

APPENDIX III

AGREEMENT BETWEEN GOVERNMENT
AND COMPANY FOR MINE OPERATION

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement).

GENERAL ANNOTATION.

ADMINISTRATION.

As at 13 February 1976 (the date of gazettal of the most comprehensive allocation of responsibilities to Ministers and Departments at about the effective date), the administration of this Chapter was vested in the Minister for Natural Resources, with the exception of Sections 3(1) and 5(1) of the Act, the administration of which was vested in the Prime Minister.

Accordingly, as at that date, unless a different intention is clearly indicated, by note or in the text, and except as noted above, references in and in relation to this Chapter to—

"the Minister"—should be read as references to the Minister for Natural Resources;

"the Departmental Head"—should be read as references to the Secretary for Natural Resources¹;

"the Department"—should be read as references to the Department of Natural Resources².

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¹ Previously the Director of Lands, Surveys and Mines.

² Previously the Department of Lands, Surveys and Mines.

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CHAPTER NO. 196.

Mining (Bougainville Copper Agreement) Act.

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INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement) Act.

Being an Act to provide for the approval and implementation of an agreement made on 6 June 1967 between the Administration of the former Territory of Papua and New Guinea and Bougainville Copper Pty. Limited, concerning the development of certain mineral deposits in Bougainville, as varied by a further agreement made on 21 November 1974 between the Government of Papua New Guinea and Bougainville Copper Limited, and for other purposes.

1. Interpretation.

In this Act, unless the contrary intention appears—

"the Agreement" means the agreement a copy of which is set out in Schedule 1, as varied by the agreement set out in Schedule 2, and where that agreement is further varied under Section 3 includes that agreement as so varied;

"the commencement date" means 30 November 1967 (being the date of commencement of the pre-Independence *Mining (Bougainville Copper Agreement) Act 1967*);

"the Company" means Bougainville Copper Limited, a company incorporated in Papua New Guinea and, subject to the provisions of the Agreement, includes its successors and assigns.

2. Approval of Agreement.

The Agreement is approved, and takes effect according to its tenor.

3. Variation of Agreement.

(1) The Agreement may be varied by a further agreement or agreements between the Prime Minister on behalf of the State, and the Company.

(2) A further agreement under Subsection (1) is of no force or effect until notice of its approval is published in the National Gazette by the Head of State, acting on advice.

(3) A notice under Subsection (2) shall be laid before the Parliament within 15 sitting days after the date of publication of the notice, together with a copy of the further agreement to which it relates.

(4) The Parliament may, by resolution passed at the meeting at which a notice under Subsection (2) is laid before it, or at the meeting next following that meeting, disallow the notice.

(5) If the Parliament passes a resolution disallowing a notice under Subsection (2), the approval ceases to have effect, but without prejudice to the validity of anything done or suffered in the meantime.

(6) Subject to Subsection (7), any purported variation to the Agreement, otherwise than in accordance with this section, is void.

(7) This section does not affect the operation of Clause 5, 19 or 20 of the Agreement.

4. Effect on and of other laws.

(1) Except as provided in Subsection (2), the Agreement has the force of law as if contained in this Act, and applies notwithstanding anything to the contrary in any other law.

(2) The provisions of Subsection (1) do not apply to or in relation to Clause 11(b), Clause 13(e) and Clause 14(a) of the Agreement.

(3) No pre-Independence law made after the commencement date, and no other law of Papua New Guinea, affects this Act or the Agreement—

(a) unless the contrary intention appears, expressly or by implication, in that law;
or

(b) except as provided by the Agreement.

(4) Except where the contrary intention appears, either expressly or by implication, in the Agreement, and subject to the preceding provisions of this section and to Section 5, all laws that are not inconsistent with this Act or the Agreement apply to and in relation to all acts, matters or things done or suffered under the Agreement.

5. Ancillary powers of the Prime Minister.

(1) Notwithstanding any other law, the Prime Minister has power, on behalf of the State, to make all grants, issues, renewals and extensions required by or under the Agreement to be made by the State, and is not bound in that regard by any provisions of any such law requiring or permitting any authority, consent, approval, report, recommendation, appeal, procedure or formality, or by any similar provision.

(2) The provisions of Clause 2(d) of the Agreement do not apply to or in relation to an amendment made to Subsection (1), or that was made to Section 7(1) of the pre-Independence *Mining (Bougainville Copper Agreement) Act 1967* after the commencement date, but no such amendment relieves the State of any of its obligations or liabilities under the Agreement.

6. Offences as to Company roads.

(1) A person who fails to obey a direction given by the Company or by a person authorized by the Company (whether by a traffic sign or traffic line or otherwise), under the powers conferred by Clause 14 of the Agreement is guilty of an offence.

Penalty: A fine not exceeding K100.00 or imprisonment for a term not exceeding 3 months.

(2) For the purposes of Subsection (1), "traffic line" and "traffic sign" have the same meaning and effect as in the *Motor Traffic Regulation*.

(3) It is a defence to a prosecution under this section for the defendant to prove that he honestly and reasonably believed that the direction given was not given by the Company or a person authorized by the Company.

7. Company port, etc.

(1) In this section—

"the Company port" has the same meaning as in Clause 11 of the Agreement;

"the Company's Port Manager" has the same meaning as in Clause 11 of the Agreement.

(2) Where the Company or the Company's Port Manager gives, in accordance with the powers conferred by Clause 11 of the Agreement, directions for regulating—

- (a) the time and manner in which any vessel shall enter into, depart from or lie in the Company port, or the position, mooring, unmooring, placing or removing of any vessel within the Company port; or
- (b) the manner in which or the time at which any vessel shall take on or discharge its cargo or any part of its cargo or shall take on or deliver ballast, water or fuel,

the master of a vessel in the Company port who fails to regulate the vessel according to the directions of the Company or of the Company's Port Manager, as the case may be, is guilty of an offence.

Penalty: A fine not exceeding K400.00.

(3) Where the Company or the Company's Port Manager has, in accordance with the powers conferred by Clause 11 of the Agreement, caused a vessel in the Company port to be moored, unmoored, placed or removed in default of compliance by the master of the vessel with a lawful direction given by the Company or the Company's Port Manager, the master of the vessel is liable to pay all expenses incurred by the Company in the mooring, unmooring, placing or removal of the vessel, and the Company may recover the amount as a debt in any court of competent jurisdiction.

(4) Neither the Company's Port Manager nor any employee or agent of the Company is personally liable for any act or default of himself or of the Company done or committed in good faith in the course of the exercise of the powers of the Company or of the Company's Port Manager in relation to the management and control of the Company port.

(5) The Company port or any other port serving any of the facilities referred to in Clause 11(a) of the Agreement shall be deemed to be a proclaimed port under the *Shipping Act 1951* (Adopted).

8. Rights of shareholders, etc.

In the event of a breach of the Agreement by the State, being a breach of a provision under which a right or benefit is granted specifically to a member of the Company or a beneficial owner of a share in the Company, any member of the Company and any beneficial owner of a share in the Company who suffers any loss by reason of the breach has the same rights and remedies as he would have had if he were a party to the Agreement.

9. Waiver of rights under Agreement.

Notwithstanding anything in this Act or in the Agreement, a party to the Agreement or any other person may waive any of his rights under the Agreement in the circumstances of any particular case, without prejudice to the exercise of those rights in any other case.

10. Purposes of Agreement a public purpose.

The purposes of the Agreement are a public purpose within the meaning of any law.

11. Appropriation.

All amounts from time to time due and payable by the State to the Company under the Agreement shall be paid out of the Consolidated Revenue Fund which, to the necessary extent, is appropriated accordingly.

SCHEDULES.

SCHEDULE 1.

Sec. 1.

THE 1967 AGREEMENT.

THIS AGREEMENT is made the sixth day of June, One thousand nine hundred and sixty-seven, between THE ADMINISTRATION OF THE TERRITORY OF PAPUA AND NEW GUINEA (hereinafter called "the Administration" which expression shall include the administration or government for the time being of the said Territory) of the one part and BOUGAINVILLE COPPER PTY. LIMITED a company incorporated in the said Territory and having its registered office at Panguna on Bougainville Island in the said Territory (hereinafter called "the Company" which expression shall include its successors and assigns) of the other part.

WHEREAS:

- (1) C.R.A. Exploration Pty. Limited, a company which is related to the Company, holds Prospecting Authorities Nos. 1 to 7 both inclusive under the *Mining Ordinance 1928-1966* of the Territory of New Guinea over an area of land on the said Bougainville Island and promising indications of the possible presence of large deposits of low grade copper ore in association with other minerals have been discovered in that area at a cost in excess of \$4,000,000;
- (2) the confirmation of the presence of the said deposits and the determination of their economic significance will require continued detailed investigations and assessments in and in relation to the said area and the full investigation of the economic significance of the said deposits and the viability of a mining and concentrating operation based thereon will involve continued inquiries into roads and other access facilities, shipping facilities, power supply and water supply facilities, residential accommodation and other ancillary facilities and services required in connection therewith;
- (3) the said investigations assessments and inquiries are at present estimated to involve the expenditure of at least a further \$4,000,000 and possibly \$6,000,000 and the establishment of a mining and concentrating operation as aforesaid is likely to require a total expenditure including the above-mentioned amounts of at least \$30,000,000 and possibly of the order of \$100,000,000, a large portion of which must necessarily be borrowed from international finance organizations;
- (4) the Administration is satisfied that such large capital expenditure is necessary to ensure that the said deposits are efficiently and economically developed and that the Company has access to the requisite technical resources for developing the same, and that the Company intends if it proceeds with such a mining and concentrating operation to conform to good mining practice relating (*inter alia*) to the maximum recovery of ores of copper and of gold and other minerals found in association with such ores of copper;
- (5) the Administration is also satisfied that the development of such a large scale operation would bring significant benefits to the Territory in respect of revenues from royalties and other forms of taxation, in respect of overseas trade balances, and in respect of the economic and social development of the people through employment opportunities, training in new skills, the purchase of local supplies, community development, improved communications and the extension of education and health services;
- (6) it is intended that the products of operations carried on by the Company hereunder will after meeting local and domestic requirements be sold for consumption beyond the Territory on terms having regard to then prevailing world prices;
- (7) the Administration desires to assist and co-operate with the Company so as to enable it to continue to carry out the said investigations, assessments and inquiries, and to enable it to establish and maintain such an operation and it is intended that nothing be done which might impede the Company in carrying out such investigations, assessments and inquiries, or in establishing and maintaining such an operation;
- (8) it has been agreed that the Company shall offer one-fifth of its ordinary share capital for subscription by the Administration or a statutory authority of the Administration and the Administration, being satisfied that the rights attaching to those shares will be adequately safeguarded by this

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Agreement and the general law of the Territory, intends subject to the Company's proposed operation proving sound and offering reasonable prospects of profitable operation that such offer will be accepted; and

(9) it is therefore desirable that in consideration of the Company entering into the obligations on its part hereinafter set out, the Company should be granted the titles, rights and privileges hereinafter mentioned.

NOW THIS AGREEMENT WITNESSES AS FOLLOWS:—

I. DEFINITIONS.

(a) In this Agreement, unless the context otherwise requires—

"Administration land", "mineral", "mining tenement", "private land", "prospecting authority" and "secondary prospecting authority" have the meanings respectively given to them by Section 6 of the Mining Ordinance as at present in force;

"f.o.b. revenue" means—

(i) in the case of a delivery of concentrated or unconcentrated ores of copper other minerals or gold won from the area the subject of the special mining lease which is made pursuant to a sale by the Company other than a sale to which sub-paragraph (ii) of this definition applies—the value of the whole of the consideration receivable by the Company therefor less all or any costs charges and expenses bona fide incurred or suffered by the Company in respect thereof from the time when the same is loaded on board ship at a port in the said Bougainville Island until the same is delivered and accepted by the purchaser including without limiting the generality of the foregoing—

(A) taxes, dues, duties, excises, tariffs and other levies imposed on the export of the same from the Territory;

(B) trimming costs;

(C) ocean freight;

(D) marine insurance;

(E) port and handling charges at the port of discharge;

(F) costs incurred in delivering the same from the port of discharge to any place for the purpose of any further processing;

(G) weighing sampling assaying inspection representation and selling agency costs and charges;

(H) shipping agency charges after loading as aforesaid; and

(I) taxes, dues, duties, primage duties, tariffs and other levies imposed in the country of the port of discharge on the import of the same; and

(ii) in the case of any delivery of any such ores which is made pursuant to a sale by the Company for a consideration which is not a consideration which would be receivable by a willing seller from a willing buyer or which is made pursuant to a disposition by the Company other wise than by way of sale—the value of the whole of such consideration as would have been receivable by the Company if the same had been sold at the weighted average of the values of the whole of the considerations receivable by the Company (less all or any costs charges and expenses referred to in sub-paragraph (i) of this definition) in respect of deliveries of ores of substantially the same composition which were made during the period of six months immediately preceding the relative delivery and to which such sub-paragraph applied, or in the event of there being no such deliveries such amount as the parties hereto agree or failing agreement as is determined by arbitration as hereinafter provided as the amount which would be receivable therefor by a willing seller if sold to a willing buyer on a free on board basis at the port in the said Bougainville Island then serving the Company's operations;

"governmental authority" means the government of any political division or subdivision of the Territory any agency or instrumentality of the Administration or of any

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such government or any local or other authority in the Territory but does not include the Administration itself;

"land" includes the sea bed;

"lease" includes easement right of way and other right over land;

"month" means calendar month;

"person" includes company and corporation;

"petroleum" has the meaning given to it by Section 6 of the Petroleum (Prospecting and Mining) Ordinance as at present in force;

"related company" means a company which is related (as that expression is used at present in Section (5) of the *Companies Ordinance 1963-1966* of the Territory) to the Company;

"unimproved value" in relation to land means the capital sum which the fee simple of the land might be expected to realize if offered for sale on such reasonable terms as a bona fide seller would require assuming—

(i) that the improvements thereon (if any) other than ground improvements as hereinafter defined did not exist at the date to which the valuation relates; and

(ii) that the purchaser may use the land for no purpose other than the purpose for which it is being used as at the date of this Agreement,

less the ground improvements allowance as hereinafter defined (if any) applicable to the land but in calculating such capital sum no account shall be taken of the value of any gold or minerals in or under the land or of any right to extract or to receive payments in respect of the extraction of any such gold or minerals therefrom;

In this definition "ground improvements" means in relation to land—

(i) the reclamation of the land by draining or filling, together with the construction and maintenance of retaining walls and ancillary works;

(ii) the excavation grading or levelling of the land;

(iii) the clearing or thinning out of trees scrub or other vegetable growth on the land;

(iv) the improvement of the fertility of the soil or the structure of the soil on the land; and

(v) the construction of underground drains,

and "the ground improvements allowance" means in relation to land—

(A) a sum equal to the expenditure (if any) in respect of ground improvements made to the land (not being ground improvements made more than fifteen years before the date of valuation or ground improvements made before any of the owners of the land as at the date of valuation became owners thereof); or

(B) the estimated increase which the incurring of such expenditure has made to the value of the land as at the date of valuation,

(whichever is the less);

"the *Gazette*" means the *Papua and New Guinea Government Gazette*;

"the *Land Ordinance*" means the *Land Ordinance 1962-1966* of the Territory;

"the *Mining Ordinance*" means the *Mining Ordinance 1928-1966* of the Territory of New Guinea;

"the *Petroleum (Prospecting and Mining) Ordinance*" means the *Petroleum (Prospecting and Mining) Ordinance 1951-1965* of the Territory;

"the *Prospecting Authorities*" means *Prospecting Authorities Nos. 1 to 7* both inclusive under the *Mining Ordinance* at present vested in *C.R.A. Exploration Pty. Limited* and includes any extensions thereof;

"the *special mining lease*" means the *special mining lease* or *special mining leases* granted to the Company pursuant to *Clause 5* and includes any renewal thereof;

"the Territory" means the Territory of Papua and the Territory of New Guinea together called by the name of the Territory of Papua and New Guinea in Section 10 of the *Papua and New Guinea Act 1949-1966* of the Commonwealth of Australia.

The singular includes the plural and vice versa.

The masculine gender includes the feminine and neuter genders and vice versa.

Any reference to an Ordinance or any provision thereof includes a reference to any modification or re-enactment thereof or substitution therefor.

- (b) Headings shall not affect the operation of this Agreement.
- (c) Where in this Agreement reference is made to a law in force as at a particular date, no account shall unless the context otherwise requires be taken of any modification or re-enactment thereof or substitution therefor effected by a law made after that date but deemed to have come into operation or to have been made on or before that date.
- (d) Where in this Agreement reference is made to any office authority or body that reference shall if that office authority or body is abolished be read as a reference to the then corresponding or analogous office authority or body or to such other office authority or body as is agreed upon by the Administration and the Company for the purpose.

2. RATIFYING LEGISLATION.

- (a) The Administration shall as soon as is reasonably practicable introduce and sponsor in the House of Assembly of the Territory a Bill for an Ordinance to approve this Agreement which Bill shall be in the form of the draft Bill heretofore agreed upon between the Administration and the Company and signed on their behalf for the purpose of identification.
- (b) Apart from paragraph (a) of this Clause which shall come into effect upon the execution hereof, this Agreement shall come into effect on the day on which an Ordinance in the form hereinbefore referred to (but with such amendments thereto (if any) as the parties hereto shall prior to the coming into effect of such Ordinance agree upon) comes into effect, and in the event that such an Ordinance does not come into effect prior to the thirty-first day of December, One thousand nine hundred and sixty-seven, or such later date as the parties hereto shall agree upon in writing, this Agreement other than paragraph (a) of this Clause shall be void and of no effect and neither of the parties hereto shall have any claim against the other of them with respect to any matter or thing arising out of done or performed or omitted to be done or performed under this Agreement other than under the said paragraph (a).
- (c) If such Ordinance comes into effect as aforesaid but at any time thereafter such Ordinance is expressly or impliedly amended or repealed or this Agreement is expressly or impliedly varied added to cancelled abrogated or deprived of any of the force or effect which it has upon the coming into effect of such Ordinance (except as provided by the Ordinance or this Agreement, or with the prior consent of the Company) then irrespective of whether such amendment repeal variation addition cancellation abrogation or deprivation would otherwise constitute a breach of this Agreement the Company the members of the Company and the beneficial owners of shares in the Company shall in respect of the same have all the rights and remedies which it or they would have as if the same were a breach of this Agreement by the Administration.

3. INTERIM RIGHTS OF COMPANY.

- (a) The said C.R.A. Exploration Pty. Limited shall be entitled to transfer the Prospecting Authorities to the Company and the Company shall ensure that the Prospecting Authorities are so transferred to it within one month after the whole of this Agreement comes into effect.
- (b) Unless and until the Company's rights under this Clause have terminated pursuant to paragraph (f) of this Clause—
 - (i) the Administration shall from time to time cause to be granted to the Company successive extensions of the terms of the Prospecting Authorities, which extensions shall be granted subject to the provisions of this Agreement but not to any other terms or conditions and shall unless the Company has previously and in

writing agreed otherwise be granted over the whole of the land at present the subject of the relative prospecting authority; and

(ii) upon application from time to time by the Company any related company or the employees agents or contractors of any of them for a permit to be issued pursuant to Section 54 of the Mining Ordinance to enter and prospect any private land (being the whole or part of the area then the subject of the Prospecting Authorities) specified in the application, the applicant shall be entitled to the issue of such permit which permit shall specify that it shall remain in force for a period of six months and shall—

(A) if at the time of application a permit issued pursuant to this sub-paragraph is in force in respect of the whole of the land specified in such application—be issued so as to come into force upon the expiration of such current permit; and

(B) in any other case—be issued so as to come into force as soon as is reasonably practicable.

For the purposes of this paragraph, the right of the Company, any related company, their employees, agents and contractors and the employees of such agents and contractors to prospect on any land under the Prospecting Authorities or under any permit under Section 54 of the Mining Ordinance issued in accordance with this Clause shall be deemed to include the right to carry out any operations reasonably necessary for the carrying out of the investigations assessments and inquiries referred to in Recital 2.

- (d) During the currency of the Prospecting Authorities the Administration shall not without the prior consent of the Company (which consent shall not unreasonably be withheld) grant or permit the grant of any secondary prospecting authority or mining tenement or any other right to prospect for or to mine any gold or minerals over the whole or any part of the area then the subject of the Prospecting Authorities PROVIDED THAT nothing in this paragraph shall apply to any permit licence or lease issued or granted pursuant to the Petroleum (Prospecting and Mining) Ordinance in respect of petroleum.
- (e) Neither Section 25F nor Section 25J (a) of the Mining Ordinance shall apply to the Prospecting Authorities and the Prospecting Authorities shall be deemed hereafter not to be subject to any terms or conditions under Section 25A(1) of that Ordinance.
- (f) Nothing in this Clause shall affect the operation of Section 56 of the Mining Ordinance.
- (g) The Company's rights under this Clause the Prospecting Authorities any permit issued pursuant hereto and the Company's obligations under Clause 4 shall terminate if and when—
- (i) the Company has not as at the end of the period mentioned in Clause 5(a) applied for the special mining lease;
 - (ii) (in the event that the Company has applied as aforesaid) the special mining lease and all other leases the grant of which the Administration is obliged to procure to the Company pursuant to such application are granted to the Company; or
 - (iii) the Company gives to the Administration notice of its intention to abandon and cancel this agreement (exclusive of Clause 21).

4. COMPANY'S INVESTIGATIONS.

- (a) The Company shall ensure that the investigations assessments and inquiries referred to in Recital (2) and metallurgical and market research in relation thereto are carried out or continued with reasonable diligence and shall endeavour to make its decisions as to whether it will proceed with the establishment of a mining and concentrating operation of the kind referred to in the said Recital (2) and as to whether it will make application pursuant to Clause 5(a) as soon as is reasonably practicable.
- (b) Until such time as the investigations assessments inquiries and research referred to in paragraph (a) of this Clause have been completed or until the Company makes an application pursuant to Clause 5(a) (whichever is the later) it shall within two months of the end of the relative period make to the Administration in respect of each successive

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period of six months the first of which ends on the thirty-first day of December, One thousand nine hundred and sixty-seven—

- (i) a report in reasonable detail on such investigations assessments inquiries and research (including a description of the investigations carried out in the area then the subject of the Prospecting Authorities and of the results of those investigations) and as to the expenditure incurred in connection therewith and as to any other expenditure of the kind referred to in Clause 5(b) (i) which has been incurred; and
- (ii) a report on the general progress (if any) made in the obtaining of the finance necessary to enable it to comply with its obligations under Clause 6(a).

5. LEASES AND OTHER RIGHTS.

(a) The sum of \$4,514,851 having prior to the first day of January, One thousand nine hundred and sixty-seven, been expended on the discovery mentioned in Recital (1) the Company may (so long as the total expenditure as at the date of application is not less than the required total expenditure as at that date) apply to the Administration at any time during the period ending on the thirty-first day of December, One thousand nine hundred and seventy-one by way of a single application—

- (i) for a special mining lease or special mining leases to be granted to it over the area or areas of land specified in such application (being the whole or part of the area then the subject of the Prospecting Authorities); and
- (ii) for the other leases specified in the application to be granted to it over or in respect of the relative area of land specified in the application, which leases shall be those reasonably needed by the Company for its purposes under this Agreement including without prejudice to the generality of the foregoing those required for—

- (A) mining purposes generally;
- (B) treatment plants;
- (C) townsites and other accommodation including any green belt or rural zone on the outskirts thereof;
- (D) wharves, docks, piers, slips, jetties, landing stages, platforms, landing ramps, markers, buoys, beacons, leads, channels and berthing and mooring places, to be constructed, installed, provided, dredged or deepened in accordance with Clause 11;
- (E) power stations;
- (F) dams;
- (G) roads, railways and other modes of access;
- (H) tunnels, pipelines, water channels and races, transmission lines and ropeways; and

(I) the disposal of overburden and tailings in accordance with Clause 15.

(b) For the purpose of paragraph (a) of this Clause—

(i) a reference to total expenditure as at a particular date shall be to the sum of the amounts (expressed in dollars) expended and liabilities incurred but not then satisfied on or after the said first day of January, One thousand nine hundred and sixty-seven, by the Company or by any related company or (pursuant to arrangements made with the Company or any related company) by any other company whatsoever directly or indirectly upon or in connection with—

- (A) exploration prospecting or testing on or in relation to the areas at present the subject of the Prospecting Authorities;
- (B) all or any of the matters referred to in Clause 4(a); or
- (C) the provision of facilities necessary or requisite for the taking of any of the action hereinbefore referred to in this paragraph; and

(ii) a reference to the required total expenditure as at a particular date shall be to that sum which bears to the sum of \$4,000,000 the same proportion as the period between the said first day of January, One thousand nine hundred and sixty-seven,

and such date (exclusive of any extensions to which the Company becomes entitled under Clause 20(b)(i)) bears to five years.

For the purpose of this paragraph—

- (1) any amount expended in currency other than Australian currency shall be taken into account at its equivalent in Australian currency at the rate of exchange prevailing at the time of expenditure and any liability incurred in currency other than Australian currency shall be taken into account at its equivalent in Australian currency at the rate of exchange prevailing at the time at which the liability was incurred; and
 - (2) any reference to amounts expended, liabilities incurred or arrangements made by or with a related company shall include a reference to amounts expended, liabilities incurred or arrangements made between the said first day of January, One thousand nine hundred and sixty-seven, and the date of the incorporation of the Company by or with a company which is now a related company.
- (d) The Company may at any time after making application pursuant to paragraph (a) of this Clause apply to the Administration for further leases to be granted to it over or in respect of the relative areas of land specified in the application which leases shall be those reasonably needed by the Company for the purposes aforesaid.
- (d) Prior to the Company making application pursuant to paragraph (a) or (c) of this Clause it may from time to time notify the Administration that it intends, if it makes an application under the said paragraph (a) or (c), to apply pursuant thereto for the lease specified in the notification over or in respect of the area of land specified therein but if it does so notify the Administration and subsequently makes application under the said paragraph it shall unless the Administration agrees otherwise include in such application an application for such lease.
- (d) Any application or notification made or given under the preceding provisions of this Clause shall describe each area in respect of which it is made or given with such particularity as will enable it to be marked off and if necessary surveyed or otherwise identified.
- (f) Upon receipt from the Company of an application pursuant to paragraph (a) or (c) of this Clause the Administration shall as soon as practicable but in any event—
- (i) in the case of a lease in respect of which the Company has given a notification under paragraph (d) of this Clause—within three months after the receipt of such application or one year after such notification (whichever is the later); or
 - (ii) in any other case—within one year after the receipt of such application,
- (or within such longer period if any as the parties hereto shall agree upon) procure the grant to the Company of the leases therein specified over or in respect of the relative areas therein specified or save in the case of the special mining lease over or in respect of such other areas as the Administration demonstrates would meet the reasonable needs of the Company for the purposes aforesaid.
- (g) The special mining lease shall be in the form of the Schedule to this Agreement (but with such modifications thereto if any as the parties shall agree upon in writing) the annual rental payable thereunder shall be one dollar per acre or part thereof and the special mining lease shall be for an initial term of forty-two years with successive rights of renewal for further terms of twenty-one years which renewals shall—
- (i) in the case of the first and second renewals—be on the same terms save as to royalty and rent as those on which the special mining lease is originally granted as aforesaid, the terms of the said renewals as to royalty and rent being such as are (after discussion with the Company and consideration of all the then prevailing facts and circumstances) determined by the Administration as being fair and reasonable; and
 - (ii) in the case of the third and subsequent renewals—be on such terms as are (after discussion and consideration as aforesaid) determined by the Administration as being fair and reasonable as aforesaid.
- (h) The Company shall pay royalty at the rate of one and one quarter per cent. (or, during the currency of any renewal of the special mining lease, such other rate as is determined pursuant to paragraph (g) of this Clause) of the f.o.b. revenue applicable to deliveries

made by the Company pursuant to sales or other dispositions made by the Company of ores of copper other minerals or gold (whether or not the same have been concentrated) won from the area the subject of the special mining lease, which royalty shall be payable monthly in accordance with procedures agreed between the Administration and the Company.

(i) For the purposes of paragraph (b) of this Clause, the processing by the Company of ores referred to in that paragraph beyond the stage of concentration shall be deemed to be a delivery by the Company (made at the time when the further processing begins) of the ores pursuant to a disposition by the Company otherwise than by way of sale.

(j) The rentals or like charges payable under any lease granted in accordance with this Agreement (other than the special mining lease) shall be such as are prescribed by law or (in the case of any rentals or charges the amount of which is not fixed by legislation) as are fair and reasonable and subject as hereinafter provided in this Agreement the said leases (other than the special mining lease) shall be granted on such terms and for such periods as are fair and reasonable. The instrument evidencing each such lease shall—

(i) contain a condition that the Company will not without the consent of the Administration use the relative land for a purpose other than the purpose for which the grant is made or a purpose ancillary to that purpose;

(ii) oblige the Company to construct install or provide on the relative land, within the period specified in the Company's application (not being a period longer than five years) and at a cost of not less than an amount to be specified in the said application as the minimum amount which the Company proposes to expend on improvements thereon, improvements of the kind specified in the said application as those which the Company proposes to construct install or provide thereon (but shall not otherwise oblige the Company to construct install or provide improvements); and

(iii) shall confer on the Company rights of such renewals or extensions of the relative lease as will ensure that it may remain in force at least until the expiration of the last renewal of the special mining lease.

The rentals or like charges payable under the said renewals or extensions shall be such as are prescribed by law or (in the case of any rentals or charges the amount of which is not fixed by legislation) as are fair and reasonable and such renewals or extensions shall—

(A) in the case of such renewals or extensions as are granted upon or prior to the expiration of the second renewal of the special mining lease—be granted on the same terms as those on which the relative lease was originally granted; and

(B) in the case of any renewals or extensions granted subsequently—be granted on such terms as are (after discussion with the Company and consideration of all the then prevailing facts and circumstances) determined by the Administration as being fair and reasonable.

(k) All land the subject of any lease granted to the Company in accordance with this Agreement shall be and remain zoned and available for use by the Company for any purpose permitted under the lease and no legislation fixing or limiting rentals or restricting the present rights of sub-lessors to evict sub-lessees shall apply to any land the subject of any lease granted to the Company pursuant hereto.

(l) The Company shall (without prejudice to any rights which it may have to be compensated in respect thereof but subject to it doing to the relative land as little damage as may reasonably be and to any agreement which may be made between the parties hereto for the purchase of the same) have the right in the event of the expiration or sooner determination for any reason of any lease or any renewal or extension thereof granted in pursuance of this Agreement within a reasonable time after such expiration or determination to remove any improvements affixed by it or on its behalf to the relative land.

(m) The Administration shall not grant or permit the grant of any prospecting authority or mining tenement or any other right to prospect for or mine any gold or minerals over the whole or any part of the area then the subject of the special mining lease unless—

(i) the Company has previously consented thereto; or

- (ii) the Administration demonstrates that the exercise of such right to prospect or mine would not interfere with any present or prospective operation of the Company on or in the relative area and has previously made a written offer to the Company upon and subject to the same terms and conditions (whether as to rent royalty or any other matters whatsoever and whether to be contained in the instrument evidencing the grant or in any other instrument or contract) as those upon and subject to which the Administration is bona fide prepared to grant or permit the grant of the said right to any other person or company and the Company has refused such offer in writing or has failed for a period of twelve months after the date of receipt of such offer to accept the same (whichever is the earlier),

PROVIDED THAT nothing in this paragraph shall apply to any grant made pursuant to the Petroleum (Prospecting and Mining) Ordinance in respect of petroleum.

6. CONSTRUCTION OBLIGATIONS OF COMPANY.

- (a) In the event that the Company makes application under Clause 5(a) it shall within five years of the granting to it of the special mining lease and the other leases the grant of which the Administration is obliged to procure pursuant to the said Clause 5(a) and at a cost of not less than \$30,000,000 construct install and provide facilities to enable it to mine ores from the land the subject of the special mining lease, to concentrate such ores, to transport the concentrates so derived to wharf facilities and to ship such concentrates from such facilities in commercial quantities and shall within the said period of five years commence, so to ship such concentrates. All the expenditures costs amounts and liabilities referred to in Clauses 5(a) and 5(b)(i) (including the expenditure of \$4,514,851 specifically referred to in the said Clause 5(a)) shall be deemed to have been part of the cost incurred by the Company pursuant to this paragraph irrespective of whether they were expended or incurred by the Company or some other company and whether they were expended or incurred prior to or on or after the date hereof.
- (b) In the event that the Company fails to comply with paragraph (a) of this Clause and to remedy such default within a reasonable time after a notice specifying the default is given to it by the Administration the Administration may by notice to the Company and subject as hereinafter provided in this Clause determine this Agreement (exclusive of Clause 21) and thereupon the special mining lease and the other leases vested in the Company shall notwithstanding their terms cease and determine PROVIDED THAT if the Administration gives to the Company a notice specifying a default as aforesaid and the Company promptly refers to arbitration the question whether such alleged default has taken place then if on such arbitration it is decided that the Company has made such default but that there has been a bona fide dispute and that the Company has not been dilatory in pursuing such arbitration then neither this Agreement nor the special mining lease nor any of the said other leases may be determined under this Clause unless and until a reasonable time fixed by the award as the time within which the Company must remedy such default has elapsed without such default having been remedied.
- (c) Notwithstanding anything contained in this Agreement no default by the Company in the construction installation and provision of facilities or in the shipping of concentrates in accordance with paragraph (a) of this Clause shall constitute a breach of this Agreement and the only consequences arising therefrom shall be those set out in paragraph (b) of this Clause.
- (d) Until the Company has complied with paragraph (a) of this Clause or this Agreement has been determined as aforesaid (whichever is the earlier) the Company shall within two months of the end of the relative period make in respect of each successive period of six months the first of which ends on the thirtieth day of June or the thirty-first day of December (whichever is the earlier) next following the making of application by the Company pursuant to Clause 5(a) a report in reasonable detail to the Administration as to the progress made in complying with paragraph (a) of this Clause and as to the expenditure incurred in connection therewith.

7. TAXATION.

- (a) The income of the Company shall be exempt from income tax for a period commencing on the date on which the Company first enters into commercial production of copper concentrates under this Agreement and ending on the last day of the period of three

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years next following that date, but subject to paragraphs (b) (c) and (d) of this Clause no amounts which would but for this paragraph have been deducted in the determination of the amount upon which is calculated the income tax (if any) otherwise payable by the Company in respect of the tax exemption period shall be deducted in the determination of the amount on which is calculated the income tax payable by the Company in respect of any period following the tax exemption period.

- (b) Any expenditure incurred by the Company either before or during the tax exemption period which would entitle the Company to a deduction calculated in accordance with Division 10 of Part III. of the Income Tax Ordinance shall be deemed to have been incurred on the day following the day on which the tax exemption period expires and the Company shall for the purposes of the determination of the amount upon which income tax is calculated and of taxable income be entitled to deductions under the said Division accordingly.
- (c) If any expenditure is incurred by the Company either before or during the tax exemption period in borrowing money for the purpose of producing income such money shall be deemed to have been borrowed (for the period for which it was in fact borrowed) on the day following the day on which the tax exemption period expires and the Company shall for the purposes of the determination of the amount upon which income tax is calculated and of taxable income be entitled to deductions under Section 89 of the Income Tax Ordinance accordingly.
- (d) If in a year of income or part of a year of income falling within the tax exemption period the income which would but for paragraph (a) of this Clause have been assessable income of the Company under the then law relating to income tax is less than the total of the amounts which would but for the said paragraph (a) have been deducted in determining the amount upon which is calculated the income tax (if any) otherwise payable by the Company in respect of that year of income or part of a year of income (other than any of the amounts referred to in paragraphs (b) and (c) of this Clause) the difference between such income and such total shall be deemed to be an expenditure incurred on the day following the day on which the tax exemption period expires which is a deduction for the purposes of the determination of the amount upon which income tax is calculated and of taxable income.
- (e) The deductions now allowable to the Company in respect of the matters covered by Sections 68, 72, and 101 and Division 10 of Part III. of the Income Tax Ordinance and the exemption now provided for in Section 33 of the Income Tax Ordinance and Regulation 5 of the Regulations thereunder shall continue to be available to the Company and the Company shall continue to be entitled to relief from income tax accordingly.
- (f) The exemption now provided for in Section 42(1)(b) (i) of the Income Tax Ordinance shall continue to be available to members of the Company and beneficial owners of shares in the Company and such members and beneficial owners shall continue to be entitled to relief from income tax accordingly.
- (g) Neither the Company nor any other person shall have any liability to any income tax on the payment or repayment of or measured by reference to the amount of any interest payable or any other amount payable in respect of any amount which is lent to the Company by any person who is not a resident of the Territory or on or in respect of the principal of any such loan other than any liability thereto which would exist under the Income Tax Ordinance.
- (h) No alteration made to the law of the Territory (other than any alteration made to give effect to any agreement for the avoidance of double taxation entered into with the Government of the country of which the relevant member or beneficial owner is a resident) shall apply to or in respect of the Company or a member of the Company or a beneficial owner of a share in the Company if it would have the effect of increasing the amount of any tax charge due duty or other levy payable by the Company or by such a member or beneficial owner in respect of any dividends declared credited or paid by the Company to an amount in excess—
 - (i) where the member or beneficial owner is a company which is a resident of Australia (as that expression is used in the *Income Tax Assessment Act 1936-1967* of the Commonwealth of Australia)—of the amount of income tax calculated by applying to the dividend the rate of income tax payable generally by companies of

- the same class for the purposes of income tax which are also residents of Australia as aforesaid on dividends derived from a source in the Territory in the year of income in which the dividend is paid or credited or the minimum rate of income tax payable generally by companies of the same class for the purposes of income tax which are residents of the Territory in respect of income derived from a source in the Territory in the said year of income (whichever is the lesser rate);
- (ii) where the member or beneficial owner is a company which is not a resident of the Territory and is not a resident of Australia aforesaid—of the amount calculated by applying to the dividend the minimum rate of income tax payable generally by companies of the same class for the purposes of income tax which are residents of the Territory in respect of income derived from a source in the Territory in the year of income in which the dividend is paid or credited; or
- (iii) where the member or beneficial owner is an individual—of the amount calculated by applying to the dividend the rates of income tax payable by individuals who are residents of the Territory in respect of income derived from a source in the Territory in the year of income in which the dividend is paid or credited.
- (i) No rate, tax, rent, charge, due, duty, tariff or other levy and no legislation, procedure or practice relating thereto which is discriminatory (whether in law or in practice) in its effect on the Company any member of the Company or any beneficial owner of any share in the Company shall be payable by or (as the case may be) applicable to the Company or any such member or beneficial owner (as the case may be) in respect of the operations of the Company under this Agreement or of any income arising directly or indirectly therefrom.
- (j) No local government rates or taxes on land calculated otherwise than in relation to the unimproved value of the land shall be payable by the Company.
- (k) In addition to income tax and any other taxes, rates, charges, dues, duties, tariffs and other levies payable by the Company, the Company shall pay to the Administration by way of an additional tax in respect of each year of income after the tax exemption period such amount (if any) as is equal to the amount (if any) by which the total of the amount of income tax payable in respect of that year of income and the prescribed taxes is less than fifty per cent. of the adjusted taxable income of the Company for that year of income PROVIDED THAT no additional tax shall be payable under this paragraph in respect of the first year of income after the tax exemption period in which the Company derives a taxable income and in respect of the second third and fourth years of income after such first year the amounts of additional tax (if any) otherwise payable under this paragraph shall be reduced by 75 per cent., 50 per cent. and 25 per cent. respectively.
- (h) If in respect of any year of income the total of the income tax payable by the Company and the prescribed taxes exceeds the greatest of—
- (i) the prescribed proportion of the adjusted taxable income for that year of income;
 - (ii) the total of those prescribed taxes which were imposed in respect of the importation of goods into the Territory by the Company; or
 - (iii) \$275,000,
- the Administration shall (save in a year of income in which the Company is obliged to pay income tax but the adjusted taxable income does not exceed \$3,000,000) pay the excess to the Company.
- (m) In respect of each year of income the Company shall at the time at which it lodges its return of income for purposes of income tax furnish to the Administration a return setting out the prescribed taxes.
- (n) Any additional tax payable under paragraph (k) of this Clause or (as the case may be) any payment under paragraph (h) of this Clause shall become due and payable at the time at which the income tax (if any) payable by the Company becomes due and payable but if no such income tax is payable any payment under the said paragraph (h) shall become due and payable nine months after the end of the relative year of income.
- (o) If by reason of any event occurring after the payment of any additional tax or the making of any payment under paragraph (h) of this Clause including (without prejudice to the generality of the foregoing) the amendment reduction increase or variation of any income tax assessment, the amount of such payment is more or less than the amount which

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should in fact have been paid as the case may be the necessary adjustment shall be made as soon as practicable thereafter.

(p) In this Clause, unless the context otherwise requires—

"additional tax" means the additional tax imposed under paragraph (k) of this Clause;

"adjusted taxable income", in relation to a year of income, means the sum of—

(i) the taxable income of the Company in respect of that year of income; and

(ii) the amount of the prescribed taxes which have been deducted in order to arrive at the taxable income;

"income tax" includes a like tax but does not include provisional income tax or additional tax;

"taxable income", in relation to a year of income, means the amount which would have been the taxable income of the Company if the Income Tax Ordinance had been in force throughout that year of income;

"the Income Tax Ordinance" means the *Income Tax Ordinance 1959-1966* of the Territory and the Regulations thereunder as in force at the date of this Agreement but as amended by this Agreement;

"the prescribed proportion of the adjusted taxable income", in relation to a year of income, means fifty per cent. of the adjusted taxable income for that year, increased by one per cent. of the adjusted taxable income for each year of income after the twenty-fifth complete year of income calculated from the end of the year of income in which the Company first enters into commercial production of copper concentrates under this Agreement but so that that proportion shall not exceed sixty-six per cent. of the adjusted taxable income;

"the prescribed taxes", in relation to a year of income, means—

(i) such rates taxes charges dues duties tariffs and other levies as are imposed by the Administration or a governmental authority and are deducted in order to arrive at the taxable income of the Company for that year of income; and

(ii) such other rates taxes charges dues duties tariffs and other levies as are imposed by the Administration or a governmental authority and are paid by the Company during that year of income,

but does not include any normal charges for services rendered, local government rates or taxes on land, duties on the importation into the Territory of goods for resale or for hiring under hire-purchase agreements or the royalty payable under this Agreement;

"the tax exemption period" means the period during which the income of the Company is exempt from income tax under paragraph (a) of this Clause;

Other expressions used shall have the meanings given to them in the Income Tax Ordinance.

8. FINANCIAL PARTICIPATION.

(a) The Company shall, not later than two years after the granting of the special mining lease, notify to the Administration total of the amount of the Company's ordinary share capital which is then issued and which it is then intended shall be issued and offer to the Administration or if so requested by the Administration to an approved authority for subscription in cash at par ordinary shares in the Company having a total nominal value equal to 20 per cent. of the total amount notified under this paragraph and as soon as practicable and in any event not later than six months thereafter the Administration shall or (as the case may be) shall procure the said approved authority to notify the Company whether or not it accepts such offer.

(b) Notwithstanding any provision in the Articles of Association of the Company transfers of the Administration shares of the following kinds may be made :—

(i) transfers made at any time by the Administration an approved authority or approved authorities on the basis of a reasonable spread of shareholdings to eligible Territory residents (so long as the total of the shares so transferred does not prior to the prescribed date exceed 25 per cent. of the total nominal value of

- the Administration shares for the time being issued without the agreement of the Company);
- (ii) transfers made at any time among the Administration and an approved authority or approved authorities; and
- (iii) transfers made at any time among eligible Territory residents.
- (c) The Administration shall not and shall procure that any approved authority holding Administration shares does not dispose prior to the prescribed date (otherwise than by way of transfer of the legal title therein) of any of the Administration shares or any interest in any of the Administration shares without the agreement of the Company.
- (d) The Company shall ensure that at the time at which an offer is made pursuant to paragraph (a) of this Clause its Articles of Association provide that no Administration share may be held by any person other than the Administration an approved authority or an eligible Territory resident and that such Articles of Association continue thereafter so to provide.
- (e) The Company shall if and so long as the total nominal value of the Administration shares equals not less than 15 per cent. of the adjusted share capital of the Company ensure that the holders for the time being of a majority in number of the Administration shares are entitled to appoint a director of the Company.
- (f) The Administration shall, if it or an approved authority accepts any offer made pursuant to paragraph (a) of this Clause, use its good offices as requested by the Company in assisting the Company to seek and make arrangements for loan capital from time to time required by the Company.
- (g) In this Clause—

"approved authority" means a statutory authority of the Administration approved for the purpose by the Administration;

"co-operative company" means a co-operative company within the meaning of Division 9 of Part III. of the *Income Tax Ordinance 1959-1966* of the Territory, which is a resident of the Territory;

"eligible Territory residents" means persons (being Territory residents who are individuals or co-operative companies or native bodies all of the members of which are Territory residents who are individuals) declared from time to time to be such by law;

"native body" means—

- (i) a Society as defined in the *Co-operative Societies Ordinance 1965* of the Territory;
- (ii) a society certified by the Administration to be a native rural development society; or
- (iii) any other group or body of persons resident in the Territory which is—
- (A) a native body for the purposes of the *Income Tax Ordinance 1959-1966* of the Territory; or
- (B) declared by the Administration and the Company to be a native body for the purposes of this Clause;

"the adjusted share capital of the Company" means an amount which is five times the nominal value of the total of—

- (i) the shares in the Company which are issued to the Administration pursuant to paragraph (a) of this Clause; and
- (ii) any other shares which are offered to holders of such shares by virtue of their holdings thereof (whether or not such shares have been taken up by such holders);

"the Administration shares" means—

- (i) the shares in the Company which are issued to the Administration or an approved authority pursuant to paragraph (a) of this Clause; and

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- (ii) any other ordinary shares in the Company which are issued to the holder thereof by virtue of his holding shares of the kind mentioned in sub-paragraph (i) of this definition;

"the prescribed date" means the date fifteen years after acceptance of the offer referred to in paragraph (a) of this Clause or the first day after the Company has completed its obligations under Clause 6(a) on which it has no obligations for the repayment (otherwise than to its members) of money borrowed by it for the purposes of the performance of its obligations under that paragraph or for any re-financing in relation thereto (whichever is the earlier).

9. SUPPLIES AND CURRENCY.

- (a) The Company shall so far as is reasonably and economically practicable use supplies plant machinery and equipment manufactured or produced in the Territory.

- (b) Subject to any requirements of defence the safety of the public and quarantine and to the obligations of the Administration under multilateral international agreements entered into by the Government of the Commonwealth of Australia or the Administration and implemented by subsequent legislation, the Company any related company and agents and contractors of the Company or of any related company shall have the right to acquire import into and move within the Territory and use any plant machinery equipment vehicles explosives fuels reagents and supplies—

- (i) required for the construction installation provision expansion maintenance or operation of any of the facilities referred to in Clause 6(a), any facilities required for any further processing of concentrates produced as a result of the Company's operations under this Agreement or any other facilities required for the purpose of the said operations; or

- (ii) otherwise required for the purpose of the said operations,

and to export from the Territory the products (whether processed or otherwise) resulting from the said operations.

- (c) No tax, charge, due, duty, primage duty, tariff or other levy shall be imposed on—

- (i) the acquisition importation into or movement within the Territory or use (between the period commencing on the date hereof and expiring upon the completion by the Company of the performance of its obligations under Clause 6(a)) of such of the plant machinery equipment vehicles fuels and supplies referred to in paragraph (b) of this Clause (other than articles for resale and food-stuffs) as could at present be imported into the Territory free of import duty under the *Customs Ordinance 1951-1959* of the Territory; or

- (ii) on the acquisition importation into or movement within the Territory or use (between the period commencing on the date hereof and expiring ten years after the completion by the Company of the performance of its said obligations) of any plant machinery or equipment required for the replacement of any of the plant machinery or equipment referred to in sub-paragraph (i) of this paragraph or of such of the explosives and reagents referred to in paragraph (b) of this Clause as could at present be imported into the Territory free of import duty under the said Ordinance,

PROVIDED THAT nothing in this paragraph shall apply to the importation of any plant machinery equipment vehicles explosives fuels reagents or supplies of a kind which is at the time of such importation wholly or substantially manufactured or produced in the Territory and is available to the Company in the Territory at reasonable prices or (subject to Clause 14) to the imposition of normal motor vehicle registration fees.

- (d) No tax, charge, due, duty, excise, tariff or other levy shall be imposed on the mining production disposition or export of any of the products referred to in paragraph (b) of this Clause (other than any general export tax or levy which is imposed and levied at the same rate on all goods or merchandise of whatsoever kind produced or manufactured in the Territory and exported from the Territory in the ordinary course of trade).

10. PERSONNEL.

- (a) The Company shall so far as is reasonably and economically practicable use and train in new skills labour available in the Territory and in particular the Company shall continue

and expand the training programme instituted prior to the execution hereof with a view to the early employment by it in technical and staff positions of suitably qualified inhabitants of the Territory.

- (b) No restriction which is unreasonable shall be placed on the freedom of the employees agents and contractors of the Company or any related company and the employees of such agents and contractors and their families to enter remain and move within and depart from the Territory for the purpose of the Company's operations hereunder and neither the law of the Territory relating to the entry of persons into, the movement of persons within and the departure of persons from the Territory nor the administration of such law shall discriminate (whether in law or in practice) against any such employees agents or contractors or their families.

11. PORT.

- (a) The Company shall for the purpose of its operations under this Agreement have the power on or in the waters adjacent to the said Bougainville Island to construct install provide maintain and use wharves, docks, piers, slips, jetties, landing stages, platforms, landing ramps, markers, buoys, beacons and leads and to construct dredge deepen maintain and use channels and berthing and mooring places PROVIDED THAT no such facility may be constructed installed provided dredged or deepened without the prior consent of—

(i) in the case of facilities in a port which is a declared port—the Board; or

(ii) in the case of any other facilities—the Superintendent of Marine of the Territory,

which consent shall not be withheld unless the said Board or the said Superintendent of Marine (as the case may be) believes on reasonable grounds that the construction, installation, provision, dredging or deepening of the relative facility in the manner or at the place proposed by the Company would prejudice navigation, the accessibility of other ports in the Territory or the development of any declared port within which the facility is or is to be situated.

- (b) The Company shall (to the extent to which it is not prejudiced and its operations hereunder are not interfered with) permit the Administration and other persons to use the facilities referred to in paragraph (a) of this Clause on reasonable terms and at reasonable charges.

- (c) In relation to the Company port—

(i) any by-laws from time to time made by the Board relating to declared ports shall (except to the extent agreed between the Company and the board and notified in the *Gazette*) apply as if the Company port were a declared port;

(ii) the Company may with the approval of the Board make local rules for the management and control of the Company port which rules shall be deemed to be local rules made under Section 44(1) of the Harbours Board Ordinance and shall apply in the Company port as if it were a declared port; and

(iii) subject to sub-paragraph (i) of this paragraph, the Company and the Company's Port Manager shall have in relation to the management and control of the Company port all the powers which the Board or a Port Manager or Harbour Master appointed by it to manage the Company port would respectively have if the Company port were then a declared port,

PROVIDED THAT any express or implied reference to the Board its Port Manager or Harbour Master or to its other officers or employees or its agents in any of the said by-laws shall be read and construed as references to the Company the Company's Port Manager or the Company's other employees or its agents (as the case requires).

- (d) The Company shall have sole control over all wharves, docks, piers, slips, jetties, landing stages, platforms and landing ramps referred to in paragraph (a) of this Clause and the sole power to regulate the use thereof (including use permitted by paragraph (b) of this Clause) and the recruitment of labour employed in connection therewith, whether or not any such wharf, dock, pier, slip, jetty, landing stage, platform or landing ramp is situated in the Company port (if any).

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- (c) No tax, charge, due, duty or other levy other than income tax, the light dues and pilotage now provided for in the Territory and import and export duties or levies which may be charged under Clause 9 shall be imposed on or in relation to—
- (i) the use of any facilities referred to in paragraph (a) of this Clause;
 - (ii) the shipment of any goods to or from any such facilities; or
 - (iii) any vessel engaged in such shipment.

- (d) The Company may for its operations under this Agreement and on the same terms as other commercial users thereof use any harbour and wharf facilities on the said Bougainville Island which are now or may in the future be under the control of the Administration or the Board or any like body and the Administration shall if requested by the Company provide in connection with any such wharf facility for use by the Company as aforesaid any lifting gear of a normal commercial nature which is or will in the reasonably foreseeable future be required for the general use of such facility and which is reasonably required by the Company for its said operations.

- (e) In this Clause—

"declared port" has the meaning given to it by Section 4 of the Harbours Board Ordinance as at present in force;

"the Board" means the Papua and New Guinea Harbours Board;

"the Company port" means that area of waters adjacent to Bougainville Island and contiguous land which—

- (i) lies wholly outside a port which is now a declared port;
- (ii) is an area reasonably required by the Company for the proper regulation of the use of the facilities referred to in paragraph (a) of this Clause and of shipping using the same; and
- (iii) has for the time being been designated by the Company by notice in the *Gazette* as the port serving its operations under this Agreement;

"the Company's Port Manager" means the person for the time being appointed by the Company to manage the Company port;

"the Harbours Board Ordinance" means the *Papua and New Guinea Harbours Board Ordinance 1963-1964* of the Territory.

12. TOWNS AND SERVICES.

- (a) The Administration shall (except as otherwise agreed with the Company) provide education police postal telecommunication and medical facilities of the standard reasonably required to serve the Company its employees and any town camp or other accommodation established or constructed by the Company on the said Bougainville Island and shall staff and service such facilities at no cost to the Company or any of its employees other than the normal service charges (if any) made therefor.

- (b) The Company shall at a time determined by it during, but in any event prior to the expiration of, the period of five years mentioned in Clause 6 (a) construct or procure the construction to a design and at a place and at a cost approved by the Administration of a hospital of the standard reasonably required to serve (*inter alia*) employees of the Company and any town camp or other accommodation established or constructed by the Company as aforesaid and the Administration shall procure the grant to the Company of all necessary rights to enable it to do so. Unless the Company has previously agreed otherwise in writing the Administration shall forthwith upon the completion of the construction of the said hospital commence to staff and service the same and thereafter continue to do so at no cost to the Company or its employees other than the normal service charges (if any) made therefor. The Administration shall unless arrangements have previously been made with the Company for the postponement thereof reimburse to the Company the cost as aforesaid of constructing or procuring the construction of the said hospital within two months of the completion of the construction of the same.

13. POWER AND WATER.

- (a) The Company shall have power to generate, transmit, use for its own purposes and supply electric power to any related company, the employees agents and contractors of

- the Company or of any related company and the employees of any such agents or contractors and to charge therefor.
- (b) The parties hereto shall consult with a view to the establishment by the Company of a hydro-electric power station for the generation of electric power for use by the Company, the Administration and other persons and without prejudice to paragraph (c) of this Clause the Administration shall on the request of the Company use its best endeavours to preserve the water resources necessary for the establishment of such a station and shall if the Company decides to proceed with the establishment of such a station grant or procure the grant to the Company of any further rights necessary therefor (which rights shall be granted on fair and reasonable conditions).
- (c) The Company may from time to time and whether before or after it has made application pursuant to Clause 5(a) notify the Administration that it desires the provisions of this paragraph to apply to the area specified in the notification (being an area in respect of which the Company reasonably requires the Administration to take the action hereinafter specified for the purposes of a dam which has been or may in the future be constructed by or on behalf of the Company) and thereupon the Administration shall—
- (i) either procure such last-mentioned area (or such other area as the Administration demonstrates to the Company would meet the reasonable requirements of the Company for the purpose aforesaid) to become pursuant to the *Water Resources Ordinance* 1962 of the Territory a water control district, or take such other action as will result in the use of such area (or as the case may be, such other area) being restricted to the same extent as if the same were now a water control district as aforesaid; and
 - (ii) ensure that no approval licence permit or lease pursuant to the said Ordinance or any similar right is granted to any person other than the Company over the relative area if any acts permitted by such grant would or would be likely substantially to prejudice the Company or interfere with its operations under this Agreement.
- (d) The Company shall to the extent reasonably necessary for its operations under this Agreement have power to take, use for its own purposes and reticulate water to any related company, the employees agents and contractors of the Company and of any related company and the employees of any such agents and contractors and charge therefor.
- (e) Subject to the Administration procuring the grant to the Company of all necessary rights and powers to enable it to do so the Company shall to the extent to which it is not prejudiced and its operations under this Agreement are not interfered with permit the Administration and other persons to use (on reasonable terms and at reasonable charges) electric power generated and water taken by the Company.

14. ROADS.

- (a) Save in the case of any Company roads which the Company determines after consultation with the Administration should in order to ensure the proper safety and maximum efficiency of its operations under this Agreement be reserved for its exclusive use the Company shall (to the extent to which it is not prejudiced and its said operations are not interfered with and subject to the Company and related companies and the agents and contractors of the Company or any related company having absolute priority of use of the relative roads) permit the use of Company roads—
- (i) in the case of use for or in connection with agricultural or pastoral pursuits of substantially the same kind and extent as those at present followed in the area served by such Company roads or for administrative, private, domestic, social or religious purposes—free of charge to the user; and
 - (ii) in any other case—on such reasonable charges (having regard to the cost to the Company of the construction maintenance and repair of such Company roads) as are from time to time determined by the Company.
- (b) The Company shall have power to prohibit restrict or regulate the use of and traffic on all Company roads and at any time and from time to time to close any Company road to the public or to any class of users.

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- (d) While any Company road is a public road or street as that expression is used in the *Motor Traffic Ordinance 1950-1965* of the Territory such Ordinance and the *Motor Vehicles (Third Party Insurance) Ordinance 1952-1956* of the Territory and the Regulations thereunder shall subject to the preceding provisions of this Clause apply to and in respect of that Company road but—
- (i) no provision of the said Motor Traffic Ordinance or the said Regulations thereunder relating to the payment of fees on or in connection with the registration of motor vehicles shall apply to motor vehicles owned by the Company any related company any employee agent or contractor of the Company or any related company or any employee of any such agent or contractor and used solely on Company roads; and
 - (ii) no provision of the said Motor Traffic Ordinance or the said Regulations thereunder (other than provisions thereof the breach of which would or might endanger the safety of other road users) shall apply to the use on any Company road of any vehicle so owned.
- (d) The Company shall not be liable to the Administration any governmental authority or any person in respect of any failure or alleged failure by it to maintain or repair any Company road or any loss damage or injury suffered by reason of any such failure or alleged failure if a Local Government Council established under the *Local Government Ordinance 1963-1967* of the Territory and having the care control and management of such a road would not have been so liable.
- (e) In this Clause "Company road" means a road constructed by or on behalf of the Company or a related company on the said Bougainville Island other than any such road which by agreement in writing between the parties hereto is not to be or is not a Company road.
- (f) The Administration shall from time to time publish in the *Gazette* details of all roads which are as at the date of the notice Company roads and shall from time to time cause that notice to be amended as necessary.

15. OVERBURDEN TAILINGS AND SAFETY.

- (a) The Company shall not dispose of any overburden removed in the course of, or any tailings produced as a result of, its operations under this Agreement in an area or in a manner not previously approved for that purpose pursuant to the provisions of this Clause, it being intended that such overburden and tailings shall be disposed of in a manner which is reasonably safe and results in as little damage or disturbance (having regard always to the need for the Company to carry out its said operations efficiently and economically) as may reasonably be.
- (b) The Company may at any time and from time to time hereafter submit to the Administration a proposal for the disposal of such overburden and tailings, setting out the area or areas and manner in which it is proposed to dispose of the same. Forthwith upon receipt of such proposal the Administration shall consider the same (having regard to the factors mentioned in paragraph (a) of this Clause) and shall within two months of such receipt either—
- (i) notify the Company that its proposal has been approved either without modification or with such modifications as are set out in the notification; or
 - (ii) submit to the Company an alternative approved proposal for the disposal of the said overburden and tailings, setting out the area or areas and manner in which the same are to be disposed of thereunder.
- (c) In the event that the Administration does not approve the Company's proposal without modification the Company may at any time thereafter refer to arbitration as hereinafter provided in this Agreement the question of the disposal of the said overburden and tailings. Upon such arbitration the arbitrator or arbitrators shall have regard to the factors mentioned in paragraph (a) of this Clause and shall either approve the Company's proposal or approve that of the Administration in either case without modification or with such modifications as he or they consider proper.
- (d) Notwithstanding that the same may have been disposed of in an area and in a manner approved as hereinbefore provided in this Clause the Company shall make compensation for any loss suffered by any indigenous or other inhabitant of the said Bougainville Island or the other islands adjacent thereto resulting from any damage done (whether to land,

- anything on land, water or otherwise) or any interference with any right to use land or water caused by the disposal by the Company of any overburden removed in the course of, or tailings produced as a result of, its operations under this Agreement, but nothing in this paragraph shall oblige the Company to make any compensation to the Administration or any governmental authority. Such compensation shall be provided either in cash or by way of provision on reasonable terms and conditions of land or other facilities or benefits or partly in one form and partly in another and in default of agreement thereon between the Company and the person seeking such compensation the entitlement to and the amount and nature of such compensation shall upon application by such person be determined in accordance with the procedures provided for in Part VII. of the Mining Ordinance, such person or (as the case may be) the Company having from such determination the rights of appeal set out in the said Part VII.
- (e) The Company shall not save as is hereinbefore provided in this Clause be liable for any loss damage disturbance or interference caused by the disposal by the Company of any of the said overburden or tailings and save as aforesaid neither the Administration nor any governmental authority or person shall be entitled to any remedy in respect thereof but nothing in this paragraph shall exclude any liability for negligence.
- (f) In addition to complying with the present provisions of the Regulations made under the *Mines and Works Regulation Ordinance 1935-1962* of the Territory relating to safety and protection the Company—
- (i) shall when any dump for overburden and tailings established by it for the purpose of its operations under this Agreement ceases to be utilized for such purpose ensure that in order to facilitate the rapid regeneration of vegetation thereon such dump is left with a reasonably flat upper surface; and
 - (ii) shall within a reasonable time after any such dump ceases to be utilized as aforesaid carry out experiments for the determination of whether vegetation can be established thereon and use its best endeavours to establish thereon vegetation of a type which can be so established,
- but the Company shall not be required to do any further or other acts or carry out any further or other works for the rehabilitation or restoration of any of the areas affected by its operations under this Agreement.

16. FURTHER PROCESSING.

The Company may at any time and from time to time after it makes application pursuant to Clause 5(a) submit to the Administration a proposal for the establishment by it in the area in the Territory specified in the proposal of facilities for the processing to the metallic or some further stage of any concentrates produced as a result of the Company's operations under this Agreement and the Administration shall within two months of such submission notify the Company whether or not it objects (on the ground that the same would have a substantially detrimental effect on the agriculture and general amenity of the surrounding area) to the establishment of such facilities in the area specified in the proposal and provide to the Company the detailed reasons for its decision and the Company may within two months of such notification refer to arbitration as hereinafter provided in this Agreement the question whether any objections made by the Administration were justified on such ground. If the Administration does not so object, or it objects but upon the arbitration it is determined that the Administration's objections were not so justified the Company shall be at liberty at any time thereafter to establish facilities in accordance with its proposal and carry out processing at such facilities and the Company may at any time and from time to time thereafter apply to the Administration for the leases specified in the application to be granted to it over or in respect of the relative areas specified in the application which leases shall be those reasonably needed by the Company therefor including (without prejudice to the generality of the foregoing) those needed for adequate buffer zones covering areas likely to be affected by fume dispersal. The provisions of paragraphs (d) (e) (f) (g) (h) and (i) of Clause 5 shall apply mutatis mutandis to such application and the leases granted pursuant thereto.

17. NO INTERFERENCE OR EXPROPRIATION.

- (a) The Company shall be at all times entitled and permitted fully to enjoy all the rights, benefits and privileges granted or intended to be granted by or as a result of this Agreement and the same and also the rights of all past present and future members of the Company and beneficial owners of shares in the Company fully to enjoy the benefit of their shareholdings or their interests in shares and other rights arising therefrom shall at no time be to the detriment of the Company or such members or beneficial owners

substantially altered or impaired impeded or interfered with by executive or administrative action or in any other manner whatsoever (whether directly or indirectly) and without affecting the generality of the foregoing—

- (i) subject to the provisions of this Agreement, the Company's present freedom of choice of directors, managers, executives, advisers, consultants, associates, employees, contractors, suppliers and customers and its present freedom to declare credit and pay dividends and to grant other rights to its members shall continue without substantial interference; and
 - (ii) no discriminatory action whether by way of industrial fiscal or social legislation or otherwise shall be taken against the Company or all or any of the members of the Company or the other persons mentioned in sub-paragraph (i) of this paragraph in their capacities as such in relation to the Company.
- (b) So long as the Company complies with this Agreement and with any lease granted thereunder, the Administration—
- (i) shall not cancel or permit the cancellation of any such lease or require the surrender of the whole or any part of any area the subject of any such lease; and
 - (ii) shall not resume or expropriate or permit the resumption or expropriation of any asset (whether movable or not) of the Company used in connection with any of its operations under this Agreement, any of the products (whether processed or otherwise) resulting from such operations, the business of the Company, or any shares held or owned by any person in the Company.

PROVIDED THAT nothing in this paragraph shall prevent the acquisition pursuant to the provisions of the Land Ordinance of any land or interest therein the subject of any such lease—

- (A) if such acquisition is necessary for the defence of the Commonwealth of Australia or of the Territory or for securing the public safety of the said Commonwealth or of the Territory; or
- (B) if such acquisition is for a purpose which is at present a public purpose under the Land Ordinance and does not prejudice the Company or interfere with its present or prospective operations under this Agreement.

For the purposes of this paragraph "expropriation" includes in the case of an asset, product or share any substantial interference with the rights of the owner fully to utilize and enjoy or to deal with or dispose of the asset product or share and in the case of a business any substantial interference with the rights of the owner to control or carry on or to deal with or dispose of that business but does not include any action which would not but for this definition constitute expropriation and which is equitable and is in the circumstances of the case and having regard to similar action taken in relation to other persons in the Territory reasonable and necessary for the peace order and good government of the Territory.

- (c) Nothing in this Clause shall derogate from any other provision of this Agreement limiting the action which may be taken or permitted to be taken against the Company.

18. ASSIGNMENT.

The Company shall have the right to—

- (i) assign mortgage charge sublet or dispose of the whole or any part of the rights of the Company under this Agreement including its rights to or as holder of any lease granted hereunder, to any wholly-owned subsidiary of the Company and, in the case of subletting of any land on which a dwelling is erected, to any person, as of right and save as aforesaid with the consent in writing of the Administration (which consent shall not be unreasonably withheld); and
- (ii) appoint a wholly-owned subsidiary of the Company or with the consent of the Administration (which consent shall not be unreasonably withheld) any other person to exercise all or any of the powers functions and authorities conferred on the Company under this Agreement.

subject in the case of any assignment under this Clause to the assignee undertaking to the Administration to observe and comply with all the obligations of the Company in relation to the matter

assigned. Upon the giving of any such undertaking the Company shall have no further obligation in relation to the matter assigned.

19. VARIATION OF LEASES.

The Administration and the Company may from time to time by mutual agreement in writing add to cancel or vary any of the provisions of any instrument evidencing any lease granted under this Agreement.

20. EXTENSIONS OF TIME.

- (a) Notwithstanding any provision of this Agreement the Administration may at the request of the Company from time to time extend any period referred to in this Agreement for such period or substitute for any date referred to in this Agreement such later date as it thinks fit.
- (b) If and whenever the Company is prevented or hindered by any circumstance or event of a kind set out in Clause 24 from undertaking (at a time at which the Company reasonably desires to do so) all or any of the activities referred to in Clause 3(b) (i) or Clause 6(a) then—
- (i) in the case of prevention or hindrance of all or any of the activities referred to in Clause 3(b) (i)—the period mentioned in Clause 5(a) shall be extended by a period equal to the period during which such prevention or hindrance continues; and
 - (ii) in the case of prevention or hindrance of all or any of the activities referred to in the said Clause 6(a)—the period of five years mentioned in the said Clause 6(a) shall be extended by a period equal to the period during which such prevention or hindrance continues.
- (c) If at any time or from time to time prior to the expiration of the relative period (and any extension thereof) the Company notifies the Administration that in the conditions then prevailing (whether in the Territory or elsewhere) it requires an extension, for the period specified in the notice, of the period of five years mentioned in Clause 6(a) in order to enable it to complete all marketing and financial arrangements necessary or requisite for the proper and profitable development of the deposits referred to in Recital (1) and submits to the Administration its detailed reasons for concluding that it will require such an extension, then unless within two months of such notification the Administration refers to arbitration as hereinafter provided in this Agreement the question of whether the Company reasonably requires such an extension or if on reference to arbitration the Administration is unable to substantiate that the Company does not reasonably require such an extension and (if the question arises) that the period specified in the said notice to the Administration is not the proper length of such extension, the said period shall be deemed to be extended accordingly. If on reference to arbitration the Administration is able to substantiate that the period specified in the said notice is not the proper length of such extension then the said period shall be deemed to be extended by the period determined upon the arbitration to be necessary or requisite.
- (d) Where any period is or is deemed to be extended or any later date substituted for an earlier date under this Clause, that period as so extended or that later date shall be deemed for all the purposes of this Agreement to be substituted for the relative period or date referred to in this Agreement (notwithstanding that at the time of such extension or substitution such period may have expired or such date may have been passed).

21. COMPANY'S RIGHTS OF FIRST REFUSAL.

Notwithstanding anything hereinbefore contained in this Agreement, if the Company's rights under Clause 3 have previously terminated under paragraph (f) (i) or (f) (iii) thereof or if this Agreement has previously been determined under Clause 6 the Administration shall not within ten years thereafter grant or permit the grant or undertake to grant or permit the grant to any person other than the Company (whether by way of mining tenement or otherwise) of the right to mine copper or any ore of copper from (in the case of termination under paragraph (f) (i) or (f) (iii) of Clause 3) any part of the area the subject of the Prospecting Authorities at the time of termination or from (in the case of determination under Clause 6) any part of the area the subject of the special mining lease at the time of determination unless it has first made an offer to the Company to grant or procure the grant to the Company of such right upon and subject to the same terms and conditions (whether as to rent, royalty or any other matters whatsoever and whether or not to be contained in the instrument

evidencing such mining tenement or other right itself or in any other instrument or contract) as those upon and subject to which the Administration is bona fide prepared to grant or permit the grant of the said mining tenement or other right to such other person and the Company shall have failed for a period of twelve months after the date of receipt of such offer to accept the same PROVIDED THAT for the purpose of this Clause the Administration shall be deemed to have made an offer to the Company upon and subject to the same terms and conditions as those upon and subject to which it is bona fide prepared to grant or permit the grant of the said mining tenement or other right to another person as aforesaid if—

- (i) the only difference between the relative terms and conditions is that any period specified in the terms and conditions offered to the Company within which the Company may apply for such mining tenement or other right to be granted to it is shorter than any corresponding period specified in the terms and conditions upon which the Administration is bona fide prepared to grant or permit the grant of the said mining tenement or other right to any other person as aforesaid; and
- (ii) the difference between such periods is not more than is fair and reasonable having regard to the investigations assessments and inquiries already made prior to the execution of or under this Agreement and to whether such other person has or will have access to the results of the same.

22. **SECURITY.**

- (a) The Administration shall not without the prior consent of the Company divulge to any person (not being an officer of the Administration or of the Government of the Commonwealth of Australia engaged in his duties) any of the information provided to it by the Company pursuant to Clause 4(b) or 6(d) and shall use its best endeavours to prevent information being divulged in a manner contrary to the provisions of this paragraph by any persons who are or have at any time whether before or after the date hereof been officers of the Administration.
- (b) Nothing in this Clause shall prevent the disclosure of information relating solely to the nature and results of prospecting operations conducted by the Company in an area which is not at the time of disclosure the subject of the Prospecting Authorities or the special mining lease.

23. **ARBITRATION.**

- (a) If at any time there is any dispute question or difference of opinion between the parties hereto concerning or arising out of this Agreement or its construction meaning operation or effect or concerning the rights duties or liabilities of either of the parties hereto or there is any dispute question or difference of opinion which by the preceding provisions of this Agreement is to be or may be referred to arbitration, the same shall subject to paragraph (b) of this Clause stand referred to the arbitration of a single arbitrator and such reference shall be considered a submission within the meaning of that expression given by the *Arbitration Ordinance 1951* of the Territory.
- (b) After any such dispute question or difference of opinion has arisen either party hereto may at any time prior to the appointment of an arbitrator by concurrence of the parties or pursuant to the said Ordinance by notice to the other party elect that the provisions of this paragraph shall apply to such dispute question or difference of opinion and in such event—
 - (i) the dispute question or difference of opinion shall stand referred to the arbitration of three arbitrators one of whom shall be appointed by each of the parties hereto and the third of whom (who shall unless the parties hereto otherwise agree in writing be ordinarily resident outside the Territory and the Commonwealth of Australia) shall be agreed upon by the parties in writing and in default of agreement within fourteen days after one party gives notice to the other party requiring the appointment of such a third arbitrator shall be appointed by the President of the International Chamber of Commerce;
 - (ii) if any arbitrator refuses to act is incapable of acting or dies a new arbitrator shall be appointed by the party appointing the original arbitrator or (in the case of the third arbitrator) in accordance with the procedure provided for in sub-paragraph (i) of this paragraph;

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- (iii) if on such a reference one party fails to appoint an arbitrator either originally or by way of substitution as aforesaid within fourteen days after the other party (having appointed its arbitrator) has given to it notice to appoint such arbitrator the arbitration may proceed in the absence of such arbitrator;
 - (iv) such arbitration shall be held at such place (whether within or outside the Territory) as the arbitrators determine; and
 - (v) subject to the preceding provisions of this paragraph, the provisions of paragraph (a) of this Clause shall apply to such arbitration.
- (d) If either party to any arbitration under this Clause so requests the arbitrator or arbitrators shall state in the form of a special case for the opinion of the Supreme Court of the Territory any question of law arising in the course of the reference and any opinion given shall be subject to the normal right of appeal.

24. FORCE MAJEURE.

- (a) The Administration shall not be liable to the Company nor shall the Company be liable to the Administration for any delay or failure in the performance of obligations under this Agreement, if such delay or failure is beyond the reasonable control of the party so delaying or failing and is caused by or arises from Acts of God, force majeure, floods, storms, tempests, washaways, earthquakes or other seismic disturbances, fires, acts of war (whether declared or undeclared), revolutions, acts of public enemies, riots, civil commotions, strikes, lockouts, stoppages, restraints of labour or other similar acts (whether partial or general), shortages of labour or essential materials, failure to secure contractors, delays of contractors or any other cause or causes whatsoever PROVIDED THAT no delay or failure on the part of the Administration shall be deemed to be beyond the reasonable control of the Administration for the purposes of this Clause if it was caused by or arises from any act or omission of any governmental authority.
- (b) Any party hereto who is relieved by paragraph (a) of this Clause of the consequences of any delay or failure shall take all reasonable steps to minimize the effect of such delay or failure as soon as possible after the occurrence of the cause or causes thereof.

25. STAMP DUTY.

No stamp duty shall be payable on or in respect of—

- (i) the transfer to the Company of the Prospecting Authorities;
- (ii) any instrument evidencing the grant of any lease to the Company under this Agreement;
- (iii) any assignment, mortgage, charge, sublease, disposition or appointment made pursuant to Clause 18;
- (iv) any instrument evidencing or relating to or securing the repayment of any loan made or to be made to the Company; or
- (v) any instrument evidencing or relating to an issue of shares by the Company,

PROVIDED THAT nothing in this Clause shall apply to any transfer, instrument, assignment, mortgage, charge, sublease, disposition or appointment executed more than ten years after the Company has completed the performance of its obligations under Clause 6(a).

26. NOTICES.

All notices notifications consents approvals undertakings applications requests offers reports returns and proposals required to be or which may be given made furnished or submitted under this Agreement shall unless the context otherwise requires be in writing signed by the Administrator or (as the case may be) a Director or the Secretary of the Company and if in writing shall be sufficiently given made furnished or submitted if delivered at or posted by prepaid post to the address for service of the party to whom it is to be given made furnished or submitted and all such communications if posted as aforesaid shall be deemed to have been received in the ordinary course of post. The address for service of the Administration shall be Konedobu in the Territory or such other address as the Administration from time to time by notice to the Company substitutes for such address and the address for service of the Company shall be Panguna on the Island of Bougainville or such other address as the Company from time to time by notice to the Administration substitutes for such address.

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27. GOVERNING LAW.

This Agreement shall be governed by the law of the Territory.

SCHEDULE.

TERRITORY OF PAPUA AND NEW GUINEA.

Mining Ordinance 1928-1966 of the Territory of New Guinea.

Special Mining Lease.

I, _____, Administrator of the Territory of Papua and New Guinea, by virtue of the powers conferred by the *Mining Ordinance 1928-1966* of the Territory of New Guinea and the *Mining (Bougainville Copper Agreement) Ordinance 1967* of the Territory of Papua and New Guinea and all other powers me enabling, hereby grant and demise to BOUGAINVILLE COPPER PTY. LIMITED (hereinafter called "the Company" which expression shall include its successors and assigns) ALL THAT piece of land being the whole of the land particularly described and delineated on the plan annexed hereto and signed by me for the purpose of identification and all those mines veins seams lodes and deposits of copper and such gold and other minerals as are combined in the land with such copper in such a way that they must necessarily be mined in the mining of such copper in on or under the said land together with the right and liberty to use the said land for the mining of such minerals and for all purposes necessary for the effectual carrying on of such mining or for the carrying out of any of the other operations of the Company under the Agreement made the _____ day of June, One thousand nine hundred and sixty-seven, between the Administration and the Company (hereinafter called "the Agreement") or the said *Mining (Bougainville Copper Agreement) Ordinance 1967* including without prejudice to the generality of the foregoing all of the purposes for which a mining purposes lease may be granted under the *Mining Ordinance 1928-1966* of the Territory of New Guinea TO HOLD the said land and the said mines veins seams lodes and deposits for the term of forty-two years from the _____ day of _____, One thousand nine hundred and _____, with the right to renew the same for further periods each of twenty-one years as provided in the Agreement but upon and subject to the provisions of the Agreement and the *Mining (Bougainville Copper Agreement) Ordinance 1967* and subject thereto to the *Mining Ordinance 1928-1966* of the Territory of New Guinea YIELDING and paying therefor the rent and royalty provided for in the Agreement PROVIDED THAT without the prior written consent of the Company this lease may not be determined or forfeited the Company may not be required to surrender this lease and the said land or any part thereof may not be resumed otherwise than in accordance with the Agreement.

Dated at _____ this _____ day of _____ One thousand nine hundred and _____

IN WITNESS whereof the parties hereto have executed this Agreement the day and year first above-written.

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SIGNED SEALED AND DELIVERED for and on behalf of the Administration of the Territory of Papua and New Guinea by DAVID OSBORNE HAY the Administrator of the Territory in the presence of:

(Sgd.) D. O. HAY.

(Sgd.) F. C. Henderson.

THE COMMON SEAL of BOUGAINVILLE COPPER PTY. LIMITED was hereto affixed by authority of a resolution of the Board of Directors:

L.S.

(Sgd.) F. Espie, Director.

(Sgd.) P. W. Quodling, Secretary.

SCHEDULE 2.

Sec 1.

THE 1974 AGREEMENT.

THIS AGREEMENT is made the twenty-first day of November One thousand nine hundred and seventy-four, between THE GOVERNMENT OF PAPUA NEW GUINEA (hereinafter called "the Government") of the one part and BOUGAINVILLE COPPER LIMITED a Company incorporated in Papua New Guinea and having its registered office at Panguna on Bougainville Island in Papua New Guinea (hereinafter called "the Company" which expression shall include its successors and assigns) of the other part.

WHEREAS:

(1) On the sixth day of June, One thousand nine hundred and sixty-seven The Administration of the Territory of Papua and New Guinea of the one part and Bougainville Copper Pty. Limited of the other part entered into a certain agreement (hereinafter called "the 1967 Agreement") relative, inter alia, to the terms and conditions upon which the said Bougainville Copper Pty. Limited should be permitted to mine ores from certain land on Bougainville Island, to concentrate such ores, to transport the concentrates so derived to wharf facilities and to ship such concentrates from such facilities in commercial quantities.

(2) On the ninth day of August, One thousand nine hundred and seventy-three the said Bougainville Copper Pty. Limited did convert to a public company and the name of the said Bougainville Copper Pty. Limited is now Bougainville Copper Limited.

(3) Section 9A of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that the Government is a body politic with perpetual succession by the name "The Government of Papua New Guinea" and is (subject to that Act) capable by that name of suing and being sued, making contracts, acquiring, holding and disposing of real and personal property, and doing and suffering all other matters and things a body corporate may do or suffer.

(4) Section 13 of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that subject to that Act the Government shall be administered by the High Commissioner of Papua New Guinea.

(5) Section 37 of the Papua New Guinea Act (No. 2) 1973 of the Commonwealth of Australia provides that on the date of commencement of Section 5 thereof, all real and personal property of the Administration is, by force of that Section 37, transferred to, and vested in, the Government and there are also transferred to, and vested in, the Government.

- (a) all rights and liabilities of the Administration subsisting immediately before that date; and
(b) all rights and liabilities of the Commonwealth of Australia subsisting immediately before that date by virtue of a contract or agreement entered into on behalf of the

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Commonwealth of Australia in accordance with the Administration Contracts Ordinance 1950 or that Ordinance as amended or in accordance with a law repealed and replaced by that Ordinance.

(6) The Government and the Company have after a series of negotiations in the year One thousand nine hundred and seventy-four agreed that certain changes should be made to the 1967 Agreement and in particular to Clause 7 thereof.

(7) Such negotiations took account of the establishment by the Company on Bougainville Island pursuant to the provisions of the 1967 Agreement of a copper mine, copper concentrating facilities, roads and wharf facilities, and other facilities relative thereto at a total cost of over \$400 000 000, and further took account of the profits realised by the Company and of the expectation that its operations would continue to be profitable.

(8) Such negotiations also took account of the change in status of Papua New Guinea since the year One thousand nine hundred and sixty-seven to a stage of emerging nationhood and imminent independence and the need to modify certain provisions of the 1967 Agreement to accord with that change in status.

(9) Such negotiations also took account of the fact that the minerals mined and converted by the Company into saleable form are a non-renewable asset belonging to Papua New Guinea and that accordingly it is the responsibility of the Government to ensure that the taxes to be paid by the Company provide at all times for Papua New Guinea an equitable return on the minerals which the Company is extracting.

(10) The Government recognizes the role of the Company as the major pioneer investor in Papua New Guinea and recognizes further that any variations to the 1967 Agreement should be framed bearing that fact in mind.

(11) The Government and the Company while acknowledging that legislative sovereignty in Papua New Guinea is vested in Parliament wish the 1967 Agreement, as varied hereby, to be an enduring arrangement and do not intend that it should be altered by any unilateral action but only with the mutual consent of the Government and the Company.

NOW THIS AGREEMENT WITNESSES AS FOLLOWS:

1. Clause 1 of the 1967 Agreement is varied

(a) by the addition of the following definition after the definitions of "Administration land", "mineral", "mining tenement", "private land", "prospecting authority" and "secondary prospecting authority":

"Amendment Date" means the date upon which the Agreement made the twenty-first day of November, One thousand nine hundred and seventy-four between the Government of the one part and the Company of the other part comes into effect; and

(b) by the addition of the following definition after the definition of "f.o.b. revenue":

"the Government" means The Government of Papua New Guinea;

2. Clause 1 of the 1967 Agreement is further varied by the addition of the following paragraph after paragraph (d) thereof:

"(d) In this Agreement, unless the context otherwise requires a reference to the Administration shall be read as a reference to the Government and a reference to the Territory shall be read as a reference to Papua New Guinea."

3. Clause 5(l) of the 1967 Agreement is varied by the addition of the following after the word "land" at the end thereof:

"PROVIDED THAT the parties hereto shall, at the meeting which takes place pursuant to Clause 26A hereof during the twenty-first year after the year in which the Amendment Date occurs consider whether it would be appropriate to adopt arrangements other than those set out in the provisions of this paragraph"

4. Clause 5 of the 1967 Agreement is varied by the addition of the following paragraphs after paragraph (m) thereof:

"(n) Notwithstanding anything contained in the foregoing paragraphs of this Clause or otherwise but subject always to paragraph (o) hereof the Government may to the extent that such lease or leases or special mining lease or special mining leases would be over or in respect of all or part of the Mainoki and Karato areas delay procuring the grant to the

Company of the lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) specified in any application by the Company pursuant to paragraph (a) or (c) of this Clause until such time as the Government in its absolute discretion decides that development of the Mainoki and Karato areas may proceed.

- (a) Until such time as the Government shall have notified the Company in writing that in the exercise of its discretion aforesaid it has decided that development of the Mainoki and Karato areas may proceed
- (i) any application by the Company pursuant to paragraph (a) or (c) of this Clause for a lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) the grant of which to the Company the Government is permitted pursuant to paragraph (n) of this Clause to delay procuring will to the extent that such lease or leases or special mining lease or special mining leases would be over or in respect of all or part of the Mainoki and Karato areas stand deferred PROVIDED THAT notwithstanding anything contained in this Clause or in any law any application which so stands deferred shall continue in full force and effect; and
- (ii) the Company shall not without the prior consent of the Government engage in any further prospecting or exploration activities on areas (other than any area which falls within the area or areas of land over which the special mining lease extends) the subject of the Prospecting Authorities PROVIDED THAT this sub-paragraph is without prejudice to the continued validity of the Prospecting Authorities and does not derogate from the obligations of the Government to cause to be granted to the Company successive extensions of the terms thereof.
- (p) If, at any time before the Government has pursuant to paragraph (a) notified the Company that it has decided that development of the Mainoki and Karato areas may proceed, the Government so requests the parties shall meet together with a view to considering in good faith the manner in which such development should proceed, if it were to do so, and with a view further to discussing inter alia:
- (i) whether or not any other company or other enterprise should conduct such development and, if so, the extent to which each of the Government and the Company should beneficially be interested in such other company or other enterprise and the manner in which and the consideration for which their respective interests (if any) should be taken up (it being contemplated by the parties that the Government shall have the right to take up a majority beneficial interest should it so desire); and
- (ii) whether or not the relevant lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) should, notwithstanding anything contained in this Clause or in any law, be granted direct to any such other company or other enterprise as is referred to in sub-paragraph (i) hereof and; if so, the terms upon which it or they should be so granted.
- (q) For the purposes of this Clause, the Mainoki and Karato areas are those areas on Bougainville Island within Prospecting Authority 7B held by the Company and being more particularly described in the plan and description accompanying that plan initialled on behalf of the parties for identification prior to the execution hereof."

5. The 1967 Agreement is varied by the deletion therefrom of Clause 7 thereof and by the substitution therefor of the following:

"7. (a) Except where the contrary intention appears, either expressly or by implication, the provisions of the Income Tax Act which are not inconsistent with the provisions of this Agreement are applicable to the Company.

(b) The income of the Company for the period from the 1st day of April, 1972, the date on which the Company first entered into commercial production of copper concentrates under this Agreement, to the 31st day of December, 1973 is and shall continue to be exempt from income tax; save as hereafter provided no amounts which would but for such exemption have been deducted in the determination of the amount of taxable income derived during the aforesaid period shall be deducted in the determination of the

- amount on which is calculated the income tax payable by the Company in respect of any period following that period.
- (c) If the rate of tax in respect of the taxable income of the Company for the Tax year commencing on the 1st day of January, 1975, and for any subsequent Tax year, determined in accordance with the provisions of Part I of the Second Schedule hereto, is higher than the rate of tax which would otherwise be applicable in respect of the taxable income of the Company for that Tax year the Company will be liable to pay income tax on its taxable income for that Tax year calculated at the rate determined in accordance with such provisions.
 - (d) For the purpose of determining the amount of income tax payable by the Company in respect of the Tax year commencing on the 1st day of January, 1974 the Chief Collector shall assess tax on the basis that the first six months of that Tax year and the second six months of that Tax year comprised separate and distinct periods of taxable income and in determining the taxable income of the Company for each of those periods one half of the total amount which would otherwise have been allowable as deductions from the assessable income derived by the Company during the whole of that Tax year shall be allowable as a deduction from the assessable income deprived by the Company during each of those periods.
 - (e) The tax payable by the Company in respect of the Tax year commencing on the 1st day of January 1974 shall be the total of the amount of tax payable in respect of the taxable income of the Company for the first six months of that Tax year determined in accordance with the provisions of Part II of the Second Schedule hereto and the amount of tax payable in respect of the taxable income of the Company for the second six months of that Tax year determined in accordance with the provisions of Part III of the Second Schedule hereto.
 - (f) In respect of the Tax year commencing on the first day of January, 1974 and in respect of each subsequent Tax year the company shall be entitled to deductions from its assessable income in respect of expenditure of a capital nature as follows :—
 - (i) Where that expenditure relates to a unit of property in respect of which depreciation is an allowable deduction under the provisions of Subdivision A of Division 3 of Part III of the Income Tax Act or otherwise under that Act howsoever than under the provisions of Division 10 of Part III the amount of allowable deduction in respect of any such unit of property in relation to each Tax year (the first of which shall be the Tax year during which that unit of property was first used by the Company or installed ready for use) shall be the greater of one-twentieth of the cost of that unit or such proportion of that cost as may be allowable as a deduction from assessable income under the Income Tax Act PROVIDED THAT the amount of deduction allowable in respect of the Tax year in which such unit of property was first used or installed ready for use shall be such proportion of the amount which would have been allowable as a deduction if such unit of property had been first used or installed ready for use on the first day of that Tax year as bears to such lastmentioned amount the same proportion which the unexpired period of the Tax year at the time such unit was first used or installed ready for use bears to the whole period of that Tax year.
 - (ii) Where any unit of property of the kind referred to in sub-paragraph (i) above is by reason of the provisions set out in sub-paragraph (C) below deemed to have been first used on the first day of January, 1974 but was disposed of lost or destroyed prior to that date the cost of that unit of property on the first day of January, 1974 shall be deemed to be the actual cost thereof less any consideration received or receivable by the Company in respect of such disposal loss or destruction.
 - (iii) Where that expenditure does not relate to a unit of property in respect of which depreciation is an allowable deduction as mentioned in sub-paragraph (i) above the amount of allowable deduction in respect of such expenditure in relation to each Tax year shall be the greater of one-twentieth of that amount or such amount as may be allowable as a deduction for tax under the Income Tax Act including the provisions of Division 10 of Part III thereof.
 - (iv) Where any expenditure of a capital nature of the kind referred to in sub-paragraph (iii) above is by reason of the provisions set out in sub-paragraph (B) below

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deemed to have been incurred on the 1st day of January, 1974 but the property in respect of which such expenditure was incurred has been disposed of lost or destroyed prior to that date the cost of that property on the 1st day of January, 1974 shall be deemed to be the actual cost thereof less any consideration received or receivable by the Company in respect of such disposal loss or destruction.

- (v) The total of any deductions allowable pursuant to sub-paragraph (i) above in respect of any unit of property shall not exceed the cost of that unit of property and the total of any deductions allowable pursuant to sub-paragraph (iii) above in respect of any item of capital expenditure shall not exceed the cost of that item of capital expenditure.
- (vi) For the avoidance of doubt it is declared that the provisions of the Income Tax Act relating to the disposal, loss or destruction of any unit of property or of property in respect of which expenditure of a capital nature was incurred (which provisions are at the Amendment Date contained in Sections 78 and 160 of the Income Tax Act) shall apply to the Company.

For the purposes of this paragraph

(A) expenditure of a capital nature means

- (1) all expenditure incurred by the Company prior to the 1st day of January, 1974 for the purposes of its activities in Papua New Guinea and being expenditure of the kind in respect of which a deduction was allowable under Division 10 of Part III of the Income Tax Act as it existed on the 31st day of December, 1973, expenditure on plant, machinery, equipment, buildings (including houses), roads, earthworks, development of the Company's mining property, and any improvements on any leasehold property, exploration and prospecting expenditure, and all expenditure on units of property in respect of which depreciation was an allowable deduction under Division 3 of Part III of the Income Tax Act as it existed on the 31st day of December, 1973; and
 - (2) all expenditure of a capital nature incurred by the Company after the 31st day of December, 1973 for the purposes of its activities in Papua New Guinea and being expenditure in respect of which a deduction is allowable from gross income for the ascertainment of taxable income for income tax purposes under the Income Tax Act.
- (B) all expenditure of a capital nature incurred by the Company prior to the 1st day of January, 1974 shall be deemed to have been incurred on the 1st day of January, 1974;
- (C) any unit of property which was first used by the Company or installed ready for use before the 1st day of January, 1974 shall be deemed to have been first used by the Company on the 1st day of January, 1974; and
- (D) all interest capitalised by the Company in respect of any period prior to the 1st day of April, 1972 shall be deemed to be expenditure of a capital nature.
- (g) As from the 1st day of January, 1974 the provisions of the now repealed Section 33 of the Income Tax Act 1959 (as then amended) referred to in Clause 7(e) of this Agreement prior to its variation by the Variation Agreement dated 21st November, 1974 shall not so long as that Section remains repealed apply to the Company.
- (h) (i) All expenditure incurred by the Company prior to the 1st day of January, 1974 in borrowing money used by the Company for the purpose of producing income shall for the purposes of Section 89 of the Income Tax Act be deemed to have been incurred on the 1st day of January, 1974 and the period for which the money was borrowed shall be deemed to be a period of five years commencing on the 1st day of January, 1974 and ending on the 31st day of December, 1978.
- (ii) Notwithstanding anything contained in Sections 68 or 89 of the Income Tax Act or in this Agreement the Company shall not be entitled to any deduction for any interest paid by it before the 1st day of January, 1974 other than interest referred to in paragraph (f) (D) above.

- (i) The Government recognises that abnormal conditions of inflation would cause the formula set out in Part 1 of the Second Schedule hereto to bear more severely on the Company in future years than is intended. In the event therefore of the occurrence of abnormal conditions of inflation in any Tax year commencing after 31st December, 1974 the Company may claim an increase in the amount of "N" in that formula. Upon receipt of any such claim the Minister for the time being responsible for finance and the Company will forthwith confer with a view to deciding by mutual agreement having regard to all the circumstances whether and if so to what extent "N" in that formula should be increased, such increase to be effected by a variation of this Agreement pursuant to Section 5 of the Act referred to in Clause 2 hereof, PROVIDED ALWAYS THAT if no agreement is reached to vary this Agreement as aforesaid the Company shall not be entitled to refer the matter to arbitration under Clause 23 of this Agreement. The Company shall not as a result of all or any of the provisions of this paragraph have any enforceable claim right of action or other remedy whatsoever (whether in respect of any obligation to confer as above or otherwise).

For the purpose of this paragraph abnormal conditions of inflation shall be deemed to occur in any Tax year if in that Tax year the annual rate of inflation as measured by the average annual increase in the consumer price index of the United States of America (as published on the Amendment Date in the International Monetary Fund's International Financial Statistics) in that year exceeds by 20 per cent or more the average rate of increase in that index in the five years ending at the end of that Tax year.

- (j) If at the end of any Tax year or years the U.S. dollar value of the International Monetary Fund Special Drawing Rights has varied by more than 10% from such value on the 15th day of November, 1974 then if the Government and the Company agree that the factor $\frac{F}{B}$ as used in the ascertainment of "N" as provided in the Second Schedule hereto is producing unintended or abnormal results, the Government and the Company will as soon as conveniently possible after the end of the relevant Tax year confer with a view to making appropriate adjustments to that factor.
- (k) (i) In this paragraph, unless the context otherwise requires, "dividend (withholding) tax" means
- (A) "dividend (withholding) tax" as defined by the Income Tax Act as in force on the 1st day of January, 1974 as that definition may from time to time be amended and
 - (B) any tax of a similar nature payable in respect of dividends or other distributions of profits to shareholders; and
- "gross dividend" means
- the dividend which would have been payable by the Company but for the deduction therefrom of dividend (withholding) tax.
- (ii) Subject to sub-paragraph (iii) hereof, the amount of income tax payable by the Company in respect of any Tax year shall be determined by reducing the amount of income tax which would, but for this paragraph, have been payable by the Company in respect of that Tax year by an amount (herein called "the deduction amount") equal to the aggregate of the following two amounts, or, where only one such amount is payable or deductible by the Company in respect of any particular Tax year by that amount:
- (A) an amount equal to the excess (if any) of
 - (1) the amount equal to the aggregate of the dividend (withholding) tax payable in respect of gross dividends payable by the Company to non-residents of Papua New Guinea in the relevant Tax year;
 - over
 - (2) the amount equal to 15% of the gross dividends payable by the Company to non-residents of Papua New Guinea in the relevant Tax year;
 - and
 - (B) the amount payable by the Company in the relevant Tax year in respect of any rate, tax, rent, charge, due, duty, tariff or other levy whatsoever (including but without in any way whatsoever limiting the generality of the foregoing excises, royalties, and the like impositions) raised, levied, charged or otherwise imposed by

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or payable to the Government or any other government established by or under any law in force in Papua New Guinea (whether supreme provincial district municipal local or otherwise) or any authority department or official whatsoever of or under the Government or any other government as aforesaid other than:

- (1) income tax,
- (2) import duties as permitted under Clause 9 (c) of this Agreement,
- (3) stamp duties as permitted under this Agreement,
- (4) royalties payable pursuant to and in accordance with Clauses 5 (h) and 5 (i) hereof,
- (5) rent payable in accordance with Clause 5 hereof,
- (6) light dues and pilotage referred to in Clause 11 (e) hereof,
- (7) local government rates or taxes on land used for housing where such rates or taxes are calculated in relation to the unimproved value of the land,
- (8) vehicle registration taxes as permitted under this Agreement,
- (9) any rent payable under any lease granted by the Government (other than as referred to in (5) above) where such rent
 - (a) is payable pursuant to the provisions of any such lease; or
 - (b) is in whole or in part payable in respect of any such lease under the provisions of a law of general application which does not discriminate or (having regard to reasonable standards) result in discrimination against the Company,
- (10) charges for services rendered,
- (11) payments made pursuant to Clause 16B hereof,
- (12) export duties as permitted under Clause 9(d) hereof,
- (13) other taxes or charges of a minor nature.

PROVIDED THAT there shall be deducted from the deduction amount the amount (if any) by which the tax payable by the Company is reduced as the result of the deduction from its assessable income of all or any part of the amount referred to in sub-sub-paragraph (B) of sub-paragraph (ii) of this paragraph.

- (iii) If the provisions of sub-paragraph (ii) hereof would have the effect of reducing the tax payable by the Company in respect of any Tax year below the amount which but for the provisions of paragraphs (c), (d) and (e) of this Clause would be payable by the Company in respect of that Tax year, the tax payable by the Company in respect of that Tax year shall be the amount calculated in accordance with the provisions of this Clause 7, but not including the provisions of paragraphs (c), (d) and (e) of this Clause.
- (iv) The Government will not impose dividend (withholding) tax on dividends payable by the Company otherwise than at a single flat rate and shall not impose such tax at a rate higher than the rate payable in respect of dividends payable by other companies to non residents of Papua New Guinea and if there is more than one such rate, the Government will impose on such dividends the lowest of such rates.
- (f) No rate, tax, rent, charge, due, duty, tariff or other levy and no legislation, procedure or practice relating thereto which discriminates against or (having regard to reasonable standards) results in discrimination against the Company any member of the Company or any beneficial owner of any share in the Company shall be payable by or (as the case may be) applicable to the Company or any such member or beneficial owner (as the case may be) in respect of the operations of the Company under this Agreement or of any income arising directly or indirectly therefrom.
- (m) No local government rates or taxes on land calculated otherwise than in relation to the unimproved value of the land shall be payable by the Company in respect of land held by the Company pursuant to the provisions of Clause 5 hereof.
- (n) (i) The Chief Collector shall on the application of the Company grant, upon the terms and conditions hereinafter appearing, an extension of time for the payment of part of the income tax payable in respect of all or any of the Tax years ending 31st December, 1975, 31st December, 1976 and 31st December, 1977.

- (ii) Any application for an extension of time pursuant to the provisions of this paragraph shall be in writing, shall expressly state that it is made pursuant to the provisions of this paragraph and shall be lodged with the Chief Collector not later than the later of fourteen (14) days before the due date for payment of the income tax payable in respect of the relevant year and thirty (30) days after the service upon the Company of the Notice of Assessment in respect of that Tax year.
- (iii) The amount of tax in respect of which the Company shall, at its election and upon application made in the manner hereinbefore provided, be entitled to be granted an extension of the time pursuant to this paragraph in respect of each of the said Tax years shall be the whole or such part of the amount determined in accordance with Part IV of the Second Schedule hereto as the Company shall notify to the Chief Collector at the time of making application pursuant to sub-paragraph (ii) hereof.
- (iv) Any tax for the payment of which an extension of time is granted pursuant to this paragraph shall, in lieu of any penalty for unpaid tax or additional tax and subject to the provisions of sub-paragraph (vi) hereof, bear interest calculated from the original due date for payment thereof until payment at the rate (compounded annually) which is five percentage points higher than the rate of interest per annum on four year Papua New Guinea Government Bonds which have most recently been issued (and even if by then matured) at the time the Company makes its application pursuant to sub-paragraph (ii) hereof in respect of the relevant Tax year.
- (v) Any amount of tax in respect of which an extension of time is granted pursuant to this paragraph and the interest payable thereon shall be paid to the Chief Collector in three (3) equal instalments on 30th September, 1980, 30th September, 1981 and 30th September, 1982 respectively. For the purpose of calculating the interest payable on the 30th September, 1980, the 30th September, 1981 and the 30th September, 1982 it shall be assumed that the amount of tax in respect of which the relevant extension of time was granted and which shall remain outstanding after the date in respect of which such calculation is being made shall be duly paid on the extended date or dates for payment thereof, to the effect that the amounts of the payments to be made on the abovementioned three (3) dates shall be equal and shall each include one-third of the total amount of interest, calculated at the rate first mentioned in sub-paragraph (iv) hereof, which will if all payments are duly made on the extended dates be payable in respect of the relevant overall extension of time for payment.
- (vi) In the event that default is made in the due payment on the extended dates of any amount of tax in respect of which an extension of time has been granted pursuant to this paragraph or of any interest payable in respect thereof the total of all outstanding income tax in respect of which any such extension of time has been granted together with the total amount of interest calculated at the appropriate rate (or rates) in sub-paragraph (iv) payable in respect of any income tax in respect of which any such extension of time has been granted, subject to an allowance in respect of any interest already paid, shall immediately become due and payable. In the event of such default, interest shall be payable to the Chief Collector at the rate at which interest would have been payable pursuant to sub-paragraph (iv) hereof (or if more than one such rate is applicable in respect of different parts of the outstanding income tax at the highest of such rates) upon the outstanding income tax and the total of interest owing at the date of such default or so much thereof as shall be from time to time outstanding provided that any payment or payments made after the date of such default shall be credited first to interest accruing and becoming payable after such default and then to interest accrued up until such default and then to the reduction of the outstanding income tax.
- (vii) For the avoidance of doubt:
 - (A) the Company shall be entitled, pursuant to this paragraph, to apply for an extension of time in respect of the relevant amount referred to in sub-paragraph (iii) hereof in respect of any one or more of the Tax years ending 31st December, 1975, 31st December, 1976 and 31st December, 1977;
 - (B) the Company shall be entitled to apply, pursuant to this paragraph, for an extension of time for the whole or any part of the amount calculated in accordance with paragraph (iii) hereof in respect of each or any of the said Tax years;

- (C) in the event that default is made in payment of outstanding tax in respect of any of the said three Tax years (or in payment of interest payable in respect of an extension of time granted in respect of any such Tax year), the whole of the outstanding tax in relation to any other Tax year or years in respect of which an extension of time has been granted pursuant to this paragraph (and all interest in relation thereto) shall also immediately become due and payable in accordance with sub-paragraph (vi) hereof;
- (D) the time within which such an application for an extension of time must be lodged in accordance with sub-paragraph (ii) hereof shall be calculated by reference to the due date for payment of income tax pursuant to the original assessment issued in respect of the relevant tax year to the effect that such time shall not be extended by the subsequent issue of any amended assessment provided that if the Company objects to such original assessment and the total amount of tax payable pursuant to such original assessment is subsequently reduced an appropriate adjustment shall be made in respect of the amount of tax for which an extension of time has been granted and interest payable in respect thereof.
- (viii) The amount of any interest payable by the Company pursuant to the provisions of this paragraph shall for the purposes of the Income Tax Act be deemed to be interest payable by the Company on money borrowed by the Company and an outgoing of the Company incurred in gaining assessable income.
- (o) Neither the Company nor any other person shall have any liability to any income tax on the payment or repayment of or measured by reference to the amount of any interest payable or any other amount payable in respect of any amount which is lent to the Company by any person who is not a resident of Papua New Guinea or on or in respect of the principal of any such loan if the amount in respect of which such interest or other amount is payable was lent to the Company before the 1st day of January, 1974.
- (p) The Company has, with the leave of the Chief Collector, adopted the period of a calendar year as its accounting period pursuant to Section 12 of the Income Tax Act.
- (q) In this Clause, unless the context otherwise requires—
 "the Income Tax Act" means the Income Tax Act 1959 as amended from time to time
 "Tax Year" means the calendar year in respect of which the amount of tax payable by the Company is to be calculated
 and other expressions shall have the same meanings given to them in the Income Tax Act.
- (r) The provisions of Clause 23 hereof shall not apply in respect of any dispute, question or difference of opinion relating to the liability or the quantum of liability of the Company to income tax or in respect of any other matter arising under any paragraph of this Clause."
6. The 1967 Agreement is varied by the addition of the following Clauses after Clause 8 thereof:
- "8A. BORROWINGS BY THE COMPANY WITHIN PAPUA NEW GUINEA**
 No loan other than normal bank overdraft shall be raised by the Company within Papua New Guinea without prior notice to the Minister for the time being responsible for finance.
- 8B. DONATIONS**
 The Company shall not (without the prior approval of the Directors of the Company nominated by the Government) make any donation in excess of an amount to be agreed upon from time to time between the parties."
- Clause 9(c) of the 1967 Agreement is varied by the addition of the following after the word "fees" at the end thereof:
- "AND PROVIDED FURTHER THAT** notwithstanding anything contained in this paragraph the Government may impose import duties on the Company under the Customs Act (but only if such import duties are of general application in Papua New Guinea and, as required by Clause 7(1) hereof, do not discriminate against or (having regard to reasonable standards) result in discrimination against the Company) in respect of the importation into Papua New Guinea on and after the Amendment Date by the Company of any plant machinery or equipment required for the replacement of any of the plant machinery or equipment referred to in sub-paragraph (i) of this paragraph or of such of the explosives and reagents referred to in paragraph (b) of this

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Clause as could on the sixth day of June, One thousand nine hundred and sixty-seven have been imported into the Territory of Papua and New Guinea free of import duty under the Customs Ordinance 1951-1959 of that Territory".

8. Clause 9 of the 1967 Agreement is varied by the addition of the following paragraph after paragraph (d) thereof:

"(d) Any import duty which is sought to be imposed on the importation of any plant machinery equipment explosives or reagents which at the time when such duty is sought to be imposed are imported into Papua New Guinea solely for the purpose of mining operations or of operations in connection therewith and which is sought to be imposed at a rate in excess of the average rate of duty from time to time payable on the importation into Papua New Guinea of the Customs Tariff items numbered 118, 275, 284, 309, 313, 320 and 341.04 as set out on the Amendment Date in the Second Schedule to the Customs Tariff 1959-1974 shall, without in any way whatsoever limiting the interpretation of Clause 7(h) hereof or clause 9(d) hereof, be deemed to discriminate against the Company within the meaning of both Clause 7(h) and Clause 9(d) hereof."

9. The 1967 Agreement is varied by the addition of the following Clause after Clause 9 thereof:

9A. APPROVAL OF CONTRACTS, ETC.

- (a) Notwithstanding anything contained in any other provision of this Agreement where any law which is of general application in Papua New Guinea and which does not discriminate against or (having regard to reasonable standards) result in discrimination against the Company includes provisions for regulation of foreign investment in Papua New Guinea or for regulation of dealings in foreign exchange in Papua New Guinea or for control over exports from or imports into Papua New Guinea the Company shall be subject to those provisions on and after the Amendment Date PROVIDED THAT no breach of the provisions of any such law shall be constituted by any act or omission or commission or any event occurring or any circumstances otherwise existing before the Amendment Date.
- (b) If and to the extent that any law which includes provisions for regulation of foreign investment in Papua New Guinea or for regulation of dealings in foreign exchange in Papua New Guinea or for control over exports from or imports into Papua New Guinea applies to or in relation to any agreement or arrangement (including but without limiting the generality of the foregoing any agreement or arrangement for the sale or export of concentrates produced by the Company or for the borrowing of money by the Company or for payments by the Company in foreign exchange) entered into or made by the Company before the Amendment Date or to any business or activity carried on by the Company at or prior to the Amendment Date then any approval authorisation licence permission registration or other thing whatsoever required under any such law in respect of or in relation to any such agreement arrangement business or activity (including without limiting the generality of the foregoing investment by the Company necessary to maintain the Company's present activity of producing copper (contained in concentrates) at the rate of approximately 190 000 tonnes per annum) shall be deemed to have been duly and unconditionally given granted made or done (as the case may be) and shall not be capable of cancellation revocation variation or other modification or of otherwise being limited or affected in any way whatsoever except with the prior written consent of the Company or at the written request of the Company.
- (c) Without limiting the provisions of paragraph (b) hereof where under the provisions of any law an agreement or arrangement for the sale or export of any of the Company's products has been approved by the appropriate authority or a licence issued for the export of such products the approval so granted or the licence so issued shall not thereafter be revoked cancelled or in any way varied.
- (d) Notwithstanding anything expressly or impliedly to the contrary contained in the National Investment and Development Act and in particular notwithstanding the provisions of Section 4 of that Act the Company, in respect of the existing activities—
- (i) is hereby deemed to have complied with the said National Investment and Development Act in all respects and accordingly shall not be required to give any notice or information thereunder;
 - (ii) is hereby deemed to be registered in respect of each such activity;

- (iii) shall not be precluded from carrying on or (as the case may be) continuing to carry on business in respect of any such activity; and
 - (iv) shall be entitled, subject to the remaining provisions of this Agreement and to any other law not inconsistent with this Agreement which applies to the Company to carry on its business in respect of such activities to the full extent and without any impediment or hindrance whatsoever.
- (e) Notwithstanding anything expressly or impliedly to the contrary contained in the National Investment and Development Act and in particular notwithstanding the provisions of Section 4 of that Act such deemed registration as is referred to in paragraph (d) hereof in respect of existing activities as are hereinbefore referred to shall not be cancelled (in whole or in part) and shall not except at the request of the Company in accordance with the said National Investment and Development Act be varied (in whole or in part).
- (f) In this Clause unless the context otherwise requires words and expressions which are used in the National Investment and Development Act shall have the meanings which are assigned to them in that Act and any reference to that Act shall include a reference to that Act as it may from time to time be altered amended or re-enacted and "existing activities" means.
- (i) activities which the Company was carrying on at the Amendment Date; and
 - (ii) activities carried on thereafter in order to maintain the Company's production of copper (contained in concentrates) at the rate of approximately 190 000 tonnes per annum (including, but without in any way whatsoever limiting the generality of the foregoing, any expansion or other increase necessary for such purpose in the whole or any part of the mining and concentrating activities of the Company, including the addition of more ball mills and the increase in the facilities of the Company for the generation of power and the shipment of concentrates)."
10. The 1967 Agreement is varied by the addition of the following Clause after Clause 10 thereof:

"10A. CONDUCT OF THE COMPANY'S BUSINESS ADVISORY SERVICES

- (a) The Company shall conduct its business advisory services under the general policy direction of a steering committee to be established by the Bougainville Provincial Government and the Company shall, if such general policy direction requires, make its said business advisory services available on as widespread a basis as is reasonably possible to all areas of the Bougainville District.
 - (b) Notwithstanding anything in paragraph (a) hereof the Company shall not be required to spend more on its said business advisory services in any year than the amount so spent by it in the year ending the thirty-first day of December, One thousand nine hundred and seventy-four."
11. Clause 14(c) of the 1967 Agreement is varied by the deletion therefrom of sub-paragraph (ii) and by the substitution therefor of a new sub-paragraph (i) as follows:

"no provision of the said Motor Traffic Ordinance or the said Regulations thereunder relating to the payment of fees on or in connection with the registration of motor vehicles shall apply to motor vehicles owned by the Company, any related company, or by any agent or contractor of the Company or any related company if the same are used solely on Company roads and are by reason of the manner in which they have been constructed or adapted unsuitable for use on Company roads otherwise than for or in relation to all or any of the Company's operations of mining and concentrating ore and moving concentrates to wharf facilities and into ships and the Company's road construction and road maintenance operations; and"

12. The 1967 Agreement is varied by the deletion therefrom of Clause 16 thereof and by the substitution therefor of the following:

"16. FURTHER PROCESSING

- (a) The Company shall commission a pilot study to consider the potential economic feasibility of the establishment in Papua New Guinea of facilities for the processing to the metallic or some further stage of concentrates produced as a result of the Company's operations under this Agreement and the Company shall provide the Government with the data and conclusions resulting from that pilot study.

- (b) The pilot study referred to in paragraph (a) hereof shall be completed within one year after the Amendment Date and shall consider, inter alia, all relevant social and environmental factors.
- (c) If the pilot study referred to in paragraph (a) hereof indicates that such further processing could be feasible the Company and the Government shall confer together with a view to deciding whether a full feasibility study should be undertaken and, if so, the extent to which each of them shall contribute to the cost thereof.
- (d) Thereafter the Company may at any time and from time to time submit to the Government a proposal for the establishment by it in the area in Papua New Guinea specified in the proposal of facilities for processing to the metallic or some further stage of any concentrates produced as a result of the Company's operations under this Agreement and the Government shall within two months of such submission have the right to be exercised by notice to the Company in writing to reject any such proposal on the ground that it would have a substantially detrimental effect on the agriculture and general amenity of the surrounding area.
- (e) If the Government does not pursuant to paragraph (d) of this Clause so reject any such proposal submitted by the Company, but not otherwise, the Company shall be at liberty at any time thereafter to establish facilities in accordance with that proposal and carry out processing at such facilities and the Company may at any time and from time to time thereafter apply to the Government for the leases specified in the application to be granted to it over or in respect of the relative areas specified in the application which leases shall be those reasonably needed by the Company therefor including (without prejudice to the generality of the foregoing) those needed for adequate buffer zones covering areas likely to be affected by fume disposal, and the provisions of paragraphs (d) (e) (f) (g) (h) and (i) of Clause 5 shall apply mutatis mutandis to such application and the leases granted pursuant thereto.
- (f) A decision by the Government pursuant to paragraph (d) of this Clause to reject a proposal submitted by the Company pursuant to that paragraph shall be final and conclusive and shall not be referable to arbitration under Clause 23 of this Agreement, or be otherwise justiciable."

13. The 1967 Agreement is varied by the addition of the following Clauses after Clause 16 thereof:

"16A. ENVIRONMENTAL IMPACT STUDY

For the purpose of enabling the Government to conduct a study of the impact on the environment of the mining and related operations of the Company under this Agreement the Company shall:—

- (a) (to the extent to which the operations of the Company are not interfered with) allow the Government and its agents access to the mine site and all other areas in Papua New Guinea under the control of the Company; and
- (b) upon request, make available to the Government and its agents any factual information in the possession of the Company relating to the impact on the environment of the said mining and related operations, and in respect of such information permit the Government or its agents to inspect and take copies of any relevant documents.

16B. BOUGAINVILLE NON-RENEWABLE RESOURCES FUND

The Company shall pay to the Government fifty cents per tonne of contained copper shipped on and after the Amendment Date and such payments shall be credited by the Government to the Bougainville Non-Renewable Resources Fund."

14. Clause 17(a) of the 1967 Agreement is varied by the deletion of the full stop at the end of sub-paragraph (ii) thereof and by the addition of the following words and full stop to clause 17(a) such words and full stop to be inserted immediately following the said sub-paragraph (ii) but in such a fashion that the said words do not qualify the said sub-paragraph (ii) alone but qualify instead the paragraph as a whole:

"PROVIDED THAT this paragraph shall be read and construed subject to the laws of Papua New Guinea of general application whether enacted before on or after the Amendment Date which do not discriminate against or (having regard to reasonable standards) result in discrimination against the Company its members or the beneficial owners of its shares, and nothing contained in any such law

shall give rise to any claim by the Company, its members or the beneficial owners of its shares by reason only of the provisions of this paragraph."

15. Clause 23 of the 1967 Agreement is varied by

(a) the addition before the commencement of paragraph (a) of the words "Subject to the provisions of Clause 7 and Clause 16 hereof" and by changing to the lower case the letter "I" in the word "If" immediately following; and

(b) the deletion from paragraph (b) of sub-paragraph (i) thereof and the substitution therefor of the following:

"(i) the dispute question or difference of opinion shall stand referred to the arbitration of three arbitrators one of whom shall be appointed by the Government and one of whom shall be appointed by the Company and the third of whom shall be agreed upon by the Government and the Company in writing and in default of agreement within fourteen days after the Government or the Company (as the case may be) gives notice to the other of them requiring the appointment of such a third arbitrator shall be appointed in accordance with the provisions of the Arbitration Act 1951 of Papua New Guinea from a panel of five arbitrators to be nominated within a further period of fourteen days thereafter by the President and Chairman of the Board of Directors (or failing him the Chief Executive) of the Asian Development Bank (or, failing such nomination, from any panel of arbitrators which the person or body appointing the third arbitrator considers satisfactory) PROVIDED THAT no person shall be eligible for appointment as a third arbitrator (unless the Government and the Company otherwise agree in writing in any particular case) if at the time of his proposed appointment, he is, or has been at any time prior thereto a citizen or resident of Papua New Guinea, the Commonwealth of Australia, or, if any person other than the Company or the Government is or indicates prior to the appointment of the third arbitrator that he intends to be a party to the submission (and unless the Government the Company and each such other person otherwise agree in writing in any particular case), a citizen or resident of the country of which that person is a citizen or resident;"

16. Clause 25 of the 1967 Agreement is varied by the deletion of the words figure brackets and letter "more than ten years after the Company has completed the performance of its obligations under Clause 6(a)" and by the substitution therefor of:

"after the Amendment Date if the stamp duty in question is of general application in Papua New Guinea and, as required by Clause 7(h) hereof, does not discriminate against or (having regard to reasonable standards) result in discrimination against the Company".

17. The 1967 Agreement is varied by the addition of the following Clause after Clause 26 thereof:

"26A. REVIEW

The parties shall co-operate with each other in carrying out the purposes of this Agreement and shall meet together during the seventh year after the year in which the Amendment Date occurs, and at intervals of seven years thereafter, with a view to considering in good faith whether this Agreement is continuing to operate fairly to each of them and with a view to considering in good faith whether this Agreement is continuing to operate fairly to each of them and with a view further to discussing in good faith any problems arising from the practical operation of this Agreement. If at any such meeting it is agreed that this Agreement is not so continuing to operate fairly to each of the parties, or the parties agree that there exist problems arising from the practical operation of this Agreement, then they shall confer together in good faith in an endeavour to ensure that this Agreement shall operate fairly to both of the parties or to resolve such problems (as the case may be) and, in particular, and without prejudice to the generality of the foregoing, they shall use their best endeavours to agree upon such changes to this Agreement as may be requisite in that regard."

18. The 1967 Agreement is varied by the addition of the following immediately after the Schedule thereto:

Mining (Bougainville Copper Agreement)

Ch. No. 196

THE SECOND SCHEDULE

In this Schedule:

"Tax year" means the calendar year in respect of which the amount of tax payable by the Company is to be calculated.

"Adjustment year" means the calendar year immediately preceding the Tax year.

"P" (except where used in Parts II and III of this Schedule) means and equals the number of dollars of taxable income of the Company for the Tax year.

The value of "N" in the formula in Part I of this Schedule shall be calculated, for the purpose of ascertaining the rate of tax (expressed as a percentage of taxable income) payable on the taxable income of the Company derived during a Tax year, in accordance with the following formula, namely:

$$N = M \times \frac{C}{K} \times \frac{F}{B}$$

and for the purpose of this formula

"M" equals "N" at the end of the Adjustment year.

"N" for the purposes of the Tax year 1974 equals 32,000,000.

"K" equals an amount (called the Capital Factor) at the end of the calendar year preceding the Adjustment year, the agreed amount of the Capital Factor at 31st December, 1973 being \$390,000,000.

"C" equals the Capital Factor at the end of the Adjustment year and equals $K + E - R$.

"E" equals expenditure of a capital nature relating to the mining of ores from Bougainville Island (including, without limiting the generality of the foregoing, the following: the further exploration and development of the Company's mine on the areas comprised in the special mining lease held by the Company on the Amendment Date; the transportation of such ores; the concentration of such ores; the drying, handling and movement of the concentrates so derived to wharf facilities and into ships; the construction and maintenance of roads; earthworks; facilities for power generation; housing and facilities for employees; and works of reclamation and regeneration) and activities connected therewith, but excluding

- (a) expenditure relating to smelting or other treatment subsequent to concentration and drying of the product; and
- (b) expenditure which by reason of Clause 7(f) (B) or (C) hereof is deemed to have been incurred on 1st January, 1974.

"R" equals the sum of

- (a) the total amount of depreciation for tax purposes of units of property in respect of which depreciation at a rate in excess of 5% per annum is allowable as a deduction in respect of the Adjustment year; and
- (b) the original cost of other items of a capital nature (not being items in respect of which depreciation at a rate in excess of 5% per annum is allowable as a deduction in respect of the Adjustment year) replaced, disposed of, lost or destroyed in the Adjustment year.

"B" equals the average of the daily published buying rate of the unit of currency to be adopted by Papua New Guinea (hereinafter called "the Kina") against the U.S. dollar during the Adjustment year (expressed in terms of Kinas per U.S. dollar) provided that for the Adjustment year 1974 "B" shall be the first published buying rate of the Kina against the U.S. dollar on or following the date on which the Kina first becomes currency in Papua New Guinea.

"F" equals the average of the daily published buying rate of the Kina against the U.S. dollar during the Tax year (expressed in terms of Kinas per U.S. dollar) except that in respect of the Tax year 1975 "F" shall equal the average of the daily published buying rate of the Kina against the U.S. dollar from and

including the date on which the Kina first becomes currency in Papua New Guinea up to and including 31st December, 1975 and the formula for the calculation of "N" for the Tax year 1975 will be

$$N = M \times \frac{C}{K} \times \left[1 + \left(\frac{F}{B} - 1 \right) \frac{X}{365} \right]$$

where X equals the number of days from and including that date to and including the 31st December, 1975.

"The daily published buying rate" means the buying rate from time to time published by the Bank of Papua New Guinea or other the buying rate from time to time published and recognized by the Government as the official buying rate and in calculating the average of the daily published buying rate the total of each of the daily published buying rates in a particular year shall be divided by the number of occasions in that year on which that buying rate was published.

Until such time as the Kina first becomes currency in Papua New Guinea both "B" and "F" shall equal one and if the Kina does not become currency in Papua New Guinea during 1975 the reference to 1974 in the definition of "B" above shall become a reference to the year immediately preceding the year in which the Kina first becomes currency in Papua New Guinea and the references to 1975 in the definition of "F" above shall become references to the year in which the Kina first becomes currency in Papua New Guinea.

Part I

The amount of tax payable on the taxable income of the Company derived during the Tax year commencing on the first day of January, 1975 and on the taxable income of the Company derived during each subsequent Tax Year shall be the amount determined by the application to such taxable income of a rate (expressed as a percentage of taxable income) determined by the formula

$$\frac{7}{10} - \frac{N}{P}$$

Part II

The amount of tax payable on the taxable income of the Company derived during the period 1st January, 1974 to 30th June, 1974 shall be the amount determined by the application to such taxable income of the higher of a rate of tax of 33½% and a rate of tax (expressed as a percentage of taxable income) determined by the formula:

$$\frac{1}{3} + \frac{1}{2} \left[\left(\frac{7}{10} - \frac{N}{2P} \right) - \frac{1}{3} \right] \text{ where:}$$

N = 32,000,000.

P = the number of dollars of taxable income for the said period of six months.

Part III

The amount of tax payable on the taxable income of the Company derived during the period 1st July, 1974 to 31st December, 1974 shall be the amount determined by the application to such taxable income of the higher of a rate of tax of 33½% and a rate of tax expressed as a percentage of taxable income determined by the formula:

$$\frac{7}{10} - \frac{N}{2P} \text{ where:}$$

N = 32,000,000 and

P = the number of dollars of taxable income for the said period of six months.

Part IV

An amount equal to the lesser of:—

1. Seventy per centum of the excess of the amount of capital expenditure incurred by the Company in the relevant Tax year over the amount actually allowed by the Chief Collector as a deduction for the Company in respect of that expenditure pursuant to the provisions of Section 73 of the Income Tax Act or Division 10 of Part III of that Act, and
2. The excess of the amount of tax payable by the Company in respect of the taxable income of the Company for that Tax year over the amount of tax which would have been payable by the Company in respect of the taxable income of the Company for that Tax year if paragraph (1) of Clause 7 of this Agreement were deleted therefrom. For the purposes of this Part "capital expenditure" shall include all expenditure of a capital nature, as defined in the definition of "E"

in this Schedule where such expenditure is incurred in order to maintain the Company's present activity of the production of copper (contained in concentrates) at the rate of approximately 190,000 tonnes per annum."

19. This Agreement shall not come into effect unless prior to the thirty-first day of December, One thousand nine hundred and seventy-four or such later date as is nominated by the Company to the Government in writing before that date

(a) it has been approved by the shareholders of the Company in general meeting; and

(b) an Act (in the form of the draft Bill heretofore agreed upon between the Government and the Company and signed on their behalf for the purpose of identification or in any varied form hereafter agreed between them) has been passed by the House of Assembly of Papua New Guinea and that Act has been duly assented to.

IN WITNESS whereof the parties hereto have executed this Agreement the day and year first above-written.

SIGNED SEALED AND DELIVERED for and on behalf of The Government of Papua New Guinea by MICHAEL THOMAS SOMARE the Chief Minister of Papua New Guinea in the presence of:
Rabbie L. Namaliu.

THE COMMON SEAL of BOUGAINVILLE COPPER LIMITED was hereto affixed in the presence of:

Michael Thomas Somare

R. W. Ballmer

Director

J. Rennie
Secretary

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement).

APPENDIX.

SOURCE OF THE MINING (BOUGAINVILLE COPPER AGREEMENT) ACT.

Part A.—Previous Legislation.

1. *Mining (Bougainville Copper Agreement) Act 1967* (No. 70 of 1967).
2. *Mining (Bougainville Copper Agreement) (Amendment) Act 1974* (No. 79 of 1974).

Part B.—Cross References.

NOTE.—In this table "1974" refers to the *Mining (Bougainville Copper Agreement) (Amendment) Act 1974* set out in Part A.

Section, etc., in Revised Edition.	Previous Reference ¹ .
1	3
2	4
3	5
4	6
5	7
6	8
7	9
8	10
9	11
10	12
11	13
Schedules—	Schedules—
Schedule 1	Schedule
Schedule 2	1974 Schedule

¹ Unless otherwise indicated, references are to the *Mining (Bougainville Copper Agreement) Act 1967* set out in Part A.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 197.

Mining Development.

GENERAL ANNOTATION.

ADMINISTRATION.

As at 13 February 1976 (the date of gazettal of the most comprehensive allocation of responsibilities to Ministers and Departments at about the effective date), the administration of this Chapter was vested in the Minister for Natural Resources.

Accordingly, as at that date, unless some other intention is clearly indicated, by note or in the text, it seems that references in or in relation to this Chapter to—

"the Minister"—should be read as references to the Minister for Natural Resources;

"the Departmental Head"—should be read as references to the Secretary for Natural Resources¹;

"the Department"—should be read as references to the Department of Natural Resources².

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2. Source of Regulation.	

¹ Previously the Director of Lands, Surveys and Mines.

² Previously the Department of Lands, Surveys and Mines.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER No. 197.

Mining Development Act.

ARRANGEMENT OF SECTIONS.

PART I.—PRELIMINARY.

1. Interpretation—
 - "borrower"
 - "company"
 - "developmental mining"
 - "gold"
 - "mine"
 - "mineral"
 - "mining operations"
 - "officer"
 - "the regulations"
 - "this Act".

PART II.—ADVANCES FOR DEVELOPMENTAL MINING.

2. Purposes of advances.
3. Applications for advances.
4. Reference to professional officers.
5. Agreement with borrower.
6. Security.
7. Payment of dividends, etc.
8. Recovery of advance.
9. Provisions applicable until moneys advanced have been paid.
10. Appointment of agent by borrower.
11. Non-compliance with Act.

PART III.—ESTABLISHMENT OF PLANT FOR CRUSHING, ORE-DRESSING, CYANIDING OR SMELTING.

12. Interpretation of Part III.—
 - "plant".
13. Purchase, etc., of plant by the State.
14. Erection of plant.
15. Rates for testing and treating.
16. Stealing from plant.

PART IV.—ASSISTANCE FOR BORING.

17. Minister may pay whole cost of boring for gold, etc.
18. Agreement to pay proportion of cost.

PART V.—MISCELLANEOUS.

19. Purchase and hire of boring plant.
20. Advance or expenditure of moneys for draining or making roads.
21. Assistance in marketing.
22. Regulations.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 197.

Mining Development Act.

Being an Act to encourage the mining industry.

PART I.—PRELIMINARY.

1. Interpretation.

In this Act, unless the contrary intention appears—

"borrower" means a person who applies for an advance by way of loan under Section 2;

"company" means a company incorporated or registered under any law in relation to the registration or incorporation of companies;

"developmental mining" means mining operations that, in the opinion of the Minister, are necessary or desirable for the purpose of determining the size and value of an ore body and the subsequent development of workings to facilitate the economic extraction of ore from it;

"gold" includes—

(a) platinum, osmium, iridium and any metal belonging to the platinum group of metals; and

(b) gold and any earth or substance containing or having mixed in its substance, or set apart for the purpose of extracting, platinum, osmium, iridium or a metal belonging to the platinum group of metals;

"mine" means land held or occupied under the *Mining Act, 1937* of the former Territory of Papua (Adopted) or the *Mining Act 1928* of the former Territory of New Guinea (Adopted) where mining operations are carried on;

"mineral" does not include petroleum or helium found in association with petroleum;

"mining operations" are operations on a mine for the purpose of obtaining or prospecting for gold or minerals;

"officer" means an officer of the Department;

"the regulations" means any regulations made under this Act;

"this Act" includes the regulations.

PART II.—ADVANCES FOR DEVELOPMENTAL MINING.

2. Purposes of advances.

A person may apply to the Departmental Head for an advance by way of loan for—

(a) carrying on departmental mining; and

(b) procuring, erecting and connecting machinery, plant or appliances for that purpose; and

(c) providing other works and things that, in the opinion of the Departmental Head, are necessary for that purpose.

3. Applications for advances.

(1) An application under Section 2 shall be in the prescribed form and shall be accompanied by—

- (a) a description of—
 - (i) the mine on which the mining operations are to be performed; and
 - (ii) all workings on the mine and an accurate plan and sections of them; and
- (b) a description and valuation of all machinery, plant and effects on the mine; and
- (c) a statement of the encumbrances (if any) affecting the mine, machinery, plant or effects; and
- (d) a statement showing—
 - (i) the developmental mining proposed to be performed; and
 - (ii) the object of the mining; and
 - (iii) the probable cost of the mining, and of any machinery, plant and effects proposed to be purchased in connexion with it; and
- (e) a statement showing—
 - (i) the manner in which, and the work on which, it is proposed to expend the advance; and
 - (ii) the period of time during which the expenditure will be incurred; and
 - (iii) the time when, and the amounts in which, the advance will be required; and
- (f) if the application is made by a company—
 - (i) evidence of the incorporation or registration of the company in the country, and a copy of its memorandum and articles of association; and
 - (ii) particulars as to the amount of uncalled capital of the company, and of its assets and liabilities.

(2) A borrower shall also furnish to the Departmental Head such further evidence, documents or information as he, by written notice to the borrower, requires.

(3) A borrower shall verify all evidence, statements and information furnished under this section by statutory declaration.

4. Reference to professional officers.

(1) The Departmental Head may refer an application for an advance to the Mining Engineer, Mines Inspector, Geologist or other officer authorized for the purpose by the Minister, for report.

(2) A report under Subsection (1) shall be made after personal examination of the mine to which the application relates, and shall—

- (a) fully describe the character of the mine and of the lead, lode, reef, vein, seam or other mineral formation contained in it; and
- (b) state whether the performance of the proposed mining operations would or would not, in the opinion of the reporting officer, be developmental mining; and

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Mining Development

Ch. No. 197

- (c) state whether, in the opinion of the reporting officer there is reasonable probability of the proposed operations proving to be of a remunerative character, giving the reasons and grounds for the opinion; and
- (d) state whether the machinery, working plant and appliances are of a character and description properly adapted to the proposed mining operations; and
- (e) give such other information as is prescribed or as the Departmental Head requires.

5. Agreement with borrower.

(1) After considering all the evidence and reports relating to it, the Departmental Head may recommend to the Minister the granting of the application with or without modification.

(2) On receiving a recommendation under Subsection (1), the Minister may, on behalf of the State, enter into an agreement with the borrower undertaking, subject to this Act, to advance out of moneys appropriated for the purpose by way of loan to the borrower such sum or sums as he, in that particular case, approves.

(3) An advance under Subsection (2) shall be payable in instalments of such amount and at such times as are specified in the agreement.

(4) No instalment shall be paid until it is proved to the satisfaction of the Minister that—

- (a) for every kina to be advanced the borrower has, out of his own capital, previously, actually and properly expended on mining operations on the mine the same amount; and
- (b) the borrower has—
 - (i) properly expended, in mining operations on the mine, all previous instalments advanced by the State; and
 - (ii) paid all interest (if any) due on any such instalments.

(5) For the purposes of Subsection (4)(a), no account shall be taken of moneys expended by the borrower that has already been taken into account for the purposes of that paragraph.

(6) The borrower shall pay to the State interest on the amount of the advance calculated from the dates of payment of the respective instalments, at such rate as is charged from time to time by the Papua New Guinea Banking Corporation on overdrafts, by half-yearly payments, on dates specified in the agreement.

(7) The agreement shall contain such covenants, conditions, restrictions and provisions, not inconsistent with this Act, as the Minister requires.

6. Security.

Before receiving an instalment of an advance, the borrower shall execute, at his own cost and to the satisfaction of the Minister, a first mortgage in favour of the State, of the whole of the mine and, in the case of a company, its other property and assets (except uncalled capital) to secure—

- (a) the repayment of the advance and interest; and
- (b) the due performance of the terms of the agreement; and
- (c) the provisions of this Act.

7. Payment of dividends, etc.

(1) Until it has performed all the terms of the agreement under which the advance was made, a company to which an advance has been made under this Part must not pay, credit or distribute, amongst all or any of its members, by way of dividend or otherwise, any of its money, property or assets.

(2) Where a company contravenes the provisions of Subsection (1) each director of the company with whose consent the payment, crediting or distribution was made is guilty of an offence.

Penalty: Imprisonment for a term not exceeding six months.

(3) Where any money, property or assets of a company has or have been paid, credited or distributed to a person in contravention of Subsection (1), the money and the value of the property or the assets is a debt due and payable to the company by the person.

8. Recovery of advance.

Moneys advanced to or payable by a borrower under an agreement that are due and payable are recoverable by the State as a debt.

9. Provisions applicable until moneys advanced have been paid.

(1) Until all moneys advanced under an agreement to a borrower have been repaid, and the terms of the agreement have been complied with—

(a) the Minister may appoint a person to inspect and report on—

(i) the progress of the works; and

(ii) the state and condition of the property and plant of the borrower; and

(b) the borrower shall, when so required by a person appointed by the Minister, allow—

(i) full inspection of; and

(ii) copies and extracts to be taken from,

all or any of the books, documents or records belonging or relating to the business of the borrower; and

(c) the borrower shall, within such time as the Minister allows—

(i) supply such information as the Minister demands in relation to the borrower, or to the property, assets, undertaking, work and operations of the borrower; and

(ii) if required, verify the information by statutory declaration; and

(d) in case of default by the borrower—the Minister may give notice to the borrower of his intention to enforce the security given by the borrower under Section 6.

(2) If the default continues after the expiration of 14 days from the service of a notice under Subsection (1)(d), the Minister may appoint a person to enter into possession of—

(a) the mine; and

(b) all other property and assets of the borrower comprised in the mortgage given by the borrower under Section 6.

(3) The person who is in possession under Subsection (2)—

- (a) has and may exercise the powers and authorities of a receiver and manager of the mine and of all other property and assets of the borrower comprised in the mortgage; and
- (b) may, with such assistants as are necessary, carry on the business of the borrower; and
- (c) if so directed by the Minister—may cause the mine, machinery, working plant and appliances and any other property and assets of the borrower comprised in the mortgage to be sold by public auction, by tender or by private contract, and the moneys realized by the sale shall, after payment of all expenses incurred by the Minister, be applied towards the payment of all moneys payable by the borrower to the State and the balance (if any) paid to the borrower.

10. Appointment of agent by borrower.

(1) During any absence of a borrower (not being a company) from the mine for any period of more than three days, he shall appoint, and at all times keep appointed, an agent who resides or works daily at the mine.

(2) If a borrower is a company, it shall appoint, and at all times keep appointed, as its agent some person who resides or works daily at the mine.

(3) The service of an order, demand, notice or requirement under this Act on a person under Subsection (1) or (2) appointed as an agent by the borrower shall be deemed to be service on the borrower.

(4) If the borrower—

(a) not being a company—is absent from the mine for a period of more than three days and has not appointed an agent who resides or works daily at the mine; or

(b) being a company—has not appointed an agent who resides or works daily at the mine,

the posting of an order, demand, notice or requirement under this Act at a conspicuous place on the mine shall be deemed to be service of the order, demand, notice or requirement on the borrower.

11. Non-compliance with Act.

Non-compliance—

(a) by a borrower or his agent; or

(b) if the borrower is a company, by the company, or by any of its officers or agents,

with this Act, or with an order, demand, notice or requirement of the Minister or a person appointed by him under this Act, constitutes a default by the borrower under the agreement.

PART III.—ESTABLISHMENT OF PLANT FOR CRUSHING, ORE-DRESSING, CYANIDING OR SMELTING.

12. Interpretation of Part III.

For the purposes of this Part, "plant" means plant for testing the value of, or treating, metalliferous material, and machinery and appliances for—

- (a) mechanically reducing rock, gangue, matrix, ore or other vein stuff, for the purposes of obtaining gold or mineral from it; or
- (b) classifying or dressing rock, gangue, matrix, ore or other vein stuff, and separating from it the gold or mineral contained in it; or
- (c) extracting gold or minerals from rock, gangue, matrix, ore or other vein stuff by any process.

13. Purchase, etc., of plant by the State.

The Minister may, out of moneys appropriated for the purpose—

- (a) purchase or hire and erect and operate plant; or
- (b) subsidize persons who are willing to erect and work plant for the public at such rates as are agreed on between the Minister and the person.

14. Erection of plant.

(1) Plant purchased or hired by the Minister shall be erected only in places in which, from the report of the Departmental Head, Mining Engineer, Geologist, Mines Inspector or other officer authorized for the purpose by the Minister, the Minister is satisfied that—

- (a) large deposits of metalliferous ores exist; and
- (b) plant and appliances for testing or treating such deposits in bulk at reasonable rates are not available; and
- (c) the establishment of plant is necessary for the development of mining.

(2) A subsidy under Section 13(b) shall not be granted in respect of the erection or working of plant at any place other than a place at which plant purchased by the Minister may, under this Act, be erected.

15. Rates for testing and treating.

(1) The rates charged by the Minister for testing or treating metalliferous material shall be as prescribed or as are determined by the Minister by notice in the National Gazette.

(2) The rates charged by a subsidized person for testing or treating metalliferous material shall be the rates agreed on with the Minister under Section 13.

16. Stealing from plant.

(1) A person who takes or removes gold, gold amalgam or concentrates from a plant shall be deemed to have stolen the gold, gold amalgam or concentrates unless he proves that the taking or removal was with the permission of the person operating the plant.

(2) A person receiving the gold, gold amalgam or concentrates with knowledge of its or their unpermitted removal from the plant shall be deemed to have received the gold, gold amalgam or concentrates knowing it or them to have been stolen.

(3) In an information or complaint charging a person with stealing gold, gold amalgam or concentrates from a plant, it is sufficient to lay the property in the gold, gold amalgam

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Mining Development

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or concentrates in the person operating the plant from which the gold, gold amalgam or concentrates were stolen.

PART IV.—ASSISTANCE FOR BORING.

17. Minister may pay whole cost of boring for gold, etc.

If he is satisfied, after receiving the report of the Departmental Head, Mining Engineer, Geologist or other officer authorized for the purpose by the Minister, that the boring is in the general interest of Papua New Guinea, the Minister may, out of moneys appropriated for the purpose, pay the whole cost of drilling for gold, minerals or water in any locality.

18. Agreement to pay proportion of cost.

The Minister may enter into an agreement with a person to pay, out of moneys appropriated for the purpose, a proportion of the cost (not exceeding 50% of the total cost) of drilling for gold, minerals or water.

PART V.—MISCELLANEOUS.

19. Purchase and hire of boring plant.

The Minister may—

- (a) out of moneys appropriated for the purpose, purchase boring plant and accessories; and
- (b) hire plant and accessories in accordance with the regulations.

20. Advance or expenditure of moneys for draining or making roads.

(1) The Minister may, out of moneys appropriated for the purpose, advance or expend moneys—

- (a) to drain a mining area; or
- (b) to assist mining by sinking or cross-cutting for further ore occurrences; or
- (c) to make roads in a mining area; or
- (d) to assist mining development by granting subsidies on ore produced as the result of developmental work and crushed by means of plant operated by the State or approved by the Minister; or
- (e) to provide an adequate supply of water to a mine.

(2) An advance under Subsection (1) shall be made on such terms and conditions as are prescribed.

21. Assistance in marketing.

Where ores or concentrates are to be marketed outside the country, the Minister may, on such terms and conditions as are prescribed or as he thinks proper, and out of moneys appropriated for the purpose, make advances on any such ores or concentrates not exceeding 50% of the estimated value of the ores or concentrates.

22. Regulations.

The Head of State, acting on advice, may make regulations, not inconsistent with this Act, prescribing all matters that by this Act are required or permitted to be prescribed, or that are necessary or convenient to be prescribed for carrying out or giving effect to this

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Mining Development

Act and, in particular, for prescribing penalties of fines not exceeding K100.00 for offences against the regulations.

Not

APPENDIX IV
DISPOSAL OF OVERBURDEN AND
TAILINGS AGREEMENT
1971

Note: The attached is a copy only, unsigned.
The official signed document was
unable to be reproduced here due
to legibility limitations.

27th APRIL, 1971

Mr. F. F. Espie,
Managing Director,
Bougainville Copper Pty. Limited,
Box 384D G.P.O.,
Melbourne,
Victoria 3001.

Dear Mr. Espie,

Bougainville Copper Project
Disposal of Overburden and Tailings

Your Company's most recent proposals for the disposal of overburden and tailings are contained in two volumes, one a report relating to the disposal of waste rock dated September 1970, and the other relating to the disposal of tailings and such part of the overburden as is not waste rock dated August 1969.

Discussions on the topic have been held between officers of your Company and the Administration at various times, which have assisted in resolving various points of possible contention. Below is set out details of the method approved by the Administration for the disposal of overburden and tailings. This letter supersedes all previous letters from the Administration on the subject of approval of a proposed method of disposal of overburden and tailings.

WASTE ROCK

The proposal as contained in the abovementioned volume dated September 1970 to place the waste rock in the Kawerong River Valley is approved subject to the following:

1. Only relatively fresh free-draining granular rock is to be used for a distance of 200 feet back from the ultimate downstream dump faces.

2. Adequate measures are to be taken to maintain the integrity of the dump from dangers from Kawerong River flows. These are to include:
- i) At the end of 1974 your Company and the Administration are to review the method of dumping the waste rock, and your Company shall, if requested by the Administration by June 1975, by 1st January 1976 submit a further proposal for the disposal of the waste rock based on the result of the review. This will be a proposal pursuant to Clause 15 of the Bougainville Copper Agreement and will be dealt with by the Administration as such.
 - ii) Kawerong River water which has travelled over the dump will not be discharged directly over the edge of the advancing dump face into the Kawerong River Valley.
 - iii) Filling of the rockfill pore space of the dump by tailings is to be avoided.
3. The low grade in copper and more weathered waste rock shall, as far as possible, be kept in the upper part of the dump as a surface layer on top of the dump as a means of encouraging vegetation growth.
4. The largest rocks available shall be placed at the bottom of the downstream faces of the dump and the ultimate faces shall be armoured with the largest stone available at that time.
5. It is noted that there will be a continuous engineering effort at the site in respect of the provision of the intermediate faces of the dump. However, the gradient of these faces and other gradients relating to the dump shall be reviewed annually by the Administration's Chief of Division of Mines or his nominee, and any alteration in any of such gradients requested by the Chief of Division of Mines following an annual review shall be complied with.
6. If it is practicable in the final stage of the dump, the final dump face shall be abutted on the upstream side of spurs on either side of the valley.
7. As soon as the final top of the dump has been reached at any particular place, your Company shall commence its endeavours to establish vegetation thereon in so far as such endeavours do not conflict with its other operations on the dump as a whole.

APPENDIX (cont'd)

8. Your Company shall participate in discussions with any natives who will be affected by the approved manner of disposal, and shall co-ordinate its negotiations in respect of compensation to be given to such natives (pursuant to Clause 15(d) of the Bougainville Copper Agreement) with such discussions if so requested by the Administration. Until the discussions have been completed your Company shall take no action detrimental to the interests of the relevant natives.
9. Your Company shall comply with the requirements of and any directions which are properly made under the provisions of the Mines and Works Regulation (New Guinea) Ordinance 1955-1962 (as amended from time to time).

TAILINGS AND FINE OVERBURDEN

The proposal to dispose of tailings and fine overburden by draining it into the Kawerong River (except as mentioned in 12(c) below) is acceptable subject to the following:

1. Your Company shall take such action as is necessary to confine flooding, damage or the disposal of tailings within the area granted to your Company as a lease for mining purposes for the disposal of tailings.
2. As part of or in addition to the monitoring programme referred to in your Company's Proposal your Company shall further its means of data collection by:
 - i) Installation of two rain gauges and two pluviometers in the mine pit area.
 - ii) Installation of two rain gauges and two pluviometers in the Kawerong-Jaba Valley.
 - iii) Taking vertical cross-sections of the river bed in the Jaba Valley below the Jaba-Kawerong confluence at intervals both in space and time as dictated by the weather and river conditions.
 - iv) Taking hand held vertical colour photographs from altitude 1500 feet above general terrain elevation; such photographs to be correlated to the amount of material dumped into the system and again subject to weather and river conditions. In any case, the interval between photographs shall not exceed six months.

APPENDIX (cont'd)

3. Your Company shall at three monthly intervals advise the Administration of the summarised results and interpretations of its relevant data collection and monitoring programme, and shall give the Administration access to the data collected and your Company's aerial photographs (and shall supply, without cost, a copy of any such photograph which is requested by the Administration).
4. Your Company shall have selected suitable equipment which is capable of being mobilised with six months notice to undertake such action on the river system as is necessary pursuant to Clause 1 above.
5. Your Company shall use all practicable measures to ensure that the tailings contain no more than such a sufficiently low level of copper readily soluble in natural waters as to ensure that no serious damage could result therefrom to vegetation or animal life.
6. Upon disposal of tailings in accordance with this approval your Company shall abandon any title it has in the tailings.
7. Your Company shall apply for a licence under the Water Resources Ordinance for the construction, installation, operation and maintenance of a water-work for the drainage of waste material into the Kawerong River and shall provide such information as is necessary for the grant of such a licence.
8. Your Company shall pay the Administration an amount equal to any amount which the Administration has to pay in respect of the termination of any native customary rights to water in order to be able to grant the licence referred to in 7 above.
9. Your Company shall participate in discussions with natives who will be affected by the approved manner of disposal, and shall co-ordinate its negotiations in respect of compensation to be given to such natives (pursuant to Clause 15(d) of the Bougainville Copper Agreement) with such discussions if so requested by the Administration. Until the discussions have been completed your Company shall take no action detrimental to the interests of the relevant natives.

APPENDIX (cont'd)

Discharge of tailings into the Kawerong River shall, at all times, be at a place below the downstream toe of the waste rock dump.

Your Company shall comply with the requirements of, and any directions which are properly made under the provisions of the Mines and Works Regulation (New Guinea) Ordinance 1935-1962 (as amended from time to time).

As it is the intention that the disposal of tailings be controlled, and tailings be spread in such a way as to enable re-use of the land at the earliest practicable date, your Company is to conduct the following experiments to test agricultural feasibility and to perform the following tasks:

- a) at half mile intervals (or such greater intervals as are agreed to by the Administration) along the Jaba River towards the sea from the confluence of the Jaba and Kawerong Rivers, at six monthly intervals, take vertical cross-sections of the material deposited on or forming the bed of the river, and shall analyse such materials and advise the Administration of the results.
- b) Commence development of 100 acres of land, when control equipment is moved on site, using sedimentation material from the Jaba River. The site is to be within the Lease for Mining Purposes area and to be agreed upon by the Administration and your Company. Such materials shall be deposited on this site to a height agreed to by the Administration.
- c) By January 1973, commence a small (1 to 2 acre) field experiment with tailings to a depth of at least five feet on the waste rock dump at a site to be agreed between your Company and the Administration.
- d) Establish lysimeters (the number to be specified by the Administration - not being more than fifty) on an agreed site within the Lease for Mining Purposes area, and shall fill them with various sized material from the tailings, in accordance with the direction of the Administration.

APPENDIX (cont'd)

- e) As soon as possible after respective commencements of the operations referred to in (b), (c) and (d) above, establish facilities to collect, from each of the operations respectively, data on the following:
- i) the rate of weathering of the tailings or the sedimentation material (as the case may be);
 - ii) the rate of nitrogen build up in the tailings or the sedimentation material (as the case may be);
 - iii) the rate at which vegetation naturally regenerates itself upon the tailings or the sedimentation material (as the case may be);
 - iv) the rate at which vegetation regenerates upon the tailings or the sedimentation material (as the case may be) when selected legumes or grasses have been added to them.
- f) Your Company shall, after the date tailings control equipment is placed within its Lease for Mining Purposes for the disposal of tailings, engage in tailings spreading, in accordance with an agreed plan and programme, to achieve the progressive regeneration of vegetation.

The tests foreseen in 12(c) and (e) shall be carried out under the direction of the Director, Department of Agriculture Stock and Fisheries. Your Company will carry out laboratory chemical, physical and sizing analyses requested by the Administration for the purposes of 12(e) (i) and (ii) and will provide the photographs necessary for the analyses of the regeneration referred to in 12(e) (iii) and (iv).

The approval of the method of disposing tailings and fine overburden by drainage into the Kawerong River is for a period of ten years commencing 1st January, 1970. During this period there will be a constant review of the results of this method of disposal.

APPENDIX (cont'd)

Any agreement between your Company and the Administration during the ten years as to variation in the method of disposal or as to an alternative method, is to be put into effect. At the end of eight years after the 1st January, 1970 (that is, at the beginning of 1978), and at subsequent intervals thereafter, there shall be a review by the Administration of the manner of disposal. If on the first of these reviews it is decided by the Administration that the manner of disposal should be altered from that being used or a new method substituted, either for the disposal of all or part of the tailings and fine overburden, your Company shall submit a further relevant proposal which shall be resolved pursuant to Clause 15 of the Bougainville Copper Agreement.

The review of the method of disposal shall be completed and the method for the subsequent period decided within eight and one half years from the 1st January 1970. Your Company will have until the end of ten years from the 1st January, 1970, before it will have to commence any altered or new method of disposal. This same procedure and timetable shall apply to subsequent reviews except that the eight and ten years period shall be computed from the date of completion of the previous ten year's disposal period.

It is intended that from 1st January, 1980, the method of disposal shall be consistent with the objective of re-using any land affected by tailings disposal.

It is understood that your Company is in agreement with the scheme for the disposal of tailings and overburden as approved above, and it would be appreciated if you could confirm this by letter.

Yours faithfully,

Signed

L. W. Johnson,
Administrator

APPENDIX V
DISPOSAL OF TAILINGS AND WASTE ROCK AGREEMENT - 1987

DISPOSAL OF TAILINGS AND WASTE
ROCK AGREEMENT
BOUGAINVILLE COPPER LIMITED

WHEREAS the proposal by Bougainville Copper Limited for a new method of disposing of tailings, described in Bougainville Copper Limited Tailings Disposal System - Description of Proposal, November, 1986 and in Bougainville Copper Limited Tailings Disposal Pipeline System - Environmental Impact Report - December, 1986 is considered to be a valid and acceptable way to deal with the disposal of tailings, and

WHEREAS the Independent State of Papua New Guinea (hereinafter referred to as "the State") and Bougainville Copper Limited (hereinafter referred to as "BCL") recognize the need for new Agreement to replace the Agreement of 27 April, 1971.

It is THEREFORE AGREED that this will constitute a new Agreement between the parties for the purpose of disposal of tailings and waste rock.

1. Nothing in this Agreement exempts BCL from the provisions of the Mining Safety Act, Chapter No. 195A and all regulations pursuant thereto, as amended from time to time.
2. The Disposal of Tailings Agreement of 1971 shall remain in force until such time as the new pipeline system for disposing of tailings is commissioned. From the date of such commissioning, this Agreement will have full force and effect.
3. Waste Rock

The proposal contained in the September 1970 volume to place waste rock in the Kawerong River Valley is continued in force subject to the following conditions:

- (i) only predominantly fresh free - draining granular rock is to be used; however where non-free draining material is to be dumped this material will be confined by free draining rock.

- (ii) adequate measures are to be taken to maintain the integrity of the dumps from dangers of the Kawerong River flows. This includes
 - (a) Kawerong River water which has travelled over the dump will not be discharged directly over the edge of the advancing dump face into the Kawerong River Valley, and
 - (b) filling of the rockfill pore space of the dump by tailings is prohibited.
- (iii) the company will commence revegetation as soon as the final top of the dump has been reached in so far as such endeavours do not conflict with other operations on the dump site.

Tailings

The proposal of BCL for the disposal of tailings and fine overburden by pipeline as outlined in Bougainville Copper Limited Tailings Disposal Pipeline System - Description of Proposal, November, 1986 and in Bougainville Copper Limited Tailings Disposal Pipeline System - Environmental Impact Report - December, 1986 is agreed to between the parties to this Agreement subject to the following conditions:

- (i) BCL shall take such action as is necessary to confine flooding, damage or the disposal of tailings within the area in Fig. 4. Tailings Disposal Pipeline Plan (F-80-163) outlined in Bougainville Copper Limited Tailings Disposal Pipeline system - Description of Proposal, November, 1986.

- (ii) BCL shall, at six month intervals, present to the Department of Minerals and Energy the summarized results and interpretations of its relevant data collection and monitoring programme and shall, at any time, give the said Department access to all data collected and any other material relevant thereto. The Company will supply copies at the request of the Department. BCL will be notified when and if the State makes public any information so obtained.
- (iii) BCL shall take all reasonable steps to ensure that any discharges into the river system and the bay contain no more than a sufficiently low level of copper or other contaminants readily soluble in natural waters to ensure no serious damage is done to the biota or will cause any risk to public health.
- (iv) During such times that the pipeline is not available for use due to maintenance, inspection or unforeseen circumstances, BCL shall be permitted to discharge tailings into the river system for up to a period of twenty - one days in any one year, unless a further period is granted in writing by the Minister of Minerals and Energy. During such time BCL will ensure that all undertakings and requirements pursuant to this Agreement are followed.
- (v) discharge of tailings into the river system shall, at all times, be at a place below the downstream toe of the waste rock dump.
- (vi) a survey of the Jaba River/Pangara River biological recolonization will be commenced at a time when the results of physical and chemical monitoring demonstrate its viability. Once commenced, the survey will be undertaken annually.

(vii) techniques to stabilize tailings deposits remaining in the river system will be investigated and appropriate measures taken to ensure such stabilization.

(viii) the tailings stack test area and/or tailings stack will be studied and monitored for: sediment stability, water movement on and through tailings, the chemistry of stack run-off, stack leachate and tailings weathering, development and persistence of vegetation cover, and the rate of soil formation as defined by organic carbon and nitrate accumulation.

(ix) the coastline of Empress Augusta Bay will be surveyed on an annual basis between Tuju Inlet and the Mariropa River to assess changes in beach profile. Aerial or satellite photographs of the coastline will be taken on a regular basis.

(x) dispersion of metals and sediments from the tailings disposal area into the seawater will be regularly measured at specific locations offshore from the stack for copper and any other relevant metals, pH, salinity and suspended solids.

(xi) the effects of direct disposal of tailings in the Bay on the benthos and fish populations will continue to be monitored.

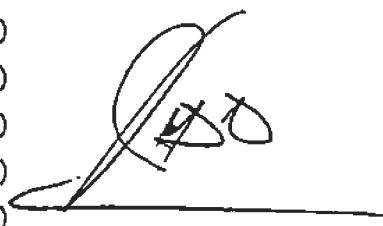
BCL shall take all reasonable steps necessary to ensure rehabilitation of land and regeneration of vegetation in areas affected by the waste rock and tailings disposal systems.

The monitoring and research programmes in effect from 1971 will continue in addition to the monitoring proposals outlined in the 1986 Environmental Impact Report. These programmes can be amended, altered or varied, at any time, after consultation between BCL and the State.

This Agreement will continue for the term of the Special Mining Lease, or any renewal thereof, granted to BCL, unless an agreement is reached between the State and BCL for variation, amendment or alteration thereto.

Dated this 28TH day of JANUARY, 1987.

Signed for and on behalf of)
the Independent State of)
Papua New Guinea by)
JOHN R KAPUTIN, Minister)
for Minerals and Energy)
in the presence of)
)
)
)



W. D. SEARSON.)
DEPT. MINS + ENERGY

BOUGAINVILLE COPPER LIMITED does hereby accept this Agreement.

Signed for and on behalf of)
BOUGAINVILLE COPPER LIMITED)
by P.W. QUOOLING, Managing)
Director, Bougainville)
Copper Limited, in the)
presence of)
)
)
)
)



Lee Bayh)
Company Secretary.

Mining (Bougainville Copper Agreement)

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27. GOVERNING LAW.

This Agreement shall be governed by the law of the Territory.

SCHEDULE.

TERRITORY OF PAPUA AND NEW GUINEA.

Mining Ordinance 1928-1966 of the Territory of New Guinea.

Special Mining Lease.

I, _____, Administrator of the Territory of Papua and New Guinea, by virtue of the powers conferred by the *Mining Ordinance 1928-1966* of the Territory of New Guinea and the *Mining (Bougainville Copper Agreement) Ordinance 1967* of the Territory of Papua and New Guinea and all other powers me enabling, hereby grant and demise to BOUGAINVILLE COPPER PTY. LIMITED (hereinafter called "the Company" which expression shall include its successors and assigns) ALL THAT piece of land being the whole of the land particularly described and delineated on the plan annexed hereto and signed by me for the purpose of identification and all those mines veins seams lodes and deposits of copper and such gold and other minerals as are combined in the land with such copper in such a way that they must necessarily be mined in the mining of such copper in on or under the said land together with the right and liberty to use the said land for the mining of such minerals and for all purposes necessary for the effectual carrying on of such mining or for the carrying out of any of the other operations of the Company under the Agreement made the _____ day of June, One thousand nine hundred and sixty-seven, between the Administration and the Company (hereinafter called "the Agreement") or the said *Mining (Bougainville Copper Agreement) Ordinance 1967* including without prejudice to the generality of the foregoing all of the purposes for which a mining purposes lease may be granted under the *Mining Ordinance 1928-1966* of the Territory of New Guinea TO HOLD the said land and the said mines veins seams lodes and deposits for the term of forty-two years from the _____ day of _____, One thousand nine hundred and _____, with the right to renew the same for further periods each of twenty-one years as provided in the Agreement but upon and subject to the provisions of the Agreement and the *Mining (Bougainville Copper Agreement) Ordinance 1967* and subject thereto to the *Mining Ordinance 1928-1966* of the Territory of New Guinea YIELDING and paying therefor the rent and royalty provided for in the Agreement PROVIDED THAT without the prior written consent of the Company this lease may not be determined or forfeited the Company may not be required to surrender this lease and the said land or any part thereof may not be resumed otherwise than in accordance with the Agreement.

Dated at _____ this _____ day of _____ One thousand nine hundred and _____

IN WITNESS whereof the parties hereto have executed this Agreement the day and year first above-written.

Ch. No. 196

Mining (Bougainville Copper Agreement)

SIGNED SEALED AND DELIVERED for and on behalf of the Administration of the Territory of Papua and New Guinea by DAVID OSBORNE HAY the Administrator of the Territory in the presence of:

(Sgd.) D. O. HAY.

(Sgd.) F. C. Henderson.

THE COMMON SEAL of BOUGAINVILLE COPPER PTY. LIMITED was hereto affixed by authority of a resolution of the Board of Directors:

L.S.

(Sgd.) F. Espie, Director.

(Sgd.) P. W. Quodling, Secretary.

SCHEDULE 2.

Sec 1.

THE 1974 AGREEMENT.

THIS AGREEMENT is made the twenty-first day of November One thousand nine hundred and seventy-four, between THE GOVERNMENT OF PAPUA NEW GUINEA (hereinafter called "the Government") of the one part and BOUGAINVILLE COPPER LIMITED a Company incorporated in Papua New Guinea and having its registered office at Panguna on Bougainville Island in Papua New Guinea (hereinafter called "the Company" which expression shall include its successors and assigns) of the other part.

WHEREAS:

(1) On the sixth day of June, One thousand nine hundred and sixty-seven The Administration of the Territory of Papua and New Guinea of the one part and Bougainville Copper Pty. Limited of the other part entered into a certain agreement (hereinafter called "the 1967 Agreement") relative, inter alia, to the terms and conditions upon which the said Bougainville Copper Pty. Limited should be permitted to mine ores from certain land on Bougainville Island, to concentrate such ores, to transport the concentrates so derived to wharf facilities and to ship such concentrates from such facilities in commercial quantities.

(2) On the ninth day of August, One thousand nine hundred and seventy-three the said Bougainville Copper Pty. Limited did convert to a public company and the name of the said Bougainville Copper Pty. Limited is now Bougainville Copper Limited.

(3) Section 9A of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that the Government is a body politic with perpetual succession by the name "The Government of Papua New Guinea" and is (subject to that Act) capable by that name of suing and being sued, making contracts, acquiring, holding and disposing of real and personal property, and doing and suffering all other matters and things a body corporate may do or suffer.

(4) Section 13 of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that subject to that Act the Government shall be administered by the High Commissioner of Papua New Guinea.

(5) Section 37 of the Papua New Guinea Act (No. 2) 1973 of the Commonwealth of Australia provides that on the date of commencement of Section 5 thereof, all real and personal property of the Administration is, by force of that Section 37, transferred to, and vested in, the Government and there are also transferred to, and vested in, the Government.

- (a) all rights and liabilities of the Administration subsisting immediately before that date; and
(b) all rights and liabilities of the Commonwealth of Australia subsisting immediately before that date by virtue of a contract or agreement entered into on behalf of the

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1 INTRODUCTION

1.1 INTRODUCTION

This is a report of an independent review of the environmental, socio-economic and public health impact of Bougainville Copper Limited's (BCL) mining operation at Panguna, Southern Bougainville, North Solomons Province (NSP). The report has been prepared by Applied Geology Associates Limited, independent consultants from New Zealand. The review was ordered by the National Executive Council after strong representations from the landowners in the mine area. It was undertaken with the landowners' assistance and with the cooperation of BCL and National and Provincial government officers and co-ordinated by the Department of Minerals and Energy of the Government of Papua New Guinea.

When mining commenced on Bougainville there was no requirement to undertake environmental impact assessment and no environmental report or plan was produced by the mining company or the Government. Prior to the current review reported here the only independent assessment of the Bougainville copper operation had been done for the United Nations Environment Programme in 1977. Environmental reviews have been produced by the Company since 1984.

The first sections of this report give the background to the review and describe consulting activities. This is followed by a description, as accurately as is now possible, of the pre-mine environment, social and physical, and the early activities of the Company and the then Administration leading up to the mine development. This is required as a 'base line' against which to assess impact and because some events of that time caused continuing concern for some people. A detailed description is given of customary land ownership. The mining activities are described together with information on proposed new developments and the possible future life of the mine. The Company towns, infrastructure, social services and village communities are described.

Most of the report comprises a description and assessment of the changes that the mining operation has brought to the region - that is, its impact. This is presented in sections on the physical environment and on social and economic changes. Much of this addresses the concerns of the landowners whose pressing demands were instrumental in getting the review done. The programmes that the Company and other organisations, where they exist, have in place for environmental monitoring and planning are described and evaluated.

The concluding sections of the report set out an analysis of the major issues together with a discussion of the opportunities we see to provide remedies for problems that exist and may arise in the future. Recommendations are presented to address the most pressing problems we see.

1.2 BACKGROUND

Conzinc Riotinto of Australia (Exploration) Pty Limited (CRAE) commenced exploration on Bougainville in 1964 in search of low grade high tonnage copper porphyry deposits. At this time Papua New Guinea was an External Territory of Australia governed by the Australian Administration. Following the success of the geologists in proving an ore body at Panguna, Bougainville Copper Pty Limited (BCP) was incorporated in June 1967 in the Territory of Papua New Guinea. Two-thirds of BCP was beneficially owned by CRAE and one-third by New Broken Hill Consolidated. Late in 1967 BCP entered into an agreement with the

Administration for the Territory for the investigation and development of mineral deposits on Bougainville. Leases were granted to BCP for mining, tailings disposal and road access and land was acquired by the Government for town and port facilities. Bougainville Copper Limited (BCL) was incorporated in 1973 and is now 19.1% owned by the Government of Papua New Guinea.

Following a development period during which extensive earthworks were undertaken in port, town and road construction, the mine commenced production in 1972 at a rate of 82 000 tonnes per day (tpd) of copper ore containing some gold. The Panguna mine is a very large mine by world standards and its current rate of operation is 140 000 tpd of ore and 120 000 tpd of waste material. Subject to metal prices and operating costs remaining satisfactory, the mine has a probable future life to 2001. The Company currently employs 3700 people, 19% of whom are from overseas.

All the land subject to development except for parts of Arawa is customarily owned by Bougainvilleans. Landowners in some locations have opposed the Company's activities from the earliest days of prospecting. These include many of the Nasioi people from the Panguna area whose land has been occupied and in some cases destroyed by mining and whose lives have been irrevocably changed by the project, and the coastal Rorovana people whose land was used for the construction of the Loloho port and Camp Six. Landowners over a wide area were adversely affected by the earthworks and construction associated with the mine development and the scope and adequacy of compensation are long-standing and continuing sources of friction between the landowners, the Company and Provincial and National governments. Issues concern the distribution of costs and benefits, whether payments are a redress or a benefit and the provision for long-term losses. Compensation for measurable losses of crops and animals, while attracting debate and dissatisfaction, have most frequently been dealt with equitably. Occupation and degradation or destruction of land was and continues to be a source of major tension between the landowners and all other parties.

Throughout most of its life the mine has been very profitable as a result of the combination of efficient and innovative management and strong metal prices for either copper or gold and occasionally both. Since 1972 BCL has contributed 16% of Papua New Guinea's internally generated income and 44% of its exports. In early years the Company's foreign shareholders achieved very high returns on their invested capital but more recently a larger share has remained in Papua New Guinea. The distribution of cash benefits from the mine over the 10 year period 1978 to 1987 was as follows:

National Government (taxes, fees, dividends)	63.0%
Provincial Government (taxes, dividends, royalties)	4.8%
Foreign shareholders	31.6%
Other PNG shareholders	0.4%
Landowners (royalties)	0.2%

(Compensation is not included in this list as it is an operating cost for the Company representing actual 'purchase' of goods or services taken by the Company. Compensation payments to landowners for the same period averaged K1. million.)

Associated with the construction of the mine was the development of a port and power station at Loloho and the growth of the new town of Arawa, which was constructed on land resumed from an expatriate-owned plantation. Planning of

the town began in 1969 and Arawa has now become the administrative centre of the North Solomons Province with a population of more than 13 000 people. Much of the housing is owned by BCL; other housing is publicly or privately owned and there are squatter settlements on the fringes of the town. BCL also constructed a town within the mining lease area at Panguna itself, which now has a population of over 3000. The urban population at Loloho is now just under 1000. Kieta, the old administrative centre of Bougainville, on a cramped coastal site, has grown more slowly, also having a present population of just over 3000. The only other towns in the North Solomons Province are at Buin and Buka Passage, with a combined urban population of approximately 2500. Hence a large proportion of the urban growth of the Province can be directly attributed to the establishment and development of the mine project. Urban growth has been associated with improvements of infrastructure, notably the emergence of new commercial enterprises, community and high schools and a large hospital at Arawa and other new facilities at Panguna.

One of the conditions of mine construction was that BCL would construct and maintain a road that extended the Port-Mine Access Road from Arawa to Panguna effectively as far as Nagovisi in South Bougainville. Completion of this road in the early 1970's linked villages in the Buin, Siwai and Nagovisi districts directly to Arawa and Kieta. This new road construction occurred during a period of dramatic expansion of smallholder cocoa cultivation in southern and central Bougainville and enabled villagers to market cocoa readily (and other agricultural products, including copra and vegetables) in Kieta, and thus obtain higher prices than had hitherto prevailed. The new road infrastructure thus directly contributed to the growth of commercial agriculture in southern Bougainville.

Political events in Papua New Guinea since mining began have both influenced and been influenced by this large operation. In the years leading up to independence in 1975 a secessionist movement emerged on Bougainville, fuelled in part by the perceived injustice of the then Administration receiving such a disproportionate share of the benefits of mining. The provisional government declared its own independence, as the Republic of the North Solomons, immediately before national independence. Eventually political issues were resolved amicably and in the same year the Provincial Government won the right to receive metal royalties previously received by the Administration, an arrangement the new National Government maintained. In 1984 and again in 1987 the National Government came under strong pressure from the Provincial Government and from the local representatives in Parliament for an improved share in the profits and ancillary benefits from mining.

In 1988 the Panguna Landowners' Association called on the Company to pay it 50% of the profits and K10 billion compensation for environmental damage since 1963. Dissatisfied with the lack of response villagers blocked the three key access roads for 12 hours during May 1988. In December 1988 as this report was being written, landowners undertook systematic attacks on Company property and closed the mine for several days.

1.3 INDEPENDENT REVIEW

Late in July 1988 Mr P Lowa (Minister for Minerals and Energy) and Fr. J Momis, (Minister for Provincial Affairs and Member of Parliament for Regional Bougainville) visited Panguna at the invitation of the Panguna Landowners' Association supported by the North Solomons Provincial Government. Following a

visit to Dapera and Moroni villages on the mine site and parts of the mining operation, the two Ministers attended a sometimes stormy meeting with the landowners. The meeting was chaired by Mr R Bele, MP for Central Bougainville and himself from Rorovana, and was attended by the Premier and officials of the North Solomons Provincial Government.

The landowners impressed upon the visitors their absolute frustration at the failure of all parties to provide acceptable responses to their concerns which had been raised with the Company, and the National and Provincial governments over a number of years. These related to health and education facilities, environmental damage, relocation of villages, business development and compensation. The landowners renewed earlier threats to close the mine if their demands were not met.

Within four days the Minister for Minerals and Energy had prepared and submitted to the National Executive Council (NEC) a policy submission outlining the problem and requesting NEC approval for investigations into the villagers' concerns. Approval was also sought to employ an independent consultant. The NEC approved the submission and requested the Department of Minerals and Energy to prepare Terms of Reference for an independent review and select a suitable consultant. Draft Terms of Reference were prepared and distributed for comment to relevant government departments and organisations. These were finalised by the end of August and consultants appointed and work underway in September.

1.3.1 Terms of reference

The Terms of Reference for the study are summarised below and reproduced in full in Appendix I.

1. OBJECTIVE

- 1.1 To determine the overall impact that mining operations at Panguna have had on the social and environmental aspects of the area.
- 1.2 To determine the likely future impacts of continued mining operations at Panguna on the environment and the people in the area, taking into account the tailings pipeline.
- 1.3 For the purpose of the study the Panguna mine will include the area within the Special Mining Lease, Tailings Lease area, Empress Augusta Bay, Road Lease, Port Facility and relevant villages in the surrounding areas.

2. SCOPE

- 2.1 To analyse and review results of all investigations to date....
- 2.2 To collect any data necessary to validate existing records of investigation....
- 2.3 To review the reports and other information on socio-economic and public health impacts that mining operations have had....
- 2.4 To formulate opinions for mitigating negative aspects and capitalising on positive aspects and recommend courses of action....

It should be noted that the terms of reference do not address the impact, mostly positive, of the mining operation on the Papua New Guinea economy.

1.3.2 Consultants and review methods

The consultants were engaged in September 1988 and instructed to complete their review and report in writing in the following December, 13 weeks after approval for the work was given.

The review team and authors of this report are:

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Robert Owen	BSc (Hons) MSc
Michael Timperley	MSc PhD MNZIC
Glenn McGregor	BSc (Hons) PhD
John Connell	BA PhD
Iain Aitken	MB BChir MPH

The team was assisted by:

Thomas Takahau	BSc
Joseph Tsinoung	

After a brief scoping visit in early October by the Team Leader, the Review Team spent November conducting the review based in Arawa. Study activities included the following:

- . Briefings, technical presentations and oral submissions from Bougainville Copper Limited, North Solomons Provincial Government, landowner associations and individual villagers
- . Inspection tours of mine, villages, road access, port, and tailings areas
- . Meetings in villages
- . Independent sampling of water, sediment and soils
- . Assessment of equipment, laboratory and field procedures
- . Review of technical reports and health records
- . Workshop/seminar style oral report by the Review Team and discussion on interim findings

The Review Team received oral submissions in many villages in the area and attended formal briefings from representatives of the North Solomons Provincial Government and BCL. Meetings were held in the following villages: Koiare, Arawa, Dapera, Guava, Kuneka, Pirurari, Pakia and Rorovana. In addition inspection visits were made to Moroni, Leira and Pokunameri.

The following government departments and other organisations were represented at various meetings and review activities:

- . Panguna Landowners' Association
- . Department of Minerals and Energy
- . Department of Environment and Conservation
- . North Solomons Provincial Government
- . Bougainville Copper Limited

A list of the reports reviewed is provided in 'References', contained in Volume Two with the Appendices. A record of the meeting at Guava is provided in Appendix II.

The review is reported in draft for distribution and comment by participating and other interested organisations. Their comments will be addressed by the Review Team in the preparation of the final report.

1.4 ACKNOWLEDGEMENTS

Many individuals assisted the Review Team with its work in Port Moresby and on Bougainville Island. In particular, the Review Team wishes to thank the very many people of the North Solomons Province who contributed time and energy to ensure the short time available to undertake the Review was well used.

2 DESCRIPTION OF THE PRE-MINE ENVIRONMENT

2.1 BOUGAINVILLE

Bougainville Island is situated 6° south of the equator at the northern end of the Solomons Islands chain (Figure 2.1.1). It has high relief rising to 2600 metres altitude at its highest point, Mt Balbi, one of several extinct volcanoes that form a central mountain chain. Mt Bagana, an active volcano, is situated near the centre of the island. Bougainville is one of the most seismically active parts of the globe.

Figure 2.1.1 shows the southern section of the island from coast to coast with the major elements marked: on the east coast the airport at Aropa, the administrative centre of Kieta, the town of Arawa, and the Company power station and concentrate load-out area at Loloho. The 25km long port to mine access road follows the Pinei Valley to the crest of the Crown Prince Range at 1100m altitude and descends to the town of Panguna at 700m in the headwaters of the Kawerong Valley. From Panguna the road continues south and west towards Boku and continues in a southwards loop through Buin and Aropa.

Prior to 1969 infrastructure in the area comprised the port and administrative centre at Kieta and airstrips at Aropa and Buin. A road extended southwards from Kieta for approximately 30km.

The climate is typical of the humid tropics with two distinct seasons: a north-west cyclone and a south-east trade season. Temperatures, rainfall and humidity are all high and are comparatively uniform throughout the year (Table 2.1.1). The mean annual rainfall at Panguna is 4353mm and that at Loloho 2891mm. Most of the rainfall occurs as regular, short-duration, high-intensity storms. The island can also be affected by prolonged high-intensity rainfall from tropical depressions. The wind climate is mild.

In this region stream flow and sediment transport are integrally connected. Rivers are generally short with steep upper catchments and very flat coastal stretches often with meander sections through swamp reaches. River flow is typified by high base flows with short-term flood peaks. The Kawerong River and the upper reaches of the Jaba River have been described in early Company reports as consisting of long boulder rapids interspersed with deep pools. In the Kawerong River there were occasional waterfalls. Lower in the Jaba River gravel reaches progressed to meandering reaches with a sandy bed towards the estuary in Empress Augusta Bay.

Upstream of the confluence of the Kawerong and Jaba rivers, the valley was densely forested land and of high relief. Many of the less steep slopes were used for gardens and cash-cropping. Subsistence agriculture employed a system of bush fallow cultivation requiring between 0.1 and 0.2 hectares (ha) of land per head. Staple crops included sweet potatoes, and to a lesser extent taro and yam with additional sugar cane, bananas, papaya and breadfruit. Surrounding land was used for hunting and gathering and the rivers and streams were used for fishing.

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Table 2.1.1 Summary of mean daily temperature, rainfall, and 1500 hr relative humidity for Loloho (LOL) and Panguna (PAN)

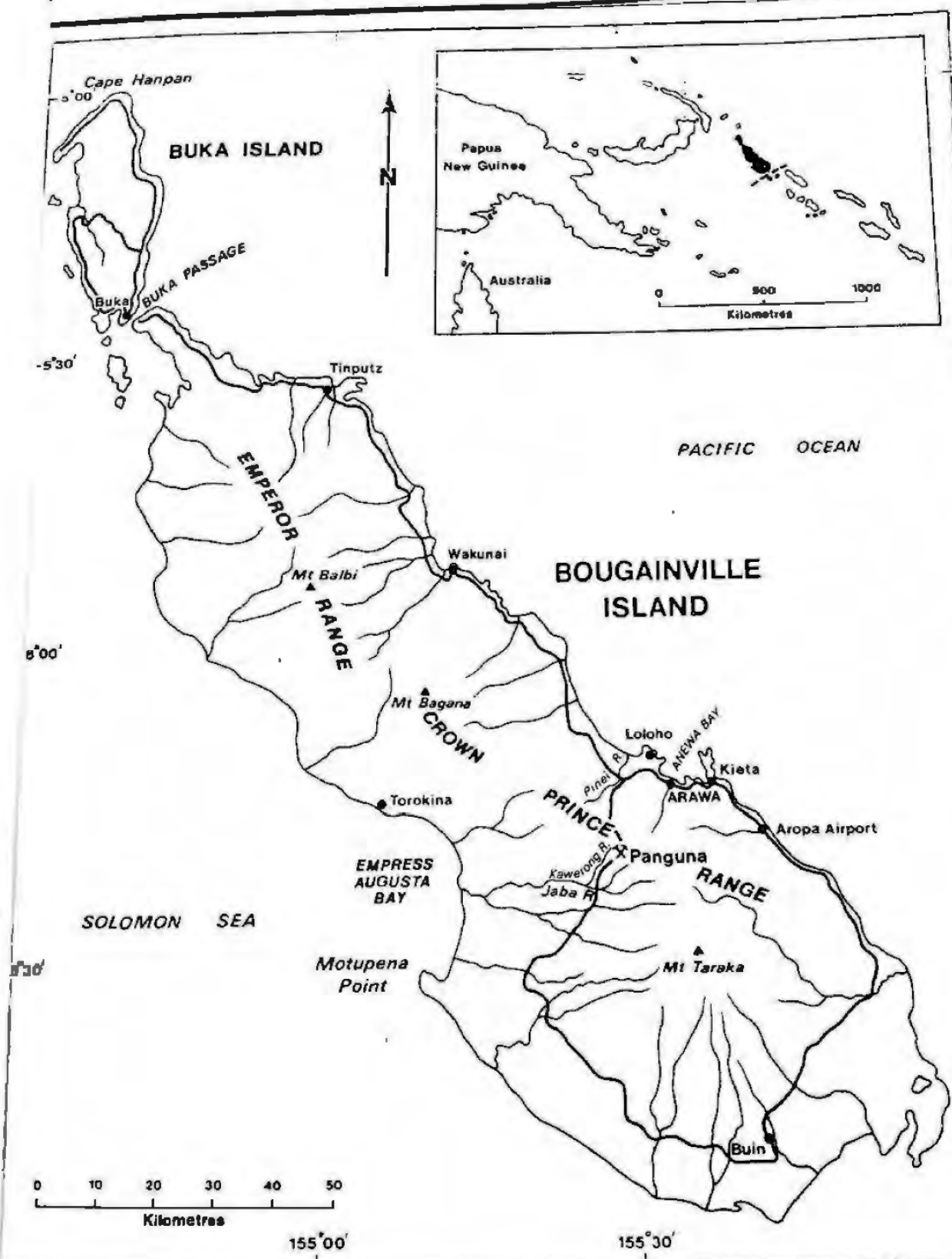
	Main daily temperature (°C)		Mean monthly rainfall (mm)		Mean monthly 1500 hr relative humidity (%)	
	LOL	PAN	LOL	PAN	LOL	PAN
Jan	27.6	23.9	227	438	77.8	88.3
Feb	27.3	23.7	336	437	80.2	88.0
Mar	27.3	23.7	315	555	81.0	88.4
Apr	27.2	23.7	266	425	81.2	88.9
May	27.4	23.7	226	289	78.5	87.1
Jun	27.2	23.2	152	212	77.0	86.8
Jul	26.8	22.8	224	324	77.2	87.9
Aug	26.7	23.0	210	264	77.6	86.4
Sep	26.8	23.0	238	282	77.3	85.5
Oct	27.2	23.3	242	333	77.8	87.5
Nov	27.6	23.8	227	370	78.9	89.6
Dec	27.6	24.0	228	424	79.5	88.1
Total			2891	4353		
Years of record	14	20	16	20	16	20

The middle reaches of the Jaba River, then and now are low-lying, broad, alluvial coastal plains with some densely forested areas, some grassland, and some areas of swamp. Villages through this area grow the same range of subsistence food crops as those in the mountain areas, although sweet potato was even more dominant on the coast. In the mountains there were some small areas of coffee, and in the Jaba River area coconut and cocoa provided cash incomes. Adjacent and towards the coast were swampy areas where there were no villages, except on the coast itself, but within which hunting and food gathering were carried out. Immediately inland from the shore is another distinct land zone on which sandy soils support tall forest and in which hunting and gathering and subsistence gardening occurred. The small village of Jaba was located at the Jaba River mouth.

On the western flank of the Crown Prince Range the Pinei River valley was very similar to the Kawerong and the upper reaches of the Jaba. Forest cover and land use patterns were not dissimilar, although at the time of mine construction, cash-crop plantations of cocoa were better developed than in many other parts of Bougainville.

2.2 CUSTOMARY LAND OWNERSHIP

As elsewhere in Papua New Guinea, there is an extremely strong relationship between people and land; indeed it is the closeness of this relationship that



BOUGAINVILLE ISLAND AND MINE LOCATION

Figure 2.1.1.

has produced a series of difficult development problems in the context of land alienation. Throughout the mine-affected areas of Bougainville the structures of land tenure are very similar, although they have been best documented for the Nasioi and Nagovisi language groups. They have not been documented for the coastal Rorovana and Banoni language groups where the structure may be very slightly different.

The populations of Central Bougainville are divided into a number of dispersed matrilineal clans. Clan affiliation provides a fixed reference point for individuals. Those residents of a clan who reside in a particular place share the right to exploit a particular tract of land. Traditionally most marriage partners were chosen from the same village group, through the practice of cross-cousin marriage. As a result the possession of cultivation rights, but not ownership of land, revolves in a tight circle with control changing hands in the male line with each succeeding generation. In this way particular tracts of land are strongly identified with particular clan, or sub-clan groups.

Land tenure can be described in terms of a hierarchy of use rights. Primary rights to a tract of land were normally established by the man who cleared an area of primary forest; these include the right to make gardens and erect houses, the right to plant tree crops of longer life than the ordinary garden and the right to allocate sections of this garden land to others. Garden land could thus be allocated to the individual's wife (or wives), other men from his clan and their wives. Women saw their primary rights as rights to recut the bush where the women's mothers had gardened decades previously and where they had worked and played as young people. Rights could also be allocated to other genealogically more distant households who might be willing to help an ambitious man clear a particularly large tract. Subsidiary rights included the right to request, with reasonable expectation of success, garden plots from the primary right holder, and to claim primary rights to the tract on the death of the primary right holder. When rights to land were passed, in the normal mode, from mothers to daughters, it was the use rights to vegetation in that area that were transferred. Rights to carry out other sorts of activities on a tract came by virtue of membership in the descent group holding title to the tract.

Primary rights did not include the right to alienate tracts of land by transferring freehold rights, or by selling such rights, to a complete stranger. In pre-contact times such a situation simply did not arise. The most common instance of rights in land being formally transferred involved the children of a primary right holder; if such children provided a sufficiently large feast to their father's close matrilineal kin and other clansmen, they thereby obtained primary rights which would otherwise have reverted to subsidiary right holders. However such traditional tenure rules seldom indicated how rights might be lost, but rather how they might be acquired, and the actual practice of land tenure was both flexible and often informal, a situation often leading to multiple and conflicting claims. Where excess land was generally available, as in most parts of Bougainville at least until the post-war years, such flexibility posed no particular problems. Potentially conflicting claims could also be accommodated by the traditional marriage system of cross-cousin marriage.

Although matrilineal kinship was important to the transmission of land rights, such rights were normally exercised by men, and have occasionally resulted in disputes when men have sought to plant cash-crops on tracts of land to which their wives have primary rights. Wives must therefore approve of their husbands' plans for land use for them to be successful. Recently Bougainvilleans have increasingly stressed the view that the right to plant semi-permanent

cash-crops such as cocoa is a primary right, and not a subsidiary right, a situation emphasised by the impact of growing population pressure and cash-cropping on land resources. Planting of cash-crops converted tracts of land that were temporarily used for gardening into areas now regarded as more firmly attached to particular individuals or small groups and ownership has become more individualistic. In general no rights to land were ever unconditionally guaranteed but land could never be made available for freehold purchase without generating substantial conflict. However at least in Nagovisi there have been a small number of cases where land has been purchased for cash. Flexibility has meant that many individuals, whether Bougainvilleans or outsiders, will attempt to establish rights of land tenure that further their perceived interests.

Land is divided into known tracts, ranging in size from a few hundred square metres to tens of hectares in the least productive and inaccessible mountain slopes. These tracts can be exploited for agriculture, settlement, hunting, gathering and pathways. Over periods of two or three generations, and especially with the recent decline of cross-cousin marriage, as individuals choose their own partners more widely, more factors have acted to disperse land holdings than to concentrate them. Consequently individuals in a particular parish or village may have access to land over quite a wide area, as in the case of Guava parish in mid-1960 (Figure 2.2.1). Hence in many villages now affected by the mine at least some individuals have access to land in areas distant from the immediate village area, which can be used for agriculture of some kind. As pressures on land have increased, fragmentation has become more common, as individuals have sought to use more distant tracts of land rather than allow them to revert to other clan members resident in those areas, and disputes over land ownership have become more frequent.

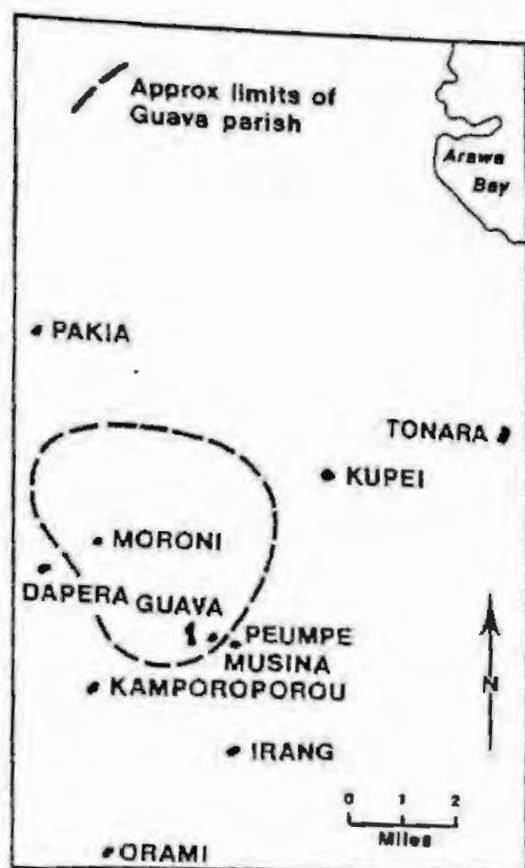


Figure 2.2.1
Approximate location of villages
outside of Guava parish, in which
Guava residents had rights to
cultivate land.

Land in Bougainville was and is of crucial importance because it is the concrete expression of the presence of the past. Its ownership demonstrates the continuity of past, present and future and identifies particular groups. Beyond this more spiritual and ideological relationship between people and land, land is the source of subsistence and survival; land is social life, politics, marriage, status and security. For people with no experience of social and economic survival detached from the land, to be landless is to be in a situation for which no monetary gain can adequately provide compensation. In those exceptional circumstances where land has been sold the purchased land was regarded as surplus to any perceived future needs and/or had no competing claimants. Otherwise land is increasingly zealously guarded by those who have primary use rights and any alienation of these rights poses a threat to the present and future welfare of landowners and their kin. Access to land is perhaps the most important element in the lives of the majority of Bougainvilleans.

2.3 LAND AND WATER USE

At the time that CRAE began exploration in the early 1960s, the area around the present mine site was one of the least developed areas of Bougainville. In 1964 a Patrol Report (Ref. 1) described the Guava census division, which included Dapera and Moroni, as a 'fairly isolated area with very restricted communication and access and the people are among the least sophisticated in Bougainville'.

Most villages depended on subsistence food production; there was little cash-crop production. Although the Administration was encouraging coffee growing, few villagers were interested although some were experimenting with cocoa cultivation. The majority of income in the Guava villages was from plantation labour on the east coast and in East New Britain. As a 1961 Patrol Report recorded (Ref. 2): 'Economically the Guava census division is very underdeveloped at the present time'. There was no road access to the villages and in 1964 coffee was being brought on foot to Kieta from villages such as Pakia and Guava. By 1964 Dapera had only 343 coffee trees, all of which were immature, although Pakia had 2660 mature and 178 immature trees. There is no record of there being significant cocoa plantations at that time.

Access to other facilities was limited. However there were primary schools in the district although few students went on to secondary education. Nutrition and health, apart from some gastroenteritis, appear to have been relatively good, partly because of the diversity of locally available food and the high altitude. All houses were made from bush materials, with local timbers, bamboo walls and sago leaf rooves. Water came from the many fast-flowing streams. A number of villagers had obtained access to land closer to the coast and for some years there had been movement of people from the more remote upland villages of Guava towards coastal sites. In 1964, for example, the villagers of Mainoki and Sirowai were in the process of moving their villages down towards the Nagovisi plain, in anticipation of better opportunities for cash-cropping.

There are few existing records of the social and economic situation of other areas currently affected by the mine at the time that exploration began. However upland villages in the headwaters of the Jaba River experienced similar conditions to those around Guava and were even more inaccessible to Kieta; there too there had been some movement down the slopes towards more accessible land around Moratona and Boku which offered greater possibilities for cash-cropping.

Valley floors were settled in a number of instances as a result of encouragement by the Administration. About two-thirds of the village of Dokotonama (in the present mine lease area) were previously residents of Dapera, located 200 metres above the ridge top. Such movements have accentuated the dispersal of line villages into a series of hamlets.

Cocoa cultivation in southern Bougainville began around Mosigetta (Nagovisi) in the early 1960s and quickly spread into other nearby areas although few trees were planted since markets were inaccessible. There too there was a basic network of primary schools and aid posts. The Jaba River valley was very thinly populated although there had been some movement into the area for cash-cropping. At Jaba, on the coast, no cash-cropping was undertaken and diets were much more dependent on coastal fishing than in the inland villages where river fishing merely supplemented diets. Coconuts provided a cash-crop that must have generated a little income. As a result throughout the area around the present tailings lease area, plantation labour contributed the bulk of cash incomes. By contrast, north Nasioi, the area inland from the future Arawa town, had already become one of the more prosperous areas of Bougainville, with good incomes from cocoa cultivation (hence Guava interest in cocoa and dislike of coffee), with better access to educational facilities and more adequate incomes to support children through the education system. However the port-mine access road lease area skirted the north of this region reaching the coast close to Rorovana and Uruawa, which also appear to have been relatively prosperous areas at this time.

In general therefore the areas currently affected by mining operations had participated in limited economic development, were dependent on external income generated by plantation labour and had some access to modern health and educational services. Virtually the whole of the population of the area had been converted to Christianity but retained a vibrant traditional social and cultural life based around localised clans and lineages. Apart from Rorovana, villages were small thinly scattered hamlets, especially in the mountains, and the population growth rate was still low, due to high infant mortality.

Available data on village populations at that time (Table 2.3.1) show that at the time that mining operations began there were fewer than 500 people in the immediate vicinity of Panguna and about 2000 people in the area that is now within the various lease areas. For the Guava Census Division as a whole, 31% of the population was aged 15 or under, as a period of more rapid population growth began to be established.

2.4 REGIONAL ADMINISTRATION

As the most remote district in New Guinea, Bougainville in the colonial era was usually lightly administered. The greatest changes in peoples' lives in the pre-war years followed the steady expansion of copra plantations and associated stores and the growth of mission activities throughout the island. Administration activities were largely confined to irregular patrols to review social development, hear court cases, assess health and conduct censuses, although one major change had been the amalgamation of scattered hamlets into more easily administered line villages. In each village local officials were appointed as government-sanctioned leaders and a dokta-boi was also usually appointed. Nonetheless in this early era of administration the population of the district scarcely grew. However by 1941 European control had ensured pacification and the establishment of Christianity imposed a new form of leadership and settlement, and resulted in the alienation of large areas of land on the east coast.

uragement
(in the
200 metres
of line

Table 2.3.1 Village populations 1965 (Source: various Patrol Reports)

Village	Population
Arawa	163
Lonsiro	117
Rorovana	434
Sierondji	82
Pakia	180
Borumai	104
Darenai	145
Onovi	176
Dapera*	206
Kokore	222
Guava	198
Musinau	145

* Includes the hamlets of Pirurari, Dokotonama, Moroni and Isibokuna

In the post-war years the pace of change slowly increased and began to incorporate some self-government and the eventual move towards independence. The three main agencies of change (administration officials, planters and missionaries) nonetheless continued their operations in much the same way. For many Bougainvilleans the post-war years presented considerable difficulties; the war had left animal stocks and gardens depleted, the principal food crop, taro, had been wiped out by taro blight (probably introduced from the Solomon Islands) and populations had declined. Approximately A\$400 000 was distributed to Bougainvilleans as compensation for wartime damage.

In time health facilities were greatly expanded and Bougainville, and many other parts of Papua and New Guinea, began to experience a steady population growth rate principally following the malaria eradication programme which led to a dramatic reduction in infant and child mortality. Education also improved with subsidies to mission schools, but it was not until the 1960s that the first two government high schools were established at Hutjena and Buin. The economy expanded further with the expansion of the plantation economy and the slow but accelerating emergence of indigenous cash-cropping. In Bougainville small quantities of copra had been sporadically sold by villagers in the pre-war years, but it was not until the 1950s that more concerted cash-cropping began, with the planting of cocoa, a more valuable crop which steadily spread into most of Bougainville from the coastal areas around Kieta. As the cash-crop economy developed Bougainvilleans became increasingly unwilling to take part in plantation labour and their places were taken by migrants from the New Guinea mainland.

In the early 1950s efforts were made to transform the pre-war system of appointed officials into local government councils with elected officials. However the scheme operated with varying degrees of success, partly because in many respects they remained vehicles for administration officials and many elected councillors lacked traditional authority. However by 1970 seven local government councils, with a combined population of 55 000, had been established

and covered most of the district. These political developments were not without Bougainvillean opposition. The well publicised Hahalis Welfare Society in Buka, began in the 1950s, opposed council development and its members refused to pay taxes. The dissidents were eventually met by police intervention and repression. While these dissidents were being jailed many Nasioi met a United Nations mission at Kieta in 1962 to complain that they were treated like dogs and that the administration should be taken over by the United States. Other localised forms of opposition to various facets of colonial administration, some with cultic forms, occurred in other parts of Bougainville.

There were regular Combined Councils Conference meetings from 1963 onwards, but Bougainvilleans had no direct role in the administration of Bougainville. However the establishment of a national House of Assembly in 1964 led to Bougainvillean participation in national elections and national development. Paul Lapun, from Banoni, became the first Member of the House of Assembly for Bougainville. In Bougainville itself the administration remained controlled and administered by Australian appointed government officials, and it was not until July 1974 that a more representative Provincial Government reached Bougainville. The status of the Provincial Government was strengthened after Independence and it has been the forerunner and model for provincial governments elsewhere in PNG.

2.5 PROSPECTING AND THE ARRIVAL OF CRAE

Gold mining in this part of Bougainville dates back to 1934 when small scale underground operations were conducted near the village of Kupei in the headwaters of the Bovo River behind Arawa. It was not until 1963 that mining companies took an interest in the area when a CRAE employee Ken Phillips was granted an Authority to Prospect over 630 km² for a term of two years. Prospecting commenced in April 1964. At no time actively encouraged by the villagers in the Kawerong Valley, prospecting was resisted by many after CRAE had been working for less than a year. With more intensive prospecting, including drilling, the exploration was at times halted by protest action. In the face of continued opposition from the villagers, the Administration upheld the rights it had awarded CRAE, sometimes using force. To help redress these problems, the mining laws were amended in 1966 to provide for compensation payments to landowners for the use of their land. It was apparent however the Bougainvilleans most directly affected by the exploration activity simply wanted CRAE to go away so they could continue their normal agricultural activities unhindered by external intrusions (Ref. 3).

Reaction to the arrival of CRAE and construction teams in the 1960s was almost invariably hostile, especially in the Guava area. One of the very few positive comments on mine activities that is recorded in the Patrol Reports of the period, at a time when approximately 90 local villagers were employed by CRAE, was 'When asked how they thought about CRA the answer was that it is a good thing, providing employment and bringing money into the area' (Ref. 1). More commonly there was strong opposition, as subsequent patrols in the region discovered. In 1966 a Patrol Report (Ref. 4) on the area around Dapera and Darenai villages recorded:

'This is where I first found that the people along this ridge were against any interference by the Company. They told me they owned the land and thus the copper and didn't want the Company to take it away and

leave their children with nothing. They said they wanted to wait until their children had received an education to handle the Company. The people refuse to accept the principle that all mining rights belong to the Government and any benefits as such go to the Territory as a whole and not to various individuals in the mining area. When talking to the priest at Deomori I found that his beliefs are the same as the people. Some of the priest's ideas are incorrect. He believes that the mining rights belong to the people and that the people have received payments for these rights.'

Such attitudes on both the part of the local people and the Administration were widespread around Guava and, as exploration activities spread further from the Panguna area, similar views were recorded. Further north at Karato in 1967 the villagers were opposed but they 'assured me that they could see that it would be useless to start fighting. The only thing they wanted to know was when they would be paid the compensation etc. for the trees destroyed by CRAE. This I could not tell them as I did not have the answer' (Ref. 5). And at Koromira to the south 'much of my time was spent trying to point out to the people that CRAE was going to start work in the area and there was nothing that could be done about this. All groups were warned as to what the consequences would be if they caused trouble when the time came' (Ref. 6). One exception to this trend was at Atamo, on the other flank of the coastal ranges from Karato, where the prominent local leader Tonepa commented in 1968 on CRAE (Ref. 7) that:

'Before I was under the false impression that they would not benefit our country [Bougainville] but only the white man. Now I know they will be the basis of our final secession. I want them to work at Panguna and develop a large concern there. This will give us a source for our people to work and revenue from taxes.'

He was however adamant that there should be no mine near Atamo itself. Generally opposition to CRAE was strongest closest to the site; as Guava villagers were reported (Ref. 8) saying in 1968: 'why does the government help CRA when it is supposed to be helping us. The government knows we do not want anything to do with the CRA'. On the grounds of perceived future land shortages, the absolute loss of land and the view that there would be nothing left for them to mine, opposition to CRAE activities was widespread during the 1960s.

Opposition to CRAE was often forceful, including physical threats to company personnel and removal of survey markers. Police often accompanied patrol teams to ensure their safety and in a well-publicised event at Rorovana, police removed protesting women from the path of incoming bulldozers - a confrontation which focused national and international interest on Bougainville. By and large, as Oliver recorded in 1973 (Ref. 9):

'A few of the villagers near the mining site seem to have greeted events with pleasurable anticipation of the material rewards they would reap from it, while a few others became and remained implacably hostile. Most of them appear to have become resigned more or less disconsolately to what they regard as another example of the white man's cupidity, deceit and irresistible power.'

It was in this kind of climate, with the Administration forcing changes on a few compliant villagers, most notably Oni a prominent traditional leader of Moroni village, that mine construction operations got underway. None of the villagers in the mine area, whether supportive or opposed, could have had any idea of what would eventually become of their land and livelihoods.

2.6 THE DEVELOPMENT PHASE

The prospecting phase continued to 1968 by which time CRAE had drilled many diamond drill holes and excavated tunnels and pits for exploratory purposes. Initially access was by helicopter but in 1967 the first access road was completed between Kieta and Panguna. Following success in proving the Panguna deposit and preparatory to undertaking the development works, a mining agreement was concluded with the Administration in 1967 and legislation passed in the Papua New Guinea House of Assembly the same year.

The signing of the agreement between the Administration and CRAE in 1967 led to resentment against the Administration, rather than against CRAE, for what was perceived as inadequate consideration for the landowners. In 1969 there were early threats of secession unless the Administration revised its laws on the selling and leasing of indigenous land. In mid-1969 a new organisation centred around Kieta, Napidakoe Navitu, emerged, with Paul Lapun as Chairman and Raphael Bele as Treasurer, initially to oppose land resumption by the Administration in the Arawa and Rorovana areas. It gained considerable support in South Bougainville and eventually moves to support a referendum for Bougainville secessionist sentiments strengthened in later years, leading to the declaration of a Republic of North Solomons in 1975, an abortive move that quickly lost any semblance of political legitimacy.

Investigations continued in 1967 and 1968 on the ore deposit and into all aspects of the development of a mine including the access road, waste and tailings dumps, town site and port. During 1967, 1970 and 1971 various leases were obtained. Land required specifically for mining purposes was applied for as mining leases and granted to Bougainville Copper Pty Ltd subject to compensation. Land required for 'a public purpose' (town, port or industrial area) was obtained by the Administration by direct purchase, lease and compulsory acquisition. Throughout this period official statements and press reports emanating from the Administration encouraged public acceptance of the project. In a statement to the House of Assembly early in 1969 the Acting Assistant Administrator (Economic Affairs), Mr APJ Newman MHA, warmly praised the proposed development and described the benefits to Papua New Guinea and the people of South Bougainville. In reference to land requirements he said the following: 'Although little of this land is improved it contains the village of Moroni (population 53) and the four hamlets of Dapera (population 186). It will be necessary for these people to move from their present locations, but they will be compensated for the disturbance, and if necessary, will be given other land to live on.'

Although many individual Bougainvilleans earned significant new incomes through employment during the exploration and construction phases there was little direct support for the mine other than from the Australian Administration. Opposition by the villagers to exploration continued and numerous acts of disruption are recorded. The Government used force to obtain access to some land. Surveying to determine boundaries of individual blocks was undertaken so that occupation fees and eventually royalties could be paid to the landowners. Compensation was negotiated between landowners, the Company and the Administration which in two instances involved litigation to the Australian High Court.

Prior to the granting of the Special Mining Lease in April 1969 work had begun on stripping the overburden from the deposit under approval of the 1967 agreement. By August 1969 the work was well underway with forest clearing

involving the aerial spraying of defoliants, and sluicing or hydraulicking the soil, volcanic ash and superficial weathered rock into the Kawerong River. Construction of the Port-Mine Access Road up the Pinei Valley and across the Crown Prince Range into the Panguna area was also undertaken between 1969 and 1970. The earthworks for this were extensive.

The new road became fully operational late in 1970 and allowed improved transport of materials from the port to the mine for the construction of the Panguna township and the mine and concentrator. Construction of the public town at Arawa, predominantly for the Company, began in 1970. The port of Loloho in Anewa Bay began receiving shipping at its permanent wharf in 1970 and an oil-burning electric power station was built there in 1971. In 1972 the crusher and concentrator were completed in time for mine opening.

A great deal has been written about the acquisition of Arawa Plantation, the Rorovana land dispute and leasing of village land for Arawa town in 1969 and 1970. Issues concerning the threats of compulsory land acquisition, use of force by the Administration, compensation policies and the emergence of Bougainvillean Nationalism are well documented (Ref. 3). They are as vital and as relevant now as they were then.

Claims for compensation for loss of trees, cash-crops, gardens, houses and fish, and disturbance and nuisance during this time were heard before the (Mining) Warden's Court. In 1970 the Company established a Village Relations Office to handle matters relating to compensation and liaison with landowners. Many compensation agreements were concluded through this office based on precedents and without recourse to the Warden's Court. Resettlement of 289 people from eight villages in the Kawerong and Jaba Valleys took place between 1969 and 1971.

Records of the prospecting and development phase highlight the general lack of consultation with the Bougainvilleans and the Administration issue of authorities and approvals without any consultation, although individual Bougainvilleans, such as Oni of Moroni, gave their support to the project. It is apparent that the Administration and to a lesser extent the Company ignored or at very least paid very little heed to the important Melanesian principle of clan decision-making or Melanesian consensus. The Bougainvillean desire for self determination or at the very least a contribution to decision-making on the type and pace of development was also overlooked.

The following summary of grievances from that time is provided in a recent report (Ref. 10):

- (a) the Administration was no longer the protector of the people;
- (b) no prior consultation occurred before the Special Prospecting Authority was granted;
- (c) Bougainvilleans did not know what the Mining (Bougainville Copper Agreement) Ordinance was all about;
- (d) Bougainvilleans were not told what the bad effects of mining would be;
- (e) Bougainvilleans did not understand Western land laws.

Specific grievances under the inadequate compensation complaints included the ideas that:

- (a) the Administration was the only government, it was superior in attitude and eventually used brute force;
- (b) the Administration was only interested in economic expediency and not the well-being of the people;
- (c) the Administration thought too much of the Company and the PNG nation as a whole and not enough of Bougainville.
- (d) Bougainvillean land was being alienated forever, and a higher premium should be paid for such uncustomary use of land.

The first national Papua New Guinea elections in 1964 brought Paul Lapun to Port Moresby as the member for Bougainville. With the expansion of numbers in the House of Assembly in 1968, he then became member for South Bougainville. By that time he had gained 5% of the copper mine royalties for some of his Guava electorate against the bitter opposition of the Australian administration. Lapun won again in 1972. The Central Bougainville electorate was then won by Raphael Bele, a Rorovana villager who had led his people in resisting the acquisition of land for mining purposes and Fr John Momis won the Bougainville Regional seat, with a stand that opposed the copper company and the Administration. Bougainvilleans critical of some aspects of mine development were now well represented in the national assembly.

By 1972 many Bougainvillean politicians had come to terms with the existence of the mine although three members of the House of Assembly (Momis, Lapun and Bele) were firmly in support of renegotiation of the original agreement. Paul Lapun had become Minister of Mines. Local Government Councils sought direct financial support from BCL and even representation on the BCL board. In 1972 Fr John Momis spoke strongly in favour of a smelter being constructed on Bougainville and, despite the BCL spokesman's explanation of the problems of sulphur pollution which might have been important for Bougainville's agriculture, the Combined Conference of Bougainville Local Government Councils passed a motion in support of smelter construction. There was then a widespread ambivalence in support for mine development, and the jobs and income it would bring to the district (which might enable a movement to Bougainvillean independence) and opposition, to the land losses and social disruption that were already occurring. Such ambivalence has scarcely changed over time.

3 THE MINING OPERATION

3.1 LEASES AND AGREEMENTS

Bougainville Copper Limited operates the Panguna Mine and all other direct and ancillary activities under the provisions of the Mining (Bougainville Copper Agreement) Act Independent State of Papua New Guinea, Chapter No 196. It is generally referred to as the Bougainville Copper Agreement or BCA. This Act provides for the approval and implementation of an agreement made on 6 June 1967 between the Administration of the former Territory of Papua New Guinea and Bougainville Copper Pty Limited as varied by a further agreement made on 21 November 1974 between the Government of Papua New Guinea and Bougainville Copper Limited (Appendix III).

The Company holds or has access to over 22 different leases under the Mining and Land ordinances. These are listed in Table 3.1.1. The main ones are shown in Figure 3.1.1. These are:

- (a) Special Mining Lease of 3770 ha covering the mine and processing areas and Panguna township;
- (b) Tailings Disposal Area, a Lease for Mining Purposes of 9030 ha covering the Kawerong and Jaba valleys to the coast;
- (c) Port-Mine Access Road, a Lease for Mining Purposes of 252 ha covering the road route from Panguna to Loloho;
- (d) Loloho Port Complex, a Special Purpose Lease of 46 ha covering the port area.

The Mining (Bougainville Copper Agreement) Act is a more or less exclusive code providing for certain rights and duties for the Company and for the Government. The Agreement was reviewed in 1974 by joint consent and substantially amended. Clause 17 of the 1974 Agreement provides for review every seven years. The next scheduled review in 1981 was not completed as discussions between the National Government and the North Solomons Provincial Government broke down.

The 1974 amendment concerns mostly taxation matters. A number of sections of the Acts specifically concern the scope of this review. These are the provision of towns and services, power and water and roads (1967 - Clauses 12, 13 and 14), overburden and tailings safety (1967 - Clause 15), business advisory services (1974 - Clause 10), environmental impact study (1974 - Clause 13), and non-renewable resources fund (1974 - Clause 13).

Table 3.1.1 Bougainville Copper Limited - schedule of leases

<u>Name</u>	<u>Type*</u>
Tailings Disposal Area	MOMining Purposes
Jaba Water Supply Site	MOMining Purposes
West Coast Access Road	MOMining Purposes
Special Mining Lease	MOMining Lease
Port-Mine Access Road	MOMining Purposes
Kumo Gravel Pit	MOMining Purposes
Mining Camp 5	MOAgreement with Owners
Industrial Area, Water Supply Site	LO Special Purpose
Pipite Rock Quarry	MOMining Purposes
Itakara Industrial Area A	LO Business Lease
Itakara Industrial Area B	LO Business Lease
Transmission Line Easement	MOSpecial Mining Easement
Rorovana 'Uruawa'	MOMining Purposes
Loloho Port complex	MOSpecial Purpose
Plantation	
Reclamation	
Foreshore Reserve	
Reclamation	
Bulk Fuel Storage	
Tokaian Agg Lease	
Kieta VHF Station	LO Special Purpose
Tokaian Plantation	LO Agricultural
Arawa Agg lease	LO Licence
Arawa Town	Numerous leases
Arawa Town Extension	Numerous leases
Tokaian VHF Station	
Aropa Airport Office	
Storage	LO Special Purpose

*LO = Land Ordinance 1962
 MO = Mining Ordinance 1928-60

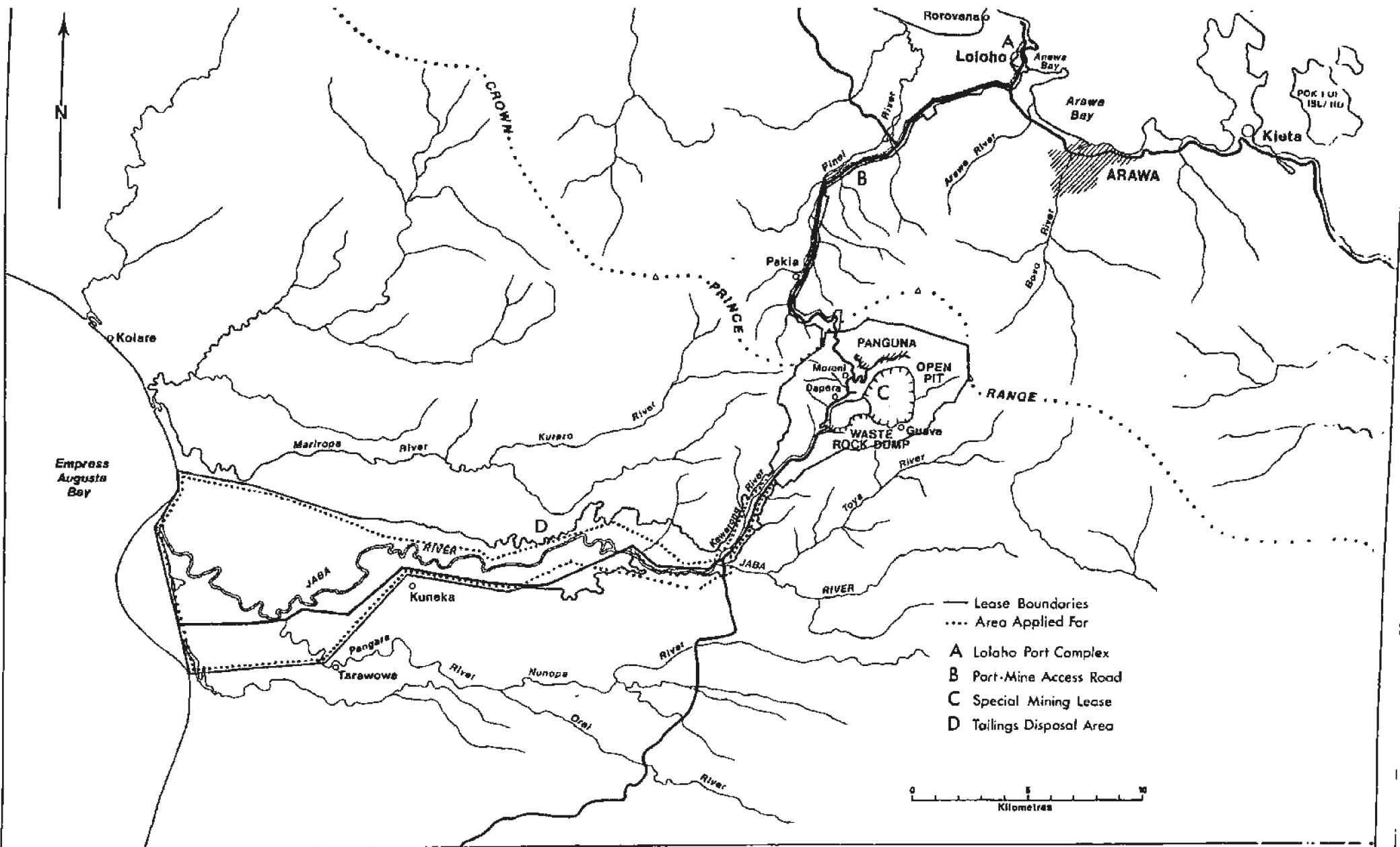
3.1.1 The 1967 Agreement

The Agreement covers all aspects of the operation with emphasis on financial matters, infrastructure and security of tenure. Apart from approving and generally facilitating the development, the Administration was bound to provide education, police, postal, telecommunication and medical facilities of a standard reasonably required to serve the Company and its employees.

The following extracts from the 1967 Agreement concerning overburden and tailings are particularly relevant to this Review:

'15 OVERBURDEN TAILINGS AND SAFETY

- (a) The Company shall not dispose of any overburden removed in the course of, or any tailings produced as a result of, its operations under this Agreement in an area or in a manner not previously



MINING LEASE AREAS AND MAJOR MINE COMPONENTS

Figure 3.1.1.

approved for that purpose pursuant to the provisions of this Clause, it being intended that such overburden and tailings shall be disposed of in a manner which is reasonably safe and results in as little damage or disturbance (having regard always to the need for the Company to carry out its said operations efficiently and economically) as may reasonably be.

- (d) Notwithstanding that the same may have been disposed of in an area and in a manner approved as hereinbefore provided in this Clause the Company shall make compensation for any loss suffered by any indigenous or other inhabitant of the said Bougainville Island or the other islands adjacent thereto resulting from any damage done (whether to land, anything on land, water or otherwise) or any interference with any right to use land or water caused by the disposal by the Company of any overburden removed in the course of, or tailings produced as a result of, its operations under this Agreement, but nothing in this paragraph shall oblige the Company to make any compensation to the Administration or any governmental authority. Such compensation shall be provided either in cash or by way of provision on reasonable terms and conditions of land or other facilities or benefits or partly in one form and partly in another and in default of agreement thereon between the Company and the person seeking such compensation the entitlement to and the amount and nature of such compensation shall upon application by such person be determined in accordance with the procedures provided for in Part VII of the Mining Ordinance, such person or (as the case may be) the Company having from such determination the rights of appeal set out in the said Part VII.
- (e) The Company shall not save as is hereinbefore provided in this Clause be liable for any loss damage disturbance or interference caused by the disposal by Company of any of the said overburden or tailings and save as aforesaid neither the Administration nor any governmental authority or person shall be entitled to any remedy in respect thereof but nothing in this paragraph shall exclude any liability for negligence.
- (f) In addition to complying with the present provisions of the Regulations made under the Mines and Works Regulation Ordinance 1935-1962 of the Territory relating to safety and protection the Company -
- (i) shall when any dump for overburden and tailings established by it for the purpose of its operations under this Agreement ceases to be utilized for such purpose ensure that in order to facilitate the rapid regeneration of vegetation thereon such dump is left with a reasonably flat upper surface; and
- (ii) shall within a reasonable time after any such dump ceases to be utilized as aforesaid carry out experiments for the determination of whether vegetation can be established thereon and use its best endeavours to establish thereon vegetation of a type which can be so established,

but the Company shall not be required to do any further or other acts or carry out any further or other works for the rehabilitation

or restoration of any of the areas affected by the operations under this Agreement.'

3.1.2 The 1974 Agreement

The 1974 Agreement introduced the following clause which has enabled this Review to be undertaken:

'13 The 1967 Agreement is varied by the addition of the following Clauses after Clause 16 thereof:

"16A ENVIRONMENTAL IMPACT STUDY"

For the purpose of enabling the Government to conduct a study of the impact on the environment of the mining and related operations of the Company under this Agreement the Company shall: -

- (a) (to the extent to which the operations of the Company are not interfered with) allow the Government and its agents access to the mine site and all other areas in Papua New Guinea under the control of the company; and
- (b) upon request, make available to the Government and its agents any factual information in the possession of the Company relating to the impact on the environment of the said mining and related operations, and in respect of such information permit the Government or its agents to inspect and take copies of any relevant documents.'

3.1.3 Mining leases and other agreements

Individual leases were issued that exactly describe the boundaries of the land involved and in some instances include conditions relating to rights and obligations of the Administration and the Company including types of compensation to be paid. The terms of the licences are usually tied to the term of the Special Mining Lease. The Special Mining Lease grants the Company:

'all that piece of land being the whole of the land particularly described and delineated on the plan annexed hereto and signed by me for the purpose of identification and all those mines veins seams lodes and deposits of copper and such gold and other minerals as are combined in the land with such copper in such a way that they must necessarily be mined in the mining of such copper in, on, or under the said land together with the right and liberty to use the said land for the mining of such minerals and for all purposes necessary for the effectual carrying on of such mining or for the carrying out of any of the other operations of the company ... for a term of forty-two years ... with the right to renew for further periods each of twenty-one years.'

More specific controls on tailings and waste disposal are provided for in three other agreements - Tailings Disposal Lease Agreement (effective 1970) the 1971 Disposal of Overburden and Tailings Agreement (DOTA) (Appendix IV) and the Disposal of Tailings and Waste Rock Agreement (Appendix V). These are concerned with the safe disposal of overburden and tailings, control of the environmental impact of disposal, and rehabilitation. They are discussed in detail in Section 3.6.

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3.2 MINING AND PROCESSING

The Panguna ore body is roughly elliptical in shape and occupies an area approximately 2500m by 1000m to a depth of 300m beneath the Kawerong Valley near its source. The deposit as originally defined comprised 950 million tonnes of ore grading 0.48% copper and 0.55 grams per tonne gold, about 3 grams per tonne silver and a trace of molybdenum. The mineralisation is not uniformly distributed and there are areas of uneconomic grade. With improvements in mining and extraction technology over the years it is possible to economically recover more ore than first thought and today after the removal of 610 million tonnes of ore, a further 530 million tonnes at 0.4% copper and 0.46 grams of gold remain. This additional ore is lower grade but is economically mineable as a result of mining and management efficiency, stronger metal prices and reduced costs.

The mine is a roughly symmetrical, cone-shaped excavation or open pit with benches stepping down from the lip (Photograph 1). The pit is approximately 2.5km across and 350m deep. Ore and waste rock (sub-economic mineralised rock and unmineralised overburden) are mined continuously from as many as six cuts. Each day approximately 300 000 tonnes of ore and waste are blasted, excavated and trucked from the pit. Blasting takes place once or twice each day around midday and at the 2.00pm shift change.

The waste rock is transported in 142 and 172 tonne capacity trucks or by conveyors to dumps in the headwaters of the Kawerong Valley (Photographs 2 and 3). Soft waste comprising overburden and weathered waste rock is selectively dumped within the hard rock dump.

The ore is selectively mined. Ore with disseminated copper is crushed for direct delivery to the mill and ore with copper in joints and fractures is upgraded in the pre-concentration and screening plant (PCS). The crushed ore is conveyed to a covered stockpile before being finely ground in ball mills ready for delivery to the concentrator. The ore at this stage contains 0.3 to 3% copper sulphides and 0.5 to 10% iron sulphides. Water, lime and measured quantities of process chemicals are added. The fine ground ore is then fed into long batteries of flotation cells to stimulate frothing which selectively removes the copper sulphides on bubble surfaces (Photograph 4). Gold and molybdenum are collected with the copper sulphides and are not separately recovered. The BCL concentrator treats more ore than any other copper mine in the world.

The sulphide concentrate containing both copper and gold is collected and piped in slurry form to tanks from which it is pumped through a pipeline beneath the Port-Mine Access Road down to the port area. Here it is dewatered and stored for batch loading on bulk carrier vessels for shipment to smelters in Japan, Spain, West Germany, Philippines, South Korea and the Peoples Republic of China. The residual water is discharged into Anewa Bay. The composition of this is shown in Table 3.2.1. Some free gold collects in the ball mills and is recovered during maintenance of the mills for refining in England.

The tailings, comprising over 98% of the ore feed, are collected, 'thickened' to reduce the water content, and piped to the headwaters of the Kawerong River into which they are discharged (Photograph 5). The chemical properties of the tailings are described in Section 5.7.2.3.

Table 3.2.1 Chemical composition of the concentrate slurry water discharged into the sea. (Data extracted from DOTA reports 41 to 49 May 1983 to September 1987.)

Property	Concentration
pH	6.4-10.9
MIBC	<0.05-1.1
PAX	<0.03-0.34
Calcium	69-149
Magnesium	0.7-3.3
Copper	0.001-0.022
Mercury	<0.0001
Cadmium	<0.001-0.002
Lead	<0.001-0.003
Zinc	0.001-0.019
Flocculant	<0.5

Notes:

* All concentrations in mg/L except pH

MIBC = 'frother' - methylisobutylcarbinol

PAX = 'collector' potassium amyl xanthate + sodium isopropyl xanthate

Flocculant = polyacrylamide

BCL is actively investigating the recovery of copper from the waste dumps. Methods being investigated are solvent extraction, ion exchange and cementation with leach enhancement by addition of acid and/or ferric sulphate and/or bacteria. If evaluations are successful a copper extraction plant could be in operation by 1993. If installed it could continue to operate after the closure of mining.

At various points along this process, dust is suppressed by water sprays, and dust and chemical fumes are removed by exhaust fans. Road and haulways are watered during dry periods. Notwithstanding normal 'housekeeping' standards for suppression of dust the mine environment is, like all large operations of its type, noisy and dusty.

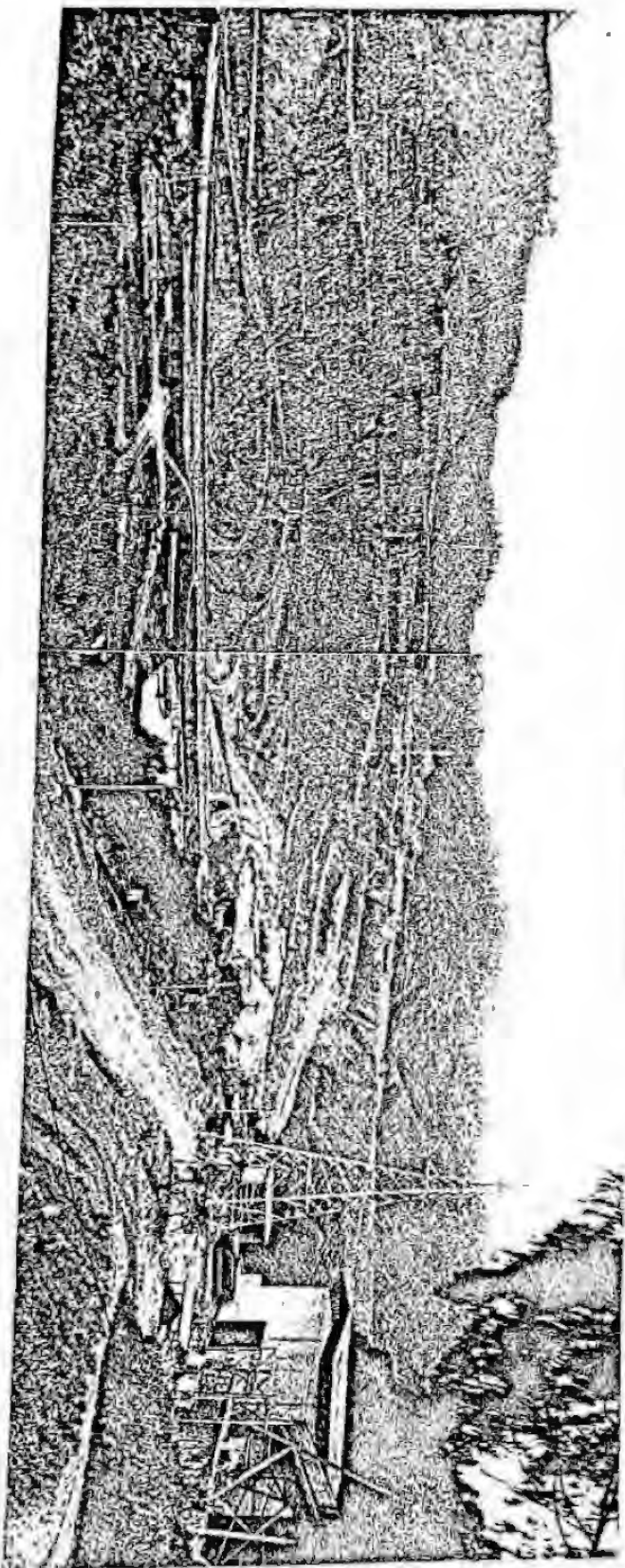
Principal elements of the mining operation are shown in Figure 3.1.1 which also notes the position of Panguna township, the mine site villages and some of the more important services.

3.3 TAILINGS AND WASTE DISPOSAL

3.3.1 Introduction

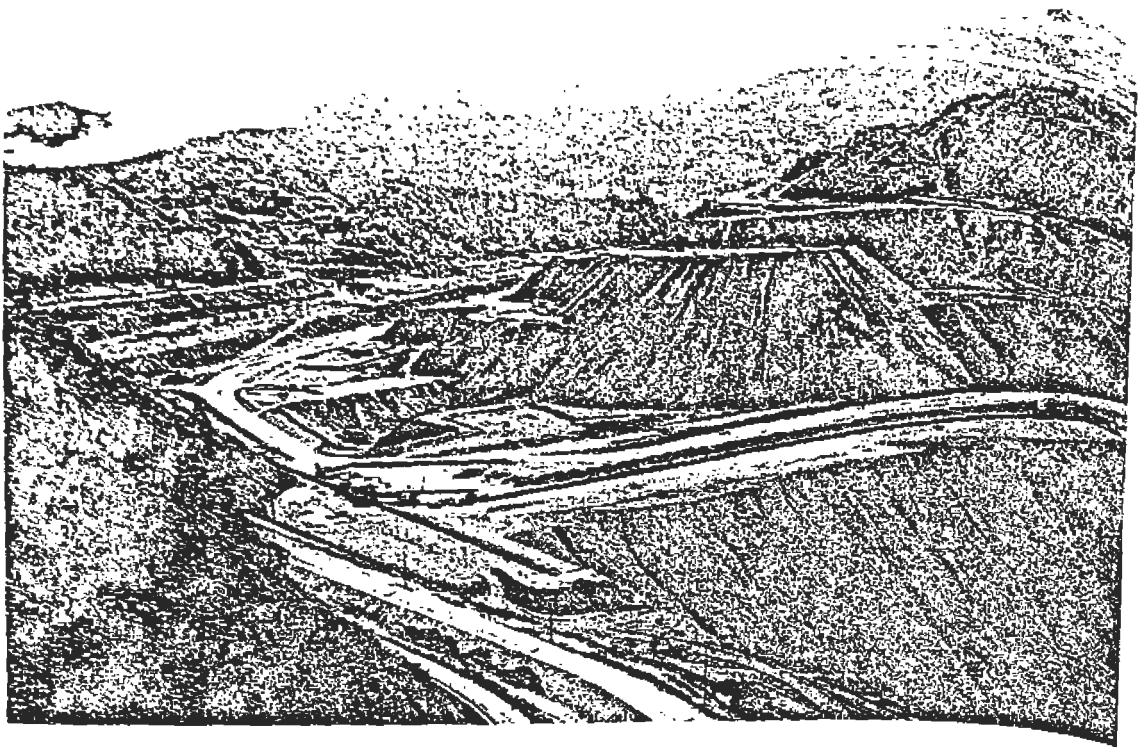
Rock wastes associated with mining at Panguna comprise three categories of material: fine overburden, waste rock and tailings.

The original proposals formulated by BCP and its consultants were for sluicing or hydraulicking the fine overburden into the Kawerong-Jaba river system. This



Photograph 1 View of open pit

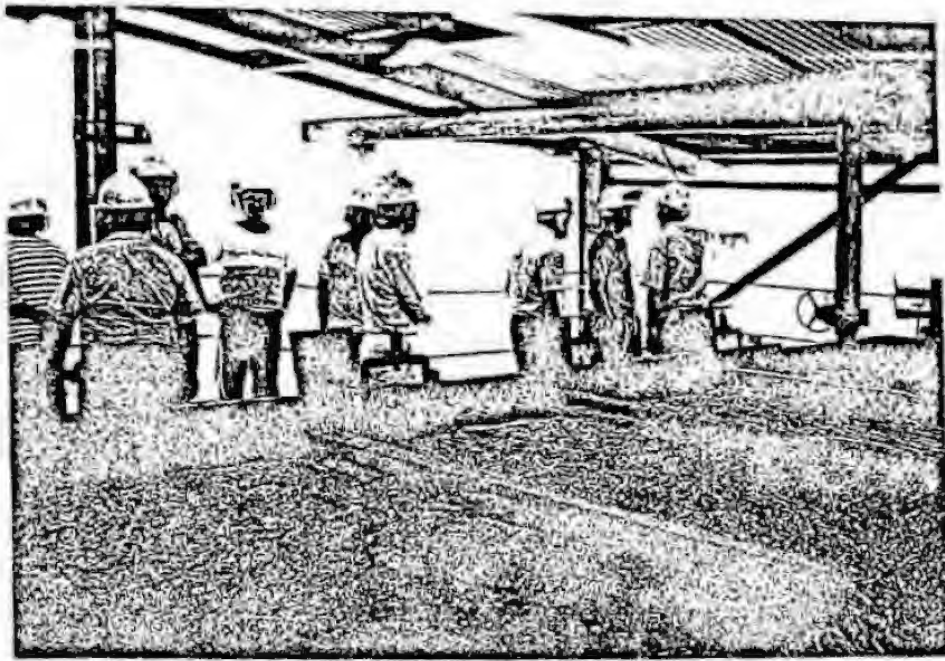
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Photographs 2 and 3

Waste rock dumps being fed
by truck and conveyor (also
with waste material entering
the head of the Kawerong
Valley (left)





Photograph 4 Ground up ore in flotation cells in processing plant



Photograph 5 Tailings in upper Kawerong River

material, comprising unconsolidated volcanic ash and weathered rock, was estimated at 40 million tons (40.6 million tonnes) and its disposal by this method was considered to result in no permanent damage to the upper streams but an anticipated delta formation near the mouth of the Jaba River (Ref. 11). The waste rock was to be end dumped, 'the most convenient and economical method of emplacement', into the Kawerong River valley (Ref. 11).

The tailings disposal system proposed (Ref. 12) was the construction of an open flume with a 1% slope to convey the tailings to tailings dams to be constructed on large areas of western lowlands adjacent to the Jaba River.

A number of consultants' reports on tailings disposal and the effects of tailings and fine overburden discharge to the Kawerong-Jaba river system were prepared in 1969 and 1970. Initially the consultants advised against discharge of tailings to the river, predicting deposition and land degradation on the scale which has eventuated (Ref. 62). The Company proposed construction of an open flume to carry tailings to the lowlands where they would be retained in conventional cycloned tailings dam (Ref. 12). Subsequently a further report was prepared (Ref. 63) in which disposal to the river near the base of the dumps was identified as the least costly of five options considered. The cost estimates were based entirely on construction and maintenance costs of disposal pipelines and associated facilities. In the report, a review and reconsideration of the earlier predictions of tailings deposition was presented and new predictions were made. Without explanation or reasoned justification for the revisions of earlier predictions, these new predictions indicated that the tailings would pass through the Kawerong and upper Jaba rivers to deposit at sea and on the flood plain adjacent to the coast. The portion reaching the sea was predicted to be removed by ocean currents. This report also indicates that the Administration had agreed that sedimentation in the Kawerong-Jaba system would be acceptable provided that the Morotana Mission and existing or potential agricultural land were protected.

There are two, possibly different reports on this subject referred to in the DOTA which neither the Government nor the Company can now locate and it is accordingly now not possible to compare the accepted proposal for tailings disposal with operational results.

In accepting the Company's proposal to dispose of tailings and waste the Administrator required certain monitoring activities in addition to those proposed by the Company (Ref. 13). In summary these consisted of:

- (a) installing rain gauges and pluviometers in the mine pit area and in the Kawerong-Jaba valley;
- (b) taking vertical cross-sections of the Jaba River bed and analysing the material deposited thereon;
- (c) taking vertical colour photographs to define the extent of the tailings spread;
- (d) establishing facilities for data collection and analysis on agricultural aspects of the deposited tailings;
- (e) preparing three monthly reports to the Administration.

This requirement was set out in the 1971 Disposal of Overburden and Tailing Agreement which is in the form of a letter from the Administrator to the Managing Director of BCL (Appendix IV).

Hydraulicking of fine overburden into the Kawerong River proceeded as proposed until 1982 and since then it has been dumped in secure areas of the waste rock dumps where support and containment is provided by competent materials.

Waste rock disposal has also proceeded as planned. Waste rock is trucked to the dump face and is finally placed by bulldozer. The dumps are constructed on several levels, each advancing some distance behind the level below it. The lowest of these levels is now composed entirely of coarse, clean and competent waste rejected from the pre-concentration plant.

Tailings are piped from the concentrator to a series of thickeners where they are thickened to approximately 60% solids. The water than has been removed is recycled to the mill. The tailings are piped from the thickeners to a very steep headwater tributary of the Kawerong River where they are discharged. They pass through the upper Kawerong River and begin depositing in the middle/lower Kawerong Valley. Deposition is greatest in the vicinity of the former confluence of the Kawerong and Jaba rivers and continues to the coast where a substantial tailings delta has formed.

3.3.2 The Disposal of Overburden and Tailings Agreement (1971)

Included in the Disposal of Overburden and Tailings Agreement (DOTA) of 1971 are a number of requirements that relate to rehabilitation of the waste and tailings area. These are summarised as follows:

Waste Rock

- (1) Only relatively fresh free-draining granular rock is to be used for a distance of 200 feet back from the ultimate downstream dump faces.
- (3) The low grade in copper and more weathered waste rock shall, as far as possible, be kept in the upper part of the dump as a surface layer on top of the dump as a means of encouraging vegetation growth.
- (7) As soon as the final top of the dump has been reached at any particular place, your Company shall commence its endeavours to establish vegetation thereon in so far as such endeavours do not conflict with its other operations on the dump as a whole.

Tailings and Fine Overburden Disposal

- (1) Your Company shall take such action as is necessary to confine flooding, damage or the disposal of tailings within the area granted to your Company as a lease for mining purposes for the disposal of tailings.
- (5) Your Company shall use all practicable measures to ensure that the tailings contain no more than such a sufficiently low level of copper readily soluble in natural waters as to ensure that no serious damage could result therefrom to vegetation or animal life.
- (12) As it is the intention that the disposal of tailings be controlled, and tailings be spread in such a way as to enable re-use of the land at the earliest practicable date, your Company is to conduct the following experiments to test agricultural feasibility and to perform the following tasks:
 - (a) At half mile intervals (or such greater intervals as are agreed to by the Administration) along the Jaba River towards the sea from the

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confluence of the Jaba and Kawerong Rivers, at six monthly intervals, take vertical cross-sections of the material deposited on or forming the bed of the river, and shall analyse such materials and advise the Administration of the results.

- (b) Commence development of 100 acres of land, when control equipment is moved on site, using sedimentation material from the Jaba River. The site is to be within the Lease for Mining Purposes area and to be agreed upon by the Administration and your Company. Such materials shall be deposited on this site to a height agreed to by the Administration.
- (c) By January 1973, commence a small (1 to 2 acre) field experiment with tailings to a depth of at least five feet on the waste rock dump at a site to be agreed between your Company and the Administration.
- (d) Establish lysimeters (the number to be specified by the Administration - not being more than fifty) on an agreed site within the Lease for Mining Purposes area, and shall fill them with various sized material from the tailings, in accordance with the direction of the Administration.
- (e) As soon as possible after respective commencements of the operations referred to in (b), (c) and (d) above, establish facilities to collect, from each of the operations respectively, data on the following:
 - (i) the rate of weathering of the tailings or the sedimentation material (as the case may be);
 - (ii) the rate of nitrogen build up in the tailings or the sedimentation material (as the case may be);
 - (iii) the rate at which vegetation naturally regenerates itself upon the tailings or the sedimentation material (as the case may be);
 - (iv) the rate at which vegetation regenerates upon the tailings or the sedimentation material (as the case may be) when selected legumes or grasses have been added to them.
- (f) Your Company shall, after the date tailings control equipment is placed within its lease for Mining Purposes for the disposal of tailings, engage in tailings spreading, in accordance with an agreed plan and programme, to achieve the progressive regeneration of vegetation.

The tests foreseen in 12(c) and (e) shall be carried out under the direction of the Director, Department of Agriculture Stock and Fisheries. Your Company will carry out laboratory chemical, physical and sizing analyses requested by the Administration for the purposes of 12(e) (i) and (ii) and will provide the photographs necessary for the analyses of the regeneration referred to in 12(e) (iii) and (iv).'

The Agreement gave approval for disposal for 10 years from 1 January 1970, and required a review of the manner of disposal after eight years. The Agreement allowed for subsequent reviews on the same basis.

The penultimate paragraph of the Agreement establishes an important intent:

'It is intended that from 1 January, 1980, the method of disposal shall be consistent with the objective of re-using any land affected by tailings disposal.'

In 1987 the Government and BCL revised the Agreement in anticipation of the installation of a tailings pipeline to discharge tailings at the mouth of the Jaba River. The 1987 document is included in Appendix V. It is much simpler and omits many of the original clauses that are now subject to other agreements or relate to (now) past events. Other omissions include Waste Rock (3) (above) which concerns the surface dumping of weathered rock.

Two significant changes which the new Agreement makes relate to disposal and rehabilitation of tailings. The Agreement requires that flooding, damage and the disposal of tailings be confined within an area delineated on a specific plan. The area shown on the plan includes areas both onshore and offshore which lie beyond the boundaries of the tailings lease. The Agreement also requires that BCL '...take all reasonable steps necessary to ensure rehabilitation of land and regeneration of vegetation...'. This is a much stronger statement than that made in the 1971 DOTA; even so it is vague and subject to a large variation in interpretation. The Agreement is vague and non-specific in many areas and does not reflect either the standards or approach that would be expected under a modern legislative or management regime on a new mine.

3.3.3 Tailings and waste disposal

At the time the DOTA was drawn up the project design allowed for a mine life of 33 years and treatment of 950 million tonnes of ore from eight ball mills. Since 1972 the size of the plant has increased and there are now 13 ball mills with two more due by mid 1989 at which time two will operate as regrind mills. The original tailings output of 82 000 tpd was increased to 130 000 tpd and the tailings grind up until 1985 was coarser than anticipated. Mine life is now estimated to the year 2001 and possibly beyond.

In the second of the Company's three monthly DOTA reports the Kawerong and river disposal sites are described as follows: 'The bed of the Kawerong River consisted of boulder rapids, pools and occasional waterfalls up to 12 feet high. The general river gradient varied from 5.6% near Panguna to about 2% at the confluence of the Kawerong and Jaba Rivers'.

The Jaba River below the Kawerong River junction originally consisted of long boulder rapids and occasional deep pools in its upper reaches, meandering reaches with a gravel bed between monitor sections 23 to 29, and meandering reaches with a sandy bed from about section 29 to the river mouth (Ref. 14). Report No 9 in 1973 (Ref. 15) states that considerable difficulties were encountered with dumping of waste rock and overburden that were not originally foreseen. These were mainly with the stability of the dumps against slumping and the loss of dumped material by river erosion. Coarse material entering the Kawerong and Jaba rivers from overburden sluicing and from waste dump erosion was depositing in river reaches with lower gradients.

DOTA reports were produced at three monthly and then six monthly intervals with schedules of materials disposed to the rivers and materials deposited in each reach of the river. In 1984 a more formal description of the environmental studies was produced at the request of the Government (Bougainville Copper Limited 1984, Environmental Update). This was amended and re-issued in 1986 (Ref. 16).

intent:

The 1984 update reported the disposal of 36 million tonnes of volcanic ash material into the river together with an additional 18 million tonnes of erosion material and waste rock. Since the mine start-up the amount of volcanic ash and weathered waste rock dumped in the river was significantly reduced and since March 1982 it was being selectively dumped within the waste dumps. A total estimated 152 million tonnes of fine overburden and waste rock have entered the river system compared to the original estimate of 40.6 million tonnes.

Deposition in the Kawerong-Jaba river system has not taken place according to the predictions made by Bougainville Copper Pty Ltd and used by the Company and the Government as a basis for the DOTA agreement. Both waste dump and weathered overburden contribute cobbles and boulders to the river making a significant impact on river aggradation rates upstream and in the vicinity of the Kawerong/Jaba confluence. Little of this coarse material travels past the confluence because of lower bed slopes downstream of it.

Approximately 40% of the tailings entering the river system is deposited there. This is at the lower end of the estimate range provided by the Company for deposition in the river. Two-thirds of this has deposited in the so called 'first tailings basin' immediately downstream of the original Kawerong/Jaba confluence (Photograph 8). A further 10% of the total is deposited in a second basin. Both basins are still upstream of the original expected aggradation reach downstream of Bato. A large delta (700 ha in 1986) has formed in Empress Augusta Bay (Photograph 7) and contrary to initial assumptions very little material is transported away from the delta region.

3.4 TAILINGS PIPELINE

As required by the DOTA agreement BCL has sought and obtained the approval of the Government to vary its current method of tailings disposal. A proposal for the new method was submitted to the government in November 1986 together with an environmental impact report (Ref. 17).

Work has commenced on the construction of a 31.7 km long pipeline to convey all the mine tailings from the concentrator at the mine site down the Kawerong and Jaba valleys to the delta in Empress Augusta Bay. This project results from a detailed feasibility study of tailings disposal by pipeline to the west coast which commenced in 1984. A road formation has been constructed along the pipeline route and bridge crossings and foundation construction for structures have commenced. A levee and starter channel are to be constructed to re-direct the Jaba River.

The pipeline will be buried beneath the road formation with inspection ports every 500m. It will terminate at the present shoreline. When the pipeline is commissioned (1989) tailings disposal will change substantially. The pipeline will carry the tailings in slurry form to the Jaba delta where they will be discharged. BCL has estimated that due to pipeline maintenance or breakdown, tailings will need to be discharged to the river on 7-8 days per year. The 1987 Waste Rock and Tailings Agreement provides for up to 21 days of tailings discharge into the river in any one year.

Tailings discharge will be alternated between two discharge points. Initially the discharge points will be elevated approximately 9m above ground and the tailings are expected to form a cone around each point. The slope of the cone surface is expected to vary from about 2% to less than 1% and the radius of the

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cone is expected to be approximately 2km. The cones formed by each of the tailings discharge points will overlap. When the initial onshore cones have reached their maximum size the pipelines will be extended and two new cones will form on the seaward side of the initial cone. This process of advance will continue throughout the life of the tailings pipeline, estimated by BCL to be 10-15 years. The pipeline advances are proposed to be made in increments of about 300m and may occur every 3-4 months. Eventually the pipeline may extend up to 7km offshore resulting in an area of tailings of about 5600ha.

The river currently carries about 60% of the tailings to the sea (about 78 000 tons/day or 28 million tons/year). When the pipeline is commissioned, tailings discharge to the river will be limited to about 16 million tons/year of which some 60% may be expected to reach the sea. Dncutting of the existing bed sediments is predicted by BCL to produce about 10 000 tons/day (3.65 million tons/year) of sediment discharge to Empress Augusta Bay. This sediment will form a new and smaller delta at the mouth of the Jaba River.

The Company has prepared an Environmental Impact Report of the pipeline project (Ref. 17) and states that there will be an overall positive environmental impact arising from this proposal in comparison with the present disposal system. This is discussed in later sections of this Review.

3.5 MINE FUTURE

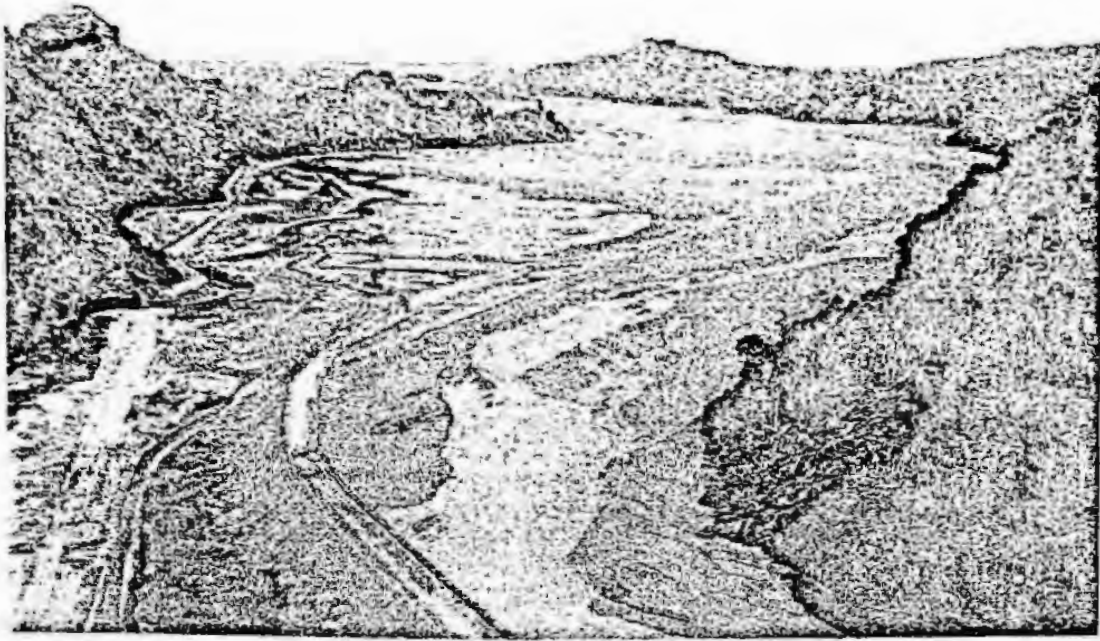
The Company undertakes mine planning for a 15 year period in advance of operations. The present plan is directed towards mine closure in the year 2001 after the removal of a further 530 million tonnes of ore and a similar quantity of waste material. It is conditional on metal prices, mining costs and imposed changes such as taxes and royalties. If metal prices drop below a certain threshold and/or costs and charges rise, the mine would close earlier. Because the Panguna ore body has a lot of low grade (0.2%) copper around it, continuation or increase in the present high copper prices or a significant reduction in costs and charges could extend the life of the mine beyond 2001.

The 15 year extension for the open pit and waste rock dumps is shown in Figure 3.5.1. Pirurari village and many of its gardens will be covered by waste dumps and part of Guava village will be affected by the open pit extension.

The Company is exploring for additional copper ore within its Special Mining Lease. In addition it would like the moratorium that is placed on exploration activities in North Solomons Province lifted to enable it to start exploring for other deposits. Discovery of more ore nearby that may be economically mined and treated could utilise the present mine-based facilities (such as the town, mechanical and civil works bases, and the concentrator) beyond 2001.

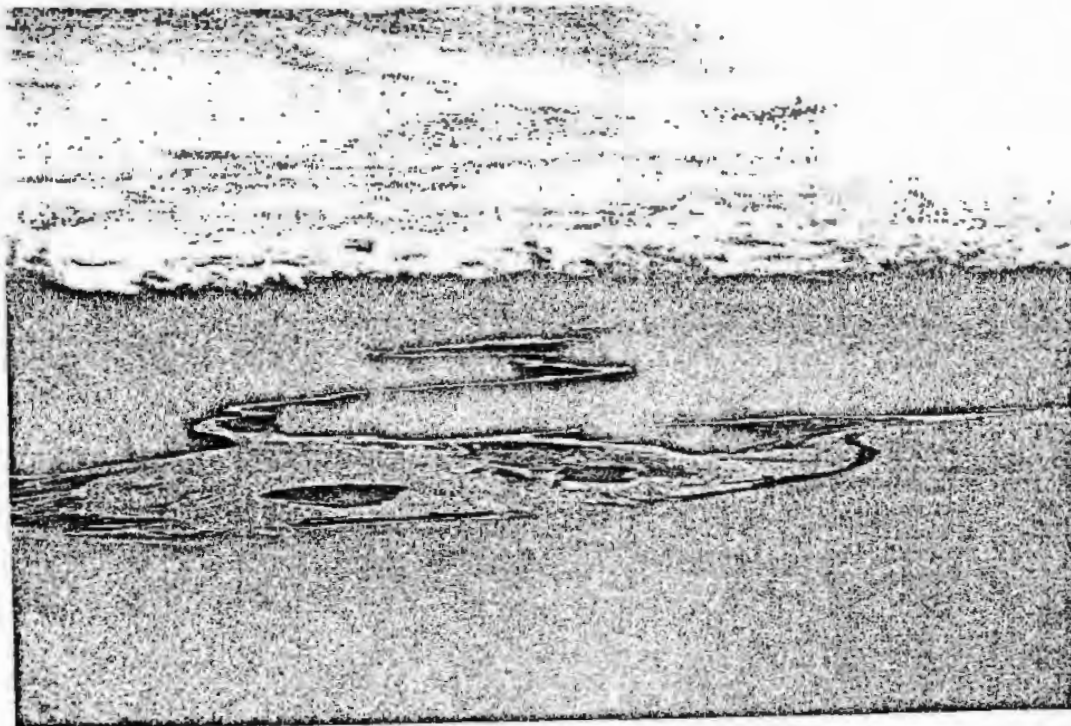
3.6 ROYALTIES AND COMPENSATION

Compensation and royalties have been paid by BCL at an average rate of about \$3 million per year since the end of 1975. The term compensation has been used in a very general way to cover payments to claimants as well as other costs borne by the Company for replacement, reinstatement and amelioration. A very brief review of compensation categories and the nature and delivery of payments is provided here as background to a more detailed analysis in Section 4.8 of the report.



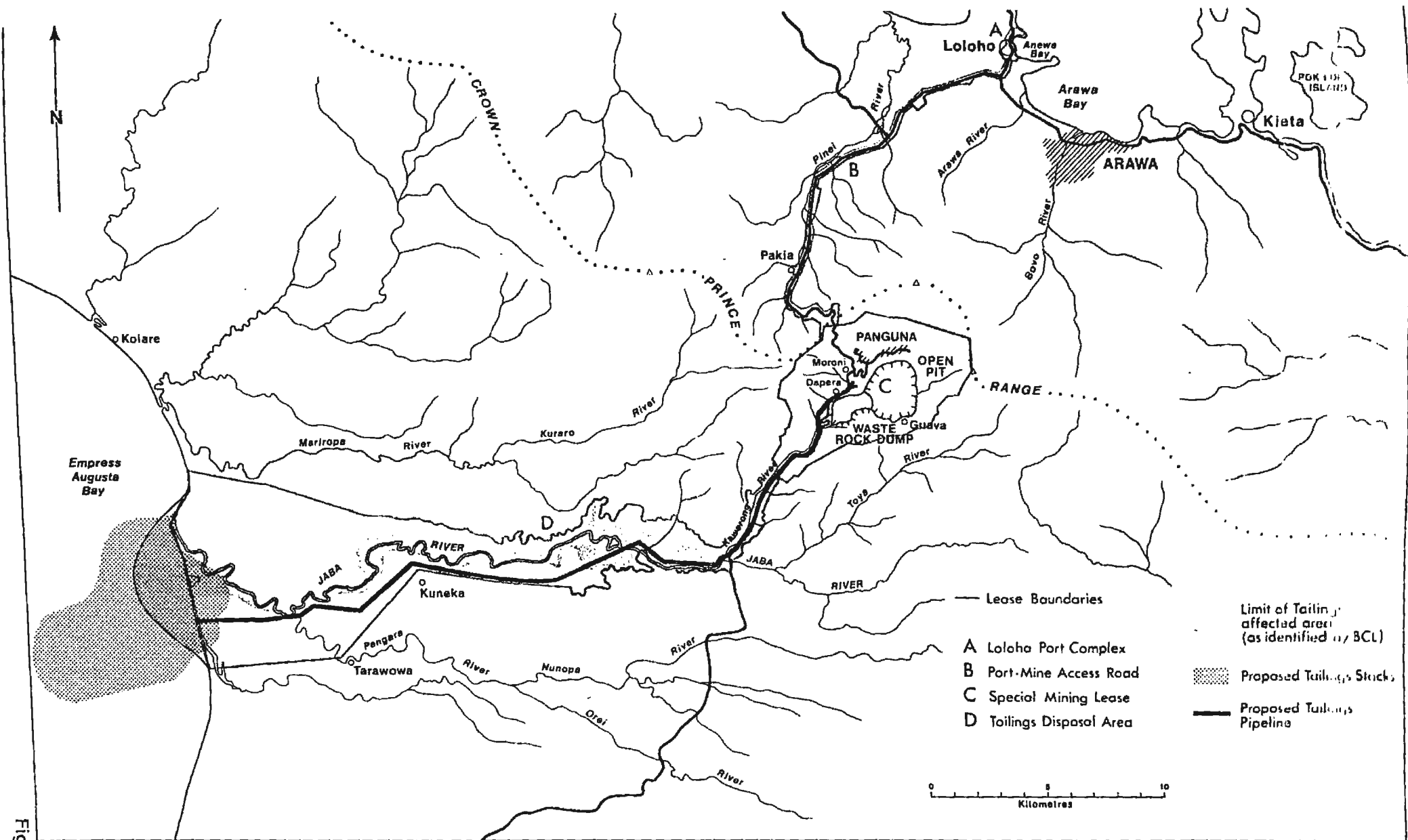
Photograph 6

Tailings deposition within the Kawerong River channel bounded by levee. Jaba River is on left - joined by Kawerong at top of photograph. Note cleared garden area adjacent to tailings on right



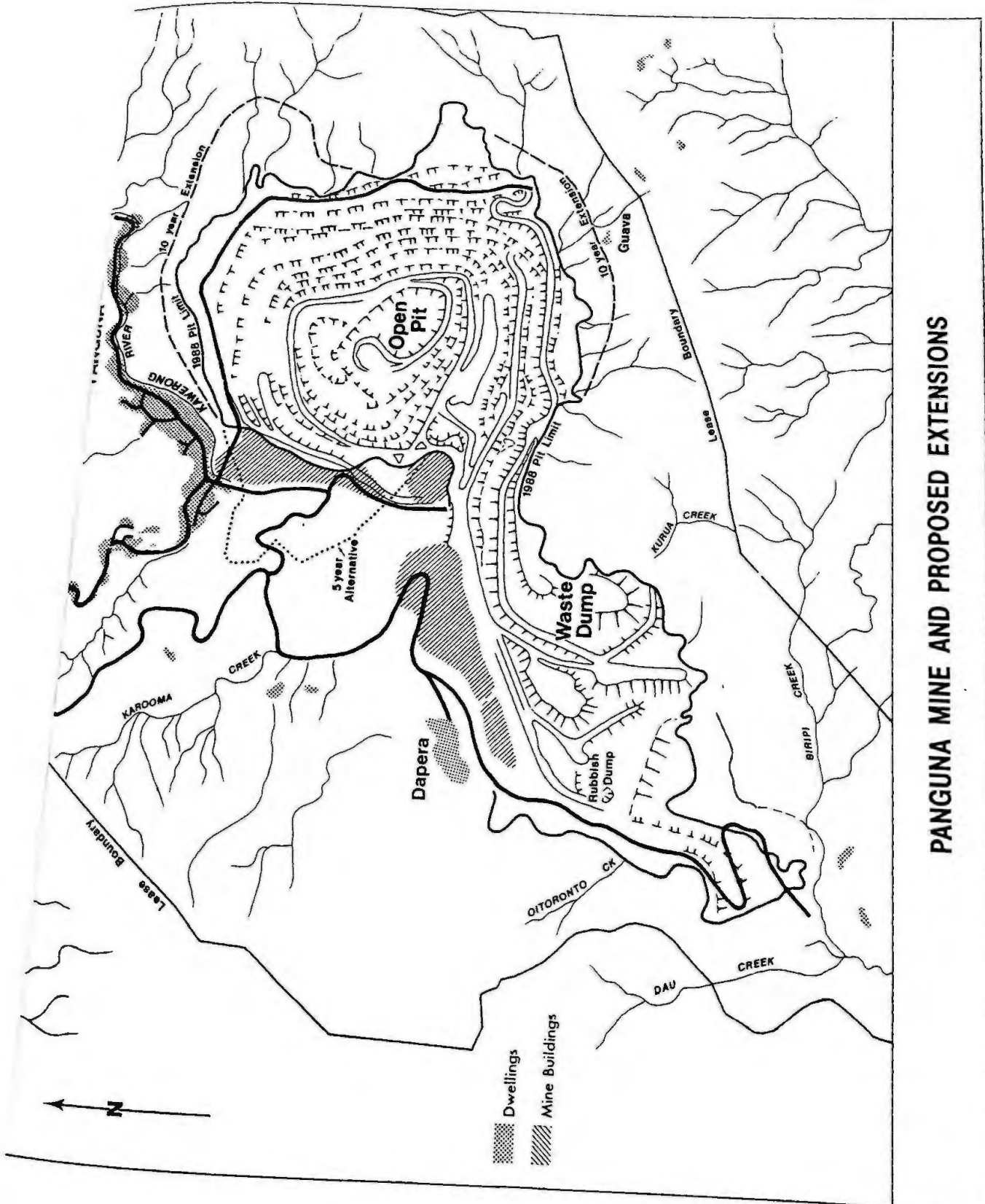
Photograph 7

The Jaba River mouth and delta created by tailings discharge.



DETAIL OF TAILINGS DEPOSITION

Figure 3.4.1.



PANGUNA MINE AND PROPOSED EXTENSIONS

Figure 3.5.1.

3.6.1 Royalties

Since 1975 over K45 million in royalties calculated at a rate of 1.25% of BCL net revenue has been collected by the National Government. Ninety-five percent of this is paid directly to the North Solomons Provincial Government and 5% is distributed by the Department of Minerals and Energy to owners of land within the Special Mining Lease area.

3.6.2 Compensation categories

Compensation has been paid by the Company under the following headings which we have grouped according to type:

- Occupation Fee
- Bush Compensation
- Physical Disturbance Compensation

- Crop Compensation
- Property Damage Compensation

- River and Fish Compensation

- Village Relocation Compensation

- Social Inconvenience Compensation
- Nuisance Compensation
- Inconvenience Compensation
- Condolence Payments

- Foot Bridge Construction

Overall, the compensation package pays in excess of the level set by the Government with payments made annually in advance. Payments for the various categories have been made by BCL in respect of activities within the Tailings Disposal Area, Coast Access Road and Special Mining Leases, and the Port-Mine Access Road lease. The recipients (individuals, clans, villages and, rarely, organisations) are distributed over a wide area inside and outside the Company's leases. Payments for other leases listed in Table 3.1.1 are single ongoing payments of a different type paid by the Company or through the Lands Department.

During the exploratory drilling phase from 1964 to 1966 compensation payments in cash and food were made directly to the villagers. Between 1966 and 1970 all claims for compensation were referred to the Mining Warden's Court for determination. After 1970 when the Company formed its Village Relations Office, the majority of claims were handled by the Company acting on guidelines established by the Mining Warden's Court.

Since production commenced in 1972 various agreements have been reached between the Company and landowners' associations often after periods of dispute and negotiation. A comprehensive compensation agreement package was negotiated between the Company, landowners' representatives, the National Government and the Provincial Government in 1980 (with some payments back-dated to 1979). It introduced automatic adjustments for some categories of compensation based on increases in the Consumer Price Index. A Supplemental Agreement followed in 1982 addressing additional claims submitted in August 1980, and April and June 1981. This agreement lapsed in 1984 and after prolonged negotiation a new agreement was concluded in 1986.

3.6.2.1 Occupation Fee, Bush Compensation and Physical Disturbance Compensation

The Company is required by the Mining Act to pay Occupation Fees to the owners of land and compensation for damage and disturbance caused to the owners of the land or persons having any rights or any interest in the land or to the owners of any crops or trees on the land. The Occupation Fee is calculated on the basis of the unimproved value of the land as at 5 November 1979. It is paid annually to owners of all land within the leases and will continue up until the mining lease is surrendered. The Company pays a K25.00 per hectare 'Panguna Regional Payment' on top of the K5.00 minimum specified in the Mining Act.

The Physical Disturbance Compensation payments were made from 1979 for owners of land within the lease which is actually physically disturbed by the operations of the Company; that is, removed by mining, buried beneath tailings or waste rock or otherwise occupied by roads, buildings or other structures. It was introduced in 1980 in acknowledgement of the greater loss of some landowners within the group receiving the Occupation Fee. Indexed payments are made annually in addition to the Occupation Fee at a rate that is at present over 50% of the Occupation Fee. Like the Occupation Fee, the Physical Disturbance Compensation will cease when mining operations cease.

Bush Compensation is a similar across-the-board payment to landowners that covers loss or damage to bush, trees and other natural foliage, for interference with use and enjoyment of bush, for severance of land, for loss of surface rights of way and hunting, and rights associated with the bush. Bush Compensation payments were paid in 1979 to owners of land within the three mining leases (Special Mining Lease, Tailings Lease, Port-Mine Access Road lease). They will cease when mining operations cease.

3.6.2.2 Crop Compensation and Property Damage Compensation

Crop Compensation and Property Damage Compensation are one-off payments for destruction of crops and economic trees and property damage resulting from the Company's operation within the lease areas. There is a schedule of payments for crops and economic trees. A discounted rate was applied to 'large scale' plantations. An alternative of plantation relocation was offered and accepted in some instances.

3.6.2.3 River and Fish Compensation

This compensation category covers loss of fish and other marine creatures and for disturbance, inconvenience and loss of customary habits and rights related to fishing in, and general use and enjoyment of, rivers. Payments were consolidated in the 1980 agreement and for the period commencing 1979 were paid annually to 'Family Group Representatives' of family groups who had traditional rights to fish in and to the general use of the Pinei River on the east coast and the following rivers on the west coast:

- (a) Upper Kawerong River;
- (b) Lower Jaba River - minor tributaries and lower Kawerong River;
- (c) Upper Jaba River and tributaries;
- (d) Pangara, Nonopa and Orei rivers.

The rate of compensation was originally set on the basis of the cost of purchasing from a village trade store the amount of fish each person would have caught and consumed in a year.

Disturbance Compensation

7 Fees to the owners of the land affected by the operations of the mine are calculated on the basis of the area of the land affected in 1979. It is paid in three instalments up until the end of the year of the hectare 'Panguna' Mining Act.

In 1979 for owners of land affected by the operations of the mine, payments for damage to buildings or waste disposal are made to the landowners. These payments are made in three instalments over 50% disturbance compensation.

Payments for the three main roads that are affected by the operations of the mine are made to the landowners. These payments are made in three instalments over 50% disturbance compensation.

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have

Part of the first payment made under this category was contributed to the Jaba Landowners' Association Fund.

Payments in respect of the Pinei River were on a diminishing scale in acknowledgement of declining impact and ceased in 1984 when it was considered that the river was no longer affected by mining operations and had reached its pre-impact situation. Other payments will cease when mining operations cease.

3.6.2.4 Village Relocation Compensation

Village Relocation Compensation is based on an award made by the Mining Warden's Court in 1969. This required BCL to:

- (1) provide compensation for damage to improvements (that is, buildings and crops);
- (2) pay the sum of \$50 for the severance of land from other land owned by the claimant;
- (3) pay the sum of \$50 for the loss of surface rights of way over hunting tracks and traditional foot paths;
- (4) pay the sum of \$200 per head as compensation for consequential damage for hardship which will follow the enforced change from the traditional village environment to a European way of life and to provide for the extra cost of maintaining a European style of residence in an urbanised community;
- (5) clear new garden land within a specified time;
- (6) provide weekly rations for the claimant and his dependents for six months and a one-third ration for a further period of six months;
- (7) provide materials for and erect a residence at least the same size as the old one on a site selected by the villagers. The residence is to be built in permanent materials with a 1000 gallon tank provided. External toilets for each dwelling are also required.

In 1976 the currency converted to kina. No adjustments have been made to this scale of rates since 1969.

3.6.2.5 Inconvenience and Nuisance Compensation

Social Inconvenience Compensation was a category introduced in 1980 to include a number of compensation payment categories. It includes inconvenience arising from dust, damage caused by vagrants to village properties, loss or disturbance of cemeteries, 'the problem of mental persons', and inconvenience to the people of Guava Village for poor access during mining.

Condolence payments have been made to relatives of landowners whose death was a result of an accident for whatever reason on the lease.

All Social Inconvenience Compensation payments, the Guava Access Road Compensation and a single back payment for Bush Compensation are contributed to a Road Mining Tailings Lease Trust Fund which was established in 1980. It is a complicated set-up comprising a company limited by guarantee which ensures that the capital (original plus accumulated) is maintained in perpetuity and that profits

can only be distributed in the form of community development. No distribution of cash to individual beneficiaries of the trust is permitted although loans may be advanced. It is administered by a Landowners' Committee with the assistance of the Company. It is addressed in more detail in Sections 4.8 and 7.2.3.

The Guava Access Road Compensation will cease when the Company provides a permanent road and other social inconvenience payments will cease when the mining operation ceases.

3.6.2.6 Foot bridge construction

A number of foot bridges have been constructed as compensation across narrow sections of the Kawerong and Pinei rivers since 1969 to enable safe crossing of the rivers to be made. Some, however, have been swept away by floods.

3.6.3 The Bougainville non-renewable resources fund

Since 1974 the Company has paid 50 toea per tonne of contained copper shipped from Bougainville. Payment is made to the Bougainville Non-Renewable Resources Trust Fund the National Government. Since August 1976 the Trust has been drawn on exclusively by the Province of North Solomons. The agreement between the Provincial and National governments reads: 'The non-renewable resource fund established under the BCL agreement in section 16(6) and defined in the Arawa agreement shall be given to the Provincial Government to be used as a non-renewable resource fund or for whatever other purposes the Province may desire'. Over the last 10 years about K100 000 has been drawn annually by the Provincial Government for unspecified uses.

4 SOCIAL AND ECONOMIC CHANGE

4.1 INTRODUCTION

Since the exploration and construction phase of mining operations began in the mid-1960s there have been substantial changes in most aspects of society and economy in Bougainville. At the same time Bougainville has moved from being a District in an Australian-administered territory to a Province in the independent state of Papua New Guinea. While there were many changes in peoples' lives before the mining era, such as the introduction of steel tools, commerce and colonial administration, in many respects changes have been more substantial since mining commenced, especially in those villages near the mine and in the new towns of Bougainville. However, many of these changes have had relatively little to do with the presence of the mine itself. In contrast, almost every social, economic and political change in Bougainville has had some impact on mining operations.

The following sections provide a description of the population and characteristics of the area and the changes that have occurred with the development of the mine. The information presented has been obtained from an examination of published material on the Province and from discussions with Bougainvilleans and others.

4.2 POPULATION

The first estimate by the government of the population on Bougainville Island for 1914 gave a counted population of 9160 and an estimated population of 23 500. By 1939 this had reached approximately 39 000. This apparent 'growth' was probably a result of contact with more remote populations and better recording techniques. Any natural increase resulting from improved health and the absence of warfare is likely to have been balanced by the departure of males for employment in the plantation sector. During the Second World War the population declined, and at the end of the war years the population was likely to have been approximately 35 000.

Since then the population has grown rapidly. The 1971 census data listed 78 700 persons as rural (most of whom were Bougainvilleans) and 11 700 urban Papua New Guineans, about half of whom were Bougainvilleans. The total Bougainvillean population was therefore approximately 80 000. The 1980 census recorded a total population within the North Solomons Province of 128 794 of whom 125 506 were citizens of Papua New Guinea; of the others, 16 780 were born outside the Province. Thus the Bougainvillean population had grown in nine years from approximately 80 000 to approximately 109 000.

Throughout the Province rapid post-war population growth rates were reflected in rapidly increasing population figures. Estimates for population growth in mine-affected areas, including Nasioi and Nagovisi, were all at least 3.5% per year, one of the highest rates in the world. These rates appear to have been maintained throughout the 1970s and 1980s. This has had a considerable impact on population pressure on resources.

This rapid increase was caused by a number of factors:

- (a) a decrease in infant and child mortality probably due to better access to health care and to the anti-malaria programme;

- (b) better natal and pre-natal care in more modern health facilities;
- (c) better health care and sanitation;
- (d) greater prosperity;
- (e) the decline of social controls that encouraged longer birth intervals;
- (f) the prohibition and dislike of any form of artificial birth control.

To estimate future population, we have used the 1980 census data and projected it based on a Crude Birth Rate of 4% and a Crude Death Rate of 0.8%. These projections are those currently used by the North Solomons Provincial Government. Thus we estimate an annual rate of natural increase of 3.2% and an overall population growth rate of 3.4% because of net immigration to the Province. From this projection we estimate that the population of the North Solomons Province is now about 163 000. By 1995 (several years before the anticipated closure of the mine) it will be 207 000. Further, we estimate that by 1995 the total urban population will be approximately 33 000 and the rural population 174 000. By the year 2010 the population of the Province is estimated to have reached approximately 340 000; that is, in less than a quarter of a century the population will have almost tripled. Although other factors are likely to be influencing population growth by this time and different assumptions result in different estimates of growth, it appears certain that a continued rapid increase in numbers throughout the Province can be expected until at least the end of the present century.

In those villages affected by the mine, there has been some population growth between 1965 and 1980-82 (Table 4.2.1). As a result there are now substantially more people dependent on compensation payments of different kinds. However, the rate of population growth has not been the same in each village; in several cases (for example, Guava), outmigration is likely to have occurred. (The population data minimise this because of the general Papua New Guinean tradition of counting people at their 'home' village, even when they may have been living elsewhere for some time.) There is no reason to believe that natural population growth rates in the mine-affected villages are significantly different, given the widespread similarity in population growth rates through Bougainville. Hence outmigration from the mine-affected villages may have been quite substantial in the past 25 years. There is therefore some evidence that people are choosing to live away from the mine-affected area. Data on the demographic structure of the mine-affected villages are unavailable but there is no reason to assume that the structure is significantly different from that of the Province as a whole, other than the lack of a male 'bulge' in the young adult years. The population of the mine-affected villages is therefore as youthful as that of the Province as a whole and thus is likely to grow as fast as that in other areas; however land pressures may, in the future, limit local migration opportunities. As a result it is possible that the real population of the mine-affected villages may grow even faster in the future.

The census data provide little useful information on economic activity. However they do show that in the Ioro-Eivo census division which includes the mine and most of the mine-affected villages, the total population was 5328 (excluding the Panguna urban area) of whom 55 persons owned their own business and 242 (235 males and 7 females) worked for salaries or wages. Most of the workforce who were engaged in any economic activity were involved in subsistence agriculture (307 males and 805 females) or commercial agriculture (1226 males and 965 females). These proportions are very similar to those of Bougainville as a whole, suggesting that the population of this area has made a belated transition from subsistence agriculture to a more commercial economy of one form or another. The 1980 census data indicate that some 31% of male Bougainville

nationals were in wage employment, a proportion approximately three times the national average.

Table 4.2.1 Populations of mine-affected villages
(Sources: National Census of Papua New Guinea (1980);
Provincial Data System (1982))

Village	1965	1980	1982	
			Resident	Total
Arawa	163	-	235	236
Rorovana	434	510	542	656
Lonsiro	117	208	141	141
Korpei	-	420	445	447
Sireondji	82	174	164	172
Pakia	180	275	287	287
Moroni	-	89	92	92
Dapera *	206	431	189	189
Onovi	176	238	208	214
Darenai	145	326	325	336
Kuneka	-	149	140	142
Jaba	-	148	150	159
Guava	198	131	126	131

*The explanation for the unusual discrepancy in the two sets of data for Dapera is unclear, though the real population of Dapera is likely to be closer to the census figure.

4.3 URBANISATION AND MIGRATION

4.3.1 Rate of urbanisation

In 1966 Kieta had a population of 755, Sohano (the administrative centre of the Territory on Buka Island) had 877, and Buin, which was little more than a collection of Chinese trade stores on the southern plain, had a population of 345 (Table 4.3.1). This represented 3% of the total population, one of the lowest rates of urbanisation of any province in Papua New Guinea. This situation changed very rapidly with the arrival of CRAE and the building of two completely new towns. Arawa is now by far the largest town on the island with a population of about 15 000 in 1988. Panguna has a population of about 3 500. Loloho is also now classified as a separate urban area although Birempa is a rural village. It also contributed to the more rapid expansion of Kieta, which has a present population of about 3 500.

By 1971 the urban population of the Province had grown to 14 000. At the 1980 census it was recorded as being 22 908 (by which time Sohano/Buka Passage had a population of 1518 and Buin 885) and is now estimated to be approximately 25 000. The rate of urbanisation thus became faster than that of any other province in the country.

4.3.2 Role of urban areas

Construction of the new towns of Arawa and Panguna began in 1969. By December 1971 Panguna and Arawa had a population of approximately 5500 Europeans and 9000 Papua New Guineans. By 1974 the construction phase was over, with the towns beginning a period of more normal population growth. They remained characterised by long-distance migration and were viewed as being Company towns and not Bougainvillean towns.

These attitudes have gradually declined and virtually disappeared as Arawa has become a more familiar component of the landscape, as its population has become rather more Bougainvillean, and as social amenities have expanded and improved. Nonetheless Arawa remains primarily a Company town; two thirds of its housing (apart from that in fringe squatter settlements) is for BCL employees and many other resident householders depend on employment in ancillary activities. It is the capital of the Province and as a result is now a more established town and not merely a dormitory for mining workers. Once the mine has closed, Arawa has a continued future as a centre for administration, commerce and manufacturing.

Table 4.3.1 Populations of urban areas from 1966 to 1988. No statistical reliability can be attached to the last set of figures. (Source: National Census (1966, 1971, 1980); North Solomons Provincial Government Law and Order Report (1988))

Town	1966	1971	1980	1988
Arawa	-	3376	12 588	14 325
Buin	345	682	885	-
Kieta	755	2699	3 491	-
Loloho	-	1967	920	517
Panguna	-	5099	3 506	2 175
Sohano/Buka Passage	877	2039	1 518	-

Officially, Arawa was intended to be 'a normal Territory town catering for Government, Company and other interests'. However, the Company was appointed the construction authority for the town and such a large and completely new town became quite different from any other in the country. The cost of construction was shared by the Administration and BCL. It was decided to integrate low, medium and high covenant areas on a zonal basis around particular primary schools. The business and commercial sector was quite separate, as was the industrial sector, although this sector also contained single men's residential accommodation.

The Administration provided educational, medical, postal and telecommunications facilities for the new town. Site preparation and road construction were undertaken by BCL. The construction of residences was shared by the Administration and BCL on a 60:40 basis. Approximately 60% of the 3333 housing units are owned by BCL. The rest are evenly shared between private and public sectors, including the National and Provincial governments, the North Solomons Capital Authority (NOSCA) and various private and public organisations, such as the Siwai Rural Producers Society. This dominance, and the single period of

construction, emphasises the fact that Arawa is a Company town, just as are Panguna and Loloho. By contrast Kieta, without BCL housing, is a more diverse and spread-eagled urban centre that has grown much more slowly and haphazardly from its previous status as an administrative centre.

Panguna was built more rapidly than Arawa, its design and layout strongly influenced by topography. It was attempted to create a residential environment similar to that in mining towns in Australia; it was not intended that this was to be a Papua New Guinean town and the number of resident nationals in the town has always been small with a proportion lower than most other towns in Papua New Guinea. Moreover Panguna was viewed as merely an adjunct to Arawa rather than as a mining town in its own right. Like Arawa, however, a semblance of community has consolidated over time, especially around the various recreational facilities, but it is above all an 'alien town', a wholly mining town (with no private or public housing) and with Bougainvilleans being only a very small proportion of its population. Its future beyond the life of the mine is extremely doubtful.

The old administrative centre of Kieta is tied to the narrow coastal strip by steep mountain ranges. It has grown only slightly during the mining years and almost all of that growth has resulted from expanding commercial development. Some of this has resulted from mine development but much has focused on agriculture and trade in various forms. There is little land available for future expansion and, with the linking of Arawa and Kieta into NOSCA, future growth, especially in services provision, appears more likely to be centred in Arawa.

The provincial capital (effectively Arawa, Kieta and its suburb Toniva), has been managed since 1987 by NOSCA which replaced the Arawa Town Authority. NOSCA is principally funded by the North Solomons Provincial Government; further revenue comes from rentals and head tax. Most expenditure is on providing services (sanitation, water, sewerage and rubbish disposal) and a declining proportion goes into capital works. NOSCA seeks to improve and seal more roads but recognises some differences between BCL and the Provincial Government over who should provide such new road facilities. NOSCA does not provide services to any squatter settlements around the areas; previously some water taps had been provided, but the Provincial Government is currently reported to be opposed to such service provision. Panguna, Loloho and Birempa are all directly administered by BCL.

4.3.3 Urban population structure and employment

As in other predominantly mining towns, the overall urban population is dominantly male although this dominance has declined over time. In 1971 at the peak of the construction period, 88% of the urban population was male, although most were housed in camp sites outside the formal urban boundaries, to minimise social disruption. Only 1500 of Arawa's total population of 5400 lived in urban housing in 1971. Similarly, in those early years, only a small proportion of the urban population came from Bougainville though this too has changed over time. In 1971, 42% of the urban population came from outside Papua New Guinea (two-thirds of whom were from Australia).

In 1981 the combined urban population of Arawa, Panguna, Loloho and Kieta was 20 505. This included 17 523 nationals, of whom only 40% were born in the North Solomons Province. Of those born in the Province, 2351 were aged 4 or under; probably a significant number of these (and other older children) are also of non-North Solomons origin. As a result, the Bougainvillean urban population

remains quite a low proportion of the total (barely more than one-third), and has experienced only a slight change since 1971. Most of the urban migrants were from East New Britain, Morobe and Enga.

Seventy percent of those born within PNG but outside the Province were males. Further, 60% of the non-citizen population were males. Thus the towns of Bougainville remain characterised by male migration from outside the Province. They are far from being balanced communities in sex or age structure (less than 2% of the total urban population is 50 years or older, compared with 9% for the Province as a whole) and thus retain the kind of population structure that is typical of mining towns, though not as extreme as in 1971 when the construction phase was under way. Indeed the populations of both Loloho and Panguna have actually declined since that period.

Although employment in Kieta, Arawa and Panguna is dominated by the mining sector, direct employment in mining represents less than half of all private sector employment and thus even less than that proportion of all formal sector employment. A survey of private sector employment in 1981 indicated that 46% of the total employed workforce of 9357 was employed in mining. Commerce, and building and construction, with 16% and 14% respectively, were the next most important sectors. Public sector employment in the urban areas has not been measured precisely, but it is possible that about a further 1000 workers were employed in the public sector, in the National and Provincial Governments, the teaching service and in other public service activities (such as water supplies and agriculture). Less than one quarter of all those in private sector employment were born in the Province although this proportion is likely to be higher in the public sector.

Informal sector employment is very slight, apart from the various market place activities in Arawa (where there are three formal markets and some much smaller centres), Kieta, Panguna and at several other sites between these towns. Almost all the sellers in these new daily markets are from rural areas and, following improvements in transport, at least some of these travel from the distant rural areas of Buin and Siwai, especially with the more exclusive goods such as betel nuts. The smallness of the urban informal sector results from the low rate of formal unemployment in the towns and the distance and expense of travelling from the main labour exporting provinces of the mainland to Bougainville.

With the growth of the towns squatter populations have also grown, on the fringes of Arawa and Kieta. Squatter settlements, though substantial and less of a problem than in Port Moresby, are widely viewed as a problem in the Province, both by the Provincial Government and by landowners. The number of squatters has steadily grown, in 1973 it was estimated that the total squatter population around the two towns was no more than 500. Despite this, housing conditions are poor for some of the settlers. A survey of squatter settlements undertaken in August 1981 found that 97% of the residents in squatter settlements were from outside the Province, but 80% of adult males had employment, and were thus an essential part of the urban workforce.

There has been much discussion of repatriation of squatters and 'vagrants' in the Province and in 1977 a group of Highlanders was actually repatriated. Attempts have also been made to impose quotas on the employment of non-Bougainvilleans in the urban areas. However, after much discussion of possible policies, there was little direct action either to reduce squatter numbers or to upgrade welfare services in squatter settlements.

A household survey conducted in mid-1988 as part of Operation Mekim Save attempted to determine the population in squatter settlements on the fringes of the coastal urban areas. Although the data have no statistical reliability, they do indicate that the urban fringe squatter settlement population was approximately 4400. Sixty-one percent of these were adults aged 17 and over, suggesting that this is a recent migrant population rather than a more balanced urban population. Fifty-four percent of all adults were reported as being employed. Nonetheless 70% of urban adults employed were found in formal housing; the unemployment rate was actually lower in the squatter settlements. Two-thirds of all children in the squatter settlements were not attending school. The squatter settlements constitute a relatively deprived and increasing group of people, mainly from the mainland of Papua New Guinea on the fringes of some of the more affluent residential areas in the country.

4.4 VILLAGE RELOCATION

Population movements in rural areas have generally been small compared with the urbanisation process. They have taken place slowly and are little different from other historic migration moves. The historic movement away from remote mountain villages has tended to continue as villagers have sought better access to potential cash-cropping land and services. This has included movement out of the higher mine-affected villages such as Guava. Some of these migrants have moved to villages on the Port-Mine Access Road because of the superior access to facilities that this offers. By contrast the historic movement downwards into the Jaba River Valley has ceased as agricultural development prospects have ended with the destruction of agricultural potential there.

However, one of the most dramatic effects of the arrival of the mine has been the relocation of villagers from the worst affected villages, notably Dapera and Moroni and, most recently, Kuneka. These movements are summarised in Table 4.4.1 and shown in Figure 4.4.1.

Since 1969 when the construction phase started, there have been three principal village relocations:

- (a) the movement of Uruawa village from the Loloho site to Rorovana;
- (b) the movement of Dapera and Moroni villages (and various hamlets such as Dokotonama, Isibokuma and Pirurari) from the mine site;
- (c) the movement of Kuneka from the Jaba flood plain to a new site at New Kuneka (Katauri) north of the tailings lease area.

Other moves have involved very small numbers of villagers in the road and tailings lease areas. In some cases (Table 4.4.1) some households preferred cash payments rather than new houses, despite the BCL preference to give new houses.

More detailed information is available on the most recent village relocation which occurred at the end of 1987. This involved the dispersal of the old village of Kuneka, in the Jaba River valley. Historically the majority of residents of Kuneka had migrated there from the hills to the north, towards Karato. As a result, most chose to move back in that direction, to a completely new village site at Katauri (New Kuneka) where a new line village was constructed, consisting of 16 buildings, including a trade store, a church and a village meeting room. A second group of villagers moved south-east to Kombaru where eight new buildings (including a chicken house) were constructed. Other villa-

gers moved to few existing hamlets (Tabaaka, Pokunameri, Tairomana and Rerebai), all on hillsides to the north of the Jaba Valley, where 14 new buildings (including a trade store) were constructed. For each of the new houses a haus (kitchen) and toilet were separately constructed. The whole village was therefore displaced to six new sites, a process of fission and fusion that is typical of rural village life, but one which would normally take place over a much longer period with intermittent visiting between the two sites.

All construction costs associated with this relocation were borne by BCL. The total cost of new buildings was K342 102 (at 1986 prices) with houses varying in cost from K3533 to K11 624. The single most expensive new building was the church, costing K18 070. The 30 kitchens cost a total of K560 and the toilets cost K885 (although installing septic toilets cost a further K1500 each). The cost of providing a water supply for each house was K1200; constructing access roads and bridges cost K130 000. With various other costs, the total cost for the resettlement of Kuneka was about K290 000.

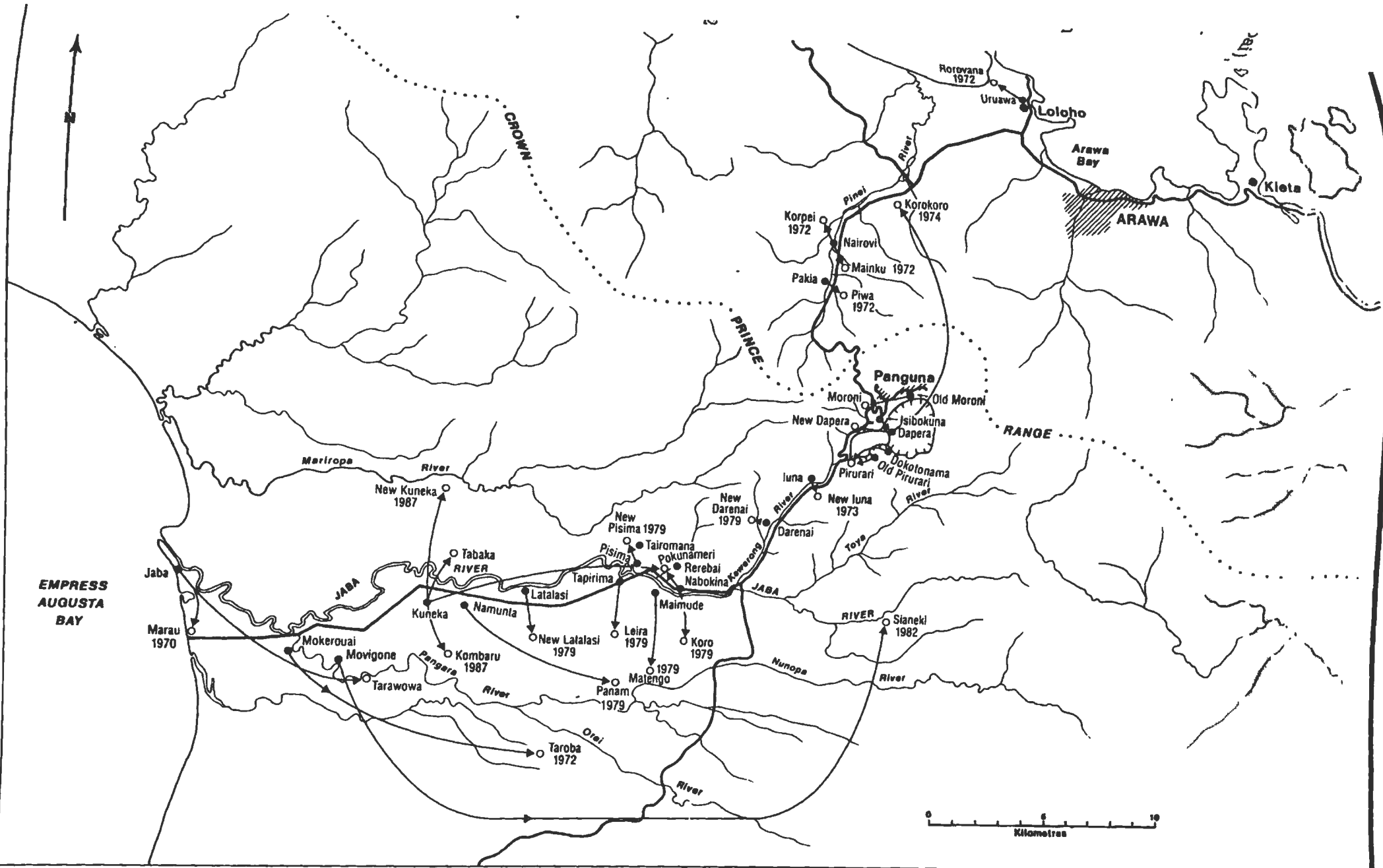
In some cases, as in Kuneka, village households were moving to areas where they had some historic claim to land, and in others, including Dapera and Moroni, villagers were able to move to sites where they had immediate claims to land. In the area of Dapera and Moroni this situation has now become critical since the amount of land that is owned by clans from these villages and not already occupied by the mine has shrunk to a tiny proportion of the historic land area. This issue and other problems attached to village relocation is discussed in Section 7.2.4. Overall these village relocations have made only a very slight difference to the population distribution in the Province. Most movements were made over as short a distance as was feasible, often no more than 1-2 kilometres. In total, 195 new houses have been built in the two decades since the relocation programme began in 1969, at a total cost of K1 638 939.

4.5 SERVICE PROVISION

4.5.1 Transport and access

There are more than 7000km of maintained roads in the Province. With the exception of those roads built and maintained by BCL (the Port-Mine Access Road from Loloho to Panguna and the Panguna-Jaba River Road), all these roads are directly or indirectly maintained by the North Solomons Provincial Government. The most important roads in the Province are the BCL road from Loloho to the Jaba pumping station, because of the access it gives to the densely populated South Bougainville area, and the relatively recently completed south coast road from Aropa to Buin. The only area of the Province now without reasonable access to roads is the area north of the Jaba River to Torokina and beyond. It may be in this area that there are possibilities for co-operation between BCL and the Provincial Government on future road provision although under the Bougainville Copper Agreement, BCL has no obligations in respect of roads other than company roads.

Almost all the mine-affected villages, apart from Jaba and Kuneka, are now very close to a sealed or gravelled road giving easy access to Panguna and Arawa. In several cases the Provincial Government has been able to provide feeder roads to these and other nearby villages. This has given these villages better access to employment, markets and a range of services. Indeed in several places, notably at Pakia and Arawa, villages have established permanent daily market stalls on the road side. However, in some cases, especially close to the Jaba River road



VILLAGE RELOCATIONS

Figure 4.4.1.

Table 4.4.1 Summary of village relocation

Area	Date of relocation	From	To	Cost (K)
Rorovana Lease	27/06/62	Uruawa	Rorovana (11 houses)	73 854
			Sub total	<u>73 854</u>
Port-Mine Access Road Lease	02/05/72	Nairovi	Kopei (4 houses)	27 024
	03/05/72	Nairovi	Mainku (2 houses)	12 765
	01/05/72	Pakia	Piwa (5 houses)	22 903
			Sub total	<u>62 692</u>
Special Mining Lease	29/10/69	Old Moroni	New Moroni (9 houses)	74 316
	18/03/70	Isibokuma	Old Dapera (3 houses)	3 476
	07/04/70	Old Pirurari	New Pirurari (8 houses)	45 551
	07/04/70	Dokotomama	Pirurari (5 houses)	6 714
	27/06/72	New Moroni	Aropa (1 house)	7 656
	11/07/72	New Moroni	Pakia (1 house)	56 140
	21/11/73	Iuna	New Iuna (10 houses)	73 854
	17/06/74	Dapera	Korokoro (7 houses)	94 326
	13/10/75	Dapera	New Dapera (24 houses)	
	13/10/75	Dokotomama	New Dapera (4 houses)	
	17/06/74	Dokotomama	Korokoro (1 house)	
Tailings Lease	27/02/79	New Dapera	Sideronsi (cash payment in lieu of house)	8 000
	02/05/79	New Pirurari	Pinei Valley (4 houses)	25 800
			Kumba (1 house) (cash payment in lieu of house)	16 800
			Sub total	<u>412 633</u>
	07/06/70	Jaba	Marau (6 houses)	189 168
	16/06/72	Mopanga	Tawarowa (20 houses)	3 476
	17/06/72	Nabokina	Cash payment in lieu of houses	39 643
	19/07/72	Mokerouai	Pokunameri (3 houses)	7 676
	08/08/79	Darenai	Taroba (1 house)	12 675
	08/08/79	Pisima	New Darenai (1 house)	101 400
08/08/79	Latalasi	New Pisima (8 houses)	12 675	
08/08/79	Tapirima	New Latasi (1 house)	15 725	
08/08/79	Nabokina	Leira (1 house)	22 675	
08/08/79	Maimude	Koro (2 houses)	12 675	
08/08/79	Namunta	Matengo (1 house)	47 100	
15/02/82	Mokerowai	Panam (3 houses)	47 100	
15/02/82	Tapirima	Cash payment Bakoram (in lieu of 3 houses)	15 675	
	Movigone 2	Leira (cash payment)	15 675	
12/12/87	Kuneka	Slaneki (1 house) (cash payment in lieu of house)		
		Katauri (16 houses) (New Kuneka)		
		Tabaaka (7 houses)		
		Kombaru (8 houses)		
		Pokunameri (3 houses)		
		Rerebai (1 house)		
		Tairomana (2 houses)		
		Cash payment (in lieu of 3 houses)	546 422	
		Subtotal	<u>1 089 760</u>	
		GRAND TOTAL	<u>1 638 939</u>	

and at Arawa village, the roads have created dust, traffic and nuisance problems. In the Pakia area especially there is concern over the excessive speed of vehicles. A number of villagers in this area now own motor transport, especially in the villages between Dapera and Rorovana. On balance, the provision of BCL roads has been a substantial gain for these villages.

Bougair provides an air service within the Province but is of limited importance in the mine-affected areas. The completion of the BCL trans-island road eventually led to the closure of both Boku and Tonu airstrips in South Bougainville, as road transport replaced air transport. Arawa town has had a light airstrip since the late 1970s which provides direct access to the town for some remote rural areas. Bougainville Development Corporation (BDC) now operates a helicopter service from its base at Panguna; this enables quick but costly access to remote mountain villages, such as Mumurai. It is used to transport cash-crops and cargo in this area, as well as other commercial operations, and also provides medical emergency services for the Health Department.

4.5.2 Power

Electricity is provided to Arawa and Kieta by the Electricity Commission (ELCOM) which purchases electricity from BCL's power station at Loloho. Power is provided directly by BCL to Loloho, Birempa and Panguna. BCL currently sells power to ELCOM at a price little more than half the charge that ELCOM passes on to the urban population; BCL is therefore effectively subsidising the urban populations of Kieta and Arawa whilst supplying power without charge to its own employees.

There is no rural electrification programme and squatter settlements have no access to electricity supplies. In the mine-affected villages most cooking is done using local firewood, although, especially in resettled villages, kerosene cooking stoves are increasingly being used. Lighting is provided by kerosene lamps. A few villages such as Guava, now have generators providing power supplies to some parts of the village. Trends in power consumption in the mine-affected villages have been broadly similar to those elsewhere in Bougainville, although, especially from Dapera eastwards, villages now have more access to electricity than most parts of rural Bougainville.

4.5.3 Water supply and waste disposal

The only reticulated water supply systems in the Province are in Arawa and Panguna. In Kieta and Toniva the water supply is almost exclusively from tanks filled by roof run-off. In the rural areas, water is principally collected either by roof run-off into tanks (which is quite rare) or from streams and springs. In most of the mine-affected villages, streams and springs provide the water supply. In many cases, because of perceptions of air pollution and contamination of water in the Jaba and Pinei rivers, the villagers are concerned over water quality; this is particularly the case, in the Rorovana villages.

New Dapera and Moroni houses were supplied with galvanised iron tanks at the time of relocation. These lasted only one or two years before becoming silted up with dust and later being destroyed by rust, as has been the case elsewhere in the Province. Villagers at New Dapera were provided with materials to construct their own reticulated supply in 1976 and have managed with that since then. A completely new system is in the process of construction by BCL at present. Five taps and showers on each side of the village may, however, be too small a number for current, let alone projected needs. Villagers from Moroni have had to manage with deteriorating roof collection methods and 44 gallon

drums until recently. In the past few weeks, BCL has installed a reticulated supply with one tap and shower. There does seem to be considerable concern and upset at the total lack of privacy for anyone wishing to have a shower. Pirurari village also has a simple reticulated supply that was constructed with materials provided by BCL.

Pakia and Rorovana both have reticulated supplies. There are 12 shower/tap units at Pakia with which the residents seem to be pleased. At Rorovana there are only four standpipes. A lot of the bathing is done in the sea at present. However the villagers have asked for six proper shower/standpipe units, one for men and one for women for each of the three clans in the village. This seems to be culturally appropriate and in keeping with the increasing size of the Rorovana population.

When the first families moved to the new site of Kuneka village in March, there was one ferro-cement water tank behind the church building. In October, it was still the only tank, but it was by now empty as the tap had broken off. The only water supply was, therefore, a stream 1km away which has several villages and a cattle project upstream. New ferro-cement tanks are due to be built for each house soon. Costs are being met by BCL, but responsibility for construction has been accepted by the Health Division of the Provincial Government.

At Leira village, water supplies are not good. There is one small permanent spring between the hamlets, and another stream about 1km away. People from several villages along the tailings have complained about back-flow up the tributaries which are used by the villagers for water. There is a need for a comprehensive review and assessment of the water supply requirements of the villages along the tailings. The number of cases of diarrhoea and dysentery in these villages (see Section 4.9.4.1) is additional reason for the installation of improved and more plentiful water supplies in order to allow improvement in the levels of personal and food hygiene.

Toilets are important in the larger villages and more densely populated area around the mine. The toilets that we were shown or which we managed to see in the mine villages and in Pakia seemed of adequate quality in general. However, none of them were covered and flies were a universal problem. The provision of toilets is a problem in Pirurari because of the difficulty in digging pits in hard ground. They therefore have none.

The new toilets in Kuneka are now filled up with water because of the high water table in that area. However, this should not hinder the process of breakdown of the faeces and should be safe provided that:

- (a) the water table does not rise any further;
- (b) no attempt is made to sink a well in the vicinity;
- (c) lids are kept on the toilets.

The construction of improved toilets in other villages along the tailings should be carried out as part of the programme of the Division of Health.

Rorovana has no toilets in the village. We were told that residents used to defaecate in the river, with the water flow being sufficient to wash the faeces out to sea. However, the river flow is no longer adequate, and defaecation takes place directly in the sea. The possibility of building toilets out over the sea was mentioned, and might be considered in consultation with the Division of Health.

Refuse disposal is a major problem in New Dapera where the edge of the valley at the backs of the houses was littered with a lot of empty cans and other debris. Refuse disposal is also a problem in Old Moroni, New Moroni and Pirurari. Recently BCL has provided two skips for refuse at Dapera and changes them every day. There is a definite need for community effort to maintain the cleanliness of the village.

4.5.4 Education

In the Province as a whole there are now six high schools, two of which (Arawa and Rigu, Toniva) are in the urban area. There are more than 150 community (or primary) schools, and about 30 village 'tok ples' schools, which are designed to give children initial confidence and skills in their own language. There is a Technical College at Arawa, International Primary Schools at Panguna, Arawa and Toniva, a small International High School at Loloho, and five vocational and trade training centres. The community schools are spread throughout the area. Access is good in most cases, the principal exception being at New Kuneka, where the relocated children now have a walk of approximately 4km to the new school that they have, in effect, left behind.

In the urban areas, schools are generally built by the Provincial Government with some parental assistance. In rural areas including the mining lease areas, schools are built and maintained on a 'kina for kina' basis, with the local community raising half the funds and the Provincial Government contributing the remainder. In the case of two new classrooms at the Community School at New Kuneka, opened in November 1988, funding was provided by the Provincial Government (K2000) and the parents, with donations of K1000 from BCL, K9000 from the Road Mine Tailings Lease Trust Fund (RMTL), K4500 from the West German Embassy and K6000 from the local Community Government (Arawa Bulletin 11 November 1988). All teachers' salaries are paid by the Provincial Government. Although the curriculum is national there is some flexibility with reference to current and local affairs; these could therefore include issues concerning the copper mine.

In the mine-affected villages most of the children in the appropriate age groups attend the community schools but the attendance rate is likely to be lower in smaller, more remote villages. For example, at Irang village, south of Guava, children face a 3 or 4 hour walk to the nearest school; as a result there is considerable demand for their own school. The average attendance rate for community schools for the total Province is somewhere between 60% and 75% of children of the appropriate age rather better than the national average. In the Kieta district attendance rates are higher than average. By contrast low attendance rates in remote, mountainous areas are not unusual and obviously reduce the likelihood of children from these areas going through to high school. Because of improved access in the mine-lease areas this is now less likely to be a problem, although there are no data on attendance rates at particular schools or on the success rate of particular schools or villages in getting children through to high school. There is no reason to believe that the standard of education in schools in the mine-lease areas is any different from that in other community schools.

Although most community schools accept pupils from the immediate neighbourhood, and thus are well designated as 'community' schools, in the case of Dapera Community School the situation is rather different. Of the 85 students at Dapera about 70 come from Panguna and Arawa and are bussed to school. The balance are from Dapera and other nearby villages, including Moroni and Pirurari. Most are children of BCL employees, and forty-four children (46% of

4.12

the total) are from outside the Province. This has caused some resentment, firstly because BCL does not provide any financial or other assistance to the school and, secondly, because there is little prospect of children from Dapera village attending the prestigious Panguna International School on the hill above Moroni village whose discriminatory fee structure presents an economic barrier to students who do not enjoy BCL bursaries. Some of the schools are in very poor condition. The worst of these are Rorovana, Deomori and Dapera.

About 17% of all children of the appropriate age go to high schools in the Province, a proportion that is rather higher than the national average but one that is barely increasing, as the population of high school age children increases rapidly. The proportion who complete high school and go on to some form of tertiary education is even higher than the national average. There appear to be no available data on the origins of these high school and tertiary educated children. However the largest high school in the Province, Arawa High School, caters mainly for BCL or public service children. This very much reflects the socio-economic composition of the urban area rather than that of the more thinly populated rural periphery. An extensive and useful discussion of possible educational policies for the Province is given in the North Solomons Provincial Development Study (Ref.18). The most recent statement of Provincial Policy is given in the Planning Statement for the 1987 Budget. It is not proposed to replicate these analyses here.

The Company runs a mine training college to improve the skills of its workers and contribute towards the employment of skilled local labour. It also sponsors employees in training institutions elsewhere in PNG and overseas. These training programmes incorporate expatriates as well as PNG citizens. Its total annual costs are approximately K6 million (about 50% more than the education budget for the North Solomons Province). Although the programme is designed specifically to be of benefit to the Company there is a steady attrition of skilled staff from the organisation. The college programme thus provides some long-term benefits to the wider community but it is not integrated into or designed to meet Provincial needs. BCL believes that the mine training college trains over half the national tradesmen. Other organisations provide training for Company employees and some, such as Bougainville Development Corporation (BDC), operate a bonding scheme for these trainees. The Bougainville Copper Foundation also provides some funds for training through scholarships and other sources of support.

4.5.5 Health services

The North Solomons Provincial Government health services are based upon the national pattern. There is one provincial hospital at Arawa, which is manned by doctors, including some specialists, and has a full range of medical services. It was opened in 1972. Intermediate level services including in-patient care and maternal and child health care are provided by health centres and sub-centres. The base level facility in the community is the aid post, manned by an aid post orderly. Some of the health facilities (such as the Moratona health centre), are run by churches.

In addition to these facilities, there are three types of private medical care available in the area:

- (a) BCL runs a mine clinic at Panguna. It is primarily intended for treating occupationally-induced illnesses and injuries, but it also operates a general out-patient service for the mine employees and provides preventive antimalarials for employees and their families;

- (b) the Bougainville Copper Foundation operates a private hospital in Arawa. This provides both out-patient and in-patient care for anyone who wants to pay. BCF doctors also provide consultations at the mine clinic at Panguna;
- (c) some independent private doctors now practice in Arawa.

There have been criticisms from the landowners that the BCL mine clinic does not provide any emergency medical assistance for local villagers who must organise transport and then travel to emergency services. There is however some evidence that the clinic does provide medical service in emergencies.

Charges at health centre out-patient clinics are 50t for adults and 30t for children for each visit. Private clinics usually charge about K15 per visit. Drugs and dressings at government facilities are free. Those prescribed by private doctors must be bought at the pharmacy. Attendances at Panguna Health Centre are said to have dropped since the introduction of charges in 1983. During the same period, the use of private facilities has been increasing. These two changes are probably unconnected and involve different groups of people.

Panguna Health Centre was built from Government funds in 1968 as the original hospital in the area. It was replaced when Arawa Hospital was opened in 1972. At that stage the doctor moved to Arawa and Panguna was downgraded to a health subcentre. At present the centre sees about 2000 out-patients and 150 ante-natal mothers each month. There is an insignificant number of admissions and no deliveries as there are no staff for night-time nursing. The staff consists of four nursing officers, two nurse aids, a clerk and a labourer. The officer-in-charge and his nurse-wife live in a house next to the centre that they rent from BCL. The labourer sleeps in a room at the centre. The remainder of the staff are wives of BCL employees who are living at Panguna.

Access to health services from the mine villages is good. It is a 30 minute walk from New Dapera, Guava and Moroni, and one hour from Pirurari. Villages along the tailings have no aid post along the road. They have the choice of going to Moratona health centre or Panguna health centre. Most go to the latter as that is where most of the traffic goes. From Leira village it is a one hour PMV journey to Panguna, costing K2.50 one-way. For those living at New Kuneka village, it is 7km to the main road and a K4.00 PMV journey to reach Panguna. For anyone to go to Arawa Hospital for admission, childbirth or special tests, etc, there is an extra K2.50 PMV journey from Panguna.

Maternal and child health (MCH) services are very uneven. There are no facilities for supervised childbirth between Moratona and Arawa. In practice, this means that most women from the lease areas have to go to Arawa or deliver at home. MCH clinics to villages in the road lease are run by the MCH staff at Arawa and are fairly regular.

There is a very poor maternal and child health outreach programme from Panguna because the centre has no vehicle. There have been seven clinics held at New Dapera in the past two years, and even fewer at other villages. Transport is only available when it is sent from the Health Division in Arawa.

Immunisation coverage among the children surveyed at New Dapera on 28 November 1988 was good (BCG - 100%, triple antigen - 84%, polio - 68%, and measles - 88%). These children are obviously close enough to Panguna to get immunisations. At New Kuneka, coverage was not as good (BCG - 86%, triple antigen -

4.14

64%, polio - 50%, measles - 30%). The villages along the tailings are supposed to have been served by the health centre at Moratona, but there has not been an MCH clinic for over one year.

There is definitely a need for improvements in the level of services in the mine and tailings lease areas. Panguna will need to be upgraded to a full health centre with in-patient and midwifery facilities. MCH services along the tailings need to be improved. These will require a vehicle at Panguna and a decision about who is responsible for the lower tailings areas.

However, for the mine-affected villages there has been a significant overall improvement in the availability and content of health services, most of which has followed the normal process of extension of Provincial Government services, and improvements in access from new road construction.

4.5.6 Conclusion

For the area affected by the mine there has been a significant improvement in availability and access to services since the mine began operating. This has followed the extension of Provincial Government services to wider areas (especially in the areas of community education and health), the construction of a road from Loloho to the Jaba River (which has significantly improved access, especially to Arawa), and the availability of new services at Panguna (including a bank, post office and market). However, these improvements are not evenly spread; areas alongside the Jaba River, especially on the northern bank, have much inferior access. Some of the most deprived areas of Bougainville are now the more remote mountain villages, some way to the north or south of the cross-island road, where access is extremely difficult (since roads are absent) and where village populations are too small, as in the case of Irang, to justify the presence of a community school or aid post. The Provincial Government is aware of these problems. Although there has been an improvement in access to services in the region, it is apparent that there could be much greater access to better quality services and that BCL could be more helpful in emergency situations.

4.6 RURAL DEVELOPMENT AND ECONOMIC ACTIVITY

At the time that mine construction began, the villages in the mine-affected areas were typical of those in similar ecological situations in Bougainville. Rorovana and Jaba were fishing villages and Rorovana was able to market fish and vegetables to nearby plantations and missions. Rorovana, and some other villages, also marketed copra; some of the villages around Guava sold small quantities of coffee, while the hamlets in the Jaba River valley traded very little. Much of the income to villages at this time was from plantation labour. There were few consumer goods, and all houses were constructed from local materials. Most village households were primarily, if not almost entirely, dependent on the subsistence economy, based on root crops, green vegetables and some fishing, hunting and gathering.

In the last 25 years substantial changes have occurred to that system. Households in the mine-affected areas are not as dependent on the subsistence economy as they were before mine construction began and in some villages, especially Dapera, dependence on the agricultural economy in any form has virtually ended because of the loss of village land. In other villages, increasing population has also put pressure on the agricultural system. In all the villages, more distant and steeply sloping gardens are now being cultivated. The com-

ponents of the food crop system have been largely unchanged in this period, although the less labour-intensive cassava is now more apparent. In most villages the depletion of the bush and the widespread use of shotguns (now banned in some areas) have reduced the significance of hunting and gathering. Wild pigs are increasingly difficult to find, possums are rapidly declining in number and the recent demise of the flying fox population (Section 5.7.3.4) has substantially depleted the variety and volume of hunted species. Gathering of vegetables and fungi continues but the use of medicinal plants has largely been replaced by commercial medicines. Freshwater fishing has particularly declined because of limited fish numbers caused by contamination of water, high sediment loads, some use of domestic detergents in rivers and more effective fishing techniques.

The greatest change in the agricultural economy has been the rapid expansion of cash-cropping. This began in most parts of Bougainville in the 1960s with the expansion of cocoa and improving road transport systems. In the villages of the Pinei and Jaba river valleys cocoa is now the major cash-crop and almost all households are involved to varying extents. Overall the price of cocoa throughout the 1970s and 1980s has been high (relative to copra), resulting in an important source of income to the region.

In valleys close to the coast copra is an alternative cash-crop. It has had a limited revival in the region due to the recent apparent high incidence of diseased cocoa, a relative rise in the price of copra, and a continued demand for cash incomes. However, this revival may be short-lived.

In high altitude villages such as Guava, the success of cocoa is limited; coffee has been grown successfully in the past, but is no longer a major cash-crop. Cardamon is being grown experimentally at Guava, Moroni and perhaps elsewhere but there appears to be a problem marketing it.

In most villages some food crops, betel nuts and other produce are sold, either at roadside markets (as at Pakia) or at the major markets of Arawa and Panguna. The small number of sellers from Moroni village at Panguna market indicate that it is probable that there is very widespread, if part-time, participation in the marketing of food and vegetables, especially from villages near the port-mine access road. However, we have no data to support this.

Little information is available on the incomes generated by cash-cropping, nor is there any information available on the distribution of cash-crops either by region or per capita. The 1980 census indicated that 77% of all rural households grew some cocoa; since some areas in the north of the province do not grow cocoa at all this suggests that the extent of cocoa growing in the mine-affected area is very high. For the Ioro-Eivo census division (the closest region to that of the mine-related villages), 75% of all households grew cocoa. Twenty-three percent, the highest proportion in the Province (excluding the outlying atolls), declared themselves to be purely subsistence households.

The CSIRO Resource Management Unit data, derived from the 1980 Census, provide cash-crop information for some distinguishable parts of the region. In Dapera and Moroni 54% of all households are recorded as growing cocoa, 28% grow copra, 81% grow food crops and 83% own pigs. Although there is no means of assessing how accurate these census data are, they suggest a surprisingly high degree of access to both cash-crops and garden land in the most severely affected villages in the mine lease area. However, they provide no adequate quantitative data; it is therefore possible that Dapera and Moroni now both face a critical shortage

of agricultural land, more severe than that noted in 1978 (Ref.19). The CSIRO data also indicate that cocoa ownership is greater in the remainder of the region.

Most households in the area thus participate in the cash economy in that during the year they market at least some agricultural produce; broadly participation appears to be a function of accessibility. Estimates made for the North Solomons Provincial Development Study (Ref.18) suggest that the incomes of cocoa-growing households varied widely, with an average of K807. However in the mine area incomes may be somewhat lower. Indeed for Ioro and Eivo community government areas the average per capita incomes from cocoa were as low as K19 and K56 respectively and for the Bolave community government area, in the Jaba Valley, incomes were K112. The study singled out the area around Guava as one of the areas in the Province with very low per capita incomes from cocoa and copra cultivation, although neither crop can grow in some parts of the region. The Banoni area, from Torokina south to Siwai, where poor access still limits cash-cropping, also had low incomes. Thus incomes from cash-cropping vary substantially within the region, being much higher in areas around the Pinei River and mine access road, where soils are good and access to food and cash crop markets is also good, and lower around the mouth of the Jaba River, in upland Guava and at Dapera and Moroni (where land is in short supply).

Apart from cash-cropping there are three principal sources of cash income in the region: remittances, compensation payments, and wages and salaries. Information on remittances is notoriously difficult to obtain. However, there are many migrants working outside the region, some outside the Province, who remit some of their wages to their families in their home villages. In general, remittances are partly a function of rural requirements in the migrant's household and partly a function of the migrant's own aspirations for future developments in the rural area. This suggests that remittances are likely to be higher per capita in the poorer parts of the region (upland Guava and the Jaba coastal region) both because needs are greater there and because the proportion of migrants is likely to be higher, as a result of the limited opportunities for earning locally.

Compensation payments are discussed in detail in Section 4.8. In summary, total payments in 1988 amounted to K1 451 475 spread over the various lease areas and to some extent beyond, in the mine-affected areas or where landowners live in distant villages. This represents a figure crudely estimated at K500 per capita. It is therefore one of the most important sources of cash income in the region.

Throughout the region some income is generated from wages and salaries, especially in villages such as Dapera and Moroni, where the alternative of agricultural work is virtually non-existent, and in villages in the Pinei Valley, including Rorovana, where educational levels are higher than the Provincial average. For the Province as a whole in 1980, 5% of the rural population worked for wages or salaries. The proportion in the mine-affected area however, is likely to be higher because of better access to employment opportunities and because of business contracts between groups of villagers in the region and BCL (and also with organisations such as NOSCA). No information is available on overall employment by villages, including such mine-related companies as MINENCO which certainly employs local villagers, although there is some information on the number of BCL employees in some of the villages of the region (Table 4.6.1). Since this information was based on the stated 'home airport' of Kieta it is likely to minimise employee numbers from the Jaba River area especially, and

almost certainly in each of the villages because of problems of classification.

Although direct employment of villagers in the mine is limited, it is more substantial in villages in the Pinei Valley. Direct employment is supplemented by a variety of business activities whereby local villagers have grouped together to provide contract services to the mine (Table 4.6.2) or have established commercial ventures in association with mine activities (Table 4.6.3). No data were available on the ownership of the shopping ventures, but at least two of these operations are owned and operated by Guava villagers.

Contracting work is identified in Table 4.6.2; Pakia village holds four contracts, Dapera has two and Kuneka has the single most valuable contract. It is possible that there are further contracts of different kinds based in the villages, both with BCL and with other organisations. For example, the Business Liaison Office of BCL claimed that there were four village contract groups composed of Dapera villagers themselves and three other groups based around individuals who had married into Dapera. Table 4.6.2 may therefore be incomplete. Moreover these data provide no information on the duration of these contracts or on the amount of employment that is generated by them. Some Dapera groups, for example, hire workers from outside Dapera itself. It is nonetheless apparent that such contracts provide substantial levels of employment and income and that the returns from shopping ventures also filter back, in some form, into the villages. There is no information available on this income distribution and, especially in the case of shopping ventures, it is likely to be unevenly distributed.

Table 4.6.1 Number of BCL employees from various villages - November 1988 (Source: BCL)

Village	Number
Rorovana	17
Sireondji	9
Dapera	7
Pakia	6
Arawa	5
Guava	4
Onovi	3
Jaba	3
Lonsiro	1
Darenai	1
Moroni	1
Pirurari	1

Table 4.6.2 Local contractors and services provided to BCL
(Source: BCL)

Business name	Base location (area)	Services provided	Approx annual value of contracts (K)
*Adana Torau Ent.	Rorovana	Grasscutting	
*Aparu Contractors	Pakia	Blockmaking	24 000
Arawa Painters	Arawa	Painting	7 000
Bruno Builders	Arawa	Building maintenance	55 000
*Dapera Business Grp	Dapera	Rewinding	28 000
Dini Sub-Contractors	Arawa	Carpentry	20 000
*Deramoai Youth	Lira	Painting	5 000
*Dopoma Contractors	Itakara	Port-Mine Access	2 500
		Road maintenance	
Golason Builders	Arawa	Building maintenance	30 000
Havesea Maint.	Arawa	Painting	30 000
*Jommy Contractors	Toniva	Yardworks	60 000
Kasi Contractors	Arawa	Building maintenance	50 000
*Kariama (Miriori)	Guava	Yardworks	5 000
*Kobu Works	Itakara	Yardworks	30 000
*Kikumo Bushclearing	Kuneka	Trucks/bushclearing	140 000
*Mariko Group	Pakia	Yardworks	250 000
Moscath Builders	Arawa	Building maintenance	2 500
*Mutapo (Bamune)	Pakia	Levee Works	10 000
*Noruama Contractors	Dapera	Building maintenance	9 000
*Norungpina Youth	Pinei	Bushclearing	65 000
*Pako Group	Pakia	Yardworks	2 000
Quality Signs	Loloho	Signwriting	8 000
Sivena Painters	Arawa	Painting	5 000
Sub-urban Maint.	Arawa	Building maintenance	50 000
*Tarve-Bironingka	Pakia	Yardworks	5 000
*Timo Contractors	Panguna	Building maintenance	4 000
Vernon-Sen	Arawa	Building maintenance	5 000
Zuelala Builders	Arawa	Building maintenance	5 000
			25 000

* Enterprises having principals believed to be natives of leased areas.

The policies of the Administration and BCL encouraged Bougainvilleans from the Guava and North Nasioi areas to participate in the commercial and transport sectors of the urban economy. Compensation payments provided the initial impetus to business development, with advice being provided by BCL. In the early years of mine operation there was therefore direct sponsorship of new ventures of all kinds (including agricultural) in the mine-affected villages and often beyond. Over the years the work of the BCL Business Liaison Office has substantially declined, firstly, because Provincial Government expertise (and also private expertise) partly took the place of BCL expertise and secondly, because there was some degree of frustration in BCL over the failures of many local business ventures, despite their promising start. There appears also to have been a degree of deliberate withdrawal from assistance in this area, with fieldwork activities substantially curtailed; the reasons for this withdrawal are unclear but could include financial constraints, individual decisions by particular officers or even the view that either BCF was now taking a more direct interest

in these kinds of business venture or that BCF was setting up more appropriate business ventures than local people were able to do. Whatever the reason there is local concern that BCL has not continued to assist and support small-scale business ventures in the region.

Table 4.6.3 Shopping ventures (Source: BCL)

No.	Name	Nature of business
1	Guava Holdings	Service station
2	Kawerong Coffee Lounge	Coffee lounge
3	Nirang Kiosk	Canteen
4	Kusito Stores	Canteen
5	Karoona Cafe P/L	Coffee lounge
6	Mopadagu Stores	Canteen
7	Mine Kai Shop	Kai shop
8	Meuka Kai Shop	Kai shop
9	Petuku Stores - Karoona Market	
10	Uruava B G Stores	Canteen
11	Itakara Kiosk	Canteen
12	Tunuru Services Station - Canteen	Stores
13	Tunuru Service	Service station
14	Karoona Market	Public market place for local affected area
15	Papoansi Business Group	Premises for rental - Arawa

As well as business ventures directly related to BCL activities, there are also a variety of other businesses in the region. Every village now has at least one trade store and larger villages such as Pakia and Rorovana have several well-stocked stores. Most villages also have at least one truck, used in various ventures. Kuneka villagers own two or three vehicles whereas Rorovana villages have several. Small-scale business ventures, not all of which survive for long periods of time, are much more likely to be located in the Pinei Valley and are to some extent independent of the existence of BCL, beyond its obvious impact on raising income levels.

Finally, a number of individuals and groups in the mine-affected villages have shareholdings in BCL and in other commercial activities such as Arawa Enterprises Limited (AEL). Many therefore earn annual incomes from these shareholdings. There is no indication of the extent of shareholdings, although in November 1988, there were 1265 shareholders in BCL with addresses in the Province. Since BCL initially encouraged shareholding by local landowners, to enable them to participate directly in the new venture, shares may be disproportionately held by individuals in mine-affected villages. There is no way of knowing this or the extent of shareholdings in other businesses. Shareholdings do contribute at least some income to the mine-affected villages.

Overall, incomes in some of the mine-affected villages are now quite significant and are much greater than income levels before mine construction began. Although cash incomes are likely to be highest in villages such as Dapera, Moroni and Pirurari, where compensation payments are higher than elsewhere and there is substantial access to employment, this is offset by the extremely limited access to agricultural land, and the resultant necessity to purchase all foodstuffs. Consequently villages in the Pinei Valley, with some compensation payments, little loss of land and good access to markets and employment, are likely to be the most favoured in the mine-affected area. Villages west of Panguna are relatively disadvantaged. Although incomes from compensation are quite high, land losses and social disruption have sometimes been severe and these villages have had poor access to services of all kinds for a long time. Rural development has been substantially transformed by mine operations, with rapid commercialisation of the rural economy and a greater dependence on income sources of various kinds. This transformation has been more substantial at the mine site and in the Pinei Valley than in the Jaba Valley.

4.7 SOCIAL CHANGE

As well as rural economic change, there has also been substantial social change in the mine-affected areas. It is difficult to provide a balanced assessment of these changes and how they have affected the lives of people in the area. Some of these changes have been discussed in previous sections: the rapidly rising population, and the consequent increased pressure on rural resources of all kinds (including land, hunted animals, fish, and bush materials) and the steady adoption of new forms of income generation through wage-earning rather than agriculture and hence the growing dependence on money and the commercial system. This has had a number of predictable effects: Bougainvilleans are much more mobile than hitherto, they are increasingly likely to consume store-bought food rather than locally produced food (and to correlate this change with increased status and prestige), wage-earning has become a more acceptable permanent way of life (rather than a temporary adjunct to rural production) and, through these changes, villagers are now much less self-reliant than they were in the past. Indeed this incorporation into a wider economy and society has generally been welcomed and Bougainvilleans are unlikely now to seek to withdraw towards increased self-sufficiency even if this were possible.

Some of these changes have followed the expansion of the education system and the greater levels of participation in this system at increasingly higher levels. Since the start of the mining era, PNG has become independent, and Bougainvilleans have gained many high-level positions in the Provincial bureaucracy and also in private sector enterprises. There is no way of assessing how many such positions are held by individuals from the mine-affected areas. Missions too have continued to influence people's lives and throughout this region there is a high level of attendance at church services. There are increasingly higher levels of participation in many activities introduced into Bougainville in the present century, whether these be commercial activities (trade stores), education, religion, medicine or sporting activities. Better communications, through radio and increasingly newspapers, have emphasised these trends.

Inevitably, not all social changes are positive. As in other areas of the country the Province has experienced an increase in various kinds of criminal activity including rape, assault, prostitution, various forms of 'rascalism', alcohol abuse and traffic accidents. In the 1980s especially, criminal activi-

ties have increased, especially in the urban areas, leading the Provincial Government to organise an 'Operation Mekim Save' (Awareness Operation) in March 1988 to combat the increase in crime. Data are not available to determine the extent to which crimes have been predominantly committed by Bougainvilleans or by migrants. Since some criminal activities have certainly been committed by migrants, the rise in crime is often attributed to the establishment of the mine complex and the substantial increase in numbers of single young men. Although national crime statistics are inadequate to provide useful data, there seems little doubt that crime levels are significantly higher on the mainland, and especially in Port Moresby, than on Bougainville. Isolation and low levels of unemployment have enabled the Province to escape the worst effects of the increase in national criminal activity.

Although changes are visibly apparent in lives and in the landscape, there is also a very great degree of continuity in peoples' lives. Most people still live extremely close to the places where their ancestors lived in the last century, speak Bougainvillean languages as a matter of course and have kinship systems that have withstood an increase in out-marriage. Traditional values and ceremonies remain important in peoples' lives and although they have come under pressure, these values are still more important in village society than any more recently introduced from beyond.

Many other changes have followed the arrival of the mine, ranging from the manner in which lives are now oriented by days and hours, to massive increases in alcohol consumption and increased numbers of road accident victims. It is difficult to make any assessment of such a variety of social changes other than to note that many of the impacts are psychological, associated with the vastness of the BCL enterprise.

Over time many Bougainvilleans have become familiar with the operations of the mine, although few have come to accept it or approve of it as anything more than a temporary part of their lives. Some have never withdrawn their initial opposition to it. Still more are at best ambivalent about it, and increasingly concerned to achieve what is perceived as a more appropriate distribution of benefits as the mine moves closer to the end of its working life. In a variety of ways the mine has been almost certainly the single most important factor in contributing to change in Bougainville in the past 25 years both through its direct effects (on employment, income, services and environmental destruction), and through its indirect contribution to National and Provincial Government revenue. However, these changes are extraordinarily unevenly distributed, between villages like Dapera (where little land remains) to villages a mountain ridge away where change has been minimal. In other villages change has had positive and negative effects that are difficult, indeed impossible to quantify. For most people in the lease areas the mine has created a series of new, and often unforeseen, problems which have led to new debate on the merits of, and compensation for, some kinds of change. It is these issues that have increasingly become of critical concern.

4.8 COMPENSATION PROVISIONS

4.8.1 History of compensation claims

Since the start of exploration, BCL has inevitably been the subject of considerable discussion and criticism over the issues of equitably sharing the profits between multinational and host, and of compensating the Bougainvilleans

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adversely affected by the development. Indeed, concern over the Administration's use of the royalties paid by BCL was a key factor in the growing demands of Bougainvilleans for secession in the late 1960s and early 1970s. The issue of compensation payments has been more complex than either the Administration or BCL ever anticipated. Further, the evolution of levels and types of compensation has proceeded largely on an ad hoc basis through individual test cases, which have at times reached the High Court of Australia. The 1980 Compensation Agreement sought to incorporate all previous agreements and bring increased regulation to the payment of compensation. However, questions still remain as to the equity of the distribution of compensation payments.

The granting of a prospecting authority to CRAE in 1963 heralded the need for some kind of compensation for those whose trees and gardens were destroyed in the establishment of camps, drill sites and helipads. There was widespread hostility to the presence of the prospectors in the area due largely to mutual incomprehension of different land tenure systems and attitudes towards property. Indeed, five men from the Guava area were imprisoned for damaging CRAE equipment on their land, an issue which still rankles in that village.

In 1966, amendments to the Mining Ordinance 1928 introduced an occupation fee payable to owners of land incorporated in mining leases at the rate of \$2.47 per hectare for land in prospecting areas and \$4.94 for land in mining leases. An attempt by the member for South Bougainville to obtain 5% of the royalties paid by BCL to the Administration for use in Bougainville was initially rejected, but subsequently passed later in 1966.

Compensation payments in cash and food were made directly to the villagers without reference to the Mining Warden or any other type of authority. Nor were thorough records kept of these payments. Payments were made for damage to improvements on the land, severance of land from other lands owned by the same person, loss of surface rights of way and consequential damage. The construction of a road between Kieta and Panguna resulted in a flood of compensation claims for damage to economic trees, crops and pig fences. Approximately 350 of these were dealt with by the Mining Warden's court. For example, one man of Dapera village received \$277.90 for damage to bananas, sago, bamboo and cassava. Such one-off claims were typical of the period.

When the construction and mining phase began in 1969, the need to acquire land on the coast on which to build a town to house personnel engaged on the mine led to the acquisition of a plantation owned by an Australian, McKillop, in the Arawa Bay area. After protracted discussion, McKillop elected to sell rather than have the land resumed by compulsory purchase. However, Rorovanans, whose land was required for the construction of port facilities refused either to sell their coconut groves at \$432 per hectare or to lease the land. Long negotiation led to BCL granting occupation fees of \$7000 per annum for 56 hectares, the rebuilding of four houses, a lump sum payment of \$30 000 for projected destruction and giving Rorovanans the option of buying 7000 shares in the Company, thus establishing a precedent for other land acquired for public purposes. Almost 20 years later many Rorovanans remain concerned at the low level of compensation, dispute the area and number of coconut palms involved, and argue that an inadequate number of replacement houses were constructed.

The areas needed for the mine site, access roads, and disposal of wastes were granted under the Mining Ordinance 1928-66. In 1969 the Pakia villagers sought a court declaration that the Administration was acting illegally in granting land to BCL. This claim was eventually disallowed on technical grounds in the

High Court of Australia. Thus, three leases were obtained: the Port-Mine Access Road (PMAR), the Special Mining Lease, and the Tailings Disposal area around the Kawerong-Jaba river system.

By the end of 1969, a schedule of compensation payments had been established with reference to the destruction of food plants, animals, fences and trees (Ref.3). In 1970, the Warden's Court ceased to hear the majority of compensation claims, this function being taken over by the BCL Village Relations Office. Thus in the period 1969-80, compensation was available for cash-crops, resettlement, nuisance, occupation, pollution of riverine environments and the loss of bush land. The history of each of these compensation classes is summarised as follows:

- (a) cash-crop compensation - by 1969, the rates which had previously been paid for the destruction of coconut palms (\$2 per plant) and cocoa and coffee plants (\$1 per plant) were considered inadequate. The test case of Martin Benggong reached the High Court of Australia. He claimed \$30 per cocoa plant based on the high prices of cocoa at the time. Confusion over the High Court judgement (which stated that the Mining Warden had been acting within his jurisdiction in awarding Benggong \$30 but that this award should not set a precedent) led to direct negotiations between the public solicitor and BCL, and an agreement on a rate of \$15 per coconut palm and \$13.50 per cocoa and coffee plant. Landowners could opt for cash compensation to be paid after the land was leased, or for BCL to pay labour to clear, plant and maintain another site. While most Bougainvilleans with cash-crop holdings in the various leases had accepted either monetary or replanting/maintenance compensation by December 1973, two major claims for large plantations in the lower Jaba Valley remained outstanding. BCL refused to pay to the Nagovisi group the standard amount which would have amounted to \$250 000. Lower rates were approved in the Warden's Court in the case of a Pinei Valley farmer in December 1974, after which the Nagovisi group accepted the lower payments offered by BCL.
- (b) resettlement - between 1969 and 1971, 289 people from eight villages in the upper Pinei and Kawerong valleys needed to be resettled. Under the terms of the Mining Ordinance 1928-66, Moroni villagers were entitled to compensation for damage to their houses, gardens and cash-crops, severance of land from other land, loss of surface right of way and all consequential damage including \$200 per head for 'the hardship which will follow the enforced change from a traditional village environment to a European way of life, and provide for the additional cost of maintaining a European style residence in an urbanised community'. The 54 Moroni villagers were resettled at a cost of \$75 000. Problems arose in the location of suitable land on which to relocate the Dapera villagers, who waited four years for their new homes.
- (c) nuisance - some recompense was given to most villages in the upper Pinei and Kawerong valleys for the inconvenience caused by blasting, deforestation and subsequent flooding, dumping of waste, noise and dust generated by heavy machinery. For example, in 1972, villagers at Iuna who experienced a landslide were granted \$25-\$50 per head for hardship; a further \$500 was paid to the village for a traditional feast to celebrate their survival and \$450 was paid for damage to property.
- (d) occupation fees - the initial occupation fee of \$2.47 per hectare to be paid annually was reset at \$4.94 in 1969 when the unimproved value of the

land was set at \$98.80 per hectare (5% of which was set as the occupation fee). Disputes arose over this figure; BCL hired a consultant who proposed a complex schedule of occupation fees depending on the character of the land. This scheme was rejected by the Government due to its complexity, and the sum of \$326 per hectare was suggested by the public solicitor. Initially rejected by the landowners who wanted \$1000 per hectare, a figure was eventually accepted which gave an occupation fee of \$16.06 per hectare to be paid annually. This produced some anomalies according to a western scale of values since some of the land in the Special Mining Lease and Tailings Lease areas was virtually worthless in terms of agricultural production. However, a standard occupation fee for all land in the leases was more consistent with Bougainvillean conceptions of property values. The current occupation fee is K30 per hectare.

- (e) fish - an annual payment was made to all members of the affected clan to compensate for loss of fish, drinking water, bathing and recreation facilities. A total figure of \$25 000 per annum was derived (from a rather complex and somewhat arbitrary formula taking into account such things as the amount of fish protein in the diet) as a fee for the 1415 people involved in the Jaba River area. By 1974, much higher rates were being claimed, leading to increasing frustration on the part of BCL from the never-ending chain of demands from those with rights in the Special Mining Lease area.
- (f) bush compensation - negotiations to establish a bush compensation fee were long and protracted, and were still in dispute by 1976. The procession of compensation claims and negotiations was highly complex and at times determined more by political manipulation than a realistic assessment of appropriate compensation for widespread destruction of the villagers' habitat. By 1979, a stalemate of renegotiation was reached.

4.8.2 Payment of compensation prior to the 1980 Agreement

The resident population eligible for compensation up to 1974 was estimated to be approximately 4000, many more than anticipated by BCL. Bedford and Mamak (Ref.3) estimated that 2654 payments were made to 1000 Bougainvilleans between 1968 and 1974. These totalled \$1.6 million and involved three types of compensation:

- (a) destruction of gardens, pig fences, and bush plants with a recognised value in the village economy;
- (b) destruction or projected destruction of cash-crop holdings;
- (c) occupation fees for land in the three major leases.

These people were from 62 separately identified villages, scattered over a wide area. Over the seven year period, each village received a median amount of just over \$10 000. Three villages received over \$100.000, while 10 villages obtained less than \$1000. The median amount received by individuals was \$244, with 3% obtaining over \$10 000 and less than one-third obtaining \$1000 or more. Almost 60% of specific payments were for \$100 or less. Most payments were therefore, for small amounts with the compensation money being distributed in a very uneven manner among the 62 communities.

In 1968/69, 85% of the money distributed went to those with land along the Port-Mine Access Road where disruption has been greatest in the early years. Of the mine site villages, Dapera received over half the amount itemised for payment to people in this area over this two year period. Compensation was paid to the

inhabitants of Moroni in the form of resettlement. During 1970 and 1971, most payments were small amounts to cover damage to gardens, although some large amounts were received by landowners in the Pinei Valley for destruction and projected destruction of their coconut, cocoa and coffee groves. Villagers in the Tailings Lease area started receiving compensation in this period, a cost to BCL which increased in 1972/73 when \$250 000 was paid to 76 Bougainvilleans in or near the Tailings Lease. Villages around the mine site area received their first occupation fees during this time, while those in the Tailings Lease were paid occupation fees in 1974.

For at least half the Bougainvilleans who received compensation, there was no prospect of a regular income from the compensation payments. The majority of those who received numerous payments lived north and west of the mine. This included Pinei Valley residents as well as villagers with homes in close proximity to the pit which had been affected most extensively and continuously by BCL.

Amounts received for destruction of gardens, pig fences and bush plants tended to be quite small, and payments were largely confined to those in the upper Pinei and Kawerong valleys. Settlements for destruction or projected destruction of cash-crops accounted for 40% of the \$1.6 million paid out between 1986 and 1974, and most went to those in the Tailings Lease area.

Apart from resettlement costs, the largest part of the compensation bill was in occupation fees, which affected a large number of people. Amounts varied according to the size of the block of land. In the Tailings Lease area, over 25% of landowners could expect to receive \$1000 per annum (the median payment was \$450, while for those in the Special Mining Lease and Port-Mine Access Road Lease areas, the medians were \$79 and \$50 respectively. Inhabitants of the Tailings Lease area together own one-quarter of the land for which occupation fees are due.

Compensation formed an important source of income over time for only a small proportion of the people with rights to land in the three lease areas. The money is distributed in a highly uneven manner over a large population, hence the number of people who were able to use the money for some form of long-term investment was very small indeed. In general the sum received could have made only a limited impact on peoples' lives and, as annual payments, were very small.

4.8.3 The 1980 Compensation Agreement

Growing concern over the amount of money being distributed in compensation payments led to new village 'claims and the eventual conclusion of a new agreement in 1980. This incorporated all previous agreements in respect of:

- (a) occupation fees;
- (b) physical disturbance compensation (new);
- (c) social inconvenience compensation (new);
- (d) resettlement;
- (e) bush compensation;
- (f) rivers and fish compensation;
- (g) crops and economic trees.

The Agreement also introduced the new concept of consumer price indexing and the Road Mining Tailings Lease (RMTL) Trust Fund into which compensation payments for social inconvenience would be paid.

The Agreement attempted to achieve a more equitable distribution of compensation, through a wider recognition of the extent of damage and disturbance and the recognition that social inconvenience also applied to villages outside the boundaries of the lease areas. The Compensation Agreement was amended in 1982, an amendment which included provision for a four yearly review. Following renegotiation in 1986 a new Agreement was signed. The present situation of all forms of compensation can be summarised as follows:

- (a) bush compensation - the new agreement settled on K3.09 per hectare to be paid to the landowners and K4.32 per hectare to be paid into the RMTL Trust Fund. This was essentially a once only payment in the first year. For new bush disturbance the rate is K12.62 per hectare;
- (b) social inconvenience compensation - payments of K25.55 per hectare are paid into the Trust Fund to cover issues such as mentally ill people, dust nuisance, cemetery disturbance and inconvenience and damage caused by vagrants to village property. The objective was to establish a 'package deal' that would cover all miscellaneous claims and discourage any new types of claim in the future;
- (c) physical disturbance compensation - this was a new form of compensation. Disturbance is determined by annual aerial photographs, and compensation is paid initially at the rate of K10 per hectare and in 1988 this rate was K17.03 per hectare;
- (d) inconvenience compensation - K20 000 is paid for inconvenience caused by disruptions to the Guava Access road. This will eventually cease when a permanent road clear of the mining operation is constructed. K5000 was also paid in 1988 for disruption of the Jaba Access Road;
- (e) river and fish compensation - this involves payments made to 'Family Group Representatives' for loss of traditional rights to fish in and to have general use of rivers. The amount was determined on the basis of each person catching and consuming 50 pounds of fish per year and tinned fish costing 20c per pound in the shop;
- (f) crop compensation - the basic rates were established in 1971 and subsequently increased by negotiation;
- (g) village relocation - as determined by the Warden's Court in 1969, this compensation covers damage to improvements, \$50 for severance of land from other land, \$50 for loss of hunting tracks and footpaths, \$200 for change to a European life style, and construction of a residence of a permanent nature, with an external toilet and a permanent water tank;
- (h) other compensation - other miscellaneous forms of compensation include Condolence payments (for deaths by accident in the lease areas whether directly or indirectly caused by BCL), Property Damage Compensation (mainly for damage from blasting) and Footbridge Construction (mainly over the Jaba River system). All these were consolidated in the 1980 Agreement.

The increasing levels of compensation and the introduction of new categories of compensation did not however, allay landowners' concerns that the totals remained inadequate. To this was eventually added a separate concern, that payment of a significant amount of compensation into the RMTL Trust Fund diverted revenue away from the landowners. These concerns are addressed in Section 7.2.

4.9 HUMAN HEALTH AND DISEASE

4.9.1 Approach to investigation

A number of complaints were received about the health of the people in the villages within the lease areas. Villagers complain that there has been an increase in both the amount and kind of diseases since the opening of the mine. Because of the incidence of disease in their crops, which they attribute to dust and chemicals from the mine, they naturally assume that their own sicknesses come from the same source. There are concerns about nutrition because of the reduced production from crops, and also because of the introduction of many new foods through the stores and supermarkets.

In order to evaluate the effect of the mine operations on the health of the people in the lease villages, we addressed the following questions:

- (a) what changes in health or disease patterns have taken place?
- (b) how do these changes compare with changes elsewhere in the Province and country?
- (c) what are the reasons for the changes and the differences?
- (d) are there any problems which are the direct effect of the mine?

No attempt has been made by either BCL or the Division of Health to monitor health conditions specifically in the villages of the lease areas. Records are kept of people who visit the health institutions, and of the sicknesses from which they are suffering. However, it is impossible to know how many people from different places and at different times actually go to a health facility when they are sick. Accordingly, these records are of little value in trying to detect differences in the pattern or amount of disease in these villages compared to other villages in the Province or country. Special records are kept for certain problems such as severe mental illnesses that need special care and for certain notifiable infectious diseases such as tuberculosis and sexually transmitted diseases. These records have been examined.

In addressing the above questions, we used two main methods of investigation. Firstly, people in the villages were interviewed and asked about changes in their experience of health and disease. Villages included were Pakia and Rorovana on the Port-Mine Road Access Lease, and New Kuneka and Leira villages on the Tailings Lease. Secondly, a survey was undertaken in New Dapera and New Kuneka of the nutrition of women and children, the immunisation of children, and the fertility and child survival experience of women.

4.9.2 Mortality

The people of the Province have experienced some dramatic improvements in life expectancy over the past 20 years. At the time of the 1971 census, the life expectancy at birth was 46.9 years. By 1980 it was 59.6 years. Much of this change resulted from the reduction in the infant mortality rate, which in 1971 was 83 per 1000 births, and by 1980 was 33 per 1000 births. Interviews of a small sample of women in New Dapera and in New Kuneka suggest that children in these villages have benefitted in the same way as the rest of the Province. Most women over 30 years old had lost some children, whereas none of the women less than 30 had lost any. These changes are the result of improved access to health services together with a willingness to use them, and the general improvements in the quality of life that have resulted from the wealth generated by cash-crops and employment.

4.9.3 Nutrition

4.9.3.1 Children

General impressions from observations of children in the villages visited suggested that there was no obvious nutritional problem. To confirm this, nutrition surveys of children under five years were carried out in New Dapera and in Kuneka villages on Friday 28 October 1988. These were done with the assistance of the provincial nutritionist, Mrs Celestine Kanawi, and Sr Maria Nanamboi of the Panguna Health Centre.

The results of the surveys are presented in Table 4.9.1 and show that on the basis of weight for height, there are no undernourished children in either of these villages. This is in contrast to the 5% found to be under-nourished (wasted) in the 1986 Nutrition Survey of children attending maternal and child health clinics in the Siwai area of the Province.

Table 4.9.1 Nutritional status of children in New Dapera and Kuneka

	Weight for age (% standard)	Height for age (% standard)	Weight for height (% standard)
<u>New Dapera</u>			
No. of children	20	20	20
Mean (SD)	92.3 (11.7)	96.8 (4.8)	96.9 (6.1)
Range	67.6 - 116.9	83.9 - 104.7	87.3 - 108.3
No. under-nourished	2 (10%)	1 (5%)	0
<u>Kuneka</u>			
No. of children	14	14	14
Mean (SD)	95.6 (16.7)	97.4 (4.9)	98.2 (9.7)
Range	73.0 - 144.0	86.7 - 105.6	88.2 - 126.3
No. under-nourished	2 (14%)	1 (7%)	0

4.9.3.2 Women

A general complaint encountered during village interviews in all the villages around the mine was that the women were becoming too fat. Our observations supported this, and we therefore included women in the nutrition surveys in New Dapera and Kuneka.

The results are presented in Table 4.9.2. The women of Kuneka appear to be well-nourished without being obese. Only one woman seemed thin but was not clinically under-nourished. In New Dapera, however, half of the women surveyed were obese ($\geq 120\%$ standard weight for age or a Body Mass Index (BMI) ≥ 27). In some cases they were extremely obese.

Table 4.9.2 Nutritional status of women in New Dapera and Kuneka

	Weight for height	Body mass index*
<u>New Dapera</u>		
No. of women	14	14
Mean (SD)	122.7 (22.8)	27.3 (5.1)
Range	97.0 - 175.0	21.6 - 39.1
No. under-nourished	7 (50%)	6 (42%)
<u>Kuneka</u>		
No. of women	9	9
Mean (SD)	105.4 (9.0)	23.3 (1.9)
Range	87.0 - 117.0	19.2 - 25.8
No. under-nourished	0	0

* BMI = Weight kg/ (Height m)²

4.9.3.3 Diet and exercise

A 24 hour diet recall from two to three women in each village indicated important contrasts. In Kuneka village, the diet is largely traditional - mostly root crop staples with a low intake of protein, occasionally supplemented by store food. In New Dapera however, meals seem to be a combination of root crops and green leaves from their gardens or the Panguna market together with rice, tinned meat or fish and chicken from the Panguna stores (this matches what we were offered while staying in the village).

The women from Kuneka are still active in their gardens, collecting firewood and carrying water from the stream 1km away. Women from New Dapera are doing some small-scale gardening; however, they are not collecting firewood from the bush, water is close to their homes, and the furthest they would walk is to Panguna.

4.9.3.4 Comment

Casual observation of women and children in the other villages around the mine suggest that the findings in New Dapera are probably representative of those villages. Women and children in Leira village appeared to have a similar nutrition status to those in Kuneka. The villages along the Port-Mine Road Access Lease still have their gardens, and the nutrition of both women and children seemed, on casual inspection, to be good. There certainly did not appear to be the same problem of obesity among the women.

The nutrition situation in villages along the Tailings and Road Leases appears to be good, and better than the general situation in the Siwai. Villagers seem to be relying successfully on traditional foods from their gardens in spite of the alleged reduction in root crop productivity. The lack of protein in their diet may nevertheless reflect loss of production of green leaves and the disappearance of game from the bush and fish from the rivers. In villages along the Road Lease, there is probably some supplementation with store foods.

Diet and nutrition in the villages around the mine are following a pattern typical of all urban and periurban communities in PNG. Cash and the availability of a large variety of foods in both markets and stores mean that a much more

energy-dense diet is consumed. This, combined with a much less active lifestyle, leads to an increasing problem of obesity. The associated problems of cardiovascular diseases, diabetes and chronic backache may be expected to follow. In these particular villages the opportunity for maintaining a traditional pattern of diet and exercise has diminished with the reduction in land available for gardening and collecting firewood. However, the significance of that handicap must be weighed against the opportunity, status and attraction of the alternatives posed by the cash incomes and the easy availability of store foods.

4.9.4 Communicable diseases

4.9.4.1 Acute respiratory infections and diarrhoea

The number of acute respiratory and diarrhoeal diseases in these communities has increased during the life of the mine. Typically, the observation has been made by villagers that, before the mine came, coughs and colds appeared during the season that the fruit was ripening in the bush. Since the mine came, however, they have been occurring in any season. As well as coughs and colds, people claim the frequency of middle ear infections has increased. These observations were made in all three of the lease areas and did not appear to have any particular relationship to how close the village was to the mine.

This is the same process that has been occurring at different times and rates in other parts of the Province and PNG, and is a product of the increases in both population size and mobility. Because there are more people and because they are moving around much more than before, the potential for the transmission of germs of all sorts has increased commensurately. People therefore get sick more frequently.

4.9.4.2 Malaria

People, particularly in the villages along the tailings, claim to have experienced an increase in the amount of malaria. They connect this with the flooding of creeks and swamps with tailings, allowing for a greater number of mosquitoes. There have been no malaria studies undertaken in villages in the Tailings Lease area which could confirm these reports. However, the observed increase in malaria is almost certainly correct because it has been true of the whole Province.

Residual spraying of houses with DDT commenced in the late 1960s in the Province and continued until 1983. Spraying was stopped because of a national policy decision to do so on the basis of its increasing failure to control transmission. Table 4.9.3 shows the parasite rates in indicator village surveys in the Province. By the early 1970s the spraying had reduced transmission very considerably, but since then the parasite rates have steadily increased. This increase in transmission was not as marked in NSP as in many other provinces because of the quality of the programme. However, a number of factors did combine to make the programme much less effective. Firstly, the increase in population size and mobility already described had the same effect on malaria as it had on the transmission of other pathogens. Secondly, the increased use of chloroquine selected the more efficient *Pl. falciparum* parasites for transmission instead of *Pl. vivax* and *malariæ*. Thirdly, DDT spraying seems to have selected strains of mosquitoes that prefer to bite outside houses and earlier in the evening than was the pattern previously. This now coincides with people's socialising outside in the evening. Such mosquitoes will rest on

unsprayed surfaces after biting and will therefore escape the effect of DDT. Fourthly, there was an increasingly large number of houses that were either unsprayed (because the doors were locked) or inadequately sprayed because of technical inefficiencies by the staff.

Table 4.9.3 Parasite rates (%) in children under 10 years of age in sprayed indicator villages in the Province

Year	1960	1971	1974	1977	1979	1980	1981	1982	1983	1984	1985
%	21.8*	3.8	1.7	9.2	8.3	7.8	7.5	6.8	13.7	14.3	19.8

* Initial pre-spray parasite rate

Spraying stopped in 1983. In 1984 there was a particularly large increase in the number of malaria cases because the population was then only partially immune having previously been protected to some extent by the spraying. Today, malaria continues at quite a high level all over the Province.

The question remains as to whether malaria has increased excessively in the villages along the tailings as a consequence of the presence of tailings. Villagers claim that significant amounts of their land have become more marshy than before. The blocking of some tributaries by the tailings has certainly created large collections of water which would favour the breeding of An. farauti, a year-round vector. At the same time the continuous road works in the area and the activities of the villagers in their villages and cocoa plantations result in the presence of more temporary collections of water during the rainy season. These favour the breeding of An. punctulatus. Whether or not these collections of water have actually increased the amount of malaria cannot be proved at this stage. However, their presence certainly makes malaria control substantially more difficult. An attempt should be made to reduce the number of mosquitoes by the introduction of appropriate fish into the more permanent waters and by filling in the temporary pools created by the road works.

4.9.4.3 Tuberculosis

Tuberculosis is of interest because of the greater chance of infection resulting in disease in those exposed to significant amounts of silica dust. Tuberculosis was introduced to the Province approximately 100 years ago. It is found in many parts of the Province but has been less frequent in the villages around the mine. This is understandable considering the relative isolation of these villages prior to the construction of the mine.

One man from Pirurari contracted tuberculosis while in Port Moresby and was successfully treated there. Three people from Guava have also been treated for the disease. At present the only known case in the area is a woman in Moroni who has been a constant defaulter from treatment. There is, therefore, no positive evidence of a problem of either tuberculosis or silicosis. Current immunisation levels against tuberculosis in these villages are very good.

4.9.4.4 Sexually transmitted diseases

Sexually transmitted diseases in the Province are found almost entirely in the Toniva-Kieta-Arawa-Loloho-Panguna urban areas. Records from the Arawa Hospital showed that in 1985 there was an incidence of 25.2 cases per 1000 adults from these areas. There were about equal numbers of married and single people suffering from the diseases. The data have not been analysed to determine the number of people from villages within the Special Mining Lease and Port-Mine Access Road Lease areas who have been treated for the diseases.

4.9.5 Non-communicable diseases

4.9.5.1 Chronic lung disease and asthma

Considerable concern was expressed about the effect of dust on people's health, and the increase in coughs and colds was consistently blamed on the presence of the dust. In fact during the village interviews most of the complaints related to attacks of acute upper respiratory infections, a few cases of asthma, some bronchitis (particularly in men in Rorovana), and only one actual case of chronic lung disease (in Pakia).

We obtained information about one or two adult cases of asthma from each of the mine villages, but met only one of them, a genuine severe case. There was a suggestive history of asthma in two of the grandchildren of the case in Moroni. Asthma has been emerging as a new problem in various parts of PNG over the past 25 years, and is another problem associated with changing life styles. In many cases, it has been shown to be associated with allergy to the house mite. The house mite becomes a problem particularly in cool, damp situations such as are found in many of the mine villages. The actual number of people who suffer from asthma in the mine villages is not excessive by PNG standards, and is unlikely to be associated with dust levels. However, if dust or other atmospheric pollutants increase to an irritant level, they can trigger an asthma attack. In the one case that we met, stress associated with the present conflict almost certainly contributes to the frequency and severity of the attacks.

Chronic lung disease is common in older people in PNG, especially in the highlands where such disease is more frequently caused by respiratory infections than by smoke in houses. As explained in Section 4.10.1 we do not think that dust and silicosis are likely to be significant causes of chronic lung disease in the villages studied. Bronchitis is much more likely to be associated with the great increase in the amount of cigarette smoking (the apparent difference in the amount of coughing between men and women probably represents the difference in smoking habits). The one case of chronic lung disease that we did meet in Pakia village confessed that he smokes 80 cigarettes each day.

4.9.5.2 Peptic ulcer disease

We heard of a few cases of peptic ulcer disease, one of whom had undergone surgery at Arawa Hospital. This is another disease that has appeared in PNG in recent years. The reasons for the variation in its distribution within the country and worldwide, and at different times, are still not understood. It is associated with changes in life style, and in this situation may also be exacerbated by situational stresses.

4.9.5.3 Sores

In New Dapera it was mentioned that children who play in the sand and waste rock tend to get sores. In the villages along the tailings it was said that the sores of those who walk through the tailings tend to get bigger or heal more slowly. One child is said to have got very sore eyes after swimming in the tailings, but was said to have completely recovered. Our personal observation of the material at New Dapera is that it is abrasive to the skin. Further, because of the chemical nature of the waste rock, puddles of water in these areas tend to become acidic and therefore cause irritation. By contrast, the water in the tailings tends to be alkaline due to the residual lime that the tailings contain. It is a likely contribution to the sore eyes and to the slow healing of sores exposed to the tailings.

4.9.6 Mental illness

4.9.6.1 Severe mental disease

Since 1970 nine people from the Special Mining Lease and upper Road and Tailings Lease areas have been treated at Arawa Hospital for psychotic (severe mental) illness. This is a cumulative incidence of 3 per 1000 over 18 years, or 17 per 100 000 per year. This compares with what is generally accepted as a uniform worldwide incidence of 30 per 100 000 per year. There have been suggestions that the incidence in PNG and some other parts of the South Pacific may be lower. If that is the case, the incidence in this population would be at a normal or low level.

4.9.6.2 Stress illness

It is impossible to make any assessment of the amount of stress illness in these communities. Diseases such as peptic ulcer and asthma that are well known to be responsive to stress are present in these villages, but are also common elsewhere. Other psychosomatic illnesses or symptoms are probably common but cannot be quantified.

Antisocial behaviours such as excessive drinking and drunkenness have become common in these communities, and can also be considered as a reaction to stress. Disputes between clans and villages are said to be increasing because of the diminishing availability of land. Disputes within families are common because of problems over the distribution of royalties and compensation payments. These factors need to be considered within the broad context of mental and emotional health, and seem to us to constitute an increasingly important and central health issue in these communities.

4.9.6.3 Dependency and lack of self-determination

Statements such as 'The mine is so big and we are so small,' and 'We are so powerless', sum up many of the feelings of people in these villages. This results in a tendency to assume that the mine is the cause of all of their problems. An associated and consequent problem is that of the 'handout' mentality, whereby some individuals expect BCL to deal with many or most of their problems. Partly this is a belief that it is BCL's duty as redress for the damage and loss caused. However, it is also seen in the attitude that, for example, since BCL built the houses in the relocated villages, it is also responsible for all maintenance of those houses and the construction of new houses to accommodate the new families when the children get married. We did

not find this attitude universal; indeed it is clear that many in these villages are getting on with their lives and making the most of their opportunities. However, it is present in a significant proportion of people. Regardless of the amount of responsibility that BCL has for the problems of these people and/or for putting them right, the persistence of this passive, negative attitude is highly detrimental to any possibility of the villagers rising above the situation and beginning to improve their lives in a constructive way. To be successful, any solutions arising out of this or any other study must elicit and involve responsible participation of the village people in order to overcome this set of attitudes.

4.10 ENVIRONMENTAL HEALTH

4.10.1 Dust

Two main possible effects of dust on human health need to be considered: silicosis, and an irritant effect leading to acute respiratory symptoms and asthma. Complaints from people in the villages around the mine itself were concerned with the latter. In the areas near the tailings, people were much more concerned about the possible toxic effects of the dust upon their crops.

4.10.1.1 Silicosis

Silicosis is a chronic lung disease which results in scarring of the lung thereby reducing the lung's capacity to function. It is caused by the toxic effect of small particles of free silica which have been deposited in the air-sacs of the lungs. The risk of getting the disease and the rate at which it develops depends upon:

- (a) the concentration of dust in the air, especially of the smaller particles of less than 5 microns;
- (b) the percentage of free silica in the dust;
- (c) the duration of exposure.

Because of the damage done to the local defence system of the lung, the incidence of pulmonary tuberculosis in people with silicosis is found to be much higher than in the rest of the population.

Because of the potential for the development of silicosis at the mine, BCL regularly monitors respirable dust and free silica exposures in different areas of the mine. Annual clinical and radiological checks are carried out on high risk personnel.

At the request of the landowners, BCL's Environmental Division undertook an investigation into dust nuisance at New Dapera. The report on the Study (Ref.20) was addressed to Mr P Mapah of the Village Relations Office for transmittal to the villagers. It provides a very thorough professional discussion of methodological issues and the results of the monitoring studies carried out. It identifies the significant risks of excess exposure associated with crushing operations in general, followed by ore-screening and diamond drilling operations. High risk personnel are identified and an estimate made of the anticipated number of cases of silicosis. In fact no cases of silicosis have yet been recorded among mine personnel. As part of the study total suspended particles (TSP) in the air were measured several times over a period of time, using a standard method at a site on the embankment near the village

access road. Comparative measurements were made in the mine compound (B79) and in a housing area at Panguna Town. Rainfall measurements at the time were kept.

The TSP concentration at New Dapera was 0.2 mg/m^3 . This is below the Australian National Health and Medical Research standard of 0.25 mg/m^3 and the US Environmental Protection Agency limit of 0.26 mg/m^3 . The level at B79 was 0.16 mg/m^3 and 0.02 mg/m^3 at the Town site. The higher levels at New Dapera and at B79 in the compound are consistent with their being:

- (a) in locations where the prevailing winds carry dust across them from either crushing or waste rock disposal operations;
- (b) close to unsealed roads which experience a lot of heavy traffic.

However, an important point is that while the average level at New Dapera was 0.2 mg/m^3 , that figure is a combination of readings of more than twice that level during dry weather and much lower readings during rain. None of the readings at the Compound and Town sites were above the safety threshold limit.

Measurements of the distribution of particle sizes in the dusts collected at these sites indicated that at both New Dapera and B79, 36% of the dust particles were less than 0.5 microns in diameter. This is the portion that comes from the mine operations and is potentially dangerous. In both areas, more than 50% of the dust was greater than 0.3 microns in diameter, suggesting that a large proportion of the total dust is from roads, which is not dangerous. Rainfall reduces the TSP level by removing the larger particles. This implies that when peak levels of dust do exceed the standard limits during dry periods, the excess is likely to be made up predominantly of larger dust particles that will not reach the air sacs and which probably contain non-toxic materials.

Having reviewed these reports, we are inclined to agree that the amount and composition of the dust in the New Dapera area is unlikely to pose a hazard of silicosis to the villagers. However, it is clear that dust concentrations do rise a long way above the safety threshold during dry weather, and while particle size is a reasonable guide to the chemical composition of the dust, there were in fact no measurements made of free silica. There is therefore sufficient uncertainty and concern in this situation to warrant inclusion of the high risk villages around the mine in the regular monitoring programme of the mine installations and its personnel. This should include measurement of free silica levels as well as TSP concentrations. Further, any reasonable effort to reduce the amount of dust around these areas should be encouraged. We are pleased to see that a cover has been placed on the tailings drop-box at the entrance to New Dapera. This should have been done a long time ago. We support the proposal to plant a lot more trees in New Dapera. The people of Moroni are expecting to move in the near future in order to escape the excess dust that occurs in the present location.

4.10.1.2 Respiratory tract symptoms and asthma

As indicated in Sections 4.9.4.1 and 4.9.4.3 the increases in acute respiratory tract infections and asthma are universal to the Province and country as a result of the demographic and socio-economic changes that have taken place. Against this general background and in the absence of specific epidemiological data, any specific contribution of dust to this situation is hard to assess. Pollution from the burning of fossil fuels is certainly known to increase the risk of chronic bronchitis, and may weaken the local respiratory tract defences against acute infections. This sort of pollution is not a problem at Panguna,

and is probably not a problem at Rorovana. However, the latter is potentially at risk from the smoke stack of the power station at Loloho. Sulphur dioxide emissions monitored by BCL from 1977-79 had values less than 20 ug/m³ (within WHO limits). Monitoring should continue however after study of the plume dispersion pattern. The persistent cough of chronic lung disease, as far as it exists, is most likely a product of repeated infections and the growing use of cigarettes. It is possible that higher concentrations of dust may stimulate an attack of asthma on occasions, but it would constitute only one of several possible triggers for asthma attacks. Acute upper respiratory tract infections, exercise and stresses of other sorts will all be equally or more important.

Dusts may cause irritation of the upper respiratory tract producing a stuffy, runny nose and cough. This would be a particular problem during dry periods when concentrations of dust rise. However, these symptoms may also be caused by allergic reactions to plant pollens and mould spores. Pollens usually cause seasonal 'hay fever', whereas mould spores cause a more persistent pattern. In New Dapera we noticed considerable mould on the walls of some houses. Removal of this by cleaning could help reduce respiratory tract symptoms.

4.10.2 Noise

Noise is not a health hazard in the villages that we visited. In Moroni and Guava villages, and at the entrance to New Dapera one is conscious of a background hum of noise. Further into the valley at New Dapera, the houses are shielded from noise by the hill. Only in Pirurari and Leira did we ever find it difficult to hear what someone was saying or have to raise our voices in order to be heard. Those occasions were when a large truck was passing on the road, and were therefore only temporary. Such levels of noise do not cause damage to hearing.

In Guava, it was the children who were said to have trouble with hearing. We examined three children from one family who were apparently having difficulty hearing. All three had evidence of chronic nasal discharge. The youngest child had her external ears almost completely blocked with wax. The middle child had an infected eardrum suggesting a mild middle ear infection. The oldest child had very dull-looking eardrums indicating several previous middle ear infections. These are findings typical of children throughout PNG at present, and reflect the increase in upper respiratory tract infections already described.

4.10.3 Risk of arsenic poisoning from burning of treated timber

People at New Dapera have very little access to firewood from the bush and therefore use discarded timber from the mine as a source of fuel. This timber has previously been used for building and for pallets, and most of it, supplied locally by Bowman's, has probably been treated by dipping in a copper-arsenic-boron mixture to prevent destruction by pests. When such wood is burnt in a confined, poorly ventilated place this arsenic may be inhaled or later ingested with food that has been cooked over it. This may cause a chronic toxic effect in the body, especially on the nerves to the skin and muscles. Because of this risk, a public warning was placed in the local newspaper at the time of housing construction in 1976/77.

The extent of this practice among BCL's employees and the villagers at present is not known. It would be desirable for BCL staff to investigate the matter further and ensure that, if it is still a problem, warnings are given in such a way that the affected people can be sure of knowing.

5

DESCRIPTION OF CHANGES IN THE PHYSICAL ENVIRONMENT

5.1

INTRODUCTION

Section 2 of this Review described the area around the mine site as it was before mine construction and operation began. The subsequent changes to the physical, chemical and biological environments are addressed in the following sub-sections. The changes have been addressed largely as a result of specific concerns being made known to us by the villagers. Some of these were received in written form (Appendix VI). These issues were then investigated by us, as well as other issues which became apparent to us through our own observations, by means of reviewing work undertaken to date and by field investigations where time permitted. Further analysis of some questions is presented in Section 7.

The changes have been grouped as follows:

- (a) land occupation;
- (b) disposal of waste rock and tailings;
- (c) changes to the geomorphic environment (including changes to coastal and river characteristics);
- (d) changes to climate;
- (e) chemical changes in earth materials, water and air;
- (f) consequent changes in the biology of the land, sea and river.

Figures 3.1.1 and 3.4.1 refer to most of the mine components that have brought about these changes.

5.2

LAND OCCUPATION

Occupation of lands populated by approximately 3200 people from the villages at Dapera, Moroni, Isibokuna, Pirurari, Tapirima, Maimude, Latalasi, Kuneka, Namunta, Movigone, Mokerourai, Jaba and others is perhaps the single greatest change imposed on the physical environment of the people of the mine-affected area. Land is central to and inseparable from the life, culture and spirit of the people. It supports, by subsistence agriculture, cash-cropping, hunting and fishing, a large proportion of the population many of whom have lost virtually all their land. The impact of this is addressed more fully in Section 7, but we believe that grievances stemming from occupation and/or destruction of land are the real reasons behind many of the other disputes between the Company and the people whose land they occupy.

The following list gives the various components of the mining operation that physically occupy land:

- (a) open pit - at the time of this Review, the pit covers nearly 400 ha. Over the next 10-15 years it is expected that this area will increase to 560 ha. This area comprises ground which has physically been removed, leaving a large hole;
- (b) waste rock dumps - these have filled an area of approximately 300 ha in the Upper Kawerong Valley to depths of approximately 100 to 200 metres. Much of this area has now been occupied by mine buildings and other facilities;
- (c) tailings - these have covered or flooded an area of approximately 3100 ha. This is land which has been severely modified, lost most of its original values and is unlikely to regain them (see Section 7.3);

- (d) other areas - smaller areas have been occupied by the Port-Mine Access Road, the power station and port facilities, other Company facilities in the Pinei Valley, and by the town of Arawa.

These areas are occupied by BCL under a variety of leases granted by the National Government.

5.3 DISPOSAL OF WASTE ROCK AND TAILINGS

5.3.1 Landowners' concerns

Our investigations into the disposal of waste rock and tailings have been carried out with two objectives; firstly, to examine the operation in terms of currently accepted standards of environmental management and secondly to examine the operation in terms of the concerns expressed by the landowners.

The landowners' concerns regarding the physical aspects of the disposal of waste rock and tailings as expressed to us by a number of people at different times are summarised as follows:

- (1) the people have lost land;
- (2) the people have lost natural drinking and fishing waters;
- (3) the people have lost areas of forest which formerly provided vegetables, meat and timber;
- (4) deposition of tailings has blocked tributary stream channels which has caused the streams to flood land and the water table to rise in adjacent land so that the land becomes swampy;
- (5) tailings deposition has blocked, or made dangerous, access to the north bank of the Jaba River;
- (6) the waste rock dumps are unstable and may collapse, particularly during an earthquake;
- (7) the area occupied by tailings and waste rock is far greater than the people had understood it would be;
- (8) the area occupied by tailings extends beyond the boundaries of the tailings lease.

These concerns and other matters specified in the Terms of Reference of this Review are discussed in the following sub-sections.

5.3.2 Tailings

The greatest impact arising from waste disposal from the mine is generated by disposal to the river system of tailings from the concentrator. The tailings are a fine-medium sand and are discharged along with residual process chemicals at a rate which has increased gradually since 1972 and is now approximately 130 000 tpd.

The tailings have deposited in the Kawerong/Jaba river system and in a delta which has formed at the mouth of the Jaba River in Empress Augusta Bay. The

Company reports that approximately 40% of all tailings produced have been deposited in the river system, the remaining 60% forming the delta in Empress Augusta Bay. It appears that very little material has been transported away from the delta.

The sizing of the tailings is a critical factor in determining the location and quantity of tailings deposition. Obviously, if at some point in the river, flow or channel characteristics change so that the river can no longer carry all the sediment it did before, then it is the larger, heavier particles which will be deposited first. This process is the basis of the sediment transport model discussed in Section 6.3.

The sizing of the tailings varies according to the hardness of ore being treated and the grinding process used in the mill. In particular, the use of one or more mills to regrind the flotation residue to extract more copper produces much finer tailings which will be carried by the river at much lower flow velocities and gradients. The variability is difficult to predict reliably and is a major constraint on the reliability of prediction of tailings transport and depositions.

Tailings have been deposited to varying depths both onshore and offshore over a total area of approximately 4000 ha. The extent of deposition is still increasing and most of the tailings area is subject to periodic flooding or fresh deposition. Onshore, within the Kawerong-Jaba Valley, the fine overburden and tailings deposited in the river very quickly exceeded the transport capacity of the river system and began to deposit outside the original river channel. By the end of March 1972, 385 ha of low-lying land adjacent to the river had been affected by deposition and by the end of December 1974 approximately 1900 ha of the valley floor inshore from the original coastline was covered by tailings. The most recent information available to us (1988) indicates that approximately 3000 ha of the valley floor inshore from the original coastline is covered by tailings.

In addition to the onshore deposition of tailings a marine delta has formed in Empress Augusta Bay. The delta grew from 65 ha in March 1972, to 195ha in December 1974, and in 1988 is approximately 900 ha in size.

There has been some confusion over the position of the boundary of the Tailings Disposal Area. The area applied for and described in the 'Notice of Grant of Application for Lease for Mining Purposes' published in April 1971 is significantly smaller than the area within the surveyed lease boundary. Both are shown on Figure 3.1.1. The lease was granted 'subject' to survey which is the explanation given for this difference. The tailings depositing at the coast and forming the delta are outside the lease boundary by either definition.

Numerous side creeks have been blocked by tailings deposition; land has been flooded in flatter areas, and subject to elevated water tables. In the Jaba Valley below Bato and near old Kuneka we observed large areas where the forest trees and undergrowth were dying and being replaced by swamp vegetation (Photograph 8). We presume this is a result of the high elevated water table, resulting from both blockage of tributaries and the raising of the river's bed and banks by tailings deposition (see Section 5.6.1). The result has been further loss of land, bush and bush resources. Flooded land and induced swampy land provide barriers to access, suitable habitat for mosquito breeding (with associated problems of malaria) and have in many areas destroyed waterways previously used for drinking water, washing, recreation etc. It is not clear to what extent compensation is paid for these losses.

Access to the villages on the right bank of the upper Jaba Valley is obtained by walking across or along up to 2km of tailings, if the river is not in flood. Three footbridges in the Kawerong Valley provide access to the right bank in case of flood, and a single road bridge provides access to the right bank of the Jaba Valley at Bato (Photograph 9). However, the only practicable access up or down the right bank in the lower Kawerong or Upper Jaba Valleys in many places is to walk along the tailings.

We crossed the river in order to visit Pokunameri and found the tailings soft and slippery. A foot track along the right bank is now covered by tailings in many places and led to some very difficult crossings of the tailings. The surface layer was particularly soft and several times we found ourselves knee deep. In negotiating flooded land adjacent to the tailings we retained our footing in knee deep mud only by holding on to overhanging vegetation. In all respects it was easier and safer to cross the river directly and so avoid the worst of the soft areas along the edges. This is the access which the people who now live on the right bank below the bridged section of the Kawerong River use to reach Panguna or Arawa, for access to schools and markets.

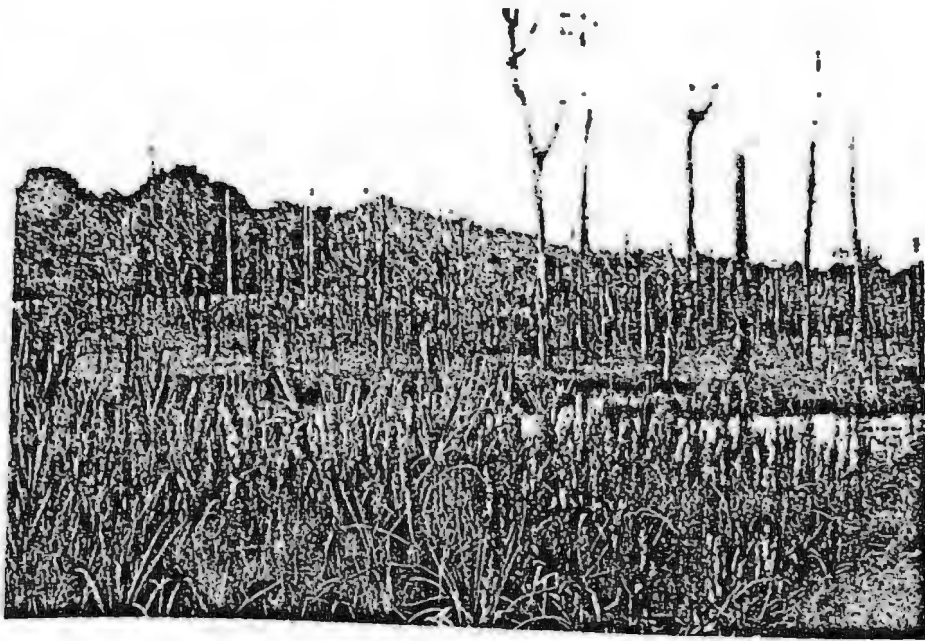
5.3.3 Waste rock

The waste rock produced by the mining operation is dumped in engineered waste dumps in the upper Kawerong Valley in accordance with the agreements discussed in Section 3.3.2. Our terms of reference do not require us to conduct a technical evaluation of the stability of the waste dumps and we have not done so. We understand that the Mines Inspector from the National Government describes the BCL dumps as a model situation and has advised other developers to learn from the example set by BCL. The Government is quite confident that the dumps are sufficiently stable as not to be dangerous.

In order to describe and evaluate the environmental impact of the dumping operation the materials can be classified into three groups:

- (a) superficial materials - these comprise the soils and weathered rock near the ground surface which, on their own, are not strong enough to form secure dumps. This material was formerly discharged into the Kawerong River but is now placed in the dumps in such a way that stronger materials will provide confinement and support;
- (b) truck waste - this comprises strong waste rock which is taken directly to the dumps from the pit;
- (c) conveyor waste - this is material rejected from the pre-concentration plant, after crushing and screening. It is very strong, hard and of a fairly uniform size (minimum size about 100-150mm). It contains very little fine material and is highly permeable.

Until 1982 the superficial material was dumped in the Kawerong River where much of it deposited and contributed substantially to sedimentation problems throughout the Kawerong/Jaba river system. A large volume of the dumped material is still lying in the bed of the Kawerong River, where it is mixed with tailings. This material is a potential source of readily available sediment and is mobilised by the river during floods and during periods when tailings are not discharged to the river. The tailings and waste rock component of the mixture contributes dissolved copper to the river system (see Section 5.7).



Photograph 8

Dead forest vegetation and induced swampiness as a result of raised water table levels near old Kuneka



Photograph 9

Sole road bridge at Bato providing access to right (northern) bank of Jaba River

The original proposal for location and size of the waste rock dumps is contained in a report prepared by BCL and submitted to the Administration in September 1970. We have been unable to locate a copy of that report but we understand from BCL staff that the report is the same as a report prepared for BCL by Bechtel in August 1969. The proposal described in the Bechtel report is for a flat-topped dump at a maximum height of 580m. The area to be occupied by the '33 year' dump (that is, the dump at the end of mine life) was about 470 ha, with the '20 year' dump to occupy about 390 ha. In 1988 after 16 years of operation the dumps occupy about 300 ha at heights between 550m and 760m. The presently planned 'end of mine life' dump will occupy about 550 ha, about 17% more land than was originally proposed.

It is not possible to make definitive statements about the waste rock and tailings disposal practices of BCL in terms of internationally accepted environmental management. This is primarily because there is a considerable range in current management practices and because many older operations, commenced under less conservative regulatory regimes, are still operating. We can however state our own opinion of the present disposal systems.

Waste rock disposal is typical of that permitted in many modern mines worldwide although modern systems would usually incorporate more demanding leachate collection and control. The location and structure of the dumps is such that we were initially led to question their overall stability, particularly under earthquake shaking. However, we accept the professional opinion of the Mines Inspector and BCL's own engineers that the waste rock dumps are stable and that the risk of collapse of the dumps is insignificant.

Tailings disposal of this type on this scale is now an outmoded system. Even at the time mining commenced it was questioned, as evidenced by consideration being given to tailings stacks on land. It seems unlikely that approval for the present system would have been given at commencement if investigations of the extent and location of tailings deposition made at that time had been more thorough and the present extent of deposition predicted.

5.3.4 Pinei Valley

Substantial earthworks in the headwaters of the Pinei Valley caused heavy sedimentation in the river and resulted in changes to its course. Land was occupied by the roadway and its often substantial batters and side dumps. Garden land was buried and villages relocated.

Siltation in the upper Pinei River continued over many years as the road cuts and dumps stabilised and throughout the length of the river to the coast sediment was deposited. The river channel has now stabilised although in a different course over some stretches. The batters, side dumps and riverbank have been substantially revegetated.

5.3.5 Summary

In terms of the landowners' concerns listed in Section 5.3.1 we believe they have correctly identified the environmental changes and the consequences of them with the exception of stability of the waste dumps. Land, natural waters and forest resources have been lost. Tailings deposition has caused flooding and waterlogging of adjacent land and has destroyed or made dangerous access to the north bank of the Jaba and lower Kawerong rivers.

The tailings and associated flooding occupy approximately 700 ha outside the 1971 lease application boundary but within the surveyed boundary. Overall we believe the nature and scale of the effects of tailings disposal are well beyond what the people of the Kawerong and Jaba valleys could have imagined prior to the start of operations and are certainly beyond what BCL predicted and the Administration accepted at the commencement of mining.

We must note, however, that BCL and possibly the National Government believe that the losses suffered as a result of the disposal of tailings and waste rock have been adequately compensated. Compensation is discussed in Section 4.8 of this report.

5.4 CHANGES IN RIVERINE MORPHOLOGY

5.4.1 Pre-mine river morphology

Little detailed information is available on pre-mine river morphology in the way of aerial photographs and geomorphic survey. At the time of report writing, pre-mine imagery of the Kawerong-Jaba system was not available for analysis. What follows is based mainly on details presented by Scott and others (Ref.21) and comparisons of the Kawerong-Jaba system with adjacent fluvial systems.

The upper Kawerong Valley was characterised (as it still is) by steep (25°-35°) bouldery channels up to 6-7m wide with fast flowing streams in times of runoff. Most contributions of material to the channel were from processes occurring on the hill slopes in the form of surficial erosion and mass movement. Streams in the upper Kawerong Valley were actively incising. The area between the upper Kawerong and the Kawerong-Jaba confluence was characterised by low gradient streams flowing on a bouldery bed with a well developed pool-riffle system. This sort of situation can still be seen in the Jaba River above the Jaba Pump Station. Associated with the bouldery channel would have been small flood terraces composed mostly of material finer than the channel bed.

Below the Kawerong-Jaba confluence both river systems opened into a broad alluvial plain characterised by a very low gradient river bed with rapid sorting of material occurring with distance down the valley. In its lower reaches the Kawerong-Jaba system represented a good example of a lowland tropical river with large areas of swamp, a wide meandering channel with narrow point bars, and occasional natural levees. Bed material would have been predominantly sand to gravel size. Areas adjacent to the wide meandering low gradient channels were naturally swampy and subject to frequent flooding. Characteristic of this wide (up to 1.5km) floodplain were relict meander scars and cut off meanders. The Kawerong-Jaba system exited to the ocean through a series of low beach ridges. The Jaba River mouth had a small but insignificant delta.

Sediment yield was low, most sediment transported to the coast being in the sand to silt size range. The low sediment budget of the Kawerong-Jaba system is exhibited in the small size of the old Jaba delta which showed little signs of active progradation.

5.4.2 Present river morphology

The most dramatic changes to riverine morphology have occurred below the Kawerong-Jaba confluence. Above the confluence the original morphology of the Kawerong River is still preserved. However, following stripping of waste rock

and direct dumping into the Kawerong River, the channel of the Kawerong River rapidly built up. When dumping of the waste rock stopped and the nature of material input to the upper Kawerong system changed there was some incising through the prograded bed and a series of terraces formed in the waste rock material (Photograph 12). The Kawerong River is actively cutting into the waste rock material and has almost reached its original bed.

Presently erosion of the bed and banks is occurring in the upper Kawerong River above the mine pit tunnel exit point. Below this point active deposition of tailings material continues. The most dramatic deposition has been near the Kawerong-Jaba confluence where changes in bed level of up to 30 m have occurred at the cross-section. Such rapid and unexpected build-up has resulted in the need for a levee system (Photograph 6) to be constructed to retain the river within the mine lease boundary.

In coping with increases in sediment, the Kawerong-Jaba system has changed from a single thread, well-defined channel to a braided channel network with an unstable channel pattern. Channel bed material is now characterised by fine sand to silt in the area of the Kawerong-Jaba confluence. This contrasts with the former channel bed material of sand, gravel and small boulders comprising well-defined pool-riffle systems. The water has both a high suspended sediment load and a significant bed load. Standing wave patterns on the water's surface indicate that the channel bed is highly unstable.

In the area below the Bato River bridge the channel no longer possesses its original meandering form but presently exists as a broad braided network up to 1.5km wide. The channel bed now overlies its former floodplain in this area and also lies higher than the surrounding area.

In the Kawerong-Jaba system below the Kawerong-Jaba confluence there are still some areas where the channel is confined. Such areas downstream of the original broad open alluvial valley floor have been modified and used as damming sites to create sedimentation basins. In the largest of these basins between the Kawerong-Jaba confluence and Mananau, the active area of sedimentation has increased in width by over 20 times compared to the pre-mine river depositional area. It is within this area that channel bed level changes have been the greatest.

In summary, the impact of tailings input to the Kawerong-Jaba system has been, in geomorphic terms, dramatic. The channel, because of rapid build-up, is presently oversteepened and highly turbulent flow is maintained most of the time. Retraining the river to its former shape and size will depend on reducing the channel slope to allow a single thread channel to develop. This may be difficult as the imposition of engineered drop structures in the highly unstable Kawerong-Jaba system may be unproductive and create further instability.

5.5 CHANGES IN COASTAL MORPHOLOGY

5.5.1 Pre-mine coastal morphology

Empress Augusta Bay is characterised by a formerly prograding (outwardly-building) coast formed of subparallel beach ridges of sandy volcanic detritus. Separating beach ridge crests are swales of 70-100m width. The area beside the former Jaba outlet is characterised by a small vegetated delta.

Inspection of the coast north and south of the Jaba River indicates that in the pre-mine period the Jaba River probably had a small spit and bar system similar to that presently developed at the mouths of other rivers draining into Empress Augusta Bay. Sediment delivered to the coast would have been transported to the north. Rates of coastal progradation immediately before the mining operations began would have been negligible compared with the rates of beach ridge construction covering 100km² over the last 6000 years.

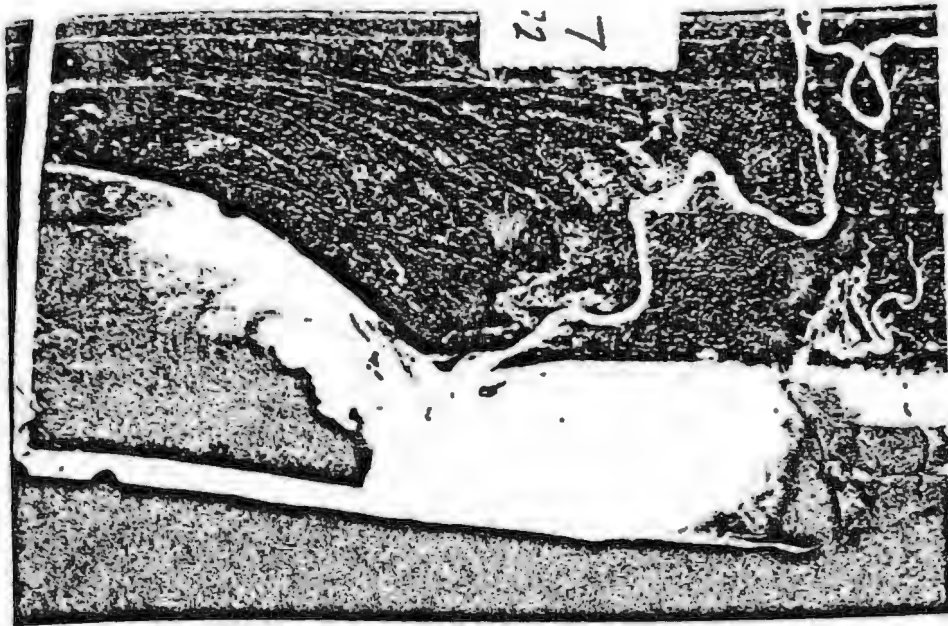
5.5.2 Present coastal morphology

The large inputs of sediment to the Kawerong-Jaba system from the development of the mine have had a dramatic impact on the form of the coast. Prior to the mine commencing the Jaba exited to Empress Augusta Bay north of the present delta (Photographs 10 and 11). However, the large inputs of volcanic ash and soils to the Kawerong-Jaba system as a result of stripping waste rock caused the shoreline to build up rapidly, immediately north of the old Jaba mouth. Inspection of this area of progradation revealed that it is composed of three to four low beach ridges each separated by a small swale of about 10m width. A section dug through the back part of the beach in this area revealed distinct layers of volcanic ash detritus derived from stripping of waste rock.

Following waste rock stripping and commencement of tailings input to the Kawerong-Jaba system, the Jaba River was re-routed in its lower reaches to a more direct course to Empress Augusta Bay. The massive input of tailings into the Kawerong-Jaba system resulted in deposition at the mouth of the Jaba River in the form of a large delta presently covering an area of approximately 970 ha.

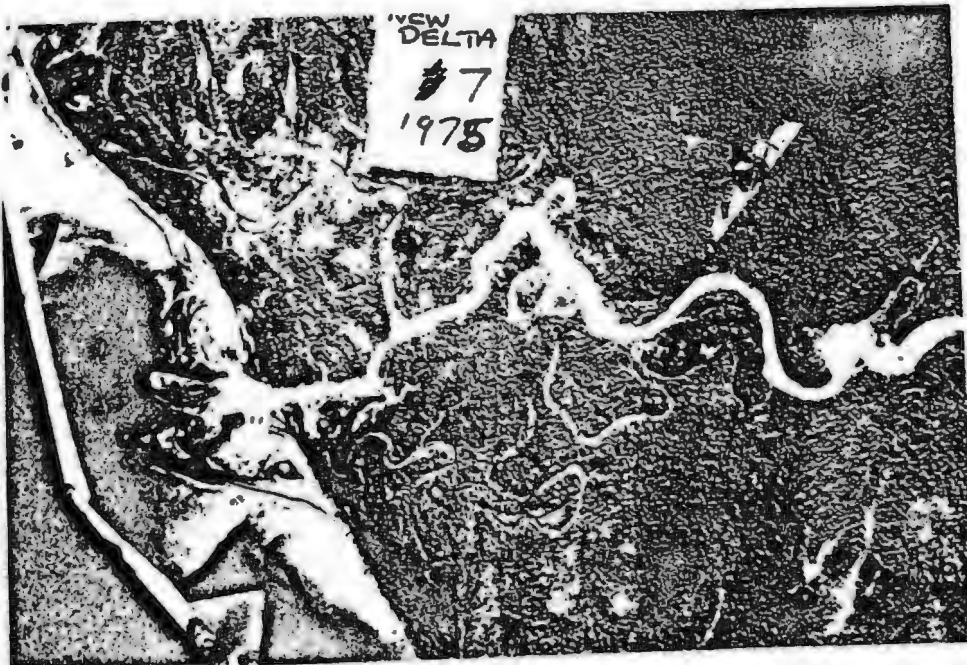
North and south of the delta, the form of the coast still resembles that of the pre-mine situation. Beach slopes are steep varying from 1:3 to 1:6. Some building out of the shoreline is occurring at various locations as indicated by active colonisation of small new beach ridges. However areas of erosion are evident at other locations in the Empress Augusta Bay north and south of the Jaba delta. This can be seen by active scarping of the shoreline, with the sea in places cutting back into areas of lowland coastal tropical forest. In these areas trees falling on the shoreline are a clear indicator of active sustained erosion. Evidence of erosion scarps in back beach locations suggests that episodic events are functional in moving large amounts of material offshore. However following the erosional events natural renourishment of the beach seems to occur.

It is not possible to establish quickly present coastal processes in detail and we have undertaken no investigations of them. However, Reidel and Byrne (Ref. 22) have conducted some preliminary work in Empress Augusta Bay which does shed some light on present coastal processes. Sediment transport rates have been calculated for nine sites in Empress Augusta Bay and show a net northward drift of sediment. However some variation in direction and volume of sediment transport occurs with sea state. For sea waves (storm waves) sediment transport is southward at locations between the Saua and Reini and Reini and Taugarunga rivers. Sediment transport is also southward immediately south of the Jaba delta and north of Nama River. Under swell conditions (long wavelength, long period) sediment transport is northward except on the southern side of the Jaba delta. The highest rates of sediment transport occur at the Jaba delta due to the finer sized sand and flatter beach slopes. Delta shoreline orientation will also be effective in increasing the angle of wave attack thus increasing sediment transport rates at this site. Refraction of waves around the delta may



Photograph 10

Jaba River mouth and delta in 1972, pre-mine



Photograph 11

New exit and delta formed by Jaba River by 1975 after mine waste discharge commenced. Note old river channel and mouth (1972 route) towards top of photograph

cause a concentration of wave energy at sites north and south of the delta with associated implications for erosion. The degree of delta induced wave refraction will increase with delta growth.

5.5.3 Future coastal morphology and processes

The Jaba delta will continue to grow and be the predominant coastal feature in the area of the Jaba River. This will occur due to erosion of the channel bed of the Kawerong-Jaba system and the proposed deposition of tailings by pipeline in the nearshore coastal area of the Jaba River mouth. This will have significant impacts on coastal processes. We believe that wave refraction around the Jaba delta area is likely to intensify causing increased erosion on the coast north and south of the Jaba delta. This is in contrast to the suggestion by Reidel and Byrne that continued delta growth will have little effect on coastal processes although increased erosion is considered a possibility by them.

A critical area for the future development of the Jaba delta and coast is the effect of the proposed tailings stacks and associated sediment movement on the proposed new mouth of the Jaba River. We believe there is currently insufficient information available to make reliable predictions about the long-term viability of the proposed new Jaba mouth.

Before a full statement can be made on likely changes to coastal processes and morphology a full assessment of a range of bathymetric physical processes needs to be made. Further, implicit in the work undertaken to date concerning predictions of future coastal processes has been the assumption of a relatively static long-term sea level. This may be inappropriate given the mounting evidence that climatic warming by the year 2050 may result in a sea-level rise of 20cm. If this occurs, it will have implications for the behaviour of tailings sediment, shoreline erosion rates and the flood hydrology of the lower Jaba River. To date a rising sea level has not been planned for or taken into consideration as far as the future behaviour of the Jaba River delta and the feasibility of an offshore tailings disposal scheme are concerned.

5.5.4 Conclusion

We believe that before statements concerning future coastal processes can be made the contemporary processes need to be thoroughly understood. An empirical study detailing the interaction between the present day wave climate and the bathymetry of Empress Augusta Bay needs to be commissioned. This will necessarily involve a detailed bathymetric survey with special attention being given to the Motupena Point and Jaba delta areas and the establishment of a regular if not continuous wave climate recording programme.

No comparison has been made between computed and measured coastal sediment transport rates. An evaluation needs to be undertaken of the suitability of the sediment transport formulae and results for modelling current sediment transport rates. An active field programme therefore needs to be commissioned to establish the magnitude of present sediment transport rates both onshore-offshore and alongshore given a variety of meteorological conditions.

An evaluation of the likely impact of sea level rise on coastal processes with respect to the offshore disposal site and Jaba delta needs to be made. A rising sea level will have implications for shoreline erosion rates and the inundation of the coastal zone and perhaps remobilisation of delta sediment and river mouth choking.

5.6 CHANGES IN THE HYDROLOGY AND CLIMATE OF THE KAWERONG-JABA VALLEY

5.6.1 Hydrology

Little analysis has been performed to date to establish if changes in runoff have occurred with mine development. The opportunity for good comparative studies of runoff characteristics for non-disturbed and disturbed catchments exists given the hydrological data collected to date (see Section 6.2). Surface disturbance is likely to have resulted in an increase in runoff volumes in the upper Kawerong Catchment and an associated increase in the magnitude of the mean annual flood. Basin lag times have undoubtedly decreased in the upper Kawerong due to channelisation of drainage and the creation of large areas of impermeable surfaces.

Rapid build-up of the channel bed of the Kawerong River following dumping of waste rock direct to the Kawerong Valley resulted in the blockage of tributary streams draining the Kawerong valley sides. It has been reported that this blockage has caused flooding in villages adjacent to these streams on the lower slopes of the Kawerong Valley opposite and upstream of the pit drainage tunnel exit. However, due to the Kawerong River now cutting down through the overburden material (Section 5.4.2) the tributary streams have adjusted to near their former base level, thereby reducing the flooding problem.

However, increased flooding has become a problem below the Kawerong-Jaba confluence. This is related to both an increase in the area of swamps and an increase in backwatering effects from the combined Kawerong-Jaba flow. Swamp areas have been created by damming tributary valleys either by active tailings deposition or levee construction as noted in Section 5.3.2. An extensive area of such a swamp exists on the southern side of the first tailings sedimentation basin. In this area tributary streams have been blocked from entering the main valley in most cases by the construction of the levee (Photograph 6), resulting in large areas of ponded water stretching several hundred metres back up the tributary valleys. Some attempts have been made to release the drainage from these areas but drainage points have been blocked off by tailings deposition. The impact of these large ponded areas on the vegetation has been dramatic with large areas of tree kill as shown in Photograph 8). Insufficient time was available to us to establish whether or not areas of swamp have encroached on land outside the mine lease area but it appeared that this is a distinct possibility.

There is evidence of increased areas of swamp on the northern side of the Jaba River adjacent to both the first and second sedimentation basins. Significant increases in the areas of swamp have also been noted on the northern side of the Jaba River below the Bato River bridge. In this area increased areas of swampiness can be seen by an advancing front of dead trees due to high water tables away from the river and a gradual encroachment on the alluvial plain forest of a swampy grassland community.

In summary, we consider the impacts of mine development on the hydrology of the Kawerong-Jaba Valley and tributary valleys as significant. This is especially so with reference to the proliferation of areas of valley side swamp adjacent to the first and second sedimentation basins. Although time did not permit an in-depth analysis of runoff records, on conceptual grounds increases in runoff volumes and the mean annual flood and a decrease in basin lag time for the Kawerong Valley are strong possibilities. These impacts, especially flooding

and backwatering effects in tributary valleys, need to be quantified and addressed.

5.6.2 Climatology

We consider that changes of the climate of the Kawerong-Jaba Valley due to mine development are likely to be negligible. The only significant changes in climate are likely to be restricted to the micro-scale level.

Some concern was expressed by landowners in the Kawerong-Jaba Valley that rainfall has changed since mine development. The nature of change however was not specified. A brief analysis of the inter-annual variability of rainfall for Panguna was conducted to determine whether there had been any noticeable changes in rainfall since 1969 (Figure 5.6.1). Plotting of the departure of annual rainfall from the long-term mean at Panguna shows that rainfall at Panguna is highly variable from year to year. Significant features revealed by the plot are the very wet years of 1969 and 1972 and a succession of below average years from 1973 to 1975. Comparison of the inter-annual variability of rainfall as recorded at Panguna with other locations throughout PNG reveals convergent temporal patterns of rainfall variability. This shows that rainfall at Panguna is largely controlled by the same meteorological controls or components of the tropical atmospheric circulation that determine rainfall variability elsewhere in PNG. Mine development has therefore had no impact on rainfall quantity.

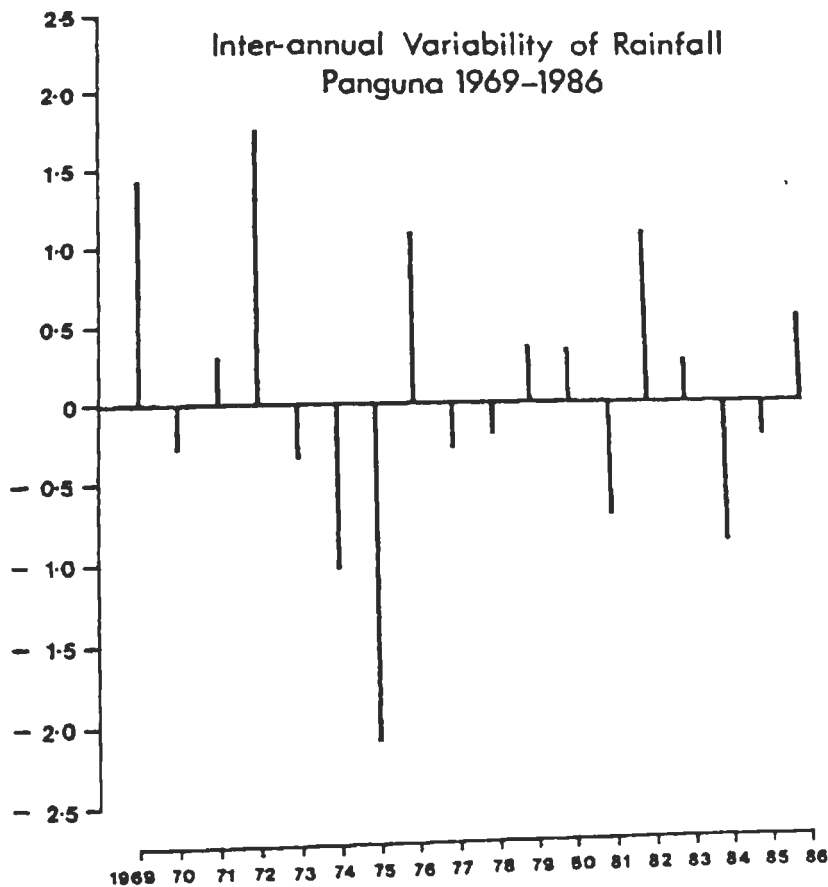


Figure 5.6.1.

5.7 CHEMICAL AND BIOLOGICAL CHANGES

5.7.1 Landowners' concerns

The concerns expressed to us by the landowners (Appendix VI) formed the initial basis for our investigations. In this section we present our summary of their concerns and then describe the results of our investigations into the mining activities which involve chemical emissions and into the changes which have been observed in the environment influenced by the mine operation. Our conclusions in this section are based primarily on our own investigations, but for some issues it was necessary for us to examine studies done by BCL (Section 6) before forming an opinion. In Section 7 the concerns raised by the landowners together with other issues which we identified are examined again and we identify those issues which require further consideration.

The landowners' concerns relating to chemical and biological effects are summarised below:

- (a) low productivity and disease in subsistence and cash-crops;
- (b) loss of forest timber, dying trees and the introduction of foreign plants;
- (c) poisoning of the soil by chemicals, dust from blasting and other mine activities;
- (d) chemicals in the tailings and contamination of river water;
- (e) loss of freshwater and marine fish, shellfish, and disease of marine fish;
- (f) disposal of chemical wastes from the mine, and the use of defoliants.

As a basis for addressing these concerns we have assessed the possible ways in which these may come about. The following sub-sections therefore address aspects of the mining operation that have bearing on these concerns.

5.7.2 Chemical emissions

5.7.2.1 Chemicals leaving the mine

Chemicals leave the mine in both solids (such as tailings) and in solution (waste rock leachate, tailings slurry water, concentrate slurry water and pit drainage). Some of the chemicals such as copper and cadmium originate from the ore body and waste rock, others are process chemicals added to extract the copper and gold, and yet others come from the many small associated wastes such as sewage, smoke, fertilisers and defoliants. Each of these is addressed in the following sub-sections.

As a focus for this discussion the mine operation is considered as three components: the pit, the process and the port. For each of these the chemical emission/biological impact relations were identified. These are dealt with in each of the following sub-sections.

5.7.2.2 Waste rock leachate

The waste rock is deposited into dumps which are open to the entry of water and oxygen. These ingredients cause oxidation of the sulphide present in the waste rock and result in the production of acid. This process proceeds initially by a chemical reaction in which oxygen and water attack iron sulphide pyrite to produce acid and soluble reduced iron. As this process continues more acid accumulates until eventually conditions become suitable for a bacteria to grow in the acid environment. This bacteria (Thiobacillus ferrooxidans) uses the soluble

reduced iron for part of its energy requirements and in so doing produces soluble oxidised iron (this oxidised iron remains soluble because of the acid conditions). The soluble oxidised iron then reacts very quickly with more pyrite to accelerate greatly the accumulation of more acid and more soluble reduced iron. The bacteria respond to this by growing and multiplying.

The acid produced by this process drains through the dumps and dissolves other minerals, in particular lime and other reactive minerals containing calcium and magnesium, but also other metal sulphides, mostly the copper iron sulphide which is the ore mineral. As these minerals are dissolved, the acid is removed from the drainage so that when the water flows out of the dump it is a mixture of mostly calcium, magnesium, copper and acid; all of these are in the form of sulphates which is the chemical form of sulphides after it has dissolved in the dumps. The amount of each of these substances remaining in the dump leachate depends on how much lime, other calcium and magnesium minerals, and copper iron sulphides have been contacted by the water, how much acid the water had originally, and how long the water was in the dump. The final composition can range from entirely acid with no calcium, magnesium or copper, through to no acid with the maximum amount of calcium, magnesium and copper. The dump leachate at Panguna is almost to this latter state.

This description of the production of acid leachate containing copper suggests several consequences:

- (a) if the dumps contain more sulphide than lime (or other minerals which react with acid) then the drainage will be acid;
- (b) the dumps will produce acid leachate containing copper until all the available sulphide and copper is dissolved ('available' in this context means in contact with flowing water);
- (c) if the rate of acid production and copper leaching can be accelerated then the dumps will produce acid drainage containing copper for a shorter time;
- (d) if the amount of water flowing into the dumps is decreased, the dumps will leach copper at a slower rate for a longer time.

Our observations (and BCL's monitoring programme discussed in Section 6.4) indicate that significant concentrations of copper are presently leaching from the waste dumps (Photograph 12). This copper flows into the Kawerong River where it mixes with the tailings discharge which is alkaline because of added lime. Under these conditions copper is likely to precipitate and some of this precipitate will deposit in the two main tailings sedimentation basins. The remaining precipitate suspended in the flowing water will eventually be flushed into Empress Augusta Bay. The precipitate may dissolve in sea water and release soluble copper.

There is apparently a little more than 800 000 tonnes of copper retained in the waste rock dumps and at the present rate of leaching (about $0.6 \text{ m}^3/\text{s}$ at 70 mg/L of copper), the dumps will take about 600 years for complete removal of all the copper. This is a simplistic calculation because firstly, not all the copper will be available for leaching (some will not be in contact with the flowing water), and secondly, as the amount of copper available for leaching decreases, the concentration in the leachate will also decrease. The physical structure and location of the dumps indicate that the total water available to flow through the dumps is unlikely to increase much above the present amount.

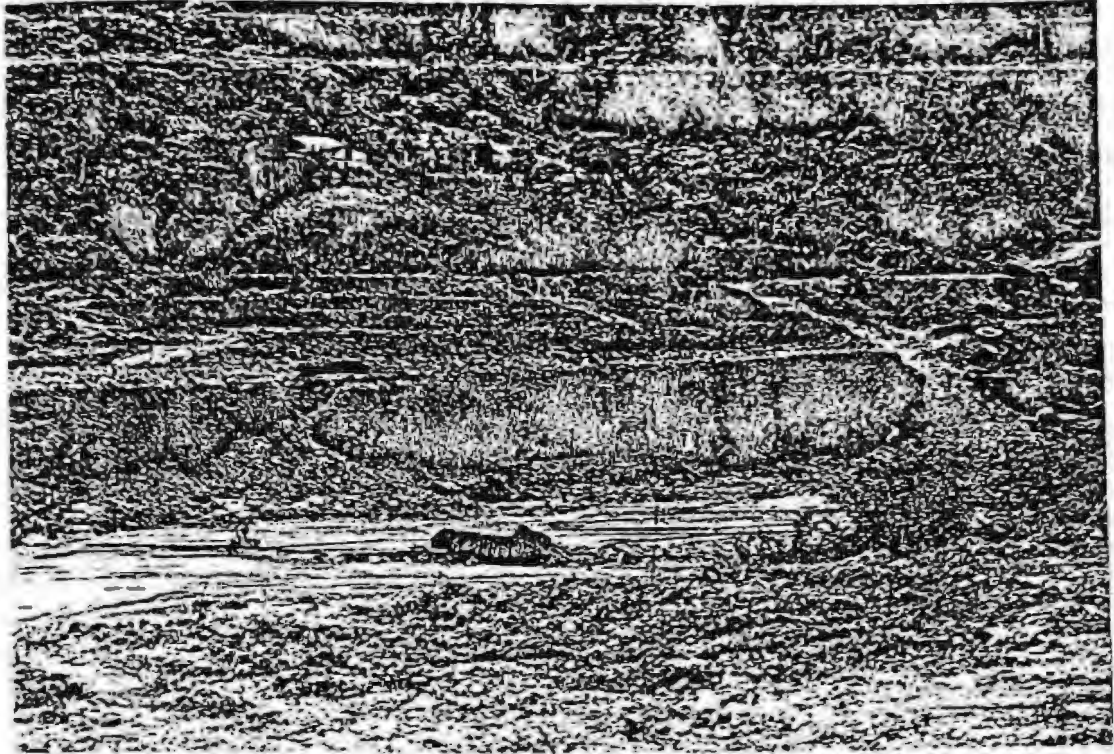
Revegetation of the dumps is one of BCL's long-term objectives and if this is successful then the rate of copper leaching will be slowed because the flow of both water and oxygen into the dumps will be reduced. This would mean that a much longer time would pass before all the copper and acid leached out of the dumps. An alternative, to increase the rate of leaching to dissolve out the copper at a faster rate, could be the basis for a process to recover the copper as a valuable product. This would have the advantage of lower copper concentrations in the leachate after the end of expected mine life. The implications of these alternatives are discussed in more detail in Section 7 after BCL's work is examined in Section 6.

The major components of the waste rock leachate are calcium, magnesium, sulphate and copper. The first three are substances found in virtually all natural waters and the concentrations in the Kawerong River water including the contribution from the waste rock leachate are not hazardous to people, plants or animals. This is not the case for copper which although it is not considered to be a particularly toxic metal, it can like most substances be harmful to people in high concentrations. The World Health Organisation (WHO) guideline for drinking water is 0.05 mg/L but this is only a 'highest desirable' level (Ref.23). Many domestic water supplies using groundwater and copper pipes for reticulation contain copper at higher concentrations (such as 3 to 5 mg/L). At concentrations above about 5 to 10 mg/L, copper in drinking water can cause temporary illness as the body rejects the excessive amount. However, as a general rule, no longer term health effects result from an isolated incidence such as this. It should be remembered that copper, and also iron, zinc and some other metals are required in small amounts by our bodies.

From our assessment, we can confidently say that the concentrations of soluble copper in the waters of the Jaba River and of Empress Augusta Bay are not a hazard to people. On the other hand, acid leachates from isolated spots in the tailings and from the waste dumps, and also the blue copper precipitates seen in some drainage channels from the tailings (Photograph 13) would cause sickness if they were consumed.

Unlike the effect of copper on people, copper can be quite toxic to plants and aquatic animals. However, its toxicity to fish depends on the chemical nature of the water. If the water is alkaline (as in the Kawerong River, the Jaba River above the pumphouse and the Pangara River) only a small proportion of the total soluble copper is in toxic forms. As the water becomes more alkaline it can contain more total soluble copper without being more toxic. For example, for the present water quality of the Jaba River at Cross-section 16, the United States Environmental Protection Agency (USEPA) water quality criterion (four day average) for the long-term protection of aquatic life (including fish) would be about 0.012 mg/L (Ref.24), four times higher than the measured concentration of 0.003 mg/L (Ref.25). In the Jaba River upstream of the pumphouse, which is more acid than the Jaba River at Cross-section 16, the USEPA criterion would be 0.0065 mg/L. The latest measured value was 0.001 mg/L (Ref. 25).

The toxicity of zinc to aquatic animals is similar to that of copper but because the quantities of zinc added to the Kawerong/Jaba River system are less than 10% of the quantities of copper, and because soluble zinc is distributed among several forms of varying toxicity (as discussed for copper) it appears unlikely that zinc presents any hazard to aquatic life in the Kawerong/Jaba River system. For example, the concentrations reported in the Jaba River waters are less than 0.005 mg/L (DOTA reports) whereas the USEPA water quality criterion for the Jaba River water is about 0.047 mg/L (24 hour average - Ref. 26).



Photograph 12 Copper leaching from waste material



Photograph 13 Copper leachate in tailings drainage

Copper, zinc and aluminium (another metal leached from the waste rock by acid) are toxic to plants, and although the concentrations of zinc 'available' to be taken up by plants growing on the waste rock are probably too low to be hazardous to plants, available copper and aluminium are likely to limit plant growth severely on the fresh waste rock.

There are other metals in the waste rock leachate. In any discharge, from agriculture, industry or mining, the concentrations of the toxic metals (arsenic, cadmium, mercury and lead) must be examined. Table 5.7.1 presents the concentrations of some of these metals in the waste rock leachate. The average concentration of arsenic is given as 0.031 mg/L (based on limited data). The present (and future) flow of leachate is about 0.6 m³/s and the flow in the Kawerong River is about 5 m³/s so that the leachate is diluted eight times immediately it enters the river. The arsenic concentration is therefore about 0.004 mg/L in the Kawerong River. This is less than the WHO's guideline for drinking water of 0.050 mg/L (Ref.23), and the USEPA water quality criterion for protecting aquatic life of 0.190 mg/L (as a 4 day average) (Ref.27). The arsenic concentration in the Kawerong River is well below these criteria and is not of concern for either health or environmental reasons.

Table 5.7.1 Concentrations of chemicals in the waste rock leachate, as measured at Site KR2 (existing outflow) 1976-1985 (Source: Ref.16)

Component	Concentration
pH	5.2
Aluminium	2.0
Calcium	215
Iron	0.15
Magnesium	113
Manganese	13
Sodium	20
Chloride	5
Fluoride	1
Sulphate	1150
Silver	<0.010
Arsenic	0.031
Cadmium	0.028
Copper	70.00
Mercury	0.0008
Lead	0.0036
Zinc	3.22
Selenium	<0.010

* All concentrations in mg/L except pH.

Cadmium concentrations average 0.028 mg/L in the leachate and with dilution in the Kawerong River the concentration could be about 0.003 mg/L. Cadmium (and also zinc) changes its chemical form when it moves from acid (as in the waste dump leachate) to alkaline conditions (as in the Kawerong River). This is a similar process to that described for copper. The effect of these changes is

5.13

to reduce the concentration of the more toxic forms of cadmium. For example, 0.003 mg/L of cadmium in a slightly acid water is more toxic than is 0.003 mg/L of cadmium in slightly alkaline water. The precise effects of these changes that cadmium may undergo in the Kawerong and Jaba rivers are difficult to estimate accurately but the concentrations of the toxic forms are likely to be less than the total concentrations in the river water. The USEPA water quality criterion (Ref.28) for the protection of aquatic life is 0.001 mg/L (4 day average) for the water quality of the Jaba River downstream from the pumphouse. The WHO guideline (Ref.23) for drinking water is 0.005 mg/L. On this simple comparison the USEPA criterion will be exceeded.

Concentrations of lead in the ore are low and this is reflected in the very low concentrations found in the waste rock leachate. After dilution in the Kawerong River the total lead concentration due to the waste rock leachate is only 0.0003 mg/L. In the Jaba River water over the tailings the USEPA water quality criterion (Ref.29) is about 0.003 mg/L total soluble lead.

Mercury concentrations are also low in the waste rock leachate and after mixing the leachate into the Kawerong River water, the concentration is about 0.00001 mg/L. The WHO guideline (Ref.23) for drinking water is 0.001 mg/L and the USEPA water quality criterion is 0.000012 mg/L.

On the basis of these comparisons between international water quality criteria and the concentrations predicted to be in the Kawerong River water, levels of neither lead nor mercury in the Kawerong and Jaba river waters are dangerous to people, animals or plants. Cadmium at a measured level of <0.001 mg/l is also not dangerous to people, animals and plants in the Jaba, but in the Kawerong it (like copper) could be toxic to aquatic animals because the predicted concentration limit is higher than the USEPA criterion. However, some question remains about cadmium because the predicted concentration limit is presently higher than the USEPA criterion.

None of the other substances measured in the waste rock leachate will be dangerous to people, plants or animals after the leachate mixes into the Kawerong River.

It should be emphasised that this assessment is not relevant in the existing circumstances because until the Jaba River becomes acceptable to fish and other aquatic animals the waste rock leachate has little impact on biology (except in Empress Augusta Bay). Also by the time the Jaba River becomes acceptable to animals, the waste rock leachate may contain much lower concentrations of metals than it does now.

5.7.2.3 Tailings solids and liquids

The average composition of the ore is given in Table 5.7.2 and the components of the tailings are given in Table 5.7.3.

Table 5.7.2

Composition of ore

Rock type		Cu	S	Rb	Ba	Sr	Pb	Zn	Ni	Co	V	Cr	Zr	Y
Panguna andesite	Altered (3)	4500 (15)	5600 (12)	29	329	565	6	97	14	35	258	102	81	21
	Fresh (3)	358 (8)	660 (5)	10	103	533	9	67	15	28	326	62	87	25
Kawerong quartz diorite	Altered (7)	1500 (17)	6100 (10)	43	236	638	5	49	6	17	130	10	109	16
	Fresh (3)	236 (8)	300 (5)	28	429	771	10	139	8	14	115	11	133	19
Leucocratic quartz diorite	Altered (3)	4100 (15)	3300 (12)	35	134	566	2	34	4	17	83	31	91	10
Biotite granodiorite	Altered (5)	1350 (22)	3650 (17)	42	264	614	4	42	6	12	84	11	86	10
Biuro granodiorite	Altered (2)	1000	4100	-	-	-	-	-	-	-	-	-	-	-
	Fresh (5)	133 (7)	500 (2)	23	353	702	4	39	7	12	62	12	101	11

Notes: Bracketed numbers indicate numbers of analyses averaged. More analyses are available for Cu and S than for other trace elements.

Table 5.7.3 Components of tailings

Property	Value	Property	mg/L	Property	mg/L
		Ba	321	Mo	11
Si	28.8%	V	170	As	3.6
Al	8.1%	Cr	167	Ag	0.43
Fe	4.6%	Zn	73	Au	0.18
Na	2.9%	Bi	21	Cd	<0.5
Ca	2.5%	Se	10	Hg	0.002
Mg	2.1%	Co	16	Cu	890
K	2.0%	Pb	7.3	Cl	590
Ti	0.39%	Te	10	F	600
P	0.09%	Ni	33	Mn	490
S	0.34%			Sr	380

The process used at Panguna for recovering copper from the ore requires several chemicals which cause the finely divided copper iron sulphide to float on the surface of an ore slurry water from where it can be recovered. The chemicals used fall into four groups according to their use. The first group (and the first chemicals used) makes the ore slurry alkaline which in part reduces the amount of pyrite (an iron sulphide) which floats. At Panguna (and in other similar mines) lime is used for this purpose. The next additions are 'collectors' and 'frothers'. The collectors (a class of compounds called xanthates) attach to the very fine copper iron sulphide particles and encourage the particles to concentrate in the froth formed by the 'frothers'. These are various mixtures of compounds but mostly polypropylene glycols and methyl isobutyl carbinol (MIBC). This froth containing the copper is then recovered and the tailings are thickened with the assistance of 'flocculants' (polyacrylamides are used at Panguna). The characteristics of these chemicals are described as follows:

- (a) lime - lime used in the ore recovery process is in the form of finely powdered calcium hydroxide. This substance is identical to the 'lime' used throughout the world for soil pH correction and other chemical modifications related to nutrient availability in gardens and agricultural land. It is considered to be non-toxic to people, plants and animals and this is generally the case but as with many common chemicals, there are some circumstances where it can cause environmental damage and it can damage animal and plant tissues. This is because of its alkaline nature which can cause natural waters to become too alkaline (pH too high) for aquatic animals to survive and can also cause skin irritation, particularly on areas of broken skin, in people and animals. Too much lime added to soil can reduce plant growth. Sensible use and control of lime normally avoids these problems but large discharges can cause water quality problems. For example, in the Kawerong River below the tailings discharge point and the confluence with the Jaba River, the high pH of the river water because of lime would be unacceptable to most fish, quite apart from the unacceptable presence of any other chemicals.
- (b) other process chemicals - each of these chemicals and most of those described below have been tested for their toxicity to people, usually

those exposed in the work environment, and the American Committee of Government Industrial Hygienists (ACGIH) has established standards to protect such people. The toxicity of some of these chemicals to animals has also been tested.

We viewed various information sheets related to the hazardous nature of these chemicals and to recommend procedures for their safe use. In general this information considers only skin contact, ingestion and inhalation.

The xanthate chemicals used as collectors are potassium amylxanthate and sodium isopropylxanthate. These substances are said to be of low toxicity and relatively non-toxic on contact but skin irritation may result from contact with the concentrated chemicals (this usually means the chemicals as supplied before dilution for use). Ingestion of xanthates is harmful. Some xanthates decompose, particularly if heated, to produce gases containing sulphur. In circumstances where these gases could accumulate they could reach dangerous concentrations. We did not observe any situation in the mine processing area where such accumulation was likely to occur.

Other chemicals are often used together with xanthates particularly for coarse grinds to assist flotation. These are organic thiophosphates and one of the most commonly used is sodium di-isobutyldithiophosphate. The ACGIH has not established criteria for this substance but it has a toxicity similar to that of the xanthates but without the risk associated with gas formation. Prolonged contact with this class of thiophosphates in concentrated form can cause skin damage and severe eye irritation.

Methyl isobutyl carbinol (MIBC) is a severe skin irritant in concentrated form and can be hazardous if ingested or inhaled. However, the concentrations must be high for irrecoverable effects to occur. For example, a concentration of 2000 parts per million (by volume) in air is dangerous to health which means that less than 30 minutes exposure should have no serious effects. Handling the concentrated chemical requires normal procedures to protect skin and eyes and to provide good ventilation.

Glycols are also used to assist froth formation. These substances decompose into carbon dioxide and water and are of mild toxicity in a working situation. For example, the single lethal dose for a rat (a commonly used test animal) is 1.5 to 2.1 grams per kilogram of body weight. This dose is very large, indicating low toxicity.

The flocculant used by BCL at Panguna for water recovery from tailings is a polyacrylamide polymer. This polymer itself is of low toxicity but the material as supplied for use always contains small amounts of the monomer (this is the small chemical component which is used to make the large chemical used as a flocculant). This monomer is toxic and can be adsorbed through the skin. Ingestion and inhalation must be avoided. The manufacturer's Hygiene Guide is 0.03 mg/m^3 in air and if the monomer is 0.3% (3 parts per 1000) of the flocculant as supplied, then the Industrial Hygiene Guide for flocculant dust is 10 mg/m^3 . This concentration is likely to occur only in a working situation where the flocculant is handled and where ventilation is poor. Normal handling procedures to prevent skin and eye contact, ingestion and inhalation are used.

Our investigations revealed that BCL maintains a high standard of occupational hygiene to protect its workers and has several staff responsible for maintaining

this standard. BCL has a very good safety record in its operation and this reflects well on the chemical handling procedures and the low toxicities of the chemicals used in ore processing.

In the Environmental Update (Ref. 16), BCL reported some results from the scientific literature on the toxicities of the process chemicals to aquatic life. The collectors (xanthates) are of low toxicity and the LC50 (median concentration at which half of the tested animals died in 96 hours) for rainbow trout (a sensitive freshwater fish) has been reported as between 18 and 80 mg/L. This range is similar to that determined by BCL using the seawater mullet. The concentrations of collectors in the Jaba River water usually decreases to less than 0.03 mg/L downstream. The frothers, polypropylene glycol and MIBC, are also both of low toxicity. The LC50 for the glycol is more than 1000 mg/L for trout and a value of between 100 and 1000 mg/L is given for the 96 hour median toxicity level (a slightly different value to the LC50) of MIBC but the animal tested is not mentioned. The flocculant, polyacrylamide, is reported to be of low toxicity to plant and animal life but no data were quoted. These data indicate that all of these chemicals are of low toxicity to aquatic organisms and we have not found any information which contradicts this. However, we suggest that the literature be reviewed and if necessary further studies should be done to assess the potential impact of the tailings pipeline discharge on the animals of Empress Augusta Bay.

The first point at which these process chemicals are exposed to the environment outside the ore recovery area is at the end of the tailings discharge pipe into the Kawerong River. At this point, lime, the frothing reagents and the flocculants will be mostly unchanged but some degradation of the collector chemicals, the xanthates, may have occurred.

Approximate estimates for the rates of degradation of these substances through the ore recovery process to the tailings discharge can be obtained by comparing their initial concentrations in the ore slurry (calculated from the chemical consumption given in Table 5.7.4) with their measured concentrations in the slurry water at the tailings pipeline outfall (Table 5.7.5). This comparison implies that MIBC (a frother) does not degrade significantly whereas the xanthates (collectors) almost disappear (particularly if the latest results are considered). The flocculant is below the analytical detection limit of 0.5 mg/L although this is only one-eighth of the initial concentration. Despite this, the flocculant apparently disappears also. There appear to be no monitoring data for the DOW frother. While these observations are encouraging as far as the Jaba River water goes, there is the possibility that the collectors and flocculant remain adsorbed to the solid tailings. This question is discussed further in Section 7.

From the discharge point, the tailings slurry mixes with Kawerong River water and flows quickly down to the top of the first sedimentation basin. In this basin the coarser tailings settle along with part of the lime, and a proportion of the other process chemicals. In the second basin, this settling process continues with a finer fraction of the tailings plus another portion of the process chemicals. Beyond this basin the finest tailings and the remaining process chemicals flow into the delta.

Table 5.7.4 Consumption of process chemicals and calculated concentrations in the ore-water slurry (Source: Ref.17)

Chemical	g/tonne ore	g/m ³ slurry water*
PAX+SPX	10.0	7
MIBC	20.0	13
DOW	15.6	10
FLOC	5.7	4

Notes:

DOW (DOW AP273) polypropylene glycol.

PAX Potassium amyl xanthate - collector

SPX Sodium isopropyl xanthate - collector

MIBC Methyl isobutyl carbinol - frother

FLOC polyacrylamide - flocculant

* Assuming chemicals are entirely dissolved in the process water and that 1.5m³ of water is added per tonne of ore.

Table 5.7.5 Concentrations of process chemicals in the water fraction of the tailings slurry (Source: Refs.17, 25, 30, 31, 32)

Chemical	Date of sampling				Average 1974-1986
	17/12/85	9/7/86	9/2/86	30/9/87	
pH	10.2	9.6	9.7	9.7	-
FLOC	<0.5	<0.5	<0.5	<0.5	<0.5
MIBC	21	17	10.2	8.80	10
PAX(+SPX)	0.53	0.2	0.03	<0.03	0.23
Calcium	120	245	56	104	-
Magnesium	0.5	0.8	0.7	0.5	-
Copper	0.005	0.002	0.003	0.002	-
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	-
Cadmium	<0.001	<0.001	<0.001	<0.001	-
Lead	<0.001	0.001	<0.001	<0.001	-
Zinc	0.002	<0.001	0.001	0.001	-

Notes:

* All concentrations in mg/L except pH

Chemicals as in Table 5.7.4

A number of chemical changes take place in the tailings as they deposit or are carried down the Jaba River. The organic process chemicals, the collectors, frothers and flocculants undergo both dilution and decomposition in their passage down the Jaba Valley. The collector chemicals (xanthates) are particularly unstable and they may not reach the delta even when carried directly in the flowing water. The frothers and flocculant are more stable and may

reach the delta but in a substantially diluted and partly degraded form. Some lime (now present in a less reactive form) will deposit with the tailings and will remain there until it is either leached through the deposit or washed downstream when the tailings are resuspended.

Most of the metals contained in the tailings solids or adsorbed on to the particle surfaces will remain in place as long as the deposits remain slightly alkaline; that is, contain a small amount of lime. It is logical to assume therefore that tailings which deposit below the water table will remain in this condition as long as there is effectively zero lateral or vertical water movement. Tailings deposited above the permanent water table will be exposed to a mixture of air and water and this situation will lead to the same chemical changes described above for the waste rock, except that in the tailings, lime will also be involved.

These chemical changes will produce acid but in the early stages the acid will be removed by reaction with the lime added during processing. However, there is apparently more sulphide in the tailings than there is lime so eventually when the lime has been either washed away by rain or dissolved by acid, the water draining from the tailings will become acid and will contain copper. There is unlikely to be a significant amount of other metals in this leachate (because of the composition of the ore) and the very low concentrations which could be present will behave in the Jaba River water in the same way described above for the waste rock leachate. However, after tailings discharge to the Kawerong River ceases in 1989, the river water will have a lower capacity to reduce the concentrations of metals. This has been investigated by BCL and is discussed in Section 6.4.

Copper and acid will be a characteristic of the drainage from the tailings for a long time and whereas the acid will be removed by chemicals (natural and added calcium salts similar to lime) in the Jaba River water, some copper will remain in a form which is toxic to fish. This is discussed in more detail in Section 6.4. The acid, copper, and aluminium (another metal dissolved by the acid) in the tailings can be toxic to plants and until these metals are dissolved and washed out of the surface layer of tailings, it will be difficult to achieve sustainable plant growth for revegetation.

5.7.2.4 Dust

Dust is produced from the pit, the process area (including the waste rock dumps), the port facility (including the power station) and the tailings deposits. In the process area and to some extent the pit, dust is an occupational hazard both to workers and equipment and consequently water is used as a control measure. At the port, dust could be generated from the concentrate stockpile which contains the dried copper/gold product ready for shipment, and during the process of ship loading. The power station produces smoke (very fine particles) from the combustion of fuel oil. However the major sources of dust are the waste rock dumps and the tailings deposits.

The tailings deposits are a large surface area of very fine sediment which has low cohesion when drained and dried. Consequently these deposits are a major potential source of dust. Our observations suggest that the natural forces capable of producing dust from these deposits are few; for example, not many vehicles traverse the tailings deposits (and there will be fewer after pipeline construction ceases) and, on average, wind velocities over the tailings are low. Our visit during a wet period did not allow us to make useful observations but

we readily accept statements by the village people that dust is much more prevalent during dry periods. At any time, disturbance by vehicles or by people walking across the tailings will generate dust.

In high use areas, particularly the unsealed and unwatered roads, and the pit and the waste rock dumps, dust is generated and the potential for health risks through inhalation or ingestion with leafy vegetables should be addressed. The extent of this risk depends on the size of the dust particles (those less than about 0.5 microns in diameter are more hazardous than those larger than 0.5 microns - see Section 4.10.1) and their chemical composition. This also applies to any dust generated from the tailings deposits. The tailings deposits may contain some of the chemicals added during the ore processing and may influence the hazards associated with dust from these areas.

We have discussed the toxic properties of the process chemicals in Section 5.7.2.3 and commented on the relatively low risk to people. However, we have also pointed out that some of the collectors and the flocculant could remain adsorbed onto the deposited tailings and these chemicals could, therefore, be carried in dust. It is our opinion that the health risk from these chemicals on dust is low but we recommend that this should be confirmed (Section 7). Village people who frequently traverse the tailings complain of sores which do not readily heal (Section 4.9.5.3). This problem is possibly due to the lime contained in the tailings. Generally any alkaline substance, such as lime or cement, will aggravate open sores. After the tailings pipeline comes into operation and the lime washes from the surface of the deposited tailings, this problem should reduce.

Blasting operations in the pit are considered by the village people (particularly from Guava Village) as a serious source of dust. We were unable to observe an actual blast but considering the height of the rear pit wall (below Guava village) and the general lack of air movement within the pit, it seems unlikely to us that large amounts of dust from blasting reach Guava village. However, conditions in a dry period might be very different with some thermal convection over the pit. This circumstance may cause very fine dust to rise out of the pit and so may have led to the villagers' concerns. However, even if this movement of dust does occur, there is unlikely to be any chemical toxicity associated with the dust. The chemical composition would be essentially that of the rock in the pit. Blasting residues would be insignificant components of the dust (if they were present at all). Gases from blasting are discussed in Section 5.7.2.7.

5.7.2.5 Pit drainage

The pit collects rain water falling directly into it plus a small amount of water seeping in through the walls. Our observations indicate that seepage water is not a major contributor to the water leaving the pit and also that the drains which collect stream water which would otherwise enter the pit do operate in a reasonably efficient manner. When sulphide minerals, particularly pyrite (iron sulphide), are exposed to both water and oxygen, the pyrite oxidises to produce sulphuric acid which can then react with other metal compounds (particularly the copper iron sulphide in the Panguna ore) to release the metals in soluble form. When this process occurs inside a waste rock dump, high concentrations of metals (copper in our case) can be found in the water draining from the dump (see Section 5.7.2.2). However, the amount of water entering the pit through the walls is relatively small and although this water will certainly contain some soluble copper it will be substantially diluted by rain falling

directly into the pit. This rain will not be of sufficient volume or have sufficient time to cause acid leaching. The pit is drained by a tunnel into the Kawerong River so that any copper entering the river via this pathway can be considered as a small increment to the waste rock dump leachate discussed in Section 5.7.2.2.

5.7.2.6 Sewage

Human waste from the town of Panguna is treated by conventional methods: activated (aerated) sludge in a plant of 2.5 million litres/day. A small package plant, using the same treatment procedures, and with a capacity of 0.15 million litres/day is also used. Both of these plants are capable of better than 99% reduction in faecal bacteria. The effluents from both are discharged into the channel of the Kawerong River upstream of the tailings discharge point.

This treatment procedure is accepted worldwide for its efficiency in treating sewage and in the particular situation at Panguna, the sewage effluent presently mixes with the highly alkaline tailings discharge in the Kawerong River. This mixing will enhance the rate of die-off of the remaining faecal bacteria. Overall, in the present conditions existing in the Kawerong River, there is a good chance that faecal bacteria will disappear soon after the discharge flows into the first tailings basin. Water which leaches through the tailings deposits is also likely to be further (or completely) sterilised by the filtering action of the sands.

5.7.2.7 Atmospheric emissions

The only large atmospheric emissions are those from the power station and the concentrate drier at the port.

The predominant emission from the concentrate drier will be water (the concentrate from the filters is dried to about 8% moisture content before storage in the bulk concentrate shed) but there may be small quantities of the process chemicals and a gas, sulphur dioxide (produced when the copper iron sulphide oxidises). The air flow from the drier is scrubbed with water before being released to the atmosphere and this process will remove most of the chemicals from the flowing air. The water from the scrubber is apparently discharged with the concentrate slurry water (Section 5.2.7.8).

The power station has an installed capacity of 135 MW using steam, a further approximately 60 MW from gas turbines, and 3.3 MW from a diesel generator (a further 3.3 MW diesel unit is installed at Panguna). At average load the station delivers about 150 MW. The fuel used is a heavy oil with a maximum sulphur content of 4% and an average content of between 1.5 and 3.5%. Between 687 and 700 tonnes of fuel are used each day. At peak daily load and maximum fuel sulphur, the station could emit about 56 tonnes per day of sulphur dioxide. The specifications for the high sulphur fuel oil include maximum concentrations of vanadium (150 mg/kg) and ash (0.15%). None of the other specifications is significant from environmental aspects. If oil containing these maximum concentrations were burned, the total ash emission per day could be up to 1 tonne and this could contain 105 kg of vanadium. Vanadium is not highly toxic and despite the relatively large quantities which must be emitted from the station we cannot foresee any hazards associated with this metal. However, we have made this conclusion assuming that the flue gases and dust are widely dispersed from the station and this may not be the case. Until this is confirmed or the impacts of the flue emissions are quantified there will continue to be concern.

It should be noted that the maximum values quoted above are not typical of actual measured values which are approximately 50 to 72 mg/kg vanadium and 0.01 to 0.02% ash. The gas turbine fuel and diesel contain much lower concentrations of vanadium, ash and sulphur.

The maximum specified concentration of vanadium is 50g/tonne and at this level about 35 kg could be emitted each day. The principal component of concern in the emission is sulphur dioxide which reacts with water in the atmosphere to produce acid which in turn is washed back to the ground with rain. The impact of this acid fallout depends largely on how far the gas disperses before it reaches the ground. The main flue stacks at the power station are relatively short (about 40 m) and are lower than the hills immediately behind the station. The flue gases are cooled by heat recovery to about 150°C and this low temperature combined with the short stacks will reduce gas dispersion. We were unable to assess the likely dispersion and consequently our assessment was limited to our observations and the advice from villagers of vegetation damage in the surrounding areas. Our interviews with the people of Rorovana village (near the power station) and our inspection of plants near the village did not indicate any plant damage from sulphur dioxide emitted by the power station. However, there was general concern among the villagers and confirmation of our assessment would be appropriate. In some situations sulphur emissions can be beneficial to vegetation if soils are naturally deficient in sulphur.

There is another gaseous emission, which although it is unlikely to be a health hazard, is nevertheless important because of its negative influence on the village people's concept of chemicals from the mine, is the strong odour in the Kawerong River Valley below the tailings pipeline. At the time of our visit a trial was in progress at the mine using a new frother and this material was causing a very strong odour. It is probable that some odour is present at this location at other times also. It is difficult for local people to accept that the chemicals used are not harming the environment when such an obvious (and offensive) chemical discharge exists. We did not examine the nature of this frother and cannot comment on the nature of the gas. Occupational health requirements in the mine concentrator would prevent any chemicals being used which released toxic gases (the odour in the concentrator was many times stronger than in the Kawerong Valley). Despite this it is, in our view, rather short-sighted of BCL to run the test without considering the impact on people's perceptions in the Kawerong Valley.

Concern was expressed by the village people about gases caused by blasting in the pit and passing through the pit drainage tunnel into the Kawerong River valley. We could not establish the basis for the concern with the drainage tunnel and as far as we are aware the drainage tunnel is, for most of the time, partly full of water. This would seem to preclude the flow of blasting gases through the tunnel. It is possible that this concern arises from the chemical smell originating from the tailings as discussed above. However, we were not able to come to a definite conclusion.

The Guava villagers complained of blasting gases but as we have mentioned we were unable to observe a blast. Undoubtedly gases produced by blasting do rise out of the pit but in our opinion a person standing on the rim of the pit would be exposed for only a short duration to very low concentrations of these gases. The only gases likely to be produced in significant quantities (as far as we are aware) are carbon monoxide and nitric oxide. Both of these can be toxic in low concentrations over a long period of exposure but such conditions would not exist on the rim of the pit. Both gases are also produced from vehicle exhausts

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and from tobacco, and in our opinion exposure to these sources is of far more concern than is exposure to blasting gases on the pit rim.

5.7.2.8 Other process wastes

Process wastes are considered here to include all potentially hazardous liquids and solids which leave the mine area except those already discussed above. Included in this section are: drainage from the concentrator chemical mixing area, waste lubricating oil, waste oils from the power station and electrical installations, cooling water from the power station, slurry water from concentrate recovery at the port, spillage of concentrate during loading, and other solid wastes (such as a small amount of asbestos insulating material).

The chemicals used in the mine concentrator have been discussed previously (Section 5.7.2.3) and in our inspection of the mine we looked in particular at the area used for mixing these chemicals in preparation for adding them to the ore. The risk of accidental spillage always exists and measures to contain such spillages are essential. Our inspection revealed that the chemical mixing area is drained to a collection sump equipped with a manually operated gate. In the event of a small or a slow spillage, the gate could probably be operated quickly enough to contain the substance in the sump. All water passing through the sump including the continuous flow from the crushing area is added to the water reclaimed from the tailings and all this water is stored for reuse in the mine operation. All the bulk chemicals handled in the mixing area are in small volume (approximately 200 litre) drums and a spill of this size could easily be handled by the drainage system. Apart from a major rupture in a mixing tank which is an extremely unlikely event, we are confident that spillages in the chemical handling area would not escape from the drainage system.

The movement of ore and waste rock relies mostly on trucks and large quantities of lubricating oils are used. Careless disposal of this oil, such as uncontrolled pit soakage, can have devastating effects on streams, rivers and estuaries. However, because this oil is an expensive resource, large volume users generally find a way of extracting further value from the oil after it has been used for lubrication. Typically, the oil might be refined, processed and re-used, or it might be used as a fuel oil for steam generation. BCL is a large user of lubricating oils and it would be logical for the Company to gain further benefit from it. This is, in fact, the case and the waste lubricating oils are added to the fuel oil burnt at the power station. The only components of this oil which are lost to the environment are those emitted to the atmosphere from the station's stacks. This has been discussed in Section 5.7.2.7.

Recently the pit at the power station used for containing/trapping oil in the oil storage compound was cleaned out and sealed with concrete (it was previously lined with earth). Some oil sludge from the pit was mixed with sand and disposed of by spreading and cultivating the oil/sand mixture on to the surface of the Itakara dump. In the circumstances, this action was probably the most sensible and we cannot see any immediate problems arising. Over time, part of the oil will be decomposed by bacteria but a residue will probably remain. This can be effectively managed in the future by covering the dump with a layer of soil of sufficient depth to allow recolonisation by local plants.

Waste oils and other fluids from the power station and various large electrical installations usually contain a class of compounds referred to as PCB's (polychlorinated biphenyls) which are extremely resistant to thermal decomposition (among other things) and are also carcinogenic (cause cancer).

Acceptable disposal of wastes containing PCBs is complex but, in general, strictly regulated. The currently favoured procedure is to contain the wastes within a securely banded area (to contain any spills) and then to ship the wastes to one of the few disposal facilities in the world. Usually these facilities are based on very high temperature combustion. Provided this procedure is followed (and most countries strictly enforce these requirements) there is no hazard from these substances.

Used PCB oils are stored in a banded area within the fuel compound area at the Loloho Power Station and the information given to us indicated that this facility was properly designed and operated. A quantity of new PCB oil is stored at Panguna although this was brought to our notice by the landowners at a late stage of our study. It was subsequently confirmed on a site plan provided by BCL. We did not inspect these storage facilities and presume that the appropriate authorities of National or Provincial governments approved and inspected the structures. If this was not done then we urge the appropriate officials to undertake such inspections as soon as practicable.

The power station uses cooling water drawn from the sea. Several environmental impacts can result from this practice. Firstly, if the water intake is not screened (mechanically or chemically) fish can enter, with not only damage to the fish but also to the cooling system. Secondly, it is usually necessary to add chemicals (bacteriocides) to the water to prevent biological growth in the cooling water circuit. Thirdly, chemicals which prevent corrosion are usually necessary in the water which circulates through the steam condensers. For sea water cooling, a heat exchange system is often used so that the salt does not contact sensitive metal components (or cause other chemical problems). If this is done then corrosion inhibiting chemicals are contained in the inner fresh-water circuit and the seawater circuit contains only those chemicals needed to prevent bacterial growth. The BCL power station uses seawater cooling through a heat exchange system so that the only potential impact of the cooling water discharge is that caused by the chemical additives and the heat lost in the cooling water. We examined the cooling water outfall and observed fish swimming through the plume approximately 30 m from the discharge point. Chlorine is a major deterrent to fish (this is why it is added to the cooling water intake) and we concluded from our observations that in this case the levels of chlorine in the outfall are not a hazard to fish.

The copper concentrate is transferred to the port as a slurry containing the solid concentrate, water and small quantities of process chemicals. At the concentrator end of the pipeline (at Panguna) the concentrate is extensively washed, partly to recover process chemicals and partly to reduce the concentrations of these chemicals in the discharge water. At the port the concentrate is separated from the slurry by settling and the supernatant is discharged into the sea. As discussed above, the process chemicals are generally of low toxicity to aquatic life and it would be unlikely that the discharge on to an open shore (as is the case at Loloho) would cause any aquatic damage outside the small mixing zone. It is also probable that in an open shore situation, fish and other life would simply move away from unacceptable conditions.

During concentrate loading there is some risk of copper solids entering the sea around the wharves from spillage during loading. Whereas there is always likely to be some loss into the sea immediately adjacent to the loading area, more widespread impacts would result only from very careless practice. A survey of copper concentrations in the bed sediment near to the port showed no evidence of significant contamination by copper from the ore (Section 6.4). The only other

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significant waste from the mining operation is solid material (steel, wood, concrete, etc) which from a chemical aspect, is of no concern, and occasional quantities of more hazardous substances. The only notable example of the latter of which we are aware was a quantity of asbestos-containing pipe insulation which was unused but surplus to requirement. Asbestos fibres when inhaled over an extended period of time or at high concentrations can cause a disease, asbestiosis, which is similar to silicosis (Section 4.10.1.1) but more serious. Recommended handling and disposal practice aims to prevent skin contact and inhalation of the asbestos by using protective clothing when handling the material and by burying it in protective containers. Asbestos is a solid substance and is harmful only in this solid, fibrous state. If it is contained in sealed containers it will not move in groundwater. BCL has followed recommended practice by containing the asbestos insulation in plastic bags and then burying the bags in the Itakara dump. Our inspection of this dump showed that it is a standard type of disposal operation using a flat swampy area (in effect a reclamation). The water table appeared to be only a few metres below the finished ground level of the dump and provided that the final surface of the dump is of low permeability the risk of hazardous leachate from the dump should be acceptably low. The buried asbestos will be no hazard unless it is accidentally or deliberately exposed and handled. Although plastic bags would be acceptable in a dump which was not to be further disturbed, there could be good reasons to use stronger containers if there were any doubt about activities on the dump in future.

Our general conclusions about the way BCL handles its solid wastes are that all the procedures we saw and discussed were in accordance with typical recommended practices in other countries.

Defoliants (chemicals used to remove leaves from plants) were used to kill the vegetation which covered the land area of the present pit. Some defoliants can have serious long term-health effects on people.

Information was supplied to us by BCL and the following extract from a paper prepared in 1982 by R L Kay, Assistant Pit Superintendent - Production describes the use of sprays and poisons for vegetation clearance:

'About 560 acres of dense tropical rain forest had to be cleared before mine facilities could be constructed and stripping of the ore body commenced. Simple burning of the vegetation was precluded because of high rainfall and humidity. Removal of all vegetation from the area was necessary as the next phase of the development programme in the pit area was hydraulic sluicing of the unconsolidated ash. A clearing technique was developed which effectively permitted a thorough approach to clearing without any delays to critical development schedules.

The larger trees were poisoned and the undergrowth sprayed with a herbicide four or five months before felling. This allowed the sap to dry out and partially prevented saturation during heavy rain.

Standing dead trees were felled either by hand or dozer or a lagging technique known as 'hi-lead yarding'. Stumps were removed with dozers or explosives.

All vegetation was collected by dozer or yarder into piles and burned. Combustion even during heavy rainfall was maintained by using large diesel-driven fans into the air stream of which a spray of diesel fuel oil was injected.'

Aerial spraying was reported to have commenced on 18 August 1969 and to have been completed during the following month. The person who was handling the supply function at Panguna at the time recalls that:

'Spraying was intermittent over about a month being restricted to smooth air conditions and that foot access was curtailed with Guava villagers and their produce being carried to market by helicopter.'

The chemicals used were:

- (a) tree poison - arsenic pentoxide solution with a concentration of 4 lb per gallon of water and application of 2 oz of solution per foot of tree diameter;
- (b) herbicide - 'Bush Killer 80' as supplied by Amalgamated Chemicals with a concentration of 11% by volume in a diesel fuel base. 'Bush Killer 80' was described as 40-245T and 40-24D.

We cannot judge the wisdom of this method of vegetation clearance but assuming that it was necessary, then the procedures used by the Company recognised the danger to the Guava village people who traditionally traversed the area. Both of the active ingredients in the herbicide, and in particular 245T, are toxic to people and the production and use of these chemicals is now restricted or entirely banned in some countries. In 1969, however, they were widely used throughout the world and were seen as perhaps the most effective herbicides available. Thus there was no reason in 1969 why BCL would have been aware of what is now known about these chemicals.

In the course of our investigations we were told that some of the vegetables eaten by village people at that time are now believed to have been contaminated by drifting spray. We were also introduced and spoke at length to a man in Guava village who is about 80 years old and blind. He was apparently a security guard in or near the area of the pit ('Camp one' or 'Area one') and believes that he was exposed to the spray and that this led to his present blindness. It is almost 20 years since the spraying occurred and it is impossible to determine the precise circumstances of this man's situation at that time. Proper medical examination of the man's condition may identify some other cause of his blindness but irrespective of any conclusions from such an examination, suspicion will always remain that the 1969 spraying was the cause.

5.7.3 Changes in the biological environment

5.7.3.1 Sea and estuarine fish

Diseased fish and the disappearance of fish from the coastal areas were frequently mentioned concerns of the landowners. As part of our investigations into this issue we requested by 'Toksave' for the people of Koiare Village to keep any diseased fish they caught for us to collect two days later. Our visit to Koiare revealed that no fish had been caught because as we were told 'there are no fish to catch, they are all dead'. Whichever way this statement is interpreted it was clear to us that a serious problem was perceived to exist by the people. Later, during a trip down a branch of the Mariropa River to look at gardens we observed signs of sizable fish in the river. On questioning the villagers we were told that the small fish in the river had disappeared over the last few years. Also according to the village people, the Rinei River, which joins the branch of the Mariropa we were on just upstream of the coast, has

silted up due partly to changes in the beach (discussed in Section 5.5.2) and partly due to sediment carried downriver. We could make no constructive conclusions about fish from our visit to Koiare but it was very obvious to us that the village people were greatly concerned about diseases and the lack of fish. We were also told that they no longer use sea water for cooking because they believe that it is contaminated by mine waste.

Dr Joseph Pulau, Acting Assistant Secretary, Division of Health, North Solomons Province, has made recent observations of diseased fish, and the following information was extracted from his report to the Administrative Secretary, Department of North Solomons. Dr Pulau first became aware of the problem in September 1988 when people of Koiare Village brought four mullet fish with sores on the side and head to the Deputy Administrative Secretary's office. On 27 September he travelled to the West Coast to investigate dying fish in the Marau River and the coastal waters. Dr Pulau made the observation that sea water in the mouth of the Jaba River and out to about 10km or more into the sea and along the coast-lines both towards Koiare and towards Motupena Point was all white, dirty and muddy in colour, an obvious reference to the effects of mine tailings discharged from the Jaba River. Near the mouth of the Marau River Dr Pulau caught a small mullet (14.5cm long) with a large ulceration on the 'belly'. When high tide came the Marau River changed colour to white and milky. He then observed: 'Just as the milky waters were coming in from the sea to the mouth of the river I saw one of the mullet fish with the ulcer on the side was dying and jumping on to a floating log as if it was trying to escape, suffering'.

At both the Tavera River and the Pirirua River dead fish had been seen at the mouths of the rivers but none were caught during Dr Pulau's visit. However many dead fish were seen in the Bora'arai River at Kangu Beach, Buin, and one mullet and one perch (*Perca fluviatilis*) were caught with ulcerations and 'one eye already out'. Two dead fish were also collected. Dead fish had also been reported from Keriaka and Sipai/Kunua. However, none had been reported from Orava, Koromira and Kieta. Dr Pulau concluded that the disease had not spread to Buka, Tinputz, Wakunai, or Kieta/Koromira. He went on to say that the problem was still spreading from south to east and west and that apparently it was first reported around the mouth of the Jaba River then spread towards Nagovisi, Siwai and Buin then Koromira, and in the west to Koiare, Torokina, Keriaka, Sipai, Kunua and Hahon. In his examination of the fish he identified *Pseudomonas* (a bacteria) but acknowledged that these could have been present as secondary infection (infection after the fish had become diseased).

This report is the most comprehensive we have seen related to Bougainville but in late June 1988 an ulcerated fish was examined by the National Veterinary Laboratory of the Department of Agriculture and Livestock. In this case however, the large areas of ulceration were considered to have occurred after death. The report does go on to say that if the fish are showing the observed changes before death, then an ulcerative disease could be involved. It further states that such diseases are well recognised but their cause is still obscure. Water quality (for example, oxygen levels), can influence the mortality rate in fish and this can be influenced by a range of normal environmental factors.

The areas of Bougainville from which ulcerated fish have been reported by Dr Pulau extend approximately equal distances 100 to 150km, north and south of the Jaba River. Although the spread of the disease does not necessarily have to be at an equal rate in both directions, the fact that the Jaba River is the mid point of the infected area is consistent with Dr Pulau's statement that the disease was apparently first reported from the Jaba River mouth.

Outbreaks of fish ulceration have occurred in Papua New Guinea waters before and the brief summary below will serve to illustrate the characteristics of the problem. The following details were extracted from a 1983 report by Dr Roger Uwate, Aquaculture Co-ordinator with the Pacific Islands Development Program East-West Centre in Hawaii (Ref.33). His report deals with a fish disease situation in the Sepik River and was submitted to the Secretary of the Prime Minister of Papua New Guinea. It focusses specifically on the Sepik River outbreak but also reviews other possibly related outbreaks. The Sepik River outbreak infected mainly gudgeons (family Eleotridae) and caused lesions and ulcers (note however, that similarity to the Bougainville fish lesions has not been established).

The following extracts from correspondence about the Sepik outbreak summarise the responses and conclusions. In a letter dated 23 February 1982 to Mr Paul Bengo, Secretary, East Sepik Province, from David Coates, Senior Biologist, Fisheries Research and Surveys Branch, DPI, the following description of the disease was given:

'The symptoms are that the fish get sores on their body and fins, these eventually form blisters which burst and the open wounds become further infected. These symptoms describe a fish disease called 'Ulcerative Dermal Necrosis'. This disease is caused by a virus which attacks the fish and causes the blistering, the blister bursts and the open wound usually quickly becomes infected with fungus which normally will cause the fish to die. The disease is not uncommon in pond reared fish and when occurring in these circumstances the fish infected are usually all immediately killed and burnt to reduce the chances of further infection. However the disease also occasionally appears in natural fish populations. There is a case of a similar outbreak in the Gulf Province in 1975. There is little that can be done to control the disease in a natural population of fish. We just have to wait until the disease comes to a stop on its own. This usually happens within only a few months. It is unlikely that all the fish will suffer within the area. There should be quite a large residual fish population to keep providing food for the local people. The disease is very infectious and can be transmitted rapidly throughout a fish population.'

In July of 1982 a report from David Coates gave the following results from a pathological examination of diseased fish:

'The diseased fish were found to be infected with the bacteria Aeromonas hydrophila and this is thought to be the likely cause of the disease but the possibility of a viral infection with A.hydrophila as a secondary invader, however, cannot be ruled out. A.hydrophila is well known to cause skin lesions and septicemia ultimately resulting in death.'

Coates went on to say:

'Several points should be made clear. This bacterial infection is thought to be quite natural. There is no evidence that the disease has been caused by any human activity in the Sepik. Fish populations suffer from natural epidemics just the same as animal populations. As far as we are aware the disease does not normally attack people.'

Dr Uwate's report to the Prime Minister's secretary (Ref.33) stated:

'May I suggest to you that the disease may be a manifestation of a larger problem in your freshwater drainage system. Also, the disease may be a secondary infection, following stress, or damage to the fish (that is, escaping a gill net). The high occurrence of diseases and parasites on fishes may be indicative of recent changes in the aquatic environment which have stressed fish. Continued stress results in a weakening of a fish's normal resistance to disease and parasites, thus allowing entry or invasion by various parasites and/or diseases. I should also like to note that total eradication of the disease in a natural environment is probably impossible, but identification and containment of the source of water quality change may be possible.

As we have discussed, the change agent can be from the watershed such as new land uses (that is, mining or agricultural activities), as well as in the water drainage system itself (that is, new sewage or industrial discharges, or new water treatments).'

The important statement in this quotation is that referring to continued stress as weakening a fish's normal resistance to diseases and parasites.

In the report (Ref.33) Dr Uwate reviews all aspects of the incident including the correspondence from David Coates quoted above. In particular Dr Uwate reviewed the major activities in the Sepik River catchment which could have caused stress on the fish population but concluded that none of the activities he considered could have been implicated. He then reviewed previous outbreaks of similar diseases. A partial list of fish kills in Papua New Guinea is given in Table 5.7.6.

Table 5.7.6 Fish kills recorded in Papua New Guinea
Source: Ref.33

Date	Location	Comments
1970	Bensbach River	Hundreds of fish of various species died in a short period of time
1975	Morehead and Bensbach rivers	Fish mortality, fish had body sores
1975	Purari delta Kikori (gulf/delta) Upper Fly (Kiunga) River Middle Fly (Lake Murray) River Fly delta	
1976	Alice River	
1982	Sepik River	

Subsequent to the 1970 incident it was speculated that toxic vegetation was the causative agent, but this was subsequently disputed and it was suggested that a toxin such as DDT might be the causative agent released by a rise in water level.

The 1975 fish deaths on the Morehead and Bensbach rivers in which dead fish were described as having many body sores, were considered to be probably associated with the dry season when chemicals became concentrated in evaporating pools of water or dissolved oxygen levels decreased with decaying vegetation.

In November 1975, fish kills were reported in the Purari delta and several weeks later in the Kikori area. By the end of December most commercial and subsistence fishing had ceased. Fish deaths were also reported in the upper Fly River, middle Fly River and the Fly delta.

Five bacteria including Aeromonas hydrophila and Pseudomonas spp. were identified in the diseased fish, but no causative agent was identified. Changes in environmental conditions causing stress were identified as a reason for the disease outbreak.

Earlier, in mid-1972, fish in southern Queensland estuaries developed ulcerated lesions on their body surfaces. The epidemic subsided in late 1972 with warm weather but it reappeared in mid 1973 and again in February 1974. Initial investigations attributed the epidemic to:

- (a) fungal infections;
- (b) chemical pollutants;
- (c) a prolonged wet season.

It was suggested that the fish disease outbreak first observed in Queensland spread slowly north and south (as has possibly happened in Bougainville). The eventual extended range of the disease included Papua New Guinea and Irian Jaya to the north and the Manning River (New South Wales) to the south. It was concluded that the Australian outbreak (1972-1974) was connected with the 1975-76 fish disease outbreaks in the gulf area of Papua New Guinea. Three parasitic organisms were identified as potential causative agents of the disease but, in addition, the outbreak was linked to:

- (a) natural stress upon the fish (rapid change in temperature and salinity);
- (b) the physiological condition of the host (some fish such as mullet may be weakened by spawning and migratory activities).

The above discussion of previous outbreaks of fish diseases illustrates the following points:

- (a) fish in a stressed state or weakened by spawning and migratory activities are susceptible to disease;
- (b) stress on fish can be caused by any or all of the factors of high rainfall, chemicals, low oxygen concentrations, rapid changes in temperatures and salinity;
- (c) once the disease is established it spreads from the point of first infection to cover a wide area.

Similar ulcerative fish diseases have been recorded particularly in freshwaters throughout the Asian and Pacific Region. The Food and Agriculture Organisation (FAO) of the United Nations organised a large study of the problem covering Burma, Indonesia, the Lao Peoples Democratic Republic, Malaysia, Papua New Guinea, Singapore and Thailand. The results of the study were published in 1986 (Ref.34) and summarised in 1987 (Ref.35). They concluded that a highly pathogenic virus may be involved in the disease but knowledge of the virus was limited. They also concluded that environmental factors may have caused stress but they

were unable to establish any direct correlations between the disease outbreaks and the many environmental factors they considered. These factors included a wide range of physical and chemical water quality parameters (including metals) and also chemicals in sediments.

These conclusions, added to Dr Pulau's statement that the disease in Bougainville was first reported from the Jaba River and that it has now spread in both directions from this point, strongly suggest that the present conditions in the Jaba River caused by tailings from the mine could have been responsible for the initial stress on the fish which allowed the disease to establish. We emphasise that this suggestion has not been proven and probably can never be proven, but the circumstantial evidence is strong.

The accumulation of metals by fish has caused concern in some parts of the world particularly in Japan where effluents containing metals are commonly discharged into the marine environment. The now classic examples of mercury bioaccumulation into fish with consequent serious impacts on human health occurred in Japan. These incidents have guaranteed that metal accumulation into fish will be an issue for most mine waste discharges into fresh or sea waters. It is generally true, however, that apart from mercury and arsenic few of the trace metals associated with mining do, in fact, accumulate in fish flesh. Arsenic is commonly found in fish flesh but it apparently occurs as a form of organic arsenic which is not toxic to people. Fish organs, such as liver and kidney, often contain high concentrations of metals but these parts of fish are normally not eaten. Shellfish, particularly oysters, can accumulate high concentrations, but we have not seen any evidence of shellfish causing metal poisoning in people. Copper is one metal which does not appear to accumulate into fish flesh and extensive studies by BCL (Section 6.4) have confirmed this and also shown that no other metals have accumulated in fish as a result of the mine discharge into Empress Augusta Bay.

5.7.3.2 Freshwater fish

Claims by the villagers that fish have disappeared from the upper Jaba River (above its confluence with the Kawerong River) are easy to understand. Most fish in the rivers of Bougainville require access to the sea for at least part of their life cycle (usually for spawning or some stage of their development; J Powell, pers. comm.) and now that the access is blocked by the physical presence of the tailings deposits and by the high suspended sediment loads in the Jaba River, fish can no longer migrate upstream to either the upper Jaba or the Pangara rivers. (Some young migratory fish have been found in the Pangara River and this indicates either that fish have moved up the Jaba River, possibly during flood flows or that the Pangara River has another small connection directly to the coast.) According to village people in the upper Jaba area, this part of the river now contains only large eels, an observation which is consistent with a complete barrier to migration.

There is no natural solution to the loss of fish from these rivers until the Jaba River becomes an acceptable habitat to migratory fish. An alternative is to stock the upper Jaba and possibly the Pangara rivers artificially with suitable fish or for the Pangara River to be diverted directly to the coast. Additional problems could arise from both these options particularly the impact of introduced fish on the overall ecology of the rivers and in the case of the Pangara River outlet to the ocean, the long-term effect of this on the Jaba River itself.

Trial fish stocking programmes were undertaken in the Pangara River during the early 1970s using mullet fingerlings collected by seine netting from estuaries mostly south of the Jaba River. Observations made in 1973 showed that mullet previously released had either died or moved from the release sites but that small gudgeons, gobies and freshwater prawns (including juveniles) were still present. However it was concluded in 1973 that the results of previous stocking experiments had been successful and that large scale restocking could be initiated.

It was also observed that Tilapia had been introduced into other tributaries of the Jaba and Pangara rivers. During this time a smoke house was being operated at Hupai for the benefit of local fishermen. The BCL Fisheries Extension Officer conducted fisheries extension courses for three weeks each month. Most of the fish were traded and consumed in the general area but BCL purchased the surplus for sale in Panguna.

By the middle of 1974 the success of the mullet restocking programme was being questioned and several reasons were advanced for the poor results. A subsequent survey failed to observe any mullet at previous release sites. A subsequent correspondence subsequent to June 1974 and our discussions with village people and others indicated that the programme eventually stopped.

Several local people mentioned dead fish in the tributaries but we were not able to identify specific locations or to establish exactly when the dead fish were observed. We can readily imagine that resident (or trapped) fish in the tributaries blocked by tailings may have died when they encountered the stagnant waters in the lower parts of these blocked tributaries but apart from this there is no obvious reason why fish should have died in large numbers over a short period of time. Eventually all the migratory fish trapped in these tributaries would have died for one reason or another but this would have been a slow process.

These backwaters have generated potential breeding grounds for mosquitoes and this may be contributing to the present increased incidence of malaria in the Jaba Valley (Section 4.9.4.2). This is a serious matter and in our view, all steps should be taken to evaluate this possibility.

5.7.3.3 Shellfish

Loss of the freshwater kina shellfish from river mouths in Empress Augusta Bay had been reported but on the one occasion when we were able to question coastal village people (Koiare) we were informed that this shellfish was plentiful. Indeed, we observed a substantial catch of good size shellfish. We do not doubt that the freshwater kina shell can no longer be found in the Jaba delta and perhaps this was the origin of the claims made to us.

The situation with respect to the small saltwater 'mussel' (a small blue bivalve) is more complex. These shellfish live in the wave washed zone of Empress Augusta Bay and, as is common in this type of environment, the populations move with the shifting beaches. It is therefore quite natural that populations at a particular site show very large changes. This was clearly illustrated when we visited a hamlet of Koiare at the main mouth of the Mariropa River (about 1 km south of Koiare Village). At Koiare we were told that there were no mussels on the beach in contrast to our observations at the hamlet of large quantities of fresh shells from recent meals.

Studies by BCL have also illustrated the large variations between sites at different times. In addition to this natural variation in mussel density, BCL has found that the tailings carried from the Jaba River delta on to adjacent beaches have reduced mussel populations (see Section 6.4). These studies have also indicated that it is probably copper in the tailings which is affecting the mussels.

The beaches of Empress Augusta Bay will continue to be affected by tailings for the life of the mine and possibly longer and the evidence we have seen indicates that there could be a long slow decline in the overall population of mussels in Empress Augusta Bay. Although there is a clear requirement for the monitoring programme presently conducted by BCL to continue, we cannot see any solution to the shellfish loss for as long as tailings continue to move from the Jaba delta.

5.7.3.4 Flying foxes and other animals

There is no doubt that the flying fox population of Bougainville has declined in a dramatic manner since the early 1980s. Recollections by local people indicate that the bat was common in 1980/81 and such a rapid loss can have resulted only from a catastrophic event.

There are numerous possible reasons for loss of the bats but these animals, like sea fish discussed above, and also like people, are more susceptible to disease when they are stressed. Such a catastrophic loss of bats is, in our opinion, most likely to have resulted from an epidemic of some disease, perhaps introduced new into Bougainville or, alternatively an established disease developing in a stressed colony then rapidly spreading throughout the entire Bougainville bat population. The villagers claim that BCL's operations caused the loss of the bats but whereas sea fish could be stressed by conditions in the Jaba River or delta, we found nothing associated with BCL's operations that was likely to be a cause of stress to bats. Bats are mobile creatures and if they found conditions in the vicinity of the mine unacceptable, then they would simply go to another part of Bougainville. This does not appear to have been the case.

We have seen one pathological report on a dead 'flying fox' but it was inconclusive. The decline in the bat population on Bougainville was never (as far as we are aware) quantitatively documented and without this information we cannot make any conclusions about the causes.

If disease were the reason for the loss of the bats then in the longer term, the population on Bougainville will recover either when the disease disappears or when bats develop resistance. We have been told that these bats fly from one island to another and if this is true for the Bougainville area, then natural recolonisation may eventually occur.

Other animals such as the possum and the 'goana' have also declined in number but we were unable to establish sufficient facts to support any conclusions. Bats are highly visible because of their habits, and population changes would be readily observed. However the other forest animals are more secretive and their decline may have been gradual in response to forest clearing or hunting pressure from Bougainville's increasing human population.

5.7.3.5 Crops

One of the most frequently expressed concerns of villagers within and adjacent to the mine lease areas was the poor performance of their subsistence and cash-crops. Most saw this as a direct consequence of BCL's presence. In the short

time available during our study we visited several villages close to the mine (Sibae, Rorovana, Dapera, Guava, Moroni and Pirurari), one in Empress Augusta Bay at a greater distance from the mine (Koiare), one on the east coast south of Kieta (Kunu at Koromira), and one in Siwai (Siroi).

It was immediately apparent from our visits to these villages and from our discussions with the people that they all have real recognisable problems with their crops. However, our observations suggested that the visible symptoms are similar at all the places we visited. These can be summarised in the following general way:

- (a) bananas. Our observations: brown colouration (rust virus?) on the older leaves which eventually leads to the leaf drying and splitting. On severely affected trees this condition extended to all leaves except the youngest two or three. Villagers' comments: many trees have no bananas, affected trees die, some species of bananas have disappeared entirely.
- (b) taro. Our observations: spot or leaf edge yellow colouration developing into a hole with a surrounding area of dead leaf. When several leaves (two or three) are affected the root is usually rotten. Villagers' comments: whole gardens can be affected in this way.
- (c) sweet potato. Our observations: brown leaf colouration often as small spots (rust-like). Roots deformed, split or shrunken and stringy. Villagers' comments: many or all of the crop can produce poor roots.
- (d) tapioca. Our observations (only in Guava): brown colouration beginning at the mid rib and spreading along the lateral veins. Similar in appearance to a tobacco virus infection. Villagers' comments: did not affect all plants (at Guava our observations suggested about 20% of plants affected).
- (e) cocoa. Our observations: black rotting pods, deformed pods. Villagers' comments: damage to the cocoa crop was seen by some as a disaster, the loss of their only 'independent' source of income.
- (f) citrus. Our observations: yellowing leaves but no evidence of young leaves or leaf tips being preferentially affected. Villagers' comments: sick trees produce poor or no fruit.

Despite our obviously limited observations we have no doubt that crop productivity, in general, is not as good as it could be.

Sweet potato in mine lease areas and also at Koiare was heavily infected with the leaf 'rust' whereas at Kunu (east coast) and Guava visually similar 'rust' was present but to a much less severe extent. The simple difference between Guava and the Kunu village on the one hand, and all the others is that Kunu and Guava have plenty of gardening land and frequently shift their gardens (each year at Kunu). All the other villages we visited, because of loss of land within the tailings lease or because of population increases coupled with limited land (as at Koiare), use some of their garden continuously often for the same crop (sweet potato at Koiare had apparently been in the same garden for four years continuously). This practice, particularly in the tropics but also in temperate regions, allows plant diseases to establish and develop to serious levels. Long rotation times on the other hand can effectively remove disease from an area before it reaches a critical, damaging level.

These comments apply also to the problems with taro; a garden planted in March 1988 (at Kunu) had a much lower level of damaged taro leaves than was seen in the continuously used gardens. The poor production of bananas seemed also to follow this pattern; older trees were much more seriously affected. Black pod in cocoa is widely recognised as a serious affliction aggravated by poor management of the trees (for example, too much shading, too much water, etc). We suspect that many of the villagers receiving compensation from BCL may have developed a rather indifferent attitude to their cash-crops and that for cocoa in particular this has led to poor performance. In many areas of Bougainville, quite distant from the mine, management of cocoa is often poor and cocoa stands are often not replanted at the most appropriate time.

Several complaints of poor fruiting on citrus trees were made but our observations indicated that these trees were usually individuals among others which appeared quite healthy. If this is generally true, then it may be that the 'sick' trees are weak specimens or that they are growing in unfavourable substrate. The leaves of these trees were often yellow perhaps indicating disease or more likely a nutrient, possibly nitrogen, deficiency. If areas exist where a large proportion of citrus trees are in poor health, then this would indicate a more serious or extensive problem.

Samples of various crop plants which were suspected of being diseased were collected under our direction and were examined by DPI staff in Port Moresby. A summary of their report follows:

- (a) pawpaw (Carica papaya) (PNG 13435) - Mosaic symptoms with undetermined virus. The disease is not common and occasionally found one or two infected plants among pawpaw trees;
- (b) taro (Colocasia esculenta) (PNG 13446) - Corm rot caused by *Erwinia carotovora*, a bacteria often associated to rotting of tubers, bulbs and corms of vegetables. Prolonged dry seasons with the sudden heavy rains apparently proved conducive for the bacteria to spread through water stream and filamentous water. The disease is quite common in PNG, particularly in areas where taro is grown with heavy rainfall and prolonged dry seasons. Cultural practices proved to be successful in disease control.
- (c) tapioca (Manihot esculentum) (PNG 13447) - Leaf scald caused or is associated to insect damage.
- (d) banana (Musa spp.) (13438-13439) - Nothing was isolated from both leaf spot and root rot thus, nothing much to be said on the banana sample.

This report identified the cause of damage in pawpaw, taro and tapioca but could say nothing about the problem with bananas. None of the causes have any obvious link to the operation of the Panguna mine.

An interesting footnote to our observations is that although the villagers at Kunu were fully aware of the problems with their crops and had sought DPI advice, they did not blame BCL.

Problems specifically affecting cocoa have been examined by DPI staff and the following account has been taken directly from a report by Dr M Holderness, Cocoa pathologist, in March 1987:

- 1. Following reports of cocoa being damaged by waste gases from the blasting operations of Bougainville Copper Ltd (BCL), a visit was made (with the

relevant DAL officers) to examine cocoa owned by Anthony Kukui in the Akabei area. The cocoa was grown from Tavilo seed, planted in 1982. Soil quality was fairly good, with no hard pan. Current yields are 2000 kg dry bean from 23 ha and are declining. Much of the yield decline was attributed by the owner to black pod (Phytophthora palmivora pod rot) losses. The owner was concerned that this disease might be linked to atmospheric pollution from BCL.

The cocoa was generally overshadowed, with unpruned chupons and was planted too closely. Black pod levels were moderate to high, a product of the high rainfall, overshadowing, and poor control. Thread blight (Marasmius seane-wetter areas and on poorly managed cocoa.

The grower was advised as to the chemicals to use for Phytophthora control. It was stressed that spraying should only be considered as part of an integrated package of improved management; the yield increase would otherwise be insufficient for it to be economically justified. Hooking of infected pods (weekly if possible) should be introduced immediately to reduce the overall inoculum present. Thread blight can be controlled by pruning and burning the more severely affected branches; if a spraying and shade thinning programme is adopted for black pod this will greatly reduce the incidence of the weak thread blight pathogen.

BCL are unlikely to be producing significant amounts of atmospheric pollution over the distance involved. No smelting is carried out on site and there are no industrial smoke stacks other than at the coastal power station.

Blasting operations are carried out from time to time, but the principal waste product of blasting is dust which settles quite rapidly, near the source.

Industrial pollutant gases in themselves are known to affect plants, the threshold for injury being determined by the concentration of pollutant and duration of exposure, in interaction with a large number of biological and meteorological variables. However, no cocoa symptoms were seen consistent with damage by sulphur dioxide (SO₂), ozone or ethylene (eg. no scorching, defoliation or growth deformities). Similarly, no such symptoms were seen on other crop or weed species in the vicinity. Further evidence for an absence of significant pollution was provided by the abundance of lichens on the trees; many lichens are extremely sensitive to gases such as SO₂.

There have been few critical studies on the effects of pollutant gases on diseases. Most reports on SO₂ indicate a reduced disease incidence with increased SO₂ level eg. the incidence of tar spot disease of sycamore (Rhytisma acerinum) is used as an indicator of atmospheric pollution in England. The only cases of increased disease incidence with high SO₂ levels have occurred when the tree is damaged in some way by the pollutant and so becomes predisposed to infection; again there was no field evidence for this.

Ozone has been shown to reduce the damage caused by rusts and powdery mildews. Variable results have been found with Botrytis infection (predisposition may depend on the concentration of pollutant), but there is no detailed work on Phytophthora. As a general consideration, it is likely

that the emissions of Mount Bagana would have a far greater influence on atmospheric levels of these gases than would isolated explosions at Panguna.'

Dr Holderness also examined other crops and reported as follows:

The grower further reported that his other crops were not growing as well as they had in past years. These were also investigated; edible pit-pit was found to have dark red lesions, consistent with red rot disease (Glomerella tucumanensis). This disease is very common on pit-pit in Papua New Guinea. Bananas were found to be heavily affected by banana leaf spot (Sigatoka disease caused by Mycosphaerella musicola). It was also reported (but not seen on this visit) that banana plants were dying early and failing to set fruit. This may well be due to nematode damage at the base of the stem.'

In conclusion Dr Holderness stated:

'No evidence was found to link waste products from Panguna mine to increased Phytophthora incidence at Akabei. High disease levels can be attributed to high rainfall and wind, together with poor management.'

Our assessment of crop problems is that the damage we were shown is not restricted to areas close to BCL's operation but that the much improved access for people and their crops to large areas of Bougainville may have contributed to the rapid and widespread transfer of plant disease. Decreased crop rotation times and increased population pressure on subsistence crops is partly attributable to the loss of productive land because of the mine. For the village people who lost their land, there is no alternative but to operate their subsistence gardening and cropping in non-ideal conditions. Such a situation must inevitably lead to poor crop performance. There remains the possibility that gardens close to the mining operation receive dust and possibly higher temperatures during dry periods but in our short visit we were not able to examine this.

5.7.3.6 Forests and other plants

The loss of trees and other plants, as it was expressed to us, seemed to be a general concern related specifically to the areas which were cleared or covered by the mine operation and its waste. These losses are addressed in the compensation agreement. We discuss how we see the future of the pit area, the waste rock dumps and the tailings deposits in subsequent sections, but our general conclusion is that these areas will take a very long time to develop plant communities similar to those of the surrounding countryside and there are good reasons why they may never do so. Effectively, trees and plant communities which once existed on these areas are lost, perhaps, forever.

There are other visible losses of trees and these would have prompted some of the village people's concern. These have occurred and are now occurring where water tables have been raised by the tailings deposition. When the depth of water or tailings lying over tree roots becomes great enough to limit the flow of oxygen to the roots, the trees and other plants die. This has occurred in many areas down both sides of the tailings deposits (Section 5.3.2 and Photograph 8). While water tables remain high and certainly if they rise higher this problem will remain and may extend. There is no solution to this loss of trees within the lease boundaries but where high value timber is affected, reco-

very of the trees may be an economic benefit to the landowners. Where this loss of forest trees occurs outside the lease boundary, there would appear to be a good case for compensation to the landowners if this is not already covered by existing agreements.

6 ENVIRONMENTAL MONITORING AND PLANNING

6.1 INTRODUCTION

To fulfill the Terms of Reference we examined the work BCL has undertaken in terms of setting up monitoring programmes to address various environmental questions. Some of this work has been carried out on a regular basis since mining first commenced as a requirement of the Mining Agreement (Appendix III) or the DOTA (Appendix IV) and has been reported on accordingly. In these cases we have examined the programmes, the facilities and equipment, and the results and assessed how well these programmes have met the stated requirements. Other work has begun in subsequent years in response to environmental changes as a result of mining. Again we have assessed these investigations, in terms of their ability to address the issues.

It was, in a practical sense, impossible for us to repeat the experimental work (for example, on waste leachate, river tailings, revegetation and fish resources) done by BCL. This work has been underway for many years compared to the short time available for this Review. However, this did not prevent us from making an independent assessment of the Company's work, in particular its reliability, usefulness and completeness. We made this assessment by a two step procedure.

Firstly, we visited the mine site (pit, process area and port), the waste rock dumps and the tailings disposal areas (by both vehicle and helicopter). From the understanding we gained from these visits we made our assessment of the effects that might occur on people, plants and animals as a result of discharges (particularly chemicals) leaving the mine site (Section 5).

Secondly, we studied the work that BCL has done to evaluate the effects of these discharges, again with emphasis on chemical emissions (Section 5.7.2). We examined the performance of the chemical laboratory which is responsible for measuring the chemicals leaving the mine site. This was done by inspecting the laboratories and the equipment, by interviewing and questioning the staff, by examining the laboratory's performance when the same samples have been analysed by the BCL laboratory and by other laboratories around the world and by collecting water samples which were then analysed by the BCL laboratory and an overseas laboratory of our choice. We then reviewed the original BCL reports in which the Company's results were reported, particularly to evaluate the methods used to obtain results, the ways in which the results were interpreted and the validity of the conclusions. In this review we also looked for evidence that the work had been examined by other independent scientists; for example, if the work had been published in the international scientific literature (in which case it would have been critically refereed by impartial peers) or in one case, accepted as a thesis for a scientific degree from a reputable university.

The programmes are addressed under the following headings:

- (a) hydrometeorology;
- (b) sediment transport;
- (c) chemical and biological monitoring;
- (d) revegetation investigations.

Each of these is addressed in the following sub-sections.

6.2 HYDROMETEOROLOGY

6.2.1 Monitoring programme

A hydrometeorological network was established in the early stages of mine development to collect basic meteorological and hydrological data for mine, and mine infrastructure planning. The network consists of climatological, rainfall and stream level recording stations. Data recorded at the climatological stations include rainfall (6 minute intervals, 0.5mm increments), temperature, relative humidity and sunshine hours.

The distribution of climatological and rainfall recording stations is shown in Figure 6.2.1. Information on individual stations is presented in Table 6.2.1. Within the mine lease area the longest period of record exists for the Panguna climatological station situated at the mine site. Data recorded here and at Mananau (1970 onwards) form a good basis from which a statement of the climate of the Kawerong-Jaba valley can be made. However, apart from one report by Clarke (Ref. 36) investigating patterns in sequences of rainfall events and the mean monthly hydrometeorological tables produced by the Hydrology Section of BCL little information is available describing the climate of the Kawerong-Jaba valley system. As records for several stations in the mine lease area now exceed 15 years, a full analysis could be made of the changes in rainfall over time and at different places within the Kawerong-Jaba valley system. From a brief look at the rainfall records it appears that both these factors do vary within the mine lease area. Likewise the return frequency-rainfall intensity relationship developed using 10 years of data for Panguna (Ref. 16) could be revised, as 23 years of data are now available for this location. A full analysis will not only aid in planning within the mine lease area but enable an understanding of the nature of the area's climate for the inhabitants of the Kawerong-Jaba valley system.

Table 6.2.1 History of climatological and rainfall recording stations

Station	Station number	Commenced	Record closed
Arawa	911500	01-1-1953	Current
Loloho	911400	01-7-1969	Current
Panguna	913200	01-1-1965	Current
Mananau	913450	18-6-1970	Mid 1988
Upper Kawerong	913100	15-9-1972	Current
Mosinau	913700	12-8-1977	12-06-86
Irang	913600	12-9-1977	End 1988
Jaba Pump Station	913500	04-1-1977	Current
Popei	913500	04-1-1977	11-02-1982
Moratana	913550	11-8-1977	11-02-1982
Jaba Delta	-	01-1-1979	31-03-1982

We consider that the density of meteorological stations is adequate. In fact the Kawerong-Jaba valley system is probably one of the most intensely monitored systems in PNG. From our discussions with BCL's senior hydrometeorological

9.3

officer we believe the field data collection programme is more than adequate and that all instrumentation is checked and serviced regularly. However, for some stations breaks in the record do exist due to instrument malfunction and vandalism. Cross correlation analysis of rainfall records for stations with record breaks and stations with unbroken records could be used to fill in these gaps.

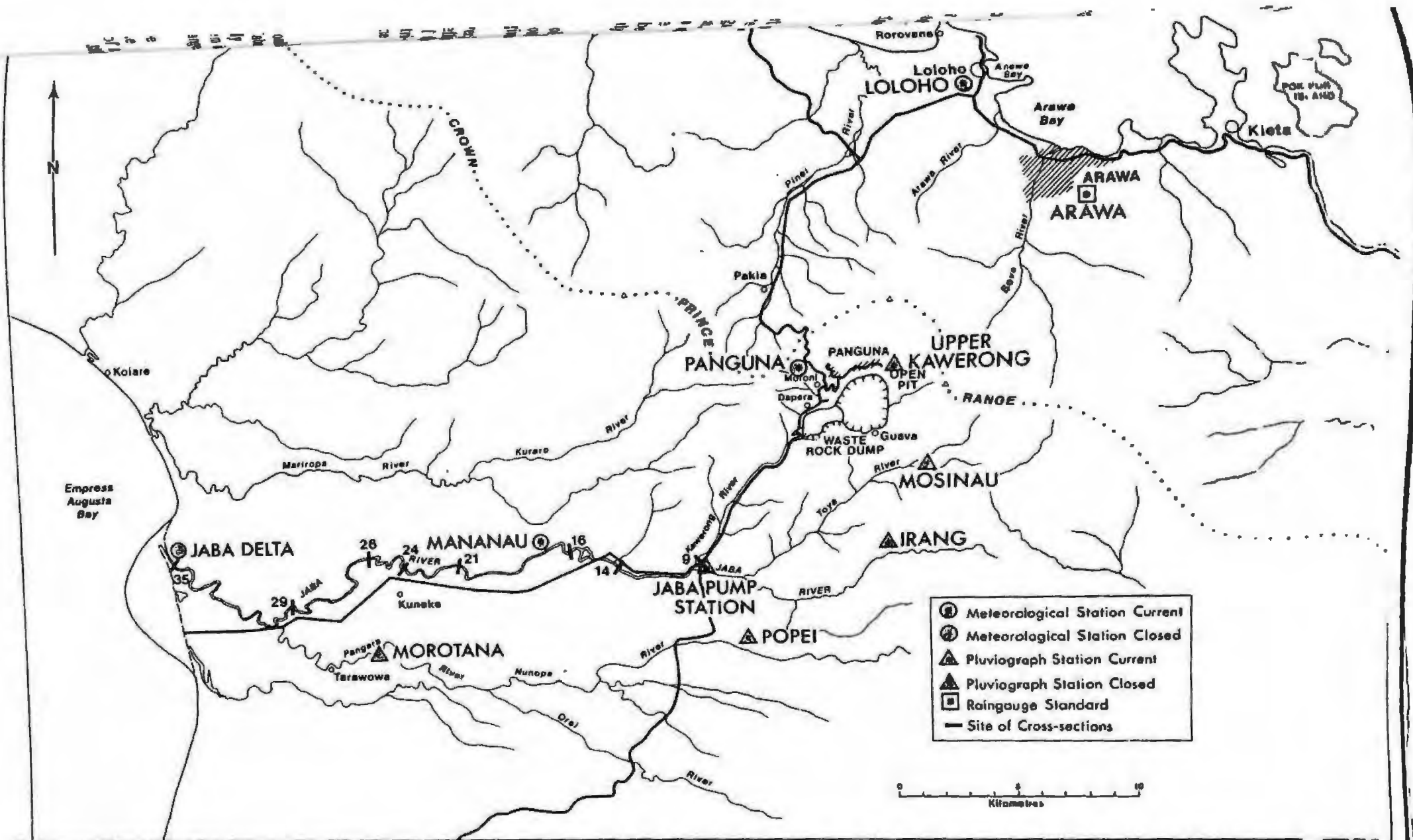
Six rainfall stations have been closed since their establishment (Table 6.2.1). At that time it appeared that data collection at these locations was of little benefit for planning and that information is no longer needed for these locations. While closure of the Popei and Moratana stations is probably warranted on economic grounds, we consider that closure of the Jaba Delta station is inappropriate given the plan to install the tailings pipeline. We believe that a rainfall recording station should be re-established at this site (pluviograph, 6 minute recording) so that depth-duration-frequency data may be gathered to allow modelling of the likely behaviour of surface runoff on tailings stacks in the delta region. To date, runoff behaviour from the tailings stacks has not been assessed with reference to rainfall depth-duration-frequency data collected at the Panguna site. As it appears that rainfall characteristics within the Kawerong-Jaba valley system vary, the use of rainfall records from Panguna for runoff modelling in the Jaba Delta region may be inappropriate.

Stream levels and river discharge are monitored at three locations. Of these locations, errors in the record are most likely to occur at the sites in the lower Kawerong River where changes in bed level are likely to have an effect on the rating curve. As no hydrological data processing is done at BCL we were unable to assess the adequacy of checks performed on individual station ratings and whether appropriate adjustments were made to stream level recording data. Hydrological data presented in the Hydrometeorological Tables are in the form of flow duration curves with little additional information on the behaviour of the Kawerong-Jaba river system hydrology over time. We believe that it would be useful to include in the Hydrometeorological Tables a summary of mean monthly discharges with instantaneous maximum and minimum flows for each month.

To our knowledge little has been written on the flood or low flow hydrology of the Kawerong-Jaba river system. Presently little flow monitoring is carried out in the lower reaches of the Kawerong-Jaba system. This is understandable given the braided nature of the channel and the instability of channel sections in this area. Regular gauging is not carried out at present on the Pangara River. This is surprising as the combined Kawerong-Jaba flow has a back-watering effect on the flood hydrology of the lower Pangara River. For a full assessment of the effect of changes in bed level and back-watering on the flood hydrology of tributaries to the Kawerong-Jaba system, the stream level gauging station in the lower parts of the Pangara River should be routinely monitored.

In addition to the standard hydrometeorological data collected and described above, a six monthly survey is carried out of bed level and channel cross-sections at 35 locations down the Kawerong-Jaba valley. This programme monitors changes in channel bed level in response to tailings input to the Kawerong-Jaba River system. The 35 cross-sections are spaced at intervals of approximately 500m and are measured each six months. The cross-section monitoring system is unique and a vast amount of information has been collected on bed level change.

While the bed level monitoring programme has given a detailed picture of the overall change of the original bed level, little information is available on the response of the bed level to infrequent hydrological events. The selection of a number of cross-sections (say cross-sections 9, 15, 17, 21, 23, 26, 29 and 35)



CLIMATOLOGICAL AND RAINFALL RECORDING STATIONS

Figure 8.2.1.

which represent depositional/erosional zones within the Kawerong-Jaba River system for monitoring bed level changes at a greater frequency (say once every 2 months) would yield valuable information as to the response of the system to aperiodic events. Likewise the performance of surveys at selected sites before and after major forecasted events would yield valuable information on the response of the Kawerong-Jaba channel to short-term events. This information may be of use in forecasting the likely behaviour of the channel bed.

6.2.2 Evaluation of the Disposal of Overburden and Tailings Agreement with respect to hydrometeorological monitoring

The Disposal of Overburden and Tailings Agreement (DOTA) of April 1971 (Appendix IV) provides details of the way in which waste rock and tailings are to be placed and managed. The DOTA is concerned with requirements for monitoring the extent of environmental impact and for undertaking experimental work to determine the feasibility of revegetation. With respect to monitoring, the following specific conditions are imposed:

- (a) the Company shall install raingauges and pluviometers in specified areas;
- (b) the Company shall take periodic measurements of river bed cross-sections below the Kawerong-Jaba junction at appropriate locations;
- (c) the Company shall periodically take vertical colour photographs of the disposed tailings;
- (d) the Company shall periodically advise the Administration of the results and interpretations of the data so collected.

With reference to conditions (a) to (c) above, BCL has complied satisfactorily. However with reference to (d), especially with regard to the interpretation of data collected, BCL has not performed particularly satisfactorily. To date only results have been presented in the regular DOTA reports although the Environmental Update is more comprehensive. There has been little synthesis of the climatological, hydrological or hydrographic data to give a coherent understanding of the physico-climatic/hydrologic dynamics of the Kawerong-Jaba River system. For example, there has to date been no integration of the results of rainfall, runoff and bed level response. This type of integration is necessary if a thorough understanding of the behaviour of the Kawerong-Jaba system is to be gained.

6.3 SEDIMENT TRANSPORT

BCL has developed a computer-based numeric model to predict the transport and deposition of sand and silt sized sediments. The model is used in prediction of bed aggradation in the Kawerong-Jaba river system and has been extended to predict behaviour of the slurry discharge from the proposed tailings pipeline.

The model was first developed in an attempt to find some solution to the problems of rapid aggradation in the river system (Ref 67). In particular aggradation threatened the Jaba Pump Station and also threatened to cause flooding and/or tailings deposition outside the lease boundary. The simple question which the

model was developed to answer was 'Will finer grinding of the tailings result in greater transport rates and less aggradation?'

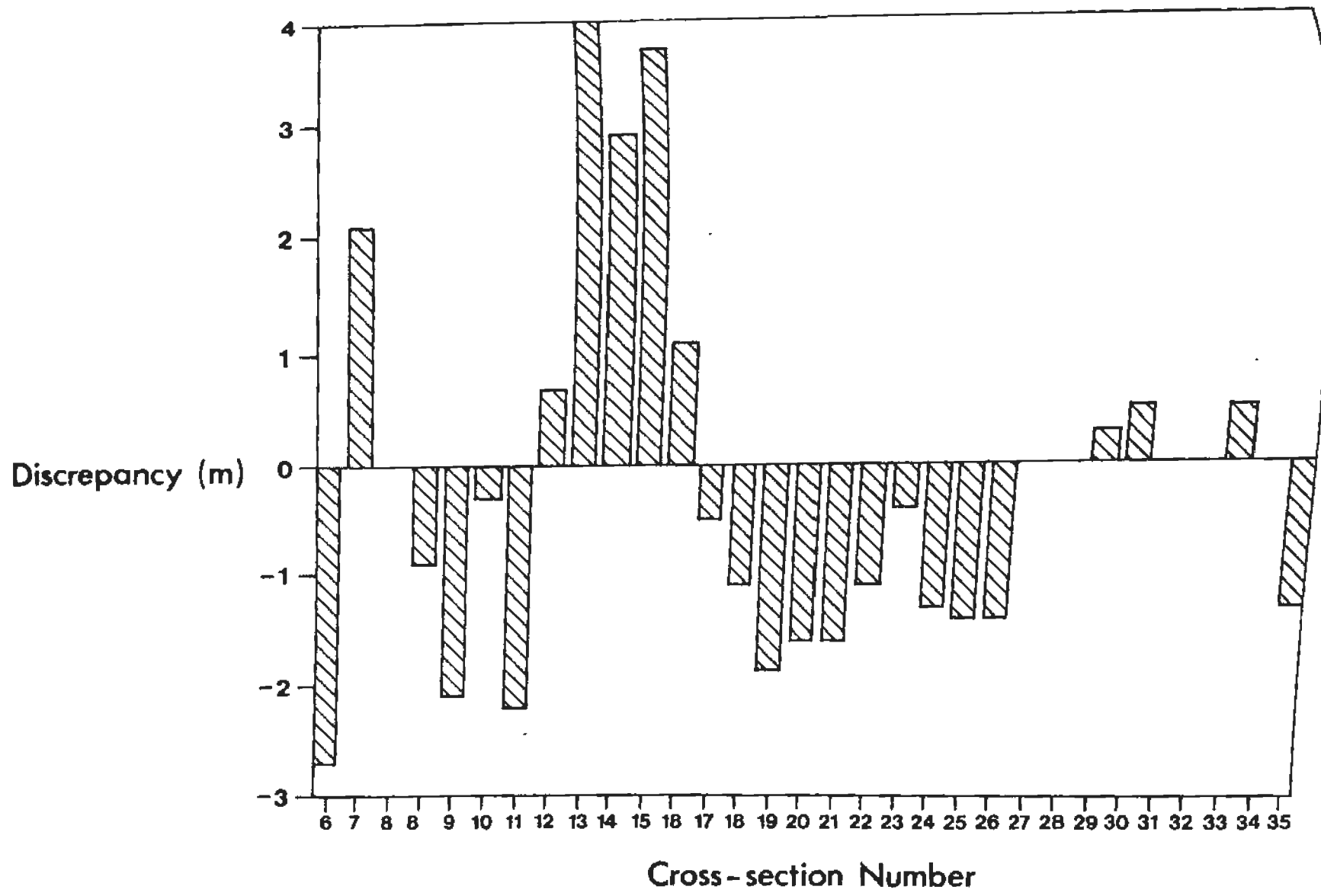
The nature of the river system is such that the only practicably measurable characteristics are discharge, channel slope and channel width. The model was accordingly developed using those characteristics.

We do not describe the operation of the model in detail in this report as it has been well described in BCL reports and publications (for example Refs. 37, 38, 39 and 40). However, a brief conceptual outline of the model is necessary to understand its limitations and utility. Its main points are:

- (a) it is primarily a transport model; it calculates the ability of the stream to transport sediment at any point and any material which cannot be transported is presumed to be deposited on the river bed;
- (b) to calculate the transport capacity of the river the model establishes a relationship between the 'fall velocity' of the sediment and the river discharge and channel slope. (The 'fall velocity' is the rate at which the sediment particles would settle in still fluid and is closely related to sediment size and the viscosity of the fluid.)

The model is a simple mathematical description of a complex natural process and relies heavily on a single 'transport constant' used in the equations to represent the effects of a number of variables. The 'transport constant' is a measure of the efficiency of sediment transport at any point in the river. The mathematics used in the model have been rigorously developed and tested but necessarily rely on a variety of assumptions or in part on equations which are very difficult to test. These limitations are recognised by BCL and the model's developer (Refs. 40 and 41). The model has produced a curious result in that the 'transport constant' at different positions along the Jaba River appears to be relatively constant at or near a theoretical maximum in spite of large variations in the factors which should control it and in spite of the fact that in other rivers and test situations the 'transport constant' does vary. The model's developer has observed that there is some support for the notion that an alluvial channel will adjust its bed form to maximise the efficiency of sediment transport (that is, the 'transport constant'). However, the result remains curious and if in future any great reliance is to be put on predictions made using the model then a more detailed review than we have been able to undertake would be advisable.

BCL has provided data which have allowed us to compare predicted and observed bed levels for 1988 (Ref. 41). This simple comparison is shown in Figure 6.3.1. The discrepancy (predicted-observed) in this period peaks at +4km at cross-section 13. The discrepancy has been attributed equally to deficiencies in model structure, differences from assumed locations for the levee, flocculant and regrind effects on the fluid behaviour of the system. This comparison illustrates the difficulties that have been encountered in all the tailings deposition predictions. Variations in tailings sizing, rate of discharge, and engineering works in the river all act to change tailings deposition from the predicted values. The model's value is as a forecasting tool and the predictions it makes are only valid while the assumed conditions of tailings sizing, output etc remain fixed. Tailings sizing in particular is critical to the success of the model's predictions. In any application of the model's output, its dependency on those assumptions must be remembered and the validity of the assumptions must be evaluated.



COMPARISON OF OBSERVED AND PREDICTED BED LEVELS
IN THE KAWERONG - JABA RIVER SYSTEM

It appears to us that the bed level of the river system, as predicted by the model is considerably less relevant to the issues of impact assessment and compensation than is the areal extent of the tailings.

In the Kawerong River and at the confluence of the Kawerong and Jaba rivers the spread of tailings is now constrained by natural topography and the levee constructed by BCL. The confining slopes are generally steep and potential for further areal spread is limited. Below the confluence, BCL has built confining structures where there is a risk of tailings or flooding spreading outside the lease area. Within these confining structures and elsewhere in the middle and lower Jaba River the land is low-lying and of very low slope gradient. Under these conditions even quite small increases in bed level of the deposited tailings can produce large increases in the areal extent of tailings. The model produces bed level predictions with potentially a considerable error and is therefore of very limited use in predicting areal extent of tailings deposition in the middle and lower Jaba River Valley.

The model has been used in studies of probable stacking behaviour of the tailings (Ref. 17). The values for the transport constant (see above) derived from the stacking tests are well in excess of the 'theoretical maximum' indicated previously and this result indicates that the model is not performing as it does when tested at the lower sediment concentrations found in the river system. The model predictions do not appear to form a major part of the available information on tailings stacking behaviour. However if that situation were to be reversed in the future we believe a very thorough review of the applicability of the model would be needed.

The sediment transport model has been used to predict a sediment discharge of 10 000 tonnes/day from the Jaba River when downcutting commences after commissioning of the tailings pipeline. The model is essentially a transport model; it does not have the capability to predict erosion of the bed reliably. This prediction and conclusions based on it should be used very carefully.

6.4 CHEMICAL AND BIOLOGICAL MONITORING

The chemical and biological monitoring programmes and the environmental research conducted by BCL can be conveniently divided into six topics:

- (1) water quality in the Jaba River and Empress Augusta Bay;
- (2) the chemical behaviour of the deposited tailings;
- (3) the chemical behaviour of the waste rock dumps;
- (4) biological changes in Empress Augusta Bay;
- (5) revegetation of tailings deposits and waste rock dumps;
- (6) other issues such as dust, power station discharges, freshwater fish, etc.

In the following sub-sections we firstly discuss BCL's monitoring facilities and programmes and then address their specific studies and results under the six topics above. As the basis for our review we examined the original BCL reports which we considered to be relevant to the critical issues discussed in Section 5, and also the two latest summaries, the Environmental Update (Ref. 16) and the

Tailings Disposal Pipeline System - Environmental Impact Report (Ref. 17).

6.4.1 Analytical facilities

The facility responsible for analysing environmental samples (such as water, soils, plants, fish etc) exists as a part of the Analytical and Environmental Services section of the Concentrator Division of BCL. The manager of the section, John Van Der Linden, and the Superintendent of the environmental chemistry group within the section, John McKenna, are both involved in the laboratory quality control organisations in Australia (NATA) and in Papua New Guinea (the National Standards Council). These two organisations are responsible for examining laboratories and ensuring that an acceptable level of quality control is maintained.

We visited the laboratories, made visual inspections of the facilities and discussed operations of the laboratories with management. A few of the more important analytical methods (for environmental purposes) were examined in detail and the past performance of the laboratory in international collaborative analytical programmes was assessed. As part of our survey of chemical conditions in some critical (as we saw them) water bodies, we conducted a joint analytical programme with the Agronomy Laboratory for some environmentally important substances.

The senior management staff (the Senior Chemist in the Agronomy Laboratory, Fred Grieshaber, was unfortunately absent) is, in our opinion, competent and would be a credit to any international laboratory. More junior staff were not assessed in detail but the smooth operation of the laboratory and the documented performance in inter-laboratory collaborative studies is as much a reflection on the junior analytical staff as it is on the management.

New accommodation of a high standard is currently under construction and the Agronomy Laboratory will move early next year into these new larger premises. We inspected other laboratories to assess the physical standards maintained rather than make judgements based on the present temporary accommodation used by the Agronomy Laboratory. The Oil Laboratory which is responsible for the analysis of metals in lubricating oils and greases, was well organised and maintained. Working area surfaces and instruments were clean and very obviously protected and serviced to maintain cost-effective and efficient service. Some of the instruments are old but their continued high performance indicates a substantial dedication to and pride in the quality of output. In any mining operation, considerable economic benefit can accrue from having accurate results and this is clearly recognised by BCL management.

Six analytical methods (some were multi-element methods) were examined in detail. As a general comment, it should be pointed out that there are several (in some cases many) alternative methods available for most of the substances routinely measured and therefore in making our assessment we looked for correct procedures for sampling, storage, preservation, method standardisation and suitability of the method for its particular purpose rather than focussing only on whether or not the latest developments and technology are being used.

The methods examined (by studying the method instructions, not by watching them being performed) were:

- (a) determination of methyl isobutyl carbinol in flotation liquor and river water;

- (b) determination of mercury in natural and waste waters;
- (c) determination of xanthate in flotation liquor and river water;
- (d) determination of methyl isobutyl carbinol at the ppm level in aqueous solutions using gas chromatography;
- (e) determination of zinc, copper, lead and cadmium in biological samples by atomic absorption spectrophotometry;
- (f) determination of zinc, copper, lead and cadmium in river and sea water by solvent extraction and atomic absorption spectrophotometry.

The methods for organic substances (a, c and d above) appear to be appropriate and capable of giving accurate results in the particular circumstances for which they are used. Specifically, the critical issues such as the instability of both compounds, variable recovery of MIBC through the distillation, and the potentially high interferences from natural humic materials on the spectrophotometric procedures are all well appreciated and corrected for. Method (e) above is a standard method, widely used, and is capable of giving reliable results.

Method (f) was once in common use but now has been replaced in many laboratories by methods with less risk of contamination from container surfaces and through handling. Our inspection of the laboratory (in temporary accommodation) did not show sufficient clean (in the sense of being specifically constructed or maintained to reduce contamination) working area to accommodate all steps in the written procedure. This, added to the use of several different containers, would make the method subject to contamination, possibly to the extent that sub-ppb measurements of metals (for example, in sea water) could be subject to large errors. We emphasise, however, that this is a fault of the method, not of the analysts and it is to their credit that they can report results at sub-ppb levels. From an environmental viewpoint, this limitation at low concentrations is not really a problem because contamination ensures that reported values are maximums; the real concentrations are less. The difficulty discussed above is recognised by management and the new laboratory and some new instrumentation can be expected to allow improved control of contamination.

The State Agricultural University, Wageningen, the Netherlands, organises an International Sample Exchange Scheme for foliar (plant material) analysis of Mg, Ca, K, N, PO_4 , Cu, Fe, Zn and Mn. In 1980, 1981 and 1982 the BCL laboratory made 678 individual assays with only one result lying outside one standard deviation of all laboratories' results. The BCL laboratory achieved first status for each of the three years. In 1982, 98 laboratories participated. Analytical precision in 1982 (as standard deviation) for the BCL laboratory was, for all parameters, less than the all-laboratories results, by factors from 2 to 6.

An inter-laboratory test of water analysis was conducted by NATA in 1983. The substances analysed were ammonia-nitrogen (NH_3-N), total Kjeldahl-N, reactive phosphorus, total phosphorus (P), chloride and chemical oxygen demand (COD). The BCL laboratory reported results for all substances except total phosphorus and COD. The results obtained were very satisfactory relative to those of the other laboratories (135 overall but not all measured all substances). BCL had no outlier results.

The BCL laboratories are registered by the National Standards Council of Papua New Guinea (the equivalent of NATA in Australia and TELARC in New Zealand) as

competent to provide analyses for a wide range of substances in various types of materials. Their registration, which we inspected, covers all substances of environmental interest in waters, sediments, plants and animals.

The results of the samples we collected during our investigation are presented in Table 6.4.1. The set of duplicate samples we collected were analysed by both BCL and the Chemistry Division of the Department of Scientific and Industrial Research (DSIR) in New Zealand. In addition to this set of duplicate samples, BCL collected a second set at the same sites. The results for these samples are included in Table 6.4.1. Overall, these results are in excellent agreement. Considering that the samples transported back to New Zealand were delayed about three weeks before analysis, the agreement between the laboratories is surprising. In only a few analyses was there a significant discrepancy and these were of no consequence from an environmental point of view. In some instances the second BCL sample confirmed the DSIR result.

The waters of the Jaba River and the stream in New Dapera Village contained very low concentrations of the trace metals measured. All other samples showed results consistent with previous BCL results except for the duplicates of Sample 4 which both contained high concentrations of zinc. The reason for this, which was not confirmed by the subsequent sample, is not known. All samples contained arsenic and lead at negligible concentrations. Cadmium was also present at low concentrations in all samples except the waste rock drainage.

In our opinion, the BCL laboratories which we examined, and in particular, the laboratory and staff responsible for analytical work relevant to the issues we address in this report, are capable of producing reliable results for all the substances which they measure. We are confident that the concentrations reported by BCL are of adequate accuracy for the purposes for which they are used. Accordingly we accept the data they have reported in their various research and monitoring documents.

6.4.2 Chemical and biological monitoring programmes

The monitoring programmes conducted by BCL are summarised in the Environmental Update (Ref. 16) and are reproduced here in Appendix VII.

The results from the surveys listed below are presented to the Government in the DOTA reports each six months:

- (a) filter plant effluent at Loloho;
- (b) dump leachate stream;
- (c) river waters (seven sites);
- (d) sea waters from Empress Augusta Bay (24 samples from 9 sites)
- (e) tailings slurry water.

Other studies are conducted as part of ongoing research programmes (although some are required as part of mining lease conditions). These programmes include the lysimeter studies (Section 6.4.4), the revegetation trials (Section 6.5), freshwater fish (Section 6.4.8) and the coastal fish and benthic (sediment-living) animals (Section 6.4.6). Our discussion of these programmes is included in the sections as noted.

Table 6.4.1 Concentrations of various substances in water samples collected in duplicate and analysed by BCL and the Chemistry Division of the New Zealand Department of Scientific and Industrial Research. A second set of samples collected by BCL is included

Sample No.	Site	Laboratory	Calcium (mg/L)	Sulphate (mg/L)	Arsenic (ug/L)	Cadmium (ug/L)	Lead (ug/L)	Zinc (ug/L)	Copper (ug/L)
1	Waste rock drainage	DSIR*	282	1650	1.3	26	1.6**	3600	82000
		BCL*	308	1611	<5	60	-	3800	97000
		BCL	314	1594	<5	30	-	3800	98000
2	Levee drainage	DSIR	174	530	1.1	0.27	0.6	21	160
		BCL	190	501	<5	<1	-	20	190
		BCL	162	421	<5	<1	-	19	120
3	Jaba River upstream of pumphouse	DSIR	9.5	6	1.1	<0.05	1.0	1.14	11.5
		BCL	9.6	33	<5	<1	-	1	1
		BCL	9.7	5	<5	<1	-	1	2
4	Jaba River end of levee	DSIR	143	410	2.0	0.20	0.7	780	2.4
		BCL	141	420	<5	<1	-	240	3
		BCL	137	386	<5	<1	-	<1	3
5	Pukitalai crossing	DSIR	34	54	1.7	<0.05	0.7	2.2	11.7
		BCL	32	64	<5	<1	-	2	7
		BCL	35	56	<5	<1	-	3	6
6	Bato Bridge	DSIR	57	140	2.8	<0.05	0.8	2.1	3.2
		BCL	56	139	<5	<1	-	1	3
		BCL	64	152	<5	<1	-	10	2
7	Dapera Village Stream	DSIR	6.9	5	2.5	<0.05	0.5	6.3	1.1
		BCL	7.3	11	<5	<1	-	1	1
		BCL	7.2	5	<5	<1	-	1	1

Notes: * Duplicates collected at the same time or in some cases sequentially. Second BCL result for sample collected 10 days later.

** BCL was not asked to analyse for lead.

6.4.3 Water quality in the Jaba River and Empress Augusta Bay

The medium (post-tailings pipeline) and long-term prospects for successful recolonisation of the Jaba River depend on the biological acceptability of physical and chemical conditions in the river. The physical effects of suspended sediment have been discussed (Section 5) and here we examine attempts made by BCL to predict the concentrations of those chemicals in the river which could limit recolonisation of the Jaba River by fish and other animals.

BCL has constructed a chemical model for the Jaba River for after the tailings pipeline comes into operation. It predicts the total concentrations of soluble copper and the various soluble forms at different locations in the river channel, for a wide range of different situations. This model considers all of the processes (see Section 5.7.2.3) which could influence the concentrations of soluble copper in the river water. The expectations of the villagers in the Jaba Valley include the return of a useful fishery to the Jaba River and this reason alone is sufficient to justify a careful examination of the chemical model. It is, after all, the only tool which can give some idea of future chemical conditions and consequently the prospects for recolonisation of the river.

In our examination of the BCL model we studied the original documents which described the results of experiments and field observations and some of the fundamental data used for the model calculations and calibrations (Refs. 42, 43, 44, 45 and 46).

We also studied the structure of the model (that is, the chemical theory and equations on which it is based), and also the data obtained from experimental work reported in the international scientific literature.

The model involves very complex calculations which can be solved in a reasonable time only by computer, but despite this, the basic principles of the model are quite simple and easy to understand. We can consider the river water (the flowing part) as a series of segments and the model calculates how much soluble copper is in each segment for any set of conditions we think might occur in the future. The size of each segment is determined by the amount of water flowing between specific cross-sections in the river. Copper and other substances flow into this segment with, for example, the leachate from the waste dumps, the Kawerong River water (without the tailings inflow), the water from other streams down the Jaba Valley, the natural sediment from the Kawerong River and other streams, and the water draining through the tailings deposits. These various flows into the segment contain different amounts of copper and other substances which can change the concentration of copper in the water. The model considers all of these substances in each segment and calculates what happens to the copper and how much soluble copper remains in the water after all of the possible changes (chemical reactions) have taken place. Not all of the soluble copper is in the same form and the model estimates how much of each different form is present in the river water. Calculations have been done for many different conditions of river flow, leachate flow and tailings drainage. These three inputs to the river are the most important for determining copper concentrations in the river water.

The model results show that when either the waste rock leachate or the drainage from the tailings or both flows into the Jaba River water, the acid is neutralised (chemically destroyed) and the copper from the leachate and drainage is changed to a solid substance called 'bronchiatite' (this is a solid containing copper, hydroxide and sulphate). Bronchiatite then controls the concentrations

of soluble copper in the river water. So as long as some of this solid can form, the soluble copper concentrations in the river water will remain almost the same. If there is more copper in the leachate or tailings drainage then more bronchiatite will form but the soluble copper concentration will remain the same; that is, about 0.2 to 0.4 mg/L. The only situation which is predicted to result in lower soluble copper concentrations is when there is no leachate entering the river (for example, if a copper recovery plant operated on the leachate) and when there is no copper draining from the tailings. In this case any bronchiatite in the river would dissolve and when it had all disappeared, soluble copper concentrations would decrease. The model predicts that they could decrease to 0.02 mg/L or less downstream of cross-section 14. If this situation is ever reached, soluble copper concentrations may not be a limitation to recolonisation of the Jaba River by fish and other aquatic animals.

The model also calculates the concentrations of different forms of soluble copper in the river water. Some of these forms are more toxic to animals than are others and this information allows more realistic predictions of future conditions for aquatic life in the Jaba River. These calculations are also consistent with chemical theory and are probably as good as can be achieved at the present time. However, as discussed below, the results of the calculations are very dependent on the validity of several assumptions.

Our study of the model revealed that the structure, chemical theory and methods of solving the equations, are consistent with other similar procedures in use around the world and we have no criticisms of either the way in which the model has been constructed or the method by which it arrives at the desired results. However, one of the critical components of the model is the formation of the solid copper phase, bronchiatite, and this is very dependent on the acidity (pH) of the river water; the acidity is largely controlled by the quantity of carbon dioxide (a gas which is naturally present in air and which is produced when the leachate mixes with river water). Carbon dioxide is lost by volatilisation into the atmosphere. The rate at which this gas is lost is dependent on the amount of turbulence in the river (effective surface area exposed to the atmosphere) and it is difficult to estimate what this rate will be if the structure of the Jaba River changes (for example, runs as a single channel through the tailings deposits). For this, and other reasons there is considerable uncertainty in the model predictions of the soluble copper concentrations in the river water.

Another complication to the ability of the model to make reliable predictions is the effect of suspended sediment (either tailings or natural river sediment) on soluble copper concentrations. Tailings have only a small capacity to adsorb copper from solution and present knowledge indicates that this will not be an important mechanism for reducing soluble copper concentrations below those controlled by the precipitate bronchiatite. For example, the model predicts that if the concentration of tailings in the water were increased to a level such as 20 000 mg/L (20 g/L) soluble copper concentrations would decrease from the solubility-controlled concentration at cross-section 35 of 0.2 mg/L, to 0.05 mg/L. However, this concentration of sediment (about 10 times the present level) would be unacceptable to fish. However, natural river sediment has a five to ten times greater potential to adsorb copper than have tailings so that low copper concentrations would require about 7000 mg/L of natural sediment. Such a concentration is unlikely ever to occur naturally except for brief periods following massive erosion in the catchment, also a very unlikely event. It must also be understood that adsorption processes cannot decrease soluble copper concentrations below those controlled by bronchiatite until this mineral has completely dissolved. Another area of uncertainty concerns the capacity of

the fine tailings in the lower reaches of the Jaba River to adsorb copper from solution. If, in fact, this capacity is greater than has been estimated so far, then adsorption of copper onto sediment could become the dominant mechanism controlling soluble copper concentrations in the lower Jaba River.

It is our opinion (and also BCL's) that the concentrations predicted by the model are maximum values and that in the longer term soluble copper concentrations could be lower. This would, of course, be advantageous for the river. However, we also caution against placing too much reliance on the precise values produced by the model because many of the assumptions have not yet been validated. Despite this caution, we are confident that the model is producing the best estimate for future soluble copper concentrations based on present knowledge but we firmly recommend that research continues as a priority on:

- (a) the influence of carbon dioxide, because it is a primary control not only on the concentrations of total soluble copper but also on the different forms of soluble copper;
- (b) on the influence of suspended particulate matter, both from natural erosion and tailings.

The results of the chemical monitoring programme conducted in Empress Augusta Bay are presented in the six monthly DOTA reports. Water samples are collected along two transects - one towards the south-west from the delta and the other towards the north-west. Four samples are collected along each transect plus one immediately off the delta (see Figure 6.2.1). High concentrations of soluble copper were reported (Ref. 16) in the plume of water (and tailings) flowing into the Bay from the Jaba River. These concentrations ranged from 0.002 to 0.027 mg/L with a mean of 0.012 mg/L, compared to concentrations of 0.0003 to 0.0007 mg/L found 10km out from the shore of Rorovana Bay. This plume was arbitrarily chosen as the region with reduced salinity (sea water mixed with freshwater) and increased suspended solids (tailings). It extended between 3 and 5km offshore. High copper concentrations (0.007 to 0.035 mg/L) were also found in the bottom waters immediately above the sediment. Concentrations in the water trapped within the sediment (called the interstitial water) were up to 0.160 mg/L and it was suggested that this copper moved up from the sediment and caused the elevated concentrations in the bottom waters. Such high concentrations in interstitial waters are unusual and must therefore be a result of an equally unusual characteristic of the deposited tailings.

BCL proposed three possible mechanisms to explain the release of copper from the tailings in the plume:

- (a) conversion of bronchiatite to atacamite (a copper hydroxide chloride solid $Cu_2(OH)_3Cl$) due to a change in the relative stabilities of the two compounds as a result of changing water composition.
- (b) desorption of copper from the solid phase (tailings) upon increase in the salinity of the water;
- (c) oxidation of organic matter causing acidification and solubilisation of copper.

Only the first two are applicable to plume waters but all three could be important in deposited tailings. BCL also studied the form of the copper released, because as mentioned earlier, different forms have different toxicities. It was

found that 40-100% of copper in the plume and bottom waters should be biologically available, but when BCL tested these waters with a marine diatom (a very small marine organism) no evidence of toxicity was found. (We did not examine these results.)

In the Environmental Update (Ref. 16), BCL suggested that the first mechanism proposed above for the release of copper from the tailings is unlikely to be important because the chemical model indicates that surface adsorption of copper onto the tailings controls copper solubility in the Jaba River. This suggestion appears to us to be inconsistent with previous conclusions from the model; for example, in the previous section of the Environmental Update, it is stated that the model, subsequent to the 1985 upgrade, indicated that when tailings are no longer being disposed into the river neither organic matter nor particulate material will significantly affect water chemistry. It is apparent to us that this question of adsorption versus precipitation as the mechanism controlling soluble copper concentrations, particularly in the lower Jaba River, has yet to be resolved, partly because the kinetics of the precipitation/dissolution process are not well understood and partly because the adsorption coefficients (in effect the capacity and strength of the adsorption process) are not accurately known. Predictions for recolonisation of the lower Jaba and Pangara rivers depend on the accuracy with which these mechanisms are understood and if it is found that adsorption will control copper solubility, this would raise hopes that soluble copper concentrations in the Jaba River will be lower than presently predicted.

The release of copper from the tailings deposited in Empress Augusta Bay could be of vital importance to benthic (sediment-living) organisms. While such levels of copper persist in the interstitial and overlying water, the sediment environment may remain unacceptable to animals. In a practical sense, this issue is somewhat academic before the end of mine life, because the continued discharge of tailings into the Bay from the pipeline will prevent any recolonisation of the deposited tailings. However, as part of understanding the rehabilitation of mine wastes in the longer term, the recovery of the animal communities in the sediment in Empress Augusta Bay clearly warrants further study of the sediment chemistry.

6.4.4 The chemical behaviour of the deposited tailings

A substantial effort has been expended by BCL to study the long-term leaching behaviour of tailings (Refs. 47, 48, 49, 50, 51, 52 and 53). Most of this work has been directed at lysimeter experiments set up in two programmes. Lysimeters are large containers filled with tailings but constructed so that samples of water draining through the tailings can be collected at different depths. Water is added to the surfaces of the tailings either from natural rainfall (the 'old' series of lysimeters) or manually in a controlled manner (the 'new' series of lysimeters).

The primary objectives of these studies can be summarised as:

- (a) to determine the concentrations of metals in the water draining through the tailings;
- (b) to determine the rate at which chemicals are leached from the tailings;
- (c) to predict from these results the long-term leaching behaviour of the tailings deposited in the Jaba River valley.

3.1

The 'old' series of lysimeters was established in 1974 and measurements continued for almost 10 years. The tailings used were fresh mill tailings which had been hydrocycloned to separate out the finest tailings (which were presumably expected to pass through to Empress Augusta Bay). The coarse fraction (intended to be representative of the tailings deposited in the river valley) was used in the lysimeters.

The results obtained from these lysimeters showed that during the first five years of leaching (by natural rainfall) the leachate pH decreased from about 10 (an alkaline condition caused mostly by the lime added during processing) to a minimum of 3.7 (this acidic condition resulted from oxidation of sulphide). The rate of change was greatest in the surface sediment where oxygen from the air was readily available. As the pH decreased below 7 (that is, became more acidic) copper concentrations in the leachate increased from very low levels up to 400 to 500 mg/L at pH 3.7 to 4.0 (about the maximum observed acidity). Concentrations of some other metals including zinc and aluminium also increased. After the first five to six years all the 'available' (in contact with the water) sulphide had been oxidised. As a consequence concentrations of the copper and other metals in the leachate decreased, in some cases quite rapidly. The acidity also began to decrease although at a slower rate. After 10 years, leachate copper concentrations ranged between 10 and 20 mg/L.

The solid tailings were examined and it was found that over the 10 years of leaching the sulphide content had decreased from an initial average concentration of about 0.2 to 0.3% (2000 to 3000 mg/kg) to a final value of less than 0.1% (1000 mg/kg). Total copper concentrations started at about 760 mg/kg and after 10 years had decreased to about 400 mg/kg. Thus a bit more than half of the sulphide and a bit less than half of the copper had leached out over 10 years. The pH after 10 years was 5.4 (slightly acidic).

Experiments such as these are assumed to represent the real situation; in this case, the behaviour of tailings in the Jaba River valley. We cannot see any reason why this assumption should be seriously wrong and although the wetting/drying processes in the lysimeters may not be typical of the tailings deposits in the Jaba River valley, the results obtained offer the prospect that most of the 'available' sulphide and copper could be leached out of the deposited tailings before the end of mine life. If this, in fact, proved to be true, BCL would have the opportunity to develop its revegetation programme to the final stage where acid, copper and aluminium no longer limit plant growth.

However, it should be remembered that almost half of the original copper and sulphide remained in the lysimeter tailings after 10 years and the reason for this is probably that this remaining fraction was not in good contact with flowing water. As long as the tailings are not disturbed this remaining copper and sulphide will either not leach or will leach only slowly. However, if the tailings are disturbed (as they are likely to be by river realignment works, or by the natural meandering of an uncontrolled river channel, or as the channel cuts deeper into the tailings) then most of the remaining copper and sulphide will eventually be exposed to oxidation.

A 'new' set of lysimeters was established in about 1980, using the coarse fraction of hydrocycloned run-of-mill tailings (freshly produced tailings) and also deposited tailings taken from between cross-section 24 and cross-section 25 for one lysimeter and near cross-section 11 for another. These experiments were commenced to examine the leaching rate under controlled water addition rather than under the uncontrolled natural rainfall situation used for the 'old' lysi-

meters, and also to investigate the chemical response of the tailings to a fluctuating water table and to water saturated conditions. The results obtained were, in general, equivalent to those obtained with the 'old' lysimeters. For example, after three years the run-of-mill tailings pH had dropped only 2 units, from 8 to 6 (the 'old' tailings had become acidic in their surface layers, with a pH of about 4). This difference was attributed to lime in the run-of-mill tailings which would have neutralised most acid produced. Tailings below the permanent water table (always water saturated) were chemically stable and did not produce acid or copper. However, in the zone of fluctuating water table and also in tailings containing the maximum quantity of water without draining (at 'field capacity'), sulphide oxidation and copper leaching occurred but at a slower rate than observed in free-draining tailings. As would be expected from these leachate observations, the river tailings producing acidic leachate showed decreased total sulphide and copper, in contrast to the run-of-mill tailings which showed no changes in total sulphide or total copper after three years.

The experiments using both the 'old' and 'new' lysimeters must be acknowledged as an attempt to transfer a small piece of the real situation (the tailings deposits in the Jaba Valley) into a semi-controlled environment. There are many potential pitfalls associated with this procedure, as BCL staff are fully aware. In our opinion, the work has been well done considering the obvious difficulties of maintaining an objective, consistent philosophy towards the experiments over 10 years. The principal conclusions, as summarised below, together with the chemical modelling (Section 6.4.3) allow predictions of a time frame for rehabilitation of the Jaba River valley (Section 7.3.2).

In summary, the lysimeter experiments have shown that:

- (a) water-saturated tailings will not produce acid or soluble copper;
- (b) lime in the tailings delays the onset of sulphide oxidation;
- (c) most of the oxidation occurs within five years, and after 10 years the tailings drainage is of low acidity with low (10 to 20 mg/L) concentration of soluble copper;
- (d) about half of the original sulphide and copper remains in the tailings after 10 years of leaching. (This conclusion refers to tailings which are not subsequently disturbed after deposition.)

6.4.5 The chemical behaviour of the waste rock dumps

In their present configuration and probably until the end of mine life, the waste rock dumps drain to a single point (BCL's KR2 site). The flow at this point is monitored and the results are presented in the DOTA reports each six months. We presented a summary table in Section 5.7.2.2 (Table 5.7.1) giving the KR2 monitoring results and discussed the implications of the results.

The monitoring programme appears to have three principal aims:

- (a) to satisfy the DOTA agreement;
- (b) to quantify the copper loss from the dumps for the purposes of assessing the feasibility of recovering copper and as a primary copper input to the chemical model;

- (c) to detect any changes to the leaching behaviour of the dumps.

The only significant research on the waste rock leachate appears to be related to investigations of options for recovering copper from the dumps. This research has focussed primarily on procedures which might accelerate the leaching process within the dumps and on locating pockets of rapid leaching of high copper concentrations. These investigations do not directly influence the environment but if any of the options proved to be sufficiently attractive to put into practice, then the result would be advantageous to the Jaba River. The copper now flowing into the river from the dump would be substantially reduced (perhaps to 1 mg/L from the present 70 mg/L) and also the reservoir of copper in the waste rock dumps (presently about 800 000 tonnes) would be much more rapidly depleted. This would result in much lower concentrations of acid and copper in the leachate (there will always be leachate) sooner than would be the case if the dumps were left to leach naturally.

One other piece of research concerning the waste rock leachate was done by BCL as part of studies of high copper concentrations in the waters of Empress Augusta Bay. It was suspected that much of this copper originated from the waste rock leachate entering the Kawerong River. As discussed in Section 6.4.3 this copper precipitates in the Jaba River and some of the precipitate must flow into Empress Augusta Bay. Experiments were conducted to test the behaviour of these precipitates in sea water (Ref. 54). Of most relevance were the observations that precipitates, formed by mixing Jaba River water with waste rock leachate, mixed in sea water for 50 days, produced initial concentrations of over 0.3 mg/L but final concentrations of 0.2 mg/L. It was also demonstrated that if enough river sediment (presumably natural sediment) were present in the river water/leachate/ sea water mixture, then soluble copper concentrations were only 0.01 to 0.07 mg/L. It was suggested that this result was due to adsorption of copper onto the river fines. (This process has been discussed earlier in relation to Jaba River water quality - Section 6.4.3). The experiments also showed that peak concentrations in sea water were not reached for 24 hours or more during which time the precipitate and the soluble copper concentrations would be considerably diluted by dispersion at the delta.

The implications of this work are that soluble copper concentrations in the waters of the Jaba delta and Empress Augusta Bay after the tailings pipeline is operational, will depend on many factors, most of which are not presently understood. However, it is encouraging from a scientific point of view, that the concentrations observed in the experiments are similar to those measured in the interstitial waters of sediments in Empress Augusta Bay.

6.4.6 Biological changes in Empress Augusta Bay

The research conducted by BCL into the fish resources of Empress Augusta Bay can be described in five parts:

- (a) a survey of fish and shellfish use by the villagers of Empress Augusta Bay;
- (b) studies of trace metal concentrations in fish from both Empress Augusta Bay and the east coast of Bougainville;
- (c) surveys of the population of the small blue mussel Donax cuneata in Empress Augusta Bay;
- (d) population studies of macroinvertebrates (animals larger than 1.2mm) in the sediments of Empress Augusta Bay and Rorovana Bay;

- (e) studies of fish population structure in Empress Augusta Bay and at sites on the east coast of Bougainville.

The two villages with fishing rights over most of Empress Augusta Bay, Koiare and Miwaraka, were surveyed by BCL to document the use made by these villages of the aquatic environment, including rivers, swamps, coastal areas and the sea (Ref. 55). The survey was conducted by questionnaire and direct interviews. Responses were generally similar at both villages. Koiare had a stated population of 171 (1980 census was 157) and fishes the sea area from, and including, the Jaba River delta to Torokina and the rivers Jaba, Mariropa, Korobi, Bereu and Dapon. Miwaraka has a population of 40 and fishes the sea from the Jaba delta south to Mokuu and the rivers Tuju, Tovena, Hupei, Nama and Mamaregu. The aquatic environment is used for recreation, washing, transport, haulage and fishing both as a regular source of food and as a source of food for feasts. Families fish three to six hours per day once or twice each week and they eat fish two to four times per week. For a feast, 15 to 25 people may fish for a week to catch 200 to 300 fish. When fish are not plentiful shellfish, fresh-water kina shellfish and the small blue mussel are eaten.

A similar survey was undertaken at Marowa, just north of Cape Torokina. This village with 188 people fishes the sea area from the Gagaun River in the south to the Astinima River in the north. More effort is put into fishing in this village perhaps because of the productive offshore reefs. For example, families averaged 14.5 hours fishing per week and eat fish three to four times per week and shellfish one or twice each week.

These surveys illustrate the quite extensive use made of the coastal and sea fishery by the village people of Empress Augusta Bay and the Torokina area. In particular, the survey results emphasise the impact that loss of the fishery (or avoidance of the fishery because of disease fears) could have on these villages. The contrast between the responses to these surveys done in 1983/84 and the comments we recorded at Koiare (see Section 5.7.3.1) show quite dramatically the substantial change which has occurred to the village peoples' perceptions of their fishery (at least at Koiare).

BCL has conducted extensive studies of the aquatic life in Empress Augusta Bay and at some east coast sites (Ref. 16). The primary objective of these studies was to investigate the impact of the tailings flowing out of the Jaba River, on the benthic animals and fish of the Bay.

The benthic animals were sampled by collecting sediment with a grab and then recovering the animals by washing the sediment through a 1.2mm sieve. The numbers, species and weights of the animals from each site (64 sites in Empress Augusta Bay and 18 sites in Rorovana Bay) were recorded and the data were used to calculate biomass levels (the weight of animals in a certain area of the bottom sediment) and indicators of the community structure (the extent to which the community is a well balanced mixture of species). The general findings of this study to date can be summarised as follows:

- (a) the Rorovana sites are probably good representations of what the situation was in Empress Augusta Bay before the mine started operation;
- (b) both the Rorovana and Empress Augusta Bay sites (those not influenced by tailings) have a low benthic biomass, about 7 to 8 g/m² (this is the weight of animals in 1m² of sediment area). Such low values appear to be natural;

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(c) a large area of Empress Augusta Bay has been affected by tailings (150km² in 1981) with sediment copper concentrations of greater than 50 mg/kg. This area contains reduced benthic biomass. As an approximate guide, sediment concentrations are greater than 100 mg/kg, benthic biomass is less than 3 g/m² (compared with 10 g/m² or more in areas not apparently affected by tailings). Above sediment copper concentrations of 500 mg/kg, the benthic biomass is <0.2 g/m².

BCL proposed three possible reasons for the loss of biomass:

- (a) copper toxicity;
- (b) physical smothering;
- (c) habitat alteration.

This last reason refers to the fact that animals which normally live in a sandy sediment might choose not to live in the very fine tailings.

At this time it is not clear which of these three reasons is dominant and, in fact, different animals may have different reasons for not living in the tailings. All of these reasons can be put into perspective by considering the physical composition of a sediment which contains 500 mg/kg of total copper. If the natural sediment contained 50 mg/kg and the sample collected contained 31% of tailings assuming a total copper concentration of 1500 mg/kg in the tailings. If the tailings were spread on the surface of the sediment they would represent a layer of 16mm which would give the physical smothering effect.

The extensive loss of benthic biomass could have a disastrous effect on the fish which depend on the benthic animals for food directly or indirectly through other fish. BCL considered this possibility and have studied fish populations at several sites, on both the west coast and the east coast (see below). Fishing using 100mm gill nets and 10mm seine nets has been carried out at about 18 month intervals but more frequently in some years since 1975. A very large amount of data on fish biomass and species has been collected and these have been evaluated by statistical analysis (mathematical techniques which detect similarities and differences between groups of data). The overall conclusions from this study (as reported in Ref. 16) were that the fish community structures of the west coast sites were similar to those on the east coast. However, the analysis also indicated that the species composition at the Jaba delta site may be changing away from those at the other sites. BCL noted that:

'it will be necessary to examine the discontinuity between sites to check whether there is a gradual 'drift' taking place in which the Jaba delta site becomes increasingly dissimilar to other reference sites.'

Much of the information from this study has been compiled into a thesis which was submitted to the University of Queensland by J Powell for a PhD degree (Ref. 56). The thesis was accepted for the degree in August 1987 and this means that the work discussed in the thesis has been examined and approved by independent scientists. We viewed this thesis with the permission of Dr Powell. The sampling programme is summarised below and we quote some of the main conclusions. Fish were sampled (using nets as described above) on 11 occasions between 1974 and 1984 from just outside seven estuaries - four in Empress Augusta Bay (including the Jaba delta) and three on the east coast. The results of this fishing programme are described above but in the Thesis, the relationship between the fish populations and the benthic biomass was considered further. As mentioned above, it was thought that the loss of benthic biomass could have

caused a decline in some species of fish but according to the results of surveys up to 1984 this had not occurred. The Thesis concluded:

'that loss of benthos has not been accompanied by loss of fish, indicating that fish either make extensive use of macrobenthos stocks beyond the area of tailings disposal or that macrobenthos is of secondary importance in the support of this tropical assemblage.'

It was also suggested:

'that detritus from terrestrial sources (rain forest and coastal swamps) forms the primary energy source for this tropical coastal ecosystem (augmented by zooplankton of oceanic origin) and that the feeding strategies of the fish species within the coastal assemblage are adopted to make use of the detritus pathway.'

These conclusions seem to us to be consistent with the fish population data and the low natural levels of benthic biomass. However, we also note that in the Environmental Update (Ref. 16) it is reported that of the 130 demersal fish species captured, only 3% were detritivores (feed on detritus) whereas 80% are mainly carnivorous (feeding either directly on benthic organisms or feeding on other fish which in turn may feed on benthic organisms). If the conclusions in both the Thesis and the Environmental Update are correct then the 3% of demersal species which are detritivores must contribute the major part of the demersal fish biomass. We doubt that this is the case because there are many fish that are not demersal but the apparently contradictory conclusions are confusing.

The fish resources of Empress Augusta Bay are important to the coastal (and to some extent the inland) village people and it is, in our opinion, essential that the long-term impacts of tailings (particularly from the pipeline) are adequately understood. There will obviously be a severe impact on the benthic animals of Empress Augusta Bay for a long time and a continued monitoring programme of fish stocks seem to be a necessary activity. We comment on this further in Section 7.

A further extension of the current fish monitoring programme is a study of heavy metal concentrations in fish flesh and some organs. This work has involved more than 20 000 analyses over the period June 1976 to December 1984 for copper, lead, arsenic, zinc, cadmium and mercury in 15 species of coastal marine fish from the east and west coasts of Bougainville Island.

Copper was the only metal which showed an obvious difference between the east and west coasts. Two species of west coast fish, both trevallies, showed evidence of bioaccumulation of copper but the highest recorded concentration (2.14 mg/kg wet weight in the flesh) was less than 10% of the standard (30 mg/kg) recommended by the Australian National Health and Medical Research Council (ANHMRC). Lead and zinc were not bioaccumulated in any species and concentrations were less than the recommended levels (ANHMRC) of 2 mg/kg for lead and 40 mg/kg for zinc. (These standards for copper and zinc reflect the low toxicities of these metals to people as discussed in Section 5.7.2.2).

Cadmium and mercury showed evidence of bioaccumulation in some species but these were about equally distributed between the east and west coast. This is evidence against any influence from the mine but in almost all cases the ANHMRC recommended levels were complied with.

Arsenic was bioaccumulated in some species again from both the east and west coasts but it is now known that the arsenic accumulated in some fish is present in a non-toxic form.

It was concluded 'that the current method of tailings disposal is not having an adverse effect on trace element levels in coastal fish'. We have examined the data reported and agree with this conclusion.

The final part of the biological monitoring programme is a survey of mussel (*Donax cuneata*) populations in Empress Augusta Bay. We have reported the apparent loss of this mussel from the beach at Koiare while some stocks were available to the hamlet 1km south of Koiare. BCL has recorded a loss of mussels from beaches affected by tailings and has concluded that the loss is probably due to the copper content of the tailings. However, in addition to this loss, there are large natural variations in mussel populations at any particular location often over a relatively short period. These short-term fluctuations are natural and result from changes to beach morphology particularly as a result of storms. These types of changes are illustrated by the following data obtained by BCL. At a site just north of the Taugarunga River (between the Mariropa and the Rinei rivers) the numbers of mussels per square metre of beach (the inter-tidal zone) were 56, 7, 4 and 30 on four sampling occasions during 1986. At another site between the Rinei and Saua rivers, the numbers varied from 81 to 6 then back to 42 between April and October 1987.

It was interesting to note that the BCL surveys did not record more than nine mussels/square metre on any of six sampling occasions during 1988 at the site near the Taugarunga River which was the closest site to Koiare village.

6.4.8 Revegetation of tailings deposits and waste rock dumps

The revegetation process depends primarily on water and chemicals; too much or too little of these, and plants will not thrive. The tailings and waste rock as they mostly exist now, are unfavourable for plant growth because they do not hold sufficient water, they contain metals which are toxic to plants and they are deficient in the major plant nutrients, phosphorus and nitrogen and also some trace elements. For successful, permanent plant growth all of these problems must be removed.

Revegetation of the tailings and waste rock by natural processes would pass through four stages. Firstly, rainfall would wash the surface layers free of acid and metals. Secondly, some local plants which can tolerate sandy, low nutrient conditions would establish. These would be mostly grasses and reeds in association with plants able to convert nitrogen gas from the air into nutrient nitrogen called nitrogen fixers. Thirdly, a soil would develop from the decaying organic matter produced by the plants and from chemical changes (weathering) of the tailings or waste rock. Finally, other local plants would displace the grasses and reeds.

If left to nature this progression back to a vegetation cover would take a very long time, possibly many or perhaps hundreds of years. It is unlikely that the tailings in particular, would ever be covered by the vegetation community of the Panguna area because the habitat on the tailings is flat, well-drained and sandy, whereas the surrounding countryside is steep and the soils are well developed on volcanic ash. It is more likely that the ultimate vegetation of the tailings will resemble that on the coastal plains but even then the similarity may be limited by the difference in the water available on the tailings compared to that on the coastal plain.

It is possible to help nature to revegetate the tailings and waste rock by speeding up some of the stages discussed above. The revegetation programme being pursued by BCL is aimed at showing that plants will, in fact, grow on the tailings (Ref. 16). There was never any doubt about this but the question was how long would it take. BCL has attempted to accelerate the process described above experimentally by:

- (a) adding lime to remove acid and reduce the toxicity of copper (by processes similar to those described previously for the Jaba River water);
- (b) introducing some plants from other places which are more tolerant of the sandy, acid conditions;
- (c) choosing some plants which are nitrogen fixing;
- (d) adding chemical fertilisers.

All of these actions are steps to help nature to develop a soil; the first essential requirement before a well-balanced plant community can survive. From an ecological point of view, introducing new plant species is undesirable but in reality the material on which the plants are required to grow is also new to the area. It is not surprising that few local plants can tolerate the sandy, acid conditions of the tailings simply because most forest plants of the Panguna area have evolved or adapted to well developed, friable, nutrient-sufficient soils of near neutral pH (only slightly acid, or in some cases weakly alkaline). However, the potential impacts of introduced plants on the Bougainville ecosystem must be clearly understood before such plants are used for revegetation.

Our examination of the BCL revegetation programme is discussed in detail in Section 6.5 but the chemical issues are relatively simple: addition of lime and fertiliser and planting with rapid growing, tolerant grasses and nitrogen-fixing legumes is the correct approach to encourage soil development. The remaining question is how much lime and fertiliser will be needed before a self-sustaining soil/plant ecosystem is formed? BCL's monitoring programme on the revegetation plot at Bato has shown that the initial treatment with lime and fertiliser successfully supported growth, but after four years the tailings under the plants are becoming acid, presumably because of sulphide oxidation. If this process continues, conditions may eventually become unacceptable to plants because of acid and toxicity from aluminium and copper. In addition to the direct effect of acid, it will also leach away some of the essential plant nutrients particularly calcium, magnesium, potassium, boron and phosphorus (most of which were added in the fertilisers). One solution to this is to wait for a longer period of natural leaching before planting but a faster alternative worth testing is to add either more lime (although this can cause other problems) or preferably to add lime which does not readily wash away.

The BCL revegetation studies have progressed to the stage where longer term difficulties, principally acidification, are beginning to appear and these are the issues which must now be addressed.

Not all of the tailings are inhospitable to plants. Tailings which are saturated with water do not produce acid, copper or aluminium and are readily colonised by local plants. This is understandable because the small quantities of plant nutrients initially available from the tailings are not leached away. Another essential requirement for plant growth under these saturated conditions

is that air can mix into the tailings. It is possible that in the future this may cease to happen on saturated tailings because of a thick surface layer of organic matter. In this event a swamp would develop and the plant species would change to reflect the new environment. The initial plant community would also be destroyed if the water table dropped. At the moment, the water table in the Jaba Valley is maintained at an unnaturally high level by the deposited tailings. In future when the river channel is stabilised it will cut down into the tailings deposits and the water table will drop. The implications of this for the plant communities on saturated tailings must be a consideration in the rehabilitation programme.

All these comments also apply to the waste rock dumps. Generally, the establishment of plants on these dumps must follow the same progression.

Our review of the chemical aspects of BCL's experimental vegetation programme suggests to us that the programmes have followed a logical course as far as they have gone. There are a few minor modifications which might help the chemical situation and these are mentioned in Section 7.

6.4.9 Other studies

Several other monitoring programmes have been undertaken by BCL; some of which have now been terminated and others which continue. In addition to the monitoring results already discussed, several other rivers are studied (Kawerong, Pangara, Mariropa and Torokina rivers) and these results are presented in the DOTA reports. No significant changes have occurred to the compositions of these river waters.

The effluent from the concentrate recovery process at the Port is analysed at six monthly intervals and these data also appear in the DOTA reports. The flows of this discharge are typically about 0.1 m³/s and the composition is given in Table 3.2.1. We have commented on this discharge in Section 5.7.2.8 and the low concentrations reported confirm our earlier assessment.

The study on dust at New Dapera village has been discussed in Section 4.10.1.

Sampling of freshwater fish has been undertaken in the Pangara, Mariropa, Arawakou, Pinei and Luluai rivers in 1976, 1980 and 1984 (reported in the Environmental Update 1986 - Ref. 16). The 1984 data had not been interpreted by 1986 and we had not seen any more recent reports on these data. The 1976 results showed that at that early stage 10 estuarine fish had been excluded from the Pangara River. There is little doubt that most estuarine fish are now absent from this river.

6.5 REVEGETATION

6.5.1 Requirements under DOTA

The Agreement under which waste rock and tailings are disposed of requires that BCL undertakes certain actions and investigations with the objective of vegetation being established on both the waste rock dumps and the tailings. More specifically the Agreement requires that from 1980 the method of disposal be consistent with the objectives of re-using any land affected by tailings disposal. BCL has undertaken a range of investigations which effectively fulfill the terms of the Agreement. Some activities required by the DOTA have not yet been

practicable; specifically, capping the waste rock dumps with the more weathered rock when the final level is reached and spreading of tailings to achieve progressive revegetation.

6.5.2 Revegetation investigations

BCL has successfully conducted a series of revegetation investigations and experiments on both tailings and waste rock. The work is fully described in a number of Company reports and publications and is summarised in Ref. 57. Neither the tailings nor the waste rock provide hospitable surfaces for revegetation. The tailings are essentially a sterile sand with a number of adverse chemical conditions (Sections 6.4.4 and 6.4.7), notably adverse pH and extremely low nutrient availability or holding capacity. The waste rock dumps are steep-sided and excessively free-draining with little fine material.

We are satisfied that the Company has demonstrated, by using selected plant species which are tolerant of the difficult conditions in combination with a carefully managed fertiliser programme, that both tailings and waste rock can be revegetated under certain conditions. The Company has also obtained data on the weathering and acidification of tailings under natural conditions. The results indicate, as would be expected from consideration of chemical equilibria and experience elsewhere in the world, that free draining aerated tailings undergo rapid sulphide oxidation and reductions in pH, in this case to about 3-4. Saturated tailings do not undergo rapid sulphide oxidation and pH remains nearly neutral.

The revegetation process developed by BCL consists of seven basic steps:

- (a) pH control, if necessary by application of agricultural lime;
- (b) application of slow release (water insoluble) rock phosphate fertiliser;
- (c) application of water soluble nitrogen/phosphate fertiliser;
- (d) seeding or planting using selected tolerant species (the bulk of the seed mix is of leguminous (nitrogen fixing) species);
- (e) six weeks after germination application of water soluble nitrogen/phosphate fertiliser;
- (f) three months after germination application of a nitrogen/phosphate/potassium/magnesium/boron fertiliser;
- (g) repeat step (f) if necessary after a further three months.

Subsequent to successful revegetation using tolerant species a number of native species have been observed to 'volunteer' (self-seed) and grow on the waste rock or tailings. Some very limited, natural regeneration of the seeded or planted species can also be observed. None of the trial areas gives any indication of the probable long-term viability of the revegetated areas. Many of the areas are only a few years old so would not be expected to provide information on long-term viability.

The work carried out to date has concentrated very much on the establishment of plant cover. The pH control and fertiliser programme is designed to optimise, and is judged by the success of, plant establishment. The establishment of a

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plant community is seen as the initial step in the natural process of soil formation which is essential to the eventual establishment of a naturally stable, self-sustaining ecosystem. From the information available to us and from our own visits to the sites there appears to be very little, if any, work being done to assess the value of the revegetation programme in terms of soil development as opposed to simple monitoring of changes in soil chemistry. Information on the rate of incorporation and accumulation of organic matter in the 'soil' and on the depletion or cycling of the nutrients applied as fertiliser would be valuable in assessing the possible long-term viability of the plant community. It would also provide a measure of the real success of the revegetation programme.

Our observation of the trial plot at Bato is that very little soil formation is occurring, (albeit, in only a few years). There is a dry leaf litter 2-3cm thick over much of the unburnt areas of the plot in which there is little evidence of the humifying processes necessary to provide organic material to the soil. Beneath the litter the surface of the tailings sands is firm and the litter/sand boundary is quite abrupt. There is little evidence of incorporation of organic matter from the litter into the sands. If the sands do indeed remain devoid of organic matter then any nutrients released from the litter are likely to be leached rapidly. In the absence of any assessment of the rates or processes of soil development we seriously question the Company's expectation of the long-term viability of the vegetation.

The main tailings trial area at Bato is located on tailings dredged from the river. The water table lies 3-4 metres below the surface over most of the area. The surface of the raised trial area slopes gently down to the original ground level and at the margins, where the water table is much closer to the surface, the revegetation has been less successful. A seeding rate trial conducted in 1987 (Ref. 58) showed a very clear detrimental effect on plant establishment associated with elevation of the test sites which was attributed to hydrologic (that is, groundwater) or soil effects. This is in effect an unrepresentative situation compared with the tailings areas as a whole. A preliminary analysis of groundwater movement in tailings (Ref. 59) indicates that large areas of the tailings may have a water table at, or close to, the surface. Under those conditions the probable success of the revegetation process developed at Bato has questionable application elsewhere. Furthermore, while at Bato the tailings are not exposed to erosion by running water, the tailings areas in the Jaba Valley are sufficiently large that, during rainstorms, substantial channel flow is likely to occur. The implications of this to tailings stability and survival of vegetation have not been addressed in the investigations to date. At Bato the sloping edges of the plot show substantial instability under the effects of incident rainfall only.

The revegetation programme is essentially an attempt to establish a natural soil-forming process and it appears to us that there are some practicable measures which could have potential to enhance that programme. In particular:

- (a) the use of a coarse crushed limestone in addition to the finely crushed agricultural lime may provide better long-term control of soil pH;
- (b) the introduction of small quantities of soil and soil litter materials from undisturbed sites may speed soil-forming processes by 'seeding' the areas with the soil micro-organisms essential to breakdown and incorporation of organic matter in soils;
- (c) mechanical incorporation of leguminous and other specially grown cover crops would provide significant increases in the rate of soil development through addition of organic material and plant nutrients.

We believe that the Company has not yet demonstrated the viability of its revegetation programme. Furthermore, we believe that investigations are not being carried out which would assist in assessing that viability. We believe a number of important questions need to be answered:

- (a) what is the long-term fate of the applied phosphate and other fertiliser?;
- (b) does phosphate become available from the tailings material as soil development occurs?;
- (c) if the applied phosphate and other fertiliser is the only source of those nutrients, is the quantity supplied sufficient to support the 'stable ecosystem' envisaged, after allowance for leaching losses?;
- (d) what is the rate of organic matter decay and incorporation into the tailings?;
- (e) what is the fate of plant nutrients released by decay of dead plant material?;
- (f) what soil micro-organisms (other than Rhizobium spp.) are present in the tailings or the leaf litter?;
- (g) what soil animals are present in the tailings or the leaf litter?;
- (h) do moisture, chemical or other conditions in the tailings effectively preclude essential soil forming micro-organisms and animals?;
- (i) what range of groundwater and stability conditions are likely to exist in the tailings areas?.

Answers to these questions are required before reasonable predictions can be made about probable long-term success of the revegetation programme.

6.5.3 Rehabilitation

While BCL has convincingly demonstrated that vegetation can be established on tailings and waste rock under controlled conditions, the problems of revegetation under the conditions likely to prevail on the tailings when deposition ceases have not been fully addressed. Furthermore, the Company's proposals to revegetate the area do not recognise the need, expressed by the landowners and stated in the DOTA, to rehabilitate the areas so as to 'enable re-use of the land at the earliest practicable date'.

The Company's plans to revegetate the tailings area appear to us to be less than would be required by an equitable interpretation of the DOTA. The phrasing used in the DOTA is certainly open to differing interpretations but we believe that if the land is to be 'reused' by the present landowners, then a rehabilitation programme which goes well beyond the current revegetation proposal is necessary. Certainly the 1987 Agreement (Appendix V) requires rehabilitation of land and regeneration of vegetation. The land has not been alienated in the sense of purchase, and after mining ceases it will revert to the original landowners.

The landowners, whose lifestyle and culture is intimately tied to their land, have a legitimate expectation that their land, taken by force in many cases, should be returned to them in a 'usable' condition. The growing realisation

that that expectation is unlikely to be fulfilled is one of the sources of the present anger and frustration being expressed by the landowners.

We believe there may be good reason to consider variations in the overall rehabilitation programme with the intention of providing a long-term sustainable land use capable of supporting the future population of the affected landowners. A sustainable land use need not be based on the subsistence lifestyle formerly followed by the landowners, provided the landowners agree. We believe a very careful and imaginative review of future land use options should be carried out in consultation with the affected landowners.

6.5.4 Subsistence use of plant species

A number of the species evaluated by BCL for use in the revegetation programme are used directly or indirectly by the local people. Species trialed on tailings and waste rock were evaluated according to their ability to establish and survive under the conditions prevailing after the minimal substrate treatment necessary to ensure survival of the tolerant species specially selected to grow under the prevailing difficult conditions. Under those conditions it would not be expected that intolerant species would perform well. The reporting of those trials (Ref. 60) uses a very broad classification of results in three groups (Good, Poor and Fail) and does not readily allow us to make our own evaluations of the results. The locally-used species that were evaluated are described briefly in Table 6.5.1. This information has been taken from Refs. 60 and 61.

The very low success rate of these potentially useful species can be attributed to the conditions under which they were trialed. Their subsequent evaluation by BCL as largely 'unsuitable' for revegetation purposes can be attributed to BCL's revegetation objective; that is, to obtain a plant cover using minimal substrate treatment and tolerant species. That objective maximises the likelihood of success while (in this case) minimising the prospects of the established vegetation being of use in the landowners' subsistence lifestyle.

Table 6.5.1 Subsistence use of trialed plant species

Use	Species	Local name	Result on	
			Tailings	Waste rock
Food (direct) ¹	<u>Gnetum gnemon</u> <u>Ficus spp.</u>	Kintu Tona/Bumisi	Fail Poor	Not tried Fail
Food (indirect) ²	<u>Homolanthus</u> <u>arfakensis</u> <u>Ficus spp.</u> <u>Parasponia</u>	Tougki Tona/Bumisi -	Poor Poor Good	Poor Fail Good
Medicine ³	<u>Canarga</u> <u>Alstonia</u> <u>scholaris</u> <u>Evodia spp.</u> <u>Pipturus spp.</u>	Daavo Kenung Sibaako Tamang	Poor Good Poor Good	Not tried Not tried Not tried Poor
Building material	<u>Terminalia</u> <u>brassii</u> <u>Macaranga spp.</u> <u>Petrocarpus</u> <u>indicus</u> <u>Terminalia</u> <u>sepicana</u> <u>Ficus spp.</u>	Kaipika Piingkiri Pangkirang Sirisiri Kukuvi	Poor Poor Poor Poor Poor	Poor Poor Not tried Poor Fail
Firewood	<u>Macaranga spp.</u> <u>Ficus spp.</u> <u>Pometia</u> <u>pinnata</u> <u>Vitex</u> <u>Parasponia</u>	Piingkiri Kaikai Taun - -	Poor Poor Fail Fail Fail Good	Poor Fail Fail Not tried Good

Notes:

1 Food - direct consumption

2 Food - indirect consumption; that is, used to find food

3 Medicine - few recorded as they are usually 'kept secret'

ASSESSMENT OF THE ISSUES

7

7.1 INTRODUCTION

In this section of the report we assess the issues raised by the landowners as they relate to our terms of reference and other issues which in the course of our review we have identified as being important. As we have done elsewhere in the text we have endeavoured to provide historical background insofar as it is necessary to full understanding of the issues.

7.2 SOCIAL, CULTURAL AND ECONOMIC CONCERNS

7.2.1 Introduction

A Bougainvillean student, now employed in a senior management position at BCL, once concluded in a review of the impact of BCL's operation on local economy and society, that 'the tragedy is that by its very nature BCL's purpose will always be in conflict with the cultural environment in which they are operating'. These conflicts revolve around land issues and it was immediately apparent that land would always be the major critical element in the negotiations for mine construction and in the operation of the mine. Three Bougainvillean students, two of whom now work for the Provincial Government, expressed this well in 1974 at the time the mine was coming into production (Ref. 64):

'Land is our life. Land is our physical life - food and sustenance. Land is our social life; it is marriage; it is status; it is security; it is politics; in fact, it is our only world. When you [the Administration] take our land, you cut away the very heart of our existence. We have little or no experience of social survival detached from the land. For us to be completely landless is a nightmare which no dollar in the pocket or dollar in the bank will allay; we are a threatened people.'

Although compensation (discussed in Section 4.8) has been paid for land leased and damaged, there has been much debate over the extent of the damage and the level of compensation payments. In the last few years, these concerns have intensified.

Other concerns too were important from the very earliest period of mine construction. Fr John Momis, Member for Bougainville Regional and now Minister for Provincial Affairs, summarised the impact of the mine on the Nasioi people at a time when the mine was just going into production (Ref. 65):

'Mining in this area has created sharp antagonism between the people, who regarded the land as theirs, and the Government, which, under the law, possessed claim to the minerals under the surface. Mining has provided some employment for the Nasioi, but at the same time it has had serious social effects. For example, school enrolment has declined, either because young people leave school to seek employment in the towns or because older village leaders increasingly reject education as part of the white man's system of exploitation. Alcoholism has become a serious problem, and traditional systems of social control are being destroyed without any suitable alternative being offered in their place. Nasioi society is no longer the stable, satisfying society that it once was, and mining must bear part of the blame.'

7.2

Then there is the question of conservation and the environment. Mining can have disastrous effects on a region. In a copper mining operation, tailings from the ore concentrating plant kill the fish in the rivers and destroy vegetation in the valleys. This is already happening on Bougainville. The constructions associated with a mine result in ripping up hundreds of acres of trees and garden land and replacing it with sterile concrete or simply with a huge hole in the ground. In the case of smelting operations, the gases that escape from a smelter may poison people's lung and kill off vegetation for miles around. Unless very careful controls are exercised, mining poses a real danger to the environment.¹

Over the years almost all of these issues have arisen repeatedly and the area of concern has spread far beyond the Nasioi area that was first affected by mine operations. Increasingly the absolute loss of land and the physical and chemical impact of mining on the environment have become the most important issues, as the sheer size of the hole and the volume of the tailings become more and more apparent. Subsidiary issues are those affecting village relocation and compensation payments and the availability of information from BCL and mine development trends. In recent months, these issues have surfaced fully, alongside a situation where there are various degrees of anger, resentment and despair amongst landholders and growing evidence of dependency, despondency and, up to a point, demoralisation.

As the previous quotations suggest, there was serious concern over the social and environmental aspects of the mine from the very earliest stages. Indeed during the early stages of mine construction and operation BCL paid out what were, by (then) contemporary Bougainvillean standards, large sums of money in compensation payments. In so doing they were able to progress relatively smoothly through the early phases of mine operation. This early phase is discussed in considerable detail in Ref. 3.

Section 4.8 described the provisions made for compensation payments in the past. However, in the 1980s demands for increased compensation and related assistance began to increase and, although increasing sums of compensation money were paid out annually, averaging K1.5 million per year in the period 1980-85 compared with \$0.4 million per year in the period 1969-74, BCL response was regarded by many landowners as too limited. Two issues that were of concern in this period were, firstly, the staffing of a government mine liaison office at Panguna and, secondly, the health and welfare situation in Moroni village.

When mining began a number of government staff were employed at Panguna to resolve relations between BCL and the local people. This role was slowly scaled down until in 1981, due to a staff shortage, the office was only visited once per week. This was inadequate for the amount of work that needed to be done. By 1981 there was a considerable backlog of work and the Provincial Government sought to re-establish the position. No funding was available and the request was not re-activated by the Provincial Government until 1985 when it was supported by the landowners. Again however, no office was situated at the mine, apparently principally because it could not be decided who should fund the position. Throughout the 1980s therefore, the backlog of work relating to resolving issues of concern to landowners has increased - there has been no intermediate body between BCL and the landowners. This has undoubtedly been one of the reasons for the deterioration in relations between BCL and the landowners.

The long-standing problems of the Moroni villagers were taken up in 1985 by Mr Joe Kabui, the Minister for Provincial Affairs and Community Government in the Provincial Government (and, since mid-1988, the Premier of the North Solomons). These issues were:

- (a) the failure of BCL to provide homes for newly married couples, which was regarded as necessary because of the absence of sago palms and other bush materials used for house construction;
- (b) the need for a new site with adequate water supplies where the whole village could have access to services;
- (c) inadequate water supply, toilet facilities, power supply and roads;
- (d) the need for better dialogue with the Village Relations Office and the Personnel Department of BCL.

It was felt that the posting of an officer to Panguna would assist in rectifying the position. In 1986 a report on Moroni village by the Provincial Health Inspector noted overcrowding, inadequate toilet facilities, rotting housing, and the rusting and consequent lack of use of BCL water tanks. It was recommended that the village be relocated with BCL assistance. It was recommended previously suggested relocation, but some villagers did not wish to move, that the Company was not responsible for building houses that the villagers had built themselves or for maintaining houses, and that there was no room for adequate pit toilets. Although BCL agreed to replace the tanks with a new water supply system, by pipe from nearby streams, it appears that the pipe was not put in place for two years. This is where the matter remained and, although Moroni village has now received a new water supply, there is dissatisfaction over the single, central, water and shower system, and continued concern over the issues that were rejected by BCL in 1986.

During the first period of mine construction there was no landowners' association with which BCL could negotiate; negotiations were therefore conducted directly with village elders. Although the Company tried to mobilise landowners into a negotiating group it was not until 1979 that the Panguna Landowners' Association (PLA) was formed under the leadership of Michael Pariu, a former teacher. Customary landowners in the three lease areas automatically became members of the PLA. In 1978 or 1979 the PLA presented a set of grievances to the Company but there was no negotiation on the issues raised and in 1980 a demonstration was held at Panguna; when BCL refused to take note of the demands there was considerable disturbance in which the Panguna supermarket was looted and damaged. BCL eventually agreed to discuss the issues, leading to the new compensation agreements (Section 4.8.3) and the establishment of the RMTL Trust Fund. The Trust was set up with an executive committee which included several members of the PLA, including Michael Pariu, Wendelinus Bitanuma and Matthew Kove. These events largely took place during the lead-up to the 1980 Provincial Government elections which saw a change in the government following a wide ranging debate on provincial development and strong pressure on BCL from the new Provincial Government for a different distribution of royalty payments. The review of the Bougainville Copper Agreement fell into disarray through lack of Provincial involvement. In 1982 the mine was temporarily shut down by Arawa villagers, claiming compensation from BCL for the land on which Arawa town was established. In 1988 the old PLA was, in a sense, replaced by a new group of generally younger people, similarly calling themselves the Panguna Landowners' Association. This takeover led to much stronger opposition to BCL in almost every sphere of its operations.

The old PLA was replaced by the new PLA for two main reasons. Firstly, the new PLA was dissatisfied with the response from BCL to several long-standing grievances and believed that the old PLA was not vocal enough in demanding redress of those grievances. Secondly, the new PLA believed that the old PLA was largely led by older men, who had become settled in office and had themselves benefitted from Company policy; they were also believed to have been gaining directly from the financial resources of the RMTL Trust Fund. However, the members of the old PLA regarded themselves as the legitimate village leaders, as opposed to the more radical, younger group in the new PLA who, they believed, received only minimal support in the villages.

The replacement of the old PLA, with whom BCL originally negotiated, by the new PLA, which has been recognised by the Provincial Government, has led to the much greater incorporation of younger, more educated individuals in the debate over the issues of greatest concern. The new PLA immediately began to place greater pressure on the Company, on a range of issues, including demands for basic services (education, housing, health care etc), amendment of the 1969 Land Title Agreement, increased localisation of employment, more contracts to be awarded to landowners, greater control of erosion and pollution and a new land survey. BCL took little note of these wide-ranging demands (expressed in subsequent form in several submissions included in Appendix VI). The new PLA therefore closed the mine on 17 May and escalated their demands to include a request for the 20% National Government share ownership in the mine (that the Government had considered selling in 1987) and a demand for K10 billion compensation.

During the 1980s, the extent and scale of demands on BCL slowly increased but often met with a belated or negative response. The Company appeared to be unaware that the situation was changing, perhaps as much because of poor communications within BCL as because of poor communications with the landowners. Moreover, although landowners' demands were more sympathetically received by the Provincial Government, that Government was unable or unwilling to act on these issues or to intercede with BCL. This was particularly true after the Bougainville initiative of 1987, which linked landowners inconvenience with Provincial Government funding, and the Regional Premiers' recommendation to give Provincial Governments a greater share of benefits arising from mineral development. As the landowners became more radical, the situation worsened further. Moreover, from around 1987 Bougainville also experienced environmental problems (the death of the flying fox population and subsequently fish sickness - see Section 5.7.3). There also seems to have been a growth in support for the new PLA, especially in the Pinei Valley and Rorovana, whose people tended previously to have different concerns from those landowners near the mine site. Overall therefore, the situation in 1988 moved closer to crisis point, with a series of meetings that achieved little other than frustration, road blocks and so on.

At the same time new demands on the Company were coming in from other areas. Villagers at Miwaraka (south of the Jaba estuary) presented a series of claims for crop compensation. There were new claims from Dapera villagers for compensation for cemeteries damaged during relocation and underpayment of compensation for historic damage to food crops and cash crops. Other claims were received from Guava and elsewhere. The new Minister for Mines and Energy, Patterson Lowa, intervened at a meeting at Panguna in August 1988 to note that there would be a review of service provision (including health and education) and pollution and an early decision on the relocation of Moroni. The decision to hold an inquiry brought in a series of new concerns, some of which we set out in Appendix VI, mainly relating to environmental issues.

A variety of issues is currently causing concern in the villages in and around the mine lease areas. Some of these concerns are shared by more distant villages. These can be summarised as follows:

- (a) that the Panguna landowners (that is, landowners throughout the lease area) and the North Solomons Provincial Government have received an inadequate share of the mine profits;
- (b) that BCL has provided insufficient compensation for the disruption of lifestyle, damage and inconvenience caused by mining operations;
- (c) that the Trust Fund has diverted money away from the villagers most affected by mining operations and is run in an inefficient and corrupt manner;
- (d) that the replacement facilities provided by BCL (mainly houses) are of inadequate standard and that there are inadequate facilities in the relocated villages;
- (e) that BCL's activities have caused air, soil and water pollution, resulting in the death of fish, crustacea and shellfish populations, the failure of crops, the decline of wildlife (especially flying foxes) and further possible long-term effects on agriculture;
- (f) that there is inadequate communication between the villages and the BCL Village Relations Office on issues concerning compensation, resettlement etc;
- (g) that pollution of the environment has caused health problems and that further long-term health problems might arise;
- (h) that BCL is involved in activities other than mining and that these activities should be ended.

Although the first issue is an important element in people's lives through the resentment felt concerning resource depletion and the outflow of profits (within PNG and beyond), it is outside the Terms of Reference of this Review. The remaining seven are relevant to it. Of these, (b), (c), (d), (f), (g) and (h) are social, cultural and welfare concerns and are therefore addressed in the following sub-sections. Issue (e) is concerned with the physical and biological environment, and is addressed in Section 7.3.

7.2.2 Compensation adequacy

During the early period of compensation payments, the total sum involved was quite small, with few individuals receiving large amounts (Section 4.8.2). In large parts of the lease areas, notably around Guava and the Jaba river system, even small sums of cash were then reasonably significant and, when land remained available, could be seen as something of a windfall payment. Over time this perspective inevitably changed for a number of reasons, all of which were quite independent of the 1980 Agreement:

- (a) there was a widespread view that the total amount of money paid out as compensation (K19 million from 1969 to 1988) was very small, relative to the profitability of the mine and the revenue gained by the National and Provincial governments and the BCL shareholders. This was emphasised by the relative deprivation experienced by villagers close to the mine site.

It would, necessarily, be hard to envisage a situation where landowners would ever be wholly satisfied with the level of compensation payments, especially where there is widespread lack of knowledge and doubt over the structure of Company finances;

- (b) it is believed that the actual historic rate of compensation payments (for example, 2 cents for a sweet potato plant) was a mockery and that one-off compensation payments for cash-crops were totally inadequate, since the cash-crops could have been bearing throughout the whole of the period. Such concerns have lasted for virtually the life of the mine;
- (c) there was a growing recognition of the enormity of the open pit and the volume of tailings produced. Where once there had been general assumptions that only some land would be used and that after the mine and the lease ended, land would revert to its traditional owners, there was now a clear indication that land had been effectively destroyed and could never be of any social or economic use again;
- (d) much of the compensation had been used by the recipients for short-term purposes, and local business development had not been sustained. There was therefore a recognition that the money that had been received had not been converted into long-term development;
- (e) the compensation money was received by traditional landowners and family heads. Over time those children who became adults often found access to that money difficult. Moreover, as such young men often had poor employment prospects, they would have benefited from access to the money. Further, increasing population size meant that particular sums had to be shared between more and more people. This is accentuated by the 'diversion' of money into the RMTL Trust Fund (see Section 7.2.3). This combination of factors contributed to new and more vociferous demands for increased compensation payments.

To understand the significance of these concerns fully the structure of compensation payments must be reviewed, using data provided by BCL for the year 1988 (a year which must be considered typical of previous years in the 1980s). In some vital respects the data are limited; hence some of the distributional aspects of compensation cannot be fully investigated. This would be an important exercise to be undertaken in its entirety. The available data can now be summarised for the three different lease areas and the fish compensation agreements.

7.2.2.1 Tailings Lease area

Information obtained from BCL on compensation payments made to people within the Tailings Lease area is given in Table 7.2.1. However the information provided for the lease area does not include the name of the villages of the 251 people who received compensation. Moreover, this total double-counts a small number of people who owned more than one tract of land. These are serious limitations since it means that the figures cannot be grouped into compensation per village, but can only be treated as one entity. Nor is there any information on how many people in the lease area depend on those 251 people for a share of that compensation payment. This situation is true of the other lease areas and could not be calculated without detailed field work.

Overall, 53% of those in the tailings area who received compensation received under K1000, 21% received between K1000 and K1999, and 25% received over K2000. Five individuals (2%) received more than K10 000.

It is significant that payments to individuals in the Tailings Lease Area are substantially higher than in any other area because of the much larger areas of land owned by small groups in this area and because these payments are related solely to the land area.

7.2.2.2 Port-Mine Access Road Lease area

Data for the Port-Mine Access Road Lease data are provided in Table 7.2.2. As with the data for the tailings area, BCL records do not include information on the villages of the 62 recipients.

Most recipients (94%) received less than K1000, 5% received between K1000 and K2000 and only one person (less than 1%) received over K2000. The total and mean figures are much lower than those for the tailings area, as would be expected from the much smaller disruption in the access road area.

Table 7.2.1 Tailings Lease area compensation payments - 1988

Compensation type	Total	Mean	Range
Bush compensation	K 115 986	K 462	K 2 - 11 761
Occupation fee	K 275 721	K 1098	K 2 - 27 960
Physical disturbance	K 75 791	K 302	K 0 - 3 491
Total	K 467 500	K 1863	K 4 - 43 213

Table 7.2.2 Port-Mine Access Road Lease compensation payments - 1988

Compensation type	Total	Mean	Range
Bush compensation	K 4 167	K 67	K 3 - 450
Occupation fee	K 9 907	K 160	K 8 - 1069
Physical disturbance	K 5 624	K 91	K 4 - 607
Total	K 19 698	K 317	K 16 - 2127

7.2.2.3 Special Mining Lease area

In this area in 1988 BCL paid a total of K192 452 to more than 500 people in 34 villages (Table 7.2.3). The number of payments in a single village ranged from 1 to 92 (Table 7.2.4), with a median of 14 persons per village receiving

payments. Where villages had few recipients of compensation payments they were usually very distant from the mine site. The mean amount of compensation received per person in each village ranged from K50 in Tonanau to K1116 in Guava. The maximum received by a single village was K14 029. Eighty-five per cent of payments were less than K1000, 7% between K1000 and K2000, 3% were over K2000 and 5% were payments for blocks of land where there was a dispute over ownership. In the latter case the compensation payments were held in trust until the outcome of the land dispute was known. At an individual level only 13 individuals (3%) received total payments of more than K2000 each, the highest being K3266. Seven percent of individuals received payments of between K1000 and K1999, and 90% received less than K1000.

Inevitably some individuals were owners of more than one tract of land; accordingly some individuals could have received more than this total.

Table 7.2.3 Special Mining Lease compensation payments by category - 1988

Compensation type	Total	Mean	Range
Bush compensation	K 48 676	K 95	K 2 - 949
Occupation fee	K 115 713	K 226	K 3 - 2256
Physical disturbance	K 28 063	K 55	K 0 - 906
Total	K 192 452	K 377	K 8 - 3266

7.2.2.4 Fish compensation

Information on fish compensation payments is given in Table 7.2.5. This does include the location of the recipients. Payments totalling K236 000 were made to people in more than 200 villages (1300 individuals) although residents of one village may have sections in more than one river system. Seventeen villages contained people who had rights to land in at least two river systems.

Most payments were less than K200 per person; in the Pangara area most were much less than K100. Twenty-one people (2%) received sums of more than K1000 - most of these were in the lower Jaba River area.

Sixty-eight percent of villages obtained less than K1000, 16% obtained between K1000 and K1999, 14% obtained between K2000 and K1000, and 2% obtained over K10 000.

Table 7.2.4 - Special Mining Lease compensation payments by village - 1988

Village	Number of owners	Total	Mean	Range
Irang	1	K 179	K 179	K 179
Paonu	1	K 3 173	K 3 173	K 3 173
Pidia	1	K 37	K 37	K 37
Arawa	1	K 1 375	K 1 375	K 1 375
Piavora	1	K 861	K 861	K 861
Pokunameri	1	K 35	K 35	K 35
Pakia	2	K 127	K 64	K 39 - 87
Peumpe	2	K 788	K 394	K 230 - 557
Poaru	2	K 2 988	K 1 494	K 1 494
Tonanau	3	K 153	K 51	K 17 - 86
Bakavori	3	K 355	K 118	K 63 - 191
Pavaire	3	K 2 133	K 427	K 220 - 1 404
Damara	3	K 323	K 108	K 94 - 141
Pankibai	4	K 1 921	K 480	K 19 - 1 666
Tonara	4	K 2 247	K 562	K 51 - 1 007
Piva	4	K 3 163	K 761	K 59 - 2 679
Mainku	4	K 2 066	K 517	K 36 - 1 304
Darenai	5	K 1 132	K 226	K 28 - 453
Kope	6	K 4 248	K 708	K 51 - 1 972
Paraino	8	K 5 529	K 691	K 59 - 1 642
Korokey	8	K 3 465	K 33	K 17 - 1 173
Sideronsi	12	K 1 076	K 90	K 15 - 241
Korokoro	20	K 4 626	K 231	K 31 - 1 672
Kupe	21	K 9 852	K 469	K 10 - 1 064
Guava	21	K 25 618	K 1 220	K 101 - 3 920
Enamira	25	K 3 342	K 134	K 5 - 490
Onove	25	K 5 215	K 209	K 16 - 1 668
Parakake	41	K 10 424	K 254	K 17 - 1 064
Moroni	43	K 20 323	K 473	K 25 - 2 894
Dapera	57	K 13 890	K 244	K 14 - 1 135
Pirurari	61	K 14 029	K 230	K 8 - 2 337
Naniere	92	K 34 875	K 379	K 5 - 2 900
Disputed Blocks	26	K 12 884	K 496	K 11 - 2 704
Total	511	K 192 452		

Table 7.2.5 Fish compensation payments - 1988

River system	Number of villages	Number of people	Payments made		
			Total	Mean	Range
Upper Kawerong	13	130	K 27 866	K 214	K 75 - 1818
Upper Jaba	37	273	K 32 557	K 119	K 18 - 601
Lower Jaba/ Kawerong	92	323	K 102 596	K 318	K 41 - 1400
Pangara	80	574	K 73 784	K 128	K 53 - 793

7.2.2.5 Conclusion

Although these compensation payments cover three distinct areas, in some cases they can be aggregated together. Most of those people receiving compensation payments for land in the tailings area also received fish compensation payments. Payments per capita in the tailings area were also somewhat higher than in other areas; hence those who have gained most from compensation payments are likely to be in that area. Apart from areas which received only the special fish compensation payments, where effectively only one component of the ecological system is damaged, compensation was least in the Port-Mine Access Road Lease area. Adding all the figures together gives a total compensation sum of K753 434 received by 1998 people. Excluding some doubling up the average sum received is K539. Excluding fish compensation the average is K824.

Overall, most annual payments were for less than K1000, a lump sum payment which would be extremely difficult to use for any long-term development purpose, even if that sum were kept in its entirety, rather than distributed to other family members with claims on a particular tract of land. Sub-divided, the annual payment becomes extremely small, even if it is assumed that the average household contains no more than five people. Consequently only a very small number of recipients of compensation payments receive enough to satisfy the monetary needs that they increasingly experience. For most households the annual payment is likely to be spent extremely quickly. Although it is impossible to assess the quality and potential for other economic uses of the land leased by the mine, since this varies from place to place, crude assumptions derived from land use in other comparable areas of Bougainville suggest that an average hectare of land might generate, at the most, perhaps K300 at 1988 figures, if all that land were planted in cocoa. However, most if not all households have current incomes in addition to compensation payments - hence this is not their only source of income.

Obviously, this would be significantly more than the (approximate) K50 per hectare that compensation payments produce. However, those assumptions suggest that the cocoa is grown, dried and marketed using unpaid family labour, that the land (and other factors including altitude) are appropriate for cocoa production, that no land is used for other purposes (such as food production) and so

on. They do suggest that, in at least some cases, compensation payments may be less than the real economic value of the land. These are very crude calculations but they do suggest that it would be appropriate to re-examine the level of compensation that is currently being paid by BCL.

7.2.3 The Road Mining Tailings Lease Trust Fund

In recent years the operations of the Road Mining Tailings Lease Trust Fund (RMTL) have come under increasing scrutiny and criticism from landowners, because of the widespread view that its management was corrupt and self-serving, its investments were of no benefit to landowners and virtually no payments or projects were being undertaken in the lease areas. These concerns can now be investigated.

The RMTL was set up under the terms of the 1980 agreement on funds and incorporated in October 1981 (see Section 4.8.3). Compensation payments for social inconvenience, Guava Access Road disruption, and bush compensation were paid into the Fund on an annual basis to enable the payments to be used for the benefit of landowners within or near the lease areas. The beneficiaries were stated to be the 'registered proprietors of, or traditional landowners of, any traditional land as determined by company law or any legislation affecting same within or affected by Bougainville Copper Limited in connection with its mining activities'. According to the terms of the Trust the Fund cannot be distributed amongst its members but can only be replaced by another Trust Fund of a similar type.

The RMTL Trust Fund has 75 official members; there are no individual benefits to membership but members can vote on the composition of the executive committee (or board of directors). BCL established the Fund, with the settlor being the Managing Director. However, there is no evidence that BCL has sought to do anything other than acquiesce in decisions taken by the Fund's executive committee. At the time the Fund was set up the executive committee was led by Michael Pariu as Chairman and included Matthew Kove, Wendelinus Bitanuma and five others. By 1988 the committee had changed; Wendelinus Bitanuma had gone and although Pariu and Kove remained, Severinus Ampaoi was now Chairman of the committee as he had been since 1983. Late in 1988 the Board of Directors approved 55 new membership applications bringing the registered membership to 130.

After disputes over the use of the Fund the Directors were removed by a 'Deed of Removal' and replaced by a new group, including Wendelinus Bitanuma, Patrick Bano, Andrew Pisi, Peter Laurasi and four others, a group more similar in composition to the new PLA than the 'old guard' who were synonymous with the old PLA. This is now the subject of a legal case and an independent inquiry.

The basic assumption underlying the establishment of the Fund was that it would act as some form of 'business arm' for the landowners. It could therefore generate an alternative source of income, in place of the ground that had been lost, which would operate during the remainder of the mine life period and would continue after the Company eventually ceased operation. It was intended to provide assistance to such basic services as education, health care, sponsorship of students through secondary and tertiary education and so on. There is now no indication of whether, at the time the Fund was established, landowners believed that it would directly contribute income to them. This was certainly what was later expected. Over time concern has grown in five main areas:

- (a) that the directors of the Trust were 'eating the money' of the Fund themselves, mismanaging it and not using it directly or indirectly for the benefit of members;

- (b) that no income was being distributed to individual members although they had paid K6 to register as members of the Trust;
- (c) that the actual expenditure of the Trust was trivial, being on projects of little value to landowners in the lease areas;
- (d) it was argued that the task of the Trust was not to make profits but to give loans to small businessmen for their individual activities. Individuals sought loans to pay school fees or buy building materials but were refused, thus adding to their disenchantment with the Fund. Members were increasingly concerned about the infrequency of meetings and thus the lack of reporting to members on the work of the Trust;
- (e) there have been objections to the appointment of a Filipino, Ray Jacinto, as Managing Director of the Trust, who may be easily manipulated by the Board and/or uninterested in village issues.

Broadly, the Trust was increasingly seen as very closely associated with the old PLA and this too directly linked to BCL rather than to the real interests of the landowners.

At the end of 1981 after one year of operation the Fund had total capital assets of K1 351 480. This consisted of K1 340 881 in compensation money and K10 608 in interest from Income Bearing Deposits (IBD). The operation of the Fund then met with a degree of success for a few years; meetings were held regularly and there appears to have been harmony between the board members and the landowners.

During the first two or three years a substantial number of loans were given to landowners but relatively few of these loans were repaid; for the year ending 1983, K29 806 was written off as bad debts and in the following year that figure had risen to K127 097. Over time it appears to have passed K300 000. When Ampaoi became Chairman of the Trust in 1983 it appears that more adequate accounting principles were introduced, there was much greater pressure on debtors, fewer loans were distributed and the new general manager (Jacinto) took over. In short, where landowners had once had ready access to loans, and there had been limited, if any, pressure to repay them, there was now strict financial management and very few individuals saw any direct income (loans) from the Fund. Thus it appears that during a period of what was in effect financial mismanagement, individuals benefited directly, but subsequently these benefits were lost.

Tightened control over the expanding resources of the Fund enabled investment in a series of projects to increase the capital of the Fund. Investments broadly went into three areas. Firstly, following the initial purchase of IBDs, the Trust purchased shares in a series of large companies, many with obvious Bougainville interests, such as Arawa Enterprises Limited (AEL), Bougainville Development Corporation (BDC), Niugini Lloyds, PNG Investment Corporation, ANGCO and so on. Secondly, the Trust invested in real estate, including houses in Arawa and Kieta, which were available for rent. Thirdly, two Bougainville plantations were purchased - Tenakau (667 hectares) north of Arawa, and Toboroi (167 hectares) adjoining Toniva. Thus investments were made in areas that were of no apparent direct concern to most landowners and, with the purchase of the plantations, appeared to take resources directly away from the landowners. Thus in the second phase of the Trust's existence its more obviously business-like activities, which expanded the income of the Trust and effectively transformed it into a major company, were associated with a period where landowners received

virtually no income as loans from the Fund.

Under the terms of the Trust, provision was made for the distribution of donations and grants to projects in or near the lease areas. Broadly, the Investment Advisory Committee of the Trust (which consists of the Chairman and Secretary, a representative of BCL, a representative of the Provincial Government and a representative of the accountants, Cooper and Lybrand) recommended that 75% of the annual profits be redistributed and 25% be held back for re-investment. Generally, this seems to have occurred, although data on the structure of distribution are limited. In 1981 no donations were made and in 1982 they amounted to only K200, much less than the more than K22 000 distributed as loans. It was not until September 1983 that the first genuine donations were made and by the end of 1983 K30 000 had been distributed equally to six community schools: two in the Special Mining Lease area (Dapera and Deomori), one in the Port-Mine Access Road Lease area (Sipatako) and three in fish compensation areas (Orami, Koro and Konkopine). The overall distribution of donations and grants is given in Table 7.2.6 and shows that until the end of 1987 almost K250 000 was distributed. In terms of spatial distribution, data for the only years where this is broken down by area show that more than half the donations went outside the mining, tailings and road lease areas. Although data are unavailable for 1985 and 1986 when the structure may have been different, it does indicate why concern has grown in the lease areas that the Trust's income was not being used for the benefit of landowners.

Table 7.2.6 RMTL Trust Fund grants and donations in various areas (K)

Year	Mining	Tailings	Road	Other	Total
1983	10 000	-	5 000	15 000	30 000
1984	13 500	6 000	11 000	19 548	45 048
1985	-	-	-	-	16 481
1986	-	-	-	-	53 989
1987	10 067	21 099	10 173	58 580	99 919
Totals	33 567	27 099	26 173	93 128	245 437

Notes: The totals are from the annual financial statements of the Trust. Other more detailed data supplied by the Trust suggest a higher figure for 1986.

The variety of projects funded is considerable, but has tended to concentrate on support for schools, health centres, social clubs (women, sport, youth etc), feeder roads and churches. Virtually all these projects are of considerable welfare benefit to the community and also appear to have reached, in one form or another, most of the mine-affected areas. Most donations and grants were for sums of less than K5000; the only identifiable donations of more than K5000 were to the Guava Village Community Hall (K15 000) and to 'old and existing committee members for services rendered in the past' (K5400). K5000 went to each of Tunuru parish church, Poaru aid post, Pakia church, Deomori school and the 'Michael Pariu feeder road'. It is clear that some of these donations may be interpreted in different ways by those opposed to the Fund. However, overall

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the Trust appears to have identified appropriate projects to fund but, in any one village in the mine-affected area, such activity ultimately may be seen as quite limited.

A major concern expressed by those opposed to the Fund was the view that the Directors were corrupt, self-serving and mismanaging the funds, and that therefore inadequate funds were available for distribution in the mine-affected area. These allegations were principally directed at Severinus Ampaoi the most recent Chairman of the Directors, in whose Arawa office block the Trust is based. Ampaoi is a Dapera villager, married into Guava village, a former Village Relations Officer with BCL and a prominent businessman; he is widely seen by the new PLA as a 'company man' who has profited at the expense of other landowners.

Allegations of business corruption are widespread in Papua New Guinea because of the general and usually correct view that managers are self-interested, that the profits (if any) are short-lived and that mismanagement prevails. This is compounded by the tradition of individuals contributing small shares to become members of the business, as has occurred with the Fund, and by a widespread misconception that revenue is more or less equivalent to profit. Although there is no evidence of mismanagement and corruption, the absence of regular meetings and any newsletter, and perhaps what may appear lavish Director's fees, has contributed to this view. Although the Trust has recently appointed a Public Relations Officer, the choice of a close relative of Severinus Ampaoi may not have been wise. Without the available data, further consideration of mismanagement cannot be considered here.

It is apparent that, because of the terms of the Trust, money cannot be distributed to individual members and landowners, but has in the early years been given out as loans, most of which were not repaid. Abandoning this liberal policy and substantially reducing the number of loans contributed to the view that the Trust was no longer distributing funds, but was conserving them for investment, or more dubious purposes. Moreover landowners were aware that significant annual compensation funds were being paid into the Fund but that little of this effectively reappeared. As a result, frustration mounted as the Trust, by adopting sounder business principles, moved towards increased profitability. This was combined with the view that funds should be used for loans and not the profit of the Trust as a whole. Once again there appears to be no evidence of corrupt practices and the Trust appears to be currently issuing loans under the same kinds of procedures, and guarantees, used by the Papua New Guinea Development Bank, which is, in any case, a more appropriate agency for loans.

Inevitably the donations and grants made by the Trust appear thinly spread over space and time, but they do appear to have generally been distributed to projects that benefit people throughout the area (and beyond) and are the kinds of projects that villagers seek support for. If more revenue were distributed to projects there is a danger that the funds available for investment would decline and even that projects of more limited utility might be funded. There is little evidence that this has yet occurred. This is important since the available information suggests that the Fund is currently well managed, has made significant investments (notably in coastal plantations) that offer some security beyond the life of the mine and, in this case, secured some land that might, at some point, be required for resettlement. This seems to have been the greatest achievement of the Trust, while simultaneously supporting projects. However the Trust has never been able to convince the bulk of landowners of the wisdom of this policy, despite the situation where it is currently the only source of mine-related income for mine-affected villages beyond the life of the mine.

Since, when the mine eventually closes, villagers in Dapera, Moroni (and perhaps elsewhere) will have virtually no land left, few employment opportunities, no compensation payments and worsened access to services, the existence of such a fund is at the moment absolutely crucial to their future.

7.2.4 Relocation and BCL replacement facilities

Since 1969 when construction work started, 28 villages and hamlets, including just under 200 houses, have been relocated, at a total cost to BCL of K1 639 000 (see Section 4.4). According to a determination of the Mining Warden's Court in 1969, the Company was obliged to construct permanent houses, with 1000 gallon water tanks and external toilets. BCL also provided access roads to new village sites where no such access road existed; this would however have been inevitable since access was essential for house construction. The Mining Warden's Court also established that there would be compensation payments of \$200 per head for the hardship which would follow the enforced change from a traditional village environment to a European way of life, and to provide for the additional cost of maintaining a European-style residence in an urbanised community. This latter provision has increasingly become of importance. The initial delays and difficulties in resettlement are set out in Bedford and Mamak (Ref.3). This study emphasises the manner in which BCL's mining engineers continually revised plans for use of land in the mine-lease area, thereby regularly delaying and disrupting plans for village relocation. These early experiences have, in some respects, continued as BCL does not appear to have been aware of, or concerned at, the serious problems that delays and inadequate communications caused for villagers in the mine-affected areas.

There are currently six areas of particular concern:

- (a) the lack of houses for newly married couples;
- (b) maintenance of BCL houses;
- (c) inadequate water supplies, toilet facilities etc;
- (d) inadequate information on relocation, replacement etc;
- (e) poor quality and poor designed housing;
- (f) limited facilities in the resettled villages.

These are examined in turn in the following sub-sections. The limited number of possible sites for village relocation, especially for Dapera and Moroni villages, has made the planning of relocation more difficult, but is not regarded as a critical concern by villagers, because of their very strong preference to remain on their own land, even if that land is not wholly appropriate for village relocation.

7.2.4.1 Insufficient housing

In every relocated village there is a demand that BCL provides houses for newly married couples, on the grounds that villagers in these villages now have inadequate access to bush materials to construct their own houses. There is no market in bush construction materials and in the most seriously affected villages it is claimed that there are few if any construction materials available on the extremely limited land areas still owned by the villagers. The Company has rejected this view, arguing that it was its duty to provide for those people who were actually relocated, but not for their children (contemporary or subsequent) or those who married into these villages and that this decision has previously been accepted by the landowners. No houses have therefore been built for newly-married couples some of whom remain in the house of one of the partner's parents, a situation which is in conflict with Nasioi tradition.

Information on the supply of bush materials to villagers in the relocated villages is lacking. It was apparent that in New Kuneka, some villagers had already constructed buildings (usually kitchens) from bush materials and it is probable that at least some households in all the relocated villages have access to bush materials. However, construction of new houses in bush materials would produce something a 'two-class' village, especially in Dapera and Moroni, where people have become used to living in contemporary permanent housing. The cost of constructing houses for newly-married couples, with one partner at least coming from the relocated villages, would not be high since the basic village infrastructure exists, it would be in the spirit of the initial agreement, and it would contribute to much greater good will between BCL and local villagers. However, it would present problems at Moroni where suitable sites are in short supply.

7.2.4.2 House maintenance

Villagers have consistently requested that BCL maintain the modern houses and other facilities (such as water tanks) in the relocated villages, in some cases noting that they have neither materials, nor appropriate skills to do so themselves. BCL has rejected this request, arguing that in traditional villages, maintenance has always been carried out by the householders and that this practice should be continued in modern villages. Over the years, especially at Moroni, decay is now apparent, although some villagers have conducted their own housing repairs.

It is not possible to maintain modern houses without modern materials and appropriate skills; these are costly and not always available. It is not appropriate for BCL to provide all maintenance work required on the new housing, this would unduly reinforce the existing 'dependence syndrome' in which most problems are considered to have been caused by BCL, hence solutions must therefore be provided freely by BCL. It may nonetheless be appropriate for BCL to provide appropriate housing materials on an at-cost basis for villagers to undertake their own housing repairs. The issue of water supplies is dealt with in Section 7.2.4.3.

7.2.4.3 Inadequate services

Dissatisfaction with the water supplies is prevalent in all resettled villages. In Rorovana there is concern at the small number of water stand-pipes though they have been replaced several times by BCL and in Kuneka there is concern that after almost a year in the village no water tanks have been completed and the stream source was almost 1km away from the village. At Moroni the four original water tanks have long since rusted away, and for some time the villagers collected rain water in 44 gallon drums; these were sometimes contaminated and provided a breeding ground for mosquitoes. (Recently BCL has constructed a new pipeline and a single central water supply system.) In Dapera there was no water supply to individual houses.

The terms of the original agreement indicate that BCL was expected to provide and maintain water supplies and toilets to each house. Initially this appears to have occurred and toilets have consistently been provided to new houses (although at Moroni there is now no suitable area for new toilets and at Kuneka the pits are flooded after rain). However over time the supply has deteriorated and, as in the case of Dapera and Kuneka, apparently promised water supplies have failed to be constructed at the appropriate time; that is, when households were moving into the new houses. Once again this is not an unduly expensive undertaking; it meets the terms of the initial agreement and should have been provided appropriately by BCL. It is also appropriate that the Company maintains these new water supplies adequately or assists with materials and

training, since the task may be beyond the capacity of the village households themselves.

7.2.4.4 Inadequate liaison

In every village, concern has been expressed over the lack of communication with BCL's Village Liaison Office (which is responsible for decisions affecting resettlement, compensation etc) and with senior BCL management. This shows itself in the apparent lack of knowledge over when promised services will actually materialise. It was most apparent at Pirurari where villagers are living virtually in the shadow of the waste dump (and are concerned over water and earthquake-induced landslides) - they were awaiting a decision on when they would be relocated to the new site that they had chosen. BCL argue that this site is too small and is attempting to liaise with the villagers and the North Solomons Premiers Department for an alternative site. However this has resulted in an apparent lack of communication that has made the villagers frustrated, angry and concerned that the Company is not genuinely interested in planning their future. Constant complaints were directed at the Village Liaison Officer who was accused of being insensitive (other than to instructions from within BCL) and desk- and car-bound.

It is always easy to say that in the 'old days' things were much better, communications were smooth and problems between BCL and landowners quickly resolved. It is difficult to demonstrate. It is equally apparent that the Village Liaison Office (VLO) is unlikely to win any praise from landowners in the area for any of its activities. It is therefore in a very sensitive position, transferring village concerns to management and attempting to respond to them appropriately. This is particularly so if the Company's senior management has little understanding of the culture and history of the area. It is possible, although there is no evidence on this matter, which is worthy of further enquiry, that the VLO operates under financial constraints which limit its ability to respond quickly, if at all, to particular issues. However, although Bedford and Mamak (Ref.3) have clearly indicated that there were considerable problems with resettlement in the earliest phases, there is some evidence that initially the VLO worked more efficiently, at a time when there were also government administrative officers posted at Panguna, and that, over time, the VLO may have moved closer to a position of tokenism responding to consensus, rather than actively working in the field on village issues.

We believe that the work of the VLO should be reviewed with a view to upgrading its status, possibly giving it extra financial support and strengthening its field operations.

7.2.4.5 Standard of housing

Villagers have increasingly emphasised that the standard of housing provided by BCL in the resettled villages is inadequate. Specifically they request that they be provided with accommodation similar to that provided for mine workers in Panguna and Arawa. These houses cost approximately K60 000 each. The houses that are presently provided for the villagers cost approximately K12 000 each.

Casual inspection suggests that the houses provided for the villagers contain facilities appropriate for most standard-sized houses, are similar to those constructed of modern materials by Bougainvilleans in the other villages in the Province (although with additional finance, such villagers may have preferred larger houses), and are superior to bush material houses, which must normally be replaced after 10-12 years and repaired rather more frequently. This is a complex issue, which has national implications. We do not consider it further here.

7.2.4.6 Facility provision

There is concern that the social facilities in the resettled villages are inadequate, and that BCL should have provided additional amenities beyond those specifically indicated in the original agreement. This was most firmly expressed at a meeting in Rorovana village, where there were requests for improved roads, an aid post, sporting facilities, support (financial or through new buildings) to youth, church and women's groups and a central electricity power point. Similar but less comprehensive concerns have been expressed elsewhere.

We consider that it is not appropriate for BCL to respond to every request from mine-affected areas for three reasons:

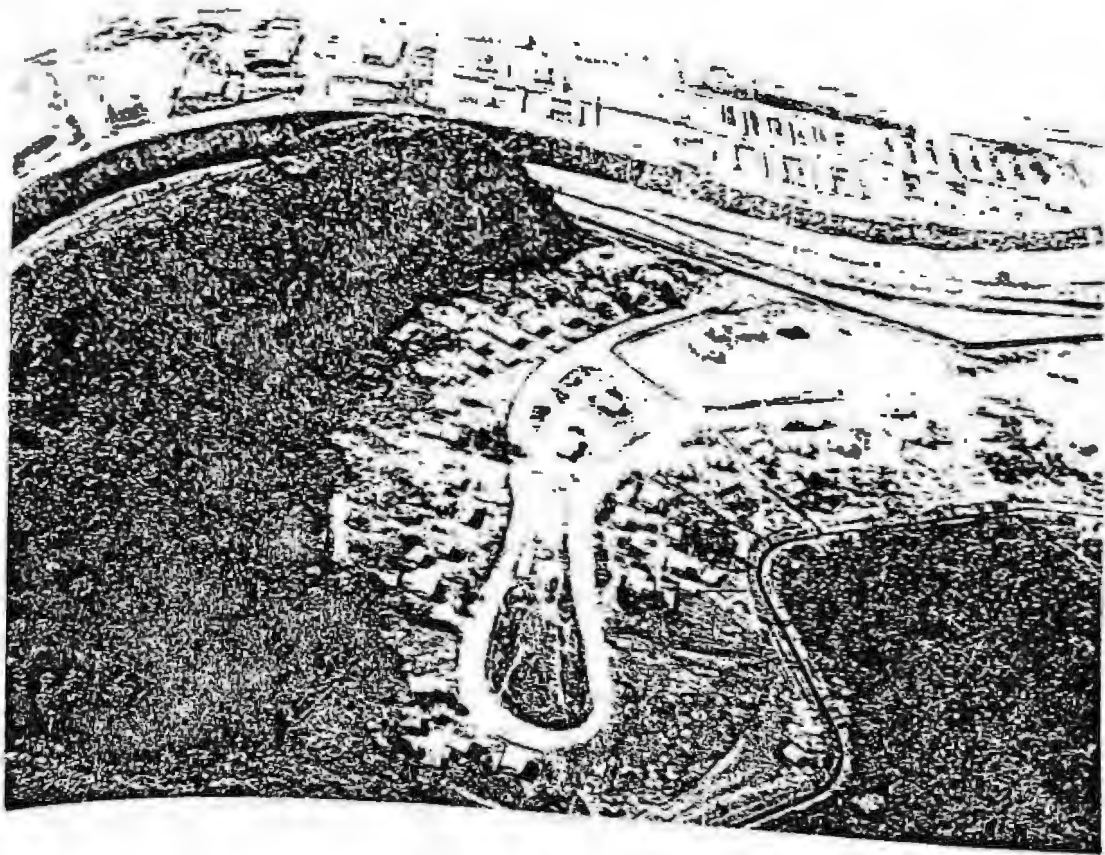
- (a) the evidence presented in earlier sections of this report (Section 4.5) suggests that most amenities (such as aid posts and community schools) are, with few exceptions, as well supplied in the mine-affected areas as in other areas of rural Bougainville;
- (b) the Provincial Government has a clear responsibility to provide some services in the area, although it is apparent that the division of responsibility is not clearly understood;
- (c) in some areas (such as youth and women's groups) it is important, in terms of self-reliance and the reduction of dependency on BCL, that village groups run their own affairs, with support from Community Governments.

However in some cases BCL could probably have gone beyond the letter of the agreement. The best example is Dapera village which is constructed on waste containing sulphide-bearing rock, steel mill balls and related debris. This dusty, bleak area without topsoil or even weathered overburden could have been a model village rather than the depressing and desolate reminder of the Company's lack of commitment to the landowners (Photograph 14).

In general, the provision of such services as aid posts and schools is the responsibility of the Provincial Government, with assistance from Community Governments and the local people, sometimes with church support. Within the mine-affected area it might be expected that BCL, perhaps through BCF, would make a direct contribution to such services, but in association with the Provincial Government, who would ultimately take responsibility for most of these services when the mine closes. BCL already makes a contribution through some provision of materials, bus services, furniture and so on, including the Panguna Community School itself. A number of schools in the mine-affected area are in need of upgrading and maintenance, and it is widely believed that BCL at one time promised assistance in this area; it would therefore be appropriate for there to be a meeting between BCL, the Provincial Government and the relevant missions, to devise a new agreement for funding such programmes. Any new division of responsibilities would have to be clearly understood and adhered to by all parties.

7.2.4.7 Conclusion

Overall, it is apparent in many villages that planning for resettlement has often been inadequate, that attention to the concerns of resettled villages may have declined over time and that, in many details, provision of services was lacking. This was most apparent at New Kuneka, established at the end of 1987, where BCL seemed to have gained little from its previous experience of resettlement. The village layout was uninspiring, water tanks were not yet installed,



Photograph 14

The village of Dapera which has been relocated from within the mining area onto part of the waste dump

inadequate fencing wire had been provided for new pig compounds, some of the steps of new houses were already rotting and disintegrating (since the rooves did not extend beyond them), the village hall was tiny and the kitchens had such poor foundations that after heavy rain water seeped inside. At Dapera, the tailings drop-box remained uncovered for years, sending dust into the village, when the cost of a covering was minimal. As noted in Section 7.2.4.6, it remains a depressing environment, situated on a flat, sometimes mosquito-ridden, waste dump, without any similarity to traditional Bougainvillean villages. Here and elsewhere villagers were rarely given adequate information on service provision or other critical issues affecting their lives.

Beyond this some problems are inevitably due to the relative deprivation experienced by villagers in comparison with mine workers; in Dapera this is brought home to people by the presence of mine workers' children in the village school. Relocation held out the promise of a new life which might have put them on the same footing as the urban residents of Panguna, but this has never materialised, as BCL insist that villagers maintain their own houses to make 'productive' use of compensation payments. As Jackson and Filer correctly observe (Ref.66): 'In the eyes of the landowners this adds insult to injury since they feel they are not only being transformed into squatters on their own land, but are also being blamed by others for the physical decline of their settlements' (p 83). In many respects BCL has lost the opportunity, at relatively low cost (compared, for example, to the cost of a truck tyre), of creating a series of model villages, creating goodwill and demonstrating good, old-fashioned, benevolent paternalism. It may not be too late.

Finally, in a national sense the provision of resettlement facilities is an important one. There is little doubt that a group of villagers from Lihir who recently visited Panguna were unimpressed with the relocated villages. Such inadequate planning is likely to hamper national efforts to convince other Papua New Guineans of the merits of mining on their land. Indeed as Jackson and Filer also point out (Ref.66): 'it is difficult to imagine that any Papua New Guinean villager would freely choose the fate which has befallen the people of Moroni and Dapera if their choice were guided by the knowledge of the consequences' (p.80). We believe that the people of Moroni and Dapera would certainly not have made that choice.

7.2.5 Inadequate communications

To some extent this issue has been discussed in Section 7.2.4, with particular reference to the work of BCL's Village Liaison Office, which was regarded as inefficient, insensitive, responsive to BCL management only, and incapable of transmitting village requests to management. One Dapera villager simply noted that 'they are our enemies'. Beyond this there was the specific view that the Business Development Office within the VLO was no longer interested in, or willing to, provide information to villagers interested in entrepreneurial activities. It is clear that the VLO can never win praise for its activities, yet it is also apparent that it is currently experiencing obvious difficulties in contributing to liaison between landowners and management. This is partly a function of the absence of government administrative officers who were previously contributing to this administration process.

It was also apparent to us that villagers generally lacked information on the structure of administration in the Province; that is, the division of responsibility between National, Provincial and Community governments over the provision of various services. In some specific cases, such as the diseased coastal

Nikana Wholesalers; not surprisingly the supermarkets at Arawa and Panguna are often seen as the 'company stores'. BCF has two subsidiaries: the North Solomons Agricultural Foundation (NSAF) and the North Solomons Medical Foundation (NSMF).

From 1971 onwards BCL provided agricultural development and extension services in Bougainville, especially in the mine-affected areas, initially through a separate Agricultural Extension Services division, with the intention of increasing production of agricultural commodities, increasing village revenue and satisfying BCL's needs for fresh food. Despite some successes, village food production never met BCL's needs and it appears that BCL to some extent lost interest in directly supporting local production activities. In any event the Extension Services division no longer exists and its functions were taken over by the NSAF in 1981. It is currently oriented to developing, at Mananau in the Tailings Lease area, an egg layer project that would make Bougainville self-sufficient in eggs, and an intensive piggery. Both eggs and pork are products affected by import restrictions where local production has not met market demands. Although SHRM, the catering firm which supplies BCL, is intended to purchase local production preferentially it appears that the Mananau egg project will compete with, and discourage, local production. There has therefore been a movement away from extension services, undoubtedly partly out of disappointment over limited success, towards direct BCF production.

The North Solomons Medical Foundation (NSMF) was established in 1979 to promote and improve health care, train Papua New Guineans in health care techniques and provide supplementary private medical services in Panguna, Arawa and Kieta. NSMF now has a 15-bed private hospital (the Arawa Clinic) which has various outpatient services. Similar but less extensive services are provided in Panguna (but not Kieta) and NSMF markets occupational health services to BCL there. About 60% of patients at the clinic are PNG citizens; about 50% are BCL employees and their families and 10% come from rural areas. The Arawa Clinic has been strongly criticised for its competition with the public Arawa Hospital and its relatively high fees and charges, which are argued to be a considerable burden on many local citizens, though they are intended to ultimately give NSMF self-sufficiency beyond the life of the mine. NSMF has however given funds to the Arawa General Hospital and to other bodies such as the North Solomons branch of the Red Cross. There is little recent evidence of NSMF being engaged in any local training activity or in any support for aid posts, or aid post orderlies, in the rural areas, even in the mine-affected area. NSMF does therefore exhibit a considerable degree of urban bias, and certainly gives the impression of being in competition with the Arawa Hospital, to create two tiers of access to health care. It is an impression that the NSMF needs to dispel by establishing and publicising a genuine low cost medical insurance fund and by ensuring that it has a greater commitment to supporting Provincial Government health services in rural areas.

BCF has provided donations and grants in a variety of areas, totalling K3.28 million over the period 1977-1989. Almost half (47%) of this has gone into health and 28% has gone into agriculture. However a very high proportion (74%) of health donations have gone to the NSMF, primarily to cover operating losses and the purchase of capital equipment, and fully 99% of expenditure on agriculture has gone into supporting NSAF. Two-thirds of all donations and grants thus go directly to BCF subsidiaries. The remainder of the funding goes into a variety of health, educational and community activities, including some direct support for provincial government projects. Not all of this funding is within Bougainville; some 12% of all funding, mainly for education and some health projects, is outside the province, though it may directly or indirectly support provincial activities. Despite the visibility of some BCF donations (eg. school

It is apparent that criticisms of BCL have focussed on what is perceived to be its 'self-interest' through BCF. This is in two areas; that is firstly, supplying reliable, cheap agricultural produce from its own establishment, rather than giving more concerned assistance to local producers, and secondly, ensuring good quality health care to those with high incomes, mainly employed by BCL. In terms of agriculture BCL has, in the past, provided extension services and, in general, this is the role of the DPI, a role which is often conspicuous by its absence. In health services, BCF does not appear to have made any serious attempt to support local, rural-based services. All this has occurred at the same time as the reduction in activities of BCL's Business Liaison Office. Moreover to achieve its present status BCF has made massive investment in commerce in Bougainville, so that there is little effective local ownership of significant commercial enterprises, although BCF has attempted to divest itself of AEL, limited capital ownership in the province amongst other factors has resulted in these not being taken up locally. Moreover whilst most of the investments appear to be in a sector which will experience considerable financial problems at the end of the mine life because of the almost certain downturn in employment levels and thus commerce. Thus for what appears to be rather limited welfare and charitable gains, BCF has alienated many Bougainvilleans who would welcome more direct support for local enterprises and less expansion of what is inevitably viewed as a branch of BCL into the commercial and industrial activities of the Province.

All the available evidence suggests to us that business contracts are given to local groups. No examination was made of the employment policies of BCL although a review of such policies may be appropriate to allay, if possible, local concerns. Initially BCL tended to favour local labour, which was often better educated and cheaper to recruit, and there is no reason to believe that this policy has changed over time. Available employment data nevertheless suggest that as many as 70% of all citizens employed by BCL are from outside the Province, a high proportion, given the distance between Bougainville and the mainland and the emergence of new mine employment opportunities. This situation has been accentuated by changes in the local mine job market. Most workers are staying for longer and longer spells in mine employment, increasingly seeing this as a career rather than a job. As a result fewer vacancies occur. Moreover the overall workforce of BCL and ancillary industries has contracted rather than expanded in the past decade. Alongside a period of rapid population growth this has necessarily focused local attention on increasing unemployment in local villages, although this phenomenon extends far beyond the mine-affected area and is more severe in other parts of PNG.

7.2.7 Effect on health

We found no evidence of direct harm to human physical health by the mine's operation. Two possible minor exceptions to this may be the irritant effect of residual lime in the tailings which may delay the healing of sores exposed to them, and the possible irritant effect of excess dust during dry spells which may bring on attacks of asthma in residents of villages in the Special Mining Lease area.

The nutrition of children in all villages in this area seems to have benefitted from the improved socio-economic situation. The nutrition of adults in the mine villages, particularly that of the younger women, has deteriorated leading to the incidence of a lot of obesity. This is a consequence of changes in diet and lifestyle and may be expected to produce complications later.

Communicable diseases such as acute respiratory infections, diarrhoea, and malaria have all increased during the life of the mine due to changes in population size and mobility. Middle ear infections in children and not noise are the probable cause of any deafness that is present. Malaria has become worse as a result of changes affecting the whole Province, but may have been exacerbated locally by flooding in certain areas alongside the tailings.

High diarrhoea rates correlate with insufficient water supplies, especially along the tailings. The Provincial Government's Division of Health should carry out a needs assessment in these communities and provide appropriate installations and health education on personal and food hygiene as a matter of priority.

Chronic lung problems including asthma have resulted from changes in housing and lifestyle and the use of cigarettes. We do not think that dust should be considered a significant health hazard either for silicosis or for other respiratory problems. However, given the probability of dust becoming a nuisance and irritant in the New Dapera area during dry spells further efforts to contain dust in that area should be taken.

Mental and emotional health is clearly a problem for at least some members of these communities. Situational stress probably contributes to asthma, peptic ulcer disease and other psychosomatic illness. However, the main problem is the negative, passive attitude developing in a significant proportion of these people as a result of a perception of powerlessness and inability to control their own lives. This arises from the simple fact of the mine's presence and the destruction of their land with its economic resources. Complementary to these are the continuing problems over equitable distributions of royalties and compensation payments.

The Panguna Health Centre needs to be upgraded to full health centre status with a Health Extension Officer in charge, staff and facilities to provide in-patient and midwifery services, and a vehicle to carry out maternal and child health clinics, aid post supervisions and other extension activities. There is probably a need for a further aid post to improve access to services for the villages in the mid- and lower tailings areas. Panguna Health Centre, when adequately staffed and equipped, should be made responsible for the provision and supervision of all health services to the villages in the tailings lease area.

7.3 PHYSICAL, BIOLOGICAL AND CHEMICAL ISSUES

7.3.1 Introduction

A variety of general and specific problems were made known to us with regard to physical, biological and chemical issues. Six specific concerns were identified:

- (1) the absolute loss of land through mining operations and the inadequacy of revegetation programmes;
- (2) climatic change and air pollution;
- (3) crop failure and declines in productivity, of both food and cash-crops;
- (4) the loss of wildlife, notably flying foxes and possums;
- (5) the loss of fish, crustacea and shellfish and declining aquatic productivity;

(6) uncertainty about future changes.

By considering the chemical and biological issues we addressed in Section 5 and subsequently examined further by considering in Section 6 the research and monitoring done by BCL, these can be conveniently grouped according to the following criteria:

- (a) issues which are substantial and which have no prospect of resolution in the short term (by short term we mean 1 to 5 years);
- (b) issues which in our opinion do have a realistic chance of resolution in the short term.

In the first group the substantial physical issues are obvious; there is now a large pit, approximately 3000ha of land covered by tailings and a delta of tailings at the Jaba River mouth approximately 900ha in extent. This all adds up to a massive change; in effect a new environment has been created being essentially an inhospitable replacement for the natural ecosystem. Concern numbers 1 and 5 come into this category. In our assessment these issues cannot be resolved in the short-term, irrespective of the life of the mine.

These obvious consequences of mine development have lead to a complex mixture of impacts on the people, plants and animals of the lease areas. The impacts on the people include social, health, nutrition, economic and psychological changes. Some of these have resulted directly from the operation of the mine, and others are indirect and are the inevitable consequences of any very large scale development such as a hydro-electric power scheme, for instance. Some changes, particularly economic, may be seen by local people (mostly those who have retained their land) as beneficial but other people believe that the changes have been disastrous.

There have been many changes to the biological component of the ecosystem and these are apparent to anyone who looks closely enough. The actual causes of these changes are in some cases equally obvious but for others the causes remain obscure. We have considered the observed and suspected changes which have occurred to plants and animals and have made our assessment of the causes. In this section we attempt to put the changes into perspective and to develop a realistic picture of what these changes mean to the total mine environment, now and in the future.

7.3.2 Land losses and revegetation

7.3.2.1 Physical depletion of land

By definition every village considered in this review (with the possible exception of Koiare) has been directly affected by the loss of land. In the case of villages in the Special Mining Lease area, notably Dapera, Moroni and Pirurari, and Jaba, at the mouth of the river, a very high proportion of all land has been lost. In the case of Dapera this proportion may already be as high as 90% whereas in villages on the Port-Mine Access Road losses of land were relatively small and have now stopped. In some cases villagers in affected areas have been able to activate land claims elsewhere and there has been some voluntary migration away from affected areas, notably from Dapera to the Pinei Valley and from the lower reaches of the Jaba River into Nagovisi. However, most villagers have little ability to establish land rights elsewhere and therefore no opportunity to migrate into other land areas.

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7.3.2.2 Reinstatement and revegetation

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Loss of land has almost completely destroyed the agricultural base of Dapera and Moroni villages and severely reduced agricultural development opportunities in such villages as Pirurari. In these and other villages there is serious concern over these losses, in terms of the present and future agricultural system. Land losses have put pressure on both food production and cash-cropping systems, provoking recurrent statements that villages could not produce enough food for local consumption and/or marketing and that there was inadequate land for cash-cropping of cocoa. Such statements disguise the fact that within all villages there are significant variations in access to land so that, even within Dapera, some households may well have adequate gardening land. Conversely, even in villages where land losses have been relatively slight, some clans and households may now have very poor or non-existent access to land, and be almost wholly dependent on purchased foods. Dependence on purchased foods has caused considerable concern, because the prices of such foods are rising and are considered disproportionate to the value of foods produced from the land (and consequently compensation payments), because this represents an unacceptable break from traditional patterns of food consumption and because such foods are (sometimes) considered to be less nutritionally adequate than traditional garden foods and wildlife.

7.3.2.2 Reinstatement and revegetation

The pit will remain, more or less in its present form although perhaps a bit wider and deeper, for hundreds of years until nature remolds the landscape by erosion or earth movement. It will never recover to its pre-mining condition.

There are no plans to modify the pit artificially after mining ceases except to revegetate suitable slopes. The scope of the revegetation plan depends on whether the pit will be permanently drained or allowed to fill with water. In our opinion permanent drainage of the pit through the existing tunnel into the Kawerong River is not a viable long-term solution unless an indefinite commitment is made (probably by either the National or Provincial Government) to maintain the tunnel. If this commitment were not made (or the maintenance were not carried out) at some time in the future, the tunnel would cease to function because of earth movement leading to tunnel collapse or simply because of blockage by erosion debris from within the pit. Following this the pit would probably fill with water until it eventually drained over the south-western edge into the Kawerong River. Whether or not this situation was ever reached would depend on the amount of water flowing into the pit relative to the amount of water lost from the pit by drainage through existing fissures in the rock surrounding the pit.

The chemical and biological consequences of the different options for the future of the pit are not easy to foresee but as a best guess we predict that if the streams in the present pit catchment were re-diverted back into the pit and if a lake developed up to the existing level of the lowest wall, then this lake would eventually stabilise with an oxygen deficient (anaerobic) layer of bottom water, probably several hundreds of metres deep, overlain with a layer of oxygenated water of a chemical quality probably good enough to support an aquatic community including fish. Artificial stocking and perhaps addition of nutrients and lime, at least in the early stages of biological colonisation, would be required. Deep tropical lakes do not, in general, mix completely to the bottom (as temperate lakes do) and for this reason we would expect the lake to maintain a viable long-term community despite the uninhabitable bottom waters. This picture is, however, a long way into the future. In the meantime, the pit will have no productive or ecological value.

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There would be other consequences of the pit filling with water, particularly the effects of hydrostatic pressures and hydraulic forces on the stability of the surrounding land forms. These would need to be considered.

The waste rock dumps and tailings deposits are unlikely to ever (or at least not for a very long time) recover to the state of the surrounding country. The reasons for this have been discussed in Section 6.4.8. At best, when the existing chemical impediments to plant growth have been removed, the revegetation will proceed towards a plant community appropriate for the physical structures of the dumps and tailings deposits. It is not possible to say what this community will be, particularly on the tailings, because similar land forms in Bougainville either do not exist or have not yet been identified.

It is important to remember that the chemical difficulties presently preventing plant growth (acid, copper, aluminium and insufficient nutrients) are only temporary (on nature's time scale). The time will come (sooner, if man lends a hand) when the tailings will become essentially the same (chemically, physically and biologically) as beach sand. The development of a self-sustaining plant community (with associated animals) will then progress much as it does for coastal sand reclaimed (naturally) from the sea. Coastal sand normally revegetates by extension of the landward plant community but this is not likely on the tailings deposits because these deposits are physically alien to the adjacent vegetation. For this reason it will be necessary to help nature by deliberately transferring appropriate plants onto the tailings. The waste rock dumps are physically different to the tailings deposits in terms of slopes and the grain size of the material. This may have some influence on the species composition which eventually develops on the waste rock dumps. The chemical constraints to plant growth are similar to those on the tailings, but because the waste rock contains some naturally weathered materials (clays), nutrient deficiencies may not be quite as severe as they are on the tailings.

It is apparent to villagers, especially those close to the BCL trial revegetation site at Bato, that experiments in revegetation have so far been total failures in terms of the growth of species of some nutritional or commercial value. It is considered by BCL that it is impractical to return the tailings area or the mine site to its original state and all experiments in the growth of species requested by local villagers (including sweet potatoes, aipika, bananas, coconuts and cocoa) have been failures. BCL claims that there are future possibilities for timber production (that may be of value for construction, firewood or a handicraft industry) and that enough species may return to the area for it to be used for hunting and gathering. Such possibilities remain in the distant future, beyond the probable life of the mine. This situation has caused enormous resentment in nearby villages to the extent that the Bato revegetation plot was recently severely damaged by arson. This resentment has followed the situation where villagers have assumed that at least a proportion of their land would eventually revert to something approaching its historic use. Villagers close to the mine site continue to demand that their land be restored to its historic condition after the closure of the mine. Not only would this be technically impossible in many areas and prohibitively expensive, but there is no likelihood of any significant revegetation programme continuing beyond the life of the mine. In other words village land that has been used in the mining operations will not revert to land of any real economic or social value to the villagers.

In our opinion, the revegetation programme BCL is presently pursuing is chemically correct but if more effort were devoted to the programme, other options for enhancing revegetation could be investigated. However, we accept the logic advanced by BCL that practical progress on long-term revegetation is best

delayed until the tailings deposits and waste rock dumps are in a stable state. We see no reason why this condition should not be reached on the tailings deposits soon after the tailings pipeline comes into operation.

From biological considerations the objectives should be first to establish a plant cover on the tailings then to develop stable conditions which will promote soil development. A good plant cover will have the immediate benefits of reducing dust and of retaining moisture (essential for development of viable soil micro-organisms). Only when a viable soil ecosystem is established can the plant community develop towards its ultimate form.

The most serious problem confronting villagers who have lost significant areas of land is therefore that, at the termination of mining, they will be left with only a fraction of the land that they previously owned whilst, at the same time, all compensation payments will be concluded and employment opportunities at the mine site and in Bougainville generally will dramatically decline. This situation will be exacerbated by continuing rapid population growth (although there may be some minor compensating outmigration from the Province) throughout the region. This situation must be faced and planned for now.

7.3.3 Loss of river and marine resources

7.3.3.1 Freshwater

All the rivers of the Jaba River catchment have been detrimentally affected by the mining operation. The most obvious loss has been that of fresh flowing water from the Kawerong River and other streams that originally crossed the pit area, from the Jaba River downstream of the pumphouse and from parts of other tributaries which have been dammed by the tailings deposits. The reasons for the loss of freshwater from the rivers receiving tailings is obvious: high sediment concentrations and chemicals. Where the tributaries of the Jaba River have been dammed by tailings, the water no longer flows and it is probable that these stagnant conditions have lead to loss of oxygen from the bottom waters with consequent tastes and odours in the surface waters. Such water is not aesthetically attractive to consumers and may even be harmful if faecal matter, carried in from the upper catchments, accumulates in the stagnant areas.

We do not see any prospect of recovering this lost resource of freshwater in the foreseeable future. The rivers now contaminated by tailings will slowly improve in quality as the tailings become stabilised both physically and chemically, but even in the longer term when the waters are chemically fit to drink, they will not be attractive and are likely to be avoided by local people for cooking and drinking. The tributary streams are, however, likely to recover if the Jaba River cuts down substantially into the tailings deposits and so allows the tributaries to do the same. This could reduce or eliminate entirely the present areas of ponded water but will still take many years.

As discussed in Section 5.7.3.2, most of the fish present in the rivers of Bougainville must spend part of their life in the sea. All the rivers of the Jaba River catchment are now depleted of these fish because of the physical and chemical barrier the tailings present to this migration. The Pangara River (which joins the Jaba River a short distance upstream of the delta) will probably be the first river to recolonise with migratory fish when the waters in this part of the Jaba River become of acceptable quality to migrating fish. It is not possible to predict when this situation will be reached but there is some evidence to suggest that when the Pangara River is in flood fish may even now find the waters acceptable. However, there is little doubt that it will be a long time before fish migration into the Pangara River returns to its pre-mine

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level. An unknown factor in this situation is the impact of the discharge from the tailings pipeline. This is discussed further below.

Two options exist for returning fish to the Pangara River in the short-term; restock the river with fish or divert the Pangara River directly to the coast. There may in fact already be a small direct connection. The restocking option has been attempted but with only short-term success. The alternative, diverting the river to the coast, would require a channel about 5km long, structured to suit migratory fish.

Our understanding of the chemistry of the tailings, waste rock and Jaba River water, indicates to us (as it also does to BCL) that both physical and chemical conditions in the Jaba River will prevent fish from passing upstream for some considerable time to come. However, fish will eventually return to the upper Jaba River catchment when conditions are suitable. Only efforts made towards achieving these conditions should be directed towards reducing the adverse effects of water chemistry and channel instability. Any success in these areas will bring forward the day when fish recolonise the Jaba River.

In the Jaba and Pangara rivers where fish migration is interrupted, BCL pays fish compensation to the villages affected (Section 4.8). However, BCL no longer pays compensation for the Pinei River, arguing that since 1984 the fish stocks have returned to their normal level. By contrast, Rorovana villagers argue that this has not occurred either in the river or in the sea close to its mouth and seek further compensation. BCL has produced evidence that suggests that stocks are similar to those in a comparable but unaffected river to the north. If volumes and variety of fish are lower than previously this may be a result of a number of factors. Firstly, there may be contamination from waste dumps and factories, such as at Itakara, close to the Pinei River; there is no available evidence that this occurs. Secondly, increased populations at Rorovana, and in other villages close to the banks of the Pinei River may have resulted in increased levels and efficiency of fishing. Thirdly, contamination from detergents and erosion, following more extensive plantings of cash-crops, may have damaged and disturbed river ecology. Fourthly, perceptions of the past may be at variance with the real situation. A meeting of the BCL environmental staff and Rorovana villagers failed to resolve this particular issue. It is clear to us that there can be no consensus on the cause(s) of depletion of riverine aquatic life.

7.3.3.2 Marine resources

Whereas we are confident that some action can be taken to speed up the biological recovery of the tailings, waste rock and Jaba River channel, we are not so optimistic about the resources of Empress Augusta Bay. On the basis of BCL's research to date the only substantial loss of biological resource has been among the benthic organisms including the blue mussel. So far, no impacts on the fin fish resource of the Bay have been detected but we caution against assuming that this situation will be true in the longer term. As we have pointed out (Section 6.4.6) the conclusion that most of the fish productivity in the Bay is based on detritus whereas most of the demersal fish are carnivores depending directly or indirectly on benthic animals, leaves some doubt about the long-term risk to the fish population from the tailings discharge. Not all the fish in the Bay are demersal (living near the bottom) and when this is taken into account our pessimism may not be justified.

A second factor, which we believe is cause for concern, is the circumstantial evidence suggesting that stress on fish in the Jaba delta area may have allowed

the 'ulcerative' fish disease to establish. Certainly, it was made clear to us by the villagers including those far from the coast, that this issue is of extreme concern to them, particularly in view of the rapidity with which diseased fish appeared, and the lack of information on this situation that has been returned to them. The information we have viewed indicates that these diseases usually abate within a few months but the question remains as to whether or not the Jaba delta environment has made fish susceptible to disease and whether it will continue to do so. However, even if both answers are yes, there does not appear to be any solution to the problem. Whereas other studies have shown that only a small proportion of the fish population is diseased at one time, observations of diseased fish could discourage the local people from using any of the resource. Such a situation would be effectively equivalent to a complete loss unless it is clearly demonstrated to them that particular species are unaffected and safe to eat.

Yet a third factor, which may influence the long-term stability of the fish resource in Empress Augusta Bay is the new tailings pipeline. As far as we are aware the fate and behaviour of process chemicals in the tailings slurry after it leaves the pipeline have not been considered in detail. At present most of these chemicals either degrade or are retained in the tailings deposited in the Jaba River valley and so do not reach the delta. Until reliable information is available on the behaviour of these chemicals in the slurry and in seawater, and on their toxicities to marine organisms the future of marine resources in Empress Augusta Bay remains uncertain.

The decline of the mussel population is likely to continue while tailings enter the Bay. At this stage, however, it is not possible to predict the long-term future for the mussels; they may disappear completely or they may decrease to a smaller population which is sustained by recruitment from areas not affected by tailings.

7.3.4 Conclusion

The previous two sub-sections discussed the major chemical and biological issues which we can see no prospect of resolving in the short term but there are many other issues, mostly raised by the landowners, which we believe can be partially or completely resolved within 1 to 5 years. By 'resolved' we do not mean that an issue as perceived by the landowners will necessarily be settled by compensation or by BCL alone. Some of the landowners complaints are not, in our opinion, a direct consequence of chemicals from the mine nor are they a direct consequence of this particular mine. Some problems perceived by the landowners are the inevitable results of development and usually occur to a greater or lesser extent whenever development takes place. For example, some health problems such as more frequent sickness and obesity are mainly products of development as discussed in Section 7.2.7, not of harmful chemicals. A range of complaints was received from villagers in the mine-affected area relating to the disappointing performance of a number of cash-crops (especially cocoa) and food crops (including almost all food crops, but especially bananas and several root crops). On only one occasion was there any suggestion that coconut productivity had declined and there was no mention of damage to betel nut palms. Although cocoa was reported to be suffering excessively from blackpod, there were no other concerns about tree crops. The availability of produce in Bougainville markets suggested that some food crop species, notably pineapples and peanuts, were in surplus and were not affected by declining productivity.

In our assessment, the poor performance of these subsistence and cash-crops within and adjacent to the lease areas is caused primarily by diseases which are common in other gardens remote from the mine. We cannot say where these crop

diseases originated or where they first appeared on Bougainville but we believe that the increased pressure on land for gardens, particularly in villages within and adjacent to the lease areas, because of both growing populations and loss of land to the mining operation, is enhancing the effects of disease.

These same pressures have probably led also to nutrient deficiencies in the gardens. Problems like these almost always follow development and population growth and are experienced in all countries with intensive agriculture. Herbicides, pesticides and fertilisers are the only way to maintain high yields from continuous use of a limited areas of land.

The land now occupied by the pit and by tailings and waste rock cannot be returned to productive gardening and there seems to us to be no alternative but to introduce intensive horticultural practices if crop production on the remaining land is to be improved and sustained. In our view there are no technical reasons why this should not be done but as with any fundamental change to traditional ways, the enthusiastic support of the people who will benefit is essential for success.

Several other causes were suggested by the landowners for poor crops; chemicals in dust, gases from the mine, and heat from the tailings deposits. As we have discussed, there was no evidence of dust effects on plants during our inspection but we cannot completely dismiss the possibility of some effect during dry periods. However, most plants are capable of tolerating large amounts of dust and in view of the low concentrations of process chemicals and toxic metals likely to be on the dust from the surface of the tailings we believe that adverse effects from dust on plants are very unlikely. We could find no situation where gases from the Panguna operation could accumulate to concentrations which would damage plants. There was also no indication that the gas emissions from the power station at Loloho were damaging crops. There is no doubt that heat absorbed into the tailings is an impediment to plant growth simply because water which is essential will be quickly evaporated. However, we can see no way in which the hot tailings can have any effect on plants growing on the surrounding hillsides. Close to the tailings some plants may suffer because of radiant heat but this would be a local effect.

There is no doubt that the presence of the mine and consequent development, population growth and reduced land for gardening in some villages, has contributed to poor crop yields but there is no evidence that chemicals from the mine are involved. Disease and nutrient deficiencies, the direct cause of the problem, can be remedied by standard horticultural techniques.

Health problems have been attributed to chemicals from the mine but the only situation where this might be true is on the deposited tailings and in the Kawerong and Jaba rivers receiving tailings where lime, because of its alkaline nature, could retard healing of cuts and sores. This problem will disappear in time as the lime washes out of the tailings and as a vegetation cover establishes.

The reasons for loss of animals, such as the flying foxes, from Bougainville Island, remain unknown. If the animals are considered to be a valuable source of food for the Bougainville people then there could be some justification for restocking Bougainville with flying foxes from elsewhere. The logistics of such a project would be daunting; as a minimum it would need to be fully supported by all the people of Bougainville, otherwise the flying foxes would not survive hunting pressure.

The semi-stagnant areas of water formed where tributary streams are dammed by tailings may eventually disappear when the Jaba River channel stabilises but in the meantime these bodies of water are unhealthy to people because of poor water quality and because they are probable breeding areas for mosquitoes. It is clearly necessary for the local people to understand the hazards of stagnant waters and if this is not already the case then they must be told. Mosquito control is also highly desirable in view of the malaria situation (Section 4.9.4.2). Spraying could be used but only as a last resort and we believe that biological control (for example, using Rainbow fish (Melanotaenia species)) should be investigated.

All of the issues, crop performance, health effects from chemicals, the loss of animals, the hazards from stagnant waters, can be resolved in the sense that some remedial actions together with better understanding by all parties concerned, will put the problems into correct perspective. These are not issues which will disappear overnight, but they are issues which can be managed in ways that will reduce the burden on village people of the lease areas.

The situation in which villagers have consistently raised these problems with the Government and BCL without receiving any satisfactory answers has increased the certainty in peoples' minds that they are caused by the presence of the mine and its discharges, and that no-one is willing to admit this to them.

More generally there is increasingly widespread concern that at the end of the mine life, Bougainville will have become a barren island, seared in the centre by an enormous hole and the barren Jaba flood plain and new delta, surrounded by areas of land and sea depleted of wildlife and fish and useless to the human population. While there is always nostalgia for the 'good old days' when nature appeared more bounteous, and smaller populations may have emphasised this perspective, there is no doubt that in one part at least of Bougainville, environmental problems are continuing to mount, as tributary rivers more and more distant from the Jaba Valley, flow less freely into the Jaba River or to the coast, and the potential for waterlogging and reduced garden productivity increases. This situation is also emphasised by the continually growing volume of tailings and the increased size of the hole at the mine site, both far beyond any possible local (and most other) imaginations at the start, at a time when the mine may only be half way through its working life. Such general concerns can only be addressed in specific terms in this report but point to, firstly, the deep and pervasive concern felt by many local people and, secondly, the necessity to make current provisions and plans for some degree of environmental restoration at the end of the mine life.

CONCLUSIONS AND RECOMMENDATIONS

8

INTRODUCTION

8.1

In the previous sections of the report we have described in detail the work undertaken to complete our review of BCL's operations. Conclusions and recommendations have been made throughout this report, a style of presentation that seems to us most workable in a large and complex study such as this and where the conclusions are derived from discussion and analysis of technical questions. The conclusions (as impacts) are restated below, classified by type and severity. Other conclusions and our recommendations are then discussed.

Simple statements of the impact of mining on the Panguna area and its landowners are quite inadequate an explanation for the very strong feeling the landowners hold. These are complex questions deserving some discussion.

The impact on the physical environment of the mine has been extreme by any measure and most of the adverse impacts are long lasting; in some cases permanent. It is important to emphasise that these have been made legally, for the most part, subject to the BCA. They were permitted, even to some degree encouraged, by the Australian Administration initially and then by the Government of Papua New Guinea. On a national scale they have been judged an acceptable cost for the considerable income that the mine has generated. While the National Government particularly, and the Company, have enjoyed the benefits, the costs have not been borne by them but by the Nasioi people and in particular several hundred local landowners who have lost land and lifestyle. The severity of loss ranges from virtually all garden land for some essentially subsistence villages, to a few hectares of hunting land for others. Lifestyle changes, inextricably linked to land ownership and use, have been similarly affected.

The landowners have received education and health services, improved communication and infrastructure, and earning opportunities as waged workers and contractors and from produce sales. The question facing the Government is whether these benefits are sufficient for its people. Since they are not of a very high standard compared to some parts of the country notwithstanding that they are in many cases a great improvement on pre-mine conditions. Ironically some of these 'benefits' are seen by some as contributions to the destruction of cultural values.

A further dimension to the social impact of the operation derives from the landowners' widespread opposition to prospecting and mining at the outset and the fact that their land was made available by the Administration for mining against their wishes and in circumstances where they were powerless to prevent it. During the early stages of the development opposition from the landowners diminished, in part in recognition of the futility of continuing and in part because the development seemed to offer modernisation benefits such as roads, schools, hospitals, jobs and cash incomes. It is clear that the landowners had expectations that were not met and there are many factors contributing to this. Certainly communication problems (more cultural than linguistic) played a part in this but there were also promises made or benefits alluded to that failed to eventuate. Education was received, money earned but seldom was significant wealth forthcoming. Most of it ended up in the hands of mine workers, other Bougainvilleans or the Company store although a few landowners became wealthy. Compensation payments and, later, royalties were significant sources of cash in the early stages but in comparison with benefits others were receiving, they were soon judged to be inadequate.

Claims for compensation by the villagers directly affected by mining have been a continuing source of disharmony between these people and the Company and more recently the Government. The Company has established and maintained a compensation policy based on well publicised guidelines and quite a lot of money has been paid by the Company in one form or another over the years. The casual observer might question whether the escalating claims do not represent an attempt by the villagers to extract as much money as possible from the Company using increasingly obscure demands. Indeed this appears to be a widely held view amongst the Company staff. While there is an element of this in the compensation claims, this view of the situation does not hold up under examination although the Company may reasonably believe that it should not be the only contributor to compensation and in some instances it appears that it has been dissuaded by the National Government from increasing payments.

The compensation payments need to be identified for what they are. Most are no more than a redress for immediate loss of produce from the land. Only for some is there an element of compensation for permanent loss. Others are a relocation cost where roads and villages are repositioned to suit the Company's plans. There are important distinctions between these types of compensation that are not clearly identified. Few if any of these payments convey a benefit to the recipients in the sense that they profit from the mining.

We believe the continuing claims for compensation in one form or another are a symptom of a problem rather than the problem itself and that there is a great deal of justice in many of the villagers' demands. Some important facts need to be acknowledged by all parties before this complex question can be satisfactorily resolved, although we doubt that a solution exists that will satisfy all parties. The key factors are:

- (a) the importance of land to the individuals involved. This is best illustrated by the following quotation cited earlier in the text (Ref. 64):

'Land is our life. Land is our physical life - food and sustenance. Land is our social life; it is marriage; it is status; it is security; it is politics; in fact it is our only world. When you (the Administration) take our land, you cut away the very heart of our existence. We have little or no experience of social survival detached from the land. For us to be completely landless is a nightmare which no dollar in the pocket or dollar in the bank will allay; we are a threatened people.'
- (b) the loss of the land and water resource - the National Government (in fact its predecessor the Administration, but in an agreement that has been ratified by the National Government) has issued a lease over this land to a private company, giving it rights to conduct certain activities which include laying large areas of land waste, making river water unusable and polluting the coastal waters;
- (c) the land holdings of some villagers have been significantly decreased - the area of land suitable for gardening, owned or customarily used by Dapera and Moroni villages has decreased by perhaps as much as 90%. Other villages have lost arable land;
- (d) alternative land is not available - some clan groups and families have no land away from the mine to move to and have no option but to live in the close vicinity of the mine, suffering all the disruption and inconvenience that entails. Again these are the villagers from Moroni and Dapera.

the permanent loss of food and materials - land occupied or laid waste by the mine has removed for all time an adequate source of traditional foods and materials for the landowners. Gardening on the remaining land cannot sustain these people because the land is too steep and infertile or because increased crop rotation leads to smaller and more disease-prone crops. Population increases have added to this problem.

These factors are presented in the most straight forward terms without reference to many other important considerations that might be generally termed cultural concerns. These include loss of contact/connection with ancestors through destruction of cemeteries, the land they occupied, and the feelings of having betrayed the trust of both past and future generations as a result of ceding the land. Loss of cultural values associated with the traditional lifestyles is another important consideration.

The questions that arise are how can these people be compensated for their loss, and who is responsible for delivering this compensation.

It is important to remember that the tailings and dumps cover much larger areas and are in different locations to those originally planned by the Company or agreed to by the Administration. Probably more importantly the scale of the whole development and its physical and social impact has been much greater than could be conceived by any community unfamiliar with mining. As the mine and the extent of physical damage increased and the anticipated benefits remained undelivered the landowners' frustration and anger have grown. The compensation payment system quickly became the focal point for all real and perceived grievances against the Company and the Government. Meetings to discuss, or more often dispute, sources or quanta of compensation became virtually the only forum for communication between the parties. As time went on, the often slow and apparently ungenerous response by the Company to requests by the landowners for additional compensation and improved services seemed to them insulting and at times deceitful and we note with regret that this review and report has been prejudged in much the same way. This is because it appears to the landowners to be yet another excuse for delaying delivery of recognition and payment for their loss and for what they believe to be a rightful share of benefits from the mine profits.

4.2 MINE CLOSURE

The Panguna mine is an efficiently run, relatively low cost mine which is capable of continuing to operate profitably until at least the year 2001 if metal prices and mining costs remain relatively stable. The Company has reasonable control over the majority of its costs but not over metal prices. Early closure, in as few as five years, cannot be ruled out if prices fall rapidly. On the other hand if the Company were able to explore the nearby leases, as it strongly wishes to, a new ore body may be found to extend the useful life of some or all of the infrastructure at Panguna.

Thus for Panguna town and perhaps the mill and concentrator a set of future options can be considered as follows:

- (a) premature close-down due to falling prices - say 5-6 years;
- (b) exhaustion of present Panguna ore body and no additional ore - say 12-15 years;

- (c) additional nearby ore allowing extended life of facilities - say 15-30 years.

Irrespective of which scenario is followed, the Panguna pit, the waste dumps, the tailings in the Kawerong and Jaba rivers and the delta, and the modified valley drainage in the tributary streams and rivers will remain. Rehabilitation and revegetation of these areas are a responsibility of the present operation. It will be a time consuming process for which active planning and early implementation is required.

Stabilisation of the area may take tens of years, rehabilitation much longer. It will never be fully repaired. This was understood at the outset by the Administration and the Company (but almost certainly not by the landowners) and is an acknowledged cost of such large scale mining everywhere it takes place. The question now is how much cost and effort is to be put into rehabilitation activities, some of which will show little return and how much into more productive enterprises that will survive beyond the mine. Again there is the question of who pays the costs and who receives the benefits. The land-owners argue that this is the time for the Company and National Government to address this constructively. (A real inducement for the Government and the Company must surely be to win the confidence and support of the landowners for further prospecting in the moratorium areas. It is principally their anger at the treatment they have received and the lack of acknowledgement of the high cost they have paid with loss of land for what they perceive (in many cases justifiably) as relatively insignificant benefit that fuels continued opposition to further exploration.)

In 1971 when the original DOTA Agreement was written the Administration and the Company clearly indicated their intent as follows:

- (a) to keep the weathered rock in the upper parts of the waste dumps to encourage vegetation growth, and to actively establish vegetation;
- (b) to dispose of the tailings in such a way as to enable re-use of the land at the earliest practicable date;
- (c) to undertake investigations and planning aimed at progressive revegetation of the tailings;
- (d) to keep the soluble copper content of the tailings to a level that would protect vegetation and animal (including fish) life.

This intent was probably as strong an environmental constraint as was put on any mining company anywhere 20 years ago. However it is now 1988, standards have changed and mining companies in most places now would accept these intentions as minimum requirements and ensure they were carried out. At this time it is hard to see how these can all be accomplished. This would apply to all areas physically disturbed by the operation, although the Pinei Valley has been substantially rehabilitated already. What is now needed is active planning for mine closure. Planning must include social as well as physical concerns.

Between 35 and 50 million tonnes of overburden and weathered rock is outlined for removal over the next 15 years and some of this material could be made available for spreading over the waste dumps.

Establishing a stable medium and long-term bed for the Kawerong and Jaba rivers is a high priority. The Company has investigated this and we believe that a

2.5

firm proposal should be developed and agreement reached between the Government and the Company for early implementation. Attention needs to be paid to the flow from minor tributaries, many of which have backed-up to form swamps or ponded bodies of water. The plan should include the provision of good access across the rivers at the present locations or suitable alternatives negotiated with landowners.

In the Kawerong Valley and the Upper Jaba Valley there is, we believe, an additional and more pressing requirement for the time when mining ceases, an additional mine stops operating compensation and royalty payments cease. When the landowners who have clan or family links into other areas, alternative land is available from which to earn an income or at least maintain subsistence agriculture. For a few people their land does not exist any more. Some of these people have lost all or most of the productive land, others only some of it. As we have pointed out earlier, compensation payments to date have been calculated and paid at a rate consistent with loss of income from the land not for loss of the land itself. The landowners in most cases have made no provision for the future when they had neither land nor compensation or royalty, even if they had understood the need for it; nor has there been realistic opportunity for them to provide for it. Planning for mine closure must address this. (The Road Mining Tailings Lease Trust Fund is set up and managed to secure income beyond mine closure but payments as income to the beneficiaries cannot be made.)

A possible long-term source of income could be copper extraction from the dumps if a low maintenance low technology process such as cementation could operate effectively. Such a scheme could be investigated by the Company. Scrap iron for use in the plant should be in abundance when the mine closes.

Other possibilities include commercial scale fish farming, using high value species such as barramundi that could be air freighted as frozen fillets. There may be suitable land on the tailings which could be gravity fed with water from the Jaba River above the pump station. Both this and the copper extraction from the dumps could commence before the mine closes if they are technically and economically feasible. Elsewhere we raise the possibility of small scale hydro-power generation from the eventual mine lake and crushed rock production for roading.

8.3 SUMMARY OF IMPACTS

8.3.1 Long-term ecological damage

8.3.1.1 The Kawerong-Jaba river valleys

If present engineering predictions are correct the Kawerong and Jaba rivers will down cut as the supply of tailings is reduced. It will take many years to attain a stable channel and for the remaining areas of tailings to stabilise and revegetate. Copper is likely to continue to leach from them for many years. The water and fish resources of the Kawerong River and the Jaba River below its confluence with the Kawerong, have been lost for probably several generations. The unstable flow of water, high sediment loads and unacceptable water chemistry deter fish from migrating to the upper Jaba River system. There is some hope of recovery for the Pangara River but it will be a long slow process unless an innovative solution, such as diversion directly to the coast, is found. When the water quality in the Jaba and Kawerong rivers does eventually improve to allow fish to return it is likely that local people may continue to avoid using the water because of lingering suspicion.

The forests that once occupied the Jaba Valley are unlikely ever to return. The substrate and physical character of the tailings deposits are foreign to the vegetation of the upper Jaba Valley and the future vegetative community on the tailings is likely to be unique to the area. Perhaps, this plant community will eventually contain useful species or provide a useful habitat but it is not possible to predict how long this will take.

The tailings have dammed most of the tributaries which once flowed into the Jaba River. About 120 ha (BCL estimate) of ponds have formed behind the dams providing habitat for mosquitoes. Where the water table has been raised, trees have died. In the longer term, if a single channel establishes in the tailings it will cut down and so allow the tributaries to do the same. In time if this happens the ponded areas will disappear.

8.3.1.2 Empress Augusta Bay

The central bay is now dominated by a delta of tailings approximately 900 ha in area. This delta will eventually revegetate, depending on sea level changes but the new tailings disposal scheme will dramatically alter the existing form of the delta and so delay the natural process of revegetation. This will be a vast area about six times the size of the present tailings delta which will erode only very slowly and will continue to produce copper leachates. Over about half the area of Empress Augusta Bay, the animals that once lived on the bottom sediment have been either buried by tailings or killed by copper. It is difficult to imagine how the discharge from proposed tailings pipeline at the coast can improve the present almost sterile state of the bottom sediment.

Evidence collected to date indicates that there has been no major impact on the fish resource of the Bay and a convincing theory has been proposed to explain these observations. However the theory has not been proven and there remains the possibility that the situation will change. There is circumstantial evidence implicating the discharge from the Jaba River in the present 'ulcerative' fish disease affecting sea fish of the western and southern coasts of Bougainville. This cannot be proven but there is good reason for suspicion.

The chemical impact of the tailings from the pipeline could be more pronounced than is that of the present discharge from the river. The tailings will reach the coast a matter of hours after they leave the mine and little degradation and no dilution will occur.

8.3.2 Permanent changes to physical environment

8.3.2.1 The pit and waste rock disposal areas

The pit now occupies almost 400 hectares; the proposed 10 and 15 year extensions will occupy approximately 560 ha and 650 ha respectively. This land is lost forever. Irrespective of any deliberate revegetation the land is unlikely ever to regain any significant productive value. Eventually, either as a result of deliberate action or by natural processes, the drainage adit will become blocked and the pit will fill with water to a level determined either by geohydrological conditions or by the lowest point on the pit rim. The lake so formed may have ecological value if designed carefully. An opportunity to use the lake for small scale electric power production utilising the present drainage adit is worthy of investigation. This could supply the Panguna area and nearby villages after the mine has closed.

The waste rock dumps presently occupy approximately 300 ha and, if mine life extends a further 15 years, may occupy a total of approximately 550 ha. The

1987 DOTA agreement requires the Company to cap the dumps with a layer of the more weathered rock prior to commencing revegetation. The Company is not stockpiling suitable capping material and we were advised that they had no intention of doing so. If that policy remains unchanged the Company will not be able to cap the dumps in accordance with the agreement. This land will have virtually no productive value for several generations.

This situation could be avoided to some extent if stockpiling, spreading and conditioning of weathered rock and soil is undertaken. Alternatively, some commercial or industrial use could be made of the flat land resource. A small crushed rock plant could be established based on the hard rock dumps to provide a small industry after mining ceases.

8.3.2.2 The tailings areas

Approximately 3000 ha of the Jaba Valley inshore from the original coastline is occupied either by tailings or flooding caused by tailings deposition. The tailings delta occupies approximately 900 ha of Empress Augusta Bay offshore from the original shoreline. The onshore deposits represent 3000 ha of lost land. If the Company and the Government continue on their present agreed course, the Company will attempt to stabilise and revegetate the majority of the onshore tailings area. There is as yet little evidence that the Company can either provide long-term stability in the tailings area or revegetate tailings under the conditions likely to prevail over much of the area. Where revegetation of the tailings is successful the vegetation will have very little productive or subsistence value. There is little evidence at this stage that the vegetation established by the Company will develop to an ecologically viable self-sustaining community.

While the present delta revegetates naturally where it is stable the proposed tailings stacks are likely to be very much less stable, subject to channelisation and much of the area may be unsaturated and subject to the problems associated with low pH.

8.3.2.3 Infrastructure

The mining project dramatically speeded up the pace and extent of urbanisation, with the creation of two new towns, Arawa and Panguna, and the construction of a major highway between them. In some respects, despite an increase in law and order problems, new service facilities at Arawa (hospitals, schools, commercial facilities etc) have improved the quality of life of a large proportion of the population of the Province. Panguna and, to a lesser extent, Arawa will become 'ghost-towns' on the closure of the mine, although many of their facilities will have a much longer life. When the leases expire many of the improvements on the land may become the property of the landowners. Although much of the mining related infrastructure is likely to be removed by the Company there is an opportunity to leave behind some buildings and roads of real value to the landowners.

The future of these towns, and especially Panguna, will need to be examined by the Provincial Government in association with the traditional landowners and the National Government and BCL.

8.3.3 Impacts affecting quality of life

The smell of process chemicals in the Kawerong Valley is a constant reminder to the local people that the mine is discharging chemicals into the environment. Irrespective of the actual hazard associated with these chemicals (it is quite small) their presence signalled in such an obvious and offensive way does

nothing to calm the suspicions of the people. The tailings and Kawerong River water through which there is little alternative for some to walk are alkaline and abrasive and this may aggravate sores and delay healing.

Dust is seen as a threat to health and crops. Although we doubt that this is a serious threat we must realise that the landowners have not had the exposure to dust that those in less well vegetated countries have had and this may contribute to their fears. The Dapera and Moroni village sites are certainly more dust-prone than other villages elsewhere in the lease areas. The closeness of mining operations also inconveniences villages in other ways, such as noise (primarily from blasting) and the presence of 'strangers' who are not always welcome. Although none of these problems is as great as in many urban areas, they have not been freely chosen by villages populations.

Throughout the mine-affected area traffic has greatly increased, in many cases from nothing, and traffic accidents have similarly increased and caused concern, especially in villages such as Pakia where vehicle speed is often excessive. Roadside litter has also become a problem in these areas. In some areas, especially along the northern bank of the Jaba River, access to villages has been hindered by the deposition of tailings which provide an uncomfortable and sometimes dangerous access to the road for which there is no alternative.

8.3.4 Employment, social services and infrastructure

The construction of the Port-Mine Access Road from Arawa to Panguna, and beyond to the Jaba River, significantly improved access to services and markets for all the mine-affected villages and for the whole of South Bougainville. In many respects this has been the least controversial and most wide-ranging benefit from mine operations. In the mine-affected area this has meant that access to education and health services is significantly better than in many other parts of Bougainville, and a very considerable improvement on the pre-mine era. The construction of the power station at Loloho has been a substantial benefit to ELCOM through the supply of electricity at reduced cost.

Although there have been improvements in infrastructure and services throughout the mine-affected areas, these gains have been at the expense of a decline in some elements of the quality of life in the resettled villages. To various extents the villages of Dapera, Moroni, Pirurari and Kuneka, have lost much of their land and, consequently, their traditional livelihood. The increased availability of jobs and compensation payments cannot wholly compensate for these losses and, especially around the mine lease area, this situation will considerably worsen on the closure of the mine.

Mine construction contributed to a significant expansion of the labour market for both skilled and unskilled labour, at the mine, in ancillary industries, in new services and in administration. Formal sector employment increased many times in the early part of the mining era although in the 1980s there has been virtually no expansion in this sector. A significant part of the new employment, especially with BCL, is of expatriates and of citizens from outside the Province though the proportion of Bougainvillean employment at BCL has grown to 29% of the total.

Increased income from employment of various kinds (and from the contemporary expansion in cash-cropping) has contributed to the growth of the service sector, and there has been an expansion of trade store activities in the villages. Other larger businesses in the mine-affected area have developed specifically under contract to BCL. Although several of these provide a significant level of employment and incomes none is viable beyond the life of the mine.

A very high proportion of the increased employment generated by BCL is so linked to the mine that the closure of the mine will result in a substantial decline in formal employment in Bougainville. Although this will lead to out-migration from the Province it will also precipitate an employment crisis in Bougainville, especially if population growth continues at the present high rate.

Increased levels of personal income have occurred throughout the mine-affected area, enabling households to exercise greater freedom of choice over their pattern of consumption. Such incomes, whether as wages or compensation payments, are tied to mine-related activities and are not likely to be sustained at those levels when the mine closes.

Health services have improved considerably overall but mostly in Panguna and Arawa. On balance health has improved in the mine-affected areas, because of superior access to services and incomes, but there have been increases in the extent of accidents, obesity, asthma and possible cancer. Elsewhere in the lease areas improvements are needed. Only the first of these can be directly attributed to the presence of the mine; the others are related to changing social conditions attendant on urbanisation. Nutrition has generally improved although the diet in resettled villages such as Dapera, now shows grounds for concern. High levels of alcohol consumption by some also point to the disruptive influence of extremely rapid modernisation.

8.3.5 Other changes

Many changes have taken place in Bougainville during the mining era that have no direct relationship to mining activities. Such changes include the independence of Papua New Guinea, the establishment of the North Solomons Provincial Government, an accelerating population growth (although mine incomes and new health services have some influence on this) and increased cash-cropping, especially of cocoa. The last two trends have placed considerable and increasingly pressure on land resources, and show no sign of diminishing.

Other changes have occurred in recent years that may have some indirect relationship to mining activities.

The mine and related activities have contributed to accentuating the pace of monetisation and modernisation and the adoption of new patterns of behaviour. In most respects, such trends were largely established before the mine began, yet accelerated modernisation has caused some stress in village life, contributing to friction between generations, new forms of consumption (of consumer goods, including food and drink) and some decline in traditional values. Not all such trends are negative, education is now valued more highly and there is greater communication within Bougainville and beyond. Industrial development wherever it occurs brings changes in lifestyle. People and their produce move further and faster. Diseases of people and plants spread more quickly and health services reduce infant mortality and prolong life.

Despite assurances to the contrary, poor crop performance will continue to be attributed by some people to the mine. To some extent this is correct, not because of chemicals from the mine, but because development may have enhanced the transfer of diseases, and the land lost to the mine has put increased pressure on remaining land for gardening. Shorter crop rotations allow diseases to establish and lead to nutrient deficiencies. The larger populations demand more from the same areas of gardens and both plant diseases and nutrient deficiencies follow. Modern horticultural practices based on herbicides, pesticides but mostly fertilisers may offer the only solution.

Flying foxes were a traditional source of protein and their loss from Bougainville is a serious concern to the local people. The dramatic loss of these animals was unlikely to have been related to the mine operation but this does not make it any less of a loss. Other animals have also declined in number but hunting pressures and forest clearance may have contributed to this.

Overall, the quarter of a century during which mine-related events have occurred in Bougainville has been a period of extremely rapid change on the island and, more generally, in Papua New Guinea. The mine has affected many aspects of people's lives in Bougainville; so too have other changes, and the impacts are not always distinguishable. Above all the mine has substantially changed lives in the lease areas, for better and worse, and resulted in a host of localised and regional environmental, social, economic, political and psychological changes that cannot easily be disentangled.

8.4 RECOMMENDATIONS

In the course of our review we have found many things about the mining operation and particularly the Government's role in administering it that would benefit from changes. We have been charged specifically with 'formulating opinions for mitigating negative aspects and capitalising on positive aspects' and recommending courses of action on payment of compensation, village relocation, improvements in infrastructure and the delivery of social services, and the benefits of revegetation (2.4 of the Terms of Reference). These are addressed in the following subsections:

To address only these subjects would in our opinion serve very little purpose and completely fail to tackle major underlying problems of which the requests for improvements in compensation, social services etc are symptoms of the problem rather than the problem itself. Indeed the need for this whole Review arises from fundamental problems in communication and administration which we have discussed at some length in Section 7. We make recommendations about these as well. Finally we comment on some aspects of the Company's environmental planning and monitoring that arise from our analysis and review of that work to date (2.1 of the Terms of Reference).

An overriding recommendation and one that relates to many of those listed below is for agreement to be quickly reached between the Company and the National and Provincial governments on their relative responsibility for provision and maintenance of facilities, services, and communication.

8.4.1 Administration and communication

- (1) The Company and the Government urgently need to establish a procedure, backed by adequate staff and funds, to ensure there is rapid, frequent and clear communications between all parties and in particular with landowners and the Provincial Government. Necessary components of this are the Provincial Government and National Government Officers at Panguna, regular meetings between all parties, acknowledgement of the landowners as partners in the management of the area and more ready disclosure of information on mine planning and operation.
- (2) Lease documents, land ownership records and related information need to be brought up to date, revised where necessary and made freely available in a format and at locations that will ensure ready understanding. The

status and boundaries of the Tailings Lease in particular needs to be determined and the lease boundary marked on the ground.

- (3) A review of the operations and functions of the Company's Village Relations Office (including the Business Liaison Office) is a clear need with a view to strengthening its capacity to deal with village relations.
- (4) Information should be provided and disseminated in Pidgin language, explaining the operations of the mine, future plans etc. This could incorporate parts of the existing magazine Siapako, but more oriented towards village interests and hence which might include more information on business liaison. Ironically, such a publication existed in the early years of the mine.
- (5) Senior staff members of the Company in all areas should be encouraged to set time aside to learn Pidgin English. One of the clearest indications and causes of the breakdown of communications is the inability of landowners and management to discuss issues, other than by translation through a third party.
- (6) There is an urgent need for the local people to understand the nature of the mining process better, the characteristics of the chemicals used and the potential biological impacts. This will be difficult to achieve but the benefits would justify the effort. In our opinion, the people have a right to know what is being released into their environment.

8.4.2 Compensation

- (1) The present system for compensation payments needs urgent overhauling. Recognising that compensation payments have taken their present form for eight years, despite regular pressure from landowners to amend them, there is a need for a further review of the level of compensation payments (particularly as they affect the Special Mining Lease) and especially as they relate to the needs of those without other sources of land and/or income. This should take into account the existing compensation payment systems in operation at new mines such as Misima. More research is needed to establish the individual or clan rights of use for customarily owned land to ensure that the users as well as the owners of land are compensated for temporary and permanent loss.

The system must be flexible enough to address the situation where some individuals, still culturally or actually dependent on subsistence gardening, lose all or a very large percentage of gardening or cash-cropping land, relative to those who may lose a similar area but which comprises a less significant percentage of their land.

- (2) Some attempt needs to be made to review the possibility of compensation in non-monetary form to ensure that compensation goes beyond payment of cash sums which are viewed as handouts, destroy local pride and emphasise dependency. In other words, as far as possible, compensation payments should be directed towards long-term social and economic development of the people most directly affected.
- (3) The process of reviewing compensation payments should also include examination of the Uruava land agreement where re-negotiation has been long overdue. It has not been reviewed since 1969 despite an agreement that

it would be reviewed every seven years. It has not therefore been reviewed since Colonial times. All parties should be involved in such a review.

- (4) With the assistance of the Provincial Government's business development services, the landowners should be encouraged to devise schemes for the long-term use of compensation payments, within or outside the lease areas.
- (5) An independent assessment of areas outside the Tailings Lease is required to determine the exact extent of land affected by flooding or raised groundwater levels and whether compensation is being paid to all the owners and/or users affected.
- (6) Where trees have died because of tailings or backed-up water, assistance could be given to village people to recover any useful timber.
- (7) In villages which have been seriously disadvantaged by reductions in the areas of land for gardening or have poor crops for other reasons the use of agricultural chemicals and fertilisers should be considered. A substantial education and subsidy programme may be a necessary part of any such scheme.

8.4.3 Village relocation and resettlement

Serious consideration should be given to requests for improved information and housing, as these are born out of years of frustration. Over time it appears that the Company has become more immune, rather than increasingly responsive, to the needs of the most seriously affected villages.

- (1) All parties should review policies on resettlement to investigate four key areas further:
 - (a) the supply of information to villagers on resettlement moves;
 - (b) the appropriateness of house type and other facilities (notably toilets and water supplies) in particular resettled villages;
 - (c) the possibility of providing some form of assistance (perhaps construction materials at cost) to villagers in relocated villages for maintenance of their houses;
 - (d) the housing needs of married adult children of resettled villagers.
- (2) The scale of relocation compensation, unchanged since 1970, needs to be reviewed. Some back payments or contribution in kind may be appropriate for recently resettled villagers.
- (3) Outstanding commitments for relocation, maintenance, supply of services and landscaping at Dapera and Moroni should be actioned without delay and site preparations for the new Pirurari site undertaken soon.
- (4) Trees and shrubs should be planted immediately and subsequently maintained in Dapera, Moroni and the new Pirurari site to reduce the incidence of dust generation.

- 5) All relevant parties should investigate the position of a road on the north bank of the Kawerong-Jaba River system and/or the provision of new bridges from the present road to the north bank. The possibility of the road being extended to Torokina should also be investigated.

3.4.4 Health and welfare

- (1) Attempts should be made to control malaria by reducing the potential breeding areas for mosquitoes. Specifically, that appropriate fish (rainbow fish - Melanotaenia species) be introduced to areas where water is permanently backed-up by tailings deposition, and that temporary pools created by road works be filled in.
- (2) A comprehensive review and assessment should be undertaken of the water supply requirements of villages within the Tailings Lease area with a view towards providing a permanent, good quality water reticulation or storage tank system ideally designed to remain after the mine has closed.
- (3) The Company should extend its current monitoring programme of respirable dust and free silica at the mine to include those villages in the high risk area around the mine, namely Dapera, Moroni and Pirurari.
- (4) Levels of sulphur dioxide emanating from the Loloho power station should be monitored by the Company at Rorovana and the ultimate fate of the components in the flue gases from the power station should be determined to allay fears of health risks and crop damage.
- (5) The Panguna Health Subcentre should be upgraded to full health centre status, providing in-patient and mid-wifery services, an active maternal and child health programme and other forms of out-reach to communities in the Special Mining and Tailings Lease areas, active aid post supervision in the area, a vehicle to make this action possible, and a small laboratory for simple tests and microscopy.
- (6) The Provincial Government should provide an aid post in the mid to lower Tailings Lease area and ensure that maternal and child health care are re-established in this area preferably by the Panguna Health Subcentre.
- (7) The Provincial Government should undertake a nutrition education programme in the villages within the Special Mining Lease area.
- (8) The villagers of New Dapera and Moroni should be encouraged to clean up the refuse from their villages to reduce the health hazard. The Company could assist by removing the refuse, once collected.
- (9) The villagers should be encouraged to remove mould from the walls of their houses to reduce the incidence of respiratory tract symptoms.
- (10) The quantities of process chemicals in the deposited tailings and on dust from these tailings should be determined conclusively and the impact on health assessed.
- (11) The impact of dust on crops should be examined to determine the extent of the problem. The information from (10) above would be relevant.

8.4.5 The RMTL Trust Fund

These recommendations are made following our assessment of the operations of the Trust. They may well be subject to some revision following the outcome of the legal case that is now pending. This would not affect our views about the general significance of these proposals.

- (1) The Trust should take immediate steps to organise village meetings (through the new Public Relations Office) and disseminate information to villagers on the Trust's operations. A summary of the Trust's activities (investments, donations, administration etc) should be produced in Pidgin as soon as possible, to provide a permanent record, available for consultation.

8.4.6 BCL in business

- (1) The Company should review its employment policies to ensure that business contracts are given to local groups wherever possible. In fact a form of positive discrimination may be appropriate.
- (2) The Company and Bougainville Copper Foundation should investigate:
 - (a) ways in which further support can be given to local agricultural enterprises rather than further development of the egg layer project and piggery at Mananau;
 - (b) divesting BCF of the majority of shares in Arawa Enterprises Limited, to encourage greater local participation in large-scale commercial development;
 - (c) the establishment of a genuine low cost medical insurance fund through the North Solomons Medical Foundation and increased commitment to supporting Provincial Government health services in rural areas.

8.4.7 Rehabilitation and mine closure

- (1) The Company urgently needs to undertake serious planning (as distinct from investigations) for mine closure covering rehabilitation of all mine-affected areas, engineering design for long-term stability, and revegetation. Establishing objectives and timetables for this work is the responsibility of the Government and should be covered in the current BCA Review. A five or seven year rolling plan may be appropriate. The Government in consultation with all other parties needs to address now and plan for the social consequences of mine closure and in particular the needs of landowners who have lost a substantial part of their land.
- (2) The Company and the Government should review the Company's rehabilitation objectives and in consultation with all relevant parties should develop revised objectives which focus on provision of land and livelihood for the affected landowners.
- (3) The Company should revise and renew its revegetation investigations with two specific goals:
 - (a) to develop techniques which will contribute to rapid initiation of soil development, organic matter accumulation and natural nutrient holding and cycling capacity;

- (b) to develop techniques appropriate to the full range of conditions likely to be encountered in revegetation of the tailings.

- (4) An integrated plan should be developed for rehabilitation of the tailings area and stacks. The plan should take into account all the problems likely to be encountered and the optimum solutions to those. Particularly important is that the planned solutions to the problems of stability, revegetation and river chemistry be integrated.
- (5) The Government should review the 1987 Disposal of Tailings and Waste Rock Agreement with two specific goals:
 - (a) to determine positively and state the standards of environmental protection and rehabilitation which the Company is required to achieve;
 - (b) to achieve a wording in the Agreement which is specific and unambiguous.
- (6) No further consideration should be given to the filling of swamps with tailings. Such an action would not act as a means of replacing lost land, as the productive potential of the tailings is limited. It would serve only to destroy what are now important ecological areas.
- (7) A report should be prepared on waste rock and tailings disposal to include all or some of the following:
 - (a) area covered or otherwise affected;
 - (b) area covered expressed as a percentage of total affected area predicted when agreements were made;
 - (c) population formerly dependent or in possession of the area covered (this measure would change with disposal and population growth);
 - (d) predictions of dependent population at the end of mine life;
 - (e) estimated cost of rehabilitation of affected areas.
- (8) Routine monitoring of the area of land affected by flooding and the raised water table should be commenced and included in routine reporting. The reporting of areas of off-lease tailings disposal or flooding should be carried out as above. This should include reliable mapping of the lease boundary and the limits of tailings deposition. The ecological, economic and cultural costs of off-lease flooding and water table elevation should be determined and included in reporting.
- (9) Alternative uses of the tailings deposits should be evaluated. In particular, the possibility of developing fish farms using raised ponds and gravity-fed water from the upper Jaba River. The hydrostatic head in raised ponds would prevent contamination from the tailings and so this may be a near future option.
- (10) An investigation should be carried out of:
 - (a) the possibility of land being reserved at Tenakau plantation for resettlement by villagers who wish to move from the mine lease area

3.5

(and other affected areas) who currently or in future will have inadequate land for subsistence or cash-crop purposes;

- (b) the possibility of purchasing Bove plantation if land at Tenakau is not available.

It should be noted that:

- (a) resettlement is extremely difficult;
 - (b) that plantation land does have a traditional 'owner' other than the current plantation owner and that such owners must be involved in discussions over future land use;
 - (c) that discussion of shifting Dapera village to Tokaian coastal plantation in 1970 created no interest from the Dapera villagers who saw themselves as mountain people unwilling to move away from their home-land. Thus resettled villages will need to continue to hold secure title to what is left of their land at the mine site;
 - (d) that if steps are not taken to achieve some degree of resettlement to an area with agricultural potential, on a voluntary basis, this will become increasingly difficult in the future;
 - (e) that the Provincial Government be directly involved in any settlement scheme, because of its greater neutrality and its experience in the Carterets scheme;
 - (f) that a considerable area of land will become available at closure of mining operations in Bougainville (such as at Lolohe, Itakara, parts of Panguna and Arawa etc) and these should be reviewed as sites that might be developed for the benefit and/or settlement of displaced landowners.
- (11) A reassessment of options for returning fish to the Pangara River should be made. In particular the feasibility of opening the Pangara River directly to the coast should be investigated (from cultural as well as engineering aspects).

8.4.8 Environmental monitoring

The Review Team considers the following additions to the Company's environmental monitoring programme would be of assistance in planning for and achieving early stability of the Kawerong-Jaba River system and determining long-term impacts on Empress Augusta Bay:

- (1) A pluviograph at the former Jaba River Delta site could be recommissioned or a full climatological station installed.
- (2) Rainfall records could be reviewed with respect to incomplete data and interstation rainfall correlations assessed as a means of filling in the gaps in the rainfall record.
- (3) The return frequency-rainfall intensity relationship (developed on 10 years data) would benefit by being updated using 30 years of Panguna rainfall data.

- (4) More detailed information could be included in the Hydrometeorological Tables on the temporal distribution of runoff; that is, mean monthly discharge, instantaneous maximum and minimum discharges.
- (5) The frequency of channel cross-section surveys could be increased at selected erosional/depositional sites so as to increase the understanding of channel and levee response to irregular events.
- (6) A stream gauging station should be commissioned in the lower reaches of the Pangara River to establish the likely magnitude of backwatering effects from the aggraded Kawerong-Jaba channel system.
- (7) A detailed analysis of all climatological and hydrological data collected to date would be helpful, including spatial and temporal analysis of rainfall and other climatic parameters; evaluation of rainfall-runoff response for disturbed and undisturbed catchments within the Special Mining Lease area; integration of rainfall, runoff, sediment input and bed level change data; and an evaluation of the flood and low flow hydrology of the Kawerong-Jaba River system.
- (8) Chemical work on the Jaba River system should continue so as to allow more precise predictions of future water quality using the RIVCHEM model. In particular, effort should be directed at more accurately quantifying the roles of carbon dioxide and sediment adsorption on copper solubility.

APPENDIX II

NOTES FROM MEETING IN GUAVA VILLAGE
16 NOVEMBER 1988

GUAVA VILLAGE MEETING - 16 NOVEMBER 1988

It is not possible to record in detail the many meetings and discussions held in the mine-affected area. Each had its own particular form and the outcome was influenced by the amount of time available and the people participating. The meeting at Guava was unusual firstly in that it involved several key members of the Panguna Landowners Association, including the Chairwoman, Perpetua Serero (in whose large haus kuk, lit by a generator-powered neon light, the meeting took place), a former radio announcer and Asitavi High School student, her sister Cecilia Genel and Philip Miriori. These committee members played the major roles in the meeting with few of some 20 other hamlet members, apart from Perpetua's husband John (a Manam migrant employed by BCL) taking a significant part. Secondly the meeting was unusual in that it took the strongest possible line on the necessity to transform the relationship between BCL and the Panguna landowners. Most of the discussion was in Tok Pisin or English, and was constantly led by Perpetua Serero, who spoke both these languages (and Nasioi) fluently. Although it is not now possible to identify particular speakers she was very much the key speaker and her views were clearly shared and often acclaimed by all the people present. Some repetition inevitably occurred, sometimes in response to questions from team members, but this is the fullest possible account of a highly articulate discussion. No other meeting covered such a range of issues.

Mining is an emotional issue; our lives have been ruined by modern technology.

My health has been damaged. My mind has changed.

BCL is like an octopus.

From River of Tears¹ we knew that we could fear the worst.

There are now too many holes.

Chemicals are ruining our agriculture; we will not have money for fertilizers when our agriculture is damaged. Land is our lifeline.

We have grown up with the Company.

We have seen no changes here since the 1950s. We are still living as our ancestors did. If Fr Ogan² came back now he would see that nothing had changed.

What the Company gives to the people is peanuts compared to the profit.

Our people were forced to sell their land in colonial days. The agreement was only between the National Government and the mine, not with the landowners. The Company are using some of our people against us; this is divide and rule tactics.

If the mine closes tomorrow BCL and the National Government will be the losers.

It is too late now to have shares in the Company; we want part ownership of whatever BCL owns, including BCL itself. The Jaba people should become automatic owners of the Mananau piggery and chicken business.

BCL should stick to mining.

Our parliamentarians (Momis and Bele) are not fighting for a better share for the North Solomons but are far too involved in national politics, which is full of white advisers (such as Roman Grynberg³ who came and greased us, tried to buy us off and told us to buy shares).

The original agreement over-rode our customs, denied us our land rights and was too rushed. It contradicts our way of life: what comes from the land should benefit the landowners. Only land title holders (850 of them) gain the benefits. Nobody else.

BCL must pay all the landowners since our land is almost finished. We oppose this resettlement scheme. Dapera and Piruari have lost their land rights.

They must put the land back to its original state, but it's too late.

Daily blasting causes landslides; our water is slipping down into the ground. Chemicals cause unknown damage to plants and animals. All the old people know what agriculture was like before.

Mining causes mental illness and asthma. Dust and chemical pollution cause

problems.
We are still very firm on kicking the Company out.
Oni⁴ told lies to Espie that all the ground was his and he would give it to the Company to use. When CRA was new, there were promises of good schools and hospitals but those promises were never kept.
The Trust Fund is only for rich people. The funds are never distributed to the people.
Landowners must get 25 per cent of the profits and PNG, BCL and the Provincial Government can also take 25 per cent, so that shares are genuinely equitable.
Before BCL vehicles used to give people lifts with their cargo. Now they refuse to do that but we expect that kind of service.
The National Government is selling us for 30 pieces of silver. To the government and the Company we are nothing.
There must be one landowner on the Board of Directors.
We don't trust white men or National Government leaders.
The type of houses in the resettled villages are just matchboxes; landowners deserve something better, the same standard as the mineworkers.
Why doesn't BCL show more goodwill?
The Company has created classes in our society, where there were none before the Company came. Family disputes have now occurred over land, even within families and within villages. Matthew Kove of Guava is in dispute with us.
There must be a new land review; there are too many disputes over overlapping ownership, since the surveyors did not do a good job.
Contracts are not given to PNG companies but to foreign-owned companies, even the small contracts. Most contracts are owned by redskins who also cause social problems. Another example is Kieta Plumbing Contractors, part-owned by Barry Wynn of BCL. These contracts should be shared out.
MINENCO mainly employ people from outside this area.
The Business Liaison Office (BCL) started but when they got our land they lost interest. They should train landowners.
Black men in the top offices - such as Joe Auna and Philip Mapah⁵ - are just window-dressing. We don't know who to believe - the National Government, the Provincial Government or who? And we have no advisers, unlike them. But we don't need them. We grew up with the problem.
We will never allow any more mining.
Women are the real landowners so we know.
If this is not sorted out there will be problems and violence.
We don't want a history of CRA to be written by an Australian woman. If they want our history they must come with a cheque.
There is acid rain, chemicals, dust on the cassava leaves - all from the mine.
Our food is not as good as before.
We may experience the same second-generation problems as the Marshall Islands.
We do not trust any white men.
The North Solomons people are really firm against any more mining.
We are planning how we can use force against the Company; if necessary we will die on our own soil.
We don't want to finish up like the African Third World countries.
We are willing to lay down our lives for our land.
This is our land, not that of the National Government - they cannot take away our land rights.
Trees and crops don't bear fruit like they did before. River beds are drying up as water disappears into blasting cracks.
Landowners should be given medical check-ups like those that are given to mineworkers. They should send a doctor round to the mine villages. The hospital at Panguna has no permanent doctor, so we get sent to Arawa. BCL should provide a doctor there, with accommodation, who could be directed by the Provincial Government. The BCL ambulance refused to attend a child who died on the Jaba River, but they said they had to get the Arawa ambulance, whereas the accident occurred in the lease area, because of the impact of the tailings. Such cases are compensated on a goodwill basis of K5000 each, but

each case should be treated on its merits. Women can bear many children so they should receive more. Two children have died inside the mine area, one by sand and one by electrocution. Even paybacks in the Highlands lead to more compensation than BCL provide. Relatives of these people were even told to go through the court to get insurance payments from the Company. All essential services should be distributed freely to the landowners. A high technology operation can help us.

There must be a landowner on the mine review process. In the Provincial Government the Premier, Joe Kabui, is a landowner but he doesn't help us. If we had spoken out forcefully and raised problems the government wouldn't have sent this review team to grease us. As Chairperson and spokesperson of my people I say that we want to get rid of the Company.

We want compensation for crops on the side of the Kawerong valley. There is no proper compensation in the special mining lease area. Not enough children are going through high school. We need more education for employment. Most young people finish at Grade 6 and jobs only go to those with education. We were promised 75 per cent of BCL employment. Employing outsiders is not good for us and it costs the Company extra money to pay their fares, accommodation etc. Here there are many unemployed youths who could work for BCL.

Landowners own what is above the land and what is under the ground. Roads for landowners are just bulldozer tracks. We deserve something better.

Before there was no road at all until we got angry and demonstrated. The permanent houses here in Guava were built by us not the Company. There are only five beneficiaries in Guava; we're only secondary beneficiaries.

When the money is distributed from occupation fees and royalties the share is not enough for any of us, since there are two clans in Guava and one has more than a hundred people. It's not our job to settle these distribution issues; the initial agreement was too rushed.

We never see any donations from BCF though it goes throughout the country, even to EXPO 88 in Brisbane. Exactly the same is true of the Trust Fund. That's why we want to get rid of the Company.

We strongly recommend that Philip Mapah be removed since he gives contradictory information to the Company. We requested CRA Melbourne to demote him. If Joe Auna and Philip Mapah weren't there, these problems wouldn't have arisen. They're helping the Company not the landowners. Landowners should be in these positions. The South Bougainvilleans are only there for the money.

We see no evidence of the operations of the Trust fund, except that it benefits a very small group of people. Matthew Kove and Severinus Ampaol were the people who gave our land away⁶. They are doing the same with the Trust Fund. It's just a cover-up to keep us all quiet. Quadling fooled the old men. We were all happy when it started. Now we have tried to change the leaders at the AGMs, but the only way we can do it is when they leave in coffins.

Crop compensation should go to those with garden rights not the title holder along.

Flying foxes and possums are not dying out from any epidemics, but from chemical pollution. Flying foxes fly everywhere, as far as Rabaul, and drink the seawater. Now there's not one left. This is our proof.

BCL said they would stay for only five years. We are fed up with white men telling us what to do. We are going to get rid of Arawa town.

BCL sell gold on the black market, exported in full 44-gallon drums in specially chartered ships which go to Melbourne. The gold is scraped from the bottom of the ball mill every 3 months when the mine is closed down. It is not recorded since it doesn't go down the pipeline, so this adds even more to BCL's profit. This is tax-free smuggling. They guard the drums so we know it's not just rubbish. We know this because we have people everywhere watching BCL. That's why we don't believe any white men. We have never told this to anyone before. This is our knowledge?

The Village Relations Office are selling sand and gravel and old BCL machinery,

such as screen wire. To get this you must give them a carton of beer and then pay.
The Hash House Harriers destroy the image of the North Solomons. It must be stopped. It operates as a cricket club, with naked dancers and striptease. Its just a front for prostitution, even if they do provide money for charity. The Company must stick to mining activity; they have no other business on our land.

All the modern houses have come from BCL wages not royalty payments. Our demand for K10 billion is for the whole province, to set the province up for when the mine ends and all we have left is a hole.

The Panguna Landowners Association are having no more discussions with BCL. This is the last meeting we will have with outsiders. We have had too many useless meetings. They must now give us the cheque.

Real BCL figures are quite different from the Annual Reports. They use transfer pricing and buy equipment from overseas CRA subsidiaries.

This is the only village that knows what's going on.

The coconuts in the Jaba river are not bearing properly now.

Footnotes

- 1 Richard West, River of Tears. The Rise of the Rio Tinto-Zinc Corporation Ltd (Earth Island Ltd, London, 1982). The book is a scathing attack on global RTZ operations, including a long chapter on Bougainville. It was mentioned several times in different meetings. At the final review session Wendelinus Bitanuma of the PLA described it as the blueprint of CRA's plan to destroy Third World countries which had been deliberately kept out of print.
- 2 Dr Eugene Ogan is an American anthropologist who worked in several parts of Nasioi, including Guava, in the mid-1960s and early 1970s.
- 3 Dr Roman Grynberg of UPNG is economic adviser to the Prime Minister.
- 4 Oni of Moroni village was the most prominent leader in Guava at the time the first negotiations were held.
- 5 Joe Auna is the most senior Bougainvillean in BCL; Phillip Mapah is head of the Village Relations Office.
- 6 Both Severinus Ampaoi and Matthew Kove are from Guava and both have been prominent in the RMTL Trust Fund.
- 7 This view was also expressed at a meeting in Pakia village.

APPENDIX III

AGREEMENT BETWEEN GOVERNMENT
AND COMPANY FOR MINE OPERATION

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement).

GENERAL ANNOTATION.

ADMINISTRATION.

As at 13 February 1976 (the date of gazettal of the most comprehensive allocation of responsibilities to Ministers and Departments at about the effective date), the administration of this Chapter was vested in the Minister for Natural Resources, with the exception of Sections 3(1) and 5(1) of the Act, the administration of which was vested in the Prime Minister.

Accordingly, as at that date, unless a different intention is clearly indicated, by note or in the text, and except as noted above, references in and in relation to this Chapter to—

“the Minister”—should be read as references to the Minister for Natural Resources;

“the Departmental Head”—should be read as references to the Secretary for Natural Resources¹;

“the Department”—should be read as references to the Department of Natural Resources².

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¹ Previously the Director of Lands, Surveys and Mines.
² Previously the Department of Lands, Surveys and Mines.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement) Act.

ARRANGEMENT OF SECTIONS.

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 - "the Agreement"
 - "the commencement date"
 - "the Company".
2. Approval of Agreement.
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4. Effect on and of other laws.
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SCHEDULES.

- SCHEDULE 1.—The 1967 Agreement.
SCHEDULE 2.—The 1974 Agreement.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement) Act.

Being an Act to provide for the approval and implementation of an agreement made on 6 June 1967 between the Administration of the former Territory of Papua and New Guinea and Bougainville Copper Pty. Limited, concerning the development of certain mineral deposits in Bougainville, as varied by a further agreement made on 21 November 1974 between the Government of Papua New Guinea and Bougainville Copper Limited, and for other purposes.

1. Interpretation.

In this Act, unless the contrary intention appears—

"the Agreement" means the agreement a copy of which is set out in Schedule 1, as varied by the agreement set out in Schedule 2, and where that agreement is further varied under Section 3 includes that agreement as so varied;

"the commencement date" means 30 November 1967 (being the date of commencement of the pre-Independence *Mining (Bougainville Copper Agreement) Act 1967*);

"the Company" means Bougainville Copper Limited, a company incorporated in Papua New Guinea and, subject to the provisions of the Agreement, includes its successors and assigns.

2. Approval of Agreement.

The Agreement is approved, and takes effect according to its tenor.

3. Variation of Agreement.

(1) The Agreement may be varied by a further agreement or agreements between the Prime Minister on behalf of the State, and the Company.

(2) A further agreement under Subsection (1) is of no force or effect until notice of its approval is published in the National Gazette by the Head of State, acting on advice.

(3) A notice under Subsection (2) shall be laid before the Parliament within 15 sitting days after the date of publication of the notice, together with a copy of the further agreement to which it relates.

(4) The Parliament may, by resolution passed at the meeting at which a notice under Subsection (2) is laid before it, or at the meeting next following that meeting, disallow the notice.

(5) If the Parliament passes a resolution disallowing a notice under Subsection (2), the approval ceases to have effect, but without prejudice to the validity of anything done or suffered in the meantime.

(6) Subject to Subsection (7), any purported variation to the Agreement, otherwise than in accordance with this section, is void.

(7) This section does not affect the operation of Clause 5, 19 or 20 of the Agreement.

4. Effect on and of other laws.

(1) Except as provided in Subsection (2), the Agreement has the force of law as if contained in this Act, and applies notwithstanding anything to the contrary in any other law.

(2) The provisions of Subsection (1) do not apply to or in relation to Clause 11(b), Clause 13(e) and Clause 14(a) of the Agreement.

(3) No pre-Independence law made after the commencement date, and no other law of Papua New Guinea, affects this Act or the Agreement—

(a) unless the contrary intention appears, expressly or by implication, in that law;
or

(b) except as provided by the Agreement.

(4) Except where the contrary intention appears, either expressly or by implication, in the Agreement, and subject to the preceding provisions of this section and to Section 5, all laws that are not inconsistent with this Act or the Agreement apply to and in relation to all acts, matters or things done or suffered under the Agreement.

5. Ancillary powers of the Prime Minister.

(1) Notwithstanding any other law, the Prime Minister has power, on behalf of the State, to make all grants, issues, renewals and extensions required by or under the Agreement to be made by the State, and is not bound in that regard by any provisions of any such law requiring or permitting any authority, consent, approval, report, recommendation, appeal, procedure or formality, or by any similar provision.

(2) The provisions of Clause 2(e) of the Agreement do not apply to or in relation to an amendment made to Subsection (1), or that was made to Section 7(1) of the pre-Independence *Mining (Bougainville Copper Agreement) Act 1967* after the commencement date, but no such amendment relieves the State of any of its obligations or liabilities under the Agreement.

6. Offences as to Company roads.

(1) A person who fails to obey a direction given by the Company or by a person authorized by the Company (whether by a traffic sign or traffic line or otherwise), under the powers conferred by Clause 14 of the Agreement is guilty of an offence.

Penalty: A fine not exceeding K100.00 or imprisonment for a term not exceeding 3 months.

(2) For the purposes of Subsection (1), "traffic line" and "traffic sign" have the same meaning and effect as in the *Motor Traffic Regulation*.

(3) It is a defence to a prosecution under this section for the defendant to prove that he honestly and reasonably believed that the direction given was not given by the Company or a person authorized by the Company.

7. Company port, etc.

(1) In this section—

"the Company port" has the same meaning as in Clause 11 of the Agreement;

"the Company's Port Manager" has the same meaning as in Clause 11 of the Agreement.

(2) Where the Company or the Company's Port Manager gives, in accordance with the powers conferred by Clause 11 of the Agreement, directions for regulating—

- (a) the time and manner in which any vessel shall enter into, depart from or lie in the Company port, or the position, mooring, unmooring, placing or removing of any vessel within the Company port; or
- (b) the manner in which or the time at which any vessel shall take on or discharge its cargo or any part of its cargo or shall take on or deliver ballast, water or fuel,

the master of a vessel in the Company port who fails to regulate the vessel according to the directions of the Company or of the Company's Port Manager, as the case may be, is guilty of an offence.

Penalty: A fine not exceeding K400.00.

(3) Where the Company or the Company's Port Manager has, in accordance with the powers conferred by Clause 11 of the Agreement, caused a vessel in the Company port to be moored, unmoored, placed or removed in default of compliance by the master of the vessel with a lawful direction given by the Company or the Company's Port Manager, the master of the vessel is liable to pay all expenses incurred by the Company in the mooring, unmooring, placing or removal of the vessel, and the Company may recover the amount as a debt in any court of competent jurisdiction.

(4) Neither the Company's Port Manager nor any employee or agent of the Company is personally liable for any act or default of himself or of the Company done or committed in good faith in the course of the exercise of the powers of the Company or of the Company's Port Manager in relation to the management and control of the Company port.

(5) The Company port or any other port serving any of the facilities referred to in Clause 11(a) of the Agreement shall be deemed to be a proclaimed port under the *Shipping Act 1951* (Adopted).

8. Rights of shareholders, etc.

In the event of a breach of the Agreement by the State, being a breach of a provision under which a right or benefit is granted specifically to a member of the Company or a beneficial owner of a share in the Company, any member of the Company and any beneficial owner of a share in the Company who suffers any loss by reason of the breach has the same rights and remedies as he would have had if he were a party to the Agreement.

9. Waiver of rights under Agreement.

Notwithstanding anything in this Act or in the Agreement, a party to the Agreement or any other person may waive any of his rights under the Agreement in the circumstances of any particular case, without prejudice to the exercise of those rights in any other case.

10. Purposes of Agreement a public purpose.

The purposes of the Agreement are a public purpose within the meaning of any law.

11. Appropriation.

All amounts from time to time due and payable by the State to the Company under the Agreement shall be paid out of the Consolidated Revenue Fund which, to the necessary extent, is appropriated accordingly.

SCHEDULES.

SCHEDULE 1.

Sec. 1.

THE 1967 AGREEMENT.

THIS AGREEMENT is made the sixth day of June, One thousand nine hundred and sixty-seven, between THE ADMINISTRATION OF THE TERRITORY OF PAPUA AND NEW GUINEA (hereinafter called "the Administration" which expression shall include the administration or government for the time being of the said Territory) of the one part and BOUGAINVILLE COPPER PTY. LIMITED a company incorporated in the said Territory and having its registered office at Panguna on Bougainville Island in the said Territory (hereinafter called "the Company" which expression shall include its successors and assigns) of the other part.

WHEREAS:

- (1) C.R.A. Exploration Pty. Limited, a company which is related to the Company, holds Prospecting Authorities Nos. 1 to 7 both inclusive under the *Mining Ordinance 1928-1966* of the Territory of New Guinea over an area of land on the said Bougainville Island and promising indications of the possible presence of large deposits of low grade copper ore in association with other minerals have been discovered in that area at a cost in excess of \$4,000,000;
- (2) the confirmation of the presence of the said deposits and the determination of their economic significance will require continued detailed investigations and assessments in and in relation to the said area and the full investigation of the economic significance of the said deposits and the viability of a mining and concentrating operation based thereon will involve continued inquiries into roads and other access facilities, shipping facilities, power supply and water supply facilities, residential accommodation and other ancillary facilities and services required in connection therewith;
- (3) the said investigations assessments and inquiries are at present estimated to involve the expenditure of at least a further \$4,000,000 and possibly \$6,000,000 and the establishment of a mining and concentrating operation as aforesaid is likely to require a total expenditure including the above-mentioned amounts of at least \$30,000,000 and possibly of the order of \$100,000,000, a large portion of which must necessarily be borrowed from international finance organizations;
- (4) the Administration is satisfied that such large capital expenditure is necessary to ensure that the said deposits are efficiently and economically developed and that the Company has access to the requisite technical resources for developing the same, and that the Company intends if it proceeds with such a mining and concentrating operation to conform to good mining practice relating (*inter alia*) to the maximum recovery of ores of copper and of gold and other minerals found in association with such ores of copper;
- (5) the Administration is also satisfied that the development of such a large scale operation would bring significant benefits to the Territory in respect of revenues from royalties and other forms of taxation, in respect of overseas trade balances, and in respect of the economic and social development of the people through employment opportunities, training in new skills, the purchase of local supplies, community development, improved communications and the extension of education and health services;
- (6) it is intended that the products of operations carried on by the Company hereunder will after meeting local and domestic requirements be sold for consumption beyond the Territory on terms having regard to then prevailing world prices;
- (7) the Administration desires to assist and co-operate with the Company so as to enable it to continue to carry out the said investigations, assessments and inquiries, and to enable it to establish and maintain such an operation and it is intended that nothing be done which might impede the Company in carrying out such investigations, assessments and inquiries, or in establishing and maintaining such an operation;
- (8) it has been agreed that the Company shall offer one-fifth of its ordinary share capital for subscription by the Administration or a statutory authority of the Administration and the Administration, being satisfied that the rights attaching to those shares will be adequately safeguarded by this

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Agreement and the general law of the Territory, intends subject to the Company's proposed operation proving sound and offering reasonable prospects of profitable operation that such offer will be accepted; and

(9) it is therefore desirable that in consideration of the Company entering into the obligations on its part hereinafter set out, the Company should be granted the titles, rights and privileges hereinafter mentioned.

NOW THIS AGREEMENT WITNESSES AS FOLLOWS:—

1. DEFINITIONS.

(a) In this Agreement, unless the context otherwise requires—

"Administration land", "mineral", "mining tenement", "private land", "prospecting authority" and "secondary prospecting authority" have the meanings respectively given to them by Section 6 of the Mining Ordinance as at present in force;

"f.o.b. revenue" means—

(i) in the case of a delivery of concentrated or unconcentrated ores of copper other minerals or gold won from the area the subject of the special mining lease which is made pursuant to a sale by the Company other than a sale to which sub-paragraph (ii) of this definition applies—the value of the whole of the consideration receivable by the Company therefor less all or any costs charges and expenses bona fide incurred or suffered by the Company in respect thereof from the time when the same is loaded on board ship at a port in the said Bougainville Island until the same is delivered and accepted by the purchaser including without limiting the generality of the foregoing—

(A) taxes, dues, duties, excises, tariffs and other levies imposed on the export of the same from the Territory;

(B) trimming costs;

(C) ocean freight;

(D) marine insurance;

(E) port and handling charges at the port of discharge;

(F) costs incurred in delivering the same from the port of discharge to any place for the purpose of any further processing;

(G) weighing sampling assaying inspection representation and selling agency costs and charges;

(H) shipping agency charges after loading as aforesaid; and

(I) taxes, dues, duties, primage duties, tariffs and other levies imposed in the country of the port of discharge on the import of the same; and

(ii) in the case of any delivery of any such ores which is made pursuant to a sale by the Company for a consideration which is not a consideration which would be receivable by a willing seller from a willing buyer or which is made pursuant to a disposition by the Company other wise than by way of sale—the value of the whole of such consideration as would have been receivable by the Company if the same had been sold at the weighted average of the values of the whole of the considerations receivable by the Company (less all or any costs charges and expenses referred to in sub-paragraph (i) of this definition) in respect of deliveries of ores of substantially the same composition which were made during the period of six months immediately preceding the relative delivery and to which such sub-paragraph applied, or in the event of there being no such deliveries such amount as the parties hereto agree or failing agreement as is determined by arbitration as hereinafter provided as the amount which would be receivable therefor by a willing seller if sold to a willing buyer on a free on board basis at the port in the said Bougainville Island then serving the Company's operations;

"governmental authority" means the government of any political division or subdivision of the Territory any agency or instrumentality of the Administration or of any

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such government or any local or other authority in the Territory but does not include the Administration itself;

"land" includes the sea bed;

"lease" includes easement right of way and other right over land;

"month" means calendar month;

"person" includes company and corporation;

"petroleum" has the meaning given to it by Section 6 of the Petroleum (Prospecting and Mining) Ordinance as at present in force;

"related company" means a company which is related (as that expression is used at present in Section 6(5) of the *Companies Ordinance 1963-1966* of the Territory) to the Company;

"unimproved value" in relation to land means the capital sum which the fee simple of the land might be expected to realize if offered for sale on such reasonable terms as a bona fide seller would require assuming—

(i) that the improvements thereon (if any) other than ground improvements as hereinafter defined did not exist at the date to which the valuation relates; and

(ii) that the purchaser may use the land for no purpose other than the purpose for which it is being used as at the date of this Agreement,

less the ground improvements allowance as hereinafter defined (if any) applicable to the land but in calculating such capital sum no account shall be taken of the value of any gold or minerals in or on or under the land or of any right to extract or to receive payments in respect of the extraction of any such gold or minerals therefrom;

In this definition "ground improvements" means in relation to land—

(i) the reclamation of the land by draining or filling, together with the construction and maintenance of retaining walls and ancillary works;

(ii) the excavation grading or levelling of the land;

(iii) the clearing or thinning out of trees scrub or other vegetable growth on the land;

(iv) the improvement of the fertility of the soil or the structure of the soil on the land; and

(v) the construction of underground drains,

and "the ground improvements allowance" means in relation to land—

(A) a sum equal to the expenditure (if any) in respect of ground improvements made to the land (not being ground improvements made more than fifteen years before the date of valuation or ground improvements made before any of the owners of the land as at the date of valuation became owners thereof); or

(B) the estimated increase which the incurring of such expenditure has made to the value of the land as at the date of valuation,

(whichever is the less);

"the *Gazette*" means the *Papua and New Guinea Government Gazette*;

"the *Land Ordinance*" means the *Land Ordinance 1962-1966* of the Territory;

"the *Mining Ordinance*" means the *Mining Ordinance 1928-1966* of the Territory of New Guinea;

"the *Petroleum (Prospecting and Mining) Ordinance*" means the *Petroleum (Prospecting and Mining) Ordinance 1951-1965* of the Territory;

"the *Prospecting Authorities*" means *Prospecting Authorities Nos. 1 to 7* both inclusive under the *Mining Ordinance* at present vested in *C.R.A. Exploration Pty. Limited* and includes any extensions thereof;

"the *special mining lease*" means the *special mining lease* or *special mining leases* granted to the *Company* pursuant to *Clause 5* and includes any renewal thereof;

"the Territory" means the Territory of Papua and the Territory of New Guinea together called by the name of the Territory of Papua and New Guinea in Section 10 of the *Papua and New Guinea Act 1949-1966* of the Commonwealth of Australia.

The singular includes the plural and vice versa.

The masculine gender includes the feminine and neuter genders and vice versa.

Any reference to an Ordinance or any provision thereof includes a reference to any modification or re-enactment thereof or substitution therefor.

- (b) Headings shall not affect the operation of this Agreement.
- (c) Where in this Agreement reference is made to a law in force as at a particular date, no account shall unless the context otherwise requires be taken of any modification or re-enactment thereof or substitution therefor effected by a law made after that date but deemed to have come into operation or to have been made on or before that date.
- (d) Where in this Agreement reference is made to any office authority or body that reference shall if that office authority or body is abolished be read as a reference to the then corresponding or analogous office authority or body or to such other office authority or body as is agreed upon by the Administration and the Company for the purpose.

2. RATIFYING LEGISLATION.

- (a) The Administration shall as soon as is reasonably practicable introduce and sponsor in the House of Assembly of the Territory a Bill for an Ordinance to approve this Agreement which Bill shall be in the form of the draft Bill heretofore agreed upon between the Administration and the Company and signed on their behalf for the purpose of identification.
- (b) Apart from paragraph (a) of this Clause which shall come into effect upon the execution hereof, this Agreement shall come into effect on the day on which an Ordinance in the form hereinbefore referred to (but with such amendments thereto (if any) as the parties hereto shall prior to the coming into effect of such Ordinance agree upon) comes into effect, and in the event that such an Ordinance does not come into effect prior to the thirty-first day of December, One thousand nine hundred and sixty-seven, or such later date as the parties hereto shall agree upon in writing, this Agreement other than paragraph (a) of this Clause shall be void and of no effect and neither of the parties hereto shall have any claim against the other of them with respect to any matter or thing arising out of done or performed or omitted to be done or performed under this Agreement other than under the said paragraph (a).
- (c) If such Ordinance comes into effect as aforesaid but at any time thereafter such Ordinance is expressly or impliedly amended or repealed or this Agreement is expressly or impliedly varied added to cancelled abrogated or deprived of any of the force or effect which it has upon the coming into effect of such Ordinance (except as provided by the Ordinance or this Agreement, or with the prior consent of the Company) then irrespective of whether such amendment repeal variation addition cancellation abrogation or deprivation would otherwise constitute a breach of this Agreement the Company the members of the Company and the beneficial owners of shares in the Company shall in respect of the same have all the rights and remedies which it or they would have as if the same were a breach of this Agreement by the Administration.

3. INTERIM RIGHTS OF COMPANY.

- (a) The said C.R.A. Exploration Pty. Limited shall be entitled to transfer the Prospecting Authorities to the Company and the Company shall ensure that the Prospecting Authorities are so transferred to it within one month after the whole of this Agreement comes into effect.
- (b) Unless and until the Company's rights under this Clause have terminated pursuant to paragraph (f) of this Clause—
 - (i) the Administration shall from time to time cause to be granted to the Company successive extensions of the terms of the Prospecting Authorities, which extensions shall be granted subject to the provisions of this Agreement but not to any other terms or conditions and shall unless the Company has previously and in

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writing agreed otherwise be granted over the whole of the land at present the subject of the relative prospecting authority; and

(ii) upon application from time to time by the Company any related company or the employees agents or contractors of any of them for a permit to be issued pursuant to Section 54 of the Mining Ordinance to enter and prospect any private land (being the whole or part of the area then the subject of the Prospecting Authorities) specified in the application, the applicant shall be entitled to the issue of such permit which permit shall specify that it shall remain in force for a period of six months and shall—

(A) if at the time of application a permit issued pursuant to this sub-paragraph is in force in respect of the whole of the land specified in such application—be issued so as to come into force upon the expiration of such current permit; and

(B) in any other case—be issued so as to come into force as soon as is reasonably practicable.

For the purposes of this paragraph, the right of the Company, any related company, their employees, agents and contractors and the employees of such agents and contractors to prospect on any land under the Prospecting Authorities or under any permit under Section 54 of the Mining Ordinance issued in accordance with this Clause shall be deemed to include the right to carry out any operations reasonably necessary for the carrying out of the investigations assessments and inquiries referred to in Recital 2.

(d) During the currency of the Prospecting Authorities the Administration shall not without the prior consent of the Company (which consent shall not unreasonably be withheld) grant or permit the grant of any secondary prospecting authority or mining tenement or any other right to prospect for or to mine any gold or minerals over the whole or any part of the area then the subject of the Prospecting Authorities PROVIDED THAT nothing in this paragraph shall apply to any permit licence or lease issued or granted pursuant to the Petroleum (Prospecting and Mining) Ordinance in respect of petroleum.

(e) Neither Section 25F nor Section 25J (a) of the Mining Ordinance shall apply to the Prospecting Authorities and the Prospecting Authorities shall be deemed hereafter not to be subject to any terms or conditions under Section 25A(1) of that Ordinance.

(g) Nothing in this Clause shall affect the operation of Section 56 of the Mining Ordinance.

(f) The Company's rights under this Clause the Prospecting Authorities any permit issued pursuant hereto and the Company's obligations under Clause 4 shall terminate if and when—

(i) the Company has not as at the end of the period mentioned in Clause 5(a) applied for the special mining lease;

(ii) (in the event that the Company has applied as aforesaid) the special mining lease and all other leases the grant of which the Administration is obliged to procure to the Company pursuant to such application are granted to the Company; or

(iii) the Company gives to the Administration notice of its intention to abandon and cancel this agreement (exclusive of Clause 21).

4. COMPANY'S INVESTIGATIONS.

(a) The Company shall ensure that the investigations assessments and inquiries referred to in Recital (2) and metallurgical and market research in relation thereto are carried out or continued with reasonable diligence and shall endeavour to make its decisions as to whether it will proceed with the establishment of a mining and concentrating operation of the kind referred to in the said Recital (2) and as to whether it will make application pursuant to Clause 5(a) as soon as is reasonably practicable.

(b) Until such time as the investigations assessments inquiries and research referred to in paragraph (a) of this Clause have been completed or until the Company makes an application pursuant to Clause 5(a) (whichever is the later) it shall within two months of the end of the relative period make to the Administration in respect of each successive

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period of six months the first of which ends on the thirty-first day of December, One thousand nine hundred and sixty-seven—

- (i) a report in reasonable detail on such investigations assessments inquiries and research (including a description of the investigations carried out in the area then the subject of the Prospecting Authorities and of the results of those investigations) and as to the expenditure incurred in connection therewith and as to any other expenditure of the kind referred to in Clause 5(b) (i) which has been incurred; and
- (ii) a report on the general progress (if any) made in the obtaining of the finance necessary to enable it to comply with its obligations under Clause 6(a).

5. LEASES AND OTHER RIGHTS.

(a) The sum of \$4,514,851 having prior to the first day of January, One thousand nine hundred and sixty-seven, been expended on the discovery mentioned in Recital (1) the Company may (so long as the total expenditure as at the date of application is not less than the required total expenditure as at that date) apply to the Administration at any time during the period ending on the thirty-first day of December, One thousand nine hundred and seventy-one by way of a single application—

- (i) for a special mining lease or special mining leases to be granted to it over the area or areas of land specified in such application (being the whole or part of the area then the subject of the Prospecting Authorities); and
- (ii) for the other leases specified in the application to be granted to it over or in respect of the relative area of land specified in the application, which leases shall be those reasonably needed by the Company for its purposes under this Agreement including without prejudice to the generality of the foregoing those required for—

- (A) mining purposes generally;
- (B) treatment plants;
- (C) townsites and other accommodation including any green belt or rural zone on the outskirts thereof;
- (D) wharves, docks, piers, slips, jetties, landing stages, platforms, landing ramps, markers, buoys, beacons, leads, channels and berthing and mooring places, to be constructed, installed, provided, dredged or deepened in accordance with Clause 11;
- (E) power stations;
- (F) dams;
- (G) roads, railways and other modes of access;
- (H) runnels, pipelines, water channels and races, transmission lines and ropeways; and
- (I) the disposal of overburden and tailings in accordance with Clause 15.

(b) For the purpose of paragraph (a) of this Clause—

- (i) a reference to total expenditure as at a particular date shall be to the sum of the amounts (expressed in dollars) expended and liabilities incurred but not then satisfied on or after the said first day of January, One thousand nine hundred and sixty-seven, by the Company or by any related company or (pursuant to arrangements made with the Company or any related company) by any other company whatsoever directly or indirectly upon or in connection with—
 - (A) exploration prospecting or testing on or in relation to the areas at present the subject of the Prospecting Authorities;
 - (B) all or any of the matters referred to in Clause 4(a); or
 - (C) the provision of facilities necessary or requisite for the taking of any of the action hereinbefore referred to in this paragraph; and
- (ii) a reference to the required total expenditure as at a particular date shall be to that sum which bears to the sum of \$4,000,000 the same proportion as the period between the said first day of January, One thousand nine hundred and sixty-seven,

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and such date (exclusive of any extensions to which the Company becomes entitled under Clause 20(b)(i)) bears to five years.

For the purpose of this paragraph—

- (1) any amount expended in currency other than Australian currency shall be taken into account at its equivalent in Australian currency at the rate of exchange prevailing at the time of expenditure and any liability incurred in currency other than Australian currency shall be taken into account at its equivalent in Australian currency at the rate of exchange prevailing at the time at which the liability was incurred; and
 - (2) any reference to amounts expended, liabilities incurred or arrangements made by or with a related company shall include a reference to amounts expended, liabilities incurred or arrangements made between the said first day of January, One thousand nine hundred and sixty-seven, and the date of the incorporation of the Company by or with a company which is now a related company.
- (d) The Company may at any time after making application pursuant to paragraph (a) of this Clause apply to the Administration for further leases to be granted to it over or in respect of the relative areas of land specified in the application which leases shall be those reasonably needed by the Company for the purposes aforesaid.
- (d) Prior to the Company making application pursuant to paragraph (a) or (c) of this Clause it may from time to time notify the Administration that it intends, if it makes an application under the said paragraph (a) or (c), to apply pursuant thereto for the lease specified in the notification over or in respect of the area of land specified therein but if it does so notify the Administration and subsequently makes application under the said paragraph it shall unless the Administration agrees otherwise include in such application an application for such lease.
- (d) Any application or notification made or given under the preceding provisions of this Clause shall describe each area in respect of which it is made or given with such particularity as will enable it to be marked off and if necessary surveyed or otherwise identified.
- (f) Upon receipt from the Company of an application pursuant to paragraph (a) or (c) of this Clause the Administration shall as soon as practicable but in any event—
- (i) in the case of a lease in respect of which the Company has given a notification under paragraph (d) of this Clause—within three months after the receipt of such application or one year after such notification (whichever is the later); or
 - (ii) in any other case—within one year after the receipt of such application, (or within such longer period if any as the parties hereto shall agree upon) procure the grant to the Company of the leases therein specified over or in respect of the relative areas therein specified or save in the case of the special mining lease over or in respect of such other areas as the Administration demonstrates would meet the reasonable needs of the Company for the purposes aforesaid.
- (g) The special mining lease shall be in the form of the Schedule to this Agreement (but with such modifications thereto if any as the parties shall agree upon in writing) the annual rental payable thereunder shall be one dollar per acre or part thereof and the special mining lease shall be for an initial term of forty-two years with successive rights of renewal for further terms of twenty-one years which renewals shall—
- (i) in the case of the first and second renewals—be on the same terms save as to royalty and rent as those on which the special mining lease is originally granted as aforesaid, the terms of the said renewals as to royalty and rent being such as are (after discussion with the Company and consideration of all the then prevailing facts and circumstances) determined by the Administration as being fair and reasonable; and
 - (ii) in the case of the third and subsequent renewals—be on such terms as are (after discussion and consideration as aforesaid) determined by the Administration as being fair and reasonable as aforesaid.
- (b) The Company shall pay royalty at the rate of one and one quarter per cent. (or, during the currency of any renewal of the special mining lease, such other rate as is determined pursuant to paragraph (g) of this Clause) of the f.o.b. revenue applicable to deliveries

made by the Company pursuant to sales or other dispositions made by the Company of ores of copper other minerals or gold (whether or not the same have been concentrated) won from the area the subject of the special mining lease, which royalty shall be payable monthly in accordance with procedures agreed between the Administration and the Company.

(i) For the purposes of paragraph (b) of this Clause, the processing by the Company of ores referred to in that paragraph beyond the stage of concentration shall be deemed to be a delivery by the Company (made at the time when the further processing begins) of the ores pursuant to a disposition by the Company otherwise than by way of sale.

(j) The rentals or like charges payable under any lease granted in accordance with this Agreement (other than the special mining lease) shall be such as are prescribed by law or (in the case of any rentals or charges the amount of which is not fixed by legislation) as are fair and reasonable and subject as hereinafter provided in this Agreement the said leases (other than the special mining lease) shall be granted on such terms and for such periods as are fair and reasonable. The instrument evidencing each such lease shall—

(i) contain a condition that the Company will not without the consent of the Administration use the relative land for a purpose other than the purpose for which the grant is made or a purpose ancillary to that purpose;

(ii) oblige the Company to construct install or provide on the relative land, within the period specified in the Company's application (not being a period longer than five years) and at a cost of not less than an amount to be specified in the said application as the minimum amount which the Company proposes to expend on improvements thereon, improvements of the kind specified in the said application as those which the Company proposes to construct install or provide thereon (but shall not otherwise oblige the Company to construct install or provide improvements); and

(iii) shall confer on the Company rights of such renewals or extensions of the relative lease as will ensure that it may remain in force at least until the expiration of the last renewal of the special mining lease.

The rentals or like charges payable under the said renewals or extensions shall be such as are prescribed by law or (in the case of any rentals or charges the amount of which is not fixed by legislation) as are fair and reasonable and such renewals or extensions shall—

(A) in the case of such renewals or extensions as are granted upon or prior to the expiration of the second renewal of the special mining lease—be granted on the same terms as those on which the relative lease was originally granted; and

(B) in the case of any renewals or extensions granted subsequently—be granted on such terms as are (after discussion with the Company and consideration of all the then prevailing facts and circumstances) determined by the Administration as being fair and reasonable.

(k) All land the subject of any lease granted to the Company in accordance with this Agreement shall be and remain zoned and available for use by the Company for any purpose permitted under the lease and no legislation fixing or limiting rentals or restricting the present rights of sub-lessors to evict sub-lessees shall apply to any land the subject of any lease granted to the Company pursuant hereto.

(l) The Company shall (without prejudice to any rights which it may have to be compensated in respect thereof but subject to it doing to the relative land as little damage as may reasonably be and to any agreement which may be made between the parties hereto for the purchase of the same) have the right in the event of the expiration or sooner determination for any reason of any lease or any renewal or extension thereof granted in pursuance of this Agreement within a reasonable time after such expiration or determination to remove any improvements affixed by it or on its behalf to the relative land.

(m) The Administration shall not grant or permit the grant of any prospecting authority or mining tenement or any other right to prospect for or mine any gold or minerals over the whole or any part of the area then the subject of the special mining lease unless—

(i) the Company has previously consented thereto; or

(ii) the Administration demonstrates that the exercise of such right to prospect or mine would not interfere with any present or prospective operation of the Company on or in the relative area and has previously made a written offer to the Company upon and subject to the same terms and conditions (whether as to rent royalty or any other matters whatsoever and whether to be contained in the instrument evidencing the grant or in any other instrument or contract) as those upon and subject to which the Administration is bona fide prepared to grant or permit the grant of the said right to any other person or company and the Company has refused such offer in writing or has failed for a period of twelve months after the date of receipt of such offer to accept the same (whichever is the earlier),

PROVIDED THAT nothing in this paragraph shall apply to any grant made pursuant to the Petroleum (Prospecting and Mining) Ordinance in respect of petroleum.

6. CONSTRUCTION OBLIGATIONS OF COMPANY.

- (a) In the event that the Company makes application under Clause 5(a) it shall within five years of the granting to it of the special mining lease and the other leases the grant of which the Administration is obliged to procure pursuant to the said Clause 5(a) and at a cost of not less than \$30,000,000 construct install and provide facilities to enable it to mine ores from the land the subject of the special mining lease, to concentrate such ores, to transport the concentrates so derived to wharf facilities and to ship such concentrates from such facilities in commercial quantities and shall within the said period of five years commence, so to ship such concentrates. All the expenditures costs amounts and liabilities referred to in Clauses 5(a) and 5(b) (i) (including the expenditure of \$4,514,851 specifically referred to in the said Clause 5(a)) shall be deemed to have been part of the cost incurred by the Company pursuant to this paragraph irrespective of whether they were expended or incurred by the Company or some other company and whether they were expended or incurred prior to or on or after the date hereof.
- (b) In the event that the Company fails to comply with paragraph (a) of this Clause and to remedy such default within a reasonable time after a notice specifying the default is given to it by the Administration the Administration may by notice to the Company and subject as hereinafter provided in this Clause determine this Agreement (exclusive of Clause 21) and thereupon the special mining lease and the other leases vested in the Company shall notwithstanding their terms cease and determine PROVIDED THAT if the Administration gives to the Company a notice specifying a default as aforesaid and the Company promptly refers to arbitration the question whether such alleged default has taken place then if on such arbitration it is decided that the Company has made such default but that there has been a bona fide dispute and that the Company has not been dilatory in pursuing such arbitration then neither this Agreement nor the special mining lease nor any of the said other leases may be determined under this Clause unless and until a reasonable time fixed by the award as the time within which the Company must remedy such default has elapsed without such default having been remedied.
- (c) Notwithstanding anything contained in this Agreement no default by the Company in the construction installation and provision of facilities or in the shipping of concentrates in accordance with paragraph (a) of this Clause shall constitute a breach of this Agreement and the only consequences arising therefrom shall be those set out in paragraph (b) of this Clause.
- (d) Until the Company has complied with paragraph (a) of this Clause or this Agreement has been determined as aforesaid (whichever is the earlier) the Company shall within two months of the end of the relative period make in respect of each successive period of six months the first of which ends on the thirtieth day of June or the thirty-first day of December (whichever is the earlier) next following the making of application by the Company pursuant to Clause 5(a) a report in reasonable detail to the Administration as to the progress made in complying with paragraph (a) of this Clause and as to the expenditure incurred in connection therewith.

7. TAXATION.

- (a) The income of the Company shall be exempt from income tax for a period commencing on the date on which the Company first enters into commercial production of copper concentrates under this Agreement and ending on the last day of the period of three

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years next following that date, but subject to paragraphs (b) (c) and (d) of this Clause no amounts which would but for this paragraph have been deducted in the determination of the amount upon which is calculated the income tax (if any) otherwise payable by the Company in respect of the tax exemption period shall be deducted in the determination of the amount on which is calculated the income tax payable by the Company in respect of any period following the tax exemption period.

- (b) Any expenditure incurred by the Company either before or during the tax exemption period which would entitle the Company to a deduction calculated in accordance with Division 10 of Part III. of the Income Tax Ordinance shall be deemed to have been incurred on the day following the day on which the tax exemption period expires and the Company shall for the purposes of the determination of the amount upon which income tax is calculated and of taxable income be entitled to deductions under the said Division accordingly.
- (c) If any expenditure is incurred by the Company either before or during the tax exemption period in borrowing money for the purpose of producing income such money shall be deemed to have been borrowed (for the period for which it was in fact borrowed) on the day following the day on which the tax exemption period expires and the Company shall for the purposes of the determination of the amount upon which income tax is calculated and of taxable income be entitled to deductions under Section 89 of the Income Tax Ordinance accordingly.
- (d) If in a year of income or part of a year of income falling within the tax exemption period the income which would but for paragraph (a) of this Clause have been assessable income of the Company under the then law relating to income tax is less than the total of the amounts which would but for the said paragraph (a) have been deducted in determining the amount upon which is calculated the income tax (if any) otherwise payable by the Company in respect of that year of income or part of a year of income (other than any of the amounts referred to in paragraphs (b) and (c) of this Clause) the difference between such income and such total shall be deemed to be an expenditure incurred on the day following the day on which the tax exemption period expires which is a deduction for the purposes of the determination of the amount upon which income tax is calculated and of taxable income.
- (e) The deductions now allowable to the Company in respect of the matters covered by Sections 68, 72, and 101 and Division 10 of Part III. of the Income Tax Ordinance and the exemption now provided for in Section 33 of the Income Tax Ordinance and Regulation 5 of the Regulations thereunder shall continue to be available to the Company and the Company shall continue to be entitled to relief from income tax accordingly.
- (f) The exemption now provided for in Section 42(1)(b)(i) of the Income Tax Ordinance shall continue to be available to members of the Company and beneficial owners of shares in the Company and such members and beneficial owners shall continue to be entitled to relief from income tax accordingly.
- (g) Neither the Company nor any other person shall have any liability to any income tax on the payment or repayment of or measured by reference to the amount of any interest payable or any other amount payable in respect of any amount which is lent to the Company by any person who is not a resident of the Territory or on or in respect of the principal of any such loan other than any liability thereto which would exist under the Income Tax Ordinance.
- (h) No alteration made to the law of the Territory (other than any alteration made to give effect to any agreement for the avoidance of double taxation entered into with the Government of the country of which the relevant member or beneficial owner is a resident) shall apply to or in respect of the Company or a member of the Company or a beneficial owner of a share in the Company if it would have the effect of increasing the amount of any tax charge due duty or other levy payable by the Company or by such a member or beneficial owner in respect of any dividends declared credited or paid by the Company to an amount in excess—
 - (i) where the member or beneficial owner is a company which is a resident of Australia (as that expression is used in the *Income Tax Assessment Act 1936-1967* of the Commonwealth of Australia)—of the amount of income tax calculated by applying to the dividend the rate of income tax payable generally by companies of

the same class for the purposes of income tax which are also residents of Australia as aforesaid on dividends derived from a source in the Territory in the year of income in which the dividend is paid or credited or the minimum rate of income tax payable generally by companies of the same class for the purposes of income tax which are residents of the Territory in respect of income derived from a source in the Territory in the said year of income (whichever is the lesser rate);

(ii) where the member or beneficial owner is a company which is not a resident of the Territory and is not a resident of Australia aforesaid—of the amount calculated by applying to the dividend the minimum rate of income tax payable generally by companies of the same class for the purposes of income tax which are residents of the Territory in respect of income derived from a source in the Territory in the year of income in which the dividend is paid or credited; or

(iii) where the member or beneficial owner is an individual—of the amount calculated by applying to the dividend the rates of income tax payable by individuals who are residents of the Territory in respect of income derived from a source in the Territory in the year of income in which the dividend is paid or credited.

(i) No rate, tax, rent, charge, due, duty, tariff or other levy and no legislation, procedure or practice relating thereto which is discriminatory (whether in law or in practice) in its effect on the Company any member of the Company or any beneficial owner of any share in the Company shall be payable by or (as the case may be) applicable to the Company or any such member or beneficial owner (as the case may be) in respect of the operations of the Company under this Agreement or of any income arising directly or indirectly therefrom.

(j) No local government rates or taxes on land calculated otherwise than in relation to the unimproved value of the land shall be payable by the Company.

(k) In addition to income tax and any other taxes, rates, charges, dues, duties, tariffs and other levies payable by the Company, the Company shall pay to the Administration by way of an additional tax in respect of each year of income after the tax exemption period such amount (if any) as is equal to the amount (if any) by which the total of the amount of income tax payable in respect of that year of income and the prescribed taxes is less than fifty per cent. of the adjusted taxable income of the Company for that year of income PROVIDED THAT no additional tax shall be payable under this paragraph in respect of the first year of income after the tax exemption period in which the Company derives a taxable income and in respect of the second third and fourth years of income after such first year the amounts of additional tax (if any) otherwise payable under this paragraph shall be reduced by 75 per cent., 50 per cent. and 25 per cent. respectively.

(l) If in respect of any year of income the total of the income tax payable by the Company and the prescribed taxes exceeds the greatest of—

(i) the prescribed proportion of the adjusted taxable income for that year of income;

(ii) the total of those prescribed taxes which were imposed in respect of the importation of goods into the Territory by the Company; or

(iii) \$275,000,

the Administration shall (save in a year of income in which the Company is obliged to pay income tax but the adjusted taxable income does not exceed \$3,000,000) pay the excess to the Company.

(m) In respect of each year of income the Company shall at the time at which it lodges its return of income for purposes of income tax furnish to the Administration a return setting out the prescribed taxes.

(n) Any additional tax payable under paragraph (k) of this Clause or (as the case may be) any payment under paragraph (l) of this Clause shall become due and payable at the time at which the income tax (if any) payable by the Company becomes due and payable but if no such income tax is payable any payment under the said paragraph (l) shall become due and payable nine months after the end of the relative year of income.

(o) If by reason of any event occurring after the payment of any additional tax or the making of any payment under paragraph (l) of this Clause including (without prejudice to the generality of the foregoing) the amendment reduction increase or variation of any income tax assessment, the amount of such payment is more or less than the amount which

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should in fact have been paid as the case may be the necessary adjustment shall be made as soon as practicable thereafter.

(p) In this Clause, unless the context otherwise requires—

"additional tax" means the additional tax imposed under paragraph (k) of this Clause;

"adjusted taxable income", in relation to a year of income, means the sum of—

(i) the taxable income of the Company in respect of that year of income; and

(ii) the amount of the prescribed taxes which have been deducted in order to arrive at the taxable income;

"income tax" includes a like tax but does not include provisional income tax or additional tax;

"taxable income", in relation to a year of income, means the amount which would have been the taxable income of the Company if the Income Tax Ordinance had been in force throughout that year of income;

"the Income Tax Ordinance" means the *Income Tax Ordinance 1959-1966* of the Territory and the Regulations thereunder as in force at the date of this Agreement but as amended by this Agreement;

"the prescribed proportion of the adjusted taxable income", in relation to a year of income, means fifty per cent. of the adjusted taxable income for that year, increased by one per cent. of the adjusted taxable income for each year of income after the twenty-fifth complete year of income calculated from the end of the year of income in which the Company first enters into commercial production of copper concentrates under this Agreement but so that that proportion shall not exceed sixty-six per cent. of the adjusted taxable income;

"the prescribed taxes", in relation to a year of income, means—

(i) such rates taxes charges dues duties tariffs and other levies as are imposed by the Administration or a governmental authority and are deducted in order to arrive at the taxable income of the Company for that year of income; and

(ii) such other rates taxes charges dues duties tariffs and other levies as are imposed by the Administration or a governmental authority and are paid by the Company during that year of income,

but does not include any normal charges for services rendered, local government rates or taxes on land, duties on the importation into the Territory of goods for resale or for hiring under hire-purchase agreements or the royalty payable under this Agreement;

"the tax exemption period" means the period during which the income of the Company is exempt from income tax under paragraph (a) of this Clause;

other expressions used shall have the meanings given to them in the Income Tax Ordinance.

8. FINANCIAL PARTICIPATION.

(a) The Company shall, not later than two years after the granting of the special mining lease, notify to the Administration total of the amount of the Company's ordinary share capital which is then issued and which it is then intended shall be issued and offer to the Administration or if so requested by the Administration to an approved authority for subscription in cash at par ordinary shares in the Company having a total nominal value equal to 20 per cent. of the total amount notified under this paragraph and as soon as practicable and in any event not later than six months thereafter the Administration shall or (as the case may be) shall procure the said approved authority to notify the Company whether or not it accepts such offer.

(b) Notwithstanding any provision in the Articles of Association of the Company transfers of the Administration shares of the following kinds may be made:—

(i) transfers made at any time by the Administration an approved authority or approved authorities on the basis of a reasonable spread of shareholdings to eligible Territory residents (so long as the total of the shares so transferred does not prior to the prescribed date exceed 25 per cent. of the total nominal value of

the Administration shares for the time being issued without the agreement of the Company);

(ii) transfers made at any time among the Administration and an approved authority or approved authorities; and

(iii) transfers made at any time among eligible Territory residents.

(c) The Administration shall not and shall procure that any approved authority holding Administration shares does not dispose prior to the prescribed date (otherwise than by way of transfer of the legal title therein) of any of the Administration shares or any interest in any of the Administration shares without the agreement of the Company.

(d) The Company shall ensure that at the time at which an offer is made pursuant to paragraph (a) of this Clause its Articles of Association provide that no Administration share may be held by any person other than the Administration an approved authority or an eligible Territory resident and that such Articles of Association continue thereafter so to provide.

(e) The Company shall if and so long as the total nominal value of the Administration shares equals not less than 15 per cent. of the adjusted share capital of the Company ensure that the holders for the time being of a majority in number of the Administration shares are entitled to appoint a director of the Company.

(f) The Administration shall, if it or an approved authority accepts any offer made pursuant to paragraph (a) of this Clause, use its good offices as requested by the Company in assisting the Company to seek and make arrangements for loan capital from time to time required by the Company.

(g) In this Clause—

"approved authority" means a statutory authority of the Administration approved for the purpose by the Administration;

"co-operative company" means a co-operative company within the meaning of Division 9 of Part III. of the *Income Tax Ordinance 1959-1966* of the Territory, which is a resident of the Territory;

"eligible Territory residents" means persons (being Territory residents who are individuals or co-operative companies or native bodies all of the members of which are Territory residents who are individuals) declared from time to time to be such by law;

"native body" means—

(i) a Society as defined in the *Co-operative Societies Ordinance 1965* of the Territory;

(ii) a society certified by the Administration to be a native rural development society; or

(iii) any other group or body of persons resident in the Territory which is—

(A) a native body for the purposes of the *Income Tax Ordinance 1959-1966* of the Territory; or

(B) declared by the Administration and the Company to be a native body for the purposes of this Clause;

"the adjusted share capital of the Company" means an amount which is five times the nominal value of the total of—

(i) the shares in the Company which are issued to the Administration pursuant to paragraph (a) of this Clause; and

(ii) any other shares which are offered to holders of such shares by virtue of their holdings thereof (whether or not such shares have been taken up by such holders);

"the Administration shares" means—

(i) the shares in the Company which are issued to the Administration or an approved authority pursuant to paragraph (a) of this Clause; and

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- (ii) any other ordinary shares in the Company which are issued to the holder thereof by virtue of his holding shares of the kind mentioned in sub-paragraph (i) of this definition;

"the prescribed date" means the date fifteen years after acceptance of the offer referred to in paragraph (a) of this Clause or the first day after the Company has completed its obligations under Clause 6(a) on which it has no obligations for the repayment (otherwise than to its members) of money borrowed by it for the purposes of the performance of its obligations under that paragraph or for any re-financing in relation thereto (whichever is the earlier).

9. SUPPLIES AND CURRENCY.

- (a) The Company shall so far as is reasonably and economically practicable use supplies plant machinery and equipment manufactured or produced in the Territory.

- (b) Subject to any requirements of defence the safety of the public and quarantine and to the obligations of the Administration under multilateral international agreements entered into by the Government of the Commonwealth of Australia or the Administration and implemented by subsequent legislation, the Company any related company and the agents and contractors of the Company or of any related company shall have the right to acquire import into and move within the Territory and use any plant machinery equipment vehicles explosives fuels reagents and supplies—

- (i) required for the construction installation provision expansion maintenance or operation of any of the facilities referred to in Clause 6(a), any facilities required for any further processing of concentrates produced as a result of the Company's operations under this Agreement or any other facilities required for the purpose of the said operations; or

- (ii) otherwise required for the purpose of the said operations,

and to export from the Territory the products (whether processed or otherwise) resulting from the said operations.

- (c) No tax, charge, due, duty, primage duty, tariff or other levy shall be imposed on—

- (i) the acquisition importation into or movement within the Territory or use (between the period commencing on the date hereof and expiring upon the completion by the Company of the performance of its obligations under Clause 6(a)) of such of the plant machinery equipment vehicles fuels and supplies referred to in paragraph (b) of this Clause (other than articles for resale and food-stuffs) as could at present be imported into the Territory free of import duty under the *Customs Ordinance 1951-1959* of the Territory; or

- (ii) on the acquisition importation into or movement within the Territory or use (between the period commencing on the date hereof and expiring ten years after the completion by the Company of the performance of its said obligations) of any plant machinery or equipment required for the replacement of any of the plant machinery or equipment referred to in sub-paragraph (i) of this paragraph or of such of the explosives and reagents referred to in paragraph (b) of this Clause as could at present be imported into the Territory free of import duty under the said Ordinance,

PROVIDED THAT nothing in this paragraph shall apply to the importation of any plant machinery equipment vehicles explosives fuels reagents or supplies of a kind which is at the time of such importation wholly or substantially manufactured or produced in the Territory and is available to the Company in the Territory at reasonable prices or (subject to Clause 14) to the imposition of normal motor vehicle registration fees.

- (d) No tax, charge, due, duty, excise, tariff or other levy shall be imposed on the mining production disposition or export of any of the products referred to in paragraph (b) of this Clause (other than any general export tax or levy which is imposed and levied at the same rate on all goods or merchandise of whatsoever kind produced or manufactured in the Territory and exported from the Territory in the ordinary course of trade).

10. PERSONNEL

- (a) The Company shall so far as is reasonably and economically practicable use and train in new skills labour available in the Territory and in particular the Company shall continue

and expand the training programme instituted prior to the execution hereof with a view to the early employment by it in technical and staff positions of suitably qualified inhabitants of the Territory.

- (b) No restriction which is unreasonable shall be placed on the freedom of the employees agents and contractors of the Company or any related company and the employees of such agents and contractors and their families to enter remain and move within and depart from the Territory for the purpose of the Company's operations hereunder and neither the law of the Territory relating to the entry of persons into, the movement of persons within and the departure of persons from the Territory nor the administration of such law shall discriminate (whether in law or in practice) against any such employees agents or contractors or their families.

11. PORT.

- (a) The Company shall for the purpose of its operations under this Agreement have the power on or in the waters adjacent to the said Bougainville Island to construct install provide maintain and use wharves, docks, piers, slips, jetties, landing stages, platforms, landing ramps, markers, buoys, beacons and leads and to construct dredge deepen maintain and use channels and berthing and mooring places PROVIDED THAT no such facility may be constructed installed provided dredged or deepened without the prior consent of—

(i) in the case of facilities in a port which is a declared port—the Board; or

(ii) in the case of any other facilities—the Superintendent of Marine of the Territory,

which consent shall not be withheld unless the said Board or the said Superintendent of Marine (as the case may be) believes on reasonable grounds that the construction, installation, provision, dredging or deepening of the relative facility in the manner or at the place proposed by the Company would prejudice navigation, the accessibility of other ports in the Territory or the development of any declared port within which the facility is or is to be situated.

- (b) The Company shall (to the extent to which it is not prejudiced and its operations hereunder are not interfered with) permit the Administration and other persons to use the facilities referred to in paragraph (a) of this Clause on reasonable terms and at reasonable charges.

- (c) In relation to the Company port—

(i) any by-laws from time to time made by the Board relating to declared ports shall (except to the extent agreed between the Company and the board and notified in the *Gazette*) apply as if the Company port were a declared port;

(ii) the Company may with the approval of the Board make local rules for the management and control of the Company port which rules shall be deemed to be local rules made under Section 44(1) of the Harbours Board Ordinance and shall apply in the Company port as if it were a declared port; and

(iii) subject to sub-paragraph (i) of this paragraph, the Company and the Company's Port Manager shall have in relation to the management and control of the Company port all the powers which the Board or a Port Manager or Harbour Master appointed by it to manage the Company port would respectively have if the Company port were then a declared port.

PROVIDED THAT any express or implied reference to the Board its Port Manager or Harbour Master or to its other officers or employees or its agents in any of the said by-laws shall be read and construed as references to the Company the Company's Port Manager or the Company's other employees or its agents (as the case requires).

- (d) The Company shall have sole control over all wharves, docks, piers, slips, jetties, landing stages, platforms and landing ramps referred to in paragraph (a) of this Clause and the sole power to regulate the use thereof (including use permitted by paragraph (b) of this Clause) and the recruitment of labour employed in connection therewith, whether or not in the Company port (if any).

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- (a) No tax, charge, due, duty or other levy other than income tax, the light dues and pilotage now provided for in the Territory and import and export duties or levies which may be charged under Clause 9 shall be imposed on or in relation to—
- (i) the use of any facilities referred to in paragraph (a) of this Clause;
 - (ii) the shipment of any goods to or from any such facilities; or
 - (iii) any vessel engaged in such shipment.

- (b) The Company may for its operations under this Agreement and on the same terms as other commercial users thereof use any harbour and wharf facilities on the said Bougainville Island which are now or may in the future be under the control of the Administration or the Board or any like body and the Administration shall if requested by the Company provide in connection with any such wharf facility for use by the Company as aforesaid any lifting gear of a normal commercial nature which is or will in the reasonably foreseeable future be required for the general use of such facility and which is reasonably required by the Company for its said operations.

- (c) In this Clause—

"declared port" has the meaning given to it by Section 4 of the Harbours Board Ordinance as at present in force;

"the Board" means the Papua and New Guinea Harbours Board;

"the Company port" means that area of waters adjacent to Bougainville Island and contiguous land which—

- (i) lies wholly outside a port which is now a declared port;
- (ii) is an area reasonably required by the Company for the proper regulation of the use of the facilities referred to in paragraph (a) of this Clause and of shipping using the same; and
- (iii) has for the time being been designated by the Company by notice in the *Gazette* as the port serving its operations under this Agreement;

"the Company's Port Manager" means the person for the time being appointed by the Company to manage the Company port;

"the Harbours Board Ordinance" means the *Papua and New Guinea Harbours Board Ordinance 1963-1964* of the Territory.

12. TOWNS AND SERVICES.

- (a) The Administration shall (except as otherwise agreed with the Company) provide education police postal telecommunication and medical facilities of the standard reasonably required to serve the Company its employees and any town camp or other accommodation established or constructed by the Company on the said Bougainville Island and shall staff and service such facilities at no cost to the Company or any of its employees other than the normal service charges (if any) made therefor.

- (b) The Company shall at a time determined by it during, but in any event prior to the expiration of, the period of five years mentioned in Clause 6 (a) construct or procure the construction to a design and at a place and at a cost approved by the Administration of a hospital of the standard reasonably required to serve (*inter alia*) employees of the Company and any town camp or other accommodation established or constructed by the Company as aforesaid and the Administration shall procure the grant to the Company of all necessary rights to enable it to do so. Unless the Company has previously agreed otherwise in writing the Administration shall forthwith upon the completion of the construction of the said hospital commence to staff and service the same and thereafter continue to do so at no cost to the Company or its employees other than the normal service charges (if any) made therefor. The Administration shall unless arrangements have previously been made with the Company for the postponement thereof reimburse to the Company the cost as aforesaid of constructing or procuring the construction of the said hospital within two months of the completion of the construction of the same.

13. POWER AND WATER.

- (a) The Company shall have power to generate, transmit, use for its own purposes and supply electric power to any related company, the employees agents and contractors of

- the Company or of any related company and the employees of any such agents or contractors and to charge therefor.
- (b) The parties hereto shall consult with a view to the establishment by the Company of a hydro-electric power station for the generation of electric power for use by the Company, the Administration and other persons and without prejudice to paragraph (a) of this Clause the Administration shall on the request of the Company use its best endeavours to preserve the water resources necessary for the establishment of such a station and shall if the Company decides to proceed with the establishment of such a station grant or procure the grant to the Company of any further rights necessary therefor (which rights shall be granted on fair and reasonable conditions).
- (c) The Company may from time to time and whether before or after it has made application pursuant to Clause 5(a) notify the Administration that it desires the provisions of this paragraph to apply to the area specified in the notification (being an area in respect of which the Company reasonably requires the Administration to take the action hereinafter specified for the purposes of a dam which has been or may in the future be constructed by or on behalf of the Company) and thereupon the Administration shall—
- (i) either procure such last-mentioned area (or such other area as the Administration demonstrates to the Company would meet the reasonable requirements of the Company for the purpose aforesaid) to become pursuant to the *Water Resources Ordinance 1962* of the Territory a water control district, or take such other action as will result in the use of such area (or as the case may be, such other area) being restricted to the same extent as if the same were now a water control district as aforesaid; and
 - (ii) ensure that no approval licence permit or lease pursuant to the said Ordinance or any similar right is granted to any person other than the Company over the relative area if any acts permitted by such grant would or would be likely substantially to prejudice the Company or interfere with its operations under this Agreement.
- (d) The Company shall to the extent reasonably necessary for its operations under this Agreement have power to take, use for its own purposes and reticulate water to any related company, the employees agents and contractors of the Company and of any related company and the employees of any such agents and contractors and charge therefor.
- (e) Subject to the Administration procuring the grant to the Company of all necessary rights and powers to enable it to do so the Company shall to the extent to which it is not prejudiced and its operations under this Agreement are not interfered with permit the Administration and other persons to use (on reasonable terms and at reasonable charges) electric power generated and water taken by the Company.

14. ROADS.

- (a) Save in the case of any Company roads which the Company determines after consultation with the Administration should in order to ensure the proper safety and maximum efficiency of its operations under this Agreement be reserved for its exclusive use the Company shall (to the extent to which it is not prejudiced and its said operations are not interfered with and subject to the Company and related companies and the agents and contractors of the Company or any related company having absolute priority of use of the relative roads) permit the use of Company roads—
- (i) in the case of use for or in connection with agricultural or pastoral pursuits of substantially the same kind and extent as those at present followed in the area served by such Company roads or for administrative, private, domestic, social or religious purposes—free of charge to the user; and
 - (ii) in any other case—on such reasonable charges (having regard to the cost to the Company of the construction maintenance and repair of such Company roads) as are from time to time determined by the Company.
- (b) The Company shall have power to prohibit restrict or regulate the use of and traffic on all Company roads and at any time and from time to time to close any Company road to the public or to any class of users.

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(c) While any Company road is a public road or street as that expression is used in the *Motor Traffic Ordinance 1950-1965* of the Territory such Ordinance and the *Motor Vehicles (Third Party Insurance) Ordinance 1952-1956* of the Territory and the Regulations thereunder shall subject to the preceding provisions of this Clause apply to and in respect of that Company road but—

(i) no provision of the said Motor Traffic Ordinance or the said Regulations thereunder relating to the payment of fees on or in connection with the registration of motor vehicles shall apply to motor vehicles owned by the Company any related company any employee agent or contractor of the Company or any related company or any employee of any such agent or contractor and used solely on Company roads; and

(ii) no provision of the said Motor Traffic Ordinance or the said Regulations thereunder (other than provisions thereof the breach of which would or might endanger the safety of other road users) shall apply to the use on any Company road of any vehicle so owned.

(d) The Company shall not be liable to the Administration any governmental authority or any person in respect of any failure or alleged failure by it to maintain or repair any Company road or any loss damage or injury suffered by reason of any such failure or alleged failure if a Local Government Council established under the *Local Government Ordinance 1963-1967* of the Territory and having the care control and management of such a road would not have been so liable.

(e) In this Clause "Company road" means a road constructed by or on behalf of the Company or a related company on the said Bougainville Island other than any such road which by agreement in writing between the parties hereto is not to be or is not a Company road.

(f) The Administration shall from time to time publish in the *Gazette* details of all roads which are as at the date of the notice Company roads and shall from time to time cause that notice to be amended as necessary.

15. OVERBURDEN TAILINGS AND SAFETY.

(a) The Company shall not dispose of any overburden removed in the course of, or any tailings produced as a result of, its operations under this Agreement in an area or in a manner not previously approved for that purpose pursuant to the provisions of this Clause, it being intended that such overburden and tailings shall be disposed of in a manner which is reasonably safe and results in as little damage or disturbance (having regard always to the need for the Company to carry out its said operations efficiently and economically) as may reasonably be.

(b) The Company may at any time and from time to time hereafter submit to the Administration a proposal for the disposal of such overburden and tailings, setting out the area or areas and manner in which it is proposed to dispose of the same. Forthwith upon receipt of such proposal the Administration shall consider the same (having regard to the factors mentioned in paragraph (a) of this Clause) and shall within two months of such receipt either—

(i) notify the Company that its proposal has been approved either without modification or with such modifications as are set out in the notification; or

(ii) submit to the Company an alternative approved proposal for the disposal of the said overburden and tailings, setting out the area or areas and manner in which the same are to be disposed of thereunder.

(c) In the event that the Administration does not approve the Company's proposal without modification the Company may at any time thereafter refer to arbitration as hereinafter provided in this Agreement the question of the disposal of the said overburden and tailings. Upon such arbitration the arbitrator or arbitrators shall have regard to the factors mentioned in paragraph (a) of this Clause and shall either approve the Company's proposal or approve that of the Administration in either case without modification or with such modifications as he or they consider proper.

(d) Notwithstanding that the same may have been disposed of in an area and in a manner approved as hereinbefore provided in this Clause the Company shall make compensation for any loss suffered by any indigenous or other inhabitant of the said Bougainville Island or the other islands adjacent thereto resulting from any damage done (whether to land,

- anything on land, water or otherwise) or any interference with any right to use land or water caused by the disposal by the Company of any overburden removed in the course of, or tailings produced as a result of, its operations under this Agreement, but nothing in this paragraph shall oblige the Company to make any compensation to the Administration or any governmental authority. Such compensation shall be provided either in cash or by way of provision on reasonable terms and conditions of land or other facilities or benefits or partly in one form and partly in another and in default of agreement thereon between the Company and the person seeking such compensation the entitlement to and the amount and nature of such compensation shall upon application by such person be determined in accordance with the procedures provided for in Part VII. of the Mining Ordinance, such person or (as the case may be) the Company having from such determination the rights of appeal set out in the said Part VII.
- (e) The Company shall not save as is hereinbefore provided in this Clause be liable for any loss damage disturbance or interference caused by the disposal by the Company of any of the said overburden or tailings and save as aforesaid neither the Administration nor any governmental authority or person shall be entitled to any remedy in respect thereof but nothing in this paragraph shall exclude any liability for negligence.
- (f) In addition to complying with the present provisions of the Regulations made under the *Mines and Works Regulation Ordinance 1935-1962* of the Territory relating to safety and protection the Company—
- (i) shall when any dump for overburden and tailings established by it for the purpose of its operations under this Agreement ceases to be utilized for such purpose ensure that in order to facilitate the rapid regeneration of vegetation thereon such dump is left with a reasonably flat upper surface; and
 - (ii) shall within a reasonable time after any such dump ceases to be utilized as aforesaid carry out experiments for the determination of whether vegetation can be established thereon and use its best endeavours to establish thereon vegetation of a type which can be so established.

but the Company shall not be required to do any further or other acts or carry out any further or other works for the rehabilitation or restoration of any of the areas affected by its operations under this Agreement.

16. FURTHER PROCESSING.

The Company may at any time and from time to time after it makes application pursuant to Clause 5(a) submit to the Administration a proposal for the establishment by it in the area in the Territory specified in the proposal of facilities for the processing to the metallic or some further stage of any concentrates produced as a result of the Company's operations under this Agreement and the Administration shall within two months of such submission notify the Company whether or not it objects (on the ground that the same would have a substantially detrimental effect on the agriculture and general amenity of the surrounding area) to the establishment of such facilities in the area specified in the proposal and provide to the Company the detailed reasons for its decision and the Company may within two months of such notification refer to arbitration as hereinafter provided in this Agreement the question whether any objections made by the Administration were justified on such ground. If the Administration does not so object, or it objects but upon the arbitration it is determined that the Administration's objections were not so justified the Company shall be at liberty at any time thereafter to establish facilities in accordance with its proposal and carry out processing at such facilities and the Company may at any time and from time to time thereafter apply to the Administration for the leases specified in the application to be granted to it over or in respect of the relative areas specified in the application which leases shall be those reasonably needed by the Company therefor including (without prejudice to the generality of the foregoing) those needed for adequate buffer zones covering areas likely to be affected by fume dispersal. The provisions of paragraphs (d) (e) (f) (g) (h) and (i) of Clause 5 shall apply mutatis mutandis to such application and the leases granted pursuant thereto.

17. NO INTERFERENCE OR EXPROPRIATION.

- (a) The Company shall be at all times entitled and permitted fully to enjoy all the rights, benefits and privileges granted or intended to be granted by or as a result of this Agreement and the same and also the rights of all past present and future members of the Company and beneficial owners of shares in the Company fully to enjoy the benefit of their shareholdings or their interests in shares and other rights arising therefrom shall at no time be to the detriment of the Company or such members or beneficial owners

substantially altered or impaired impeded or interfered with by executive or administrative action or in any other manner whatsoever (whether directly or indirectly) and without affecting the generality of the foregoing—

- (i) subject to the provisions of this Agreement, the Company's present freedom of choice of directors, managers, executives, advisers, consultants, associates, employees, contractors, suppliers and customers and its present freedom to declare credit and pay dividends and to grant other rights to its members shall continue without substantial interference; and
 - (ii) no discriminatory action whether by way of industrial fiscal or social legislation or otherwise shall be taken against the Company or all or any of the members of the Company or the other persons mentioned in sub-paragraph (i) of this paragraph in their capacities as such in relation to the Company.
- (b) So long as the Company complies with this Agreement and with any lease granted thereunder, the Administration—
- (i) shall not cancel or permit the cancellation of any such lease or require the surrender of the whole or any part of any area the subject of any such lease; and
 - (ii) shall not resume or expropriate or permit the resumption or expropriation of any asset (whether movable or not) of the Company used in connection with any of its operations under this Agreement, any of the products (whether processed or otherwise) resulting from such operations, the business of the Company, or any shares held or owned by any person in the Company.

PROVIDED THAT nothing in this paragraph shall prevent the acquisition pursuant to the provisions of the Land Ordinance of any land or interest therein the subject of any such lease—

- (A) if such acquisition is necessary for the defence of the Commonwealth of Australia or of the Territory or for securing the public safety of the said Commonwealth or of the Territory; or
- (B) if such acquisition is for a purpose which is at present a public purpose under the Land Ordinance and does not prejudice the Company or interfere with its present or prospective operations under this Agreement.

For the purposes of this paragraph "expropriation" includes in the case of an asset, product or share any substantial interference with the rights of the owner fully to utilize and enjoy or to deal with or dispose of the asset product or share and in the case of a business any substantial interference with the rights of the owner to control or carry on or to deal with or dispose of that business but does not include any action which would not but for this definition constitute expropriation and which is equitable and is in the circumstances of the case and having regard to similar action taken in relation to other persons in the Territory reasonable and necessary for the peace order and good government of the Territory.

- (c) Nothing in this Clause shall derogate from any other provision of this Agreement limiting the action which may be taken or permitted to be taken against the Company.

18. ASSIGNMENT.

The Company shall have the right to—

- (i) assign mortgage charge sublet or dispose of the whole or any part of the rights of the Company under this Agreement including its rights to or as holder of any lease granted hereunder, to any wholly-owned subsidiary of the Company and, in the case of subletting of any land on which a dwelling is erected, to any person, as of right and save as aforesaid with the consent in writing of the Administration (which consent shall not be unreasonably withheld); and
- (ii) appoint a wholly-owned subsidiary of the Company or with the consent of the Administration (which consent shall not be unreasonably withheld) any other person to exercise all or any of the powers functions and authorities conferred on the Company under this Agreement.

subject in the case of any assignment under this Clause to the assignee undertaking to the Administration to observe and comply with all the obligations of the Company in relation to the matter

assigned. Upon the giving of any such undertaking the Company shall have no further obligation in relation to the matter assigned.

19. VARIATION OF LEASES.

The Administration and the Company may from time to time by mutual agreement in writing add to cancel or vary any of the provisions of any instrument evidencing any lease granted under this Agreement.

20. EXTENSIONS OF TIME.

- (a) Notwithstanding any provision of this Agreement the Administration may at the request of the Company from time to time extend any period referred to in this Agreement for such period or substitute for any date referred to in this Agreement such later date as it thinks fit.
- (b) If and whenever the Company is prevented or hindered by any circumstance or event of a kind set out in Clause 24 from undertaking (at a time at which the Company reasonably desires to do so) all or any of the activities referred to in Clause 5(b) (i) or Clause 6(a) then—
- (i) in the case of prevention or hindrance of all or any of the activities referred to in Clause 5(b) (i)—the period mentioned in Clause 5(a) shall be extended by a period equal to the period during which such prevention or hindrance continues; and
 - (ii) in the case of prevention or hindrance of all or any of the activities referred to in the said Clause 6(a)—the period of five years mentioned in the said Clause 6(a) shall be extended by a period equal to the period during which such prevention or hindrance continues.
- (c) If at any time or from time to time prior to the expiration of the relative period (and any extension thereof) the Company notifies the Administration that in the conditions then prevailing (whether in the Territory or elsewhere) it requires an extension, for the period specified in the notice, of the period of five years mentioned in Clause 6(a) in order to enable it to complete all marketing and financial arrangements necessary or requisite for the proper and profitable development of the deposits referred to in Recital (1) and submits to the Administration its detailed reasons for concluding that it will require such an extension, then unless within two months of such notification the Administration refers to arbitration as hereinafter provided in this Agreement the question of whether the Company reasonably requires such an extension or if on reference to arbitration the Administration is unable to substantiate that the Company does not reasonably require such an extension and (if the question arises) that the period specified in the said notice to the Administration is not the proper length of such extension, the said period shall be deemed to be extended accordingly. If on reference to arbitration the Administration is able to substantiate that the period specified in the said notice is not the proper length of such extension then the said period shall be deemed to be extended by the period determined upon the arbitration to be necessary or requisite.
- (d) Where any period is or is deemed to be extended or any later date substituted for an earlier date under this Clause, that period as so extended or that later date shall be deemed for all the purposes of this Agreement to be substituted for the relative period or date referred to in this Agreement (notwithstanding that at the time of such extension or substitution such period may have expired or such date may have been passed).

21. COMPANY'S RIGHTS OF FIRST REFUSAL

Notwithstanding anything hereinbefore contained in this Agreement, if the Company's rights under Clause 3 have previously terminated under paragraph (f) (i) or (f) (iii) thereof or if this Agreement has previously been determined under Clause 6 the Administration shall not within ten years thereafter grant or permit the grant or undertake to grant or permit the grant to any person other than the Company (whether by way of mining tenement or otherwise) of the right to mine copper or any ore of copper from (in the case of termination under paragraph (f) (i) or (f) (iii) of Clause 3) any part of the area the subject of the Prospecting Authorities at the time of termination or from (in the case of determination under Clause 6) any part of the area the subject of the special mining lease at the time of determination unless it has first made an offer to the Company to grant or procure the grant to the Company of such right upon and subject to the same terms and conditions (whether as to rent, royalty or any other matters whatsoever and whether or not to be contained in the instrument

evidencing such mining tenement or other right itself or in any other instrument or contract) as those upon and subject to which the Administration is bona fide prepared to grant or permit the grant of the said mining tenement or other right to such other person and the Company shall have failed for a period of twelve months after the date of receipt of such offer to accept the same PROVIDED THAT for the purpose of this Clause the Administration shall be deemed to have made an offer to the Company upon and subject to the same terms and conditions as those upon and subject to which it is bona fide prepared to grant or permit the grant of the said mining tenement or other right to another person as aforesaid if—

- (i) the only difference between the relative terms and conditions is that any period specified in the terms and conditions offered to the Company within which the Company may apply for such mining tenement or other right to be granted to it is shorter than any corresponding period specified in the terms and conditions upon which the Administration is bona fide prepared to grant or permit the grant of the said mining tenement or other right to any other person as aforesaid; and
- (ii) the difference between such periods is not more than is fair and reasonable having regard to the investigations assessments and inquiries already made prior to the execution of or under this Agreement and to whether such other person has or will have access to the results of the same.

22. SECRECY.

- (a) The Administration shall not without the prior consent of the Company divulge to any person (not being an officer of the Administration or of the Government of the Commonwealth of Australia engaged in his duties) any of the information provided to it by the Company pursuant to Clause 4(b) or 6(d) and shall use its best endeavours to prevent information being divulged in a manner contrary to the provisions of this paragraph by any persons who are or have at any time whether before or after the date hereof been officers of the Administration.
- (b) Nothing in this Clause shall prevent the disclosure of information relating solely to the nature and results of prospecting operations conducted by the Company in an area which is not at the time of disclosure the subject of the Prospecting Authorities or the special mining lease.

23. ARBITRATION.

- (a) If at any time there is any dispute question or difference of opinion between the parties hereto concerning or arising out of this Agreement or its construction meaning operation or effect or concerning the rights duties or liabilities of either of the parties hereto or there is any dispute question or difference of opinion which by the preceding provisions of this Agreement is to be or may be referred to arbitration, the same shall subject to paragraph (b) of this Clause stand referred to the arbitration of a single arbitrator and such reference shall be considered a submission within the meaning of that expression given by the *Arbitration Ordinance 1951* of the Territory.
- (b) After any such dispute question or difference of opinion has arisen either party hereto may at any time prior to the appointment of an arbitrator by concurrence of the parties or pursuant to the said Ordinance by notice to the other party elect that the provisions of this paragraph shall apply to such dispute question or difference of opinion and in such event—
 - (i) the dispute question or difference of opinion shall stand referred to the arbitration of three arbitrators one of whom shall be appointed by each of the parties hereto and the third of whom (who shall unless the parties hereto otherwise agree in writing be ordinarily resident outside the Territory and the Commonwealth of Australia) shall be agreed upon by the parties in writing and in default of agreement within fourteen days after one party gives notice to the other party requiring the appointment of such a third arbitrator shall be appointed by the President of the International Chamber of Commerce;
 - (ii) if any arbitrator refuses to act is incapable of acting or dies a new arbitrator shall be appointed by the party appointing the original arbitrator or (in the case of the third arbitrator) in accordance with the procedure provided for in sub-paragraph (i) of this paragraph;

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- (iii) if on such a reference one party fails to appoint an arbitrator either originally or by way of substitution as aforesaid within fourteen days after the other party (having appointed its arbitrator) has given to it notice to appoint such arbitrator the arbitration may proceed in the absence of such arbitrator;
 - (iv) such arbitration shall be held at such place (whether within or outside the Territory) as the arbitrators determine; and
 - (v) subject to the preceding provisions of this paragraph, the provisions of paragraph (a) of this Clause shall apply to such arbitration.
- (d) If either party to any arbitration under this Clause so requests the arbitrator or arbitrators shall state in the form of a special case for the opinion of the Supreme Court of the Territory any question of law arising in the course of the reference and any opinion given shall be subject to the normal right of appeal.

24. FORCE MAJEURE.

- (a) The Administration shall not be liable to the Company nor shall the Company be liable to the Administration for any delay or failure in the performance of obligations under this Agreement, if such delay or failure is beyond the reasonable control of the party so delaying or failing and is caused by or arises from Acts of God, force majeure, floods, storms, tempests, washaways, earthquakes or other seismic disturbances, fires, acts of war (whether declared or undeclared), revolutions, acts of public enemies, riots, civil commotions, strikes, lockouts, stoppages, restraints of labour or other similar acts (whether partial or general), shortages of labour or essential materials, failure to secure contractors, delays of contractors or any other cause or causes whatsoever PROVIDED THAT no delay or failure on the part of the Administration shall be deemed to be beyond the reasonable control of the Administration for the purposes of this Clause if it was caused by or arises from any act or omission of any governmental authority.
- (b) Any party hereto who is relieved by paragraph (a) of this Clause of the consequences of any delay or failure shall take all reasonable steps to minimize the effect of such delay or failure as soon as possible after the occurrence of the cause or causes thereof.

25. STAMP DUTY.

No stamp duty shall be payable on or in respect of—

- (i) the transfer to the Company of the Prospecting Authorities;
- (ii) any instrument evidencing the grant of any lease to the Company under this Agreement;
- (iii) any assignment, mortgage, charge, sublease, disposition or appointment made pursuant to Clause 18;
- (iv) any instrument evidencing or relating to or securing the repayment of any loan made or to be made to the Company; or
- (v) any instrument evidencing or relating to an issue of shares by the Company.

PROVIDED THAT nothing in this Clause shall apply to any transfer, instrument, assignment, mortgage, charge, sublease, disposition or appointment executed more than ten years after the Company has completed the performance of its obligations under Clause 6(a).

26. NOTICES.

All notices notifications consents approvals undertakings applications requests offers reports returns and proposals required to be or which may be given made furnished or submitted under this Agreement shall unless the context otherwise requires be in writing signed by the Administrator or (as the case may be) a Director or the Secretary of the Company and if in writing shall be sufficiently given party to whom it is to be given made furnished or submitted and all such communications if posted as aforesaid shall be deemed to have been received in the ordinary course of post. The address for service of the Administration shall be Konedobu in the Territory or such other address as the Administration from time to time by notice to the Company substitutes for such address and the address for service of the Company shall be Panguna on the Island of Bougainville or such other address as the Company from time to time by notice to the Administration substitutes for such address.

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27. GOVERNING LAW.

This Agreement shall be governed by the law of the Territory.

SCHEDULE.

TERRITORY OF PAPUA AND NEW GUINEA.

Mining Ordinance 1928-1966 of the Territory of New Guinea.

Special Mining Lease.

I, _____, Administrator of the Territory of Papua and New Guinea, by virtue of the powers conferred by the *Mining Ordinance 1928-1966 of the Territory of New Guinea* and the *Mining (Bougainville Copper Agreement) Ordinance 1967 of the Territory of Papua and New Guinea* and all other powers me enabling, hereby grant and demise to BOUGAINVILLE COPPER PTY. LIMITED (hereinafter called "the Company" which expression shall include its successors and assigns) ALL THAT piece of land being the whole of the land particularly described and delineated on the plan annexed hereto and signed by me for the purpose of identification and all those mines veins seams lodes and deposits of copper and such gold and other minerals as are combined in the land with such copper in such a way that they must necessarily be mined in the mining of such copper in on or under the said land together with the right and liberty to use the said land for the mining of such minerals and for all purposes necessary for the effectual carrying on of such mining or for the carrying out of any of the other operations of the Company under the Agreement made the _____ day of June, One thousand nine hundred and sixty-seven, between the Administration and the Company (hereinafter called "the Agreement") or the said *Mining (Bougainville Copper Agreement) Ordinance 1967* including without prejudice to the generality of the foregoing all of the purposes for which a mining purposes lease may be granted under the *Mining Ordinance 1928-1966 of the Territory of New Guinea* TO HOLD the said land and the said mines veins seams lodes and deposits for the term of forty-two years from the _____ day of _____, One thousand nine hundred and _____, with the right to renew the same for further periods each of twenty-one years as provided in the Agreement but upon and subject to the provisions of the Agreement and the *Mining (Bougainville Copper Agreement) Ordinance 1967* and subject thereto to the *Mining Ordinance 1928-1966 of the Territory of New Guinea* YIELDING and paying therefor the rent and royalty provided for in the Agreement PROVIDED THAT without the prior written consent of the Company this lease may not be determined or forfeited the Company may not be required to surrender this lease and the said land or any part thereof may not be resumed otherwise than in accordance with the Agreement.

Dated at _____ this _____ day of _____ One thousand nine hundred and _____

IN WITNESS whereof the parties hereto have executed this Agreement the day and year first above-written.

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SIGNED SEALED AND DELIVERED for and on behalf of the Administration of the Territory of Papua and New Guinea by DAVID OSBORNE HAY the Administrator of the Territory in the presence of:

(Sgd.) D. O. HAY.

(Sgd.) F. C. Henderson.

THE COMMON SEAL of BOUGAINVILLE COPPER PTY. LIMITED was hereto affixed by authority of a resolution of the Board of Directors:

L.S.

(Sgd.) F. Espie, Director.

(Sgd.) P. W. Quodling, Secretary.

SCHEDULE 2.

Sec 1.

THE 1974 AGREEMENT.

THIS AGREEMENT is made the twenty-first day of November One thousand nine hundred and seventy-four, between THE GOVERNMENT OF PAPUA NEW GUINEA (hereinafter called "the Government") of the one part and BOUGAINVILLE COPPER LIMITED a Company incorporated in Papua New Guinea and having its registered office at Panguna on Bougainville Island in Papua New Guinea (hereinafter called "the Company" which expression shall include its successors and assigns) of the other part.

WHEREAS:

(1) On the sixth day of June, One thousand nine hundred and sixty-seven The Administration of the Territory of Papua and New Guinea of the one part and Bougainville Copper Pty. Limited of the other part entered into a certain agreement (hereinafter called "the 1967 Agreement") relative, inter alia, to the terms and conditions upon which the said Bougainville Copper Pty. Limited should be permitted to mine ores from certain land on Bougainville Island, to concentrate such ores, to transport the concentrates so derived to wharf facilities and to ship such concentrates from such facilities in commercial quantities.

(2) On the ninth day of August, One thousand nine hundred and seventy-three the said Bougainville Copper Pty. Limited did convert to a public company and the name of the said Bougainville Copper Pty. Limited is now Bougainville Copper Limited.

(3) Section 9A of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that the Government is a body politic with perpetual succession by the name "The Government of Papua New Guinea" and is (subject to that Act) capable by that name of suing and being sued, making contracts, acquiring, holding and disposing of real and personal property, and doing and suffering all other matters and things a body corporate may do or suffer.

(4) Section 13 of the Papua New Guinea Act 1949-1973 of the Commonwealth of Australia provides that subject to that Act the Government shall be administered by the High Commissioner of Papua New Guinea.

(5) Section 37 of the Papua New Guinea Act (No. 2) 1973 of the Commonwealth of Australia provides that on the date of commencement of Section 5 thereof, all real and personal property of the Administration is, by force of that Section 37, transferred to, and vested in, the Government and there are also transferred to, and vested in, the Government.

(a) all rights and liabilities of the Administration subsisting immediately before that date; and

(b) all rights and liabilities of the Commonwealth of Australia subsisting immediately before that date by virtue of a contract or agreement entered into on behalf of the

d.) D. O. HAY.

L.S.

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Commonwealth of Australia in accordance with the Administration Contracts Ordinance 1950 or that Ordinance as amended or in accordance with a law repealed and replaced by that Ordinance.

(6) The Government and the Company have after a series of negotiations in the year One thousand nine hundred and seventy-four agreed that certain changes should be made to the 1967 Agreement and in particular to Clause 7 thereof.

(7) Such negotiations took account of the establishment by the Company on Bougainville Island pursuant to the provisions of the 1967 Agreement of a copper mine, copper concentrating facilities, roads and wharf facilities, and other facilities relative thereto at a total cost of over \$400 000 000, and further took account of the profits realised by the Company and of the expectation that its operations would continue to be profitable.

(8) Such negotiations also took account of the change in status of Papua New Guinea since the year One thousand nine hundred and sixty-seven to a stage of emerging nationhood and imminent independence and the need to modify certain provisions of the 1967 Agreement to accord with that change in status.

(9) Such negotiations also took account of the fact that the minerals mined and converted by the Company into saleable form are a non-renewable asset belonging to Papua New Guinea and that accordingly it is the responsibility of the Government to ensure that the taxes to be paid by the Company provide at all times for Papua New Guinea an equitable return on the minerals which the Company is extracting.

(10) The Government recognizes the role of the Company as the major pioneer investor in Papua New Guinea and recognizes further that any variations to the 1967 Agreement should be framed bearing that fact in mind.

(11) The Government and the Company while acknowledging that legislative sovereignty in Papua New Guinea is vested in Parliament wish the 1967 Agreement, as varied hereby, to be an enduring arrangement and do not intend that it should be altered by any unilateral action but only with the mutual consent of the Government and the Company.

NOW THIS AGREEMENT WITNESSES AS FOLLOWS:

1. Clause 1 of the 1967 Agreement is varied

(a) by the addition of the following definition after the definitions of "Administration land", "mineral", "mining tenement", "private land", "prospecting authority" and "secondary prospecting authority":

"Amendment Date" means the date upon which the Agreement made the twenty-first day of November, One thousand nine hundred and seventy-four between the Government of the one part and the Company of the other part comes into effect; and

(b) by the addition of the following definition after the definition of "f.o.b. revenue":

"the Government" means The Government of Papua New Guinea;

2. Clause 1 of the 1967 Agreement is further varied by the addition of the following paragraph after paragraph (d) thereof:

"(e) In this Agreement, unless the context otherwise requires a reference to the Administration shall be read as a reference to the Government and a reference to the Territory shall be read as a reference to Papua New Guinea."

3. Clause 5(h) of the 1967 Agreement is varied by the addition of the following after the word "land" at the end thereof:

"PROVIDED THAT the parties hereto shall, at the meeting which takes place pursuant to Clause 26A hereof during the twenty-first year after the year in which the Amendment Date occurs consider whether it would be appropriate to adopt arrangements other than those set out in the provisions of this paragraph"

4. Clause 5 of the 1967 Agreement is varied by the addition of the following paragraphs after paragraph (m) thereof:

"(n) Notwithstanding anything contained in the foregoing paragraphs of this Clause or otherwise but subject always to paragraph (o) hereof the Government may to the extent that such lease or leases or special mining lease or special mining leases would be over or in respect of all or part of the Mainoki and Karato areas delay procuring the grant to the

ousand nine hundred and (hereinafter called "the ny incorporated in Papua nd in Papua New Guinea sors and assigns) of the
The Administration of per Pty. Limited of the eement") relative, inter Pty. Limited should be such ores, to transport from such facilities in
venty-three the said e name of the said
nwealth of Australia by the name The name of mining and onal property, and
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wealth of Australia al property of the rument and here
one that date an immediately here y behalf of

Company of the lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) specified in any application by the Company pursuant to paragraph (a) or (c) of this Clause until such time as the Government in its absolute discretion decides that development of the Mainoki and Karato areas may proceed.

- (a) Until such time as the Government shall have notified the Company in writing that in the exercise of its discretion aforesaid it has decided that development of the Mainoki and Karato areas may proceed
- (i) any application by the Company pursuant to paragraph (a) or (c) of this Clause for a lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) the grant of which to the Company the Government is permitted pursuant to paragraph (n) of this Clause to delay procuring will to the extent that such lease or leases or special mining lease or special mining leases would be over or in respect of all or part of the Mainoki and Karato areas stand deferred PROVIDED THAT notwithstanding anything contained in this Clause or in any law any application which so stands deferred shall continue in full force and effect; and
- (ii) the Company shall not without the prior consent of the Government engage in any further prospecting or exploration activities on areas (other than any area which falls within the area or areas of land over which the special mining lease extends) the subject of the Prospecting Authorities PROVIDED THAT this sub-paragraph is without prejudice to the continued validity of the Prospecting Authorities and does not derogate from the obligations of the Government to cause to be granted to the Company successive extensions of the terms thereof.
- (p) If, at any time before the Government has pursuant to paragraph (a) notified the Company that it has decided that development of the Mainoki and Karato areas may proceed, the Government so requests the parties shall meet together with a view to considering in good faith the manner in which such development should proceed, if it were to do so, and with a view further to discussing inter alia:
- (i) whether or not any other company or other enterprise should conduct such development and, if so, the extent to which each of the Government and the Company should beneficially be interested in such other company or other enterprise and the manner in which and the consideration for which their respective interests (if any) should be taken up (it being contemplated by the parties that the Government shall have the right to take up a majority beneficial interest should it so desire); and
- (ii) whether or not the relevant lease or leases (including, but without in any way whatsoever limiting the generality of the foregoing, any special mining lease or special mining leases) should, notwithstanding anything contained in this Clause or in any law, be granted direct to any such other company or other enterprise as is referred to in sub-paragraph (i) hereof and; if so, the terms upon which it or they should be so granted.
- (q) For the purposes of this Clause, the Mainoki and Karato areas are those areas on Bougainville Island within Prospecting Authority 7B held by the Company and being more particularly described in the plan and description accompanying that plan initialled on behalf of the parties for identification prior to the execution hereof."

5. The 1967 Agreement is varied by the deletion therefrom of Clause 7 thereof and by the substitution therefor of the following:

- "7. (a) Except where the contrary intention appears, either expressly or by implication, the provisions of the Income Tax Act which are not inconsistent with the provisions of this Agreement are applicable to the Company.
- (b) The income of the Company for the period from the 1st day of April, 1972, the date on which the Company first entered into commercial production of copper concentrates under this Agreement, to the 31st day of December, 1973 is and shall continue to be exempt from income tax; save as hereafter provided no amounts which would but for such exemption have been deducted in the determination of the amount of taxable income derived during the aforesaid period shall be deducted in the determination of the

amount on which is calculated the income tax payable by the Company in respect of any period following that period.

- (c) If the rate of tax in respect of the taxable income of the Company for the Tax year commencing on the 1st day of January, 1975, and for any subsequent Tax year, determined in accordance with the provisions of Part I of the Second Schedule hereto, is higher than the rate of tax which would otherwise be applicable in respect of the taxable income of the Company for that Tax year the Company will be liable to pay income tax on its taxable income for that Tax year calculated at the rate determined in accordance with such provisions.
- (d) For the purpose of determining the amount of income tax payable by the Company in respect of the Tax year commencing on the 1st day of January, 1974 the Chief Collector shall assess tax on the basis that the first six months of that Tax year and the second six months of that Tax year comprised separate and distinct periods of taxable income and in determining the taxable income of the Company for each of those periods one half of the total amount which would otherwise have been allowable as deductions from the assessable income derived by the Company during the whole of that Tax year shall be allowable as a deduction from the assessable income deprived by the Company during each of those periods.
- (e) The tax payable by the Company in respect of the Tax year commencing on the 1st day of January 1974 shall be the total of the amount of tax payable in respect of the taxable income of the Company for the first six months of that Tax year determined in accordance with the provisions of Part II of the Second Schedule hereto and the amount of tax payable in respect of the taxable income of the Company for the second six months of that Tax year determined in accordance with the provisions of Part III of the Second Schedule hereto.
- (f) In respect of the Tax year commencing on the first day of January, 1974 and in respect of each subsequent Tax year the company shall be entitled to deductions from its assessable income in respect of expenditure of a capital nature as follows:—
 - (i) Where that expenditure relates to a unit of property in respect of which depreciation is an allowable deduction under the provisions of Subdivision A of Division 3 of Part III of the Income Tax Act or otherwise under that Act howsoever than under the provisions of Division 10 of Part III the amount of allowable deduction in respect of any such unit of property in relation to each Tax year (the first of which shall be the Tax year during which that unit of property was first used by the Company or installed ready for use) shall be the greater of one-twentieth of the cost of that unit or such proportion of that cost as may be allowable as a deduction from assessable income under the Income Tax Act PROVIDED THAT the amount of deduction allowable in respect of the Tax year in which such unit of property was first used or installed ready for use shall be such proportion of the amount which would have been allowable as a deduction if such unit of property had been first used or installed ready for use on the first day of that Tax year as bears to such lastmentioned amount the same proportion which the unexpired period of the Tax year at the time such unit was first used or installed ready for use bears to the whole period of that Tax year.
 - (ii) Where any unit of property of the kind referred to in sub-paragraph (i) above is by reason of the provisions set out in sub-paragraph (C) below deemed to have been first used on the first day of January, 1974 but was disposed of lost or destroyed prior to that date the cost of that unit of property on the first day of January, 1974 shall be deemed to be the actual cost thereof less any consideration received or receivable by the Company in respect of such disposal loss or destruction.
 - (iii) Where that expenditure does not relate to a unit of property in respect of which depreciation is an allowable deduction as mentioned in sub-paragraph (i) above the amount of allowable deduction in respect of such expenditure in relation to each Tax year shall be the greater of one-twentieth of that amount or such amount as may be allowable as a deduction for tax under the Income Tax Act including the provisions of Division 10 of Part III thereof.
 - (iv) Where any expenditure of a capital nature of the kind referred to in sub-paragraph (iii) above is by reason of the provisions set out in sub-paragraph (B) below

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- deemed to have been incurred on the 1st day of January, 1974 but the property in respect of which such expenditure was incurred has been disposed of lost or destroyed prior to that date the cost of that property on the 1st day of January, 1974 shall be deemed to be the actual cost thereof less any consideration received or receivable by the Company in respect of such disposal loss or destruction.
- (v) The total of any deductions allowable pursuant to sub-paragraph (i) above in respect of any unit of property shall not exceed the cost of that unit of property and the total of any deductions allowable pursuant to sub-paragraph (iii) above in respect of any item of capital expenditure shall not exceed the cost of that item of capital expenditure.
- (vi) For the avoidance of doubt it is declared that the provisions of the Income Tax Act relating to the disposal, loss or destruction of any unit of property or of property in respect of which expenditure of a capital nature was incurred (which provisions are at the Amendment Date contained in Sections 78 and 160 of the Income Tax Act) shall apply to the Company.

For the purposes of this paragraph

(A) expenditure of a capital nature means

- (1) all expenditure incurred by the Company prior to the 1st day of January, 1974 for the purposes of its activities in Papua New Guinea and being expenditure of the kind in respect of which a deduction was allowable under Division 10 of Part III of the Income Tax Act as it existed on the 31st day of December, 1973, expenditure on plant, machinery, equipment, buildings (including houses), roads, earthworks, development of the Company's mining property, and any improvements on any leasehold property, exploration and prospecting expenditure, and all expenditure on units of property in respect of which depreciation was an allowable deduction under Division 3 of Part III of the Income Tax Act as it existed on the 31st day of December, 1973; and
 - (2) all expenditure of a capital nature incurred by the Company after the 31st day of December, 1973 for the purposes of its activities in Papua New Guinea and being expenditure in respect of which a deduction is allowable from gross income for the ascertainment of taxable income for income tax purposes under the Income Tax Act.
- (B) all expenditure of a capital nature incurred by the Company prior to the 1st day of January, 1974 shall be deemed to have been incurred on the 1st day of January, 1974;
- (C) any unit of property which was first used by the Company or installed ready for use before the 1st day of January, 1974 shall be deemed to have been first used by the Company on the 1st day of January, 1974; and
- (D) all interest capitalised by the Company in respect of any period prior to the 1st day of April, 1972 shall be deemed to be expenditure of a capital nature.
- (g) As from the 1st day of January, 1974 the provisions of the now repealed Section 33 of the Income Tax Act 1959 (as then amended) referred to in Clause 7(e) of this Agreement prior to its variation by the Variation Agreement dated 21st November, 1974 shall not so long as that Section remains repealed apply to the Company.
- (h) (i) All expenditure incurred by the Company prior to the 1st day of January, 1974 in borrowing money used by the Company for the purpose of producing income shall for the purposes of Section 89 of the Income Tax Act be deemed to have been incurred on the 1st day of January, 1974 and the period for which the money was borrowed shall be deemed to be a period of five years commencing on the 1st day of January, 1974 and ending on the 31st day of December, 1978.
- (ii) Notwithstanding anything contained in Sections 68 or 89 of the Income Tax Act or in this Agreement the Company shall not be entitled to any deduction for any interest paid by it before the 1st day of January, 1974 other than interest referred to in paragraph (f) (D) above.

- (i) The Government recognises that abnormal conditions of inflation would cause the formula set out in Part 1 of the Second Schedule hereto to bear more severely on the Company in future years than is intended. In the event therefore of the occurrence of abnormal conditions of inflation in any Tax year commencing after 31st December, 1974 the Company may claim an increase in the amount of "N" in that formula. Upon receipt of any such claim the Minister for the time being responsible for finance and the Company will forthwith confer with a view to deciding by mutual agreement having regard to all the circumstances whether and if so to what extent "N" in that formula should be increased, such increase to be effected by a variation of this Agreement pursuant to Section 5 of the Act referred to in Clause 2 hereof, PROVIDED ALWAYS THAT if no agreement is reached to vary this Agreement as aforesaid the Company shall not be entitled to refer the matter to arbitration under Clause 23 of this Agreement. The Company shall not as a result of all or any of the provisions of this paragraph have any enforceable claim right of action or other remedy whatsoever (whether in respect of any obligation to confer as above or otherwise).

For the purpose of this paragraph abnormal conditions of inflation shall be deemed to occur in any Tax year if in that Tax year the annual rate of inflation as measured by the average annual increase in the consumer price index of the United States of America (as published on the Amendment Date in the International Monetary Fund's International Financial Statistics) in that year exceeds by 20 per cent or more the average rate of increase in that index in the five years ending at the end of that Tax year.

- (j) If at the end of any Tax year or years the U.S. dollar value of the International Monetary Fund Special Drawing Rights has varied by more than 10% from such value on the 15th day of November, 1974 then if the Government and the Company agree that the factor $\frac{F}{B}$ as used in the ascertainment of "N" as provided in the Second Schedule hereto is producing unintended or abnormal results, the Government and the Company will as soon as conveniently possible after the end of the relevant Tax year confer with a view to making appropriate adjustments to that factor.

- (k) (i) In this paragraph, unless the context otherwise requires, "dividend (withholding) tax" means

- (A) "dividend (withholding) tax" as defined by the Income Tax Act as in force on the 1st day of January, 1974 as that definition may from time to time be amended and
 (B) any tax of a similar nature payable in respect of dividends or other distributions of profits to shareholders; and

"gross dividend" means

the dividend which would have been payable by the Company but for the deduction therefrom of dividend (withholding) tax.

- (ii) Subject to sub-paragraph (iii) hereof, the amount of income tax payable by the Company in respect of any Tax year shall be determined by reducing the amount of income tax which would, but for this paragraph, have been payable by the Company in respect of that Tax year by an amount (herein called "the deduction amount") equal to the aggregate of the following two amounts, or, where only one such amount is payable or deductible by the Company in respect of any particular Tax year by that amount:

- (A) an amount equal to the excess (if any) of

- (1) the amount equal to the aggregate of the dividend (withholding) tax payable in respect of gross dividends payable by the Company to non-residents of Papua New Guinea in the relevant Tax year;

over

- (2) the amount equal to 15% of the gross dividends payable by the Company to non-residents of Papua New Guinea in the relevant Tax year;

and

- (B) the amount payable by the Company in the relevant Tax year in respect of any rate, tax, rent, charge, due, duty, tariff or other levy whatsoever (including but without in any way whatsoever limiting the generality of the foregoing excises, royalties, and the like impositions) raised, levied, charged or otherwise imposed by

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or payable to the Government or any other government established by or under any law in force in Papua New Guinea (whether supreme provincial district municipal local or otherwise) or any authority department or official whatsoever or under the Government or any other government as aforesaid other than:

- (1) income tax,
- (2) import duties as permitted under Clause 9 (c) of this Agreement,
- (3) stamp duties as permitted under this Agreement,
- (4) royalties payable pursuant to and in accordance with Clauses 5 (h) and 5 (i) hereof,
- (5) rent payable in accordance with Clause 5 hereof,
- (6) light dues and pilorage referred to in Clause 11 (e) hereof,
- (7) local government rates or taxes on land used for housing where such rates or taxes are calculated in relation to the unimproved value of the land,
- (8) vehicle registration taxes as permitted under this Agreement,
- (9) any rent payable under any lease granted by the Government (other than as referred to in (5) above) where such rent
 - (a) is payable pursuant to the provisions of any such lease; or
 - (b) is in whole or in part payable in respect of any such lease under the provisions of a law of general application which does not discriminate or (having regard to reasonable standards) result in discrimination against the Company,
- (10) charges for services rendered,
- (11) payments made pursuant to Clause 16B hereof,
- (12) export duties as permitted under Clause 9(d) hereof,
- (13) other taxes or charges of a minor nature.

PROVIDED THAT there shall be deducted from the deduction amount the amount (if any) by which the tax payable by the Company is reduced as the result of the deduction from its assessable income of all or any part of the amount referred to in sub-sub-paragraph (B) of sub-paragraph (ii) of this paragraph.

- (iii) If the provisions of sub-paragraph (ii) hereof would have the effect of reducing the tax payable by the Company in respect of any Tax year below the amount which but for the provisions of paragraphs (d), (d) and (e) of this Clause would be payable by the Company in respect of that Tax year, the tax payable by the Company in respect of that Tax year shall be the amount calculated in accordance with the provisions of this Clause 7, but not including the provisions of paragraphs (d), (d) and (e) of this Clause.
- (iv) The Government will not impose dividend (withholding) tax on dividends payable by the Company otherwise than at a single flat rate and shall not impose such tax at a rate higher than the rate payable in respect of dividends payable by other companies to non residents of Papua New Guinea and if there is more than one such rate, the Government will impose on such dividends the lowest of such rates.
- (h) No rate, tax, rent, charge, due, duty, tariff or other levy and no legislation, procedure or practice relating thereto which discriminates against or (having regard to reasonable standards) results in discrimination against the Company any member of the Company or any beneficial owner of any share in the Company shall be payable by or (as the case may be) applicable to the Company or any such member or beneficial owner (as the case may be) in respect of the operations of the Company under this Agreement or of any income arising directly or indirectly therefrom.
- (m) No local government rates or taxes on land calculated otherwise than in relation to the unimproved value of the land shall be payable by the Company in respect of land held by the Company pursuant to the provisions of Clause 5 hereof.
- (n) (i) The Chief Collector shall on the application of the Company grant, upon the terms and conditions hereinafter appearing, an extension of time for the payment of part of the income tax payable in respect of all or any of the Tax years ending 31st December, 1975, 31st December, 1976 and 31st December, 1977.

- (ii) Any application for an extension of time pursuant to the provisions of this paragraph shall be in writing, shall expressly state that it is made pursuant to the provisions of this paragraph and shall be lodged with the Chief Collector not later than the later of fourteen (14) days before the due date for payment of the income tax payable in respect of the relevant year and thirty (30) days after the service upon the Company of the Notice of Assessment in respect of that Tax year.
- (iii) The amount of tax in respect of which the Company shall, at its election and upon application made in the manner hereinbefore provided, be entitled to be granted an extension of the time pursuant to this paragraph in respect of each of the said Tax years shall be the whole or such part of the amount determined in accordance with Part IV of the Second Schedule hereto as the Company shall notify to the Chief Collector at the time of making application pursuant to sub-paragraph (ii) hereof.
- (iv) Any tax for the payment of which an extension of time is granted pursuant to this paragraph shall, in lieu of any penalty for unpaid tax or additional tax and subject to the provisions of sub-paragraph (vi) hereof, bear interest calculated from the original due date for payment thereof until payment at the rate (compounded annually) which is five percentage points higher than the rate of interest per annum on four year Papua New Guinea Government Bonds which have most recently been issued (and even if by then matured) at the time the Company makes its application pursuant to sub-paragraph (ii) hereof in respect of the relevant Tax year.
- (v) Any amount of tax in respect of which an extension of time is granted pursuant to this paragraph and the interest payable thereon shall be paid to the Chief Collector in three (3) equal instalments on 30th September, 1980, 30th September, 1981 and 30th September, 1982 respectively. For the purpose of calculating the interest payable on the 30th September, 1980, the 30th September, 1981 and the 30th September, 1982 it shall be assumed that the amount of tax in respect of which the relevant extension of time was granted and which shall remain outstanding after the date in respect of which such calculation is being made shall be duly paid on the extended date or dates for payment thereof, to the effect that the amounts of the payments to be made on the abovementioned three (3) dates shall be equal and shall each include one-third of the total amount of interest, calculated at the rate first mentioned in sub-paragraph (iv) hereof, which will if all payments are duly made on the extended dates be payable in respect of the relevant overall extension of time for payment.
- (vi) In the event that default is made in the due payment on the extended dates of any amount of tax in respect of which an extension of time has been granted pursuant to this paragraph or of any interest payable in respect thereof the total of all outstanding income tax in respect of which any such extension of time has been granted together with the total amount of interest calculated at the appropriate rate (or rates) in sub-paragraph (iv) payable in respect of any income tax in respect of which any such extension of time has been granted, subject to an allowance in respect of any interest already paid, shall immediately become due and payable. In the event of such default, interest shall be payable to the Chief Collector at the rate at which interest would have been payable pursuant to sub-paragraph (iv) hereof (or if more than one such rate is applicable in respect of different parts of the outstanding income tax at the highest of such rates) upon the outstanding income tax and the total of interest owing at the date of such default or so much thereof as shall be from time to time outstanding provided that any payment or payments made after the date of such default shall be credited first to interest accruing and becoming payable after such default and then to interest accrued up until such default and then to the reduction of the outstanding income tax.
- (vii) For the avoidance of doubt:
 - (A) the Company shall be entitled, pursuant to this paragraph, to apply for an extension of time in respect of the relevant amount referred to in sub-paragraph (iii) hereof in respect of any one or more of the Tax years ending 31st December, 1975, 31st December, 1976 and 31st December, 1977;
 - (B) the Company shall be entitled to apply, pursuant to this paragraph, for an extension of time for the whole or any part of the amount calculated in accordance with paragraph (iii) hereof in respect of each or any of the said Tax years;

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(C) in the event that default is made in payment of outstanding tax in respect of any of the said three Tax years (or in payment of interest payable in respect of an extension of time granted in respect of any such Tax year), the whole of the outstanding tax in relation to any other Tax year or years in respect of which an extension of time has been granted pursuant to this paragraph (and all interest in relation thereto) shall also immediately become due and payable in accordance with sub-paragraph (vi) hereof;

(D) the time within which such an application for an extension of time must be lodged in accordance with sub-paragraph (ii) hereof shall be calculated by reference to the due date for payment of income tax pursuant to the original assessment issued in respect of the relevant tax year to the effect that such time shall not be extended by the subsequent issue of any amended assessment provided that if the Company objects to such original assessment and the total amount of tax payable pursuant to such original assessment is subsequently reduced an appropriate adjustment shall be made in respect of the amount of tax for which an extension of time has been granted and interest payable in respect thereof.

(viii) The amount of any interest payable by the Company pursuant to the provisions of this paragraph shall for the purposes of the Income Tax Act be deemed to be interest payable by the Company on money borrowed by the Company and an outgoing of the Company incurred in gaining assessable income.

(o) Neither the Company nor any other person shall have any liability to any income tax on the payment or repayment of or measured by reference to the amount of any interest payable or any other amount payable in respect of any amount which is lent to the Company by any person who is not a resident of Papua New Guinea or on or in respect of the principal of any such loan if the amount in respect of which such interest or other amount is payable was lent to the Company before the 1st day of January, 1974.

(p) The Company has, with the leave of the Chief Collector, adopted the period of a calendar year as its accounting period pursuant to Section 12 of the Income Tax Act.

(q) In this Clause, unless the context otherwise requires—

"the Income Tax Act" means the Income Tax Act 1959 as amended from time to time

"Tax Year" means the calendar year in respect of which the amount of tax payable by the Company is to be calculated

and other expressions shall have the same meanings given to them in the Income Tax Act.

(r) The provisions of Clause 23 hereof shall not apply in respect of any dispute, question or difference of opinion relating to the liability or the quantum of liability of the Company to income tax or in respect of any other matter arising under any paragraph of this Clause."

6. The 1967 Agreement is varied by the addition of the following Clauses after Clause 8 thereof:

"8A. BORROWINGS BY THE COMPANY WITHIN PAPUA NEW GUINEA

No loan other than normal bank overdraft shall be raised by the Company within Papua New Guinea without prior notice to the Minister for the time being responsible for finance.

8B. DONATIONS

The Company shall not (without the prior approval of the Directors of the Company nominated by the Government) make any donation in excess of an amount to be agreed upon from time to time between the parties."

Clause 9(c) of the 1967 Agreement is varied by the addition of the following after the word "fees" at the end thereof:

"AND PROVIDED FURTHER THAT notwithstanding anything contained in this paragraph the Government may impose import duties on the Company under the Customs Act (but only if such import duties are of general application in Papua New Guinea and, as required by Clause 7(1) hereof, do not discriminate against or (having regard to reasonable standards) result in discrimination against the Company) in respect of the importation into Papua New Guinea on and after the Amendment Date by the Company of any plant machinery or equipment required for the replacement of any of the plant machinery or equipment referred to in sub-paragraph (i) of this paragraph or of such of the explosives and reagents referred to in paragraph (b) of this

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Clause as could on the sixth day of June, One thousand nine hundred and sixty-seven have been imported into the Territory of Papua and New Guinea free of import duty under the Customs Ordinance 1951-1959 of that Territory".

8. Clause 9 of the 1967 Agreement is varied by the addition of the following paragraph after paragraph (d) thereof:

"(d) Any import duty which is sought to be imposed on the importation of any plant machinery equipment explosives or reagents which at the time when such duty is sought to be imposed are imported into Papua New Guinea solely for the purpose of mining operations or of operations in connection therewith and which is sought to be imposed at a rate in excess of the average rate of duty from time to time payable on the importation into Papua New Guinea of the Customs Tariff items numbered 118, 275, 284, 309, 313, 320 and 341.04 as set out on the Amendment Date in the Second Schedule to the Customs Tariff 1959-1974 shall, without in any way whatsoever limiting the interpretation of Clause 7(h) hereof or clause 9(d) hereof, be deemed to discriminate against the Company within the meaning of both Clause 7(h) and Clause 9(d) hereof."

9. The 1967 Agreement is varied by the addition of the following Clause after Clause 9 thereof:

9A. APPROVAL OF CONTRACTS, ETC.

- (a) Notwithstanding anything contained in any other provision of this Agreement where any law which is of general application in Papua New Guinea and which does not discriminate against or (having regard to reasonable standards) result in discrimination against the Company includes provisions for regulation of foreign investment in Papua New Guinea or for regulation of dealings in foreign exchange in Papua New Guinea or for control over exports from or imports into Papua New Guinea the Company shall be subject to those provisions on and after the Amendment Date PROVIDED THAT no breach of the provisions of any such law shall be constituted by any act or omission or commission or any event occurring or any circumstances otherwise existing before the Amendment Date.
- (b) If and to the extent that any law which includes provisions for regulation of foreign investment in Papua New Guinea or for regulation of dealings in foreign exchange in Papua New Guinea or for control over exports from or imports into Papua New Guinea applies to or in relation to any agreement or arrangement (including but without limiting the generality of the foregoing any agreement or arrangement for the sale or export of concentrates produced by the Company or for the borrowing of money by the Company or for payments by the Company in foreign exchange) entered into or made by the Company before the Amendment Date or to any business or activity carried on by the Company at or prior to the Amendment Date then any approval authorisation licence permission registration or other thing whatsoever required under any such law in respect of or in relation to any such agreement arrangement business or activity (including without limiting the generality of the foregoing investment by the Company necessary to maintain the Company's present activity of producing copper (contained in concentrates) at the rate of approximately 190 000 tonnes per annum) shall be deemed to have been duly and unconditionally given granted made or done (as the case may be) and shall not be capable of cancellation revocation variation or other modification or of otherwise being limited or affected in any way whatsoever except with the prior written consent of the Company or at the written request of the Company.
- (c) Without limiting the provisions of paragraph (b) hereof where under the provisions of any law an agreement or arrangement for the sale or export of any of the Company's products has been approved by the appropriate authority or a licence issued for the export of such products the approval so granted or the licence so issued shall not thereafter be revoked cancelled or in any way varied.
- (d) Notwithstanding anything expressly or impliedly to the contrary contained in the National Investment and Development Act and in particular notwithstanding the provisions of Section 4 of that Act the Company, in respect of the existing activities—
- (i) is hereby deemed to have complied with the said National Investment and Development Act in all respects and accordingly shall not be required to give any notice or information thereunder;
 - (ii) is hereby deemed to be registered in respect of each such activity;

- (iii) shall not be precluded from carrying on or (as the case may be) continuing to carry on business in respect of any such activity; and
 - (iv) shall be entitled, subject to the remaining provisions of this Agreement and to any other law not inconsistent with this Agreement which applies to the Company to carry on its business in respect of such activities to the full extent and without any impediment or hindrance whatsoever.
- (e) Notwithstanding anything expressly or impliedly to the contrary contained in the National Investment and Development Act and in particular notwithstanding the provisions of Section 4 of that Act such deemed registration as is referred to in paragraph (d) hereof in respect of existing activities as are hereinbefore referred to shall not be cancelled (in whole or in part) and shall not except at the request of the Company in accordance with the said National Investment and Development Act be varied (in whole or in part).
- (f) In this Clause unless the context otherwise requires words and expressions which are used in the National Investment and Development Act shall have the meanings which are assigned to them in that Act and any reference to that Act shall include a reference to that Act as it may from time to time be altered amended or re-enacted and "existing activities" means:
- (i) activities which the Company was carrying on at the Amendment Date; and
 - (ii) activities carried on thereafter in order to maintain the Company's production of copper (contained in concentrates) at the rate of approximately 190 000 tonnes per annum (including, but without in any way whatsoever limiting the generality of the foregoing, any expansion or other increase necessary for such purpose in the whole or any part of the mining and concentrating activities of the Company, including the addition of more ball mills and the increase in the facilities of the Company for the generation of power and the shipment of concentrates)."

10. The 1967 Agreement is varied by the addition of the following Clause after Clause 10 thereof:

"10A. CONDUCT OF THE COMPANY'S BUSINESS ADVISORY SERVICES

- (a) The Company shall conduct its business advisory services under the general policy direction of a steering committee to be established by the Bougainville Provincial Government and the Company shall, if such general policy direction requires, make its said business advisory services available on as widespread a basis as is reasonably possible to all areas of the Bougainville District.
- (b) Notwithstanding anything in paragraph (a) hereof the Company shall not be required to spend more on its said business advisory services in any year than the amount so spent by it in the year ending the thirty-first day of December, One thousand nine hundred and seventy-four."

11. Clause 14(d) of the 1967 Agreement is varied by the deletion therefrom of sub-paragraph (i) and by the substitution therefor of a new sub-paragraph (i) as follows:

"no provision of the said Motor Traffic Ordinance or the said Regulations thereunder relating to the payment of fees on or in connection with the registration of motor vehicles shall apply to motor vehicles owned by the Company, any related company, or by any agent or contractor of the Company or any related company if the same are used solely on Company roads and are by reason of the manner in which they have been constructed or adapted unsuitable for use on Company roads otherwise than for or in relation to all or any of the Company's operations of mining and concentrating ore and moving concentrates to wharf facilities and into ships and the Company's road construction and road maintenance operations; and"

12. The 1967 Agreement is varied by the deletion therefrom of Clause 16 thereof and by the substitution therefor of the following:

"16. FURTHER PROCESSING

- (a) The Company shall commission a pilot study to consider the potential economic feasibility of the establishment in Papua New Guinea of facilities for the processing to the metallic or some further stage of concentrates produced as a result of the Company's operations under this Agreement and the Company shall provide the Government with the data and conclusions resulting from that pilot study.

- (b) The pilot study referred to in paragraph (a) hereof shall be completed within one year after the Amendment Date and shall consider, inter alia, all relevant social and environmental factors.
- (c) If the pilot study referred to in paragraph (a) hereof indicates that such further processing could be feasible the Company and the Government shall confer together with a view to deciding whether a full feasibility study should be undertaken and, if so, the extent to which each of them shall contribute to the cost thereof.
- (d) Thereafter the Company may at any time and from time to time submit to the Government a proposal for the establishment by it in the area in Papua New Guinea specified in the proposal of facilities for processing to the metallic or some further stage of any concentrates produced as a result of the Company's operations under this Agreement and the Government shall within two months of such submission have the right to be exercised by notice to the Company in writing to reject any such proposal on the ground that it would have a substantially detrimental effect on the agriculture and general amenity of the surrounding area.
- (e) If the Government does not pursuant to paragraph (d) of this Clause so reject any such proposal submitted by the Company, but not otherwise, the Company shall be at liberty at any time thereafter to establish facilities in accordance with that proposal and carry out processing at such facilities and the Company may at any time and from time to time thereafter apply to the Government for the leases specified in the application to be granted to it over or in respect of the relative areas specified in the application which leases shall be those reasonably needed by the Company therefor including (without prejudice to the generality of the foregoing) those needed for adequate buffer zones covering areas likely to be affected by fume disposal, and the provisions of paragraphs (d) (e) (f) (j) (k) and (h) of Clause 5 shall apply mutatis mutandis to such application and the leases granted pursuant thereto.
- (f) A decision by the Government pursuant to paragraph (d) of this Clause to reject a proposal submitted by the Company pursuant to that paragraph shall be final and conclusive and shall not be referable to arbitration under Clause 23 of this Agreement, or be otherwise justiciable."

13. The 1967 Agreement is varied by the addition of the following Clauses after Clause 16 thereof:

"16A. ENVIRONMENTAL IMPACT STUDY

For the purpose of enabling the Government to conduct a study of the impact on the environment of the mining and related operations of the Company under this Agreement the Company shall:—

- (a) (to the extent to which the operations of the Company are not interfered with) allow the Government and its agents access to the mine site and all other areas in Papua New Guinea under the control of the Company; and
- (b) upon request, make available to the Government and its agents any factual information in the possession of the Company relating to the impact on the environment of the said mining and related operations, and in respect of such information permit the Government or its agents to inspect and take copies of any relevant documents.

16B. BOUGAINVILLE NON-RENEWABLE RESOURCES FUND

The Company shall pay to the Government fifty cents per tonne of contained copper shipped on and after the Amendment Date and such payments shall be credited by the Government to the Bougainville Non-Renewable Resources Fund."

14. Clause 17(a) of the 1967 Agreement is varied by the deletion of the full stop at the end of sub-paragraph (ii) thereof and by the addition of the following words and full stop to clause 17(a) such words and full stop to be inserted immediately following the said sub-paragraph (ii) but in such a fashion that the said words do not qualify the said sub-paragraph (ii) alone but qualify instead the paragraph as a whole:

"PROVIDED THAT this paragraph shall be read and construed subject to the laws of Papua New Guinea of general application whether enacted before on or after the Amendment Date which do not discriminate against or (having regard to reasonable standards) result in discrimination against the Company its members or the beneficial owners of its shares, and nothing contained in any such law

shall give rise to any claim by the Company, its members or the beneficial owners of its shares by reason only of the provisions of this paragraph."

15. Clause 23 of the 1967 Agreement is varied by

- (a) the addition before the commencement of paragraph (a) of the words "Subject to the provisions of Clause 7 and Clause 16 hereof" and by changing to the lower case the letter "I" in the word "If" immediately following; and
- (b) the deletion from paragraph (b) of sub-paragraph (i) thereof and the substitution therefor of the following:

"(i) the dispute question or difference of opinion shall stand referred to the arbitration of three arbitrators one of whom shall be appointed by the Government and one of whom shall be appointed by the Company and the third of whom shall be agreed upon by the Government and the Company in writing and in default of agreement within fourteen days after the Government or the Company (as the case may be) gives notice to the other of them requiring the appointment of such a third arbitrator shall be appointed in accordance with the provisions of the Arbitration Act 1951 of Papua New Guinea from a panel of five arbitrators to be nominated within a further period of fourteen days thereafter by the President and Chairman of the Board of Directors (or failing him the Chief Executive) of the Asian Development Bank (or, failing such nomination, from any panel of arbitrators which the person or body appointing the third arbitrator considers satisfactory) PROVIDED THAT no person shall be eligible for appointment as a third arbitrator (unless the Government and the Company otherwise agree in writing in any particular case) if at the time of his proposed appointment, he is, or has been at any time prior thereto a citizen or resident of Papua New Guinea, the Commonwealth of Australia, or, if any person other than the Company or the Government is or indicates prior to the appointment of the third arbitrator that he intends to be a party to the submission (and unless the Government the Company and each such other person otherwise agree in writing in any particular case), a citizen or resident of the country of which that person is a citizen or resident;"

16. Clause 25 of the 1967 Agreement is varied by the deletion of the words figure brackets and letter "more than ten years after the Company has completed the performance of its obligations under Clause 6(a)" and by the substitution therefor of:

"after the Amendment Date if the stamp duty in question is of general application in Papua New Guinea and, as required by Clause 7(f) hereof, does not discriminate against or (having regard to reasonable standards) result in discrimination against the Company".

17. The 1967 Agreement is varied by the addition of the following Clause after Clause 26 thereof:

"26A. REVIEW

The parties shall co-operate with each other in carrying out the purposes of this Agreement and shall meet together during the seventh year after the year in which the Amendment Date occurs, and at intervals of seven years thereafter, with a view to considering in good faith whether this Agreement is continuing to operate fairly to each of them and with a view to considering in good faith whether this Agreement is continuing to operate fairly to each of them and with a view further to discussing in good faith any problems arising from the practical operation of this Agreement. If at any such meeting it is agreed that this Agreement is not so continuing to operate fairly to each of the parties, or the parties agree that there exist problems arising from the practical operation of this Agreement, then they shall confer together in good faith in an endeavour to ensure that this Agreement shall operate fairly to both of the parties or to resolve such problems (as the case may be) and, in particular, and without prejudice to the generality of the foregoing, they shall use their best endeavours to agree upon such changes to this Agreement as may be requisite in that regard."

18. The 1967 Agreement is varied by the addition of the following immediately after the Schedule thereto:

Mining (Bougainville Copper Agreement)

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THE SECOND SCHEDULE

In this Schedule:

"Tax year" means the calendar year in respect of which the amount of tax payable by the Company is to be calculated.

"Adjustment year" means the calendar year immediately preceding the Tax year.

"P" (except where used in Parts II and III of this Schedule) means and equals the number of dollars of taxable income of the Company for the Tax year.

The value of "N" in the formula in Part I of this Schedule shall be calculated, for the purpose of ascertaining the rate of tax (expressed as a percentage of taxable income) payable on the taxable income of the Company derived during a Tax year, in accordance with the following formula, namely:

$$N = M \times \frac{C}{K} \times \frac{F}{B}$$

and for the purpose of this formula

"M" equals "N" at the end of the Adjustment year.

"N" for the purposes of the Tax year 1974 equals 32,000,000.

"K" equals an amount (called the Capital Factor) at the end of the calendar year preceding the Adjustment year, the agreed amount of the Capital Factor at 31st December, 1973 being 5390,000,000.

"C" equals the Capital Factor at the end of the Adjustment year and equals $K + E - R$.

"E" equals expenditure of a capital nature relating to the mining of ores from Bougainville Island (including, without limiting the generality of the foregoing, the following: the further exploration and development of the Company's mine on the areas comprised in the special mining lease held by the Company on the Amendment Date; the transportation of such ores; the concentration of such ores; the drying, handling and movement of the concentrates so derived to wharf facilities and into ships; the construction and maintenance of roads; earthworks; facilities for power generation; housing and facilities for employees; and works of reclamation and regeneration) and activities connected therewith, but excluding

- (a) expenditure relating to smelting or other treatment subsequent to concentration and drying of the product; and
- (b) expenditure which by reason of Clause (f) (B) or (C) hereof is deemed to have been incurred on 1st January, 1974.

"R" equals the sum of

- (a) the total amount of depreciation for tax purposes of units of property in respect of which depreciation at a rate in excess of 5% per annum is allowable as a deduction in respect of the Adjustment year; and
- (b) the original cost of other items of a capital nature (not being items in respect of which depreciation at a rate in excess of 5% per annum is allowable as a deduction in respect of the Adjustment year) replaced, disposed of, lost or destroyed in the Adjustment year.

"B" equals the average of the daily published buying rate of the unit of currency to be adopted by Papua New Guinea (hereinafter called "the Kina") against the U.S. dollar during the Adjustment year (expressed in terms of Kinas per U.S. dollar) provided that for the Adjustment year 1974 "B" shall be the first published buying rate of the Kina against the U.S. dollar on or following the date on which the Kina first becomes currency in Papua New Guinea.

"F" equals the average of the daily published buying rate of the Kina against the U.S. dollar during the Tax year (expressed in terms of Kinas per U.S. dollar) except that in respect of the Tax year 1975 "F" shall equal the average of the daily published buying rate of the Kina against the U.S. dollar from and

including the date on which the Kina first becomes currency in Papua New Guinea up to and including 31st December, 1975 and the formula for the calculation of "N" for the Tax year 1975 will be

$$N = M \times \frac{C}{K} \times \left[1 + \left(\frac{F}{B} - 1 \right) \frac{X}{365} \right]$$

where X equals the number of days from and including that date to and including the 31st December, 1975.

"The daily published buying rate" means the buying rate from time to time published by the Bank of Papua New Guinea or other the buying rate from time to time published and recognized by the Government as the official buying rate and in calculating the average of the daily published buying rate the total of each of the daily published buying rates in a particular year shall be divided by the number of occasions in that year on which that buying rate was published.

Until such time as the Kina first becomes currency in Papua New Guinea both "B" and "F" shall equal one and if the Kina does not become currency in Papua New Guinea during 1975 the reference to 1974 in the definition of "B" above shall become a reference to the year immediately preceding the year in which the Kina first becomes currency in Papua New Guinea and the references to 1975 in the definition of "F" above shall become references to the year in which the Kina first becomes currency in Papua New Guinea.

Part I

The amount of tax payable on the taxable income of the Company derived during the Tax year commencing on the first day of January, 1975 and on the taxable income of the Company derived during each subsequent Tax Year shall be the amount determined by the application to such taxable income of a rate (expressed as a percentage of taxable income) determined by the formula

$$\frac{7}{10} - \frac{N}{P}$$

Part II

The amount of tax payable on the taxable income of the Company derived during the period 1st January, 1974 to 30th June, 1974 shall be the amount determined by the application to such taxable income of the higher of a rate of tax of 33½% and a rate of tax (expressed as a percentage of taxable income) determined by the formula:

$$\frac{1}{3} + \frac{1}{2} \left[\left(\frac{7}{10} - \frac{N}{2P} \right) - \frac{1}{3} \right] \text{ where:}$$

N = 32,000,000.

P = the number of dollars of taxable income for the said period of six months.

Part III

The amount of tax payable on the taxable income of the Company derived during the period 1st July, 1974 to 31st December, 1974 shall be the amount determined by the application to such taxable income of the higher of a rate of tax of 33½% and a rate of tax expressed as a percentage of taxable income determined by the formula:

$$\frac{7}{10} - \frac{N}{2P} \text{ where:}$$

N = 32,000,000 and

P = the number of dollars of taxable income for the said period of six months.

Part IV

An amount equal to the lesser of:—

1. Seventy per centum of the excess of the amount of capital expenditure incurred by the Company in the relevant Tax year over the amount actually allowed by the Chief Collector as a deduction for the Company in respect of that expenditure pursuant to the provisions of Section 73 of the Income Tax Act or Division 10 of Part III of that Act, and
2. The excess of the amount of tax payable by the Company in respect of the taxable income of the Company for that Tax year over the amount of tax which would have been payable by the Company in respect of the taxable income of the Company for that Tax year if paragraph (c) of Clause 7 of this Agreement were deleted therefrom. For the purposes of this Part "capital expenditure" shall include all expenditure of a capital nature, as defined in the definition of "E"

in this Schedule where such expenditure is incurred in order to maintain the Company's present activity of the production of copper (contained in concentrates) at the rate of approximately 190,000 tonnes per annum."

19. This Agreement shall not come into effect unless prior to the thirty-first day of December, One thousand nine hundred and seventy-four or such later date as is nominated by the Company to the Government in writing before that date

(a) it has been approved by the shareholders of the Company in general meeting; and

(b) an Act (in the form of the draft Bill heretofore agreed upon between the Government and the Company and signed on their behalf for the purpose of identification or in any varied form hereafter agreed between them) has been passed by the House of Assembly of Papua New Guinea and that Act has been duly assented to.

IN WITNESS whereof the parties hereto have executed this Agreement the day and year first

above-written.

SIGNED SEALED AND DELIVERED for and on behalf of The Government of Papua New Guinea by MICHAEL THOMAS SOMARE the Chief Minister of Papua New Guinea in the presence of:
Rabbie L. Namaliu.

THE COMMON SEAL of BOUGAINVILLE COPPER LIMITED was hereto affixed in the presence of:

Michael Thomas Somare

R. W. Ballmer

Director

J. Rennie
Secretary

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 196.

Mining (Bougainville Copper Agreement).

APPENDIX.

SOURCE OF THE MINING (BOUGAINVILLE COPPER AGREEMENT) ACT.

Part A.—Previous Legislation.

1. *Mining (Bougainville Copper Agreement) Act 1967* (No. 70 of 1967).
2. *Mining (Bougainville Copper Agreement) (Amendment) Act 1974* (No. 79 of 1974).

Part B.—Cross References.

NOTE.—In this table "1974" refers to the *Mining (Bougainville Copper Agreement) (Amendment) Act 1974* set out in Part A.

Section, etc., in Revised Edition.	Previous Reference ¹ .
1	3
2	4
3	5
4	6
5	7
6	8
7	9
8	10
9	11
10	12
11	13
Schedules— Schedule 1 Schedule 2	Schedules— Schedule 1974 Schedule

¹ Unless otherwise indicated, references are to the *Mining (Bougainville Copper Agreement) Act 1967* set out in Part A.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 197.

Mining Development.

GENERAL ANNOTATION.

ADMINISTRATION.

As at 13 February 1976 (the date of gazettal of the most comprehensive allocation of responsibilities to Ministers and Departments at about the effective date), the administration of this Chapter was vested in the Minister for Natural Resources.

Accordingly, as at that date, unless some other intention is clearly indicated, by note or in the text, it seems that references in or in relation to this Chapter to—

“the Minister”—should be read as references to the Minister for Natural Resources;

“the Departmental Head”—should be read as references to the Secretary for Natural Resources¹;

“the Department”—should be read as references to the Department of Natural Resources².

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2. Source of Regulation.	

¹ Previously the Director of Lands, Surveys and Mines.

² Previously the Department of Lands, Surveys and Mines.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 197.

Mining Development Act.

ARRANGEMENT OF SECTIONS.

PART I.—PRELIMINARY.

1. Interpretation—
 - "borrower"
 - "company"
 - "developmental mining"
 - "gold"
 - "mine"
 - "mineral"
 - "mining operations"
 - "officer"
 - "the regulations"
 - "this Act".

PART II.—ADVANCES FOR DEVELOPMENTAL MINING.

2. Purposes of advances.
3. Applications for advances.
4. Reference to professional officers.
5. Agreement with borrower.
6. Security.
7. Payment of dividends, etc.
8. Recovery of advance.
9. Provisions applicable until moneys advanced have been paid.
10. Appointment of agent by borrower.
11. Non-compliance with Act.

PART III.—ESTABLISHMENT OF PLANT FOR CRUSHING, ORE-DRESSING, CYANIDING OR SMELTING.

12. Interpretation of Part III.—
 - "plant".
13. Purchase, etc., of plant by the State.
14. Erection of plant.
15. Rates for testing and treating.
16. Stealing from plant.

PART IV.—ASSISTANCE FOR BORING.

17. Minister may pay whole cost of boring for gold, etc.
18. Agreement to pay proportion of cost.

PART V.—MISCELLANEOUS.

19. Purchase and hire of boring plant.
20. Advance or expenditure of moneys for draining or making roads.
21. Assistance in marketing.
22. Regulations.

INDEPENDENT STATE OF PAPUA NEW GUINEA.

CHAPTER NO. 197.

Mining Development Act.

Being an Act to encourage the mining industry.

PART I.—PRELIMINARY.

1. Interpretation.

In this Act, unless the contrary intention appears—

"borrower" means a person who applies for an advance by way of loan under Section 2;

"company" means a company incorporated or registered under any law in relation to the registration or incorporation of companies;

"developmental mining" means mining operations that, in the opinion of the Minister, are necessary or desirable for the purpose of determining the size and value of an ore body and the subsequent development of workings to facilitate the economic extraction of ore from it;

"gold" includes—

(a) platinum, osmium, iridium and any metal belonging to the platinum group of metals; and

(b) gold and any earth or substance containing or having mixed in its substance, or set apart for the purpose of extracting, platinum, osmium, iridium or a metal belonging to the platinum group of metals;

"mine" means land held or occupied under the *Mining Act, 1937* of the former Territory of Papua (Adopted) or the *Mining Act 1928* of the former Territory of New Guinea (Adopted) where mining operations are carried on;

"mineral" does not include petroleum or helium found in association with petroleum;

"mining operations" are operations on a mine for the purpose of obtaining or prospecting for gold or minerals;

"officer" means an officer of the Department;

"the regulations" means any regulations made under this Act;

"this Act" includes the regulations.

PART II.—ADVANCES FOR DEVELOPMENTAL MINING.

2. Purposes of advances.

A person may apply to the Departmental Head for an advance by way of loan for—

(a) carrying on departmental mining; and

(b) procuring, erecting and connecting machinery, plant or appliances for that purpose; and

(c) providing other works and things that, in the opinion of the Departmental Head, are necessary for that purpose.

3. Applications for advances.

(1) An application under Section 2 shall be in the prescribed form and shall be accompanied by—

- (a) a description of—
 - (i) the mine on which the mining operations are to be performed; and
 - (ii) all workings on the mine and an accurate plan and sections of them; and
- (b) a description and valuation of all machinery, plant and effects on the mine; and
- (c) a statement of the encumbrances (if any) affecting the mine, machinery, plant or effects; and
- (d) a statement showing—
 - (i) the developmental mining proposed to be performed; and
 - (ii) the object of the mining; and
 - (iii) the probable cost of the mining, and of any machinery, plant and effects proposed to be purchased in connexion with it; and
- (e) a statement showing—
 - (i) the manner in which, and the work on which, it is proposed to expend the advance; and
 - (ii) the period of time during which the expenditure will be incurred; and
 - (iii) the time when, and the amounts in which, the advance will be required; and
- (f) if the application is made by a company—
 - (i) evidence of the incorporation or registration of the company in the country, and a copy of its memorandum and articles of association; and
 - (ii) particulars as to the amount of uncalled capital of the company, and of its assets and liabilities.

(2) A borrower shall also furnish to the Departmental Head such further evidence, documents or information as he, by written notice to the borrower, requires.

(3) A borrower shall verify all evidence, statements and information furnished under this section by statutory declaration.

4. Reference to professional officers.

(1) The Departmental Head may refer an application for an advance to the Mining Engineer, Mines Inspector, Geologist or other officer authorized for the purpose by the Minister, for report.

(2) A report under Subsection (1) shall be made after personal examination of the mine to which the application relates, and shall—

- (a) fully describe the character of the mine and of the lead, lode, reef, vein, seam or other mineral formation contained in it; and
- (b) state whether the performance of the proposed mining operations would or would not, in the opinion of the reporting officer, be developmental mining; and

to state whether, in the opinion of the Departmental Head, the probability of the proposed mining operations being successful, giving the character, and description proper to give such other information as may be required.

to state whether, in the opinion of the Departmental Head, the probability of the proposed mining operations being successful, giving the character, and description proper to give such other information as may be required.

to state whether, in the opinion of the Departmental Head, the probability of the proposed mining operations being successful, giving the character, and description proper to give such other information as may be required.

to state whether, in the opinion of the Departmental Head, the probability of the proposed mining operations being successful, giving the character, and description proper to give such other information as may be required.

(a) for every kind of advance, previously, at the same amount as the same amount.

(b) the borrower shall (i) propose to pay the advance in instalments, and (ii) pay the instalments.

(c) For the purpose of this section, the amount of the advance shall be the amount of the advance as stated in the application, less the amount of any advance previously received by the borrower under this section.

(d) The borrower shall pay the instalments of the advance in accordance with the terms of the agreement, and shall pay the interest on the advance at the rate of interest specified in the agreement.

(e) The agreement shall be in writing, and shall be signed by the borrower and the Departmental Head, and shall be subject to the approval of the Minister.

(f) Security. Before receiving a recommendation from the Departmental Head, the borrower shall enter into an agreement with the Departmental Head, under which the borrower shall pay out of moneys applied for or sums as he, in that behalf, shall think fit, such sums as are specified in the agreement.

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- (d) state whether, in the opinion of the reporting officer there is reasonable probability of the proposed operations proving to be of a remunerative character, giving the reasons and grounds for the opinion; and
- (d) state whether the machinery, working plant and appliances are of a character and description properly adapted to the proposed mining operations; and
- (d) give such other information as is prescribed or as the Departmental Head requires.

5. Agreement with borrower.

(1) After considering all the evidence and reports relating to it, the Departmental Head may recommend to the Minister the granting of the application with or without modification.

(2) On receiving a recommendation under Subsection (1), the Minister may, on behalf of the State, enter into an agreement with the borrower undertaking, subject to this Act, such sum or sums as he, in that particular case, approves.

(3) An advance under Subsection (2) shall be payable in instalments of such amount and at such times as are specified in the agreement.

(4) No instalment shall be paid until it is proved to the satisfaction of the Minister that—

(a) for every kina to be advanced the borrower has, out of his own capital, previously, actually and properly expended on mining operations on the mine the same amount; and

(b) the borrower has—

(i) properly expended, in mining operations on the mine, all previous instalments advanced by the State; and

(ii) paid all interest (if any) due on any such instalments.

(5) For the purposes of Subsection (4)(a), no account shall be taken of money expended by the borrower that has already been taken into account for the purposes of that paragraph.

(6) The borrower shall pay to the State interest on the amount of the advance calculated from the dates of payment of the respective instalments, at such rate as is charged from time to time by the Papua New Guinea Banking Corporation on overdrafts, by half-yearly payments, on dates specified in the agreement.

(7) The agreement shall contain such covenants, conditions, restrictions and provisions, not inconsistent with this Act, as the Minister requires.

6. Security.

Before receiving an instalment of an advance, the borrower shall execute, at his own cost and to the satisfaction of the Minister, a first mortgage in favour of the State, of the whole of the mine and, in the case of a company, its other property and assets (except uncalled capital) to secure—

(a) the repayment of the advance and interest; and

(b) the due performance of the terms of the agreement; and

(c) the provisions of this Act.

7. Payment of dividends, etc.

(1) Until it has performed all the terms of the agreement under which the advance was made, a company to which an advance has been made under this Part must not pay, credit or distribute, amongst all or any of its members, by way of dividend or otherwise, any of its money, property or assets.

(2) Where a company contravenes the provisions of Subsection (1) each director of the company with whose consent the payment, crediting or distribution was made is guilty of an offence.

Penalty: Imprisonment for a term not exceeding six months.

(3) Where any money, property or assets of a company has or have been paid, credited or distributed to a person in contravention of Subsection (1), the money and the value of the property or the assets is a debt due and payable to the company by the person.

8. Recovery of advance.

Moneys advanced to or payable by a borrower under an agreement that are due and payable are recoverable by the State as a debt.

9. Provisions applicable until moneys advanced have been paid.

(1) Until all moneys advanced under an agreement to a borrower have been repaid, and the terms of the agreement have been complied with—

(a) the Minister may appoint a person to inspect and report on—

(i) the progress of the works; and

(ii) the state and condition of the property and plant of the borrower; and

(b) the borrower shall, when so required by a person appointed by the Minister, allow—

(i) full inspection of; and

(ii) copies and extracts to be taken from,

all or any of the books, documents or records belonging or relating to the business of the borrower; and

(c) the borrower shall, within such time as the Minister allows—

(i) supply such information as the Minister demands in relation to the borrower, or to the property, assets, undertaking, work and operations of the borrower; and

(ii) if required, verify the information by statutory declaration; and

(d) in case of default by the borrower—the Minister may give notice to the borrower of his intention to enforce the security given by the borrower under Section 6.

(2) If the default continues after the expiration of 14 days from the service of a notice under Subsection (1)(d), the Minister may appoint a person to enter into possession of—

(a) the mine; and

(b) all other property and assets of the borrower comprised in the mortgage given by the borrower under Section 6.

(3) The person who is in possession under Subsection (2)—

- (a) has and may exercise the powers and authorities of a receiver and manager of the mine and of all other property and assets of the borrower comprised in the mortgage; and
- (b) may, with such assistants as are necessary, carry on the business of the borrower; and
- (c) if so directed by the Minister—may cause the mine, machinery, working plant and appliances and any other property and assets of the borrower comprised in the mortgage to be sold by public auction, by tender or by private contract, and the moneys realized by the sale shall, after payment of all expenses incurred by the Minister, be applied towards the payment of all moneys payable by the borrower to the State and the balance (if any) paid to the borrower.

10. Appointment of agent by borrower.

(1) During any absence of a borrower (not being a company) from the mine for any period of more than three days, he shall appoint, and at all times keep appointed, an agent who resides or works daily at the mine.

(2) If a borrower is a company, it shall appoint, and at all times keep appointed, as its agent some person who resides or works daily at the mine.

(3) The service of an order, demand, notice or requirement under this Act on a person under Subsection (1) or (2) appointed as an agent by the borrower shall be deemed to be service on the borrower.

(4) If the borrower—

(a) not being a company—is absent from the mine for a period of more than three days and has not appointed an agent who resides or works daily at the mine; or

(b) being a company—has not appointed an agent who resides or works daily at the mine,

the posting of an order, demand, notice or requirement under this Act at a conspicuous place on the mine shall be deemed to be service of the order, demand, notice or requirement on the borrower.

11. Non-compliance with Act.

Non-compliance—

(a) by a borrower or his agent; or

(b) if the borrower is a company, by the company, or by any of its officers or agents,

with this Act, or with an order, demand, notice or requirement of the Minister or a person appointed by him under this Act, constitutes a default by the borrower under the agreement.

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or concentrates in the person operating the plant from which the gold, gold amalgam or concentrates were stolen.

PART IV.—ASSISTANCE FOR BORING.

17. Minister may pay whole cost of boring for gold, etc.

If he is satisfied, after receiving the report of the Departmental Head, Mining Engineer, Geologist or other officer authorized for the purpose by the Minister, that the boring is in the general interest of Papua New Guinea, the Minister may, out of moneys appropriated for the purpose, pay the whole cost of drilling for gold, minerals or water in any locality.

18. Agreement to pay proportion of cost.

The Minister may enter into an agreement with a person to pay, out of moneys appropriated for the purpose, a proportion of the cost (not exceeding 50% of the total cost) of drilling for gold, minerals or water.

PART V.—MISCELLANEOUS.

19. Purchase and hire of boring plant.

The Minister may—

- (a) out of moneys appropriated for the purpose, purchase boring plant and accessories; and
- (b) hire plant and accessories in accordance with the regulations.

20. Advance or expenditure of moneys for draining or making roads.

(1) The Minister may, out of moneys appropriated for the purpose, advance or expend moneys—

- (a) to drain a mining area; or
- (b) to assist mining by sinking or cross-cutting for further ore occurrences; or
- (c) to make roads in a mining area; or
- (d) to assist mining development by granting subsidies on ore produced as the result of developmental work and crushed by means of plant operated by the State or approved by the Minister; or
- (e) to provide an adequate supply of water to a mine.

(2) An advance under Subsection (1) shall be made on such terms and conditions as are prescribed.

21. Assistance in marketing.

Where ores or concentrates are to be marketed outside the country, the Minister may, on such terms and conditions as are prescribed or as he thinks proper, and out of moneys appropriated for the purpose, make advances on any such ores or concentrates not exceeding 50% of the estimated value of the ores or concentrates.

22. Regulations.

The Head of State, acting on advice, may make regulations, not inconsistent with this Act, prescribing all matters that by this Act are required or permitted to be prescribed, or that are necessary or convenient to be prescribed for carrying out or giving effect to this

Ch. No. 197

Mining Development

Act and, in particular, for prescribing penalties of fines not exceeding K100.00 for offences against the regulations.

Not

APPENDIX IV

DISPOSAL OF OVERBURDEN AND
TAILINGS AGREEMENT
1971

Note: The attached is a copy only, unsigned.
The official signed document was
unable to be reproduced here due
to legibility limitations.

27th APRIL, 1971

Mr. F. F. Espie,
Managing Director,
Bougainville Copper Pty. Limited,
Box 384D G.P.O.,
Melbourne, 3001.
Victoria

Dear Mr. Espie,

Bougainville Copper Project
Disposal of Overburden and Tailings

Your Company's most recent proposals for the disposal of overburden and tailings are contained in two volumes, one a report relating to the disposal of waste rock dated September 1970, and the other relating to the disposal of tailings and such part of the overburden as is not waste rock dated August 1969.

Discussions on the topic have been held between officers of your Company and the Administration at various times, which have assisted in resolving various points of possible contention. Below is set out details of the method approved by the Administration for the disposal of overburden and tailings. This letter supersedes all previous letters from the Administration on the subject of approval of a proposed method of disposal of overburden and tailings.

WASTE ROCK

The proposal as contained in the abovementioned volume dated September 1970 to place the waste rock in the Kawerong River Valley is approved subject to the following:

1. Only relatively fresh free-draining granular rock is to be used for a distance of 200 feet back from the ultimate downstream dump faces.

2. Adequate measures are to be taken to maintain the integrity of the dump from dangers from Kawerong River flows. These are to include:
 - i) At the end of 1974 your Company and the Administration are to review the method of dumping the waste rock, and your Company shall, if requested by the Administration by June 1975, by 1st January 1976 submit a further proposal for the disposal of the waste rock based on the result of the review. This will be a proposal pursuant to Clause 15 of the Bougainville Copper Agreement and will be dealt with by the Administration as such.
 - ii) Kawerong River water which has travelled over the dump will not be discharged directly over the edge of the advancing dump face into the Kawerong River Valley.
 - iii) Filling of the rockfill pore space of the dump by tailings is to be avoided.
3. The low grade in copper and more weathered waste rock shall, as far as possible, be kept in the upper part of the dump as a surface layer on top of the dump as a means of encouraging vegetation growth.
4. The largest rocks available shall be placed at the bottom of the downstream faces of the dump and the ultimate faces shall be armoured with the largest stone available at that time.
5. It is noted that there will be a continuous engineering effort at the site in respect of the provision of the intermediate faces of the dump. However, the gradient of these faces and other gradients relating to the dump shall be reviewed annually by the Administration's Chief of Division of Mines or his nominee, and any alteration in any of such gradients requested by the Chief of Division of Mines following an annual review shall be complied with.
6. If it is practicable in the final stage of the dump, the final dump face shall be abutted on the upstream side of spurs on either side of the valley.
7. As soon as the final top of the dump has been reached at any particular place, your Company shall commence its endeavours to establish vegetation thereon in so far as such endeavours do not conflict with its other operations on the dump as a whole.

APPENDIX (cont'd)

8. Your Company shall participate in discussions with any natives who will be affected by the approved manner of disposal, and shall co-ordinate its negotiations in respect of compensation to be given to such natives (pursuant to Clause 15(d) of the Bougainville Copper Agreement) with such discussions if so requested by the Administration. Until the discussions have been completed your Company shall take no action detrimental to the interests of the relevant natives.
9. Your Company shall comply with the requirements of and any directions which are properly made under the provisions of the Mines and Works Regulation (New Guinea) Ordinance 1955-1962 (as amended from time to time).

TAILINGS AND FINE OVERBURDEN

The proposal to dispose of tailings and fine overburden by draining it into the Kawerong River (except as mentioned in 12(c) below) is acceptable subject to the following:

1. Your Company shall take such action as is necessary to confine flooding, damage or the disposal of tailings within the area granted to your Company as a lease for mining purposes for the disposal of tailings.
2. As part of or in addition to the monitoring programme referred to in your Company's Proposal your Company shall further its means of data collection by:
 - i) Installation of two rain gauges and two pluviometers in the mine pit area.
 - ii) Installation of two rain gauges and two pluviometers in the Kawerong-Jaba Valley.
 - iii) Taking vertical cross-sections of the river bed in the Jaba Valley below the Jaba-Kawerong confluence at intervals both in space and time as dictated by the weather and river conditions.
 - iv) Taking hand held vertical colour photographs from altitude 1500 feet above general terrain elevation; such photographs to be correlated to the amount of material dumped into the system and again subject to weather and river conditions. In any case, the interval between photographs shall not exceed six months.

APPENDIX (cont'd)

3. Your Company shall at three monthly intervals advise the Administration of the summarised results and interpretations of its relevant data collection and monitoring programme, and shall give the Administration access to the data collected and your Company's aerial photographs (and shall supply, without cost, a copy of any such photograph which is requested by the Administration).
4. Your Company shall have selected suitable equipment which is capable of being mobilised with six months notice to undertake such action on the river system as is necessary pursuant to Clause 1 above.
5. Your Company shall use all practicable measures to ensure that the tailings contain no more than such a sufficiently low level of copper readily soluble in natural waters as to ensure that no serious damage could result therefrom to vegetation or animal life.
6. Upon disposal of tailings in accordance with this approval your Company shall abandon any title it has in the tailings.
7. Your Company shall apply for a licence under the Water Resources Ordinance for the construction, installation, operation and maintenance of a water-work for the drainage of waste material into the Kawerong River and shall provide such information as is necessary for the grant of such a licence.
8. Your Company shall pay the Administration an amount equal to any amount which the Administration has to pay in respect of the termination of any native customary rights to water in order to be able to grant the licence referred to in 7 above.
9. Your Company shall participate in discussions with natives who will be affected by the approved manner of disposal, and shall co-ordinate its negotiations in respect of compensation to be given to such natives (pursuant to Clause 15(d) of the Bougainville Copper Agreement) with such discussions if so requested by the Administration. Until the discussions have been completed your Company shall take no action detrimental to the interests of the relevant natives.

APPENDIX (cont'd)

Discharge of tailings into the Kawerong River shall, at all times, be at a place below the downstream toe of the waste rock dump.

Your Company shall comply with the requirements of, and any directions which are properly made under the provisions of the Mines and Works Regulation (New Guinea) Ordinance 1935-1962 (as amended from time to time).

As it is the intention that the disposal of tailings be controlled, and tailings be spread in such a way as to enable re-use of the land at the earliest practicable date, your Company is to conduct the following experiments to test agricultural feasibility and to perform the following tasks:

- a) at half mile intervals (or such greater intervals as are agreed to by the Administration) along the Jaba River towards the sea from the confluence of the Jaba and Kawerong Rivers, at six monthly intervals, take vertical cross-sections of the material deposited on or forming the bed of the river, and shall analyse such materials and advise the Administration of the results.
- b) Commence development of 100 acres of land, when control equipment is moved on site, using sedimentation material from the Jaba River. The site is to be within the Lease for Mining Purposes area and to be agreed upon by the Administration and your Company. Such materials shall be deposited on this site to a height agreed to by the Administration.
- c) By January 1973, commence a small (1 to 2 acre) field experiment with tailings to a depth of at least five feet on the waste rock dump at a site to be agreed between your Company and the Administration.
- d) Establish lysimeters (the number to be specified by the Administration - not being more than fifty) on an agreed site within the Lease for Mining Purposes area, and shall fill them with various sized material from the tailings, in accordance with the direction of the Administration.

APPENDIX (cont'd)

- e) As soon as possible after respective commencements of the operations referred to in (b), (c) and (d) above, establish facilities to collect, from each of the operations respectively, data on the following:
- i) the rate of weathering of the tailings or the sedimentation material (as the case may be);
 - ii) the rate of nitrogen build up in the tailings or the sedimentation material (as the case may be);
 - iii) the rate at which vegetation naturally regenerates itself upon the tailings or the sedimentation material (as the case may be);
 - iv) the rate at which vegetation regenerates upon the tailings or the sedimentation material (as the case may be) when selected legumes or grasses have been added to them.
- f) Your Company shall, after the date tailings control equipment is placed within its Lease for Mining Purposes for the disposal of tailings, engage in tailings spreading, in accordance with an agreed plan and programme, to achieve the progressive regeneration of vegetation.

The tests foreseen in 12(c) and (e) shall be carried out under the direction of the Director, Department of Agriculture Stock and Fisheries. Your Company will carry out laboratory chemical, physical and sizing analyses requested by the Administration for the purposes of 12(e) (i) and (ii) and will provide the photographs necessary for the analyses of the regeneration referred to in 12(e) (iii) and (iv).

The approval of the method of disposing tailings and fine overburden by drainage into the Kawerong River is for a period of ten years commencing 1st January, 1970. During this period there will be a constant review of the results of this method of disposal.

APPENDIX (cont'd)

Any agreement between your Company and the Administration during the ten years as to variation in the method of disposal or as to an alternative method, is to be put into effect. At the end of eight years after the 1st January, 1970 (that is, at the beginning of 1978), and at subsequent intervals thereafter, there shall be a review by the Administration of the manner of disposal. If on the first of these reviews it is decided by the Administration that the manner of disposal should be altered from that being used or a new method substituted, either for the disposal of all or part of the tailings and fine overburden, your Company shall submit a further relevant proposal which shall be resolved pursuant to Clause 15 of the Bougainville Copper Agreement.

The review of the method of disposal shall be completed and the method for the subsequent period decided within eight and one half years from the 1st January 1970. Your Company will have until the end of ten years from the 1st January, 1970, before it will have to commence any altered or new method of disposal. This same procedure and timetable shall apply to subsequent reviews except that the eight and ten years period shall be computed from the date of completion of the previous ten year's disposal period.

It is intended that from 1st January, 1980, the method of disposal shall be consistent with the objective of re-using any land affected by tailings disposal.

It is understood that your Company is in agreement with the scheme for the disposal of tailings and overburden as approved above, and it would be appreciated if you could confirm this by letter.

Yours faithfully,

Signed

L. W. Johnson,
Administrator

APPENDIX V

DISPOSAL OF TAILINGS AND WASTE ROCK AGREEMENT - 1987

DISPOSAL OF TAILINGS AND WASTE
ROCK AGREEMENT
BOUGAINVILLE COPPER LIMITED

WHEREAS the proposal by Bougainville Copper Limited for a new method of disposing of tailings, described in Bougainville Copper Limited Tailings Disposal System - Description of Proposal, November, 1986 and in Bougainville Copper Limited Tailings Disposal Pipeline System - Environmental Impact Report - December, 1986 is considered to be a valid and acceptable way to deal with the disposal of tailings, and

WHEREAS the Independent State of Papua New Guinea (hereinafter referred to as "the State") and Bougainville Copper Limited (hereinafter referred to as "BCL") recognize the need for new Agreement to replace the Agreement of 27 April, 1971.

It is THEREFORE AGREED that this will constitute a new Agreement between the parties for the purpose of disposal of tailings and waste rock.

1. Nothing in this Agreement exempts BCL from the provisions of the Mining Safety Act, Chapter No. 195A and all regulations pursuant thereto, as amended from time to time.
2. The Disposal of Tailings Agreement of 1971 shall remain in force until such time as the new pipeline system for disposing of tailings is commissioned. From the date of such commissioning, this Agreement will have full force and effect.
3. Waste Rock

The proposal contained in the September 1970 volume to place waste rock in the Kawerong River Valley is continued in force subject to the following conditions:

- (i) only predominantly fresh free - draining granular rock is to be used; however where non-free draining material is to be dumped this material will be confined by free draining rock.

- (ii) adequate measures are to be taken to maintain the integrity of the dumps from dangers of the Kawerong River flows. This includes
 - (a) Kawerong River water which has travelled over the dump will not be discharged directly over the edge of the advancing dump face into the Kawerong River Valley, and
 - (b) filling of the rockfill pore space of the dump by tailings is prohibited.
- (iii) the company will commence revegetation as soon as the final top of the dump has been reached in so far as such endeavours do not conflict with other operations on the dump site.

Tailings

The proposal of BCL for the disposal of tailings and fine overburden by pipeline as outlined in Bougainville Copper Limited Tailings Disposal Pipeline System - Description of Proposal, November, 1986 and in Bougainville Copper Limited Tailings Disposal Pipeline System - Environmental Impact Report - December, 1986 is agreed to between the parties to this Agreement subject to the following conditions:

- (i) BCL shall take such action as is necessary to confine flooding, damage or the disposal of tailings within the area in Fig. 4. Tailings Disposal Pipeline Plan (F-80-163) outlined in Bougainville Copper Limited Tailings Disposal Pipeline system - Description of Proposal, November, 1986.

- (ii) BCL shall, at six month intervals, present to the Department of Minerals and Energy the summarized results and interpretations of its relevant data collection and monitoring programme and shall, at any time, give the said Department access to all data collected and any other material relevant thereto. The Company will supply copies at the request of the Department. BCL will be notified when and if the State makes public any information so obtained.
- (iii) BCL shall take all reasonable steps to ensure that any discharges into the river system and the bay contain no more than a sufficiently low level of copper or other contaminants readily soluble in natural waters to ensure no serious damage is done to the biota or will cause any risk to public health.
- (iv) During such times that the pipeline is not available for use due to maintenance, inspection or unforeseen circumstances, BCL shall be permitted to discharge tailings into the river system for up to a period of twenty - one days in any one year, unless a further period is granted in writing by the Minister of Minerals and Energy. During such time BCL will ensure that all undertakings and requirements pursuant to this Agreement are followed.
- (v) discharge of tailings into the river system shall, at all times, be at a place below the downstream toe of the waste rock dump.
- (vi) a survey of the Jaba River/Pangara River biological recolonization will be commenced at a time when the results of physical and chemical monitoring demonstrate its viability. Once commenced, the survey will be undertaken annually.

(vii) techniques to stabilize tailings deposits remaining in the river system will be investigated and appropriate measures taken to ensure such stabilization.

(viii) the tailings stack test area and/or tailings stack will be studied and monitored for: sediment stability, water movement on and through tailings, the chemistry of stack run-off, stack leachate and tailings weathering, development and persistence of vegetation cover, and the rate of soil formation as defined by organic carbon and nitrate accumulation.

(ix) the coastline of Empress Augusta Bay will be surveyed on an annual basis between Tuju Inlet and the Mariropa River to assess changes in beach profile. Aerial or satellite photographs of the coastline will be taken on a regular basis.

(x) dispersion of metals and sediments from the tailings disposal area into the seawater will be regularly measured at specific locations offshore from the stack for copper and any other relevant metals, pH, salinity and suspended solids.

(xi) the effects of direct disposal of tailings in the Bay on the benthos and fish populations will continue to be monitored.

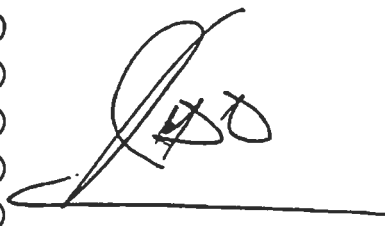
BCL shall take all reasonable steps necessary to ensure rehabilitation of land and regeneration of vegetation in areas affected by the waste rock and tailings disposal systems.

The monitoring and research programmes in effect from 1971 will continue in addition to the monitoring proposals outlined in the 1986 Environmental Impact Report. These programmes can be amended, altered or varied, at any time, after consultation between BCL and the State.

This Agreement will continue for the term of the Special Mining Lease, or any renewal thereof, granted to BCL, unless an agreement is reached between the State and BCL for variation, amendment or alteration thereto.

Dated this 28TH day of JANUARY, 1987.

Signed for and on behalf of)
the Independent State of)
Papua New Guinea by)
JOHN R KAPUTIN, Minister)
for Minerals and Energy)
in the presence of)
)
)
)



W. D. SEARSON.)
DEPT. MINS + ENERGY

BOUGAINVILLE COPPER LIMITED does hereby accept this Agreement.

Signed for and on behalf of)
BOUGAINVILLE COPPER LIMITED)
by P.W. QUODLING, Managing)
Director, Bougainville)
Copper Limited, in the)
presence of)
)
)
)
)
)



Lee Beigh)
Company Secretary.

APPENDIX VI

LANDOWNERS' CONCERNS AS
EXPRESSED TO REVIEW TEAM

ENVIRONMENTAL CHANGES AND PEOPLE'S FEELINGS DUE TO IMPACT
OF OPERATIONS AND ACTIVITIES BY BOUGAINVILLE COPPER LIMITED

(BCL) - By Mr. James Singo - Kanebita Village near Bato.
- Road Mining & Tailings Lease
(RMTL) Member.

1. The flowing current of rivers have decrease since.
2. Tubering food crops (eg. sweet potato, chinese taro, and casava), have decrease their productivity.
3. Plant crops (eg. banana; pawpaw) never reach maturity in healthy conditions. Some banana species have gone extinct.
4. The amount of rainfall have increased.
5. People are experiencing new types of diseases.
6. Some animals such as cuscus (LAGALA) and Goana (MAILAKI) have extinct in the affect areas.
7. Money have affected the living conditions of the people living around the mining area. So they find it difficult to live in such conditions.
8. Tree crops (eg. Breadfruit) have never reach maturity in healthy condition. Some rot away before reaching maturity
9. Land have become soft especially along the tailing due to the blockage by the sediments from the mining operation which make the water flow back.
10. Since the introduction of BCL, people are growing more fat than before. This is due to the introduction of foreign food stuff.
11. Giant African snail have been introduced and they cause a lot of damage to food gardens, causing food shortages around the area.
12. Local land owners never feel free to go around in the night because BCL has introduced people from other parts of the country, who are trouble makers.
13. People have lost a lot of fish from the rivers.
14. People have lost a lot of hardwood trees for producing timber for local people.
15. People have lost lot of jungle vegetables, so they are nowadays very short of local vegetables.

- 2 -

- 1. People have lost most land along the tailings.
- 2. People have lost good natural drinking and fishing waters.
- 3. People have lost alot of thick jungle which was once full of wild animals (eg. pigs)
- 4. People regard that LAND AND MAN are more worthwhile than money.
- 5. More recently, the people lost 95% of flying foxes in the province.

24-10-03

ENVIRONMENTAL STUDY - CASES NOMINATED

By Panguna Land Owners Association

- Increase of disease on garden crops
 - Growth life of crops released
 - Not bearing enough food
 - Food crops rotted away
 - Rectangular shapes found on leaves
- PLANTS
- Trees dying away around Tailings, special mine lease Road lease.
 - Cocoa Trees are affected by the unknown pollution which bears for few rounds and die away
 - Foreign plants been grown by BCL on our land which are killing local plants
 - Timber forest abuse
- SOIL
- Frequent landslides around the mine and its surroundings (special mine lease)
 - About 1/5 of land in the mining lease, Tailings, Road lease have become barren
 - Soil ecology been poisoned
 - Soil nutrition been contaminated by chemical and other foreign objects
 - Mineral oxidisation on rivers along Tailings
 - Soil sediments at Augusta Bay
- RIVERS
- No fish - Not consumable if any because of high mineral in them
 - Creeks around Guava, Kokore, Poaru villages (i.e. those above Pit drainage tunnel disappearing or sinking
 - Chemical Pollution on people's swimming rivers
- AIR
- Air pollution by burning of tyres
 - Mineral vapours
 - Water cycle
 - Blasting fumes or fall out dust from blasting
 - Industrial Pollutions
 - Dust
 - Aerial spraying carried out by BCL during 1968-69 which have killed plants and ^{many} crops. This is a starting point when every things (plants) have received severe effect on them

HUMAN


- Unlimited sickness affect people's lives (needs medical examination)
- Skin disease on people down the Tailings including infection sores as well down the Tailings

ANIMALS

- Birds dying with unknown disease
- Flying foxes dying also
- Fish with sore on their body, no eyes dying for no good reasons at all
- The whole wild life ^{from} ~~frmo~~ down to Tailings is disappearing i.e. pigs, birds and other animals

Above all every necessary test whether on human being, animals, plants and environment is required by Panguna Landowners Association. And we will co-operate and the end result will be known without fear or favour.

Thank You



24.10.88

Francis Ona
 General Secretary
 Panguna Land Owners Association

OUINE MINI COMMUNITY GOVERNMENT

Meeting - 5th October 1988



AGENDA ITEMS

1. ONOVI - PARUPARU AND KAWARONG WEST BANK ROAD (KABUI HIGHWAY - WEST BANK ROAD)
2. SCIENTIST STUDY PROPOSAL PROJECT ITEMS
3. POKUNAMERI ROAD OR (WENDELINUS B. ROAD)

MEETING STARTED AT 1.30 PM

Being the Chairman of the meeting I first of all explained to the leaders and other people of the community the importance of the first Agenda of the day, by saying that we need to organise ourselves in order to minimise any conflicting statements from each individual groups of people or persons over the issues affecting our community. At the same time I thank all the members for coming to the meeting.

There were about twenty (20) members attended the meeting.

As a matter of business I appointed Mr Linus Devata to express his peoples views over the issue of building a road from Onove - Paruparu road down towards Kento bridge area on the Western side of the Kawerong River.

Linus Devata as a spokesman for Tavora Village which is a small hamlet of the Onovi village, said that the idea of putting a road through that area is a good idea but because of the following reasons, my people have decided not to accept such a proposal for the time being.

1. We are already near the road and our existance will depend upon how we will relate ourselves to the use of that road, especially our kids and if another road is build under our village it will mean more often we will be worrying of looking after our kids on both roads.
2. There will be lot of social disordered or disturbance by the travelling public:
3. Thirdly, we don't want to sacrifice our crops for what we know as a must be done project which is a direct cause by and operation of the company.
4. Our small village is just above a cliff and is very much situated in a dangerous area where it could easily have serious landslides, if we let the company undercut the area by a dozer.

In support of Mr Linus Devata, Mr T. Birengori said, if the road has to be built through our crops, we can only accept it, if company agrees on monthly payments of our cocoas and coconut trees and not as usual a single payment, which is in adequate.

Some flat land area raised her concerned that, she would rather have proper access from the tunnel - bridge up, as it is quite difficult to cross the river in time of flood and it is even hard to carry heavy loads of cocoa wet beans either way.

After lengthy discussions, Michael Mirintoro stood up and said, okay lets go it this way, since we all agreed that there is no need at the moment to have roading right through to Onovi Paruparu road, That the bridge be built across tunnel area to continue putting road which is already been started without unnecessary delay as it is very needy project by us the people of Darenai, Pakunameri and Dai Villages.

And at the sametime I am not happy with the company proposal to build the road in two stages instead it should be a continuous project until our very need is solved. So the timing should be altered as well since the company has showned enthusiastic to put a road through to Onovi Paruparu areas, regardless of a costly bridge over Olong River, as well as the obvious other cost such as crops. While we on the other hand are prepared to sacrifice our crops while trying to get such a needed road.

So all people in the meeting argued that the bridge be built immediately across the tunnel area where existing bridge is.

In this way, people of Darenai and all other people from Paruparu area will have some chance to alleviate possible dangers that people have being encountered for so many years in the past. And because we have decided to do away with the other part of the proposed stage one, the company must add at least a same distance to make up for it.

AGENDA 2

SCIENTIST MRS MEREDITH SARSOON AND MR MARTIN WARD

It was stated by the people at the meeting that the independent environment list, Mr Martin Ward with Mrs Meredith Sarsoon the Scientist and project coordinator must work with some of our boys to carryout the study during field works. This would give some basic idea of what the scientist are doing while engaged in the project.

Following are our points or terms of references.

1. Spray (used during mining construction stage, to kill all trees around camps one and pan flat back in 1970.
2. All Food crops including fruit trees such as mangoes, galip nuts, bread-fruits, bananas etc.
3. Cash crops such as cocoa, coconuts and betlenut trees
4. General vegetation such as vegetables, wild banana, bush under-growth, economic trees, timber etc.
5. Blast pollution in the mining, that is to find out amount of Dynamire or explosives use inside pit and outside the pit, and find out how much disastrous fumes comes out through the mine drainage tunnel as each explosion occured or the blast take place.

Impurities of the atmosphere.

Water - that is rivers, creeks and brooks be tested.

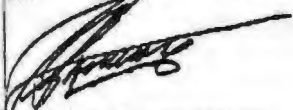
People in the lease areas be tested for medical reasons, such as psychological case affects, abnormal deformations while crossing rivers.

Biological Control systems should be thoroughly check, as we have noticed over whilmingly increase rate of black ants, and other insectionicides, which we are sure to have been caused by large flat land jungle areas occupied by tailings waste.

Heat Radiation caused by tailings disposal waste must be check and monitor to find out what damages it had caused in the case of food gardens and other vegetations.

Meeting closed at 3.30p.m.

compiled and prepared by Chairman,



WENDELINUS BITANUMA

PANGUNA LANDOWNERS IMPORTANT CONCERNS

25TH OCTOBER 1988

TO: MINERALS & ENERGY AS WELL AS ENVIRONMENTAL DEPARTMENTS OF THE NATIONAL GOVERNMENT

Following are our grave concerns over the use of our land by large scale mining operations like Bougainville Copper Limited.

1. Physical Destruction of our Welfare.

- (a) This means people within the villages are no longer living in harmonious life or in acceptable peace. There are constant disputes over the land issues because of the shortage of land.
- (b) Dishonest decisions over land clamation had begun. Do not care attitude had been created over lies in dealing with problems in the villages.
- (c) Co-operative attitude which was common to our society long ago before C.R.A.'s establishment of the mining in Panguna had been diminished or no longer enjoy by all community especially the new generation.
- (d) Stealing is a new thing especially massive stealing with break and enter and other associated means at the unacceptable level.

2. Health Problems.

- (a) Many types of sickness has risen to an unacceptable level.
- (b) Fatness has become a common means of growing around Paguna area. This brings clear unhealthy standards to our people which was not evident to our people before. Therefore, it cannot be denied that it has been caused by all sort of unhealthy food stuff brought in by the company.
- (c) Many of our people have been dying from unknown types of sicknesses in our areas. Many have gone through operations and belief to live a temporary life. This is sure to be caused by change of environment and more of the change of diet.
- (d) Our natural food has been lost thus creating possibility of malnutrition in the society and could become worse in future years to come if health authorities do not take positive steps to remedial measures, in conjunction to the environmental change.
- (e) Our meat, fish and other food have completely gone lost.

3. Economy.

Our economical status are being crippled by the careless attitude of the Company's Management. In fact, the management favour foreign owned businesses in regards to giving contracts of a reliable standard other than a lot of jobs of the type of "Give and Take Business". So if it continuously deny our existence in every means of survival, our life is surely been ruined by any doubt.

4. Effects of Psychology.

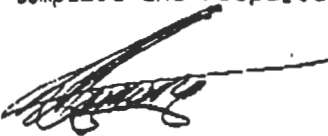
Much of our mental behaviour has changed to an extent that some people have gone kranky or psychological serious affect, as they could not understand how the white society mix with black so called elite group could not come to any psychological understanding with our society. Name a few, Mr A. Ampe and Mr Arenama and others.

Expectation to get some help from the Company in terms of minor services like feeder roads and other things has turned out to become again a complete damage to our way of thinking. Especially when we see machines lying iddle around our back yard.

Therefore, we expect our Government to start pulling its socks up, in such an enormous in fact caused by great industrial organisation if this country has to survive.

Simple people like us the Landowners cannot manage to simplify all the troubles caused by the giant mine.

Compiled and Prepared By:



WENDELINUS BITANUMA

APPENDIX VII

MONITORING PROGRAMMES
(from Environmental Update 1986)

5 MONITORING PROGRAMS CARRIED OUT BY ENVIRONMENT

A. Chemistry

1. Filter Plant Effluent - Loloho

Frequency - Weekly

Analyses - pH, Soluble Cu (mg/l), Solids Cu (mg/l), Cu in Solids (%), Suspended Solids (mg/l), PAX (mg/l)

Frequency - Six Monthly

Analyses - Cu (ug/l), Hg (ug/l), Cd (ug/l), Pb (ug/l), Zn (ug/l), Ca (mg/l), Mg (mg/l), MIBC (mg/l), PAX (mg/l), pH.

2. Dump Leachate Stream

Site - KR2

Frequency - Weekly

Analyses - Cu (mg/l), Al (mg/l), Mn (mg/l), Fe (mg/l), pH, acidity (meq/l), discharge (m³/sec)

Site - KR2 (and previously KWL)

Frequency - Six Monthly

Analyses - Cu (mg/l), Al (mg/l), Zn (mg/l), Fe (mg/l), Cd (ug/l), Pb (ug/l), Hg (ug/l), pH, acidity (meq/l), discharge (m³/sec)

3. Riverwaters

Sites - Kawerong River XS-5
Jaba River upstream pump station
Jaba XS 16
Jaba River Coast
Pangara River
Mariropa River
Torokina River

Frequency - Six Monthly

Analyses - Cu (ug/l), Hg (ug/l), Cd (ug/l), Zn (ug/l), Ca (mg/l), Mg (mg/l), MIBC (mg/l), PAX (mg/l), pH.

4. Seawater - Empress Augusta Bay

Sites - 24 samples taken along two transects running in NW and SW directions from delta. Includes surface,

mid and bottom waters.

Frequency - Six Monthly

Analyses - Suspended solids (mg/l), pH, conductivity (mS), Cu (ug/l), Zn (ug/l), Cd (ug/l), Pb (ug/l), Solids Cu (mg/kg), Organic Carbon (mg/l).

5. Tailings Lysimeters

(a) Leachate - 10 lysimeters, 5 depths per lysimeter

Frequency - Eight Weekly

Analyses - Al (mg/l), Ca (mg/l), Cu (mg/l), Fe (mg/l), K (mg/l), Mg (mg/l), Mn (mg/l), Zn (mg/l), SiO₂ (mg/l), SO₄ (mg/l), Inorganic Carbon (mg/l), pH

(b) Solids - 10 lysimeters, 5 depths per lysimeter

Frequency - Yearly

Analyses - Total Cu (mg/kg), Acid Soluble Cu (mg/kg), EDTA Cu (mg/kg), S (%), SO₄/S (mg/l), pH
Also recently analysed for: Exchangeable Cations (meq/l), Cation Exchange Capacity (meq/l).

6. Tailings Stream

(a) Frequency - Six Monthly

Analyses - Cu (ug/l), Hg (ug/l), Cd (ug/l), Pb (ug/l), Zn (ug/l), Ca (mg/l), Mg (mg/l), MIBC (mg/l), PAX (mg/l), pH.

(b) Daily sizing, Cu, tonnage

(c) Quarterly - Total Analysis

7. Dredge Plot - Bato

(a) Leachate

Sites

- 2 sites below SW corner of plot

Frequency

- Six Monthly

Analyses

- pH, Cu (ug/l), Cd (ug/l), Mg (mg/l), K (mg/l), Ca (mg/l), Mn (mg/l), Fe (mg/l), Zn (mg/l), Al (mg/l), SO₄ (mg/l), SiO₂ (mg/l), NO₃⁻ (mg/l), Inorganic Carbon (mg/l)

(b) Sediment

Sites
Frequency
Analyses

Biology
(1) Fresh wa
Frequency
Analyses
(2) Empr
Frequency
Analyses

C. Hydrolog
(1) Lolo
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(2)

Sites - 4 sites across plot - sampled at 25 cm depth intervals
Frequency - Six Monthly
Analyses - pH

B. Biology

(1) Fresh water streams

Frequency - 4 yearly
Analysis - Fish Population Study

(2) Empress Augusta Bay and East Control Sites

Frequency - 18 months
Analysis - Macrobenthos population study, bathymetry, sediment sizing and Cu, Fish Population (gill net), fish population (haulseine net) Cu, Zn, Cd, Pb, Hg ad As in fish muscle, kidney, gill, liver and reproductive organs.

C. Hydrology

(1) Loloho, Mananau, Panguna

Frequency - Continuous/Daily
Analysis - Rainfall, Evaporation, Humidity, Temperature, Sunshine

(2) Upper Kawerong, E2 and E3, Jaba U/S Pump Station, North Channel

Frequency - Continuous
Analysis - Water Level (Discharge)

(3) Upper Kawerong, Masinau, Irang, Jaba Pump Station Pit

Frequency - Continuous
Analysis - Rainfall

(4) Loloho, Magini Islet

Frequency - Continuous
Analysis - Tide Levels

(5) Buraburai

Frequency - Continuous (High Flow Conditions)
(Discontinued September 1984)

(6) Kawerong Jaba River System

Frequency - Six Monthly
Analysis - Sediment level, sediment sizing, aerial
photography

(7) Jaba Delta

Frequency - Continuous
Analysis - Wind speed and direction

(8) Empress Augusta Bay Shoreline (Tuju - Mariropa)

Frequency - Six monthly
- Beach profile.

D. Revegetation

Selected permanently Established Revegetation Plots

Frequency - Six Monthly
Analysis - Visual Appraisal and sediment pH

env ir2/5 /70

Mark Armstrong-Roper

Ingrid Unger
Wednesday, 11 September 2013 11:15 AM

... and public health review of Bougainville copper mine, Panguna
... of the Act. There is a set

REFERENCES

REFERENCES

- 1 Patrol Report Kieta No 6 1964-65.
- 2 Patrol Report Kieta No 10 1961-62.
- 3 Bedford, R; Mamak 1977: 'Compensating for development: the Bougainville case.'
- 4 Patrol Report Kieta No 8 1965-66.
- 5 Patrol Report Kieta No 16 1967-68.
- 6 Patrol Report Kieta No 18 1967-68.
- 7 Patrol Report Kieta No 10 1968-69.
- 8 Patrol Report Kieta No 23 1967-68.
- 9 Oliver, D 1973: 'Bougainville: a personal history.' Honolulu.
- 10 Tsinoung, J; Rogerson, R; Itta, D 1988: Local attitudes to mineral exploration and mining in North Solomons Province.
- 11 Bechtel-WKE 1969: Proposed mine waste rock disposal. Bougainville Copper Project. For Bougainville Copper Limited.
- 12 Bougainville Copper Pty Limited 1969: Proposed method of disposal of wastes from mining and processing.
- 13 Bougainville Copper Limited 1971: Tailings and overburden agreement. Data collection and monitoring programme. Report No 1.
- 14 Bougainville Copper Limited 1971: Tailings and overburden agreement. Data collection and monitoring programme. Report No 2
- 15 Bougainville Copper Limited 1973: Tailings and overburden agreement. Data collection and monitoring programme. Report No 9.
- 16 Bougainville Copper Limited 1986: Environmental update.
- 17 Ruppin, P 1986: Tailings disposal pipeline system - environmental impact report.
- 18 North Solomons Provincial Development Study, 1982.
- 19 Hartley, A C 1978: Survey of land pressures in the Upper Kawerong Valley. Bougainville Copper Limited.
- 20 Firth, I C 1988: Evaluation of BCL respirable dust and free silica exposures, and the potential for silicosis. Bougainville Copper Limited Internal Report OH 029.
- 20 Bougainville Copper Limited 1988: Report OH 029.
- 21 Scott, R M; Heyligers, P B; McAlpine, J R; Saunders, J C; Speight, J G 1967: Lands of Bougainville and Buka Islands, Papua New Guinea. Land Research Series Number 20. CSIRO, Australia.

- 22 Reidel and Byrne 1984: Bay Geomorphology. RC 119.
- 23 World Health Organisation 1984: WHO guidelines for drinking water quality.
World Health Organisation, Geneva.
- 24 USEPA 1985a: Ambient water quality criteria for copper - 1984.
EPA-440/5-84-031, PB 85-227023. USEPA, Washington.
- 25 Bougainville Copper Limited 1987: Disposal of Overburden and Tailings
Agreement Report No 49.
- 26 USEPA 1980: Ambient water quality criteria.
- 27 USEPA 1985b: Ambient water quality criteria for arsenic - 1984.
EPA-440/5-84-033, PB 85-227445. USEPA, Washington.
- 28 USEPA 1985c: Ambient water quality criteria for cadmium - 1984.
EPA-440/5-84-032, PB 85-227031. USEPA, Washington.
- 29 USEPA 1985d: Ambient water quality criteria for lead - 1984.
EPA-440/5-84-027, PB 85-227437. USEPA, Washington.
- 30 Bougainville Copper Limited: Disposal of Overburden and Tailings
Agreement Report No 46.
- 31 Bougainville Copper Limited: Disposal of Overburden and Tailings
Agreement Report No 47.
- 32 Bougainville Copper Limited 1986: Tailings and overburden agreement.
Data collection and monitoring programme. Report No 48.
- 33 Uwate, K R 1983: A report on the 'fish disease' situation in the Sepik
River, Papua New Guinea. Submitted to the Secretary of the Prime
Minister, Papua New Guinea.
- 34 Food and Agriculture Organisation 1986: Field and laboratory investigations
into ulcerative fish diseases in the Asia-Pacific Region. Technical
Report of FAO Project TCP/RAS/4508. FAO, Bangkok.
- 35 Food and Agriculture Organisation 1987: Epidemiological survey of a fish
disease spreading in South-east Asia. Terminal Statement prepared for
the participating governments. FAO, Rome.
- 36 Clarke, I 1977: Patterns in sequences of rainfall events. Report Number
ED 77/HY05.
- 37 Meynink, W J C 1982: Tailings transport in the Jaba River model develop-
ment. CRCE Report to BCL.
- 38 Meynink, W J C 1983: Sediment transport and hydraulic sorting in the Jaba
River. Proceedings of the DB Simons Symposium on Erosion and
Sedimentation, Colorado State University.
- 39 Meynink, W J C: Development of a tailings transport model. Conference
paper. Personal Communication.
- 40 CRC-Hydrocomp 1984: Sensitivity analysis CRC-Hydrocomp Jaba River model.
Report to BCL.
- 41 Meynink, W J C 1988: Comparison of observed and predicted bed levels.
Personal Communication.

- 42 Jeffery, J 1985: Modifications to the RIVCHEM computer chemical model.
File RC 148.
- 43 Jeffery, J 1987: A revised version of the RIVCHEM (River Chemistry) model
for use on IBM-PC compatible computers. ANSTO/C 68.
- 44 Jeffery, J 1985: Computer model predictions for soluble copper in the
Kawerong and Jaba rivers without in-river tailings discharge. File RB
299.
- 45 Jeffery, J 1985: RIVCHEM - a chemical model to compute concentrations of
copper in a river system receiving acid drainage from a porphyry copper
mine. File RB 300.
- 46 Ruppin, P 1986: Water quality in the Jaba River: predictions of copper
chemistry by RIVCHEM. File RB 320.
- 47 Jeffery, J 1983: Weathering of tailings in the new lysimeter at BCL -
lysimeter construction and the first four years of operation. File RB
225.
- 48 Jeffery, J 1983: Weathering of mine tailings in the old lysimeters at BCL.
File RB 227.
- 49 Jeffery, J; Marshman, N A 1983: Weathing of Bougainville mine tailings,
leaching column studies. File RB 211.
- 50 Marshman, N A 1983: Leaching study trials with fresh naturally deposited
tailings and a range of leaching solutions. File RB 242.
- 51 Jeffery, J 1985: Weathering of tailings in the new lysimeters at
Bougainville copper - 1984 update. File RB 293.
- 52 Jeffery, J 1985: Composition of tailings after 10 years of natural
leaching by rainfall. File RB 294.
- 53 Jeffery, J 1985: Adsorption of copper onto river sediment and tailings.
File RB 298.
- 54 Jeffery, J 1985: Release of copper from ex-mill tailings on mixing with
seawater. File RB 302.
- 55 Marshman, N; Simiha 1984: Use of the aquatic environment in the Empress
Augusta Bay Region made by the residents of Miwaraka and Koiare villages -
a preliminary survey. File RB 251.
- 56 Powell, J H 1987: The effect of mine tailings disposal on shallow coastal
benthos and tropical demersal fish assemblages. PhD Thesis, Zoology
Department, University of Queensland.
- 57 Archer, I M; Marshman, N A; Salomons, W 1986: Development of a revegetation
programme for copper and sulphide bearing mine wastes in the humid tropics.
- 58 Mada, E 1987: Seeding rate trial (Bato). BCL Report.
- 59 CRCE 1981: Lateral movement of groundwater - Jaba River tailings deposit.
- 60 Archer and Pairimu 1984: Plant species selection at BCL. BCL Report.
- 61 Berena 1984: Traditional uses of local plant species.

- 63 Bechtel-WKE 1969: Proposal for tailings disposal. BCL Report 022.
- 64 Dove, J; Miriung, T; Togolo, M 1974: Mining bitterness. In: Problems of Choice. Land in Papua New Guinea's Future. Edited by P Sack. Canberra.
- 65 Momis, J 1974: Taming the dragon. In: Problems of Choice. Land in Papua New Guinea's Future. Edited by P Sack. Canberra.
- 66 Jackson and Filer 1988: The social and economic impact of a gold mine at Lihir.
- 67 CRCE 1983: Jaba River Model Utility and limitations: an overview. Report to BCL (RC082).

APPENDIX I

TERMS OF REFERENCE

SCHEDULE 1

TERMS OF REFERENCE

OBJECTIVES

1. To determine the overall impact that mining operations at Panguna have had on the social and environmental aspects of the area.
2. To determine the likely future impacts of continued mining operations at Panguna on the environment and the people in the area, taking into account the tailings pipeline.
3. For the purpose of the study the Panguna mine will include the area within the Special Mining Lease, Tailings Lease area, Empress Augusta Bay, Road Lease, Port Facility and relevant villages in the surrounding areas.

SCOPE

1. To analyse and review results of all investigations to date:-
 - a. The physical and chemical nature of the waste input and the effluent streams.
 - b. The receiving water monitoring results for hydrology, including rainfall and streamflow, and chemistry.
 - c. The data relating to sediment transport and deposition and the sediment transport model.
 - d. The data relating to aquatic biology including all ecological aspects, trace metal content and resource utilisation.
 - e. The data relating to the terrestrial environment including revegetation trials and projects.
 - f. The data relating to dust, noise and other air quality criteria and public health in the mine and surrounding area.

- g. Any existing data relating to demography, health, nutrition and other social factors prior to mine operation.
- 2.2. To collect any data necessary to validate existing records of investigation:-
- a. The physical and chemical nature of the waste input and the effluent streams.
 - b. The chemical analysis of the receiving water.
 - c. The sediment transport, deposition and model.
 - d. The tailings pipeline with reference to the possibility of using the tailings to infill the swamp areas.
 - e. The relevant air quality criteria and noise pollution.
- 2.3. To review the reports and other information on socio-economic and public health impacts that mining operations have had including:-
- a. The demography and settlement patterns including changes due to re-location and migration.
 - b. The land use systems and natural resource utilisation both terrestrial and aquatic.
 - c. The cultural and social impacts, including business development, mine related payments, social disruptive influences, law and order.
 - d. The health and nutrition status of the population taking into account mine related condition and diseases and assess the adequacy of the health facilities and services.
 - e. The education (including facilities and services), employment and income levels of the people in the immediate area of the mine.
- 2.4. To formulate opinions for mitigating negative aspects and capitalising on positive aspects and recommend courses of action to cover the following:-
- a. The payment of compensation for mine related environmental impacts and social disruption.

- b. The possible relocation of houses/villages in the area.
- c. The improvement of the health, nutrition and social aspects (including education, road transport, power supply, water supply) of the people in the area.
- d. The possible benefits of the re-vegetation project including the tailings pipeline option and the possibility of using the tailings for swamp infill.

3. MANAGEMENT

- 3.1 The study will be Co-ordinated by the Department of Minerals and Energy.
- 3.2 The DME will be responsible for maintaining close liaison/consultation with other relevant PNG Government Departments and Bougainville Copper Limited.
- 3.3 The DME will be responsible for assisting in obtaining copies of all available relevant information where possible.

4. TIMING

- 4.1 The Study will commence on the 20th September 1988.
- 4.2 The Study will take place in 3 parts:-
 - a. Part I will be the initial visit to Bougainville by the Project Leader.
 - b. Part II will be field work by the full team in PNG.
 - c. Part III will be a presentation on Bougainville by the Project Leader.

5. REPORTING

- 5.1 The consultant will provide the DME with a Report by December 1988.