Institute of Geological Sciences

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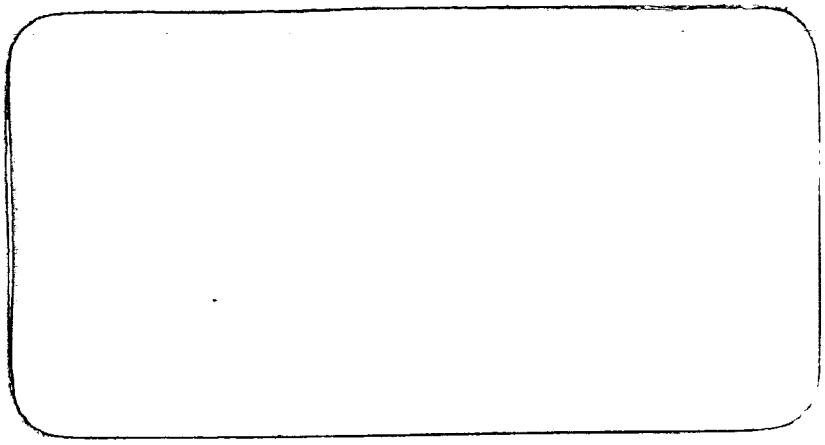

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REPORT ON VISIT TO ZIMBABWE 15-29 JANUARY 1982

by

C R Jones, OBE, AMN, BSc, PhD.

Report No 82/2

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ABBREVIATIONS

BGR	Bundesanstallt für Geowissenschaften und Rohestoffe
BRGM	Bureau Récherche Geologique et Minière
CIDA	Canadian International Development Agency

REPORT ON VISIT TO ZIMBABWE 15-29 JANUARY 1982

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1. INTRODUCTION

1.1 Plans to provide technical assistance to the Geological Survey of Zimbabwe under UK's independence pledge to Zimbabwe were briefly formulated during the visit of Mr I G Hughes to Salisbury in early 1981 (Overseas Division Report No 1981/1). Subsequently formal requests (A1 Forms) were received by ODA for an integrated geological mapping and mineral reconnaissance project in the extreme northeast of the country and help in completing and compiling standard geological sheets covering the Salisbury and Bulawayo areas where much work had been done by former officers who had left the Department.

1.2 At the request of ODA I visited Zimbabwe from 16 to 28 January, 1982 to discuss the requests in detail, to cost the work and to draw up the necessary Project Document. Prior to my visit I had a briefing in ODA with Mr Sands Smith who asked that, in addition to finalising the Project details, I should investigate the present position of the Geological Survey as regards staffing and operation and find out what assistance other aid agencies were giving to the Department. In particular I was asked to determine the position of the proposed Canadian assistance to undertake an airborne magnetic survey of the country in view of an early request by Zimbabwe for UK to fund such a survey. On arrival in Salisbury I was able to discuss the proposed Project with Mr P D Freeman, First Secretary (Aid) at the British High Commission and I had a further chance to brief him on the progress of my assignment before my departure.

1.3 I was greatly helped in my work by the generous assistance of the Director of Geological Survey, Mr E R Morrison, and his staff particularly Mr T J Broderick, Chief Field Geologist. I was able to appreciate the severe constraints under which the Department had operated over the last 10 years and the increasingly difficult position now being caused by the loss of experienced European staff. Mr Broderick also conducted me on a quick transect of the Northeast Project Area from which I was able to learn something of the geology and the logistic, security and health problems of the area. I was also able to have useful discussions with Ministry of Mines officials including the Secretary Mr C M Ushewokunze on the conditions of implementing the Project under the Technical Cooperation Memorandum of Understanding between UK and Zimbabwe. I also visited the Geology Department at the University of Zimbabwe where the Professor of Geology, J F Wilson, promised support with geological interpretation and I held discussions with Dr R Foster at the Institute of Mining Research on the assistance his organisation will provide in undertaking the preparation and analysis of geochemcial samples to be collected in the Northeast Area Project. I also visited local suppliers of Land Rovers and caravans and was able to brief British Council on the possible post-graduate training requirements which are likely to emerge from the Project.

1.4 The Project Document which includes a full costing is attached as appendix I to this Report.

2. STATUS OF GEOLOGICAL SURVEY DEPARTMENT

2.1 I was surprised to discover that in a country whose economy depends so much on mineral production that the Geological Survey Department receives only modest support from Government. I assume that the reason for this is that Zimbabwe's great mineral potential has been sufficient to attract private sector prospecting without the need for stimulation by an official Geological Survey. The Geological Survey is therefore a relatively small organisation and it is a great credit to the professionalism and dedication of its staff that so much excellent mapping has been completed. The Department does however render very useful assistance to small mine operators and three senior staff are involved in this work on a regional basis. There is also a small economic geology section which carries out investigations on specific mineralisation and identifies minerals for the public. However the fact that little regional geophysics has been carried out and that geochemical techniques have not been introduced as a routine procedure does make the Department decidedly backward in comparison with equivalent organisations in most developing countries.

2.2 Since Independence Government thinking has been turning increasingly towards greater involvement in the mining sector and plans are being formulated to set up parastatal corporations to control the sale of minerals and to undertake mineral exploration. Should these plans materialise private sector prospecting will probably decline and the position of the Geological Survey will undoubtedly rise in importance. The Director of Geological Survey has already been instructed to set up a mineral exploration unit to undertake prospecting in support of Government's new strategy.

2.3 Because of its main commitment in the past to traditional geological mapping carried out on a restricted budget the Department hardly possesses the logistical and financial capacity to carry out major regional surveys involving geochemical and other advanced procedures. The budget and operational infrastructure will need to be increased substantially if integrated regional surveys are to be effectively conducted in the future.

2.4 As a result of sanctions imposed during UDI and of economic constraints applying before and after Independence the Geological Survey is at present very poorly equipped to carry out work in the field and laboratory. As a result of the various technical cooperation projects about to commence in the Department new transport, field equipment and a wide variety of modern laboratory instruments will be acquired under the aid programme but this should not overshadow the need to provide for the procurement of a reasonable amount of new equipment in the Department's recurrent budget. Because of the peculiarly severe problems being experienced at the moment I am recommending that an unusually large number of items of field and laboratory equipment are provided as an accompaniment to the technical cooperation programme to enable the objectives to be achieved. The list has been drawn up in close consultation with the Director of Geological Survey and in consideration of equipment which other aid agencies are supplying to the Department.

2.5 The staffing situation in the Department has improved somewhat since Mr Hughes' visit a year ago. The present position is:

1 Director	:	E R Morrison
1 Dy Director	:	O K Bwerinofa
5 Sr Geologists	:	T J Broderick (Chief Field Geologist)
	:	C B Anderson (Sr Economic Geologist)
	:	D E Murangani (Regional Geologist Salisbury)
		C W Duke (Regional Geologist Gwelo)
		I Sutcliffe (Regional Geologist Bulawayo)
18 Geologists	:	S Kalpskopf (Mining)
		A J Fountain (Mapping)
		A Made (Remote Sensing)
		B N Ngwenya (Extended Sick Leave)
		N Baglow (Mapping)
		P Zhou (Geophysics)
		J Davies (Geophysics)
		S Simango (Mineral Exploration Unit)
		Mrs I Goromonze (Mineralogist Designate)
		9 Vacancies (3 possible recruits in pipeline)
1 Mineralogist	:	Dr A N Ncube

The improvement in recruiting geologists has allowed mapping to be re-started in the south part of the country and Mr A J Fountain, a young contract geologist from Britain, will act as counterpart to the Bulawayo Compilation Project. Most of the geologists are however young and inexperienced and it is hoped that the British Team will be able to arrange a number of seminars as part of the training excercise. The recent acquisition of 2 geophysicists will allow regional geophysics to be re-started and it is intended to continue with a national gravity survey which commenced in the early 1970's and which covered some 10 per cent of the country before the war prevented further work. This will however depend on procuring a second gravimeter. Landsat imagery interpretation has started in a simple way and plans are afoot to set up a Remote Sensing Centre to service various departments of Government with technical and financial help from Canada. Mr Made is the Remote Sensing Coordinator and has the task of formulating plans for the Centre.

2.6 Four honours geology students are expected to graduate from the University of Zimbabwe this year, six in 1983, eight in 1984 and ten in 1985. Although the mining industry will be the main attraction for employment it is expected that some will join the Geological Survey so that the recruitment position will almost certainly improve over the next few years. However the overall staffing situation in the Department is far from satisfactory with the remaining senior european staff expected to leave when suitable opportunities arise. At Independence a 5-year incentive scheme was introduced to induce europeans to remain in Government Service. The advantages of this scheme, which affect retirement benefits, improve during successive years but are lost entirely after the fifth year. The first three years of this scheme are now almost up so that there will be strong inducements for remaining permanent european staff in the Geological Survey to retire over the next 2 years. Should this happen the benefits of having a strong TC presence from UK to provide help and advice to the young and inexperienced indigenous staff will be appreciated. In my discussions with Mr Freeman I was infact asked if any of the senior staff on the Project would be able to provide the Ministry of Mines with advice on mineral policy and I was able to assure him that the Team Leader designate was competent in this field.

2.7 Because of the shortage of indigenous geologists and ministerial pressure to set up a Mineral Exploration Unit as part state involvement in the mining industry (Mr S Simango has been placed in charge of this work) full-time counterparts for the TC programme will not initially be available except for the Bulawayo Compilation Project. It is hoped that, as recruitment improves, counterparts will later become available for attachment to the Northeast Area Project.

2.8 Technical support in the Geological Survey remains strained especially in the Drawing Office where there are now only 2 european cartographers and 2 indigenous trainees out of an establishment of twelve. A further 3 trainees are expected in February, 1982 but they will initially have little impact on work throughput as they undertake a 3-year course at the Salisbury Polytechnic during their training period. There is a remaining european Chemist/Spectrographer in charge of the Chemical Laboratories but little modern instrumentation is available for analytical work except for a basic atomic absorption spectrophotometer (Varian AA 275) which is 2 years old.

3. OTHER AID TO THE GEOLOGICAL SURVEY

3.1 A number of aid agencies have responded positively to assisting the Geological Survey to upgrade its operational capabilities and technical facilities. Other mapping and mineral reconnaissance projects are either under way or planned and figure 1 which accompanies the Project Document indicates the areas alloted for projects by West Germany and France.

3.2 West Germany will undertake a mapping and compilation project in the south part of the country and will supply 2 geologists to carry out a sedimentological study of the Karroo coal deposits in the southwest. This 3-year programme is expected to start in June, 1982. West Germany will also provide equipment to the value of ₰ 362 000. The figure includes provision for transport, caravans and field equipment for a 6-man TC team from BGR. Laboratory and other equipment which will be acquired under this programme will be as follows:

GS Contribution of ₰ 120 000 towards XRF unit being purchased by Institute of Mining Research
1 Leitz Orthoplan polarising microscope with camera attachment
Polishing equipment for ore microscopy
Full set of gemmological equipment
Spectrospan sequential analyser
Thermostatic water bath
Accessories for AAS
UV spectrophotometer
Flame photometer
Chemical balance
Various glassware
Process camera for Drawing Office
Heavy-duty dye-line printer
Cromalin colour-proofing unit
Various drawing office equipment
Colour additive viewer for satellite imagery interpretation

3.3 France commenced a 3-year mapping and mineral reconnaissance project in the Mount Darwin area of north Zimbabwe in 1981. This work is being conducted on a short-term basis by 2 geologists from BRGM. Transport and field equipment is being supplied in this package but no other assistance is being given.

3.4 Canada has offered to undertake an airborne magnetic survey of the country and negotiations are at present under way. CIDA will also supply an expert to assist in the training of cartographers and has pledged to sponsor the setting up of a Remote Sensing Centre which will assist the Geological Survey Department in its work.

3.5 Rumania will supply 2 geologists one to be attached to the Mineral Exploration Unit and one to investigate limestone resources in the country.

3.6 North Korea has offered assistance and a 6-man team is currently in Zimbabwe reviewing aid opportunities in the Department.

3.7 The EEC will sponsor a coal study in relation to the future energy policy. A British-French-German team will visit Zimbabwe in 1982/83 to review all available data on coal deposits and to advise on future strategy.

4. CONCLUSIONS AND RECOMMENDATIONS

As a result of my investigations and various discussions in Salisbury I am able to arrive at the following conclusions and make the following recommendations.

i) The proposed TC Project will have a strong impact on the capability of the Geological Survey Department and will assist in the training of indigenous staff. In view of the run-down nature of the Department, its potentially important place in future parastatal mineral infrastructure and the offer by Canada to undertake the airborne magnetic survey I recommend that ODA supports the proposals made herein for assistance in the fullest possible way.

ii) Having reviewed the geology, mineral potential, logistic situation and the security and health positions in the proposed Northeast Project Area I am satisfied that, provided adequate planning is carried out and suitable precautions are taken, it will constitute a suitable area for the proposed integrated project.

iii) Should the security situation deteriorate before project implementation occurs, which is considered unlikely, I recommend that the integrated project be switched to one of the alternative areas which have been selected in discussion with the Geological Survey (and which are shown on figure 1 accompanying the Project Document). The position should be reviewed immediately on arrival in Zimbabwe of the Team Leader.

iv) Because of the wealth of field data already collected in the Salisbury and Bulawayo areas I am satisfied that the completion and compilation of geological sheets and accompanying reports for these areas are essential tasks of the Geological Survey which can only be completed by geologists very experienced in Archaean geology and fully familiar with map compilation and report writing. I recommend therefore that the Project should include two experienced TCO's to undertake these compilations for printing and publication by the Geological Survey as requested in the A1's.

v) Due to heavy work commitments on the Drawing Office over the next few years (including the preparation of the Salisbury and Bulawayo sheets) and its very reduced capacity due to staff shortages and also because of constraints in Salisbury on editing and printing services I recommend that contingency funds are provided in the Project for the preparation and printing, under contract, of the maps and reports

for the Northeast Project Area. However, I further recommend that the situation is reviewed by the Team Leader towards the end of the Project and that if, as agreed with the Director of Geological Survey, the situation has improved this work will be done by, and at the expense of, the Geological Survey.

vi) It is recommended that the Team Leader should be a very experienced officer who will manage the Northeast Project and will also supervise the work of the geologists engaged on the Salisbury and Bulawayo sheets. He should assist with the training of local geologists in the Geological Survey by arranging occasional seminars and should be in a position, if asked, to provide advice on mineral development policy to Government. It is further recommended that the Team Leader should be given temporary promotion to Senior Principal Scientific Officer and that a Deputy Team Leader should be designated who would receive a responsibility allowance.

vii) Because of supply problems in the area, the lack or poor condition of small but essential items of equipment for fieldwork in the Geological Survey and for other operational reasons, I recommend that local contingency funds of £1,000 per annum are made available to the Project and that the Team Leader is authorised to operate an imprest account covering this sum which would be reconciled annually at the British High Commission, Salisbury.

viii) A major international conference on gold mineralization in Precambrian rocks (Gold '82) is being held in Salisbury in May, 1982. It is recommended that, should the team not have become mobilised by this date, at least one of the designated team members should attend this meeting and go on the accompanying field excursions and that the necessary funding be made available for this purpose.

ix) Because of the poorly equipped nature of the Geological Survey laboratories I recommend that all the items of equipment listed in Appendix II, which are necessary for the successful execution of the TC Project, are provided from Project funds.

x) Locally assembled Land Rovers and locally manufactured caravans are available for early delivery in Salisbury and it is recommended that approval be given for the local purchase of these items so that field work may commence as soon as possible after arrival of the team in Zimbabwe.

xi) Because of the poorly equipped condition of the Geological Survey's Chemical Laboratories and the lack of modern analytical techniques being used I recommend that a visit be paid to the Department by a senior analytical chemist from the Institute of Geological Sciences' Analytical Chemistry Unit to advise on new equipment and the application of modern techniques. Meanwhile I am including a provision in the project costs of £20 000 to cover procurement of new equipment and reagents for the Chemical and Rock Preparation Laboratories.

5. SPECIAL OPTIONS FOR BRITISH MINING COMPANIES

5.1 I discussed with the Secretary of Mines and the Director of Geological Survey the question of British Mining Companies being given first options on the taking out of prospecting licences over promising areas discovered as a result of the TC Project in the northeast. I understand that a decision had been made that the projects being undertaken by UK, West Germany or France would confer no special privileges in these regards. Mining companies from the respective countries would be encouraged to apply for licences according to current regulations in the normal way. The progress and summary of results of the programmes will be published annually in the Annals of the Geological Survey and mining companies will be in a position therefore to review new data arising out of the projects and to take appropriate initiative.

6. ACKNOWLEDGEMENTS

I should like to thank Mr E R Morrison Director of the Geological Survey and his staff especially Mr T J Broderick for their time in discussions and valuable help and assistance while I was in Salisbury. Thanks are also due to Mr P D Freeman at the British High Commission and his assistant Caroline Gibson for their helpful advice and interest in the project.

Keyworth 1/2/82

C R JONES

Appendix I

PROJECT DOCUMENT COVERING BRITISH TECHNICAL COOPERATION TO THE GEOLOGICAL SURVEY OF ZIMBABWE

1. PREAMBLE

1.1 Following proposals made in 1981 for British Technical Cooperation to the Geological Survey of Zimbabwe in the areas of geological mapping, mineral reconnaissance, map and report compilation and training and the formal requests (A1 forms) for this assistance subsequently received from the Government of Zimbabwe this document sets out the technical specifications, equipment requirements, phasing and implementation logistics for the programme. It also provides costings for the Project to be borne by the UK Government and specifies the responsibilities of the Geological Survey in supporting the programme.

1.2 This Project Document is in two parts. The first part covers the integrated geological mapping and mineral reconnaissance programme in the northeast part of the country and hereafter termed the Northeast Area Project. The second part covers the proposal to assist the Geological Survey in compiling standard maps and bulletins for publication of areas round Salisbury and Bulawayo where extensive investigations have been made by several geologists who have since left the Department. This programme is hereafter referred to as the Salisbury and Bulawayo Compilations Project.

1.3 Costings are given individually for the two projects and an aggregate summary is given at the end of the document.

1.4 Accompanying this document is a map (figure 1) showing the project areas in relation to the areas being investigated under similar aid agreements with France and West Germany. It also shows the alternative areas selected for a British mapping and mineral reconnaissance programme in the unlikely event that the security situation prevents implementation of work in the northeast. The phasing of work in the areas selected for the three 1:100 000 geological sheets in the northeast area is also indicated.

1.5 There are sound economic and social justifications for the proposed TC programme. Zimbabwe has traditionally been a major mineral producer and the mining industry will continue to be a cornerstone of the country's economy for the foreseeable future. With Government's plans for the state to become more involved in the control of the mineral sector through the setting up of parastatal corporations it is anticipated that company prospecting will decline. A greater responsibility will therefore rest with the Geological Survey (with its new Mineral Exploration Unit) than hitherto in identifying target areas for future exploitation and in stimulating the declining private sector prospecting. The Geological Survey should therefore be strengthened to meet these new challenges. The basic job of the Department is to produce reliable geological maps which constitute the essential data-base on which all mineral development has its foundations. Geological maps also provide fundamental data for planning other industrial, urban and agricultural development and contain essential information for evaluating groundwater potential. Modern development and social improvement therefore depends heavily on the availability of reliable geological maps.

ALTERNATIVE UK PROJECT AREAS

FRENCH PROJECT AREA

NORTHEAST PROJECT AREA

SALISBURY COMPILATION AREA

WEST GERMAN SEDIMENTOLOGICAL STUDY AREA

BULAWAY COMPILATION AREA

WEST GERMAN PROJECT AREA

GEOLOGICAL SURVEY
OF
ZIMBABWE

Scale of Kilometres
20 0 20 40 60 80 100 120 140 160 180 200

INDEX OF MAPPING 1980

NOTE These maps are only obtainable from
DEPT. OF GEOLOGICAL SURVEY, BOX 8039, CAUSEWAY, SALISBURY

REFERENCE

- Mapped areas, published
- Mapped areas, not published
- Reconnaissance areas, published
- Reconnaissance areas not published
- B. Bulletin
- S.R. Short Report

Printed by the Government Printer, Salisbury.

Drawn in the Geological Survey Office, Salisbury.

FIGURE 1

2. NORTHEAST AREA PROJECT

2.1 Objectives

2.1.1 The aim is to undertake a geological survey and regional mineral reconnaissance of an area of approximately 8500 km^2 lying in the Rushinga, Mudzi, Mtoko, Shamva and Darwin Districts as shown in figure 1. The area is covered by approximately eleven 1:50 000 standard topographic sheets and has been divided into three areas marked 1, 2 and 3 on figure 1 for the purposes of producing 1:100 000 standard geological sheets. A second phase of the Project will involve the selection of geochemically anomalous areas for further investigation to ascertain whether surface or near surface prospective mineralisation exists. The results will be prepared for publication as three 1:100 000 coloured geological sheets each accompanied by a report describing the geology and mineral potential of the area for production in the Bulletin Series of the Geological Survey.

2.1.2 A parallel objective of the programme is to train Zimbabwe nationals through a) on-the-job training, b) the holding of seminars in the Geological Survey and c) post-graduate training at universities or other institutions in the United Kingdom.

2.1.3 The programme will also supply to the Geological Survey essential laboratory and field equipment to enable the work to be effectively executed and to improve the overall technical capability of the Department.

2.2 Geography, Access, Communications and Local Administration

2.2.1 The area is in the extreme northeast of Zimbabwe and is bordered by Mozambique on its north and east sides, by line of longitude 32°E on its west side and line of latitude 17°15'S on its south side. Hilly country occupies the southwest quadrant. A wide belt of low undulating terrain runs from east to west through the central part of the region. In the north are rugged mountain ranges. Two major rivers, the Mazoe and Nyadiri, drain eastwards through the centre of the region. Tributary streams are frequent and a fair number are perennial in the south but in the north stream beds are probably dry throughout the greater part of the year.

2.2.2 Nearly all the area is remote and poorly developed lying entirely within Tribal Trust Land. The A2 Salisbury to Blantyre highway traverses the southern part of the area. It is a first class tarred road running northeast to the Mozambique border at Nyamapanda and will provide the main access to the region. Elsewhere a fair number of all weather dirt roads and motorable tracks exists but there are some fairly large tracts of land in the centre of the region and to the south of the main highway which have no road access. In the west a tarred road connects Rushinga with Mount Darwin north of Salisbury and a dirt road runs to Mrewa east of Salisbury.

2.2.3 There is no town or supply centre in the area. Mtoko lying on the main highway some 20 km off the southern edge of the area is the administrative centre for the Mtoko and Mudzi Districts and will be the main supply and service centre for the south and east parts of the area.

Apart from the District HQ it has a police station, post office, fuel points, garage facilities, numerous shops and a market. Petrol may also be obtained from the police post at Nyamapanda on the border. Rushinga which is administered from Mount Darwin is an army cantonment and has no supply facilities. The main supply centre for the west side of the area will be Mount Darwin 60 km west of Rushinga.

2.2.4 There are numerous small settlements and fair tracts of cultivated land in the south and central parts of the area. Much of the region is however covered by dense brachystigia and mixed woodland through which it will be impossible to penetrate with vehicles. The north is the least developed. Local missions in the area would be helpful in case of emergency.

2.2.5 Local Government is through District Councils which are controlled by District HQ's at Mtoko, Mount Darwin and Mrewa. There are also a dozen or so tribal chiefs but they now play little part in local government. All District Councils will require briefing before fieldwork commences in their areas and it will be desirable to pay courtesy calls on tribal chiefs whose assistance might be helpful in executing fieldwork. There appears to be genuine interest amongst local inhabitants in the potential mineral wealth of the region and the project should receive considerable local support provided that proper publicity measures are taken before work commences.

2.2.6 There are no postal agencies in the area. The nearest post offices are at Mtoko and Mount Darwin where the monthly payment of temporary labour will probably be made. Although the Geological Survey does not operate a radio communication network with field parties it is considered desirable, because of the remoteness of the area, that facilities for local radio communication with base camp be provided.

2.3 Security

2.3.1 The whole region is now clear of dissident guerillas and the likelihood of infiltration of terrorists from Mozambique is considered remote by local police. Roads in the southern two thirds of the area are clear of land mines and tracks in the north are in the process of being cleared. Booby traps and antipersonnel devices exist along the Tetse Control Line and Frontier fences in the north and northeast. These areas should be avoided during the early years of the Project. Liaison should be maintained with police and district administrations on the security position when working in these areas.

2.4 Health

2.4.1 Malaria and bilharzia are endemic throughout the area. Prophylactic precautions against malaria should be observed and care taken in selecting campsites with good water supplies. Some boreholes exist and water from these should be used where possible. A water bowser will be hired from Central Mechanical and Equipment Department for transporting water. Trachoma is widespread in the central and north parts of the area and sensible hygene should be observed to avoid infection. Tetse fly incursion occurs along the Mazoe valley.

2.5 Maps and Aerial Photographs

2.5.1 Fourteen 1:50 000 scale Topographic sheets cover the area. Two 1:250 000 are also published. These maps are unrestricted and obtainable by the Geological Survey from the Surveyor General's Department.

2.5.2 Aerial photography is flown annually in Zimbabwe. The most recent photography is 1981 at a scale of 1:25 000. 990 photos cover tha area and are listed in Appendix IV. The Geological Survey has much older photography but it is desirable for the Project to have a set of the new photography. Photos are unrestricted and obtainable from the Surveyor General's Office at 78c per copy. Early ordering will be essential.

2.5.3 Prints of satellite imagery at 1:500 000 scale are available at the Geological Survey and equipment is being acquired for their interpretation.

2.6 Geology, Mineral Potential and Previous Work

2.6.1 The area is structurally complicated lying along the northeast edge of the Rhodesian Craton and about the junction zone of the Zambesi and Mozambique metamorphic belts. The structure, age and relationships of the various metamorphic groups are poorly understood.

2.6.2 In the southwest, granite and greenstones mark the undisturbed edge of the Rhodesian Craton. Immediately to the north is a wide belt of low undulating land composed of orthogneisses, migmatites and strongly metamorphosed greenstone remnants which are interpretated as deformed craton basement. Local centres reach the granulite facies of regional metamorphism. The mountainous northern part of the area is composed of east-west trending high-grade paragneisses of the Rushinga Group which rest on the deformed craton basement. Along the Mozambique boundary in the extreme north is a narrow east-west trending belt of anorthositic and calcareous paragneisses of the Kahire Group thought to be older than the Rushinga. Various dolerites, pegmatites and porphyry intrusions exist and a carbonatite complex is emplaced within the Kahire rocks at Gungwa.

2.6.3 The area appears to be one of favourable mineral potential. Some small mines have operated in the past and minor prospecting under licence is presently in progress over a small part of the area. The Sustskwe greenstone belt in the craton carries gold and copper. Along its margin with the deformed basement belt there occurs much pegmatitic impregnation and within this zone the old Benson mine was a major source of tantalite and microlite and also produced minor tin, beryl and scheelite. Greenstone remnants in the deformed craton basement have been mined for kyanite and mica and lead and zinc mineralisation is also known. The Rushinga paragneisses are prospective for gem corundum (rubies and emeralds), radio-active minerals and manganese and contain an important dolomitic marble at Rushinga which is quarried for fertiliser and paint manufacture. The Gungwa carbonatite is prospective for apatite, magnetite, rare earths and radio-active minerals. Copper showings are also known in this area.

2.6.4 The sketchy geology of the area is known from early reconnaissances and more recent photogeological interpretation based on the better known geology of neighbouring areas. Mr C Anderson, who is still on the staff of the Geological Survey, undertook detailed mapping in the southwest part of the area from 1969 to 1971 but most of the photographs containing his field observations were destroyed in a fire. A Dr Talbot of Leeds University's

School of African Geology investigated an area round Rusambo north of the Mazoe river as a PhD study in the early 1970's. There is no copy of his thesis at the Geological Survey.

2.6.5 Fairly good geological control exists from beyond the south and west boundaries of the area. Standard quarter degree maps and bulletins have been published for the neighbouring area to the west (The Geology of the Country around Mount Darwin by E G Leitner, Bulletin 73, 1974; The Geology of the Country around Shamva by P A Stidolph, Bulletin 78, 1977). Adjacent to the eastern part of the southern boundary detailed mapping of the Makaha Gold Belt was carried out by A M MacGregor in 1935 (Bulletin 28) and the area was re-mapped by I Chunnet in 1971. The surrounding area to the east and south has been mapped at the 1:100 000 scale by V.R C. Stocklmayer and is awaiting publication. Reconnaissance geological maps at the 1:250 000 scale are available for the country on the Mozambique side of the Frontier. No regional geochemistry has been carried out in the region or in the surrounding areas.

2.7 Procedures

2.7.1 Fieldwork is normally conducted in Zimbabwe from April to October when the weather is dry and cooler. Fieldwork will conveniently be operated from a number of selected base camps. Parts of the area cannot be reached by road and foot traverses using fly camps along streams will be necessary. The system which operates in the Geological Survey is for each geologist to be provided with 2 temporary labourers who act as field assistant and camp guard. The Geological Survey has been asked to seek funds to recruit additional labour for foot safaris and geochemical sampling when necessary. Four Land Rovers, 4 caravans and certain items of field equipment not obtainable from the Geological Survey will be provided from Project funds. Other items as listed in Appendix III will be supplied by the Geological Survey. The Geological Survey has no lorries on permanent hire from the Central Mechanical and Equipment Department but temporary hire will be possible at the beginning and end of the field season to assist in transporting equipment and specimens. If available, 500 gallon water and fuel bowsers will be hired from the Central Mechanical and Equipment Department.

2.7.2 Outcrop is good throughout the area and field mapping will be accomplished through photogeological interpretation and road and foot traverses using traditional hammer and compass methods. Field data will be recorded on the 1:25 000 aerial photographs. Fieldwork will be followed by the laboratory examination of rocks, chemical analysis of rocks interpretation of structures and the plotting of results at the Geological Survey Department in Salisbury where office accommodation and laboratory facilities will be provided. Additional equipment will be provided through the Project to upgrade laboratory facilities which are currently inadequate.

2.7.3 Mineral reconnaissance will be carried out through the collection of heavy minerals from stream sediments, systemmatic geochemical sampling of stream sediments and ratemeter observations. Drainage density is good throughout the area so that a fairly even density of geochemical sampling should be achieved. Heavy mineral collection will depend on the availability of water for panning. It is probable that most small streams will dry up during the winter so that panning may be confined over much of

the area to the early months of the field season. Separation and microscope identification of heavy mineral grains will be carried out at the Geological Survey where a magnetic separator is available. Some reagents will be supplied by the Project. It is estimated that the geochemical sampling programme will result in the collection of 10 000 samples. Arrangements have been made for preparation and analysis of samples to be carried out using newly acquired XRF equipment at the Institute of Mining Research. Procurement of the equipment was jointly financed by the Geological Survey and no charge will be made for this work. The following 20 metallic elements will be determined. Cu, Pb, Ni, Zn, Co, Au, Ag, V, G, Mn, Mo, Sn, Li, W, Nb, As, Sb, La, Bi and Be. Processing, interpretation and presentation of the results as individual element concentration diagrams will be carried out using a desk-top computer to be supplied by the Project. If an exploration geochemist is not included on the project staff assistance will be provided in geochemistry by the short-term attachment of a geochemist from the Overseas Division of the Institute of Geological Sciences.

2.7.4 Should time permit, or if the Project is considered worthy of being extended, follow-up work will be carried out on a selected number of promising geochemical anomalies to determine if surface or near surface mineralisation is present. This work will involve geophysics and intensified surface geochemistry followed by narrow core diamond drilling using a portable drill to be supplied by the Project. The geophysics will be carried out using appropriate methods by the short-term assignment of experts from the Applied Geophysics Unit of the Institute of Geological Sciences. Drill core material will be analysed at the Geological Survey to determine the type and amount of mineralisation present.

2.7.5 Very limited geochronology has been carried out on Zimbabwe rocks in the past and there are no facilities for undertaking isotopic age determinations in the country. Dating of the Precambrian rocks in the project area will be essential to establish the relationship between different units and to elucidate the history of deformation, igneous activity and metallogenesis. Collection of some 30-50 samples for age determination will be made with the assistance of a short-term expert from the Isotope Geology Unit of the Institute of Geological Sciences. Samples will be airfreighted to UK and determinations carried out in the Unit's laboratories in London.

2.7.6 Field and laboratory procedures in Zimbabwe will be conducted in conformity with "Notes for the Guidance of Field Staff" compiled by the Geological Survey.

2.8 Reporting and Publication of Results

2.8.1 The Team Leader will make brief monthly reports to the Director of Geological Survey summarising the progress of the Project. The Team Leader will also provide annually a summary of progress and results achieved for inclusion in the Annals of the Geological Survey. Assistance in the drafting of line diagrams for all such reports will be given by the Geological Survey.

2.8.2 1:50 000 draft geological maps will be compiled as the Project proceeds and reports for publication in the Bulletin Series of the Geological

Survey will be prepared on the geology and mineral potential of each of the three areas for which standard 1:100 000 geological sheets are completed. It is uncertain at present whether resources will be available in Salisbury for the maps to be prepared for printing and for both maps and reports to be printed locally. This is because of inadequate drafting and editing facilities in the Geological Survey and the limited availability of printing facilities at the Government Printers. The position will be reviewed as the Project proceeds but as a contingency measure project funds will be provided in the event that the work has to be contracted out.

2.9 Staffing Supervision and Phasing

2.9.1 A Team Leader and 3 geologists from the Overseas Division of the Institute of Geological Sciences on secondment to the Overseas Development Administration will staff the Project. The Zimbabwe Geological Survey will supply local counterparts when available. The Geological Survey will also provide funds for the recruitment of two local labourers per geologist to act as field assistants and camp guards and will also provide limited funds for occasional additional labour when required for foot safaris.

2.9.2 The Team Leader will manage the Project and will also supervise the two geologists assigned to Salisbury and Bulawayo Compilation Project. The Team Leader will be responsible to the Director of Geological Survey and will liaise closely with the Survey's Chief Field Geologist. The Regional Geologist responsible for Africa in the Overseas Division of the Institute of Geological Science will inspect the Project annually and discuss its progress with the Director of Geological Survey and the Secretary for Mines.

2.9.3 The Project will begin approximately in mid 1982 and last for 3 years. Because of easier access in the south and the security situation in the north fieldwork will be implemented in 3 separate phases. These will coincide with the proposed 1:100 000 geological sheets as shown in figure I starting with the sheet covering the southwest part of the area, followed by the southeast sheet and ending with the northerly sheet.

2.10 Training

2.10.1 Transfer of technology is acknowledged as an important part of technical cooperation in developing countries. Training will be imparted to local staff by the Project in 3 ways:

i) Through the provision by team personnel of occasional seminars at the Geological Survey.

ii) On-the-job training to counterparts in the field and laboratory.

iii) The provision of post-graduate scholarships to promising counterpart staff at British universities or technical institutions following completion of the Project. Such scholarships, lasting for up to 2 years, will be administered by the British Council on behalf of the Overseas Development Administration

2.11 Obligations of the Geological Survey and other Zimbabwe Government Organisations

2.11.1 The obligations of the Government of Zimbabwe to British technical cooperation projects are broadly specified in a Memorandum of Agreement between the two countries signed on 19 September 1980. The Geological Survey will give logistic support to the Project in accordance with their standard field procedures and have sought the necessary extra financial provisions in the Recurrent Budget for this purpose. The Geological Survey will supply certain field articles as specified in Appendix III. The Geological Survey will also supply laboratory services for slide preparation and chemical analyses. The Institute of Mining Research will carry out geochemical preparation and analyses at no cost. The Geological Survey will provide drafting services as the Drawing Office as capacity permits. The normal services provided to Geological Survey by other Government Departments such as the Police for supplying fuel and the Central Mechanical and Engineering Department for the maintenance of transport will cover the Project. The Ministry of Mines will administer import, export and immigration requirements for project personnel equipment. The Ministry of Mines will issue letters of identification and authority to project personnel which will include a statement making provision for free medical attention at Government hospitals.

2.11.2 Local field allowances and mileage claims (if a private vehicle is used) will be paid to project personnel by the Geological Survey at current Zimbabwe Government rates. Provision has been made in the project funding for field allowances to be topped up to the UK rates applicable to Zimbabwe (30 per cent of Salisbury rate). Rent allowance will be paid monthly by the British High Commission.

2.12 Costing

2.12.1 Residential Staffing

Staff Costs assume that each officer is married with two children of boarding school age. The figures are at January 1982 levels and no allowance is made for equipment or short term support work.

	Year I	Year II	Year III	Year IV	Total
Salaries and Allowances					
SPSO	39820	35065	39415	10124	124424
PSO	33143	28388	32738	7456	101725
SSO	29429	24674	29024	4895	88022
SSO	29429	24674	29024	4895	88022
TOTAL	131821	112801	130201	27370	402193
Travel and Subsistence					
SPSO	6107	7971	6107		20185
PSO	4539	5755	4539		14833
SSO	4887	6103	4887		15877
SSO	4887	6103	4887		15877
TOTAL	20420	25932	20420		66772
Housing	16400	17890	17890		52180
GRAND TOTAL	168641	156623	168511	27370	521145

2.12.2 Short-term Staffing

	Year I	Year II	Year III	Total
Salaries and Allowances				
SPSO	1090	1090	1090	3270
PSO	1147	11735	11735	24617
Travel and Subsistence				
SPSO	2143	2143	2143	6429
PSO	1614	3127	3127	7868
UK Laboratory Work	-	10915	10915	21830
GRAND TOTAL	5994	29010	29010	64014

2.12.3	Field Equipment (Appendix II)	87799
2.12.4	Office and Laboratory Equipment (Appendix II)	67252
2.12.5	Conferences	5000
2.12.6	Training Awards	20000
2.12.7	Contingencies (including provision for preparation and printing of maps and bulletins if necessary)	70000
	TOTAL	835210

3. SALISBURY AND BULAWAYO COMPILATION PROJECT

3.1 Objectives

3.1.1 The aims of this programme are to complete the mapping and to compile standard 1:100 000 geological sheets for publication of areas around Salisbury and Bulawayo over which considerable amounts of field data have been collected in the past. Since this fieldwork was undertaken staff have left the Geological Survey and no sufficiently experienced officers are available to finalise the work. The job will also involve the compilation of reports on the geology and mineral potential of the respective areas for publication in the bulletin series of the Geological Survey. Accounts of the mineral potential will be based on known mineralisation: no geochemistry is planned.

3.1.2 On-the-job training will be given to local staff who may be assigned as counterparts to the Technical Cooperation Officers implementing the work in the respective areas.

3.2 The Salisbury Compilation Area

3.2.1 The Salisbury compilation sheet will comprise some 4200 km^2 of lines of longitude 30° 45'E and 31° 30'E and lines of latitude 17° 30'S and 18°S is shown in fugure 1. The area is covered by six 1:50 000 topographic sheets.

3.2.2 Most of the area has been covered and only check traverses and some more detailed coverage in the northeast is required. This fieldwork is expected to take about 2 months.

3.2.3 The area lies wholly within the Rhodesian Craton. A broad greenstone belt folded into a synclinal structure swings southwards and then eastwards through the region and is flanked on the south and northeast by craton granites. The stratigraphy of the greenstone belt has been worked out in fair detail but within the granite to the northeast occur macrozenolithic remnants of greenstone and it is the relationships of these bodies to the main belt which require further investigation.

3.2.4 Maps and reports on about half the area have been published. A reconnaissance map and accompanying report on the Arcturus mining area was produced by H B Maufe some 70 years ago (The Geology of the Enterprise Mineral Belt, Bulletin 7, 1913). Part of the northwest portion of the area was mapped by J C Ferguson at the 1:100 000 scale using a plane-table base-map (The Geology of the Country around the Jumbo Mine, Bulletin 33, 1937). A 1:50 000 map of the area immediately round Salisbury was compiled to accompany a brief explanation of the geology by R Tyndale-Biscoe in 1957 (Short Report No 36). Since this work was published extensive detailed mapping has been carried out mainly during the mid 1970's (refer to 1:50 000 sheets 1-6 shown on figure 1). A Clay completed sheet 1 and no further work is required. R Hatherly covered most of sheet 4 and some check traverses are needed. V R C Stocklmayer carried out extensive investigations on sheets 2 and 5 and only check traverses and some more detailed work in the north are necessary. P A Stidolph covered most of sheets 3 and 6 but considerable filling in is required in the north. The Chinamora batholith, part of which extends into the northeast part of the area, was investigated by P Snowdon for a PhD thesis a copy of which is in the Geological Survey library. Detailed maps and field notes together with a large number of

rock specimens requiring detailed petrography have been collected together for the compilation exercise in the Geological Survey.

3.3 The Bulawayo Compilation Area

3.3.1 The Bulawayo compilation sheet will comprise some 4200 km^2 of country around Bulawayo bounded by lines of longitude 28° 15'E and 29°E and lines of latitude 20°S and 20° 30'S as shown in figure 1. The area is covered by six 1:50 000 topographic sheets.

3.3.2 Far less detailed mapping has been completed in this area than in the Salisbury compilation area and correspondingly more fieldwork will be required in order to complete the compilation. One young geologist from the Geological Survey is already mapping in the area and will act as counterpart to the Technical Cooperation expert assigned to the Project.

3.3.3 The area lies wholly within the Rhodesian Craton. A broad greenstone belt with complicated folding strikes southeast through the central and eastern parts of the area and is flanked on the east and south sides by craton granites. A large pluton is also emplaced within the greenstone belt. The stratigraphy of the greenstone belt which contains a prominent ultrabasic formation is imperfectly understood and will require detailed evaluation.

3.3.4 Some old 1:100 000 mapping by F L Amm covers the northern three quarters of the area (Geology of the Country around Bulawayo, Bulletin 35, 1940). The mapping used a plane table base and the interpretation of the geology is rudimentary. More recent work is limited (refer to 1:50 000 sheets 1-6 shown on figure 1). Professor J Wilson of the University of Zimbabwe re-interpretated the geology of sheets 3 and 6 according to modern concepts in 1973/74 and Mr A J Fountain of the Geological Survey is in the process of mapping sheet 5. Mr Fountain will continue to work on the Bulawayo sheet as counterpart to the Technical Cooperation Officer. Detailed mapping is also in progress in the Filibusi area to the east of the sheet and Mr N Baglow, another young geologist from the Geological Survey, who is undertaking this work will also be available to assist in the compilation work. Fieldwork required for the compilation will occupy 1-2 field seasons and will be directed to revision mapping and re-interpretation of the greenstone belt geology on sheets 1, 2 and 4 and detailed mapping of the craton granites along the southern edge of the area.

3.4 Staffing and Timing

3.4.1 The Salisbury and Bulawayo compilations programme will be implemented concurrently with the Northeast Area Project and will start in mid 1982. It is agreed with the Geological Survey that the Salisbury compilation will take 2 years to complete and that the Bulawayo compilation will take 3 years to finalise.

3.4.2 One senior British geologist experienced in Archaean geology will be assigned to each of the two compilation programmes under Technical Cooperation terms. The officer in charge of the Salisbury compilation will be based in Salisbury and the officer covering the Bulawayo compilation will be based in Bulawayo. A counterpart will be attached to the Bulawayo programme. The Team Leader of the British team will supervise the work of both compilation geologists.

3.5 Procedures

3.5.1 Both compilation geologists will undertake, as necessary, check traverses and detailed mapping employing traditional hammer and compass techniques and using facilities provided by the Geological Survey Department. Mapping will be carried out in conformity with 'Notes for the Guidance of Field Staff' issued by the Geological Survey. Laboratory and compilation work will be carried out at the Salisbury and Bulawayo offices of the Department. Such facilities as are not available at Bulawayo (chemical analyses, slide making) will be carried out at Salisbury. Final draft maps and manuscripts will be prepared for delivery to the Geological Survey for printing and publication.

3.6 Obligations of the Geological Survey

3.6.1 The Geological Survey will supply transport and field equipment for the execution of necessary field work and will provide office and laboratory facilities in support of the work. Some items of equipment such as hammers and microscopes will be procured from Project funds. The Geological Survey will supply at least one counterpart for the Bulawayo compilation. Field allowances and subsistence during field work will be paid at current Zimbabwe Government rates by the Geological Survey. The normal support for field operations given by other Government departments to the Geological Survey will extend to the compilations programme.

3.7 Costing

Staff Costs assume that each officer is married with two children of boarding school age. The figures are at January 1982 levels and no allowance is made for housing, equipment or short term work.

3.7.1 Salisbury Compilation Project (PSO)

	Year I	Year II	Year III	Total
Salaries and Allowances	33143	32738	4972	70853
Travel and Subsistence	4539	4539	-	9078
Housing	4100	4473	-	8576
TOTAL	41782	41750	4972	88507

3.7.2 Bulawayo Compilation Project (PSO)

	Year I	Year II	Year III	Year IV	Total
Salaries and Allowances	33143	28388	32738	7456	101725
Travel and Subsistence	4539	5755	4539	-	14833
Housing	4100	4473	4473		13046
TOTAL	41782	38616	41750	7456	129604
GRAND TOTAL	82564	80366	46722	7456	218111

4. COSTING SUMMARY

	Year I	Year II	Year II	Year IV	Total
Northeast Project					
Residential Staffing	168641	156623	168511	27370	521145
Short-term Staffing	5994	29010	29010	-	64014
Salisbury/Bulawayo Compilation					
Residential Staffing	82564	80366	41750	7456	218111
Equipment					155051
Conferences					5000
Training Awards					20000
Contingencies					70000
			GRAND PROJECT TOTAL		1053321

Appendix II

LIST OF FIELD AND LABORATORY EQUIPMENT

Field Equipment

	£
4 Racal Mobile Radios and Accessories at £3000 each	12000
3 Land Rover Pick-up (local assembled with canvas canopy, 2 spare wheels, auxiliary petrol tank, ring tow hitch and 5 pin plug) at £8470 each	25410
1 Land Rover Station Wagon (local assembled with 2 spare wheels auxiliary petrol tank, ring tow hitch and 5 pin plug) at £9569	9569
4 Campavan Field Caravans (Government Model) with standard fittings, canopy and tarpaulin at £5705 each	22822
8 Jerry Cans at £15 each	110
4 Comprehensive Tool Kits at £150 each	600
4 High Lift Jacks at £25 each	100
4 Gas Cookers at £75 each	300
4 Refrigerator (gas) at £300 each	1200
1 Deep Freeze (paraffin) at £400	400
3 Portable UV Lamps at £500 each	1500
4 Rate Meters at £1200 each	4800
1 Portable Winkie Drill and accessories at £4000	4000
2 Baromec Survey Barometers at £200 each	400
12 2lb Geological Hammer at £16 each	192
6 Compass/Clinometer at £18 each	108
6 Pocket Stereoscope at £10 each	60
6 Tin Trunks at £30 each	180
8 Camp Chairs at £6 each	40
2 Camp Tables at £15 each	30
4 Stretcher Beds at £18 each	72
4 Mattresses at £8 each	32
4 Tents at £400 each	1600
4 Mosquito Nets at £10 each	40
4 Water Filters with spare candles at £30 each	120
4 Tilley Lamps with Spare Mantles at £28 each	112
6 First Aid Kits at £25 per kit	150
4 12v Neon Table Lamps at £10 each	40
4 Rucksacks at £20 each	80
6 Clip Boards for Aerial Photographs at £5 each	30
6 Hand Lenses at £3 each	18

	£
4 Prospecting Pans at £60 each	240
4 Field Seives at £60 each	240
10000 Geochemical Sample Bags	200
1000 Specimen Bags	26
24 Field Note Books at £5 each	120
2 Rolls Tracing Medium at £52 per roll	104
6 Sets Verithin Coloured Pencils at £4 each	24
4 Steel Tapes at £20 each	80
1000 Aerial Photographs of Area	650
	87799

Office and Laboratory Equipment

6 Petrographic Microscopes at £3000 each	18000
1 Zoom Binocular Microscope at £1500	1500
1 Set of Seives and Automatic Shaker at £1500	1500
1 Point Counter at £2000	2000
1 Sketch Master at £2000	2000
2 Mirror Stereoscopes at £1000 each	2000
6 Proportional Dividers at £2 each	12
6 Sets Rotring Drawing Pens at £40 each	240
1 Research Machines Ltd Microcomputer Model 380Z and Accessories	10000
Various Instruments and Fittings for Chemical Laboratory to be determined by visit of Chemist	25000
Various Consumable Reagents for Chemical Analysis and Rock Preparation	5000
Total	67252

APPENDIX 3

LIST OF EQUIPMENT TO BE SUPPLIED TO THE PROJECT BY THE GEOLOGICAL SURVEY OF ZIMBABWE

No.	Field Instruments	No.	
.....	BAROMETER, aneroid (No.)	.....	HELMET, miners
.....	BINOCULARS	..✓..	JERRY CAN, metal (very old)
.....	CLINOMETER RULE	..✓..	JERRY CAN, plastic
.....	COMPASS, Brunton (No.)	.....	JERRY CAN SPOUT
.....	COMPASS, Prismatic (No.)	.....	LAMP, CADAC
.....	COMPASS, Wilkie (No.)	.....	" gas cylinder(s)
.....	HANDLENS	..✓..	LAMP, HURRICANE
.....	TAPE (100'/30m)	.....	LAMP, TILLEY
.....	.....	..✓..	MACHETE
.....	.....	..✓..	MAP CASE, cylindrical
.....	.....	..✓..	MATTRESS, felt
.....	.....	.....	MOSQUITO NET
	Camp Equipment	..✓..	PICKAXE
..✓..	AXE, felling	.....	RUCKSACK
..✓..	AXE, hand	..✓..	SHOVEL, round/~~square nose~~
..✓..	BADZA	..✓..	SICKLE
..✓..	BASIN, aluminium	..✓..	STRETCHER, hounsfield
..✓..	BASIN, elamel	..✓..	TABLE, metal 4'6" x 2'6"
..✓..	BATH, galvanised	..✓..	TABLE, metal 3' x 2'
.....	BOX, ba[illegible]ack (Trunk)	.....	TENT, 15' x 15'
..✓..	BOX, medicine	..✓..	TENT & FLY, 12' x 10' (No.)
.....	BOX, stationery	.....	TENT, BELL (No.)
..✓..	BUCKET, galvanised	.....	TENT, misc. (No.)
.....	BUCKSAIL	.....	TENT, PATROL (No.)
..✓..	CHAIR, folding	..✓..	WATERBAG, canvas
..✓..	CHURN	.....	WATER FILTER
..✓..	COOKING POT, 3 leg	.....	.....
..✓..	COOKING POT, other	.....	.....
..✓..	GAS CYLINDER (9,5 kg & larger)	.....	CHEMICAL TOILET
.....	GAS REGULATOR	.....	.....
..✓..	GRASS SLASHER	..✓..	HESSIAN
.....	HAMMER, geological	.....	.....
..✓..	HAMMER, 4 lb.	.....	.....
.....	HAMMER, 14 lb.	.....	.....
.....	HAVERSACK, small	.....	.....

I certify that the above equipment is in good and serviceable condition. I undertake responsibility against its loss or damage in the event of which full payment for such items will be made by myself.

TJB/PME

Signature: .....

APPENDIX 4

NORTHEAST PROJECT AREA : LIST OF 1981 AERIAL PHOTOGRAPHY

MOUNT DARWIN 1981 — 1/25 000 Photography

1.	176-191	-	15
2.	218-240	-	22
3.	271-296	-	25
4.	324-354	-	30
5.	381-415	-	34
6.	443-478	-	35
7.	506-541	-	35
8.	570-622	-	52
9.	652-704	-	52
10.	732-780	-	48
11.	808-854	-	46
12.	884-928	-	44
13.	956-1000	-	44
14.	1028-1072	-	44
15.	1100-1150	-	50
16.	1178-1222	-	44
			620

MTOKO - 1981 — 1/25 000 Photography

1.	28-72	-	44
2.	100-144	-	44
3.	171-215	-	44
4.	247-295	-	48
5.	324-371	-	47
6.	401-448	-	47
7.	475-524	-	49
8.	553-600	-	47
			370
		+	620
	TOTAL	=	990

Budget for 1 000 photographs at 0,78c each. i.e. 70c + 12% Sales Tax.

Government copyright to be waived.

T.J. Broderick

T.J.BRODERICK
SENIOR FIELD GEOLOGIST

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