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ASSESSMENT OF ENGINEERING GEOLOGICAL PROBLEMS FOR CONZINC RIOTINTO OF AUSTRALIA LIMITED, BOUGAINVILLE ISLAND. T.P.N.G. 1967.

by

J.R.L. Read

The information contained in this report has been obtained by the Department of National Development, as part of the policy of the Commonwealth Government, to assist in the exploration and development of mineral resources. It may not be published in any form or used in a company prospectus without the permission in writing of the Director, Bureau of Mineral Resources, Geology and Geophysics.

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ASSESSMENT OF ENGINEERING GEOLOGICAL PROBLEMS FOR CONZINC RIOTINTO OF AUSTRALIA LIMITED, BOUGAINVILLE ISLAND, T.P.N.G., 1967

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Plate 1: C.R.A., Bougainville Island. Map showing location of orebody and possible locations of associated works.
Scale 1 inch:2.5 miles

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SUMMARY

An inspection, to assess the nature and extent of the engineering geological problems associated with the development of the mining lease at Panguna Flat, Bougainville Island, was carried out in early March, 1967. The lease is held by Conzinc Riotinto of Australia Limited.

It is concluded that a detailed investigation of all areas likely to be involved in mining and engineering works would be needed, to determine the distribution, classification and strength of the various rocks present, and to ascertain the nature and distribution of persistent weak zones. An analysis of the regional hydrological conditions, for design of drainage, and an evaluation of the relative merits of alternative road alignments and port sites, will also be necessary.

The employment of two engineering geologists and a soils technician to carry out the work required, is also recommended.

INTRODUCTION

Following a request from the Head Office, in Melbourne, of Conzinc Riotinto of Australia Limited to the Bureau of Mineral Resources, for assistance in the study of engineering geology problems being encountered in the development of the company's mining lease at Panguna Flat, Bouginaville Island, Territory of New Guinea, a visit was made to Panguna Flat during the week February 27th to March 3rd, 1967. The locality under development was inspected and the nature and extent of the engineering geology investigation required for the development of the planned scheme was assessed.

The orebody being investigated by Conzinc Riotinto of Australia Limited consists of mineralised microdiorite, granodiorite, quartz diorite and biotite diorite at Panguna Flat, near the headwaters of the Kawerong River and about 14 miles by air south-west of Kieta (Plate 1).

At present it is anticipated that mining of the orebody will be carried out by open cut methods. The cut is expected to have two main centres, one on Panguna Ridge midway between Panguna Creek and Pankiranku Creek, and the other between Pankiranku Creek and Barapinang Creek. The bottom of the cut will probably be formed at about R.L. 1200 feet, which is about 800 to 1000 feet

below the ground level at Panguna Flat. It is planned that the ore be milled and concentrated to 30% copper at a plant located at, or near, the cut before it is transported by road to wharfing facilities on either the east or west coast for shipment overseas.

INVESTIGATIONS REQUIRED

A detailed engineering geological investigation of all aspects of the engineering works associated with the recovery of the copper ore will be required before any firm design proposals can be put forward. The nature of the investigation required is as follows:

OPEN-CUT MINE

The investigation for the open-cut mine should include a programme to determine the engineering properties of the material to be excavated and ways of providing drainage for the cut.

Design of Cut. In order to determine the most feasible design for the open cut it will be necessary to classify by engineering criteria, and determine the distribution, of soil and rock throughout the mine area. The programme should include a determination of the strengths of the rock and soil, the nature of the joints and fractures in the rock and their effect on the rock, and locate any faulted or persistent weak zones within the mining area.

Such a programme will be facilitated by the mapping and drilling programme at present under way at the site but will require selection of additional soil and rock samples for strength testing and further drilling for purely engineering design purposes around the likely perimeter of the cut.

Drainage. Two aspects will require investigation; they are:

(i) the provision of drainage around the perimeter of the cut principally involving the diversion of Panguna and Pankiranku Creeks into the Kawerong River. The investigation will necessitate the calculation of rainfall run-off and stream flow quantities for the immediate catchement area, and detailed geological mapping and survey levelling along the proposed diversion routes.

(ii) drainage of the open-cut. If the cut is mined to the planned depth the lower 600 feet of the cut could not be drained by gravity directly into the Kawerong River. Water will therefore have to be pumped from the cut or drained through large-diameter, lined boreholes to a tunnel beneath the cut. Estimates of the pattern and intensity of groundwater flow will have to be carried out from regular observations of groundwater level and flow, and water pressure testing, in diamond drill holes. If the estimated flow appears to be too great to be handled by pumping the investigation programme will have to be extended to examine the geological feasibility and cost of constructing a drainage tunnel which could release the water into the Pine, Bava, Kawerong or Toyo River systems (tunnel lines 1, 2 and 3, Plate 1). Information required would include the expected mining conditions and requirements for support and lining along the proposed tunnel routes.

ORE TREATMENT SITES

Sites are required for the crushing and milling plants. Three areas, shown as sites A, B and C in Plate 1, have been considered. Choice of a site depends rather more on the overall planning of the scheme than on geological features; at present site C appears to be preferred. However, regardless of the site finally chosen detailed geological mapping, sampling and testing to determine the extent and depth of overburden and strength and suitability of the foundation materials for construction purposes will be required.

WASTE DISPOSAL AREAS

Disposal areas are required for an estimated 220 million cubic yards of waste material. Three sites, areas A1, B1 and C1 on Plate 1, have been considered. B1 and C1 in coastal lowland areas and A1 is in the upper part of the Kawerong River valley.

Investigations will have to be carried out to determine the geological suitability of each site, the likely effect of the tailings on the drainage system of the surrounding area and the chemical and mechanical stability of the tailings dumps.

Special problems will be encountered with area A1. The present proposal is to divert the Kawerong River under the tailings through a pipeline or culvert. A possible alternative to this is to completely divert water from the valley through tunnel line 3 into the Toyo River or possibly through tunnel lines 1 or 2 into the Pine or Bava Rivers; tunnel 3 could also be designed to connect with the drainage tunnel from the open-cut mining area. Investigations will be required to determine the suitability of the foundations and grade line for the pipeline in the Kawerong valley, the total water flow to be dealt with, and the effect of the tailings dumps on the stability of the valley slopes. Particular attention will also have to be paid to the stability of the tailings dumps under earthquake shock. If diversion by tunnel is considered mining conditions and requirements for support and lining along the tunnel route will have to be assessed.

ACCESS AND PORT FACILITIES

Access to the mining area will provide one of the major problems in the overall design of the scheme. Good, all-weather roads will be required to permit uninterrupted transport of heavy mining and milling equipment and stores into the site and of copper ore to the port. Present proposals include a road to the west coast via the Kawerong valley or combined road and tunnel routes, using tunnel lines 1 or 2, to the east coast via the Pine or Bava Rivers.

Present access is by helicopter or the recently completed access road over the main divide via the Pine River valley. This road has been constructed with an average grade of 20% in highly unstable country and is unsuitable for development into a primary access road without major reinvestigation and realignment.

An intensive programme of investigation is required to select a route to either the east or west coast. As many routes as possible will have to be selected on a grade basis (possibly maximum grade 12% minimum radius curve

150 feet), from aerial photographs for more detailed investigation. The choice of route will have to be based on geological factors - predominantly slope stability - and the volume of earthworks required.

The best wharf facilities can be developed on the east coast, and this may have some bearing on the siting of the access road; however, the site of the port and related facilities will probably be determined by the best road location rather than the reverse.

CONCLUSIONS

It is concluded that:

1. A detailed investigation is required to provide basic geological information for all engineering design proposals associated with the recovery of the copper ore.

2. The investigation should include detailed surface geological mapping, supplemented by test pitting, diamond drilling and seismic exploration to determine, for engineering purposes, the distribution, classification and strength of soil and rock types at all areas being considered for mining and ancilliary operations. It is estimated that diamond drilling for engineering purposes would require up to 10,000 feet of drilling.

3. The determination of the classification and strength of soil and rock types should include an analysis of the nature and distribution of all unstable surface areas, joints, fractures, faults and persistent weak zones.

4. Surface and subsurface hydrological conditions should be determined to permit an estimate to be made of the total volume of water that would have to be controlled by drainage and or pumping.

5. Initial location of access roads should be made from grade lines based on contour maps drawn from low level aerial photography. As many alternatives as possible should be proposed and only after this has been carried out should attempts be made to prove the alignments on the ground.

6. A study of the engineering geology of the alternative port sites would be useful in evaluating the suitability of each site and the relative costs of establishing ports at the various sites.

RECOMMENDATIONS

It is recommended that:

1. Owing to the amount of investigation required in the limited time available two engineering geologists be employed on the site immediately.

2. One engineering geologist be employed for the duration of the investigation. In addition to the daily field duties,he should plan and supervise the investigation and prepare and present an investigation report.

3. The second geologist be employed probably for a period of about 6 months, and be required to assist in the basic field mapping at the site of all proposed mining and engineering works.

4. A qualified soils technician be employed to assist the engineering geologists in the field sampling and testing of soil and rock samples required for strength testing.

5. Full laboratory facilities be provided, either in the field or through the services of a consultant agency, for the conduct of mechanical tests on soil and rock samples.

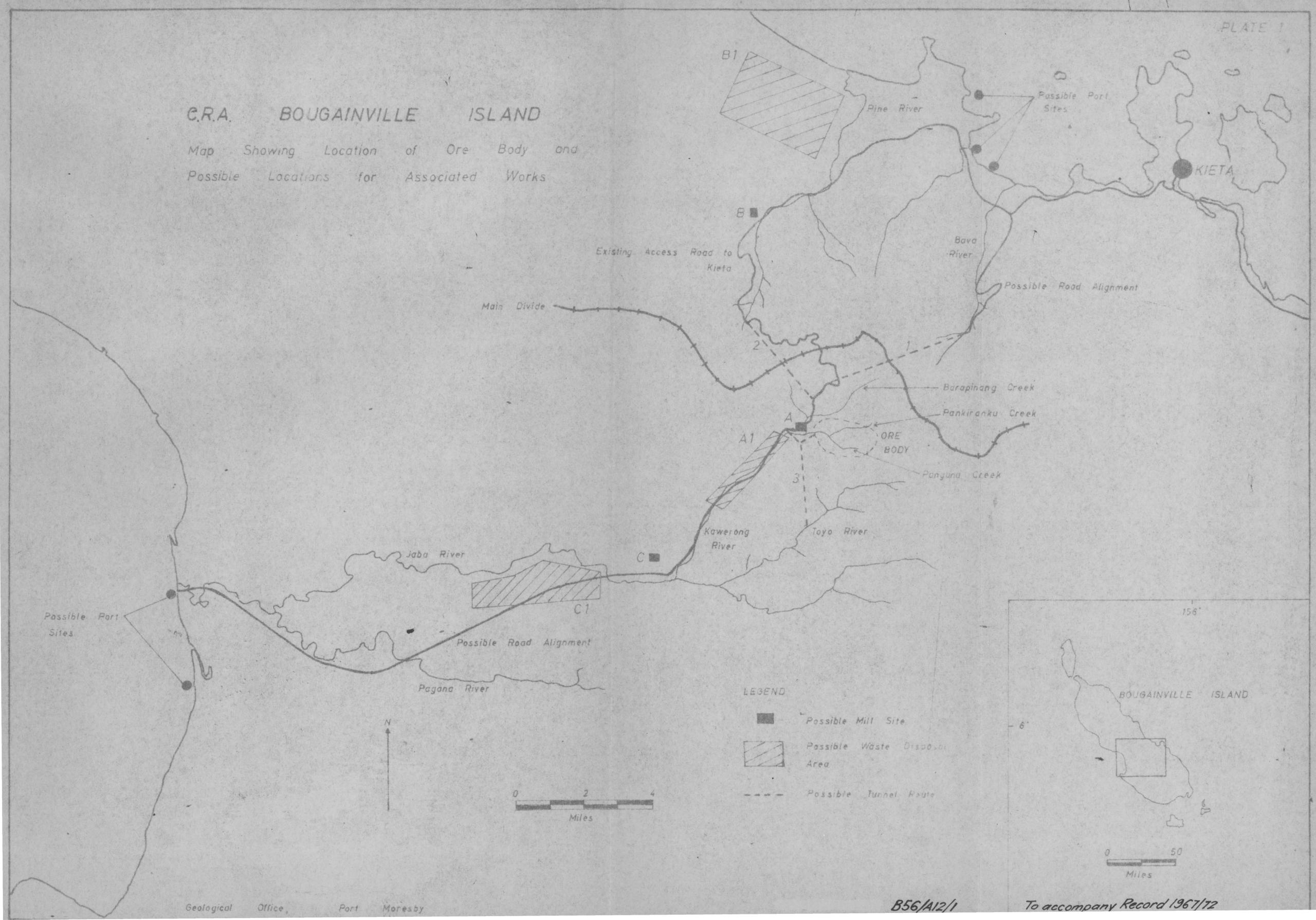
ACKNOWLEDGEMENT

The assistance of the company's Area Manager, at Kieta, by providing transport and accommodation, is gratefully acknowledged.

PLATE 1

C.R.A. BOUGAINVILLE ISLAND

Map Showing Location of Ore Body and Possible Locations for Associated Works



Geological Office, Port Moresby

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