.

The ore from the working face is loaded into 100 ton Kenworth Dart self-tipping trucks. 35 ton Euclids, self-tipping, are also used for ore haulage.

Crushing and Screening

The ore is trucked down grade to the crushing and screening plant where, it is passed through primary, secondary and tertiary crushes, screened and then stockpiled over a load-out tunnel.

The whole plant from the primary crusher to the loadout stockpile can be operated from the central control panel by one man. All the belts and units have fail-safe devices to avoid the pile up of ore at any one point due to a breakdown in any unit.

The loadout tunnel which takes the trains under the stockpile is 21 feet in diameter, has a length of 815 feet (300 feet to be added) and has 66 pneumatically operated feed openings.

The loading time for the 100 ton maximum capacity trucks is about 8 seconds.

Township

The township is about five miles from the mine and plant area. The permanent operating staff live in a self-contained community.

The married people are housed in permanent air-conditioned homes of which there are 215 at Mt. Tom Price. Single men are accommodated in air-conditioned quarters. The community is serviced with recreation facilities, community stores and swimming pool.

The company has announced that it will construct more houses at Tom Price in the next nine months.

Powerhouse

The purchase and establishment costs amounted to $1,683,000. The generating equipment consists of two 2000 KW Mirrlees, twelve cylinder engines and one 500 KW Mirrlees, three cylinder engine.

Water

The water bores are located approximately 17 miles west of Tom Price and consist of 3 producing bores, with turbine bore pumps each capable of producing 12,000 g.p.h. The main pumps are 2 Pleuger pumps of 12,000 g.p.h. each and consist of two 50 h.p. units in series.

Tank capacities are: Collector tank at bores - 250,000 gallons; Main tank - 1,000,000 gallons; Haul road - 60,000 gallons; opencut 30,000 gallons; townsite - 250,000.

REPORTED DETAILS OF CONTRACTS

High Grade Ores

(a) Main Contract with Japanese Steelmakers

65.5 million tons of iron ore of 64% Fe over a maximum of 16 years (1966-1982). Delivery will be at annual rates approximating 2.6 million tons in 1968 rising to 5 million tons in 1976. The f.o.b. prices based on an iron content of 64% Fe are as follows:

Size	Price $A equivalent	$US Actual Price
Lump ore		
30mm x 6mm	8.86	9.92 per ton
100mm x 6mm	8.63	9.664 per ton
Fine ore		
-6mm	6.86	7.68 per ton

Prices for deliveries after the first 45.5 million tons are subject to review, but are to remain unchanged unless otherwise agreed. Bonus of 20c a ton for every 1% of iron over 64%, and a penalty of 25c a ton for every 1% under 64%.

(b) Additional 1 million tons 1967-68

1 million tons between July, 1967 and March, 1968.

perce.

(c) Small Contract

500,000 tons between July, 1968 and March, 1969.

(d) Contract negotiated in September, 1967

40 million tons of lump ore and fines, worth about $270, between 1969 and 1980. The contract provides for the supply of 10 million tons of lump ore and 30 million tons of fines. Basic iron content of the ore 64%.

The new Hamersley fines contract is reported at the same price as the first contract, $US7.68 a ton for 64% ore. But the penalty for each 1% under 64% has been reportedly increased from 25 cents to 35 cents; the bonus has been increased from 17½ cents to 20 cents. This applies to ore down to 62%.

Previously ore under 62% was not acceptable, but now ore between 61 and 62% must be accepted but the penalty is understood to be 50 cents a ton for the lower 1%.

Under the new contract, if Hamersley sells 62% fines it incurs a penalty of 70 cents a ton, which brings the tonnage price down to $US6.98 a ton or 11.25 cents a unit compared with the 64% price, which is 12 cents a unit.

The new contract price for lump ore is $US9.37 a ton for 64% ore, with a bonus of 20 cents for every 1% increase in Fe content and a penalty of 25 cents for every 1% decrease in Fe content.

(e) Contract Negotiated in May 1968

15 million tons of lump ore and fines over the 10-year period from July, 1969 to March, 1979. The annual delivery rates to be 1,500,000 tons (comprising 500,000 tons of lump ore and 1,000,000 tons of fines).

Price	$US9.37 f.o.b. for lump ore	
	$US7.68 f.o.b. for fines	
Iron Content	62-64% for lump ore	
	61-64% for fines	
Iron Scale	lump ore	(+) 20 cents
		(-) 35 cents
	fines	(+) 20 cents
		(-) 35 cents for 62-64% Fe
		(-) 50 cents for 61-62% Fe

Optional Quantity lump ore ..... (+) (-) 10%
fines ..... (+) 15%
(-) 25%

Low Grade Ores

(a) 5 million tons of low grade overburden, 53-60% Fe, over approximately 10 years beginning 1967. The price varying between U.S. 8.5-10 cents per unit.

(b) 10 million tons of low grade overburden to be shipped over 12½ years beginning in 1970. The contract price is US 8.75 cents f.o.b. per 1% of iron content, with a minimum guaranteed content of 54% Fe. Hamersley expects that most of the iron ore supplied under the contract will have 58-59% Fe content. The value of the total contract is estimated at $US50 million.

Pellet Contracts

17.9 tons of pellets (63% Fe) to six Japanese steel mills over ten years, commencing in April, 1968. Price U.S. 18.5 cents per unit.

In addition to the major contracts with Japanese steel interests, Hamersley has also negotiated a number of smaller contracts with European steel mills. Trial shipments of ore have also been shipped to America.

Steel Company of Wales (S.C.O.W.) Contract

875,000 tons over three years, beginning 1967. Estimated value $A10 million.

Siderurgie Maritime S.A. (Sidmar) Contract

495,000 tons over two years. The f.o.b. value is about $A3.7 million.

Other Shipments

It is known that ore has been shipped to European and American steel interests, but details of contracts are not available.

HAMERSLEY-HANWRIGHT AGREEMENT

Hamersley has concluded an agreement with Messrs Hancock and Wright to evaluate the iron ore reserves held by Hanwright Iron Mines. The reserves lie in the Hamersley Range, in the general vicinity of Wittenoom and Tom Price.

The arrangement provides for a comprehensive and rapid evaluation of the ore reserves, by Hamersley, and a concurrent feasibility study by Kaiser Engineers and Constructors, Inc.

The objective of the investigation is to test the availability of sufficient suitable ore to justify a project which would involve a rail link from the deposits in the Wittenoom area to the Hamersley railway. Initially it is proposed to export the ore through the port of Dampier. Future plans include the construction of a separate railway to Cape Lambert and the development of a new port and loading facility at that site.

If the ore evaluation and engineering feasibility study proves satisfactory, and the necessary sales contracts and finance can be arranged, Hamersley would take up 75% of the shares in the company to be formed to operate the venture. The remaining 25% of the shares would be taken up by Messrs Hancock and Wright.

There is provision for 10% of the shares in the new company to be issued to the Australian public, in due course.

EXPLORATION

Hamersley is at present evaluating an iron ore deposit in the vicinity of Paraburdoo, approximately 35 miles south-west of Tom Price, with a view to developing another mining operation. This would involve a rail link to the present railway and would eventually lead to the development of another mining township.

NOTES ON THE DISCOVERY AND DEVELOPMENT OF BARROW ISLAND OILFIELD

M. C. Konecki & J. M. Henry

Introduction

Crude oil was discovered on Barrow Island in the Carnarvon Sedimentary Basin by West Australian Petroleum Pty. Ltd. in 1964, roughly 12 years after that company was registered in Australia as an operating company for the California Texas Company (CALTEX) an 80% shareholder, and Ampol Exploration Ltd. holding 20% interest. The current interest holders are -

California Asiatic Oil Company	2/7
Texas Overseas Petroleum Company	2/7
Shell Development (Australia) Pty. Ltd. ..	2/7
Ampol Exploration Ltd.	1/7

This first commercial success came some 11 years and 95 wells after the first exploration well, Rough Range No. 1, flowed oil during a drillstem test at a rate of some 480 barrels per day on a $\frac{1}{4}$ inch choke, only to be followed by some 27 "dry" wells in the Rough Range and Cape Range areas. Cape Range No. 2 drilled in 1956 is still the deepest well in Australia, with a total depth of 15170 feet. At the time of Barrow Island oil discovery the company's total expenditure on exploration in Western Australia was in the vicinity of $50 million, of which some $4.4 million were contributed by the Commonwealth Government in the form of subsidy. By the end of March, 1967 WAPET's total expenditure was about $85 million, including some $8.6 million in subsidy. The company estimated that by the end of 1968 it would have spent, on the exploration and development of all its areas under titles, a total in excess of $135 million, inclusive of some $15 million in subsidies.

Petroleum Title Holdings and Farmouts

At 31st December, 1967, West Australian Petroleum Pty. Ltd., held 288,128 square miles under various petroleum titles. This represented some 44.5% of the total title area held by petroleum exploration companies in Western Australia at that time. However, over the last few years the company has negotiated several "farmouts" covering approximately 69,158 square miles or 23% of its title areas. These farmout arrangements include :-

Canning Basin

P.E. 251H, 5,200 square miles - Gewerkschaft Elwerath (Germany) may earn a 50% interest by work done in the 3 years to July, 1968.

P.E. 227H, 11,400 square miles - Continental Oil Co. of Australia Ltd. (U.S.A.) and its partner Australian Sun Oil Co. Ltd. (U.S.A.) may earn a 50% interest by work done over a two year period.

P.E. 259H - 12,930 square miles - Total Exploration Australia Pty. Ltd. (French) (was French Petroleum Co. Australia, Pty. Ltd.) may earn a 50% interest by virtue of work done.

Carnarvon Basin

P.E. 226H - 34,700 square miles - Continental Oil Co. of Australia Ltd. (U.S.A.) as for P.E. 227H in Canning Basin.

Perth Basin

P.E. 228H - 2,900 square miles - Total Exploration Australia Pty. Ltd. (French) and Australian Aquitaine Petroleum Pty. Ltd. (French) may together earn a 50% interest (5/14th to Total, 2/14th Aquitaine) by exploration over a two-year period.

P.E. 261H - 3,000 square miles - Union Oil Development Corp. (U.S.A.) may earn a 50% interest by virtue of work done. Union is currently drilling Whicher Range No. 1, south of Busselton.

Footage and Wells Drilled

Footage Drilled to 31st March, 1968

	Australia and Papua	W.A.	W.A. as % of Australia and Papua
To 31st Dec. 1966	5,457,872	918,892	16.8
In 1967	1,079,756	569,300	53.0
Jan. to March, 1968 (prelim. figs.)	274,728	121,847	44.3
	6,812,356	1,610,039	23.5

Number of Wells Drilled to 31st March, 1968

	Australia and Papua	W.A.	W.A. as % of Australia and Papua
To 31st Dec. 1966	1,302	195	15.0
In 1967	274	191	70.0
Jan. to March, 1968 (prelim. figs.)	66	52	79.0
	1,642	438	26.5

Of the total number of wells drilled in Western Australia, some 234 have been drilled at Barrow Island as exploratory and developmental wells. In addition, several experimental water injection wells have been drilled at Barrow Island but their number is not included in the above totals.

The Barrow Island Oil Field

(a) Exploration

Barrow Island, 90 square miles in area, lies some 800 miles north of Perth, 35 miles off the northwest coast of the Continent of Australia, 55 miles north-northeast of Onslow and 100 miles north-east of Exmouth. The Monte Bello Islands, the site of atomic explosion experiments of the 1950's, lie some 15 miles to the north. Because of the effects of these activities, the Barrow Island could not be entered for the purpose of geological reconnaissance until 1954, to be followed in 1956 by a more detailed geological mapping which was eventually finalized during the 1962 season and demonstrated the existence of a closed 24,000 acre, 80-foot anticlinal structure in the Miocene Trealla Limestone, trending NNE SSW. A geophysical gravity survey showed a "high" in the southern portion of the island plunging gently to the northeast.

The extension by the Bureau of Mineral Resources of its 1956 aeromagnetic survey of the general area by some 500 flying line-miles from the mainland over Barrow Island has resulted in the interpretation indicating a sedimentary section in excess of 20,000 feet underneath the island. The company's seismic work included the two-line N-S and E-W refraction survey in late 1963, and a reflection survey in late 1964 - early 1965.

Although generally of poor quality, these surveys when combined with subsequent results of drilling, have elucidated most of the structural and stratigraphical complexities. It has been shown that the structural relief becomes more pronounced with depth and that a ENE-NSW trending fault in the southern end of the structure in the Lower Cretaceous beds has a throw of several hundred feet to the south.

(b) Development and Production

The oil production of the Barrow Island field comes almost exclusively from the Windalia Sandstone reservoir of Cretaceous age; it occurs at a shallow depth, roughly between 2200 and 2500 feet. The reservoir is generally tight and has low natural permeability. Actually, its significance as a producer was not recognised at first. The first wells tested flows of gas

and/or oil from the "deep" (6000'-7500') sands of Jurassic age, and when formation testing of the "deep" intervals was unsuccessful in Barrow No. 4, the shallow Windalia sand received due attention, particularly after it was demonstrated that the relatively small rates of flow could be significantly increased by fracturing the sand to increase permeability i.e. its ability to transmit the flow of oil.

Based on the results of drilling of some 25 wells in the period from mid-1964 to mid-1966, and production-testing in the February - April 1966 period, the Barrow oil field was declared to be commercial in May, 1966, with 85 million barrels of recoverable reserves from the Windalia reservoir, and an unspecified small reserve in the deeper, Jurassic sands. The area of the productive field was given at 24,700 acres (about 39 square miles) and the effective thickness of Windalia sands (net pay thickness) at 44 feet. This oil would be produced by some 240 wells at 80-acre spacing, commencing at a rate of 9,000 barrels per day and reaching a maximum of 20,000 barrels per day. Following laboratory studies of the reservoir rocks it was concluded that, by the application of the water-flood and/or gas injection techniques to assist the natural oil recovery mechanism, the amount of oil that is recoverable from the field could be increased to at least 114 million barrels. A suitable announcement to this effect was made by the W.A. Minister of Mines in December, 1966, and in April, 1967 two Petroleum (production) Leases covering the Island and surrounding waters were issued to the company by the W.A. Government.

The drilling of development wells to produce the Windalia reservoir was completed in March, 1968. For production and gathering purposes, six groups of 40 wells each have been connected to six separator stations designed for automatic operation where oil, gas and water are separated out. The "dry" oil is then transmitted to four 200,000-barrel storage tanks located about half way along the north-eastern coast of the island. The respective portions of this trunk pipe-line are as follows - 2 miles x 6-inch; 4 miles x 8-inch; 3.5 miles x 10-inch. From these storage tanks a 6-mile, 20-inch pipeline runs on the sea bottom to the offshore terminal; five 10-ton anchors provide the tanker mooring at the terminal. The pumping station located near the storage tanks on land is capable of transmitting crude to the loading tankers at a rate of up to 15,000 barrels per hour.

The offshore installations including tanker terminal, the submarine pipeline and the land pipeline from the separator stations to the storage tanks were built as a joint project by the Royal Netherlands Harbour Works - Clough.

On 23rd April, 1967 the Australian-built and owned 250,000-barrel tanker "P. J. Adams" loaded the first shipment of crude oil from the Barrow Island oilfield.

Along with the completion and connection to production facilities of development (production) wells, the volume of crude oil produced rose from 9,000 barrels in April, 1967 to 25,000 barrels per day at the end of that year, and reached 30,000 barrels per day in March, 1968.

A field water-flood experiment, initiated in 1967, is being currently applied to a portion of the Windalia reservoir to assist the oil recovery and pressure maintenance. The project is under the direction of Mr. H. Dykstra of Standard Oil Company of California.

The reserves of crude oil in the Windalia reservoir have been again up-graded in mid-1968 following the evaluation of data from the two water-flood projects commenced in the field in 1967. These results suggest that the recoverable crude oil reserves by the primary and water-flood methods may exceed 200 million barrels.

The water-flood project which may ultimately require the drilling of 208 injection wells on the 40-acre spacing is estimated to cost some $15.24 million and is to be carried out in three phases. The first phase includes 113 injection wells, 46 of which will be completed by the end of 1968.

In addition to the drilling of injection wells the Company proposes to drill 6 "primary" wells to the Windalia reservoir during the remaining months of 1968.

Exploration Outside Barrow Island

(a) Island Drilling and Discovery of Oil on Pasco Island

The developments following the discovery of the Barrow Island oil-field include exploration by the drilling of thirteen wells on islands lying between Northwest Cape and the Monte Bello Islands, using a specially adapted drilling rig and a supply landing craft, as well as geophysical seismic surveys in the general offshore and land areas. The drilling programme commenced late in September 1966 when Long Island No. 1 well on Long

Island some 30 miles west of Onslow was spudded in. It was a dry well, drilled to a total depth of 7,081 feet, and abandoned in November, 1966. The next well on Tortoise Island, 22 miles west of Onslow was also dry and abandoned in December, 1966, after reaching 7,000 feet. The Sholl Island No. 1 well, about 30 miles east of Barrow Island, was abandoned at 4,172 feet in February, 1967, without discovering any hydrocarbons. The same fate was met by Trimouille Nos. 1, 1A and 1B wells on Trimouille Island of the Monte Bello Islands, some 30 miles north of Barrow Island. The first, and the only to date, success of the island drilling programme occurred in May, 1967 in the Pasco No. 1 well on Pasco Island, about 4.5 miles south of the southern extremity of Barrow Island. This well drillstem-tested gas flow at a rate of 1.7 million cubic feet per day from the 5,168'-5,202'; a flow of oil of 42.2° API gravity in the order of 600 barrels per day from the 5,743'-5,753' interval and gas and oil of 44.5° API gravity from the 5,990'-6,010' interval through a $\frac{1}{4}$" choke. Pasco No. 2 well, some $\frac{1}{2}$ mile northwest of No. 1 was abandoned at 8,009 feet with only minor shows of oil and gas. Pasco No. 3 well, about $\frac{1}{2}$ mile east-northeast of No. 1 well was drilled to a total depth of 8,041 feet and completed as a potential oil and gas producer in August, 1967. The "Island Drilling" programme carried out after Pasco Island included the following wells, all abandoned as dry - Airlie No. 1, half way between Barrow Island and Onslow, T.D. 7,279 feet. Peak Island No. 1, 28 miles west of Onslow, T.D. 7,026 feet. Muiron No. 1, 15 miles north of Northwest Cape, T.D. 5,857 feet. Observation Island No. 1 in the Exmouth Gulf, T.D. 7,510 feet. Hope Island No. 1 on the eastern side of Exmouth Gulf opposite Learmouth, T.D. 4,680 feet. The Venard Island No. 1 12 miles offshore from Onslow, T.D. 6,810 feet. North Sady No. 1, T.D. 2,000 feet. Stockes Point No. 1 (on Barrow Island), T.D. 8,150 feet, and Mary Anne No. 1, T.D. 1750 feet.

(b) Off-shore Drilling

Wapet has an off-shore drilling programme to start in July/August 1968 in the waters surrounding Barrow Island. The jack-up drilling unit "Jubilee" owned and operated by the Offshore Company of U.S.A. The "Jubilee" is at present on tow from the Gulf of Mexico to Barrow Island via the Cape of Good Hope. This tow of some 14,000 miles is the longest tow of a drilling unit ever made.

About 100 miles northeast of Barrow Island, the B.O.C. Woodside - Shell Group is drilling Legendre No. 1, the first truly offshore well in Western Australia. This well is to be drilled to a programmed depth of 15,000' by the "Glomar Tasman", owned and operated by Global Marine Australasia Pty. Ltd. The same company owns and operates the "Glomar III" now in Bass Strait and the "Glomar Conception" now in Gulf of Papua.

References

1. WAPET News Digest, January, 1964 - March, 1968.
2. Australasian Oil and Gas Journal, May, 1967 (pp. 24-39).
3. "The Barrow Island Oilfield" by J. C. Parry. Australian Petroleum Association Journal, V. 7, Pt. 2, 1967 (pp. 130-133).
4. B.M.R. Record 1967/138, Wells and Footage Drilled for Petroleum Exploration and Development in Australia and the Territory of Papua & New Guinea in 1966.
5. The Petroleum Newsletter Nos. 29 to 33. (B.M.R.)
6. Petroleum Exploration & Development Titles Map & Key, as at 31st December, 1967. (B.M.R.)

Northern Division
June 1968

PORT DAMPIER (KING BAY)

Port Authority : Hamersley Iron Pty Ltd

Pilots : Two Pilots available

Depths In Approach Channels : Approach to Ore Jetty - 26 ft. below I.S.L.W.
Departure from Ore Jetty - 40 ft. below I.S.L.W.
Approach to Service Jetty- 25 ft. below I.S.L.W.
Jetty approaches over natural sea floor
Departure Ore Jetty - via dredged channel.

Depths Alongside and Wharf Space : Ore Jetty
Jetty projects from shore in a 314 degrees direction for about 2,600 ft., thence in a 270 degree direction for about 875 ft. Depth alongside, 51 ft. I.S.L.W., built to accommodate 100,000 ton ore carriers. Iron Ore only will be handled over this wharf.
Service Jetty
Trunk of Jetty is about 1,410 ft in length, with a "T" head 210 ft in length dredged to a depth of 27 ft. below I.S.L.W. alongside.

Number of Berths : Ore Jetty - 1 berth
Service Jetty - 1 berth

Wharf Shed Accommodation : Nil

Mechanical Cargo Handling Devices: 2 fork lifts for use on wharf or ship's hold.
1 Coles 7½ ton crane. 1,427 AWPD Pettibone Mulliken mobile crane. Iron Ore loading equipment on Ore Jetty. Several heavier mobile cranes will be available subject to priority of other work.

Bulk Loading Facilities : Loading Unit

(a) Slewing and luffing fixed length boom, long traverse ship loader.

(b) Maximum distance from wharf-edge to loading unit: 74 ft. plus ore trajectory.

(c) Maximum length of traverse of loading unit : ship loader travel 555 ft. Ship Loader plus boom 685 ft.

(d) Maximum length permissible for ship using bulk berth : 1,000 ft.

(e) Maximum beam permissible for ship using bulk berth : 140 ft.

(f) Maximum clearance of loading unit at highest high water (for non-retracting loader) : Unrestricted

(g) Gross handling rate per hour for loader : 6,000 long tons.

Road and Rail Access : Ore Jetty - Light vehicles only (Road)
Service Jetty - Road and rail access

Fresh Water : Not available.

Tugs : 1 Single screw tug - 1800 h.p.
1 Single screw tug - 350 h.p.

Bunker Facilities : Not available.

Ship Repair Services : Not available. Urgent ship repairs could be carried out in local workshop.

Principle Commodities Handled : Imports - General cargo, building materials, fuel oil.
Exports - Iron ore.

Communications : Telex to Perth and Melbourne
V.H.F. up to 20 miles
Australia wide and international telephone services

Stevedoring Companies : Hamersley Iron Pty. Ltd. do their own stevedoring

Tidal Data: High Water Springs 14.8 ft)
High Water Neaps 9.8 ft) Hampton Harbour.
)

Nature of Bottom : Approach to Ore Jetty - Sand and mud
Departure Channel from Ore Jetty - Mud and clay
Alongside Ore Jetty - Sand and Mud.

DAMPIER

HAMERSLEY IRON

Port

Hamersley Iron Pty. Ltd. selected Dampier, or King Bay as it then was, as their iron ore shipment port. The harbour is one of the few on the generally exposed north-western coast which provides some degree of protection to shipping. It is protected, apart from a small segment to the north, by the mainland and by offshore islands. In addition the approaches to the harbour are clear of major navigational hazards.

The original plans called for the development of the port in two stages; Stage I, to take ore carriers up to 65,000 tons d.w.t., and Stage II, the provision of unrestricted access for carriers up to 100,000 tons. Stage I has been completed and work has commenced on Stage II.

The rock-fill service wharf at Dampier was completed in September 1965, and is used for the unloading of fuel oil and general cargo.

The ore loading wharf consists of a rock and earth fill causeway leading to a 700 ft steel pile jetty, which, in turn, leads to the 650 ft steel-pile loading berth.

An unusual feature of the design is a system of six flexible berthing dolphins and two flexible mooring dolphins. Each berthing dolphin consists of a flexible platform sitting on nine piles and each mooring dolphin consists of a flexible platform sitting on 16 piles. Ore carriers come in contact with the flexible platforms, not the fixed wharf, when berthing and during loading.

The shiploading system has been designed for a nominal loading capacity of 6,000 tons/hour, with a maximum of 7,350 on the shiploader boom. Ore travels from the shore stockpile on a 54 inch conveyor belt, rises up the shiploader on a trailing tripper and is dropped onto a 60 inch conveyor belt which carries it to the holds of the ore carrier. The shiploader boom can slew 150°, it can be raised 20° above and 5° below the horizontal, and has a reach of about 120 ft.

The first stage involved the dredging of the approach channel and harbour to allow the unrestricted entry and departure of ore carriers of up to 65,000 tons d.w.t. and the operation of vessels of up to 100,000

tons on suitable tides. This involved the dredging of some 3,500,000 cubic yards of material from the sea bed to form a channel 3¼ miles long and with a depth of 40 ft below datum. The channel is 500 ft. wide in the straight sections and 700 ft wide on the bends.

Work has begun on the second stage, the deepening (to 46 ft) and lengthening of the approach channel, to allow the unrestricted operation of ore carriers up to 100,000 d.w.t.

Hamersley's current expansion plans also include the extension of the present wharf by 1,000 ft, to cater for the increase in loading capacity which will be required to meet contract obligations.

Another ship loader may be installed, or separate loading facilities may be built on an island about 1 mile off shore. If the company decides to construct the separate wharf and loading facilities it will be necessary to build a new conveyor system to carry ore across the bay to another stockpile on the island.

The port of Dampier is a private port, under the control of Hamersley Iron Pty. Ltd. The company operates two tugs and two workboats.

Township

Under the terms of the Agreement with the Western Australian Government, Hamersley Iron Pty. Ltd. was obliged to undertake the construction of townships at the mine site and the port. To date, the company has erected about 150 houses, a school, a hospital, a shopping centre, open air theatre and sports facilities at Dampier. A hotel/motel has been erected by the Swan Brewery Co. Ltd. Hamersley has recently announced that it intends increasing the number of houses in Dampier.

Power for the township and industrial complex is supplied by Hamersley. Two power stations are linked to the local grid; the A power station has three 2,660 KVA alternators, and the B power station has seven Mirrlees/Brush alternator sets, with a total capacity of 30 megawatts.

Because of the increasing demand for power, Hamersley has decided to erect a 60 megawatt steam power station, as this will be more economical to operate than using a large number of diesel generators.

The town's water supply is drawn from two sources. Originally, all water was pumped from Miaree Pool, in the Maitland River, some 20 miles from Dampier. This could only supply 50,000 gallons a day and, as there were no other known sources which could supply the large quantities of water required for iron ore processing, Hamersley decided to install two desalination units. These units utilise the waste heat from Dampier B power station and have a total output of 400,000 gallons of fresh water per day.

Hamersley has announced that it intends developing a second port, and township, at Cape Lambert, less than 20 miles from Dampier.

See also HAMERSLEY information sheet.

DAMPIER SALT

Dampier Salt, a joint venture of Australian and Japanese interests, signed an agreement with the Western Australian Government in November, 1967 for the establishment of a $5 million export salt industry, based on the port of Dampier.

Although initial capital expenditure on the project will be $5 million, the total cost of the scheme is expected to be $8 to $9 million.

The medium term finance will be provided by the Bank of New South Wales while the longer term finance will come from the Colonial Mutual Life Assurance Society.

Dampier Salt is owned by the following companies.

Comalco Industries Ltd (Jointly owned by Kaiser Steel Corporation and Conzinc Riotinto of Australia Ltd)	50%
Marubeni Iida Co. Ltd Nissho Co. Ltd	32%
British Tobacco	14%
Colonial Mutual Life Assurance Society	4%

Dampier Salt expects to have an initial output of 650,000 tons a year, with the first shipment to Japan in 1970. The company plans to expand production to 1 million tons a year.

The agreement with the State Government provides for Dampier Salt to be granted a lease over 28,600 acres of tidal flats behind the Dampier port area. The company also has the option of taking up a further 9,000 acres of similar land. The lease is granted for 21 years, initially, and the company will have the option of extending for another 21 years. The rental of the lease area is at the rate of $4 per 100 acres per year.

Salt loading facilities will be constructed on the service wharf owned by Hamersley Iron Pty Ltd.

Royalties payable to the State on all salt shipped by the company are :

	Rate per ton
On the 1st 500,00 tons in any year	5 cents
On the 2nd 500,000 tons in any year	6.25 cents
On all tonnages in excess of 1 million tons in any year	7.5 cents

The company will employ about 50 men on the project, and they will live in Dampier. Under the terms of the agreement with the State, Dampier Salt is required to construct houses for families and single employees at a minimum cost of $15,000 per unit.

NORTHERN DIVISION

PORT HEDLAND — June, 1968.

Contents

1. Population Growth

Although it is not possible to provide a reliable estimate of population growth in the Port Hedland area, the following figures give some indication of the expected increase in population up to 1980. (1)

Port Hedland (Urban Area)	
1966 (census)	1,778 persons
1967 (est)	3,000 "
1975	6,800 "
1980	12,000 "

It is believed that State Planning authorities are preparing town plans for a population of 20,000.

These population estimates do not take into account the large "floating" populations associated with major development projects.

The construction force for the Mount Newman iron ore project totals some 3,000 men and, although most of these men live in construction camps along the railway or at the mine, their home base is Port Hedland.

To further complicate the issue, there is a very high rate of turnover in the construction work force. A recent paper by Maddocks(2) shows that 51 per cent of the men taking up employment on north western projects leave during the first month. It is reasonable to assume that the Mount Newman project will be subject to similar conditions.

Figures quoted by Maddocks are:

Duration of stay (not retrenched)	No. of men	Indiv. %	Cum %
0 - 7 days	39	20	20
8 - 14 "	29	15	35
15 - 21 "	19	9	44
22 - 28 "	14	7	51

(1) Figures from Government publications and W.A. Department of Industrial Development personal communication.

(2) W. Maddocks, "Living and Working in the North", Labour Stability and Efficiency. The Institute of Engineers, Australia, Symposium on Northern Development Pilbara Prospects in the 1970's, Perth, 24-26 May, 1968.

From these figures it can be seen that the numbers of men in transit through Port Hedland are likely to be many times greater than would be expected for such a relatively small population.

This floating population will decrease towards the end of 1968 and the great majority will have left the area by the time Mount Newman starts exporting iron ore, in April 1969.

The population figures quoted above may be regarded as a fairly conservative estimate of Port Hedland's growth until 1980. If any other major mineral discoveries are made in the Port Hedland hinterland the population growth could exceed these forecasts.

2. Industrial Development

To date, most of the industries in the Port Hedland area are the service industries catering for the local population, and the workshops and fabrication facilities associated with the iron ore projects.

With the expected growth of population, there is likely to be an associated growth of light industry. In October 1967, it was reported that at least 40 manufacturers and businessmen had expressed an interest in blocks in the industrial areas. However, we do not have any information relating to the types of businesses likely to be established in the region.

When the decision was taken to establish a new township, some five miles south of the present townsite, a four mile belt of land was reserved between the two towns for future industrial development. The appended diagram shows the location of the industrial areas in relation to the townships and the aerodrome.

In October 1967, Imperial Chemical Industries of Australia and New Zealand Ltd. announced that it intended establishing a $500,000 explosives mixing plant at Port Hedland, aimed at supplying the Mount Goldsworthy and Mount Newman iron ore projects.

The company has signed a $2,500,000 contract with Goldsworthy Mining for the supply of explosives. Mount Newman will not start production until 1969. At present, Hamersley produces its own explosives from imported materials.

The I.C.I.A.N.Z. plant is on a 50 acre site and is surrounded by a safety buffer zone of 1,000 acres. Initial production was scheduled to start in December 1967.

The main raw material for the production of the explosives is ammonium nitrate. Although I.C.I.A.N.Z. produces this at Botany, N.S.W. and Deer Park, Victoria, it plans to use imported ammonium nitrate in the Port Hedland plant. Most of the ammonium nitrate imported into Western Australia comes from Japan, but some is imported from the United States.

The Leslie Salt Company of San Francisco is developing a $7,000,000 salt industry on 40,000 acres of tidal flats to the east of Port Hedland. The company is America's largest producer of solar salt, and distributes more than 300 salt products and derivatives throughout the world.

The harvested salt will be held in stockpile at Port Hedland for shipment to Japan.

An export contract has been signed with Toshuku Ltd of Japan. Production is expected to begin in 1969. Initial output will be 500,000 tons per annum rising to 1,000,000 tons by 1971. The plant may be expanded to produce 2,000,000 tons per annum by 1975.

Both Goldsworthy Mining Ltd and Mount Newman have commitments with the Western Australian Government to proceed to secondary processing operations.

In the case of Goldsworthy Mining Ltd, its agreement with the State Government envisages the construction of a pellet plant by 1976, and it must submit proposals for a plant to produce upgraded ore by 1983.

Mount Newman is required to have a pellet plant in operation by 1982, and must submit proposals for steel production by 1989. If the proposals are accepted, the company will be expected to commence steel production in 1994.

3. Mining Projects

By far the most important mineral in the Port Hedland hinterland is iron ore. Although increased exploration activity in the Pilbara region will lead to the discovery of other minerals, there is little doubt that, in the foreseeable future, Port Hedland's future development will remain closely linked to the shipment and local treatment of iron ore.

Goldsworthy Mining Pty Ltd started shipping iron ore from Finucane Island (Port Hedland) in June, 1966, and Mount Newman is scheduled to commence shipments from Nelson Point (Port Hedland) in April, 1969.

Goldsworthy Mining Pty Ltd is owned by the following companies:

Consolidated Goldfields Australia Ltd	33⅓%
Cyprus Mines Corporation (U.S.A.)	33⅓%
Utah Construction and Mining Co. (U.S.A.)	33⅓%

To date, the major contracts signed by the company provide for the supply of 41 million tons of lump ore and fines to Japan, between 1966 and 1979. The annual shipment was originally expected to be 2.6 million tons, but the latest

figures show that the annual rate has now reached 4.85 million tons.

Proven reserves at Mount Goldsworthy, 60 miles east of Port Hedland, exceed 50 million tons of direct shipping ore, averaging 64% Fe content. The company holds a number of temporary reserves in the Pilbara, including Yarrie, Shay Gap and Strelley Gorge. A further 650 square miles of temporary reserves are held in the Brockman Iron Formation.

Mount Goldsworthy's plans for expansion include a $3 million tertiary crushing and screening plant at Port Hedland. This will allow the production of a closely-sized lump ore product. This is in addition to the bigger lump ore produced at the mine plant.

The permanent work force is expected to rise to 300 by 1970, 200 at the mine and 100 at the port.

Mount Newman Mining is owned by the following companies:

Pilbara Iron Pty Ltd	30%
Dampier Mining Ltd	30%
Amax Iron Ore Corporation	25%
Mitsui-C. Itch Iron Pty Ltd	10%
Seltrust Iron Ore Ltd	5%

The actual operating company, Mount Newman Mining Ltd., is a wholly owned subsidiary of Broken Hill Proprietary Ltd.

Major contracts already negotiated between Mount Newman and Japanese companies provide for the supply of 100 million tons of high grade ore between 1969 and 1983. It has been reported that negotiations are under way for the sale of 5 million tons of low grade ore. In addition, Broken Hill Proprietary Ltd has contracted to take 66.5 million tons of ore between 1970 and 1990.

The iron ore deposits are at Mount Whaleback, and will be connected to Port Hedland by a 265 mile railway line.

Reserves at Mount Whaleback are estimated to be 345 million tons of high grade ore, 64% Fe and 0.04% phosphorus content. Total reserves in all areas held by the company are estimated at over 1,000 million tons of ore, with a minimum iron content of 63%.

The shiploader and stockpile will be located at Nelson Point, Port Hedland, where a 2,000 foot long pier is under construction.

The permanent work force is expected to be 560 at the mine site and 120 at Port Hedland. The workforce at Port Hedland will be substantially increased

if the company proceeds with the development of a pellet plant and a steel works.

Prior to the iron ore discoveries the major mineral export through Port Hedland was manganese. The Woodie Woodie manganese deposits lie about 250 miles to the south east of Port Hedland. Since the discovery of the manganese deposits, some 400,000 tons of manganese have been shipped through Port Hedland by Mt Sydney Manganese Pty Ltd.

Bell Bros. Pty. Ltd, owners of a mine 40 miles east of Nullagine, also ship manganese through Port Hedland.

Contracts for the sale of Pilbara manganese have been mainly on a short term basis. The Australian Financial Review of 26th April, 1968, stated that Mt. Sydney Manganese Pty. Ltd. and the Bell Brothers group had gained orders for the supply of nearly 200,000 tons of manganese, worth $4 million, for the 1968 production period. It is not known if Bell Brothers will ship manganese from the Nullagine deposits, or if their contract tonnages will be shipped from the Horseshoe mine, near Meekatharra.

Other minerals known to exist, but not necessarily in economic deposits, in the region served by Port Hedland include, asbestos, copper, gold, lead, tin, nickel, uranium.

Northern Division
June, 1968

SENTINEL MINING COMPANY INC.

Owner — The Company is a wholly owned subsidiary of National Bulk Carriers Inc., of Delaware U.S.A., which is a unit of the D.K. Ludwig group of companies.

Location - Nimingarra, about 100 miles east of Port Hedland, 40 miles from the proposed port site at Cape Keraudren.

Reserves — Area A - about 55 square miles in the Nimingarra area, 100 miles east of Port Hedland, with at least 30 million tons of ore.

Area B - about 2,550 square miles, to the south of Area A, containing unproved deposits of iron ore and manganese.

Commitment to W.A. Government

Expenditure : At this stage Sentinel Mining is not committed to anything beyond the exploration of the reserves and quarterly progress reports to the Mines Departments.

The original Agreement between Sentinel and the W.A. Government, signed on 13th March, 1968, stipulated that if the Company wishes to export from Area A it must:

(a) spent $25 million by March 1970 on mining, port, transport, town and associated facilities;

(b) submit detailed proposals by September this year for this development;

(c) give proof, also by September 30, of its ability to sell iron ore and finance the project.

Provision was made for extensions of these times by the W.A. Government and, to date, two such extensions have been granted. At the beginning of November, 1967 the company was granted a nine-month extension, to enable it to make further tests on the deposits. At that stage the company had spent more than $2 million on investigation of the deposits.

At the end of June, 1968, the W.A. Government granted the company another extension of the time for the submission of proposals for the development of the iron ore and manganese projects. The Government has still to make a decision on the period of extension to be granted.

Under the terms of the original Agreement the exploration of Area B was to be completed within two years, and the company had until March 1970 to apply for a specific mineral lease over the area.

Any lease application must be accompanied by detailed proposals for a $15 million metallised products plant, or a ferro-manganese plant with an output of the same value. A metallised products plant will be required to produce at least 250,000 tons a year within four years of the Government approving the plans, and the capacity must increase to 750,000 tons by the 11th year.

If a ferro-manganese plant is built instead it must be capable of treating at least 150,000 tons a year, reaching 50,000 tons a year in 6 years from the date of approval and rising to full capacity in 13 years.

The Agreement further specifies that if a ferro-manganese plant is built it must provide a range of iron alloys so that, within 7 years of plans being approved, its gross sales will equal or be more than those of a metallised products plant.

Estimated capital expenditure on this development is $40 million.

Company Plans

Depend upon results of exploration work.

Transport facilities are expected to be capable of handling 1 million tons a year.

A port is expected to be developed in the Cape Keraudren area, about 40 miles north of the Nimingarra ore body. No final decision has been made as to location. Initially the port would be for 60,000 ton ships but the company has said it plans to use carriers up to 240,000 tons if necessary.

$2.0 million has already been spent on exploration and geological and engineering surveys.

Possible Processing

The manganese is believed to be a low grade deposit and will require a large scale operation. The upgrading process proposed for the iron ore deposit would reduce the oxygen content of the iron ore and improve pig iron production. It would be possible to produce an ore to be fed directly into steel converters in the place of scrap or pig iron. The plant and product would be more sophisticated than the iron ore pellet plants being built by Hamersley and proposed by Mt. Newman.

Iron Ore Contracts

Press reports indicate that no large new contracts for W.A. iron ore will be signed while negotiations are taking place on the supply of Robe River ore.

Newspaper reports of June 6th, 1968 indicated that Sentinel had presented a revised offer of a long-term contract (previously offered in February 1968) to Japanese steel mills. The offer was believed to be for a total of 30.25 million tons of lump ore and fines over 14 years from 1971.

Northern Division
June 1968

GOLDSWORTHY MINING PTY. LTD.

Owners Consolidated Goldfields Ltd.

Cyprus Mines Corporation of California.

Utah Construction and Mining Company of California.

Each company has a third share in the project.

Australian equity participation is through the 23% holding in Consolidated Goldfields (Australia) Ltd. This is a recent flotation. (5m. shares out of 22m. floated on the Australian market).

Marubeni-Ieda, Mitsubishi and Nissho are the Japanese liaison trading companies associated.

Location of Operations

The Mt. Goldsworthy mine is approximately 70 miles east of Port Hedland. The country is comparatively low lying and flat, with occasional low hills of up to 250 feet in height. Mt. Goldsworthy itself is only 200 to 250 feet above the surrounding plain.

The company's port facilities are located on Finucane Island, on the opposite side of the harbour from the old township of Port Hedland.

Reserves

There are five distinct orebodies at Mt. Goldsworthy, of which numbers 1 and 3 are the largest and probably the only ones of significance for direct shipping ore. Detailed geological work has shown that numbers 1 and 3 orebodies contain between 40 and 50 million tons of direct shipping ore, which is high grade hematite averaging 64 per cent Fe.

In addition to the Mt. Goldsworthy lease of 16 square miles, the company holds a number of other temporary reserves in the Pilbara area. The 19 reserves to the north of Yarrie, 50 miles south-east of Mt. Goldsworthy, and around Strelley Gorge, Shay Gap and Abydos Station, 60 miles south-west of Mt. Goldsworthy cover about 253 square miles. Bigger reserves, covering 650 square miles, are near Weeli Wolli, some 180 miles south of Port Hedland. These reserves are in the Brockman iron formation, on the north western side of the Ophthalmia Ranges.

Commitment to W.A. Government

Expenditure

(i) not less than $40 million on mining, transportation, wharf facilities, to enable shipment of ore at a rate of 1 million tons per annum;

(ii) submit proposal at end of year 8 (i.e. 8 years after exports begin) for a secondary processing plant to cost at least $16 million. If not submitted, exports restricted to 3 million tons per annum after year 10;

(iii) submit proposal by end of year 17 for a $40 million plant to produce upgraded ore after year 19. If this proposal is not made exports after year 18 are restricted to a maximum of 5 million tons per annum.

Royalties

(i) direct shipping ore (not being locally used ore) 7½% f.o.b. revenues - min. 60 cents per ton.

(ii) on fine ore (not being locally used ore) 3¾% f.o.b. revenue - min. 30 cents per ton;

(iii) exported fines 15 cents per ton;

(iv) on concentrates produced from locally used ore by secondary processing and on locally used ore, 15 cents per ton;

(v) on all other iron ore (not being locally used ore) 7½% f.o.b. revenue, without any premium.

Lease Rental

Rental is payable annually on mineral leases at 35 cents per acre. This will be reduced to between 20 and 30 cents per acre on commencement of secondary processing or additional upgrading of beneficiated ore.

Land Rental

Land grants are conditional on payment in year 16 and thereafter of rental equal to 25 cents per ton on all iron ore or concentrates on which royalty is paid - a minimum of $150,000 per annum to be payable, rising to $300,000 if leases are taken on mining area "B" and/or "C".

Capital Expenditure

The company's initial development expenditures amount to approx. $58 million on the port, railway, townships, and mining equipment necessary to cope with an export rate of 2.5 million tons per annum. Estimates by R.I.J. Agnew, Assistant Manager of Consolidated Goldfields Ltd. indicate that cost of providing facilities for an annual production of 2.5-3.3 million tons would amount to $A14.6 - $A19.6 per ton annual capacity.

Employment

The peak construction force was about 920. The permanent work force will rise to 300 by 1970, 200 at the mine and 100 at the port.

Port

The port terminal is situated on Finucane Island, which forms the western side of the Port Hedland harbour, and is now connected to the mainland by a causeway. The uninhabited western side of the harbour was chosen as the port site as it allows room for future expansion as the ore shipping rate is increased.

Approximately five miles of approach channel had to be dredged to a depth of 29 feet, below datum, and a width of 600 feet. The inner harbour was dredged to 28 feet and the mooring basin to 52 feet; as the turning basin would only be used by vessels in ballast it was only dredged to 19 feet. The total dredging project involved the removal of some 10 million cubic yards of bottom material, of which 1.2 million cubic yards was used to reclaim 27 acres of land from the inner harbour.

The approach channel is being deepened to 37 feet, over a length of seven miles, to enable vessels of up to 100,000 tons to load Mt. Newman ore. Inner harbour channels, turning basin and loading berths have also been deepened. The loading pier is 900 feet long, and can take a 75,000 ton vessel. Provision has been made for extending, if required.

A unique feature of Goldsworthy Mining's stockpiling and shiploading system is the use of on-stream x-ray fluorescent analysis equipment to determine phosphorus, alumina, silica and iron content.

Ore Handling at Port

The 70 ton railway wagons are bottom emptying with hand operated hydraulic doors. Two wagons at a time are shunted over an underground hopper into which the ore is discharged. The operation takes about 3 minutes. The hopper has a built-in sweep and the ore is reclaimed by a conveyor passing through a short inclined tunnel. The ore can be directed by conveyor belt to either the stockpiler, the shiploader or both at the same time.

The stockpile stacker is electrically driven, railmounted and the conveyor belt which passes completely through it feeds the boom conveyor. The boom can be swung in the horizontal and vertical plane and extended or withdrawn. The stacker was supplied by Marweight Equipment Pty. Ltd. of Melbourne.

The ore is reclaimed from the stockpile for shipping by two bucket wheel reclaimers manufactured and supplied by Krupp of Germany. Each unit has a maximum capacity of 1850 tons per hour, and is self-propelled, and is mounted on caterpillar tracks.

The belt used by the reclaimers to more ore to the shiploader has a capacity of 3250 tons per hour. The consortium under the terms of their export

contract is committed to a loading rate of 2000 tons per hour.

Plans for expansion include a $3 million tertiary crushing and screening plant on Finucane Island. This will allow the production of a closely-sized lump ore product of $1\frac{1}{4}$ by $1\frac{1}{4}$. This will be in addition to the bigger lump ore of 4 in. by $1\frac{1}{4}$ in. produced at the mine plant.

The shipment rate from Finucane Island is now running at 4 to 5 million tons per annum.

Powerhouse

The power house has three English Electric Company diesel units of 1000 KVA and one of 550 KVA for domestic purposes.

Railway

Rolling stock: 3 English Electric Diesel locomotives, 1950 horsepower.
2 English Electric Diesel locomotives, 950 horsepower.
72 ore cars (bottom dump type), 70 ton capacity.
6 flatcars of 55 ton capacity.
3 rail tank cars of 15,000 gallon capacity.
2 box cars.

Train size: Ore trains generally will carry about 2,000 tons of ore, largest size would reach 4,000 tons.

Length: 70 miles, Finucane Island to Mt. Goldsworthy.

MAJOR EQUIPMENT USED AT MT. GOLDSWORTHY MINE

Number	Item
8	Le Tourneau Westinghouse 65 ton Haulpack trucks.
2	Bucyrus Erie 40R drills.
2	P & H shovels, model 955A, $2\frac{1}{2}$ cubic yard buckets.
1	42 x 65 inch Allis-Chalmers gyratory crusher manufactured by Kobe Steel, Japan.
1	17 x 84 inch Allis-Chalmers hydrocone crusher manufactured by Kobe Steel, Japan.
1	54 inch x 12 foot hydrastroke feeder-model 1000 manufactured by National Iron Works, U.S.
1	8 x 20 ft. double deck screens manufactured by Kobe Steel, Japan.

2 Radial stackers manufactured by Winget Moxey Pty. Ltd. W.A. capacity 1,600 tons per hour.

11 36 and 42 inch belt conveyors manufactured by J. & E. Ledger Pty. Ltd.

Details of Reported Contracts

(1) 16.5 million tons of lump ore of 64% Fe (100mm x 6mm) at 15.4 U.S. cents per unit. Delivery period 1966-72. Australian equivalent price of $8.80 per ton f.o.b.

(2) 3.125 million tons of iron ore fines to a consortium of Japanese mills. Delivery began February 1967 at a rate of 500,000 tons per annum to March 1973. Price will be on a c & f basis 16.5 US cents per unit for the first 375,000 tons, 16.0 US cents per unit for the next 250,000 tons and at negotiated price for the remainder.

(3) 516,000 tons lump ore for shipment between July 1967 and September 1969 to Japan.

(4) Trial shipments and spot sales of about 150,000 tons have been made or arranged for future shipment. Total value of these contracts will exceed $A175m.

(5) In June 1968, it was announced that two additional contracts had been signed with Japanese steel mills for the supply of lump ore and fines.

(a) 5 million tons of lump ore (30mm x 6 mm) over 10 years from October, 1969.

(b) 5 million tons of fines over 10 years, from October, 1969.

(c) 1.05 million tons of fines over 5 years, from July 1968.

Prices quoted for the ore are $US9.37 per ton for lump ore of 64% Fe and $US7.68 per ton for fines of 64% Fe.

BEEF ROADS SCHEME

Department of National Development

BEEF ROADS SCHEME

June 1968

BEEF ROAD DEVELOPMENT IN NORTHERN AUSTRALIA

CONTENTS

APPENDICES

I : COMMONWEALTH PARTICIPATION IN BEEF ROAD DEVELOPMENT

ENCOURAGEMENT OF MEAT PRODUCTION 1949-1954

Commonwealth participation in beef road development began in 1949 in connection with the Fifteen Year Meat Agreement with the United Kingdom. A programme of improvements to facilitate cattle transport was carried out in Queensland, Western Australia and the Northern Territory with the objective of increasing exports of beef to the United Kingdom.

The major part of the expenditure required for the works in Queensland and Western Australia was provided by the Commonwealth in the form of grants. The Commonwealth's contribution amounted to $4,332,000 and was authorized by the State Grants (Encouragement of Meat Production) Act 1949-54. Queensland received $2,654,000, mainly for upgrading of certain roads in the Channel Country, and Western Australia $1,678,000, mainly for construction of the Wyndham-Nicholson road.

In the Northern Territory, as part of the same concept, construction of a road from Timber Creek on the Victoria River to join the Wyndham-Nicholson road was commenced. At that time, virtually the only alternative market outlets to Wyndham for cattle from the Victoria River area were in Queensland, more than 1,000 miles distant.

All these works were carried to completion with the exception of the road in the Northern Territory where construction lapsed after several years. Some additional work was carried out in 1958 under the normal works programme and in 1961 the road was included in the Northern Territory's new beef road programme.

BEEF ROADS PROGRAMME 1961-1966

A new programme of beef road development commenced in 1961 following consideration by the Commonwealth Government of major developmental projects which might serve to increase Australia's export income as well as providing an opportunity for the Commonwealth to be associated more closely with productive developmental projects in the outlying areas of Australia. Development of northern cattle roads was among the projects which were given close consideration by the Government.

In February 1961, the Government announced that sympathetic consideration would be given to road development in the north, including northern and western Queensland, the Northern Territory and the north of Western Australia. Proposals were invited from the State Governments concerned and the Commonwealth looked at projects in the Northern Territory. Following the receipt of proposals, an economic study of a considerable number of these was carried out. The broad aims of this study were to relate estimates of capital and maintenance costs of the roads studied to estimates of the additional annual value of cattle turned off as a result of road construction and also to the estimated additional annual value of beef exported.

Queensland

In August, 1961, the Commonwealth approved a grant of $10 million to Queensland for specified beef road works to a gravel standard and this was to include $1.3 million of the first $2 million to be spent on the Normanton-Julia Creek road. The approved roads were:

Julia Creek-Normanton

Georgetown-Mt. Surprise-Hann Highway

Mount Isa-Dajarra

Dajarra-Boulia

Winton-Boulia

Quilpie-Windorah

The grant was authorized by the Queensland Grant (Beef Cattle Roads) Act 1961.

During 1962, the Queensland Government approached the Commonwealth with a request for additional funds to seal the roads in the approved programme. The Commonwealth agreed to provide an additional $6.6 million, as a loan, for the purpose of sealing; this was authorized by the Queensland Beef Cattle Roads Agreement Act 1962.

Western Australia

In the case of Western Australia, the Commonwealth approved a grant of $1 million for the financial year 1961-62, subject to matching expenditure by the State. This action was authorized by the Western Australia Grant (Beef Cattle Roads) Act 1961. Subsequently, the Western Australian Government proposed a financial programme under which the Commonwealth would provide a total of $6.9 million over a five-year period from 1961-62 to 1965-66. The Commonwealth Government was in agreement with the suggested programme and authorization was given in the Western Australia Grant (Beef Cattle Roads) Act, 1962.

The approved roads in Western Australia were:

The Great Northern Highway (Broome to Wyndham)

The Duncan Highway (Wyndham to Hall's Creek via Nicholson)

Derby to Mt. House and Glenroy.

Northern Territory

In the Northern Territory, the Government decided to spend $700,000 in the financial year 1961-62. Later, in July, 1962, it was announced that the approved beef road programme in the Northern Territory would involve an expenditure of $9.14 million on the following roads:

Dunmarra-W.A. Border, via Top Springs, Victoria River Downs, Jasper's Gorge, Timber Creek and Newry

Barkly Highway-Anthony's Lagoon

Stuart Highway-Yuendumu

Stuart Highway-Plenty River

Top Springs-Wave Hill

In May 1964, the Commonwealth approved construction of the Katherine-Willeroo-Top Springs road to sealed standard.

COMPREHENSIVE EXAMINATION OF BEEF ROADS, 1964

Further approaches were made by the Governments of Queensland, Western Australia and South Australia during 1963 and 1964 for additional funds for beef road construction in those States. In these proposals, the State Governments were concerned with specific roads and regions rather than with the overall integrated needs of the cattle industry. In July 1964, the Commonwealth Government directed that a comprehensive examination of beef road development be undertaken.

A detailed evaluation was carried out by Commonwealth officers. The evaluation was directed primarily to calculating benefit-cost ratios which, in essence, compared "present worth values" for (a) estimated annual benefits - in the form of additional annual cattle turn-off - likely to result from the construction of roads, and (b) estimated total road construction

costs and annual maintenance costs together with the additional annual operating costs likely to be incurred on cattle properties.

Although the prime objective of the evaluation was concerned with the beef cattle industry, the desirability of an overall programme to take account of the needs of other industries, both existing and developing, was recognized. The influence of the location of railheads, highways, meatworks, towns and ports was also given due consideration. However, net benefits which could flow to sectors of the community other than the beef cattle industry were not estimated nor specifically brought into the analyses.

The evaluation was carried out in respect of specific regions throughout northern Australia with, however, full recognition of present and future interdependence between production regions. Attention was concentrated on determining an integrated and co-ordinated programme aimed at providing major production and export results rather than reviewing the merits of particular roads nominated in representations by various organisations, pastoral and other interests, and authorities. In adopting this course, special steps were taken to obtain factual data, technical information and expert advice from a wide range of sources in the cattle industry, departments and authorities (both Commonwealth and State), and technical agencies.

Benefit-cost ratios were calculated for each of the regions, indicating those areas in which the highest returns were likely to flow in a national sense from Commonwealth investment in beef road construction.

Although no financial provisions were made in the 1965-66 Budget to finance construction of beef roads outside the then

current arrangements, a specific statement was included in the Budget Speech to the effect that no cut-off in the beef roads programme was intended; that the evaluation by Commonwealth officers was under detailed examination; and that discussions with the States would take place in due course.

INTERIM PROGRAMME 1966-67

As the investigations by Commonwealth officers were proceeding and in view of the statement that no cut-off in the beef roads programme was intended, the Commonwealth Government proposed an interim programme of financial assistance for beef roads in Queensland and Western Australia for the financial year 1966-67.

In January 1966, the Commonwealth Government indicated its agreement with the proposition that expenditure in 1966-67 should continue at the then current annual levels of $4.5 million in Queensland and $1.5 million in Western Australia. The Government directed Commonwealth officers to enter into discussions with Queensland and Western Australian officers to determine details for a suitable interim programme. This was done and, as the existing legislation providing for payments to Western Australia did not authorize payment for works after 30th June, 1966, the Parliament in May 1966 passed the Western Australia Grant (Beef Cattle Roads) Act 1966 to authorize financial assistance for 1966-67. In the case of Queensland, the existing legislation gave authority for financial assistance until June 1967 and there were funds in hand. The Parliament in September 1966 passed the Queensland Beef Cattle Roads Agreement Act 1966; the related Agreement provided for $3.9 million additional assistance to Queensland and specified the following additional roads:

Dingo-Mt. Flora

The Battery-Townsville

Mareeba-Laura

The Lynd-Charters Towers.

PROPOSED PROGRAMME, 1967-1974

In March 1967, the Commonwealth Government indicated its agreement in principle to a further programme of beef roads construction in Queensland, Western Australia and South Australia. Further details were provided in a statement by the late Prime Minister in the House of Representatives in November 1967 when it was announced that the Government intended to provide finance totalling $50 million over a seven-year period commencing 1st July, 1967. It was indicated that the funds would be allocated to the State Governments as follows:

Queensland	:	$39.5 million
Western Australia	:	$9.5 million
South Australia	:	$1.0 million

and that the assistance would be in the form of non-repayable grants. It was also indicated that it was the Government's intention that the grants would no longer be conditional on any matching expenditures by the States, although it was expected that the States would continue to make their own additional contribution to the development of beef roads.

In the case of Queensland, the proposed programme includes a number of roads additional to those approved under previous legislation as eligible for financial assistance. The additional roads are:

Oxford Downs-Mackay	:	63 miles
Cloncurry-Burketown	:	270 "
Georgetown-Normanton	:	190 "
Mt. Douglas-Collinsville	:	120 "
Mt. Coolon-Nebo	:	110 "
Mungana-Highbury	:	115 "
Windorah-Currawilla	:	105 "
May Downs Road	:	35 "

This list has been agreed in discussions between Commonwealth and State authorities. The mileages shown above are, in some cases, approximate only as details of final routes and alignments have still to be worked out. In discussion between Commonwealth and State authorities, agreement has been reached on the principle of stage construction for certain of the new roads. It is not intended, therefore, that the proposed programme should encompass construction of all of the above roads to a similar standard of construction or degree of completion.

In Western Australia, the proposed Commonwealth grant will finance continued upgrading by stage construction on the Great Northern Highway, the Duncan Highway and the Derby-Gibb River road.

In South Australia, the proposed Commonwealth grant will finance permanent works on the Birdsville Track. Although the amount proposed to be provided ($1 million) is not sufficient to improve the whole road to a standard equivalent to that necessary for high traffic densities, it is considered sufficient to alleviate to a significant extent the considerable cattle transport problems which exist in this region of South Australia.

BEEF ROADS IN THE NORTHERN TERRITORY

Some details have already been given of the programme

of beef road construction for the Northern Territory which was announced in 1962. Between 1962 and 1966, a number of additions and modifications were made to the 1962 programme, resulting in a programme as at March 1966 amounting to $13.8 million. The programme of works included the following roads:

Dunmarra-W.A. Border, via Top Springs	:	360 miles
Barkly Highway-Anthony's Lagoon	:	140 "
Stuart Highway-Yuendumu	:	160 "
Stuart Highway-Plenty River	:	120 "
Katherine-Willeroo	:	70 "
Willeroo-Top Springs	:	101 "
Top Springs-Wave Hill	:	100 "

In October, 1966, details were announced of a further programme of beef road works for the Northern Territory to be implemented over a period of about six years. The new programme includes the upgrading of 525 miles of roads to sealed standard and the sealing of 140 miles of existing beef roads, at an estimated cost of $14.3 million. The roads included in the new programme are:

Barkly Highway-Anthony's Lagoon	:	140 miles
Anthony's Lagoon-Borroloola	:	162 "
Daly Waters-Cape Crawford	:	167 "
Mataranka-Roper Bar	:	115 "
Willeroo-Timber Creek	:	81 "

II: PROGRESS AND EXPENDITURE TO DATE

QUEENSLAND

The total Commonwealth funds available to Queensland over the period 1961-62 to 1966-67 under the 1961 programme amounted to $16.6 million. By June 1966, all but $0.6 million had been spent. The position of each of the roads approved at that time is summarised in Table 1.

By the end of 1964, it was evident that considerable under-estimation of costs had occurred on the Queensland roads and that the funds available would be expended without completion of the construction envisaged. As will be seen from the table, the estimate of the costs involved had risen from $16.6 million to $27.6 million by February 1965. Although under-estimation occurred in respect of the Queensland roads, it should be appreciated that the proposed construction covered development to sealed standard of more than 900 miles distributed over widely separated areas and the original estimates were provided in 1961 by the Queensland authorities without the benefit of other than preliminary investigations. The subsequent evaluation took into account the revised estimate of $27.6 million.

Under the interim programme for 1966-67, Queensland received additional funds of $3.9 million which, together with the unexpended part of the original financial assistance, provided for a works programme of $4.5 million. The additional finance was provided on the basis of 50% grant and 50% loan. The list of approved roads on which funds could be spent was extended as shown in Table 2, which summarises expenditure during the year ended 30th June, 1967, and provides particulars of the progress to that date.

WESTERN AUSTRALIA

The policy adopted by the Western Australian Government has been directed towards a progressive upgrading, by stage construction, of the roads included in their programme.

These roads are:

The Great Northern Highway (section Broome-Wyndham)

The Duncan Highway (Wyndham to Halls Creek via Nicholson)

Derby-Mt. House-Gibb River

A condition of Commonwealth assistance to the State has been the expenditure by the State of matching amounts on roadworks in that area of the State north of 20°South latitude.

Annual expenditures by Western Australia, from both Commonwealth and State funds, are set out in the Table 3 for the period 1961-62 to 1966-67.

THE NORTHERN TERRITORY

In July 1962, the approved beef road programme for the Northern Territory was:

	$ million
Dunmarra-Top Springs-Timber Creek-W.A. border (gravel)	5.04
Barkly Highway-Anthony's Lagoon (gravel)	1.4
Stuart Highway-Yuendumu (gravel)	0.6
Stuart Highway-Plenty River (gravel)	0.5
Top Springs-Wave Hill (gravel)	1.6
Total:	9.14

Construction proceeded on all roads with the exception of that from Top Springs to Wave Hill which was referred to the Parliamentary Standing Committee on Public Works. In March 1965, the Committee recommended construction of the road to sealed standard for a revised estimated cost of $2.7 million which included $0.5 million for sealing. This and the other changes to the list of approved works between July 1962 and March 1966, are as follows:

	$ million
Approvals as above	9.14
Katherine-Willeroo (sealed)	1.55
Willeroo-Top Springs (sealed)	1.72
Top Springs-Wave Hill - additional (sealed)	1.1
Increase due to variations on (ii), (iii) and (iv) above	0.273
	13.783

The incidence of expenditure incurred against the above works and details of progress are set out in Table 4.

SUMMARY OF EXPENDITURE

Total expenditure on beef roads, by the Commonwealth and the States, since 1961 and up to 30th June, 1967, may be summarised as follows :

	Pro-gramme	Approved Programme $m.				Exp. to 30th June 1967 $m.		
		C'wealth		State	Total	C'wealth	State	Total
		Grants	Loans					
Q'ld	1961/67	10.0	6.6	2.0	18.6	16.0	2.0	18.0
	1966/67	1.95	1.95	-	3.9	4.5	-	4.5
Total		11.95	8.55	2.0	22.5	20.5	2.0	22.5
W.A.	1961/66	6.9	-	6.2	13.1	6.9	6.2	13.1
	1966/67	1.5	-	1.9	3.4	1.5	1.9	3.4
Total		8.4	-	8.1	16.5	8.4	8.1	16.5
N.T.	1961	13.8		-	13.8	10.4	-	10.4
	1966	14.3		-	14.3	-	-	-
Total		28.1		-	28.1	10.4	-	10.4
Grand Totals		57.0		10.1	67.1	39.3	10.1	49.4

TABLE 1

QUEENSLAND BEEF ROAD PROGRAMME - 1961/67

Approved Road	Length miles	Total Estimated Cost as at Feb. 1965 $m.	Progress to June 1966	Expenditure to June 1966 $m.
1. Julia Creek-Normanton	270	7.2	Approx. 210 miles completed to sealed standard. Remainder under construction.	6.246
2. Georgetown-Kennedy Hwy	92	4.4	Complete to gravel standard only. Five bridges still required.	3.135
3. Boulia-Dajarra	92	2.2	Complete to sealed standard.	2.186
4. Quilpie-Windorah	153	3.3	Complete to sealed standard.	3.204
5. Mt. Isa-Dajarra	96	2.8	Work just commenced.	0.009
6. Winton-Boulia	231	7.7	Approx. 113 miles completed to sealed standard. Work stopped, awaiting further funds.	3.240
TOTALS		27.6		18.020

Of the total expenditure to June 1966 of $18.02 million, the State contributed approx. $2.02 million.

Total expenditure of Commonwealth funds = $16.0 million.
Total funds available from Commonwealth = $16.6 million.

Balance available for expenditure in 1966/67 = $0.6 million.

TABLE 2

QUEENSLAND 1966/67 INTERIM PROGRAMME

Approved Road	Expenditure prior to 1966/67	Expenditure during 1966/67	Progress to June 1967	Total Expenditure to June 1967
	$m.	$m.		$m.
1. Julia Creek-Normanton	6.246	1.120	Virtually complete.	7.366
2. Georgetown-Kennedy Highway	3.135	1.802	Georgetown to Mt. Surprise complete to sealed standard. Work in progress on remainder including bridges.	4.937
3. Boulia-Dajarra	2.186	0.016	Complete to sealed standard.	2.202
4. Quilpie-Windorah	3.204	0.004	Complete to sealed standard.	3.203
5. Mt. Isa-Dajarra	0.009	0.601	Approx. 16 miles out of Mt. Isa complete to sealed standard. Work in progress on remainder.	0.610
6. Winton-Boulia	3.240	0.169	Approx. 113 miles complete to sealed standard. Work during year on connection to loading yards and additional drainage.	3.409
7. Dingo-Mt. Flora	-	0.272	10.5 mile section north from Dingo complete to sealed standard.	0.272
8. Battery-Townsville	-	0.112	Work in progress on 5 mile section at Townsville end.	
9. Mareeba-Laura	-	0.031	2 bridges under construction.	0.031
10. The Lynd-Charters Towers	-	0.376	Upgrading in progress near Charcoal Creek and bridge completed over Basalt River.	0.376
TOTALS	18.020	4.503		22.523

Of the total expenditure to June 1967, approx. $2.02 million has been contributed by the State from its own resources.

TABLE 3

1961 WESTERN AUSTRALIAN BEEF ROAD PROGRAMME AND INTERIM PROGRAMME 1966-67

EXPENDITURES $m.

Road (miles)	1961/62[1]		1962/63		1963/64		1964/65		1965/66		Totals to June 1966	
	C'wealth	State	C'wealth	State	C'wealth	State	C'wealth	State	C'wealth	State	C'wealth	State
Great Northern Hwy : Broome-Wyndham (713)	0.368	0.636	0.703	0.793	0.819	0.699	0.968	1.104	0.936	0.897	3.794	4.129
Duncan Hwy (335)	0.632	0.374	0.697	0.150	0.391	0.081	0.383	0.107	0.367	0.243	2.470	0.955
Derby-Mt. House Gibb River (232)	-	0.254	-	0.468	0.290	0.096	0.149	0.132	0.197	0.193	0.636	1.143
Total beef roads	1.000	1.264	1.400	1.411	1.500	0.876	1.500	1.343	1.500	1.333	6.900	6.227
Other Roadworks	-	0.390	-	0.220	-	0.424	-	0.470	-	0.574	-	2.078
Total expenditures north of 20°S latitude	1.000	1.654	1.400	1.631	1.500	1.300	1.500	1.813	1.500	1.907	6.900	8.305

Road	Totals to June 1966		Interim Prog. 1966/67		Totals to June 1967	
	C'wealth	State	C'wealth	State	C'wealth	State
Great Northern Hwy	3.794	4.129	0.962	1.593	4.756	5.722
Duncan Highway	2.470	0.955	0.281	0.289	2.751	1.244
Derby-Gibb River	0.636	1.143	0.257	0.047	0.893	1.190
Total beef roads	6.900	6.227	1.500	1.929	8.400	8.156
Other roadworks	-	2.078	-	0.525	-	2.603
Total all roadworks north of 20°S latitude	6.900	8.305	1.500	2.454	8.400	10.759

1) Figures for State are programmed expenditures only. Actual expenditures incurred not available.

TABLE 4

NORTHERN TERRITORY BEEF ROADS PROGRAMME 1961-1967

Road	Miles	Authorised as at March 1966	Annual Expenditures - $m.						Total to 30-6-67	Remarks
			61/62	62/63	63/64	64/65	65/66	66/67		
		$m.							$m.	
Dunmarra-W.A. Border	360	5.042	0.369	1.303	0.748	0.502	0.220	1.230	4.372	Substantially complete except for 90 miles between Mooloolo and Timber Creek not programmed for upgrading.
Barkly Highway-Anthony's Lagoon	140	1.550	0.138	0.392	0.646	0.260	0.178	0.013	1.627	Complete to gravel standard (sealing proposed under new programme).
Stuart Highway-Yuendumu	160	0.608	0.184	0.362	0.061	-	-	-	0.607	Complete to gravel standard.
Stuart Highway-Plenty River	120	0.613	-	0.134	0.345	0.095	0.035	-	0.609	Complete to gravel standard.
Top Springs-Wave Hill	100	2.700	-	0.131	0.002	-	-	0.009	0.142	Under construction to sealed standard.
Katherine-Willeroo	70	1.500	-	-	-	0.116	1.846	1.044	3.006	Under construction to sealed standard.
Willeroo-Top Springs	101	1.720	-	-	-	-				
TOTALS	1,051	13.783	0.691	2.322	1.802	0.973	2.279	2.296	10.363	

FUTURE BEEF ROADS PROGRAMME

QUEENSLAND WESTERN AUSTRALIA AND SOUTH AUSTRALIA

SCALE IN MILES

100 0 100 200 300

LEGEND

ROADS

Proposed

Constructed

Under Construction

Other Roads

Existing Rail Links

Each dot represents 3,000 Beef Cattle

BEEF CATTLE NUMBERS-MARCH 1966

New South Wales	3,036,000
Victoria	1,490,000
Queensland	5,934,000
South Australia	439,000
Western Australia	1,063,000
Tasmania	244,000
Northern Territory	1,031,000
Australian Capital Territory	11,000
Australia	13,248,000

ROUTES SHOWN ARE SUBJECT TO VARIATION

Prepared by the Commonwealth Bureau of Census and Statistics, Canberra 1966

Department of National Development, Canberra, A.C.T. 1963

NM-MISC/67/324

NORTHERN DIVISION

June, 1968

KUNUNURRA

Kununurra is the administrative and commercial centre for the Ord Irrigation Project, and has a population of approximately 1,000 persons. It is some 1,700 air miles from Perth and 280 miles from Darwin. It is connected to the port of Wyndham by 65 miles of all-weather road.

The name Kununurra is an aboriginal word meaning "Big Waters", and recent developments in the Ord region give added significance to the name.

The first materials for the construction of the town arrived in May 1960, ten months before work commenced on the Diversion Dam. Kununurra now has 150 houses, a 77 bed hotel, a 15 room motel, a P.W.D. hostel, a small hospital, two schools, two churches, two banks, three shops, three service stations, two workshops, two cotton ginneries, a pipe-making plant, an open-air theatre, and a licensed club. A Civic Centre has been constructed, comprising offices, a hall, and an infant welfare centre. A modern 30-bay caravan park caters for visitors to the district. A nine-hole golf course and tennis courts have also been constructed.

The town has been planned to meet the requirements of tropical living and illustrates the changed attitude that now exists towards the provision of suitably designed accommodation for tropical conditions in northern Australia.

Another radical departure from the usual concept of rural development is that provision has been made for the farmers to enjoy the benefits of community life, instead of living in comparative isolation in scattered homesteads.

A rental home is provided in the town for each farmer prior to taking up his block. Farmers are thus encouraged to live in Kununurra, and these homes may be purchased if desired. Alternatively, the farmer may purchase a building block in the town and erect a home of his own design or he may build a home on his farm.

State Housing Commission homes in Kununurra are offered for purchase at approximately $12,000 (1965 price, 1968 prices not known) or for rental at $13 per week (1965 rates). Building blocks are available from time to time, by auction, at prices of approximately $200 per block. A condition of the sale of lots is that all houses shall be at least ten squares in size and contain a minimum of two bedrooms.

Although no restrictions are placed upon settlers who wish to live on their blocks, there are many advantages to be gained by living in the township of Kununurra. In the wet season, living conditions on the blacksoil country can be extremely unpleasant and access difficult. Whereas, in Kununurra, all houses are on sandy soil and all services and amenities are within easy reach.

It is envisaged that Kununurra will be the main settlement in the region, with smaller settlements towards Weaber Plains and Carlton Plains. The smaller settlements will be modelled on Kununurra, with farmers living in these communities rather than on their farms. Construction of the satellite towns is expected to start when the population of Kununurra reaches 4,000. State Planning Authorities envisage a population of 10,000 to 15,000 in the region; the Minister for the North West, Mr. Court, has stated that a population of 20,000 may even be achieved.

Land set aside for future expansion of Kununurra includes $8\frac{1}{2}$ acres for a shopping centre and parking lot and five one-acre blocks to be used for the establishment of parks in various parts of the town. Provision has also been made for an 18-hole golf course and a sports area, with ovals, swimming pool, bowling green and tennis courts.

The buildings in Kununurra were designed and erected by the State Housing Commission. The married quarters are three-bedroom homes, set on concrete stilts and with provision for some degree of temperature control by the use of wide eaves and good cross-ventilation. Under each house there is room for a car, a laundry and outdoor living facilities. Each house is equipped with an electric stove, refrigerator and washing machine, and there are electric fans in every room. Hot water is provided by solar heating. Each house has its own septic tank.

As the cost of erecting a tropical design house at Wyndham is estimated to be around $15,500, the cost of a similar house at Kununurra is likely to be slightly higher.

The town's domestic water supply is drawn from the Diversion Dam storage during the dry season. During the wet season, water is obtained from a number of bores on the outskirts of the town. The total salinity of the town's water supply is around 380 p.p.m., with a chloride content of 61 p.p.m. The charge for domestic water is 40 cents per 1,000 gallons, and the average daily consumption is about 176,000 gallons.

The electric power supply is 240 volts, 50 cycles. The diesel operated power station has an installed capacity of 3,000 kilowatts, which will be raised to 4,000 kilowatts when another unit is installed in the near future.

Postal and telegraph facilities are available through the Kununurra Post Office. Kununurra is linked to Wyndham by radio-telephone and thence by land line to Perth. The Flying Doctor network is also available for the transmission of messages.

The Kununurra airstrip is about one mile from the township. The strip is 5,500 feet long and can accommodate aircraft of F27 Fokker Friendship and D.C.4 standard.

MacRobertson Miller Airlines Ltd operates a commercial airline service from Perth to Darwin, calling at Wyndham and Kununurra. The company has six F27 Fokker Friendships, eight Douglas DC3 aircraft and one twin Otter. There are six services a week to Perth and three services to Darwin. There are road connections between Kununurra and Wyndham (Wyndham has a more frequent service) to connect with flights which do not touch-down at Kununurra. The single fare from Kununurra to Perth is $105-60 and from Kununurra to Darwin is $25-20.

Ships of the State Shipping Service of Western Australia call at Wyndham to load cargoes for Perth, Darwin and intermediate ports. The frequency of shipping tends to vary with the season and the cargoes available. Overseas ships also call at Wyndham to load meat, and any other cargoes offering.

Private carriers operate road transport services between Kununurra and Wyndham. The State Government issues licenses for the road transport of goods beyond Geraldton and Meekatharra, provided railway facilities are used to those two points. There are no restrictions on interstate road transport operating between the Northern Territory and Kununurra.

We have no recent information on road charges, which are normally private contracts between hauliers and customers; but in 1965 quotations for loads of 10 tons and over from Perth to Kununurra were in the order of $120 per ton. Shipping rates are approximately one-quarter to one-third of the road charges, but this does not include door-to-door service.

Despite its isolation, social and welfare services have not been neglected in the planning of Kununurra.

Primary schooling is available in a modern four-room school, capable of accommodating 120 children, controlled by the State Education Department. In addition, a two-room primary school, capable of accommodating 80 children, is run by the Catholic Church.

There are no secondary schools in the area, but the Education Department operates a correspondence school, covering both primary and secondary education, for the benefit of children in remote areas. Provision has been made for the construction of a secondary school in future plans for Kununurra.

Although there is no resident doctor in the town, visits are made to Kununurra twice weekly by the District Medical Officer based in Wyndham. A dentist is stationed at Wyndham and visits Kununurra periodically.

Kununurra has an eight-bed hospital, operated by the Australian Inland Mission. There is a 25-bed hospital at Wyndham, which is staffed and operated by the State Government Medical Department. An infant health centre will be located in the Kununurra Civic Centre. Ten acres of land have been set aside for a hospital.

A unit of the Royal Flying Doctor Service is based at Wyndham and has its own aircraft and radio facilities.

Church establishments include a branch of the Australian Inland Mission and a Roman Catholic church and convent. An Anglican church is planned.

There is a police station with one resident constable.

Recreational and sporting interests are well catered for by golf, tennis, cricket, aquatic, and aero clubs. The less energetic have not been forgotten; the Ord River Club provides facilities and pleasant surroundings for over 300 members; an open-air picture theatre screens films twice weekly, and there is a public library.

Other organisations associated with community affairs include: a Progress Association, Parents and Citizens Association, a Kindergarten, Infant Health Committee, Country Women's Association, Girl Guides, Brownies, and a Chamber of Commerce.

The Hume Pipe Company established the first industry in Kununurra. The Company supplied all the concrete piping and culverts used in Stage I of the irrigation project.

The second major industrial undertaking to be constructed in the town was a cotton ginnery. The State Government constructed the first ginnery at a capital cost of $500,000. The ginnery was leased to Wesfarmers Co-operative who, in turn, organised a co-operative amongst the Ord farmers.

The Ord River District Co-operative Pty Ltd is controlled by a board of seven directors; five of whom are farmers, and two are nominated by Wesfarmers. The resident manager is appointed from the staff of Wesfarmers.

In addition to ginning seed cotton and marketing raw cotton and cotton seed the co-operative also operates a retail store, which sells groceries, hardware, drapery, fertilisers, chemicals and general farm requirements.

As the acreage of cotton increased a second ginnery became necessary. The new ginnery was built alongside the first ginnery and commenced operations in 1967. Finance for the ginneries is supplied by grower contributions. These are in the form of a general ginning and marketing fee, based on the amount of raw cotton processed by the ginneries. In addition to owning the second ginnery the growers also have the option to purchase the State financed ginnery.

The new ginnery raises the total ginning capacity to 400 bales per day. It is estimated that at least six more ginneries will be required when Stage II of the Ord Scheme is completed.

The cotton lint is pressed into 500 lb. bales and sold to spinners in Brisbane, Sydney, Melbourne and Adelaide. Apart from seed kept for sowing the following season, the bulk of the cotton seed is sold to Japan. The cotton seed fetches approximately $60 per ton f.o.b. Wyndham. Both lint and seed are shipped through Wyndham.

In the 1967 season, approximately 26.5 million lbs. of seed cotton was ginned; this yielded 7.9 million lbs. of lint and 18.1 million lbs. of seed. Of this seed, some 15.5 million lbs, was exported.

Northern Division

THE KIMBERLEY RESEARCH STATION

June 1968

The 2,000 acre Kimberley Research Station is located on the Ord River, some three miles by road from Kununurra.

The climate of the area is characterised by a warm dry winter season and a hot wet summer season. Rainfall is virtually confined to the summer, most of it falling between early December and mid-March. Mean annual rainfall is around 29 inches, but the quantity of rain, its distribution and the length of the rainy season are very variable. Theoretical moisture balance studies and early field experiments have shown that in spite of the comparatively high mean annual rainfall, rain grown crops are liable to suffer serious water stress almost every year. Irrigation is therefore a prerequisite for successful production of most crops. Temperatures in the region are suitable for a wide range of tropical and sub-tropical crops, although growth and development during the cool months is often retarded.

MONTHLY CLIMATIC AVERAGES - KIMBERLEY RESEARCH STATION

Month	Rainfall	No. of Wet Days	Evaporation	Temperature		Humidity 9 a.m.
				Max.	Min.	
	inches		inches	°F.	°F.	%
January	7.21	11	8.74	97.6	75.0	62
February	6.94	10	7.27	95.4	75.1	65
March	4.83	7	8.03	97.2	73.9	55
April	0.86	2	7.81	95.5	69.0	42
May	0.25	Nil	7.90	91.8	63.5	33
June	0.22	Nil	6.94	87.1	60.8	34
July	0.12	Nil	7.33	87.3	58.0	32
August	0.03	Nil	8.79	91.0	59.5	30
September	0.10	Nil	10.02	96.3	64.8	31
October	0.78	2	11.53	101.5	72.6	37
November	2.72	6	10.02	102.1	76.2	45
December	5.35	10	9.83	99.4	76.2	53
Year	29.44	48	104.96	*95.2	*68.7	*43

* Average

The predominant soil type in the potentially irrigable areas is an impermeable clay underlain at various depths by lighter material. Its pH varies from 7.5 to 9.5, but salt and sodium content is low. In the virgin state the soil is low in nitrogen (N = 0.02 to 0.05 percent) and in available phosphate (HCl - extracted P_2O_5 = 0.01 to 0.02 percent). Laboratory determinations and field trials have not revealed any other serious deficiencies in major and minor nutrients.

The station was established in 1946 as a joint Commonwealth/State research centre, for the purpose of obtaining information on the agricultural possibilities of the Ord region.

The cost of running the Station is shared between the Department of Agriculture, W.A. and the Commonwealth. The present cost of operating and maintaining the Station is $260,000 per annum, of which half is paid by the Commonwealth out of the vote of the Department of National Development.

The programme of work is controlled by a Policy Committee and a Supervisory Committee. The Policy Committee consists of the Director of Agriculture and Director of Works from Western Australia and the Chief of the Division of Land Research of C.S.I.R.O. and the Director, Northern Division of the Department of National Development. The Supervisory Committee consists of officers delegated by the above Departments and meets twice yearly at the Research Station.

The Department of Agriculture, W.A. and the C.S.I.R.O. are responsible for the salaries and allowances of their respective research staffs. The Department of Agriculture, W.A. is also responsible for the extension services provided for the Ord farmers.

Early research effort concentrated on crops including sugar, rice, cotton and oil seeds such as linseed, safflower and rape seed.

By 1958 it was apparent that no insurmountable difficulties were likely to be experienced in growing the above crops in the Ord area.

In 1961-62, the Bureau of Agricultural Economics carried out an investigation of the economics of possible crop enterprises on the Ord to establish the cash crops which offered the best economic prospects for large-scale irrigation development. This investigation was concentrated around cotton, rice, linseed and safflower. It did not include sugar cane because the market prospects for sugar did not warrant large-scale expansion of sugar production in Australia. Livestock enterprises and fodder crops were not considered in detail because of the almost complete absence of reliable data.

Although on technical grounds rice and oil crop production were favoured, economic considerations showed clearly that cotton production, under known technology, offered the best financial prospects in the immediate future. Until further evidence on alternative enterprises became available, the Western Australian Government decided that cotton production should be the principle enterprise on the Ord, as regards both future planning and in the initial establishment of commercial farms. The result was that research on cotton was accelerated, because up to this point, although considerable basic work had been carried out on climate, soils, fertilisers, etc., only limited research had been devoted to this particular crop. Since then, the Station's major research effort has been directed towards cotton although research into other crops has not been neglected.

The Research Station is currently engaged in the following programmes:

Cotton agronomy
Cotton breeding
Sorghum agronomy
Sugar agronomy
Wheat agronomy
Rice agronomy
Soil nitrogen chemistry
Weeds
Beef Cattle nutrition
Beef cattle husbandry.

Cotton agronomy

This programme is currently concerned with studying details of stub cotton growing, the water and nitrogen requirements of cotton, variety testing with commercial strains, etc. Data from farms and from the ginnery are analysed to determine the effect of variation in commercial agronomic practices on yield and quality.

Cotton breeding

This has both long and short-term aims. For the short-term, two closely-related new varieties (Stoneville 7A and 213) have been shown to be superior to the current varieties in use. High quality varieties, for a special sector of the Australian raw cotton market, at present supplied by imports, show promise in experiments, and a trial commercial area will be grown next year.

Sorghum agronomy

Following the finding in 1964 that grain sorghum crops on the Ord could be ratooned after harvest to yield a second crop, sorghum agronomy (varieties, time of sowing, spacing and nitrogen fertilizer studies) has progressed steadily to the point where three farmers are growing trial acreages this year. By May 3rd 1968, nearly 1000 acres had been planted and at that time it was proposed to bring the total acreage to 1800 for the season. Station yields are approximately 100 bushel/acre for the first harvest and 60 bushels/acre for the second, within 230 days. Interest in sorghum as an alternative crop is high.

Sugar agronomy

The programme of sugarcane investigations, carried out by an officer from the Colonial Sugar Refineries Co. Ltd. attached to the Kimberley Research Station under an arrangement between the Western Australian Government and Colonial Sugar Refineries Co. Ltd. is due to end in December, 1968. Two main experimental plantings

were made, in the 1964 and 1965 dry seasons. The average station yield is approximately 70 tons per acre for the plant crop and 35-40 tons per acre for the first ratoon compared with Queensland average for first ratoon crops in 1966, of 29 tons per acre. CCS levels are satisfactory.

Wheat agronomy

In the search for a possible winter cash crop, emphasis was switched three years ago from the apparently uneconomic oilseed crops linseed and safflower to the winter cereals. The winter climate has been shown to be too warm for oats, and work on barley has only just begun: the main research effort is on wheat. The present Station yield level of high-quality Australian varieties under optimum conditions is 70 bushels/acre, and that of lower-quality Mexican semi-dwarf varieties 80 bushels/acre. It is anticipated that current breeding programmes in the southern States will produce high-quality varieties adapted to irrigation and high levels of nitrogen fertilizer. Current research is concerned with matching varieties to the unusual Ord winter climate and with the efficient use of nitrogen.

Rice Agronomy

To date, the rice crops grown on the Research Station have proved disappointing. In the 1965/66 wet season, a disorder in experimental rice crops checked the rice agronomy programme severely. The symptons have reappeared in varying degrees of severity in all subsequent experimental plantings. A small rice programme, aimed at revealing the causes of the disorder, is in progress under a plant pathologist stationed in Perth and a technical officer at the Kimberley Research Station. At present, there is no firm indication of the presence of disease. Recent yield levels have been influenced by the disorder; they are still around the 1.5 ton/acre mark, which is considered uneconomic. If and when the problem is solved, the new varieties obtained from the International Rice Research should improve substantially the prospects for rice. There are still some local problems to be overcome to adapt these high yielding varieties to the Ord soils but, if successful, rice could prove an important economic crop for the flatter areas in the project.

Soil nitrogen chemistry

Current research under this programme, largely related to cotton but also to sorghum and wheat, is concerned with efficiency of use of nitrogen fertilizer in various alternative commercial forms, including anhydrous ammonia, and with assessing the beneficial effects of summer fallowing. A cotton-sorghum rotation experiment in progress suggests that, with adequate nitrogen fertilizer, there are

no major biological limitations to combining the two crops in a farming system.

Weeds

Following several years of field trial at the Kimberley Research Station the C.S.I.R. O. is now conducting experiments in the glasshouse at Canberra, on the germination behaviour of the main weed species of the Ord. Studies are also being carried out on the effects of herbicides on weed seedlings. This programme will conclude later this year.

Chemical weed control methods for cotton have been established, and staff from the Western Australian Department of Agriculture at Kununurra will continue with the testing of new herbicides.

NORTHERN DIVISION

JUNE 1968

ORD SCHEME

Interest in the agricultural potential of the Kimberleys dates back to the 1880's. The 1875-1879 expedition, led by Alexander Forrest, explored the region, particularly the valleys of the Fitzroy, Lennard, Margaret and Ord River valleys.

Following Forrest's report on the suitability of the plains for pastoral use, and for tropical agriculture, the sheep and cattle men started moving into the area.

Several farming development schemes were proposed for the region but despite encouraging experiments in cotton growing and Government endeavours to interest small settlers in tropical agriculture, virtually no progress was made.

Although the potential of the Ord Valley had been known since Forrest made his report, there was virtually no quantitative information available. In 1941, the then Director of Works, Mr. R. J. (now Sir Russell) Dumas was instructed to visit the Kimberleys and prepare a report on prospects for future settlement of the country.

His investigations convinced him that the only hope of establishing any settlement based on cropping lay in harnessing the rivers for irrigated agriculture.

In August, 1941, he spent three weeks investigating the country in the North East Kimberleys and along the Ord River. His subsequent report indicated good dam sites, ample water and a possible 100,000 acres of potentially irrigable country.

As a result of his recommendations, the Government decided to establish an experimental irrigation area of about 12 acres on the banks of the Ord, adjacent to a permanent pool known as Carlton Reach. The area was placed under the joint control of the Agriculture and Public Works Departments, and was ready to function early in the 1942 dry season.

Further engineering reconnaissance was done in 1942 and in April, 1943, a survey party moved into the area to survey the basin capacity, sites for the main dam and the diversion dam, access roads, and irrigation channels.

In 1944, a more detailed examination of the irrigation potential of the lower Ord region commenced with a soil survey by the Department of Agriculture. This revealed 56,000 acres of potentially irrigable land and a further 125,000 acres requiring examination. Soil erosion studies of the Ord catchment were carried out by the Department of Lands and Surveys.

In 1945, the Rural Reconstruction Commission recommended that intensive agricultural investigation should be undertaken. This recommendation was endorsed by the newly formed Northern Australian Development Committee, and in late 1945 a joint Commonwealth-State venture, the Kimberley Research Station, was established. The immediate aim of this station was to determine if irrigated agriculture could be successfully established on land which might be irrigated from the proposed Ord River dam. The crops to be investigated were sugar, cotton, rice, sorghum and safflower, whilst pasture plants for dry and irrigated pastures were also to be studied.

During succeeding years the programme has been extended to include research on soils, insect pests and cattle husbandry. At present, with 31 farms established, the Station also researches the problems arising from commercial production.

A programme of field crop experimentation has been carried out by by the Department of Agriculture.

In February, 1949, the State Government of Western Australia submitted proposals to the Commonwealth Government for development of the North-West, including the Ord Irrigation Project, and requested financial assistance for development of the area.

This, and other approaches for assistance with the Ord Project were not acceded to. In May, 1959, however, the case was resubmitted to the Commonwealth Government. Assistance was requested for the construction of Stage 1, comprising the Diversion Dam, a reticulation and drainage system, and the development of about 26,000 acres of irrigated farmland; this 26,000 acres was the limit of the land which could be served by the volume of water stored by the Diversion Dam. In August 1959, the Commonwealth approved the Diversion Dam as one of the schemes to be financed from the $10 million grant made available to Western Australia to promote northern development in that State under the Western Australia Grant (Northern Development) Act 1958-1959. Construction of Stage I of the Project commenced

in 1959-60 and, by March, 1963, the Diversion Dam had been completed to the stage where storage of water could commence. The portion of the grant spent on the Ord Project up to that point totalled $8.034 million.

In 1963, the Western Australia (Northern Development) Agreement Act was passed by the Commonwealth granting additional financial assistance of $7.0 million for northern development projects in Western Australia. Of this amount, $4.046 million was spent on the development of the irrigation area for Stage I of the Project.

Commonwealth financial assistance for the Ord Project to date totals $12.08 million.

Irrigation, using water from the Diversion Dam, started in April 1963. At the present time 31 farms, including the former 2,400 acre pilot farm, are operative. These farms cover a gross area of 26,000 acres, this represents the limit of development with present water supplies. The main crop grown to date has been cotton, and two ginneries have been established with a combined capacity of 400 bales per day.

A new township at Kununurra has been developed, and its present population is now about 1,000. The provision of houses, public buildings, power, water, a caravan park, and an aerodrome has been undertaken by the State. Total public costs of Stage I, to 30th June, 1967, amount to about $20 million.

In February, 1964, and November, 1965, the State Government of Western Australia submitted requests to the Commonwealth Government for financial assistance to enable a start to be made on Stage II of the Ord Project. The Commonwealth advised that it was deferring a decision on Stage II of the scheme until commercial operations were fully established in the Stage I area; when the Government would be in a better position to judge the soundness of the project.

In October, 1967, Western Australia again submitted a request for financial assistance towards the cost of Stage II of the project. On this occasion the Commonwealth Government reacted favourably to the request and a Bill was introduced to the House of Representatives on 15th May, 1968 outlining the financial assistance to be granted to Western Australia to enable Stage II to proceed. The Act, cited as the Western Australia Agreement (Ord River Irrigation) Act 1968, received Royal Assent on 21st June, 1968.

The three stages of the Ord Project are :-

Stage I (already completed) - the construction of a Diversion Dam at Bandicoot Bar on the Ord River and the development of about 26,000 acres of irrigable land, all lying within Western Australia.

Stage II - the construction of a Main Dam, 30 miles upstream of the Diversion Dam, and the development of a further 150,000 acres of which about 100,000 acres will be in Western Australia and about 50,000 acres in the Northern Territory.

Stage III - the construction of a hydro-electric power station at the Main Dam to supply the future power demand of the area.

The conditions governing the allocation of farms and general conditions of tenure relating to Stage I of the project are outlined below.

Applications - General

Allocations were made by a specially constituted Land Board, which considered the relative merits of every applicant.

Provision was made for applications to be lodged jointly by more than one person, forming a syndicate or share farming group but not a company.

Work to be done by the Government

The Government undertook to provide all the necessary headworks, channels, drains, roads and associated structures, and the appropriate supply points of 5 cubic feet per second capacity.

The Government was also responsible for the felling and grubbing on 250 acres of each farm. It was also prepared to carry out any of the following: burning, ploughing, cultivating, grading, and the construction of internal ditches and drains. This would be at actual cost to the farmer, with a maximum of $50 per acre.

Work to be done by the Lessee

He must provide control structures, turnouts, siphons and culverts inside his property and erect an approved type of machinery shed.

He must also do the final land preparation; including the preparation of furrows or check banks, pre-irrigation and cultivation for weed control. The property must be fenced before stock is carried.

General Conditions of Tenure

1. (a) Applicants may be allotted one farm only.

   (b) The lessee must plant at least 200 acres of cotton in the first season.

   (c) In subsequent years he must plant a minimum of 200 acres of an approved crop.

   (d) For the first 5 years he must accept guidance from the Director of Agriculture on crops to be grown, area to be followed, time of planting, variety of seed, fertiliser, methods of cultivation, plant and equipment, pest control, harvesting time and watering.

2. The term of the lease shall be 30 years, but a Crown Grant may be issued after 5 years provided all conditions have been met.

3. Interest only at 5% per annum on the survey fee and improvements shall be paid during the first 5 years. Thereafter, interest plus value of improvements shall be paid in equal half-yearly instalments.

4. The price of the land shall be $2 per acre.

Housing

Lessees are recommended to live in Kununurra where State Housing Commission houses are being erected either for purchase or rental.

Alternatively building blocks are available from time to time by auction at upset prices of approximately $200 per block.

ORD IRRIGATION PROJECT

Department of National Development

ORD IRRIGATION PROJECT

June 1968

ORD IRRIGATION PROJECT

CONTENTS

APPENDICES

ORD IRRIGATION PROJECT

1. HISTORY OF THE PROJECT

The first quantitative information on the resources and potential of the Ord River area was obtained in 1941 when the Western Australian Government instituted investigations into the possibility of future settlement in the area. The studies carried out indicated good dam sites, ample water and a possible 100,000 acres of irrigable country.

Further engineering reconnaissance was done in 1942, and in April, 1943 a survey party moved into the area to survey dam sites, storage capacities, access roads, diversion dam and main channel locations.

In 1944 a detailed examination of the irrigation potential of the area commenced with a soil survey undertaken by the State Department of Agriculture.

Following these studies, the Rural Reconstruction Commission recommended that intensive agricultural investigation should proceed and in 1946 the Kimberley Research Station, a joint Commonwealth-State venture, was established. Since that time the Station has undertaken research on the growing of a number of crops which include cotton, rice, sorghum, sugar, and oilseed crops and the production of both dryland and irrigated pastures. Research has also been undertaken on soils, insect pests and animal husbandry.

In February 1949, the Premier of Western Australia outlined to the Prime Minister proposals for development of the North-West, including the Ord Irrigation Project, and requested financial assistance for development of the area.

This, and other approaches for assistance with the Ord Project were not acceded to. In May, 1959, the case was resubmitted.

Assistance was requested for the construction of Stage 1, comprising the Diversion Dam, a reticulation and drainage system, and the development of about 26,000 acres of irrigated farmland; this 26,000 acres was the limit of the land which could be served by the volume of water stored by the Diversion Dam. In August 1959, the Commonwealth approved the Diversion Dam as one of the schemes to be financed from the $10 million grant made available to Western Australia to promote northern development in that State under the Western Australia Grant (Northern Development) Act 1958-1959. Construction of Stage 1 of the Project commenced in 1959-60 and, by March 1963, the Diversion Dam had been completed to the stage where storage of water could commence. The portion of the grant spent on the Ord Project up to that point totalled $8.034 million.

In 1963, the Western Australia (Northern Development) Agreement Act was passed by the Commonwealth granting additional financial assistance of $7.0 million for northern development projects in Western Australia. Of this amount, $4.046 million was spent on the development of the irrigation area for Stage 1 of the Project.

Commonwealth financial assistance for the Ord Project to date therefore totals $12.08 million.

Irrigation from the Diversion Dam commenced in April 1963 and has proceeded steadily since then. At the present time 30 farms in addition to the now privately owned 2,400 acre former pilot farm are operative. These farms cover a gross area of 26,000 acres which represents the limit of development with the existing water availability. The main crop grown to date is cotton and two ginneries have been established with a combined capacity of 400 bales per day.

A new township at Kununurra has been developed with a population at present of about 1,000. The provision of power and water, public buildings, houses, an aerodrome and a caravan park has been undertaken by the State. Total public costs of Stage 1 to 30th June, 1967, amount to about $20 million.

2. GENERAL DESCRIPTION OF THE PROJECT

The Ord Irrigation Project is essentially an irrigation scheme based on the development of the waters of the Ord River Basin. A map showing the general arrangement of the Project is attached as Appendix 1. The scheme for development may be divided into three phases:

Stage 1 (already completed); the construction of a Diversion Dam at Bandicoot Bar on the Ord River and the development of about 26,000 acres of irrigable land, all lying within Western Australia;

Stage 2 the construction of a Main Dam, 30 miles upstream of the Diversion Dam, and the development of a further 150,000 acres of which about 100,000 acres will be in Western Australia and about 50,000 acres in the Northern Territory;

Stage 3 the construction of a hydro-electric power station at the Main Dam to supply the future power demand of the area.

The request for financial assistance submitted by the Western Australian Government in October 1967 was to enable a start to be made on Stage 2.

In the Agreement for which approval of the Parliament is sought in the Bill before the House, a total of $48.18 million is estimated as necessary for the following works:

(i) construction of the Main Dam with sufficient capacity to serve, in addition to the 26,000 acres of Stage 1, a further 100,000 acres in Western Australia and 50,000 acres in the Northern Territory;

(ii) construction of a main channel in Western Australia with sufficient capacity to supply the 100,000 acres in Western Australia and the 50,000 acres in the Northern Territory;

(iii) construction of subsidiary channels, drains and ancilliary items for irrigation of that part of the scheme in Western Australia;

(iv) provision in the outlet works for the Main Dam for the possible later installation of a hydro-electric power station.

3. DETAILS OF THE PROPOSED WORKS

A summary of basic physical data relating to the engineering features of the project is attached as Appendix 2. A brief summary of the salient features is given below:

(i) Dam

The proposed dam is a rockfill structure with a maximum height above its foundations of about 300 feet. The total volume in the embankment will be 2,420,000 cubic yards, including 290,000 cubic yards of impervious fill.

Field investigations have been carried out by the Public Works Department of Western Australia and general conclusions

on the suitability of dam foundations and the availability of construction materials have been reviewed by the Snowy Mountains Authority.

Detailed designs have now been completed and the State is in a position to proceed with the calling of tenders.

(ii) Spillway

The proposed spillway is uncontrolled with a crest length of 40 feet, and is located in a saddle about seven miles north of the main embankment. The maximum discharge through the spillway in the event of the maximum probable flood occurring at a time when the reservoir is full, would amount to 80,000 cusecs. It is considered that rock conditions at the site of the spillway will obviate the need for concrete lining.

(iii) Storage

The storage available behind the dam to the level of the spillway amounts to 4,600,000 acre feet of which 400,000 acre feet are set aside for silt storage. This storage will provide an annual yield in excess of 1,000,000 acre feet.

The proposed arrangement of the dam and spillway also provides for a flood storage above the spillway level totalling 25,000,000 acre feet.

(iv) Distribution and Drainage System

Water will be released from the Main Dam into the river to maintain the level of the Diversion Dam storage. Water from the Diversion Dam will flow into two main channels, one of which has already been constructed for supply to the existing irrigation area. Subsidiary channels will convey water from the main channels to each farm and drainage will be by earth ditches to the Ord and Keep Rivers.

Some pumping will be required to certain areas not commanded by gravity flow but the lift is generally not great.

(v) Roads

It is envisaged that Kununurra will be the main settlement in the area with possibly one or two smaller settlements towards Weaber Plains and Carlton Plains, with the farmers living in these communities rather than on their farms. A good road network is therefore required throughout the area. A main road system has been designed to closely follow the main channels with secondary roads providing all-weather access to each farm. Costs of major road connections are the responsibility of the State but the overall cost estimate for the irrigation works includes the cost of farm access roads.

(vi) Hydro-Electric Power

Preliminary studies undertaken by the Western Australian Public Works Department have indicated that construction of a hydro-electric power station at the dam, utilising the releases made for irrigation, would be economically justified when the total load reached about 10 Megawatts. With assumed rates of development in the area, this could occur about 10-15 years after the commencement of the project.

It is not proposed to proceed with detailed design of the power station until more data is available on the rate of growth of power demand in the area. Provision will be made during construction of the dam, however, for the incorporation of components essential to the later construction of a power station.

4. COST ESTIMATES

The original cost estimates made by the Western Australian Public Works Department in February 1964 were considered by the Snowy Mountains Authority in mid-1964. The conclusion reached at that time was that the estimates were adequate and allowed some margin for contingencies.

In November 1965, the Western Australian Government submitted revised proposals and cost estimates. These were reviewed by the Snowy Mountains Authority in February 1966 and some increase in the level of the estimates was considered desirable. These increases were incorporated into the cost estimates by the Western Australian authorities.

The latest submission by Western Australia (October 1967) includes a further revision of estimates, based on movements in the basic wage, material costs and contract prices that have taken place since the previous review.

Since October, 1967, certain modifications have been made to the engineering design and layout. It is not expected, however, that these modifications will substantially alter the Western Australian cost estimates of about $21 million for the Dam and $27 million for the irrigation works.

Estimates for the irrigation works are of a preliminary nature as no detailed location or design of reticulation and drainage channels has been made. Estimates for these works are therefore on a 'cost per acre' basis based on experience to date with the construction of Stage 1 of the Project.

5. WATER RESOURCES

The catchment area of 17,800 square miles lies within the 18 inch to 25 inch rainfall belt and is subject to cyclonic rain between November and April, the remainder of the year being dry and hot. Stream flow records have been taken since 1945 at two gauging stations near the damsite. The reliability of some of the earlier records has not been established. These records have been used to derive a correlation between rainfall and run-off leading to a synthesis of monthly run-off figures for the 37-year period from 1922 to 1958. Over this period the arithmetic mean annual discharge has been calculated as 3,500,000 acre feet. The annual river discharge has, however, been extremely variable, calculated discharges ranging from 260,000 acre feet in 1935-36 to nearly 11,000,000 acre feet in 1958-59.

6. CATCHMENT REGENERATION

The Ord River carries a high silt content estimated in 1964 at about 12,500 acre-feet per annum which, if unchecked, could affect the active storage capacity of the Main Dam over a period of years. This was largely due to severe erosion aggravated by over-stocking in past years along the main water courses.

Of the 17,800 square miles of the Ord River catchment area above the damsite, 1,400 square miles comprise the most serious erosion hazard. This area borders the Ord River and its major tributaries. Most of the more seriously eroded areas lie in Western Australia but a portion extends into the Northern Territory.

As this is primarily a pastoral area with the cattle industry based on "open-range" conditions utilizing natural waters, over-grazing and subsequent soil erosion have been largely confined to areas adjacent to the river systems. The removal of the surface plant cover over a period of years by continuous and uncontrolled grazing, under marginal rainfall conditions and on susceptible soils, has been the underlying cause of the erosion. Fire and drought have aggravated the situation.

Gully and sheet erosion are widespread and serious in the badly affected area. Severe wind and water erosion have combined to remove the surface soil. Water erosion is responsible for most of the damage, having a serious effect on the productivity of the soil and significantly increasing the silt load of the rivers. Wind erosion removes the surface soil, compacts and glazes the surface and cuts into the subsoil, thus reducing soil fertility and further reducing the chances of establishment and survival of seedlings, even after good rains. A direct result of the soil surface compaction and glazing is the reduced water penetration of the bare soils. This lack of water penetration is one of the major limiting factors to successful re-establishment of grasses on the catchment area.

Catchment regeneration measures costing $100,000 per year have been pursued over the past seven years by the Western Australian Government.

Remedial treatment is directed at the basic cause of erosion - the removal of vegetative cover. About 1,200 square miles within the eroded area have been resumed from pastoral leases, and these areas have been fenced, cleared of stock, and successfully reseeded. A large scale fencing programme was undertaken, as an initial measure, to facilitate control of grazing within the eroded area. The establishment of a series of paddocks made possible the progressive removal of stock and treatment of the enclosed areas. About 600 miles of new cattle fencing has been erected in the eroding area.

The programme of protective and remedial work has as its major objective the re-establishment of perennial vegetation, as a means of controlling erosion and reducing the silt load of the rivers. With a protective vegetative cover re-established, runoff will be reduced, water penetration increased and the scouring effect of both wind and water reduced.

Since lack of water penetration is the major factor limiting the successful re-establishment of vegetation on the bare and eroded areas, once grazing has ceased, cultural operations performed strictly on the contour are being carried out aimed at increasing water penetration, providing a seed-bed, and reducing wind velocity at ground level.

Large quantities of improved pasture species seed including buffel and birdwood grasses and kapok bush have been sown throughout the regeneration area. The re-establishment of native perennial species is also being encouraged. Stringent, long term control of grazing will be essential to ensure that an adequate ground cover of perennial species is maintained to minimise future erosion of this susceptible area.

7. SOIL RESOURCES

The predominant soil type in the irrigable area in the vicinity of Ivanhoe Station is Cununurra Clay which is considered topographically and structurally suitable for irrigated crop and pasture production. Although often described as "black soil" plains, Cununurra Clay is more accurately a dark brown alluvial clay which overlies fine sands and loams. There is an area of about 170,000 acres of Cununurra Clay which is suitable for the production of all potential Ord River crops and commandable for irrigation.

The soil exhibits marked swelling and shrinking properties and is of low permeability. The soil properties have been subjected to much research effort to determine likely problems in their development under irrigation. Laboratory determinations and field trials have not revealed any serious deficiencies in minor nutrients or uncontrollable problems associated with salinity or alkalinity, but in its virgin state the soil is low in nitrogen and available phosphate. High yields cannot be expected unless nitrogen and phosphate are added to the soil in substantial quantities.

The organic matter content of the soil is very low, despite its colour, but it has self-mulching qualities and a high calcium content. Hard structureless clods break down to give a pleasing soil structure after a few wetting and drying cycles, and loss of soil structure with repeated cultivation seems unlikely to be a problem.

The impermeability of the Cununurra Clay soil can create drainage problems on poorly graded irrigation bays where plants may die through water-logging. Careful land levelling and grading is therefore necessary. The rate of infiltration of water drops off markedly as the soil is wetted beyond a depth of 3 feet with the result that water wastage through the profile should be insignificant.

8. KIMBERLEY RESEARCH STATION

The Kimberley Research Station on the Ord River has been jointly financed and staffed by the Commonwealth and Western Australian Governments since its establishment in 1946. Currently the Commonwealth provides half of the expenditure of the Station up to a maximum of $130,000 per year. The Western Australian Government provides the balance. These funds are used to meet the cost of wages, running expenses and all capital costs. In addition the Commonwealth Government through the C.S.I.R.O. and the Western Australian Government through its Department of Agriculture, supply salaried officers to the Station without cost to the Station's vote.

The Station is concerned not only with undertaking research to provide the scientific and technical information necessary to establish successful irrigation farming in the Ord area, but also with the accumulation of information of value for the development of agriculture in other similar irrigable areas in northern Australia, and with the study of the possible benefits of irrigated agriculture to other forms of primary production, particularly the cattle industry. The current development of some 26,000 acres of land in Stage 1 for irrigation farming and the proposals for the development of further areas in Stage 2 are largely based on the research achievements of the Station.

The research programme of the Station is aimed at finding superior varieties and improving production techniques of crops already being grown; at extending the range of crops and pasture species to enable further diversification of production; of improving the techniques of pest and weed control; and of studying the effect of protein-rich by-products such as cotton seed, on the cattle industry.

In the more developed southern parts of the country research centres are concerned mainly with improving already well established forms of agriculture and commercial farming practices are backed by generations of farming experience, both local and from other areas with similar environmental and socio-economic conditions. In contrast, the Kimberley Research Station and initial farmers have had to provide leadership in evolving a novel type of farming in a tropical environment. The development of this new type of farming has had to be done almost entirely through independent research and experimentation because local experience was not available. Moreover, experience from elsewhere is rarely applicable because, in general, this experience has been gained from either the subsistence or plantation forms of farming prevalent in tropical areas.

9 AGRICULTURAL PROPOSALS FOR STAGE 2 DEVELOPMENT

Cotton

Since commercial farming began in 1963-64, cotton has been virtually the only crop grown. The area under cotton has increased from 1,600 acres in 1963-64 to about 12,000 acres in 1967-68. Much of the activity of the Kimberley Research Station is being directed towards research into cotton-growing, with a certain amount of work being done both at the Research Station and by officers of the Department of Agriculture at pastoral properties on supplementary feeding trials with cotton seed. To date cotton seed has been sold to Japan, but with the advent of Stage 2 of the project, consideration will be given to setting up oil milling operations locally.

The main varieties grown have been Delta Pine, Rex and Rex Smoothleaf. The variety Stoneville 7A appears to offer promise for future years. Cotton-growing by ratooning (stub

cotton) is gaining popularity and appears to offer a sound commercial method of culture with savings in costs of labour, seed-bed preparation, planting, some inter-row cultivations, and some irrigation applications with no reduction in yield. This year 37% of the cotton acreage is under stub cotton.

The pattern of yields and other data from commercial farms is given in the following table:

Item	1964	1965	1966	1967
No. of growers (full-time)	6	18	22	27
Average area/farm (ac.)	272	283	322	411
Average lint yield (lb./ac.)	447	636	794	757
Average cost/acre ($)	133	157	184	n.a.
Average net return/farm ($)	2,160	15,087	10,513	n.a.

Sorghum

This is an alternative or supplementary crop to cotton for Ord River conditions. The growing demand for sorghum by the fast-developing intensive Japanese livestock industries has strengthened interest in this crop in northern Australia.

Research has been under way at Kimberley Research Station for four years and some commercial scale plantings have been carried out by farmers. In most years, the crop could be managed by farmers to yield two harvests from the one sowing. Yields of 100 bushels/acre from the first harvest and 60 bushels/acre from the ratoon crop have been achieved in the experiments on the Research Station using applications of 100-200 lb. nitrogen per acre.

Many of the present farmers in the Ord Irrigation Area are interested in growing grain sorghum for export to Japan. The limitations on the amount of water available from the Diversion Dam during the winter months is at present a limitation on any extensive commercial growing of this crop. In order to diversify the cropping programme it will be advantageous for future farmers in Stage 2 of the Project to include grain sorghum or some other alternative crop in a rotation with cotton.

Other Crops

Rice research to date at the Kimberley Research Station and the few rice crops grown on the irrigation area have not given an adequate yield level. Recently co-operation has been obtained in the rice improvement programme of the International Rice Research Institute in the Philippines. At this Institute research work over the past seven years has resulted in varieties suited for tropical conditions, growing yields of well over two tons per acre and having desirable grain quality for Asian markets. There are still some local problems to be overcome to adapt these high yielding varieties to local conditions of the Ord soils but, if successful, rice could prove an important economic crop for the flatter areas in the project.

Intensive research on wheat has been in progress for only three years and during this period the average yield from the experiments which received adequate nitrogen fertilization was 70 bushels per acre. Yields of 80 bushels per acre have been obtained from semi-dwarf varieties. Further experiments are required to find, or breed, varieties which will combine consistently high yields with satisfactory quality.

Sugar research has been undertaken, but owing to the present world sugar marketing situation no further agronomic studies at present are being done with this crop. Research on linseed and safflower was suspended about three years ago as at that time the yields were not sufficiently high to justify the commercial production of these crops at ruling world prices and local production costs. If there were facilities for oil processing in the area the economics of these oil crops would warrant review.

Research work is also being undertaken with other miscellaneous crops, such as soya beans and maize and with pasture species.

The Cropping Programme and Farm Size

The present farm size is about 600 acres and could allow a rotation of about 200 acres each of cotton, stub cotton, and grain sorghum. If grain sorghum is to become an important crop at the expense of cotton, consideration may have to be given to increasing the size of the farms in Stage 2 of the Project.

10. ECONOMIC EVALUATION

The Commonwealth Government has examined the question of providing finance for Stage 2 of the Ord Irrigation Project on several occasions. It necessarily has taken into consideration a number of aspects among which are the economic implications from the national viewpoint and the viability of farming activities in terms of the financial position of individual settlers.

On earlier occasions, the Commonwealth Government concluded that in view of a number of uncertainties which existed in regard to the future prospects of the Project, the appropriate course of action was to wait until further information was available and further experience had been gained.

Following the request from the Western Australian Government in October 1967, a further evaluation was carried out by Commonwealth officers.

This and earlier economic evaluations by Commonwealth officers have largely utilized the benefit-cost technique of comparing the present worth values of estimated net benefits with the present worth values of costs of construction and operation. These evaluations were not aimed primarily at determining particular benefit-cost ratios but rather to identify those benefits and costs which have an important bearing on the economic merit of the Project

from the national viewpoint and, also, on the viability of farming. This approach provided an indication of the long-term yields, prices and costs which would need to be achieved for economic success and also provided a measure against which present performance and forecasts of future achievement could be judged.

Bearing in mind the likely entry of Australia into the cotton export market and the probable export of grain sorghum to countries in South East Asia, the evaluation adopted export prices as appropriate for the analysis of long-term benefits.

In common with all long-term investments, there is a measure of uncertainty surrounding estimates of future benefits and costs in projects of a developmental character. The degree of uncertainty is especially acute for projects such as the Ord where future returns are largely determined by international marketing arrangements and influenced by price support schemes operating in some exporting countries.

Besides the marketing uncertainties, other uncertainties arise from the continuing evolution of a novel type of tropical agriculture for the Ord environment. Future developments could influence the crops produced, cultural techniques adopted, and the levels of yields and farm operating costs.

The investigations by Commonwealth officers also looked at the financial prospects of individual farmers. Again the approach was that of ascertaining those yields, prices and costs against which present performance and forecasts of future achievements could be judged.

The results of four years of commercial farming on Stage 1 provided a basis for assessing the future financial viability of individual farmers. There are indications that, as the Project

proceeds, certain economies of scale will become evident in ginning, marketing and freight costs and in the bulk purchase of fertilizers, insecticides and weedicides, etc. The advent of stub cotton growing, together with improved cultural practices, also will tend to lower production costs. Furthermore, farmers have commenced commercial production of grain sorghum as a supplementary or alternative crop to cotton.

In view of the uncertainties mentioned above, it was not possible to arrive at a definitive economic result from the national viewpoint or in the assessment of the likely long-term financial position of farmers. The uncertainties with regard to commodity prices in overseas markets and, to a lesser extent, costs, are unlikely to be definitively resolved by information coming available in the future.

11. EFFECT OF PROJECT ON PASTORAL INDUSTRY AND OTHER BENEFITS

The Pastoral Industry

It has been estimated by the Bureau of Agricultural Economics that some 60,000 head of cattle, worth $3.5 million at current prices, die annually in the Kimberley region of Western Australia. A large proportion of these deaths are breeders and weaners and therefore the loss is cumulative. This loss is due mainly to the low level of nutrition in the natural grasses towards the end of the dry season.

Although station improvements, such as fencing, deferred grazing, provision of tick control, etc., will improve the economic efficiency of the neighbouring pastoral industry and beef roads will improve the turn-off, the provision of protein feed supplements during periods of protein scarcity is also necessary if breeder losses are to be reduced. The availability of protein

foodstuff from the irrigation area will permit breeders and weaners on the station properties to be carried over harsh periods.

The cotton seed by-product provides an excellent means of reducing this mortality. This has been demonstrated in trials conducted at Argyle Station located in the Ord catchment area. In 1964, 292 mated cows were divided into two groups, and grazed under identical conditions on Mitchell grass country at the stocking rate of one beast to 20 acres. Whilst the control group was exposed to normal range conditions, the second group received a supplement of crushed cotton seed, averaging 2¾ lb. per head daily, from mid-August to early December. At the conclusion of the trial all cows in the group which had received the cotton-seed supplement were alive and a calving rate of 58 per cent was achieved. On the other hand, in the control group, which received no supplement, only 55 per cent of the cows survived and the calving rate was only 18 per cent.

There are also possibilities of an integrated system for finishing store cattle, from the stations, on irrigated pastures and crop stubbles, thus extending the present short killing season at the Wyndham meatworks.

Up to 50,000 acres of grain sorghum stubble could be available when the Ord Scheme is completely developed. This stubble could afford good nutritive grazing at a time when the natural grasses are at a low nutritive level. Nearby stations could take advantage of this additional pasturage not only to maintain the condition of breeders and weaners but also to improve the condition of the cattle sent to the meatworks.

Achievement of these predictions depends entirely upon the response of the regional pastoral industry to the availability

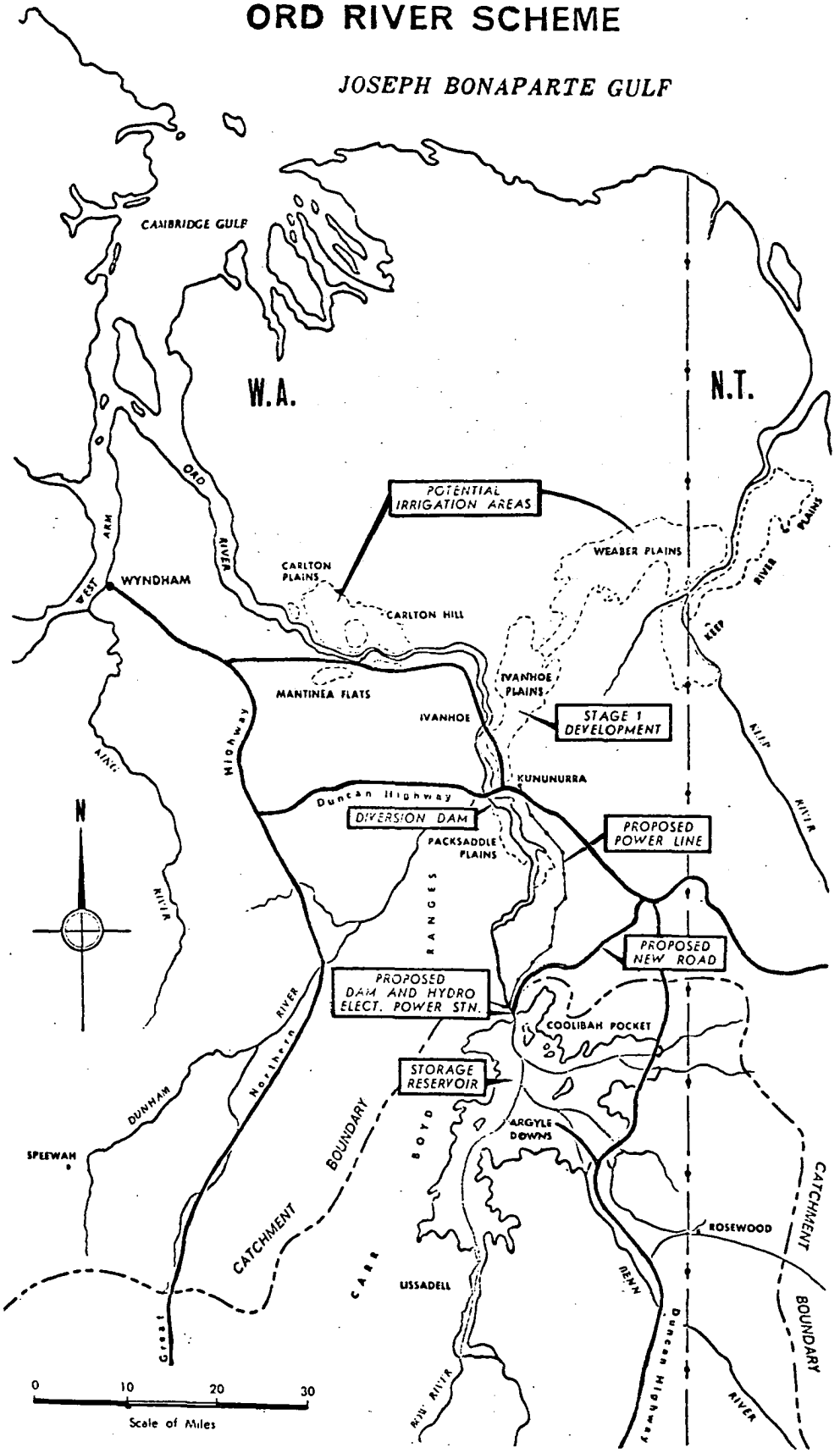
of sorghum stubble-grazing and protein supplements from the irrigation area. With the upgrading of Kimberley roads under the beef roads programme and the recent evidence that a significant number of cattle producers are interested in upgrading their herds, it is reasonable to assume that integration will take place between the irrigation area and the cattle industry. A further influence is the relatively attractive beef prices of recent years.

Other Benefits

The reservoir could provide sufficient water for irrigation, the generation of electric power, and also for establishment of future industries. Other benefits arising from the reservoir itself include the obvious recreational facilities and scenic attractions for tourists. More tangible are the benefits likely to accrue through the creation of better operating conditions for the existing irrigation farmers by way of reductions in operating costs from increased regional trading. The scheme would lead to a substantial increase in the regional population comprising some 200 farmers, 400 farm workers, and associated families. Improved community facilities such as schools, hospitals, entertainment, air services, etc. would develop along with allied trade and industrial backing for farm machinery, ginneries, oil mills, transport industries, retail stores, etc.

The thriving towns of Mildura, Renmark, Shepparton, Griffith and Leeton are examples of indirect benefits following from irrigation development. As in the districts served by these towns there would be created employment opportunities not only to absorb migrant labour but also for the local aboriginal population.

ORD RIVER SCHEME



BASIC PHYSICAL DATA RELATING TO ENGINEERING ASPECTS

1. Dam

Type:	Rockfill embankment with thin sloping core
Maximum height:	300 feet above foundations
Volume of fill:	2,420,000 cubic yards approx.
Crest length:	1,100 ft. approx.

2. Spillway

Type:	Ungated
Crest length:	40 feet
Peak inflow:	2,500,000 cusecs
Peak discharge:	80,000 cusecs

3. Storage

Dead storage:	400,000 acre feet
Storage below level of spillway:	4,600,000 acre feet
Spillway level (normal top water level):	R.L.297 ft.
Flood storage above spillway level:	25,000,000 acre feet.
Max. flood level:	R.L.371 ft.

4. Outlet Works

Two 14'6" dia. tunnels under right abutment:

- one to pass water for irrigation demand and part of the power station requirements;
- one to supply the remainder of the power station requirements (also acts as a diversion tunnel during construction).

5. Main Channels

Trapezoidal earth channels, designed with assumed efficiency of 67%.

Main channel for Stage 2 of the Project to have design capacity of 3,500 cusecs.

Existing channel for Stage 1 has design capacity of 800 cusecs.

TIPPERARY LAND CORPORATION

General

The Tipperary Land Corporation purchased the 3,500 square mile Tipperary Station in 1967, with the object of producing 300,000 tons of grain sorghum per annum from 192,000 acres.

The project is located along the Daly River, approximately 100 miles south-west of Darwin.

Ownership and Management

When the Corporation was formed it had assets and cash equivalent to $8 million. United States interests held 95 per cent of the shares and 5 per cent was held by Sir William Gunn's family interests.

The project was being managed by Gunn Rural Management Pty. Ltd., with Sir William Gunn as Managing Director. Sir William Gunn has recently resigned from the Corporation. The Tipperary Land Corporation will manage the project on its own behalf with Mr. J. Kelly as Farm Manager and Mr. Samuelson in charge of grain handling and transport.

Development Programme

The development programme commenced in the 1967-68 season with the clearing, ploughing and planting of 12,000 acres. The Corporation plans to double the acreage under crop in each of the following four years:

1968-69	24,000 acres
1969-70	48,000 acres
1970-71	96,000 acres
1971-72	192,000 acres

This development programme is expected to require an investment of some $20 million.

The Corporation proposes that Australian workers in the area could become share farmers and eventually purchase their own blocks of land.

Within two years the Corporation expects to diversify its production into other crops such as peanuts, rice and soya beans.

The Corporation has also announced plans for a long-term cattle and pasture improvement programme, with associated canning and beef marketing facilities. It is understood that this canning season the company will commence the irrigation of sorghum with water pumped from the Daly River.

1967-68 Crop

The season was very favourable for the growth of the crop. Ample rain fell during the three growing months of January, February, and March; the combined January-February rain was the highest yet recorded but there was an almost total absence of heavy eroding rain. A long dry spell in March and April provided ideal ripening conditions for the grain.

Harvesting of the crop commenced in late April and some 2,000 acres were harvested before the mid-May rains, which held up harvesting and caused secondary growth of the crop reducing the yield to 5000 tons of export quality grain with a further 5000 tons of lower quality to be used as local stock food.

Tipperary principals had earlier estimated the average yield to be around 3,000 lbs per acre. The low yields and substantial proportion of low quality grain were attributed to the abnormal May rains.

The grain was dumped at three sites on Tipperary; it was then run through an auger and treated with insecticide before being lifted by large dump trucks and stored at the 18 Mile Rice Mill, pending completion of wharf storage.

NORTHERN DIVISION

JUNE 1968

FORESTRY IN THE NORTHERN TERRITORY

On 27th May, 1966, the Minister for Territories announced that a four year development programme for forestry in the Northern Territory would commence in July 1966. The cost of the programme will be about $3.4 million.

The basic objectives of the programme are :

1. To increase the rate of plantation establishment from the present 350 acres per year to 1,000 acres per year, and native forest management activities to a level which should, in the long run, make the Territory self-sufficient in timber.
2. To provide employment and training for aboriginals at centres where employment opportunities are limited, for example on Melville Island, and at Maningrida in Arnhem Land.

The Minister's statement also foreshadowed the transfer of forestry administration responsibilities in the Territory from the Commonwealth Forestry and Timber Bureau to the Northern Territory Administration. This transfer took place on 1st July, 1967.

The Commonwealth Forest Research Institute continues to operate a regional station in the Territory, and shares facilities at Berrimah with the Forestry Branch of the Northern Territory Administration.

FOREST RESOURCES OF THE NORTHERN TERRITORY

A. Native forests

The quality of the Northern Territory's native forests is generally poor, with few millable trees per acre, even in the virgin condition.

Forest types of use, or potential use, are :

1. Tall open eucalypt forest. Occurs over much of the higher rainfall zone, on well drained sites. Useful species include Stringybark, Ironwood and on Melville Island, Island Bloodwood. Fire and termite damage are significant in much of this forest type.
2. Paperbark forests which cover extensive areas of the coastal plains on many of the Northern Rivers. On the Arafura swamp on the lower reaches of the Goyder River, paperbark stands are particularly well developed. Utilization of these forests is limited by problems associated with logging on swampy ground.

3. Cypress pine forest. Cypress pine is the Territory's most valuable timber, because of its natural resistance to termite attack. Although the species sometimes occurs in pure stands, it generally occurs as a component in tall open eucalypt forest. The principal occurrences of cypress pine are -

(i) Coburg Peninsula and the adjoining mainland.
(ii) The Maningrida region of Arnhem Land.
(iii) The Arnhem Bay hinterland, stretching south along the Parsons Range.
(iv) The Borroloola Region.
(v) The Dorisvale Plateau.
(vi) Remnants of stands in the Katherine area.

B. Plantations

Plantations have been established since 1959 by the Northern Territory Section of the Forestry and Timber Bureau, near Darwin (Howard Springs and Radio Block) and on Melville Island at Snake Bay. The main species in use is the native Cypress Pine, while successful trial plantings have been made of Caribbean Pine, and high value hardwoods such as Teak, African Mahogany and Indian White Beech. The four year programme aims at stepping up the planting rate to 1,000 acres per year by 1969.

THE WOOD CHIP INDUSTRY IN THE TERRITORY

In March 1968, the Northern Territory Administration announced that a number of Australian, American, British and Japanese companies had been granted licences to investigate wood chip industries in seven areas along the Northern Territory coast.

The area involved covers more than 44,000 square miles of forest country between the Daly River and Gove Peninsula. The Coburg Peninsula is excluded from the area included in the feasibility studies.

The companies who were granted licences include -

Marubeni-Iida Ltd
Duncan Holdings Pty Ltd
Project Development Corporation Ltd
Hawker Siddeley Building Supplies Pty Ltd
Tipperary Land Corporation

Toyo Menka (Aust) Pty Ltd
Nabalco Pty Ltd
W. R. Grace and Company.

A press report of 13th June, 1968, indicated that senior officers of the Northern Territory Administration and holders of feasibility study licences were holding informal discussions on the wood chip proposals.

According to the press, feasibility study licences were originally issued for periods ranging from seven months to nine months, after which time the organisations would be invited to submit proposals for the establishment of a wood chip industry. Preliminary results of the studies may be known by the end of August, 1968.

The same report also indicates that a yield of 400,000 tons of wood chips a year (worth about $8 million) would be the minimum economic amount required for the Territory. It also stated that Foresters estimate that each of the seven areas could yield at least a million tons a year.

If the industry is established it is hoped that it will provide regular employment for local Aborigines.

TENNANT CREEK

Tennant Creek is situated on the Stuart Highway 635 miles south of the port of Darwin and 315 miles north of the railhead at Alice Springs. It is linked by the Barkly Highway to Mt. Isa, 415 miles to the east. The township and district of Tennant Creek have a population of about 1800 people. Apart from its role as a link in the Northern Territory transport system the township is dependent on the copper and gold mines in the surrounding mineral field. The town has been enlarged and modernised during the last decade and now has most normal facilities and amenities.

In 1895 H.Y.L. Brown, the South Australian Government Geologist, discovered traces of gold in the Tennant Creek area. In the late 1920's prospectors examined the area but had little success initially because they confined their attention to barren quartz reefs. Subsequently the quartz-hematite lodes were tested and in 1933 rich gold was discovered in an abandoned shaft, 6 miles south south-west of the Old Telegraph Station.

In 1935 the area was officially proclaimed the Warramunga Goldfield and a battery, the Central Gold Milling Company's Empire Mill, was erected 7½ miles east of Tennant Creek. The Goldfield covers an area of 2,146 square miles. In 1936 treatment plants were erected at Mammoth and Eldorado gold mines and later two Government Batteries were erected with the object of encouraging interest in the field.

Production gradually increased from 63 tons of ore in 1934 to 24,732 tons in 1942 but seriously declined during the following years due to the closing down of many mines under National Security Regulations. By 1945 ore production had fallen to 5,156 tons but rose again after the war. In 1949 the Australian currency was devalued and the price of gold rose from £10.15.3. to £15.9.10d per fine ounce. This increase in price lowered the cut-off grade and allowed ore that was previously uneconomic to be mined. Before the war 113 mines were in operation but in 1950 the annual production of 26,530 tons of ore averaging 22.6 dwt per ton come from only 25 mines. In 1951 high prices for tungsten and tin coupled with a substantial increase in the Government Battery crushing charges led to a general exodus of prospectors from Tennant Creek.

Although copper had been known in the area since the 1930's it was not until 1954 that regular production of copper concentrates commenced at the Peko Mine. In recent years the value of copper production has greatly exceeded that of gold production from the field.

In 1967 the total production from the Tennant Creek field was 7904 tons of copper (in 31,494 tons of concentrates) and 72,764 ozs. of gold, plus minor silver and bismuth.

Three of the four principal mines on the field are operated by Peko Mines N.L. The largest is the Peko Mine, 7 miles east of Tennant Creek where some 180,000 tons of copper-gold ore are mined each year. In 1967 the ore produced at Peko contained 5,810 tons of copper and 12,592 ozs. of gold. The ore is treated at the mine to produce a copper-gold-silver concentrate. The Ivanhoe mine, 19 miles north-west of Peko, produces about 50,000 tons of copper-gold ore per year. This ore is hauled by a 70-ton road train to Peko for treatment at the central mill. The Orlando mine, 25 miles north-west of Peko, is a gold mine with minor copper. It is a small costly underground operation, its economies depending on the centralised facilities at the Peko mine. About 30,000 tons of ore per year is produced at the Orlando mine, which has an estimated future life of 7 years.

The other major producer at Tennant Creek is the Nobles Nob Mine, operated by Australian Development N.L. In 1967 it produced 17,932 tons of ore containing 33,735 ounces of gold.

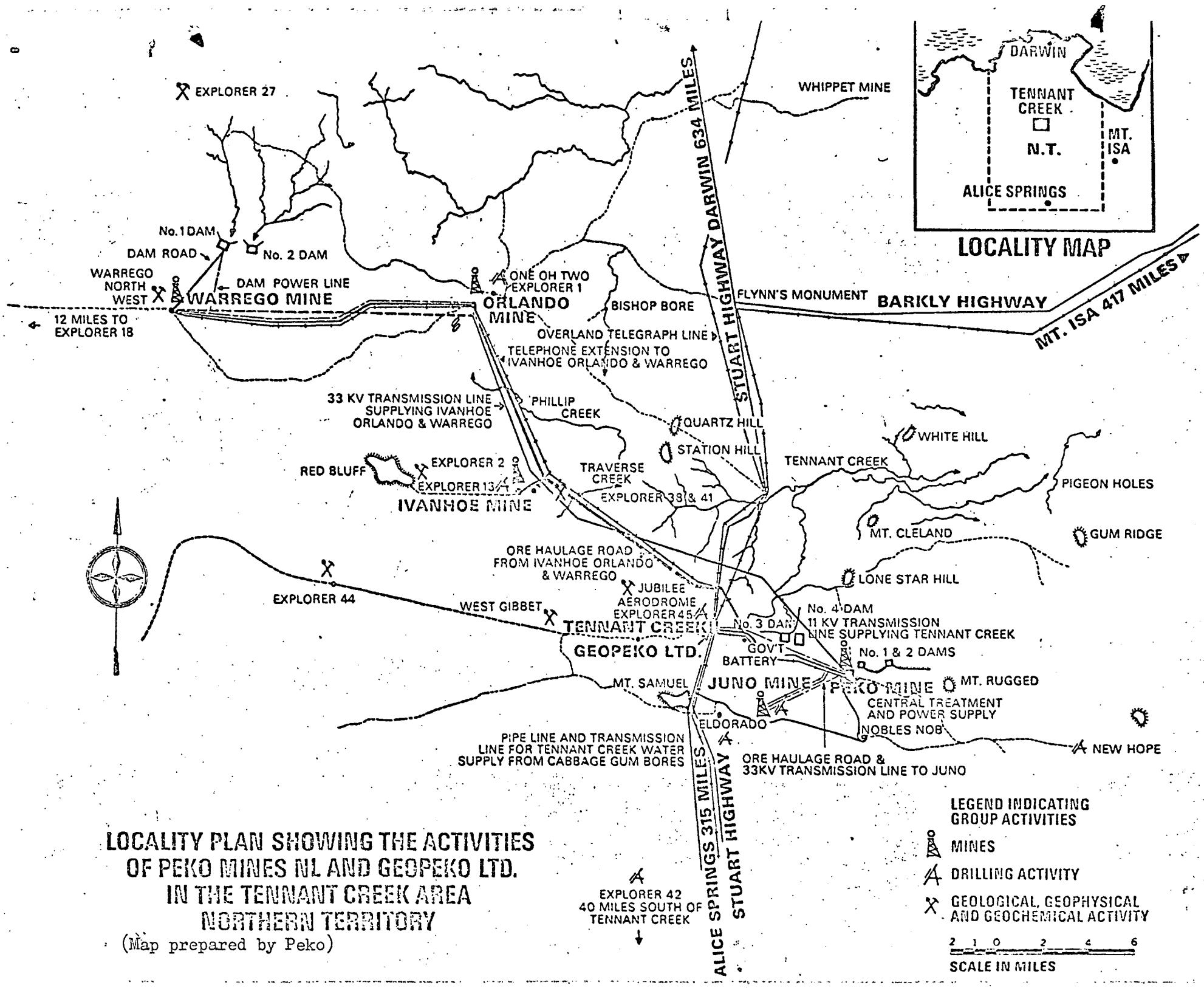
Most of the copper concentrates from Tennant Creek are shipped through Port Augusta, but shipments through Darwin have recently begun. In 1967 the concentrates shipped through Port Augusta and Darwin were valued at $8,947,000.

The number of operating mines has steadily decreased and exploration for new orebodies has become increasingly the function of the larger mining companies. Greater emphasis is being placed on following up regional geological and geophysical surveys carried out by the government and by the companies themselves. In the Tennant Creek field many of the orebodies are associated with quartz-hematite bodies which are strongly magnetic and this field has been an excellent example of the value of both ground and airborne magnetic surveys in mineral exploration.

Two new mines are being developed by Peko Mines N.L. The Juno mine is $3\frac{1}{2}$ miles southwest of Peko. It is a small but high grade gold mine with bismuth and some selenium and copper. The Warrego mine is being developed some 33 miles northwest of Peko. Development, costing about $10 million, will take four years to complete. Modern mining and milling techniques are planned to give a production rate of 400,000 tons per year.

The isolation of Tennant Creek was not a major deterrent to exploitation of the gold ores but the long and costly road transport of copper concentrates has been a problem particularly with the need for transhipment at Alice Springs if advantage is to be taken of the railroad system.

No large mines, by world standards, have been found at Tennant Creek but the field may be expected to continue as a valuable gold and copper producer for many years. Although subsurface exploration has been intensified in recent years it could be fairly stated that the total exploration is still small and that further discoveries are likely.



LOCALITY PLAN SHOWING THE ACTIVITIES OF PEKO MINES NL AND GEOPEKO LTD. IN THE TENNANT CREEK AREA NORTHERN TERRITORY

(Map prepared by Peko)

Northern Division

June, 1968

MT. ISA, QUEENSLAND

The city of Mt. Isa is about 480 miles, by air, west of Townsville, but something like 603 miles by rail.

Census figures show that the population of urban Mt. Isa has increased from 13,358 in 1961, to 16,877 on 30th June, 1966. The total population of Mt. Isa Shire, including urban Mt. Isa, was 17,485, on 30th June, 1966.

In 1963, Mt. Isa was made the centre of its own shire and became the administrative centre of a large part of North West Queensland. Police headquarters were already established in the town as well as many representatives of Government Departments. The Royal Flying Doctor Service and the Department of Civil Aviation transferred their bases from Cloncurry to Mt. Isa.

Mt. Isa has a large, all-weather airport and there are regular services to Townsville, Brisbane, and Darwin. It is also the centre of regional services to the Gulf and Western Queensland.

The recently rehabilitated railway line is used to transport mineral concentrates from Mt. Isa to Townsville, and also provides an alternative form of passenger transport by air-conditioned train.

The whole shire of Mt. Isa was proclaimed a city on 30th May, 1968.

Of the city's total population, some 4,300 work for Mt. Isa Mines Ltd.

The company rents 500 houses to employees and more than 700 houses have been sold to occupants. In 1967 the company embarked upon a home-building programme, in conjunction with the Queensland Housing Commission. Under this scheme, each party will build 100 new homes. Previously, the Housing Commission had completed over 300 homes, either for sale or rental.

The city is the commercial and shopping centre for North West Queensland. A wide range of shops, including branches of nationally known chain stores, provide a wide range of goods and services.

Lake Moondarra, about 12 miles from Mt. Isa, provides the city's water supply; in addition, it is also used for aquatic sports.

Mt. Isa Mine

The discovery of silver-lead-zinc ore at Mt. Isa was made in February 1923. The first trial shipment consisted of four and half tons of silver-lead ore from the Racecourse lode.

The first mining lease of the area was taken out in the winter of 1923. The 40 acre lease included the Mt. Isa, Racecourse and Black Star lodes as well as a lead outcrop a mile to the west.

Mount Isa Mines Ltd. (M.I.M.) was founded in 1924. Active development of the mine began in 1927 when Russo-Asiatic Consolidated Ltd. bought a controlling interest in Mt. Isa Mines Ltd. In 1929 Mining Trust Ltd of London took over all the interests of Russo-Asiatic outside Russia, including 80 per cent of the Mt. Isa share capital. In 1930 the American Smelting and Refining Company (ASARCO) bought a one-third interest in Mining Trust Ltd. and 500,000 £1 shares in Mt. Isa Mines Ltd.

Production of lead began in May 1931. About the same time, a wholly-owned subsidiary in England, Britannia Lead Company Ltd., started refining Mt. Isa lead.

After the outbreak of the 1939-45 War the Commonwealth Government asked the company to switch from lead to copper production. Some copper mineralisation had been found in four of the original drill-holes bored from the surface to delineate the orebodies at Mt. Isa. But at that time little notice had been taken of these signs.

In 1942 Mt. Isa Mines Ltd. carried out a vigorous programme of exploration and substantial tonnages of copper were indicated.

The complete changeover from lead to copper production was made in 1943. Copper production continued until April 1946 when the whole plant returned to lead production, and the treatment of silver-lead-zinc ore was resumed.

After the war, Mt. Isa Mines Ltd. decided to build milling and smelting facilities to produce copper as well as lead. Copper production was resumed in 1953 and the company was then in a position to produce lead bullion, blister copper, and zinc concentrates. In that year a new copper smelter had been commissioned.

In 1953, reserves of copper were sufficient only for about eight years at the planned rate of production.

Extensive exploration by diamond drilling began, and in two years copper ore reserves were doubled and reserves of silver-lead-zinc ore were quadrupled.

By 1956, it was obvious that ore reserves at Mt. Isa justified an even higher output. The company, therefore launched its expansion programme, which by 1967 had cost over $130 million, and lifted ore treatment capacity to 16,000 tons a day.

The first step in the expansion programme was the construction of a dam on the Leichhardt River to ensure an adequate water supply for company operations and also for the city. The dam was completed in 1957 and the storage, now named Lake Moondarra, holds 17,500 million gallons of water, which is expected to cope with all expected future requirements.

Other major projects associated with the expansion programme included the installation underground of an 84 inch by 60 inch primary jaw crusher in 1959.

The expansion of the capacity of the copper smelter to 85,000 tons per annum, at the end of 1965.

The construction of the 3,800 foot, 24-foot diameter, concrete-lined K57 Shaft. The shaft was commissioned in 1966, and full ore handling facilities on the new, deeper levels were completed in 1967.

No. 2 Concentrator, a $16.8 million project, designed to increase sulphide ore milling capacity, went into production in 1966. This Concentrator handles lead-zinc ores.

Also included in the expansion programme, at Mt. Isa, was the Mica Creek Power Station. The first stage of the power station was commissioned in 1960, and the second stage in 1961.

Outside Mt. Isa, the programme included the construction and expansion of the Townsville copper refineries; the expansion of facilities at the refineries of Britannia Lead Co. Ltd., in England, and the expansion of Bowen Consolidated Coal Mines, Bowen. In 1966 bulk loading facilities, for zinc concentrates, were completed at Townsville.

The rehabilitation of the railway line from Mt. Isa - Townsville - Collinsville was complementary to the development programme carried out by Mt. Isa Mines Ltd. Under the Railway Agreement (Queensland) Act 1961 the Commonwealth Government provided advances totalling $34.5 million for the reconstruction of the lines. The work was completed in 1965, and the State is repaying the advances, over a period of twenty years from 30th June, 1965. The ratio of Commonwealth funds to State funds for the railway rehabilitation was 2/3 : 1/3. The project involved the relaying and reconstruction of 603 miles of the Townsville - Mt. Isa line and 161 miles of the Townsville-Bowen-Collinsville lines; reconstruction of bridges, upgrading, the extension of passing loops, marshalling yards, and buildings, and the provision of rolling stock.

During the year ending 30th June, 1968 Mt. Isa had a record output of 86,330 tons of crude lead, compared with 62,900 tons in 1966-67. Zinc concentrate output was 95,224 tons, compared with 68,184 tons in 1966-67. Blister copper production was only 47,000 tons, compared with 52,090 tons in 1966-67. The metals produced are expected to return more than $70 million to the company.

The authorised capital of Mt. Isa Mines Ltd. is $60,000,000 of which the issued capital is $47,641,576 in fully paid 50 cent units.

Geology of Deposit

Mt. Isa is one of the world's largest concordant base metal deposits. In the Precambrian shield region of north-west Queensland the mineral association is distinctive in that silver-lead-zinc and copper sulphide assemblages, although located in the same stratigraphic horizon, are spatially independent of each other.

The Urquhart Shale, outcropping over a strike length of 16 miles contains all the known economic mineralisation. The unoxidized Urquhart Shales are composed of light and dark grey dolomitic and volcanic shales, fine-grained bedded dolomites, and pyritic shales with well defined bedding planes ranging in thickness from 0.01 to 12 inches. Pyrite and the economic sulphides are an integral part of the rock forming minerals. The majority of the beds are finely laminated with the bedding plane parting facilitated by the relative abundance of carbonaceous material.

The silver-lead-zinc orebodies are restricted to the virtually unaltered shale while the copper orebodies occur in zones of highly brecciated

and recrystallized shales. Both types of orebodies occur as distinct entities and even though they may be contiguous or within several feet of each other they are mined as separate ores and no contamination harmful to either milling or smelting operations occurs.

Mining

At present mining operations are underground and at the new opencut - the Black Star. The Black Rock opencut has been worked out, and is being refilled with waste.

The mining rate will increase this year to about 16,000 tons of ore removed per day. Production mining is by sublevel open stoping, sub-level caving, cut and fill. The mine is ventilated at present with large fans providing volume circulation. No refrigeration has been used to date, but it is likely that this will be needed in some areas due to the formation of "hot beds". These are caused by a deposit of pyrites which will virtually smoulder when air is blown over it.

The principal ores mined are sphalerite, galena, and chalcopyrite. The host rock in most cases has had sufficient strength to allow construction of tunnels without any framing, and only a few areas require rock-bolting.

Processing

Crushing and Grinding

The ore is crushed to minus 5" in primary and secondary jaw crushers situated underground. Further crushing to minus $\frac{1}{2}$" is carried out in conventional Symons cone crushers on the surface.

Primary grinding is done in a rod mill in aqueous suspension. Secondary grinding follows in two or more ball mills, which are usually in parallel, and in closed circuit with separator cyclones. This produces a sizing of about 80% minus 200 mesh.

Concentration

No. 1 concentrator treats most of the chalcopyrite mined. The aeration is induced by high speed impellors. The frother used is ethyl xanthate, with some butyl xanthate added in the scavenger flotation. Sodium cyanide is

added to prevent flotation of pyrites present in the ore. The xanthate is added at the rate of 0.15 lbs/ton while the amount of cyanide may be up to 0.25 lb/ton if the ore has a high pyrites content.

No. 2 concentrator (Lead-zinc) was commissioned in 1967. It uses compressed air to indice aeration with low speed agitators. The lead is floated first, using ethyl xanthate frothing agent and zinc sulphate (0.55 lb/ton) to keep the zinc down. The tails from the lead system are given a further addition of 1.20 lbs/ton of copper sulphate, which precipitates the zinc sulphate and allows the zinc ore to float.

Lead carbonate ore from the Black Star open-cut is treated in No. 3 Concentrator.

After floating, the ore is dewatered on a rotary filter, and the water removed is allowed to settle to recover dissolved and suspended minerals.

Smelting

Zinc. Zinc is sold directly as concentrate.

Lead. The concentrate is sintered with limestone and carbonate ore. The sintering machine is fired with fuel oil and small quantities of coke dust. A new sinter plant was commissioned in 1966. Hot sinter is fed into the blast furnace with scrap iron and coke. Dust from the sinter plant and the blast furnace is collected in the baghouse and recycled to the sinter plant.

The furnace output is slagged and drossed to produce lead bullion which is 99.3% lead. This is shipped to Britannia Lead Refinery, U.K., a subsidiary of Mount Isa Mines Ltd. The lead dross contains 55.1% lead, it is bagged and shipped to ASARCO. The slag contains 14.5% zinc, but it is not economic to recover this at the present price of zinc, so the slag is stockpiled.

Copper. The copper concentrate is mixed with siliceous oxide ores, lime and recycled slag. This is roasted (or calcined) by ignition with oil burners, to remove combustible sulphur and volatile substances. The calcine is transported by charge cars to the reverbatory furnace, which melts the charge, removes most of the remaining sulphur, and allows the silicates to float to the surface and be tapped off. The furnace is fired with pulverised coal. The copper matte produced is tapped into 19 ton ladles and transferred to the converter. In the converter siliceous flux is added, and air is blown through the molten charge. The blister copper is decanted, and the slag is returned to the

reverbatory furnace. The blister copper (99.3% copper) is cast into 4,000 lb. slabs for shipping to Townsville.

Dust is collected from the roasters, reverbatory furnaces and converters, and is used to make copper sulphate, for use in No. 2 Concentrator.

PHOSPHATE ROCK IN AUSTRALIA

Australia's requirements of phosphate rock for the manufacture of superphosphate are at present entirely supplied by imports. In 1967 these imports totalled about $3\frac{1}{4}$ million tons, of which Christmas Island in the Indian Ocean and Nauru and Ocean Island in the Pacific together supplied 2.4 million tons. However, discoveries of phosphate rock deposits in Australia since Mid-1966 have radically altered the situation in Australia in that major resources are now assured, although it is not yet clear how soon these resources can be economically mined.

The search for phosphate rock in and around Australia began some years ago; in 1955 a programme of search for phosphate in the south-west Pacific and in Australian waters was agreed upon by the Australian and New Zealand Governments, and that the results of this work indicated that exploitable deposits occurred only on Bellona Island, B.S.I.P., and that these reserves were small and only of medium grade. Subsequent work by the Bureau of Mineral Resources in Australia discovered phosphate rock deposits at Rum Jungle and in the Amadeus Basin in the Northern Territory, but neither of these occurrences proved of economic significance, although Rum Jungle material can possibly be used locally as raw fertilizer.

In 1964, Commonwealth and State Governments encouraged mineral exploration companies to search for phosphate and this resulted in much increased activity on the Australian continent. About the same time, the Bureau of Mineral Resources arranged for two overseas specialists to assess the phosphate potential of Australian waters and on the Australian continent; this resulted in visits to Australia by Dr. van Andel of The Scripps Institution of Oceanography in August, 1965, and by Dr. Sheldon of the U.S.G.S. from September 1965 to December 1966. Dr. van Andel indicated some areas around Australia worthy of the search for marine phosphorite, and these are being investigated as part of the work of the Marine Geological Group of the Bureau. On the continent itself, there is no doubt that company activity was stimulated by Dr. Sheldon's recommendations which were freely discussed with companies and geological surveys. In the company search, early emphasis had been placed on the Mesozoic Province of Western Australia, but the only deposit with any promise, found on the Fitzroy River 30 miles south of Derby, did not prove commercial. Sheldon's recommendations emphasised eastern Australia and northwest Queensland, and a B.M.R. study of some of the oil wells which had penetrated Lower Palaeozoic sediments of the Georgina Basin, indicated abnormally high

phosphate content in some Middle Cambrian formations. Further systematic testing of oil wells by Broken Hill South Ltd confirmed this, and in particular located phosphatic sediments in lower Middle Cambrian beds in the Black Mountain Bore, 90 miles south of Duchess. As a result of this discovery, the company took out an Authority to Prospect covering the area immediately to the south of Duchess, where existing B.M.R. geological maps showed that the phosphatic sequences penetrated in the bore came to the surface, and discovery of the Duchess deposits quickly followed.

These deposits, although containing thin beds of high-grade phosphorite, up to 37% P_2O_5, bulk about 22% P_2O_5 over economic widths ranging up to about 60 feet and are thus medium grade deposits. Phosphate rock occurs mainly in the Beetle Creek Formation of lower Middle Cambrian Age and the included Monastery Creek Phosphorite Member consists of a number of hard and soft high-grade phosphorite beds interealated with lower-grade phosphatic siltstones, phosphatic shales and chert. The deposits are described by R. T. Russell, the discoverer, in the Queensland Government Mining Journal, Volume 68 No. 786, 1967.

Discovery of the Duchess deposits in August, 1966, was followed by accelerated prospecting in the Cambrian province of north-west Queensland principally by Broken Hill South Limited, International Minerals and Chemicals Corporation and the Continental Oil Company, who between them hold prospecting permits covering most of the province. By mid 1967 continued prospecting had discovered additional deposits in the Yelvertoft area, about 100 miles north of Duchess, about 50 miles north-west from Mt. Isa, and considerably closer to the northern coast of Australia, although none of these new deposits yet match the Duchess deposits in size. Deposits in a number of localities about 150-200 miles from the Gulf of Carpentaria appear much smaller than those at Duchess although they border on medium-grade and are not greatly dissimilar in type and amenability in treatment; other deposits may well be of considerable tonnage but so far are low-grade (14-16% P_2O_5) and present added difficulties in beneficiation stemming from fine grain size and the proportion of clay and iron oxides. However, it should be noted that all of these deposits constitute indigenous resources of phosphate rock, with ranging degrees of attractiveness depending on grade, tonnage, overburden ratios, locality and ease of beneficiation.

Little detailed information of reserves has yet been released but it is apparent that reserves of both medium (20-30% P_2O_5) and low grade (less than 20% P_2O_5) will be at least of the order of hundreds of millions of tons. Beneficiation at least of medium-grade material is practicable; the main problems in exploitation stem from the isolation of the deposits which lie 150-300 miles south of the Gulf of Carpentaria. Feasibility studies to investigate exploitation are in hand but are not yet complete.

BURDEKIN DELTA REPLENISHMENT SCHEME

Purpose

Two factors, the 1964 increase in the area of cane assignments to 71,000 acres, practically all of which is irrigated from the Burdekin Delta Underground Basin, and several years of inadequate natural replenishment of this basin led to concern about the adequacy of the natural water resources of this basin. Requests were made in 1959 for the examination of the problem.

The resulting investigations revealed an average deficiency of the order of 88,000 acre feet per annum, and short-term deficiencies of 122,000 acre feet, in the 260,000 acre feet per annum which is required for the present level of assignments.

The Burdekin Delta is bisected by the Burdekin River which to this point has a catchment of 50,000 square miles and an annual average flow of 7.5 million acre feet. Stream flows are highly variable from zero to in excess of 1 million cusecs. On an average, taken over 40 odd years of records, there are 283 days each year when flows are in excess of 100 cusecs. This river was the obvious source of water to supplement the available supplies of the Delta.

The geology of the 240 square mile Delta is relatively simple: a body of deltaic sediments resting on an old granite surface. Test drilling indicated extensive aquifer systems, which when full would provide a storage in excess of 1,000,000 acre feet. Storage of this form has several desirable features and by observation of natural flows within the Delta and some trial work it was deemed possible to artificially replenish this underground basin.

A scheme was promulgated for the pumping of water from the river into a system of natural and artificial channels intersecting some of the aquifer systems which would allow water to percolate to the underground basin. It was expected that experience with operation of a scheme of this nature would possibly indicate better methods of approach and therefore the planning and execution could well allow for stage development.

Nature of Boards

The most appropriate Legislation available in Queensland is "The Water Acts" which provides the statutory authority required by a Water Board to implement a scheme of this nature. Under the authority of this Act two Boards have been constituted, one for the area to the North of the Burdekin River and named The North Burdekin Water Board was constituted on the 13th May 1965, and the other, named The South Burdekin Water Board, was constituted on the 31st March 1966.

The Boards under their respective constitutions are charged with the implement of approved plans of construction, operation of the scheme, and maintenance of all constructed works, and their principal revenue comes from a levy on sugar cane delivered to the three sugar mills of the area, and shared 2/3rd by growers and 1/3rd by millers. These schemes do not attract Government Subsidy.

The following capital works have been constructed by the Boards as the first stage of their development:

North Side: two pump stations to pump from the river, 60 cusecs to Plantation Creek, and 30 cusecs to Sheepstation Creek; the construction of 27 mile of channel system including controlling and access structures, and the construction of ten earth dams on tidal estuaries to reduce shoreline influence of sea water.

South Side: a pump station to pump 60 cusecs from the river into Warren's Gully; a 30 cusec relift from Warren's Gully to Malaponte's Diversion Line; 19 mile of natural and artificial channel with controlling and access structures.

Constitution of Boards

North Burdekin

Two representatives of each of the Kalamia and Pioneer Mill Suppliers Committees, nominated by those Committees.

One representative of Kalamia Mill.
One representative of Pioneer Mill.
One representative of the Ayr Shire Council.
One representative of the Commissioner of Irrigation and Water Supply.

South Burdekin

Four representatives elected by the growers.
Two representatives of Inkerman Mill.
One representative of the Ayr Shire Council.
One representative of the Commissioner of Irrigation and Water Supply.

Amount of Water Pumped

North Burdekin

Pumping commenced into Sheepstation Creek on 19th July 1965.
Total water pumped to 30.6.68 is 71,500 acre feet.
Financial year 67/68 23,300 acre feet.

South Burdekin

Pumping commenced into Warren's Gully on 8th February 1967.
Total water pumped to 30.6.68 27,500 acre feet.
Financial year 67/68 16,000 acre feet.

Effects of Pumping

No pumped water has flowed to waste to the sea.

Regular observations of water levels at 320 points in the Delta have shown significant early increase in water levels within relatively narrow strips astride the recharge channels. The area of water level increase broadened with time, and some paths of groundwater flow apart from the lines of the recharge channels have become apparent.

Several factors combine to explain the increased yield of sugar per acre reached in 1967, not the least of which is the more assured water supply. It is considered there is a return to confidence by the farmers who can once again regulate the yield of their cane crops.

Rainfall of between 8 and 9½ inches in June 1967 gave an appreciable boost to the underground levels and over 40 inches in January and February this year together with a flood which overtopped the river banks has secured the position for the present.

Costs

Capital Costs of the schemes to date are: -

North Burdekin	$260,000
South Burdekin	$402,000

To meet interest and redemption charges on loans, and to operate, maintain, and administer the schemes the present levy of 10c per ton of cane delivered to the mills has been struck resulting in a 1967/68 income of

North Burdekin	$128,600
South Burdekin	$ 79,900

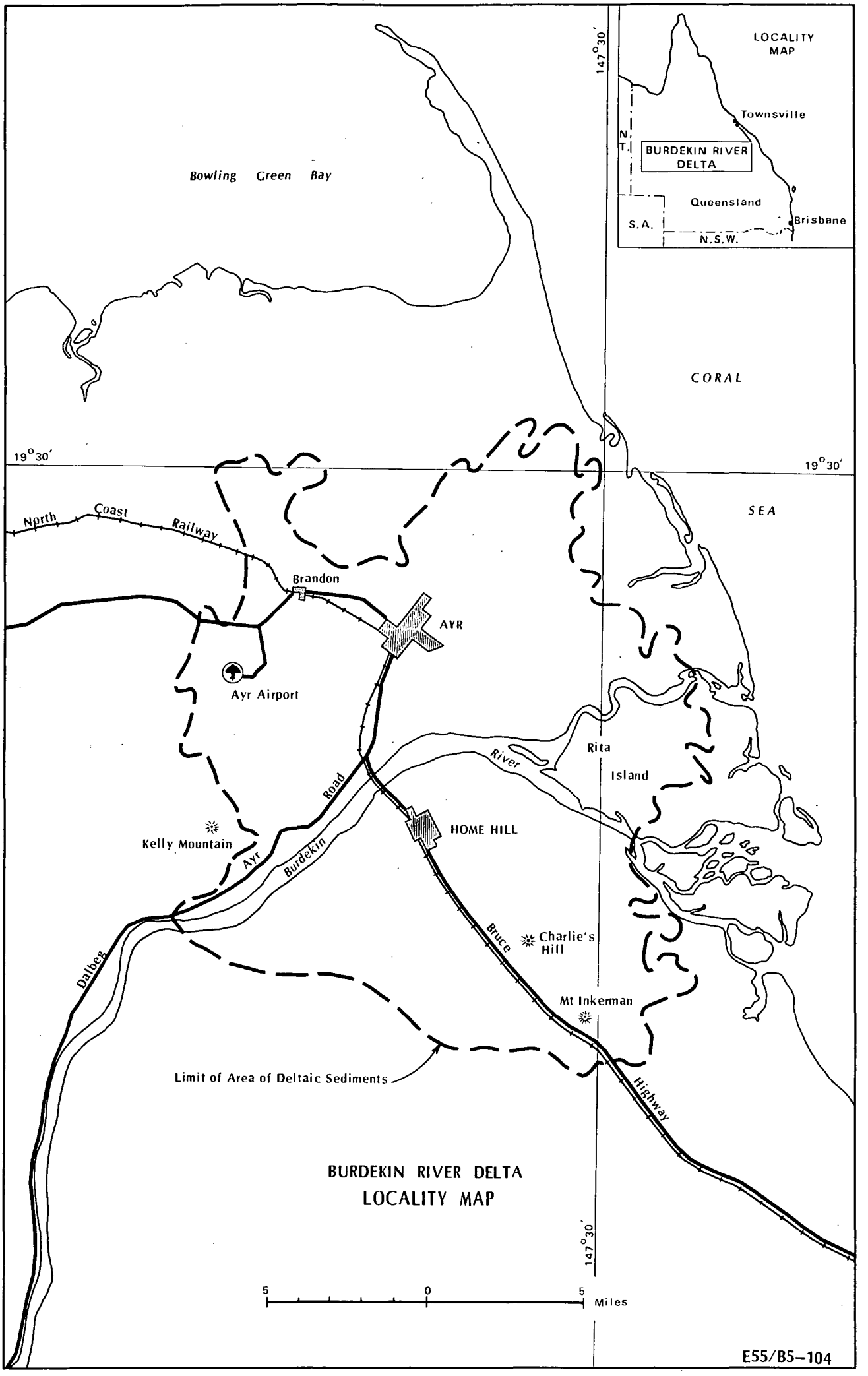
Potential of Artificial Recharge

Problems of continuing to get water to percolate to the underground beds do exist. Spreading over intake areas and exposure of aquifers by open excavation and by trenching is currently being undertaken. Regular cleaning out of the recharge system is necessary to remove silt and colloids pumped from the River. Turbidities as high as 3,000 ppm in high freshes have been recorded.

Further work such as that indicated above is necessary to increase the potential recharge to the figure earlier indicated as the difference between average natural recharge and present day requirements.

There is substantial area available for increased cropping but the limit is in available water. There is potential therefore for increased artificial recharge together possibly with reticulation.

- Notes contributed by Irrigation and Water Supply Commission.


LOCALITY MAP
Townsville
N.T.
BURDEKIN RIVER DELTA
Queensland
S.A.
Brisbane
N.S.W.
147°30'
Bowling Green Bay
CORAL SEA
19°30'
19°30'
North Coast Railway
Brandon
AYR
Ayr Airport
Rita Island
River
Road
HOME HILL
Kelly Mountain
Ayr
Burdekin
Bruce
Charlie's Hill
Dalbeg
Mt Inkerman
Highway
Limit of Area of Deltaic Sediments
BURDEKIN RIVER DELTA
LOCALITY MAP
147°30'
5 0 5 Miles
E55/B5-104

Northern Division

June, 1968.

THE BURDEKIN RIVER IRRIGATION, HYDRO ELECTRIC AND FLOOD MITIGATION PROJECT

History of Investigations

In 1945, the Co-ordinator-General of Public Works, Queensland, initiated investigations into a major scheme on the Burdekin River to serve the combined purposes of water conservation for irrigation, generation of hydro-electric energy and flood mitigation.

By 1949 the investigations were sufficiently advanced to permit the presentation of a report to the Prime Minister seeking examination of the proposals by Commonwealth technical officers, with a view to Commonwealth participation. Because of the national importance of the project it was considered by the Queensland Government that the Commonwealth Government should assist both in its implementation and in the further investigations still to be undertaken.

Legal provision for implementation of the project was made by the Queensland Government in "The Burdekin River Development Act of 1949". This Act constituted the Burdekin River Authority to undertake construction and management of the project. It also authorised the Premier and Chief Secretary to enter into an agreement with the Commonwealth, whereby, in consideration of financial assistance by the Commonwealth, the Commonwealth would be empowered to appoint not more than two representatives to the Burdekin River Authority. Until such Agreement is made (and none has been made to date) the Authority is constituted by State representatives only.

In 1951, the Authority decided that a stage had been reached where the results of all the investigation to that date should be published. This comprehensive report has since become known as the "Kemp Report", Sir John Kemp being at that time Chairman of the Authority.

Since then the Authority has issued Annual Reports describing the progress of investigations. In recent years, however, these Reports have indicated that all work under the control of the Authority has virtually ceased and the Authority now exists purely in a nominal capacity.

Outline of Proposals

The Kemp Report outlines four stages of development untimately resulting in the irrigation of about 350,000 acres out of a total farm area of about 500,000 acres, and the provision of 120 MW of installed generating capacity. Water storage would be provided by means of a 150 ft high dam at Burdekin Falls damsite (99m), impounding a storage of 6,500,000 acre ft. Suggested crops to be grown under irrigation include tobacco, sugar, maize, cotton, rice and fodders.

The total estimated cost in 1951 of all four stages of development was $140 million. Returns of $32 million per annum from irrigation and $4 million from sales of electricity were expected.

Progress of Construction

Stage 1 of the Scheme - irrigating about 3,000 acres from the Gorge and Blue Valley Weirs (10,000 acre ft) - was commenced in 1950-51 and completed in 1955-56 at a cost of about $5 million. The farms were designed for tabacco growing and mixed agriculture and were developed under war service land settlement. Early settlement was not without problems, particularly in tobacco production, and in recent years the established areas (Dalbeg, Willaroo and Clare) have changed to sugar cane production. In addition, increased assignments for sugar cane growing were granted following recommendations by the Gibb Committee, thus bringing the total irrigated area for 1965-66 to 9,500 acres.

The Queensland Department of Agriculture and Stock has established an experimental station at Willaroo and research is under way into the possibilities of rice production. These experiments, together with field trials conducted by Rolfe Bros and others, have apparently proved very successful.

The present water supply to Dalbeg, Willaroo and Clare is not always sufficient to meet the requirements of the expanded area and during 1965-66 pumping had to be curtailed because of the shortage of water. However, construction of Eungella Dam on the Broken River will provide an extra 12,000 acre ft per annum to the irrigation areas - sufficient to stabilise production from the existing areas.

The Present Situation

In addition to the problems being experienced by the sugar growers at Dalbeg, Willaroo and Clare, sugar producers on the lower Burdekin in the Ayr-Home

Hill-Brandon region, have become increasingly affected in recent years by a progressive drop in level of the water table. Sugar growers in this area pump from bores tapping the underground water supplies.

Increasing concern with the problem of saltwater encroachment into the underground supplies has led to the implementation of the Burdekin Delta Replenishment Scheme. Separate notes describing this Scheme are attached.

The problems of the lower Burdekin area and the desire for expansion at Dalbeg, Willaroo and Clare has led to renewal of interest in the development proposals for the Burdekin River.

The Burdekin Delta Replenishment Scheme

The Burdekin Delta, with some 70,000 acres of irrigated sugar cane is the largest concentration of irrigation in the State. Some problems were experienced in this area when the rapid expansion of the assigned area from 65,000 to 70,000 acres in the early 1960's was concurrent with dry seasons resulting in little natural recharge of the underground water resources.

Investigations into the underground resources of the area were intensified in 1961 by the Queensland Irrigation and Water Supply Commission. These investigations clearly indicated that the use being made of underground water exceeded the safe yield obtainable with natural recharge only. The Commission's Report of 1964 indicated that an artificial recharge of 70,000 to 80,000 acre ft. per annum was required.

Schemes to provide this replenishment are now in operation on both the north and south sides of the Burdekin Delta. On the north side works comprise two pumping stations on the Burdekin River which deliver water into two creeks which in several places intersect underground beds allowing soakage and recharge of underground storages to occur.

One pumping station, of 30 cusecs capacity, delivers water into the 17 mile long Sheepstation Creek. The other pumping station is of 60 cusecs capacity and delivers water to the 12 mile long Plantation Creek. The works were available for operation from February 1966 but low flows in the River did not allow operation for very long periods in that year. The stations started pumping continuously at the end of November, 1966 and up to the end of February had delivered about 20,000 acre ft. of water underground.

Works on the south side are not yet completed but will comprise a 60 cusec pumping installation discharging into a natural channel known as Warren's Gully. Two artificial channels are to be constructed, totally 12 miles in length, which will connect with this Gully.

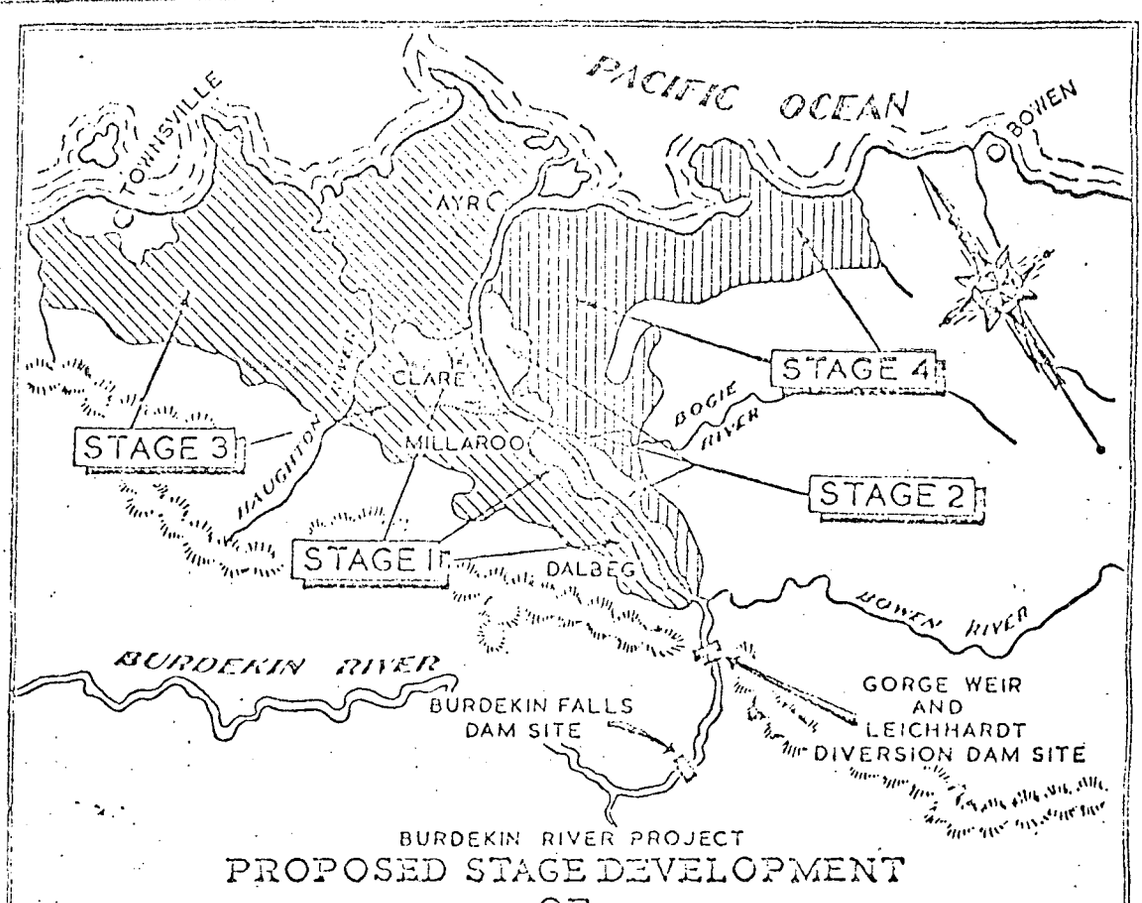
Rice Growing in the Burdekin Delta

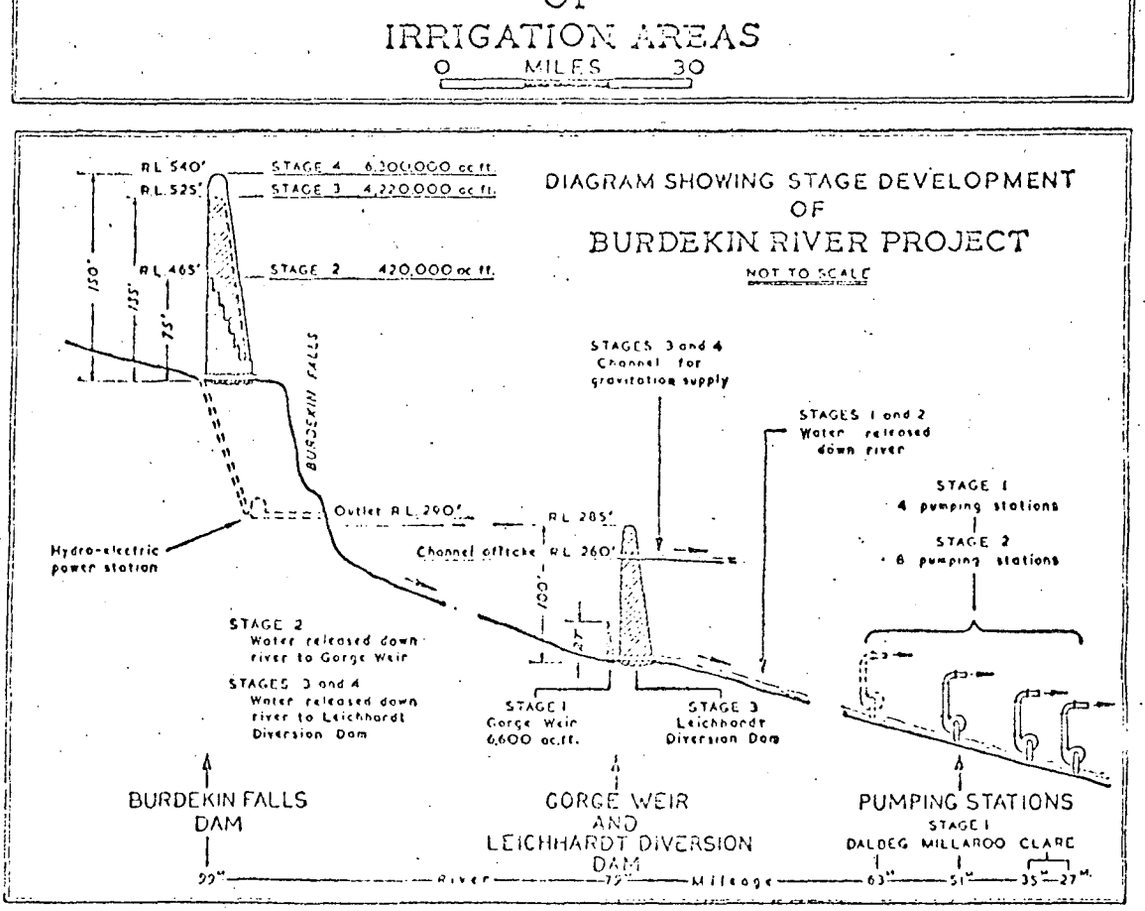
For some years the Millaroo Research Station has been investigating the agricultural potential of the heavy Oakey and Barratta clay soils of the Burdekin Delta. During this period, rice has proved to be one of the most promising crops for the region. Yields of up to three tons to the acre have been achieved in trials.

Some of the local farmers have shown an increasing interest in rice as a cash crop and they have been conducting trials on their own account for the past two years. Prominent amongst these farmers are Messrs. J.K. and T. Rolfe, who have large tracts of Oakey and Barratta soils on their properties.

In 1967, the Rolfe brothers planted 7 acres, and this year they planted 70 acres. Next year they intend planting 200 acres of rice, in rotation with soya bean - a common practice in the U.S.A. This year, they hope to achieve an overall yield of two tons per acre, and up to 3½ tons on some stands.

Two rice mills are being constructed this year; one at Brandon, by commercial interests, and one at Home Hill, by the Lower Burdekin Rice Producers' Co-operative - which recently received loan backing from the Queensland Government for $35,000.





The diagram and map above show the various stages of the Burdekin River project. Stage 1 has been in operation for some time. It includes the Gorge Weir, with a capacity of 6,600 acre feet, and the development of more than 200 farms in the Clare, Millaroo and Dalbeg areas. These are now all growing sugar cane. Stage 2, as indicated on the map, and now advocated by the Lower Burdekin Development Council for implementation, calls for construction of the Burdekin Falls Dam to a height of 75 feet with a storage capacity of 420,000 acre feet, providing sufficient water for the development of 780 irrigated farms on both sides of the river in the area generally extending from Clare to Dalbeg. Stage 3 involves the raising of the Burdekin Falls Dam to a height of 135 feet with a storage capacity of 4,220,000 acre feet, construction of the Leichhardt Diversion Dam, and diversion of water by gravitation through a channel system serving lands on the western side of the Burdekin as far as Townsville. This would permit development of 2,800 irrigated farms. Stage 4 would raise the Burdekin Falls Dam to a height of 150 feet, with a storage capacity of 6,581,000 acre feet, and extension of the channel system to command lands on the eastern side of the river, south to Bowen. The number of irrigated farms would be increased to 3,600.

Northern Division
June, 1968

TOWNSVILLE

The Townsville area was first settled in 1864, when Captain Robert Towns took up interests in the area. By the end of that year a wharf and stores were under construction in what is now the city of Townsville. It was proclaimed a port of entry in October 1865, and a Customs Officer was appointed in that year. By the end of 1866 the township was well established.

Townsville has continued to grow and it is now the second largest city in Queensland. At the 30th of June 1967 the population of the Townsville urban area was 61,000. The population is expected to reach 85,000 by 1975, and 100,000 by 1985.

Recent developments which have had a considerable impact on the growth of Townsville include the construction of a new army base, the expansion of Townsville University College to a new site at Ross River, the expansion of the Townsville Copper Refineries and port developments and reclamation work.

Army Barracks

Lavarack Barracks, the new army base, is the largest construction project ever undertaken by the Army in Australia. The estimated expenditure on the base is around $26 million and there will be facilities for a task force of 4,500 men, plus some 3,000 dependents. The task force is expected to comprise a headquarters staff, three infantry battalions, a regiment of field artillery and a full complement of support units.

The first troops started moving-in during September 1967 and the base is expected to be fully operational sometime in 1969.

When completed, the base will have about 240 major building, such as barracks, administration blocks, workshops and stores. In addition the Army is providing 835 homes for the families of married servicemen. The houses are fully furnished and include refrigerators, washing machines, fans, and carpets; even garden implements are provided.

Sporting facilities on the base include ovals, tennis courts, a squash court, a gymnasium and a swimming pool.

There will also be a community centre with an assembly hall, dental clinic, post office and telephone exchange.

Townsville University College

The new, 650 acre, campus of the Townsville University college is located at Ross River, on a site adjacent to Lavarack Barracks. The old campus is at Pimlico, some $4\frac{1}{2}$ miles from the centre of the city.

In October 1966, the Commonwealth Government allocated $5,428,000 for the construction of new facilities on the Ross River site, during the 1967-1969 trienium.

Future plans provide for the development of the site to accommodate 3,000 to 3,500 students in the first stage and an ultimate student population of approximately 10,000.

The Townsville University College was formally established on 19th May 1960, and was officially opened on 27th February 1961. The College is an integral part of the University of Queensland, and is governed by the Senate of that institution.

The directing Executive Officer for the Senate at the University College is the Warden, who is responsible to the Senate for the College's direction and control. To advise and assist the Warden there is an Advisory Council, on which are represented the major civic and church interests in North Queensland.

Student enrolments in 1967 totalled 534; of whom 340 were full-time (including 32 higher degree students) and 194 were part-time students.

Full degree courses are available in Arts, Science and Engineering and one or two years of the course in a wide range of other faculties (except architecture). The Australian Universities Commission has recommended the creation of specialist facilities at the College in 1967-69 connected with Townsville's geographical position. These include the introduction of marine biology in undergraduate and post-graduate courses, and the establishment of post-graduate facilities in tropical agriculture, tropical veterinary science and tropical forestry.

The College will be granted full autonomy by 1st January 1970, and it is expected that all University activities will be transferred to the Ross River campus by 1972.

The Commonwealth Scientific and Industrial Research Organisation has a Pastoral Research Laboratory on a 51 acre site at Ross River, adjacent to the University college campus. An associated 7,000 acre field station, "Lansdown", is near Woodstock.

Research has concentrated mainly on tropical pastures, with special emphasis on the legume Townsville lucerne.

Port of Townsville

Townsville Harbour is situated in Cleveland Bay, and is administered by the Townsville Harbour Board.

There is an open approach from the sea, through Platypus Channel, to a man-made harbour, protected by two long breakwaters. The Channel is approximately $2\frac{1}{4}$ miles in length, with a width of 250 feet; the minimum depth is 27 ft 6 ins L.W.O.S.T.

In the early days Townsville was mainly a beef and timber port. Later it became a major port for the export of wool, a trade which it has lost since World War II.

In 1913, No. 1 pier was completed to add to the berthage then available. The following year the first sugar from Inkerman Mill was handled through the port. Invicta Mill, Giru, entered theexport trade in 1921.

1929 saw the import of the first bulk oil to Townsville, and in 1931 the first shipment of Mt. Isa silver bullion passed through the port. In 1936 the first zinc concentrates were shipped, and 1943 saw the first shipment of blister copper from Mt Isa.

Townsville's first bulk sugar terminal was opened in 1959, but this was destroyed by fire in 1963. The terminal was rebuilt in 1964, and in 1965 the bulk sugar capacity was doubled to a total capacity of 280,000 tons.

The Suter Pier, used mainly for the bulk loading of sugar at its western berth and for the handling of meat cargoes at its eastern berth, was opened in 1961. This replaced the old dual purpose wharf used during the war years.

1966 saw the opening of an isolated oil berth near the mouth of the harbour, to handle all oil and gas cargoes, and the extension of No. 1 Pier; this extension carries the bulk handling facilities for mineral concentrates.

Major works at present being undertaken by the Townsville Harbour Board include the construction of a roll-on-roll-off terminal which will be leased to the Australian National Line and the reclamation of 160 acres - extending from the mouth of the Ross River to a point 800 feet along the main harbour's eastern breakwater. Application have been received for about 80 per cent of the reclaimed area from oil companies and also from A.C.F. and Shirleys Fertilisers, who have announced plans for the construction of plants to produce superphosphate and ammonium phosphate.

The Harbour Board has also announced that it intends dredging the mouth of the Ross River to open the river to small shipping. Two areas, comprising approximately 23 acres on reclaimed areas in the Ross River, will be reserved for the re-establishment of the fishing industry and those industries, such as boat building, which require water frontages.

Fisheries

The North Queensland Fish Board operates the Townsville fish market which, in addition to handling the Townsville catch, also markets fish landed at Bowen. Townsville handles about 33 per cent of the North Queensland catch or just over 5 per cent of the Queensland total.

The number of commercial fishing boats registered in Townsville in 1966 was 104 with a value of approximately $400,000. Most are small boats with a one or two man crew.

Mackerel is the principle catch, amounting to something like 60 per cent of all fish landed. Cold storage facilities are available at Townsville and mackerel received during periods of peak production - August to November - are stored to meet consumer demands in the "off season". Most of the catch is sold locally, but some is railed to Brisbane.

Increasing amounts of prawns are also being handled by the Fish Board. These are mainly received between April and July.

Industrial Activity

Townsville has a few large industrial enterprises, complemented by a large number of relatively small scale establishments.

The large scale enterprises are Copper Refineries Pty. Ltd., North Australian Cement Ltd., Queensland Meat Export Co. Pty. Ltd., and Swift (Australian) Co. Pty. Ltd. Two other major employers in the region are the Queensland Government railway workshops and the Townsville Regional Electricity Board.

Copper Refineries Pty. Ltd. is the subject of a separate paper.

North Australian Cement Ltd. - the manufacture of Stuart Portland Cement commenced in 1954 with a plant capacity of 60,000 tons per annum. In 1957-58 capacity was expanded to 100,000 tons per annum.

The works are sited close to large deposits of high grade limestone and coal is obtained from Collinsville.

In recent years several large consumers of cement have established industries in Townsville; these include Humes Ltd. (Concrete Division) and Ready Mixed Concrete (Queensland) Pty. Ltd.

Queensland Meat Export Co. Pty. Ltd. - meatworks at Ross River. Employs 125-620 persons. Produces mainly boned-out meat for export.

Swift (Australian) Co. Pty. Ltd. - meatworks at Alligator Creek. Employs 35-400 persons. Produces mainly boned-out meat for export.

In addition to these two major export meatworks, the Townsville District Abattoir processes meat for local consumption. This abattoir is controlled by the Townsville District Abattoir Board and employs a staff of 43.

A wide range of contracting facilities are available in Townsville, and several large southern firms have permanent branches in the city. A number of locally owned businesses also have facilities for large scale general building and construction work. A complete range of sub-contracting industries is available in Townsville, together with architects, surveyors and consulting engineers.

In addition to steel fabricating companies, there are about 15 small engineering workshops, carrying out blacksmithing, welding, fitting and turning.

Adjacent to the Oil Terminal at Townsville Harbour is a large Bitumen Plant, operated by the Shell Company of Australia Ltd. The plant commenced production in 1963, and its present output is around 8,000 tons of bitumen per annum. Output can be increased to over 20,000 tons per annum, and storage is available for 800 tons of finished bitumen. Bitumen feedstock is imported by sea and the manufacturing process produces fuel oil as a by-product.

Gas for industrial and domestic use is manufactured by the Townsville Gas and Coke Co. Ltd. at Pimlico. The works produces 600,000 cu. ft. of gas per day and about 120 miles of mains supply the city and suburbs. Bulk storage terminals for liquid petroleum gas are operated, at Townsville Harbour, by the Townsville Gas and Coke Co. Ltd and Mobil Oil Aust. Ltd., distributing bottled gas throughout North Queensland. The present storage capacities of 300 tons and 150 tons respectively can be expanded to meet future increased consumption.

Other industries which have established in Townsville include brick-works, joinery and furniture manufacture, a paint factory, the production of industrial and medical gases, the manufacture of cans and cartons and food processing factories.

Northern Division

June, 1968

COPPER REFINERIES LTD. (TOWNSVILLE)

INTRODUCTION

Copper Refineries Ltd., is a wholly-owned subsidiary of Mt. Isa Mines Ltd., and it refines all the blister copper produced by the parent company. Copper Refineries does not buy or sell copper, but charges Mt. Isa Mines Ltd. a tolling fee for refining the blister copper.

The decision to establish the Refinery was taken after Mt. Isa Mines Ltd. had confirmed the existence of large reserves of copper in 1954, and was part of the company's massive development plan, which started in 1956.

The plant was largely designed by American Smelting and Refining Company (ASARCO), who own a controlling interest in Mt. Isa Mines Ltd. Most basic designs come from ASARCO, although some modification and development has been carried out by the Copper Refineries engineering staff.

Significant dates in the development of the plant are:

November, 1956 - Clearing of site commenced and design work begun.

October, 1959 - Electrolytic wirebars produced, and plant officially opened. Plant capacity 40,000 tons per annum.

October, 1960 - Copper rod rolling mill and wire drawing and stranding plant commissioned.

July, 1961 - Production of semi-continuous casting of copper cakes and billets commenced.

July, 1963 - Plant capacity for electrolytic refining increased to 85,000 tons per annum.

August, 1964 - ASARCO patented shaft type melting furnace installed to supply molten copper to the ASARCO semi-continuous casting unit.

July, 1966 - Electrolytic tank capacity increased to permit electrolytic refining at a rate of 95,000 tons per annum.

January, 1967 - Programme initiated for increasing casting capacity by the installation of a second reverbatory type refined copper melting furnace plus a second wire-bar casting wheel located in an extension to the Casting House. Provision in the Casting House extension also made for an ASARCO

type refined copper shaft furnace for casting wirebars on the new wirebar casting wheel.

July, 1967 - Plant consisting of hotblast cupola and casting wheel for the manufacture of cast iron grinding balls commissioned.

PRODUCTION DETAILS

1. Anode Casting

The raw material is blister copper in 4,000 lb. slabs from Mt. Isa. These are fed to the anode furnace with scrap from around the works, and used anodes. The anode furnace is oil fired and has a hearth capacity of 400 tons. During tapping, the anodes are cast onto a casting wheel at the rate of 85 tons per hour. The casting wheel carries 26 copper moulds, which are cast in the plant.

2. Electrolysis

The cast anodes weigh 745 lbs and contain about 99.2% copper. Main impurities are lead, iron, silver, arsenic, nickel and antimony. The copper is electrolysed onto starting sheets in cells containing 41 cathodes and 40 anodes. Anodes last for 28 days and cathodes, weighing 340 lbs., are removed every 14 days. The electrolysis potential is 0.18 volts, and the current is 16,000 amps., making a current density of 20.3 amps per square foot at the cathode.

The main additive to the electrolyte is sulphuric acid, which is present at the constant concentration of 200 g/l. Only about 5-10 tons of acid per year is used. Most of the acid is regenerated by depositing the copper in cells with lead anodes. Other organic additives are used to prevent the formation of crystal growths at impurities or rough spots on the cathodes. These include gelatin glue, casein and thiourea, all of which are used at the rate of 0.07-0.08 lbs. per short ton.

3. Wire bar Casting

The cathodes from the tank house are melted in a furnace practically identical with that used for anode casting. The wire bars are cast on a 26-mould casting wheel which is also the same design as the anode wheel. The wire bars are examined and then bound into bundles of nine.

4. Cake and Billet Casting

The cathodes are melted in a new design ASARCO vertical shaft furnace, and heated to the required temperature in an 800 KW induction furnace. The molten copper is run into a vertical, water-cooled, semi-continuous casting mould, which casts to a depth of 25 feet. The maximum cross-section of the cake is $37\frac{1}{2}$" x 5". The cake is then inspected and cut into lengths as ordered by the customers.

QUALITY CONTROL

The plant laboratory is engaged almost entirely in quality control. Chemical assays of all reagents used, and detailed chemical analyses are carried out continually. A mass spectrometer has now been purchased for more accurate determination of trace elements. Physical properties are also measured, especially on drawn wire and rod.

ROD MILL

The rod mill is a semi-automatic type, designed to produce $\frac{1}{4}$", 5/16", $\frac{1}{2}$", and 5/8" rod in up to 18 passes with a cycle time of 42 seconds. The rod produced is coated with a layer of copper oxide and for 'bright' rod some of this is pickled in sulphuric acid. The copper in the pickling solution is recovered in the lead anode cells, and the acid is regenerated simultaneously. Some of the rod is drawn into wire of gauges down to 0.029 ins. Stranding machines are also operated to produce cable. For special quality wire, the rod is shaved to give an accurately-controlled diameter and a highly smooth surface.

LABOUR

The total number employed in 520, made up of about 180 staff and 340 wage-earners. These were mostly obtained locally and trained for their jobs. Labour turnover has been fairly small, except during the Mount Isa strike. Trained staff have been fairly difficult to obtain, and the company is attempting to improve the situation by encouraging junior staff to take part-time courses at technical or university colleges, and the company will pay the fees for these courses.

POWER AND FUEL REQUIREMENTS

Fuel oil is used at the rate of one ton for every five tons of copper produced.

Power consumption is 3-4 megawatts. Power for the tank house is transformed and rectified by germanium diodes. These are soon to be replaced by Japanese silica diode/transformer sets, which are more compact and efficient.

PRODUCTION

	Year ended June 30th			
	1964	1965	1966	1967
Wire bar .....tons	39,319	15,388	38,329	25,334
Cathode .....tons	4,698	2,827	6,428	542
Cake and Billet .....tons	12,921	8,951	15,731	12,787
Rod and Wire .....tons	10,488	12,536	13,071	14,728
	67,426	39,702	73,559	53,391

BALL CASTING PLANT

The plant was commissioned in July, 1967, and provides cast iron balls used in grinding ore at Mt. Isa.

The manufacturing process consists of melting scrap iron and steel in a hot blast cupola equipped with special high temperature heat exchangers.

The molten cast iron is fed to an automatic casting wheel on which the balls are cast in batches. After casting, each batch of balls is ejected on to a conveyor for removal to the stockpile. The casting fins are subsequently stripped from the balls in a rumbler, and the balls are then ready to be railed to Mt. Isa.

The balls are made in different sizes for different grinding requirements, and vary from three-inch diameter, and larger, for primary grinding down to one and a half-inch for final grinding.

Mt. Isa Mines Ltd. uses several thousand tons of these balls each year in its operations.

NORTHERN DIVISION

June, 1968

COAL DEPOSITS OF CENTRAL QUEENSLAND

In terms of tonnages and value of production, coal is becoming by far the most important mineral in Central Queensland. As the demand for high quality coking coal by the Japanese continues to increase, it is likely to retain its dominant position into the foreseeable future.

Very large deposits of coal exist in the Rockhampton and Central Western Statistical Divisions, in the Bowen Basin. Coal seams are widely distributed in the Permian sediments of these Divisions; stretching from Collinsville, in the Townsville Statistical Division in the north, to Theodore in the south.

As will be seen in the following pages where the different coal bearing areas are briefly discussed, the areas themselves are very extensive and nearly every type of black coal is present. The emphasis and exploration effort has been directed mainly towards delineating coking coal in the Bowen Basin for export to Japan. The coal reserves so far delineated are large but much investigation work remains to be done. Exploration activity is increasing.

The area has been compared in importance to the iron resources of the Pilbara region of Western Australia.

The operating mines, and probably many of the future ones, depend largely on the Japanese market for their existence. This dependence on the Japanese market could have far-reaching effects should the Japanese steel industry suffer any recession.

Some people are also worried that this dependence on the Japanese market may enable the Japanese to unduly lower the price for coal.

The Japanese Ministry of International Trade and Industry (MITI) is predicting a world shortage of coking coal by the mid-seventies.[1] Japan's entire coking coal requirements, in the 1966 Japanese financial year (April, 1966 to March, 1967), were about 27 million tons. Domestic production provided 12 million tons. By 1975, MITI forecasts demand will reach 41.8 million tons of which domestic production will supply only 11 million tons. Of the 31 million tons Japan will need to import only 21 million has

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(1) Australian Financial Review, February 28th, 1968.

so far been contracted for. As there are apparently only limited possibilities for production expansion in Canada and the U.S.A. this expected future demand may provide markets for the more recently discovered deposits now under investigation.

The coal reserves as well as being important in terms of exports should also become increasingly important in Queensland power generation and industry. Some may in the future be used as a source of petroleum and chemicals. Without the coal deposits, the increasing industrial development of the area would probably be impossible or at least heavily handicapped.

Commercial production is now taking place in the Baralaba, Blackwater, Blair Athol, Callide and Kianga-Moura regions and other new fields are expected to come into production soon.

Work undertaken by the Queensland Department of Mines and by prospecting companies has shown that the deposits are extensive and contain a wide variety of coal types. In a number of cases drilling programmes have shown that unexpected coal types exist in particular areas. At Blackwater, for instance, where the Department of Mines had been looking for steaming coals, the bulk of the reserves uncovered have been coking types. In other areas where coking coal had been sought substantial reserves of steaming coal had been found.

In order to speed up the mapping and evaluation of the Central Queensland coal deposits the Queensland Department of Mines is putting seven or eight drilling crews into the area. Two crews will be located at Moura, two at Blackwater, two at Theodore and one between Nebo and Collinsville.

Historical

Coal was first recorded in the central Bowen Basin by Leichhardt in 1845; when he noted that coal outcropped along the banks of the Mackenzie River.

Several shafts were sunk, and tunnels driven in the Tolmies area before 1895. For a few years after 1900, a seam up to twenty-four feet thick (the Mammoth seam) was prospected near Jellinbah Homestead. Later this seam was traced south towards the Central Railway. The Mount Morgan Gold Mining Company sank several shafts between Jellinbah and Blackwater. These shafts produced little coal because the quality of the coal and distance from transport made the coal uneconomic compared to coal from other sources. The Mount Morgan Gold Mining Company eventually obtained coal from Baralaba.

There was some prospecting for coal west of Duaringa between 1900 and 1910. One seam was opened up but the coal was too soft and friable to transport. Several seams were later located, up to ten feet thick, but were generally steeply dipping, anthracitic coal. During this time, several seams up to seven feet thick were found five miles north-east of Bluff. Coal was discovered cropping out in Duckworth Creek, near Bluff, in 1903.

Baralaba

Production commenced at the field in 1921 when the State opened a mine. Production from this mine which operated until 1928 totalled 215,000 tons. The Dawson Valley colliery, a subsidiary of Mount Morgan Ltd., commenced production in 1922. Except for the period 1929-1932 coal has been mined continuously. The production from this underground colliery during 1966 was 40,841 tons. The coal is a soft, low-volatile, non-coking type which ranges in rank from a semi-anthracite in the south to a semi-bituminous coal in the north. A representative approximate analysis is: moisture 1.5 per cent; volatile hydrocarbons 11.9 per cent; fixed carbon 74.1 per cent; and ash 12.5 per cent. Reid (1) estimated workable reserves to be of the order of 200 million tons, of which 93 million tons are probably contained in the Dunstan and Dawson seams ranging from 7 to 10 feet thick.

Blackwater Deposits

At Blackwater, 118 miles west of Rockhampton, it has been established that extensive deposits of coal, both coking and non-coking, exist. Reserves (2) have been published in 1964, as being 103 million tons measured, 200 million tons indicated and 500 million tons inferred.

Utah Construction and Mining Co. Ltd. has been granted a special coal mining lease over 33,457 acres in the Blackwater district. The Company has built a spur railway line, commissioned an open-cut mine and commenced exporting coking coal in early 1968 to Japan via Gladstone. Development costs are believed to have exceeded $16 million. The project is employing 150-170 men. The Company, under the terms of the lease, is to provide State power

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(1) Reid, J. H., 1945 - Baralaba coalfield. Qld. Govt. Min. J. 46 (530) 354-363.

(2) Energy Resources of Queensland and their use, Hetherington, C.R. 1964 P.5.

stations with steaming coal, mined with the coking coal, upon request, at cost. (1)

Utah's contract with Japanese steel interests is for the supply of 21.4 million tons of coking coal over the ten year period 1968 to 1977. The terms of the contract call for 0.7 million tons to be shipped in 1968, 1.5 million tons in 1969, and 2.4 million tons a year thereafter.

The contract price is reported to be $US10.07 for the first year, $US10.00 for the second and $US9.73 for the next three years. The price for the years 1973-77 is subject to negotiation.

Utah also has a very large Authority to Prospect stretching about 160 miles from Koala, in the north, to Comet Downs, in the south.

According to the Company, six coal beds in the new area run north from Blackwater for 200 miles and contain coal superior to that in the present Blackwater mine. It is estimated that 20 to 30 per cent could be mined by open-cut methods.

As well as developing coal prospects on its own, the Utah Development Company has also formed a partnership with the Japanese firm of Mitsubishi Shoji Kaishi, registered as Central Queensland Coal Associates, to examine the export potential of these large deposits of high grade coal.

The cost of developing the new area is estimated to be between $80 and $100 million.

The main deposits are located at Goonyella (79.8 million tons); Saraja (83 million tons); Peak Downs Highway (386 million tons); Barwon (62 million tons); Norwich (290 million tons); and German Creek (145 million tons).

Utah Company officials are reported to have suggested that the Goonyella district would be the most favourable site for early development.

Proposals include the opening-up of one or more of the new coal seams; the building of a new railway line north of the Central Western line; and the establishment of a new export port to enable bulk carriers of 70,000 to 100,000 tons to carry up to 4 million tons of coal a year to Japan by 1971. However it is understood that no formal offer for an export contract will be made before the end of 1968.

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(1) Queensland Government Mining Journal - September, 1966, P. 423.

Possible port sites are Bowen, Hay Point (near Mackay), and Akens Island (near Sabina Point in Shoalwater Bay). Rail distances from a chosen point on the new fields were estimated as follows: Bowen - over 200 miles; Hay Point - 122 miles; Akens Island - 155 miles.

Utah's preferred port site is the Hay Point area, and they estimate that a railway could be constructed in 18 months.

Other companies which are active in the Blackwater area include members of the Associated Group, the Bellambi Coal Co. Ltd. (a subsidiary of Consolidated Gold Fields (Australia) Ltd.); Broken Hill Pty. Co. Ltd.; C. Itoh and Co.; Clutha Development Pty.; Conzinc Riotinto of Australia; Kaiser Steel Corp.; Mt. Morgan Ltd.; Nittetsu Mining Co.; Pickands Mather and Co. International; and Thiess Holdings Ltd.

The Associated Group which is composed of Associated Australian Oilfields N.L., Associated Freney Oil Fields N.L., Papuan Apinaipi Petroleum Co. Ltd., Sleigh Exploration Ltd., Associated Continental Petroleum Ltd., and Interstate Oil Ltd., has been active in the Bluff area, and their drilling programme has indicated substantial tonnages of good quality hard coking coal in five seams. These seams range in thickness from six to 20 feet, at depths of 60 to 300 feet below the surface. Reserves are estimated to be about 100 million tons. The coal is said to contain 15 to 16 per cent of volatiles, increasing to 17 per cent as the beds run northeast. Conzinc Riotinto of Australia, Kaiser Steel Corporation of U.S.A. and Pickands Mather and Co. International are carrying out a two year feasibility study with an option to develop the deposits. Should the option be exercised the Associated Group will receive about 10% royalty.

The coal deposits being investigated by the consortium are from only one of the five prospects held by the Associated Group. These prospects are: 86 square miles north east of Bluff, 33 square miles south of Theodore, 17 square miles taking in the area around Bluff, 244 square miles in the Banwon Park area, and 12 square miles north of Bluff.

The Associated Group, with Marubeni-Ida, is investigating a major deposit of anthracite at Dingo North. Investigations are believed to have established, to date, reserves of 20 million tons. The deposits are workable by open-cut methods as 25 per cent of the deposit is within 130 feet of the surface.

The Group has two large deposits of steaming coal in the area south of Theodore whose reserves total more than 200 million tons, 50 million tons of which are suitable for open-cut extraction.

The Bellambi Coal Co. Ltd. has prospecting authorities covering two areas, viz., some 1,434 square miles in the Comet area, and 14 square miles north-east of Blackwater. To date, no authoritative information on the results of Bellambi's exploration programme has been published.

Broken Hill Pty. Co. Ltd. has a 70 square mile prospect, one mile east of Blackwater. The company has stated that years of test drilling would be necessary to prove the deposits. Reports to date indicate the presence of high grade coking coals, with a high percentage of carbon. On the debit side, it is believed that the coal may be too deep to be worked by open-cut methods.

Geologists from the Japanese firms of C. Itoh and Company and the Nittetsu Mining Company have been working on an authority to prospect, held by Hall, Ralph and Associates Pty. Ltd. This prospect, is of 302 square miles near Mt. Stuart. The area extends about 12 miles north of Blackwater, and includes Mt. Stuart and Lake Como.

Clutha Development Pty. Ltd., which is owned by the D. K. Ludwig group of the United States, has two leases. One is an area of 167 square miles between the central railway line and Rockland Creek; the other, of 385 square miles, from Rockland Creek to north of Plane Creek. At Sirius Creek where the Company's main development is taking place the estimated reserves are said to be about 400 million tons, of which 150 to 200 million tons are recoverable. It is almost certain that Clutha will have to resort to underground mining. This will mean that freight costs must be kept to a minimum for prices to be competitive with those of other Queensland suppliers using open-cut methods. For this reason the round about route to Gladstone via Rockhampton does not appeal to the company. Clutha has suggested to the Queensland Government that it be allowed to build its own railway link to the coast; but this suggestion has not had a favourable reception.

The Company plans to develop three different collieries on its deposits, each with an annual mining capacity of 1.8 million tons of raw coal. In the initial stages, two million tons a year would be shipped,

building up eventually to five million tons a year. Reports indicate that Clutha is interested in shipping its coal through Port Clinton or through Sabina Point. The cost of dredging at Sabina Point is said to be less, and it has the advantage of being closer to the coalfield.

Mt. Morgan Mining and Industrial Pty Ltd has a prospecting authority of 730 square miles, from North Dingo to Baralaba.

Blair Athol

The Blair Athol field, jointly worked by Blair Athol Open-Cut Collieries Ltd. and Blair Athol Coal and Timber Co. Ltd., is west of the main coal areas which have been the scene of the recent upsurge in exploration activity.

The two companies are the object of a take-over bid by Conzinc Rio-tinto of Australia. The D. K. Ludwig group of the U.S.A. already has 17% shareholding in both companies.

Due to the lack of demand for large tonnages of steaming coal production has remained rather small. The Blair Athol companies do supply coal to various local power stations and industrial plants, however, they have been unable to enter the export trade because of the high cost of railing the coal to the coast.

Developments may change this situation. The Utah group and Clutha Development are both developing large coking coal deposits, between Blair Athol and the coast, and both are investigating the possibility of their own railway lines and ports. It may be mutually advantageous to link Blair Athol to one of these railways, should they eventuate. This would reduce transport costs from Blair Athol making the coal more competitive on export markets.

There is a slight possibility that a power station will be built at Blair Athol to supply Central Queensland and this would supply a ready market for the coal.

Mr. Camm, the Queensland Minister for Mines, stated in November, 1967[1] that currently there were two possible uses for Blair Athol coal - the manufacture of petroleum and the manufacture of chemicals. He said that recent

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(1) Queensland Govt. Mining Journal No. 793, November, 1967, p. 493.

work in the United States has given every indication that it will shortly be possible to build installations which can economically convert coal into petroleum.

The Blair Athol deposit because of the size of the seams and the low overburden ratio can be mined cheaper than any other coal in Australia. The Big Seam has a maximum thickness of 110 feet, but is mainly between 70 and 80 feet, with an overburden ratio of 1:1 or less. This makes it one of the thickest seams in the world. The coal is high volatile, bituminous, non-coking. The reserves in the Big Seam are 222 million tons measured and 44 million tons indicated. There is a further 16,500,000 tons in seams above and below the Big Seam.

Bluff (also see page 5)

Four collieries have operated in the Bluff area, 100 miles west of Rockhampton; all four collieries have ceased production. The Bluff Colliery operated from 1905 to 1925, Windsor Colliery from 1933 to 1957; Excel Colliery from 1939 to 1965, and Cambria Colliery from 1926 to 1966. At the time of its closure the Cambria Colliery was working a twelve foot thick seam, and the Excel a six foot thick seam. The two seams are separated by about 140 feet of shale, siltstone and sandstone. The coal in this area is of a low volatile, bituminous and weakly coking nature and occurs in three strongly folded and complexly faulted seams. In 1940 tests were made, and measured and indicated reserves were estimated at 58 million tons, with additional large inferred reserves. Production ceased in April, 1966, because of reduced railway orders.

Callide deposits

Thiess Holdings Ltd. operate the Callide mine which supplies steaming coal to the Callide power station. The latest available figures show non-coking reserves in the Callide field as 193 million tons [1] of which open-cut reserves comprise approximately 93 million tons. The coal is Triassic in age.

Kianga-Moura

The Thiess-Peabody-Mitsui consortium have an open-cut mine at Kianga and an open-cut as well as an underground mine at Moura.

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(1) Queensland Government Mining Journal Year Book, Nov. 1967.

The consortium commenced operations at Kianga in October, 1959, producing soft coking coal for export to Japan. Some 270,500 tons were produced by mid-1962 when operations were suspended and the consortium concentrated on mining hard coking coal from Moura.

The open-cut at Moura was commenced in July, 1961. In October, 1963, the underground mine was opened and since then the open-cut and underground mine have operated simultaneously.

No recent reserve figures have been published. The latest published Company reserves of open-cut material for Kianga is 39 million tons measured and 39 million tons of measured open-cut reserves for Moura. Hetherington (1) reported the measured, indicated and inferred reserves of both Kianga and Moura as having been reported at 1,450 million tons, 50% being extractable.

Production from Moura was in the 3 half-year periods

		1966		1967
		Jan.-June	July-Dec.	Jan.-June
Moura - open-cut	'000 tons	629	650	588
Moura - underground	'000 tons	218	242	255

The Thiess-Peabody-Mitsui consortium has contracts for the supply of 45 million tons of coking coal to Japanese steel mills between 1968 and 1978. These call for the supply of 3 million tons in 1968, increasing to 5 million tons from 1970 onwards. From April, 1968, in order to meet shipping schedules, production will rise from the present 7,000 tons per day to 20,000 tons per day. At present 450 men are employed, including 135 underground miners.

In addition to export contracts, the consortium supply 250,000 tons of coal per annum to Queensland Alumina's plant at Gladstone. As the Alumina plant's capacity is increased so will the coal consumption which may mean extra orders for the consortium.

The Queensland Government has recently completed a direct railway line from Gladstone to Moura to facilitate coal exports and the consortium has constructed a 2,000 tons per hour coal loader at Barney's Point, Gladstone.

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(1) Energy Resources of Queensland, Hetherington, C.R., 1964.

Thiess Holdings, either alone or in association with other companies, also hold a number of prospecting authorities in the region, including 192 square miles south of Blackwater. Authorities to prospect issued in the name of Thiess-Peabody cover 253½ square miles around Kianga-Moura and Thiess-Peabody-Mitsui have 6½ square miles north of Theodore. Thiess Holdings Ltd have 84 square miles adjoining the Moura open-cut, 115 and 25 square miles south of Baralaba and 42 square miles east of Theodore.

The Associated group and Thiess, which have adjoining areas, have made a joint submission to the Queensland electricity authorities offering to supply steaming coal for a possible future 1,000 megawatt power station at Theodore.

Waterpark Creek

The Waterpark Creek field, 35 miles north-north-east of Rockhampton, contains coal of moderate quality but it is unsuitable for open-cut mining. Present conditions make this deposit uneconomic.

Styx

Coal was first discovered in the Styx River area in 1887, 80 miles north of Rockhampton, but it was not until 1918 that a shaft was sunk by the Queensland Government at Bowman to exploit a promising seam previously located by diamond drilling. Production commenced at this mine, known as Styx No. 1 State Colliery, Bowman, in the following year. Because of the unsuitability of the first site, a second shaft Styx No. 2 State Colliery, was sunk ten chains to the south. The mines at Bowman were abandoned, in 1925, in favour of a third pit commenced, in 1923, at Ogmore, two and a half miles to the north. This mine was worked for two years as Hartley State Colliery, and then continued to the present, on the one seam, as Styx No. 3 State Colliery, Ogmore. Private enterprise entered the field in 1930, when the Bowman Coal Mining Syndicate opened up a colliery adjacent to the old State Mine at Bowman. Production at Bowman from 1919 to 1948, when production ceased, was 170,467 tons and at Ogmore from 1924 to 1961 was 1,556,251 tons. Production ceased at Ogmore in 1964. The coal was of a high volatile, bituminous, non- or weakly coking variety.

Between 1948 and 1951 the Queensland Mines Department tested an area near Tooloombah Creek, by diamond drilling. Three seams, each with a minimum thickness of three feet, were found. The drilling proved reserves of four million tons of coal, of which approximately half was in seams over

four feet thick. These reserves are unlikely to support any future re-development programme.

This area is one of the few areas containing Cretaceous coal in Australia.

St. Lawrence

The occurrence of coal in the St. Lawrence area was known before 1889. The Broadsound Coal Company pursued a vigorous prospecting campaign between 1889 and 1891. Seven bore holes and at least five shafts were put down in the vicinity of St. Lawrence. They were successful in locating coal within one-quarter of a mile of the wharf at Newport, on Waverley Creek, about three and a half miles south-east of St. Lawrence. However, an influx of water in June 1891 forced closure of the mine and no production is recorded.

Rangal

A colliery operated at Rangal from 1923 to 1940; about 140,000 tons of coal were produced from a ten foot thick seam.

Other Localities

Coal has also been reported from a number of other localities in Central Queensland but, in most cases, the deposits are too small or too fragmented to be of economic importance.

In the Injune area, coal has been worked from seams in the Injune Creek Beds. But these deposits are not being worked at present. Coal is known to occur in the Blackwater Group, the Boxvale Sandstone Member, and probably the Hutton Sandstone, but no workable deposits have yet been found in these units.

Coal has been reported from various Permo-carboniferous and Triassic Formations in the Springsure area. Three seams of bituminous coal, up to 15 feet thick, occur in the upper Bandanna Formation along Cormelo Creek.

There have also been reports of coal from several bores and wells in the Winton Formation, near Winton. In the Winton No. 2 Town Bore, "black coal" was reported between 198 and 314 feet. This area would warrant detailed testing if any coal consuming industry was contemplated in the region.

In the Far Western Division, coal and lignite have been reported from the logs of some water bores.

In the Lit. Whelan area, Dunstan [1] refers to brown coal up to six feet thick in bores on Sandringham Station. The beds are thought to be of only local extent, and contain a lot of pyrite.

Coal is reported to occur in thin bands in the Longsight Sandstones in the Springvale area.

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(1) DUNSTAN, B., 1920: North-western Queensland. Geological notes on the Cloncurry-Camooweal-Burketown-Boulia area. Geol. Surv. Qld. Publ. 265

NATIONAL WATER RESOURCES DEVELOPMENT PROGRAMME

NOTES ON

EMERALD IRRIGATION PROJECT

QUEENSLAND

MAY 1968

Water, Power & Geographic Branch
DEPARTMENT OF NATIONAL DEVELOPMENT
CANBERRA

NOTES ON EMERALD IRRIGATION PROJECT

1. INTRODUCTION

The possibility of extensive irrigation development in the Emerald area, based on a water storage at the Nogoa Gap site has been under consideration by Queensland authorities for a considerable time.

For many years both State and Commonwealth departments have been engaged in studies on technical and economic aspects of the Emerald Project, and in 1966 the Queensland Government requested Commonwealth financial assistance for it. When the National Water Resources Development Programme was announced the Queensland Government then submitted this project as its number one choice for inclusion under the Programme.

The Queensland Irrigation and Water Supply Commission established two pilot farms of about 500-600 acres each in order to test the suitability of the area for continued irrigation and to gauge the profitability of certain farming programmes under commercial conditions. One pilot farm was established on the left bank of the Nogoa River in December 1965. It comprises uniform cracking clay soils which are considered to be suitable for irrigated agriculture. The other, on which the first crop was planted in October 1966, is on the right bank and contains areas of nearly all the soil types found within the proposed irrigation area, on which further experience is considered desirable.

2. OUTLINE OF THE SCHEME

(a) Water Resources

The project is based on a proposed earth-fill storage dam on the Nogoa River at a site known as Nogoa Gap about

12 miles upstream from Emerald.

The catchment area of 6,300 square miles has a mean annual rainfall averaging approximately 25 inches. Stream flow records at Emerald, with a catchment area only 172 square miles greater than at the Dam site, are available since 1919, and provide a satisfactory basis for assessing the hydrology. Over the period of record the mean annual discharge has been almost 450,000 acre feet, equivalent to a runoff of 1.35 inches over the catchment area. River discharge has, however, been extremely variable, ranging between nearly 3 million acre feet in 1955-56 and 8,000 acre feet in 1963/64.

To provide adequate regulation, a rather large storage of 1.17 million acre feet is proposed, of which 170,000 acre feet is regarded as dead storage to allow for possible siltation. The maximum height of embankment will be 148 feet above stream bed level.

The normal yield of the reservoir has been calculated as 120,000 acre feet per annum, but restrictions may occasionally be necessary in extended dry periods.

As a result of the large surface area of the storage, about 85,000 acres at full supply level, and the relatively high evaporation rate, evaporation losses from the reservoir are estimated to be of the order of 90,000 acre feet per annum. Hence this project would benefit greatly from the development of economic techniques for evaporation control.

(b) Soils

There are areas of texture contrast soils, which can be defined as soils which have sandy or loamy surface

horizons and abrupt changes to clay subsoils - this could occur at depths varying from 2" to 24". There are at present a number of questions to be answered regarding the behaviour of these soils under intensive irrigation. The least attractive of these soils have now been eliminated from the proposed project area.

There are large areas of cracking and non-cracking clays of uniform texture which are considered to be suitable for intensive irrigation. It is on these soils that the high cotton yields and high lucerne yields have been obtained in the Emerald district.

Gradational soils (red deep sandy) also occur in the proposed irrigation area. As the development of the irrigation project proceeds, it is considered that these soils will be admirably suited for the growing of lucerne and horticultural crops.

Texture-contrast and gradational soils comprise only a small proportion of the area to be developed for irrigation, in the project as amended after Commonwealth/State discussions.

The area suggested for irrigation conforms with the general pattern of suitability as indicated in soils investigations conducted by the Queensland Department of Primary Industries and confirmed by Commonwealth Authorities and totals about 60,000 acres.

(c) Number and Size of Farms

The number of farms envisaged is 130, each having about 450 acres of irrigable land. They will be situated on both banks of the Nogoa River. In determining the number and size of the farms consideration has been given to the desirability of excluding any large areas of texture-contrast

soils on individual farms. Based on yields being obtained on the pilot farms and estimated returns in the farm budgets the size of the farms appears adequate. Holdings will be held on a permanent tenure and the Queensland Government proposes to charge the settlers $3.50 per acre foot of water used.

Roads

The proposed irrigation area is particularly well served by many miles of bitumen surfaced highways - Emerald to Comet, Emerald to Anakie and Emerald to Springsure - which provide an excellent arterial system completely traversing the area.

In order to provide access for future settlers there will be a need for the development of a new minor road system linked to the existing one. This network will be constructed to a gravelled standard in the early stages of the project to provide access for the construction of irrigation, drainage and other works.

Once the allotment of farms has taken place these roads will become the responsibility of the Local Authority for future development and maintenance.

Cost Estimates

The estimated cost of the headworks is $18.7 million, and of the reticulation and drainage works $8.0 million. The Snowy Mountains Authority is co-operating with the Queensland Government in the final design of the headworks.

3. AGRICULTURAL PROPOSALS

The Emerald Irrigation area will be suitable for the production of a wide range of crops and pastures. Apart from the experience over the past three seasons on the two pilot farms, information is available on a range of crops and pastures from other irrigation areas of similar climate in Central Queensland, particularly the Biloela, Theodore and Moura areas.

Another factor which could be of importance is the location of the irrigation area in relation to the very large beef cattle and sheep industries of central Queensland. In the future the production of forage crops such as lucerne and to a lesser extent grain crops could be of great benefit to these pastoral industries. There is also the possibility that irrigated pastures could be used either for fattening of store cattle from the region or for fat lamb production.

Cotton: Cotton has been grown for many years in Central Queensland as a non-irrigated crop. In recent years it has been grown successfully under irrigation in the Biloela, Theodore and Moura areas. It has been grown for three seasons on Pilot Farm No. 1 and for two seasons on Pilot Farm No. 2.

A high proportion of the irrigable area should be suitable for cotton growing. Cotton is a crop which requires a high standard of management, large capital outlay for machinery and high operating costs for items such as fertilisers, pesticides etc. However, it is considered that this crop could be produced profitably on the basis of expected export prices.

Sorghum: Improved export markets for sorghum, particularly in Japan, and data on irrigated production from other areas indicate that sorghum growing could be a suitable enterprise in the Emerald Irrigation area. The climate is ideal for this crop and a great proportion of the irrigable soils would be suitable. Although it is subject to some disease and insect pests, it does not require as high a standard of management and as operating costs are lower than for cotton, it could give comparable net returns to farmers.

The possibilities of growing ratoon grain sorghum crops are being investigated.

Wheat: Although present varieties of wheat are not ideally suited to the Emerald environment, data from Pilot Farm No. 1 suggests that profitable yields should be attainable. Net returns per acre at yields recorded so far on the pilot farms are modest; however, wheat could have a place in farm programmes because it has relatively low water requirements and does not require high capital outlay or high operating costs.

Lucerne: Two farmers in the Emerald area are already growing lucerne successfully under irrigation with yields reported at 10 tons per acre. Similar yields are also reported under irrigation in the Biloela area of Central Queensland. To attain yields of this order a high standard of management is required throughout the whole year. Lucerne production also requires heavy capital investment in land development, irrigation layout, plant and machinery and storage facilities. Development of lucerne growing on a large scale in the irrigation area would be dependent on the adoption by Central Queensland graziers of

management practices which incorporate supplementary feeding of breeders and/or young stock.

Lucerne production in the Emerald area to date has been on alluvial soils of uniform texture. Further information would be needed to establish whether it can be grown satisfactorily on some of the other soil types in the irrigation area.

Pastures: To date no information on irrigated pastures is available specifically for the Emerald area. However, Queensland authorities draw attention to the results obtained at the Theodore Irrigation Research Station and at the Parada Irrigation Research Station near Mareeba in North Queensland.

At the Theodore Station, stocking rates of 10 ewes with lambs per acre have been obtained on irrigated legume-grass pastures. At Parada, irrigated Pangola grass pastures fertilised with 300 lb. of Nitrogen per year, grazed by beef cattle, have given production of 900 lb. of carcase beef per acre per year. The soils at the Parada station are rather similar to the texture-contrast soils in the Emerald area which are currently being investigated for use under irrigation.

It appears reasonable to expect that further research in the Emerald area will establish techniques of irrigated pasture management to give results comparable to those at Theodore and Parada.

Other Crops: Other crops which could prove suitable for production in the area under irrigation are safflower, maize, soya-bean and linseed.

Pilot Farm Results

The results from Pilot Farm 1 are as follows:

Season	Crop	Area (acres)	Yield (per acre)
1965/66	Cotton	58	2,400 lb. seed cotton (888 lb. lint)
	Wheat	15	53 bushels
1966/67	Cotton	74	3,358 lb. seed cotton (1,242 lb. lint)
	Sorghum	54	83 bushels
	Maize	11	54 bushels
1967/68(a)	Wheat	80	39 bushels

Results from Pilot Farm 2 are as follows:

1966/67	Cotton	62	2,496 lb. seed cotton (924 lb. lint)
	Sorghum	63	48 bushels
	Maize	15	18 bushels
1967/68(a)	Wheat	46	30 bushels

(a) Results of the 1967/68 summer crops are not yet to hand.

The area cropped on Pilot Farm 1 comprises uniform cracking clay soils considered suitable for irrigated agriculture. On Pilot Farm 2 the areas sown to the three crops covered both texture contrast soils and the more suitable soils of uniform texture.

4. RELATIONSHIP OF PROJECT TO PASTORAL INDUSTRY.

Central Queensland, comprising the Statistical Divisions of Rockhampton, Central West and Far West, contains 33% of the State's sheep population and 34% of its beef cattle population. During the 1965/66 drought the sheep population

of 8.1 million was reduced by death and forced sales by about 2 million. Queensland authorities value the loss to the grazing industry caused by this drought due to stock losses and a lower level of production at $27 million.

The Queensland Government Drought Mitigation Committee quotes drought incidence in Central Queensland as being one year in three with a need of some level of drought feeding for a period of 200 days each drought year.

Grain sorghum or wheat has been available in Central Queensland during favourable seasons for any grazier desirous of building up drought reserves at prices below those prevailing during drought. There is no reason to believe that the grazier's desire or the economics of maintaining drought grain reserves will alter with the implementation of the irrigation project.

However, provided that not too large a proportion of the output from the irrigation area is contracted for prior sale, the production of substantial quantities of grain would mean that drought fodder is available close to where it is required, and it may be expected that the lessons of the recent drought will lead to an increase in demand for all types of fodder.

However, in the long term, there may be greater significance in the growing interest by graziers in the practice of supplementary feeding on a routine basis. Queensland authorities have stressed this potential as a means of overcoming nutritional deficiencies in natural pastures at critical times of the year. The economics of supplementary feeding, and graziers' acceptance of this management practice will determine

what contribution the Emerald Project will make toward an upgrading of stock management in Central Queensland.

9th May, 1968

Department of National Development
Canberra.