3. 資　料　編

1) マレイシア政府 Terms of Reterence

2) 地形図作成に関する基本資料

3) ダム候補地点の地形図

4) 地形，地質調査に関する積算資料

1) Terms of Reference

UNIT PERANCANG EKONOMI
Economic Planning Unit
JABATAN PERDANA MENTERI
Prime Minister's Department
JALAN DATO' ONN
KUALA LUMPUR 11-01
MALAYSIA

Telephone: 200133
Cable: ECONOMICS
Telex: EPUPM MA 30098

Ruj. Tuan:
Your Ref:

Ruj. Kami:
Our Ref: (76)dlm.UPE.SULIT.
73/1/10 Vol.XI

Tarikh:
Date: 29th April, 1982.

URGENT/BY HAND:

Mr. K. Takada,
First Secretary,
Embassy of Japan,
6th Floor, AIA Building,
Jalan Ampang,
KUALA LUMPUR.

Dear Mr. Takada,

Request for Japanese Assistance for Kedah, Perlis and Pulau Pinang Regional Water Resources Study and Feasibility Study on Dam Project(s)

I am writing to officially request, on behalf of the Government of Malaysia for technical assistance from your Government under the Japan International Cooperation Agency's (J.I.C.A.) Development Survey Programme to undertake the Kedah, Perlis and Pulau Pinang Regional Water Resources Study and Feasibility Study on a Dam Project(s).

.... 2. The Terms of Reference for the studies are attached herewith for your perusal and onward transmission to Tokyo. In giving due consideration to this request, we trust that it will in no way affect the decision pending on the other requests already submitted to your Government for assistance under J.I.C.A.'s Development Survey Programme.

3. We hope that this request merits favourable consideration by your Government. Any assistance you could render in this matter would be much appreciated. Thank you.

Yours sincerely,

(WONG PEG HAR)
for Director General
Economic Planning Unit

Copy to:

Mr. N. Abe,
Resident Representative,
Japan International Cooperation Agency (J.I.C.A.),
23, Jalan Ampang Hilir,
KUALA LUMPUR.

WPH/rs.

REGIONAL WATER RESOURCES STUDY MALAYSIA
AND TERMS OF REFERENCE FOR THE KEDAH/
PERLIS/PULAU PINANG REGIONAL WATER
RESOURCES STUDY

A. INTRODUCTION

1. The National Water Resources Study has entered its final phase, with the Draft Final Report of the Study on Peninsular Malaysia presented to the Government in Malaysia in December 1981, the Water Resources Development and Use Plan for Sabah and Sarawak to be finalised by June 1982, and the Final Study Report to be presented by the end of 1982.

2. The Study has identified several water stress regions in Peninsular Malaysia where early action is required on the preparation of a firm medium-term (20 years or so) programme based on the notional programme formulated during the National Water Resources Study stage for the development of water resources in an orderly and timely fashion in order to solve water shortage problems. The water stress regions are:-

(i) Perlis/Kedah/Pulau Pinang region

(ii) Klang Valley region

(iii) Malacca/Muar region

(iv) South Johore region

Water stress regions in Sabah and Sarawak may also be identified during the final phase of the Study.

3. Specific regional water resources studies are being taken up by the Government of Malaysia as necessary at present. Some of these studies could be considered for technical cooperation.

4. Of these regions the Perlis/Kedah/Pulau Pinang region is deemed to have the most serious water problems at present. Indeed water is fast becoming a limiting factor to the socio-economic development in this region. With a view to alleviating pressing water problems, the Government of Malaysia has initiated two source development projects in the State of Kedah, namely, the Ahning Dam Project and the Jeniang Transfer and Naok/Reman Water Storage System Project. However, even when fully implemented these two projects will not meet the water demand in the region beyond 1985. It is therefore necessary to initiate action to carry out a regional water resources study as soon as possible with a view to formulate a

definite water resources development programme covering the States of Perlis, Kedah, Pulau Pinang and part of Perak State.

B. TERMS OF REFERENCE FOR KEDAH/PERLIS/PULAU PINANG REGIONAL WATER RESOURCES STUDY AND FEASIBILITY STUDY ON DAMS

5. Study Area

The study area is located on the west coast of Peninsular Malaysia and comprises the States of Perlis, Kedah and Pulau Pinang of some 10,000 km^2 and a part of the State of Perak.

6. Background

6. Problems and Needs

The States of Kedah and Perlis together supply about half of the Peninsular Malaysia's demand for rice. The total area under padi cultivation is about 167,900 ha, out of which 95,900 ha lie within the Muda Agricultural Development Authority (MADA) area. A further 16,600 ha of padi land outside MADA area are provided with irrigation facilities under DID schemes.

Irrigation for padi cultivation is the largest water user in the two states and almost all the irrigation water is supplied by two major river systems, namely, the Pedu/Padang Terap river which flows into Kedah river and the Muda River. The double cropped padi of MADA is supplied with water from two storage dams constructed at the upper reaches of Pedu river and Muda river, with a total catchment area of 1,156 km^2.

In addition to the padi areas in Kedah and Perlis, a sizable padi area in the State of Pulau Pinang, amounting to about 7,000 ha, also depends on the Muda river for irrigation.

The State of Pulau Pinang is the second most industrialized state next to the State of Selangor with a gross value of manufacturing output of about M $ 2 billion in 1980. The water use for industrial and domestic purposes mainly depends on Muda river and Perai river.

There are 3 main areas of demand for water and these are:

(1) The Perlis and Kedah river basins comprising the MADA areas of 95,900 ha with an irrigation water demand of about 1,700 million m^3/yr, and minor irrigation areas, outside MADA of about 19,000 ha with a projected irrigation water demand of

about 300 million m^3/yr by 1990. At the same time, domestic and industrial water demand in the area has been projected to reach about 34 million m^3/yr by 1990.

(2) The Muda river basin, downstream of Muda dam, having minor padi areas of about 22,500 ha in both the States of Kedah and Pulau Pinang with a projected irrigation water demand of about 540 million m^3/yr, and a projected domestic and industrial water demand of about 26 million m^3/yr by 1990.

(3) The southern part of the State of Pulau Pinang having an aggregate irrigation area of about 7,000 ha with an irrigation water demand of about 250 million m^3/yr in 1990.

At present, shortage of water is periodically experienced in almost all the padi areas during dry seasons. MADA does not have enough water from the existing storage reservoirs to satisfy its own demand. The domestic and industrial water uses in the States of Kedah and Pulau Pinang also suffer from shortage of supply. The condition of water shortage is expected to worsen as water demand grows rapidly in these areas.

Rivers in the three States, and the Rivers Perlis, Kedah and Muda in particular, overflow their banks from time to time, inundating vast area of land, thereby causing damage to crop and property. Flood damage in the future will be more severe as land use intensifies.

Currently, no serious problem of river water quality has been reported. In the future, however, it is likely that the water quality of rivers will degrade due to the inflow of increasing volume of domestic and industrial effluents, which will affect water supply and endanger public health.

6.2 Present Supply System of Water

The States of Perlis, Kedah and Pulau Pinang depend for their supply of water on the rivers of Perlis, Kedah, Merbok, Muda, Perai, Kerian and other rivers. Among the rivers, Muda river has the biggest catchment area with the biggest supply potential. Currently, the MADA area which lies in the States of Kedah and Perlis is supplied with water from the Muda river through the Pedu-Muda system as well as the rivers of Kedah and Perlis. The Muda river also supplies the States of Pulau Pinang with water

for domestic and industrial uses as well as irrigation use.

6.3 National Plan for Regional Water Resources Development

The National Water Resources Study undertaken as a technical cooperation project between the Government of Malaysia and the Japan Government has proposed a conceptual plan for the development of water resources of the Kedah-Perlis-Pulau Pinang Region. Eleven dams, 1 barrage, 4 water transfer facilities, channel improvement of the rivers Perlis, Kedah and Muda and pollution abatement measures comprising sewerage and palm oil and rubber disposal systems are included in the development plan with a view to alleviating the problems of water shortage, flood hazard and river water quality degradation. The Rui dam, one of the proposed 11 dams, is located on Rui river in the State of Perak. Water will be transferred from the reservoir to Ketil river, a tributary of Muda river for augmenting the flow in the latter river. General layout of the proposed facilities is shown in Fig. 1. Among the proposed facilities, the Ahning dam and Jeniang, Naok, Reman project, Mengkuang I & II project will be implemented during the Fourth Malaysian Plan period, but more source development is necessary for meeting the water demand up to 1990 and beyond. The Study has identified this region as priority area, for water resources development in view of the water shortage problem and has recommended that a detailed water resources study be carried out for this region.

7. Objectives of the Study

The proposal by the National Water Resources Study has been based on a general macro study and the various components (dams, water transfer channels, etc.) of the regional water resources development plan are only notional. In the absence of engineering survey and investigation only rough estimates were made of the capacities of the various proposed facilities, the feasibility of which have yet to be established.

The first objective of the Study is therefore to formulate and firm up a regional water resources development plan for the States of Kedah, Perlis and Pulau Pinang based on the conceptual plan proposed by the National Water Resources Study. The recommended plan should form the basis for undertaking the various water resources development projects in a timely fashion up to the years 1990 and 2000. The second objective is to carry out

the feasibility study on a dam project or projects which will be identified and which need to be implemented at an early stage in order to resolve pressing water problems.

8. Scope of Work

In order to achieve the objectives set out in Section 3 above, the Consultants shall perform all technical studies and field investigations taking into account available data and information as well as previous study findings and reports. It is intended that the Study will be undertaken in 2 parts. Part 1 shall cover a regional water resources study for the States of Kedah, Perlis and Pulau Pinang. Part 2 shall cover a feasibility study on a dam project or projects that need to be implemented at an early date.

Currently, feasibility study is being conducted for the Ahning dam and construction of Mengkuang dam will be commenced in the near future. Data and results of these studies should be incorporated in the Study. Similarly data and results of other relevant studies that may be carried out should also be incorporated in the Study.

8.1 Part 1 - Regional Water Resources Study

8.1.1 Collate existing data and information of present domestic and industrial water supply facilities, water pollution abatement measures, irrigation facilities, water source facilities including the Pedu-Muda transfer system, flood mitigation facilities and other relevant facilities.

8.1.2 Collate existing data and information of the future development plan for domestic and industrial water supply, water pollution abatement, irrigation water supply, water source facilities including both surface and groundwater facilities and flood mitigation.

8.1.3 Collate and review existing data and information of future socio-economic framework of the region including demographic characteristics of the region and gross value of manufactured products.

8.1.4 Collate and review existing data and information for the domestic and industrial water demands.

8.1.5 Collate and review existing data and information of irrigated and irrigable areas by source of water supply.

8.1.6 Collate and review existing data and information of irrigation water demand.

8.1.7 For assessing flood damage, collate and review existing data of historical flood events and collect supplementary data.

8.1.8 Examine existing meteorological and hydrological observation systems. Set up additional stations, if necessary, and collect additional data.

8.1.9 Examine existing and additional meteorological and hydrological data and analyze low flow and flood discharge records.

8.1.10 Review groundwater development potential.

8.1.11 Examine the possibility of South Thailand water diversion, on the basis of existing topographical maps including if necessary, sites visits arranged by the Government of Malaysia.

8.1.12 Determine river maintenance flow and water quality standard at key stations in all rivers concerned.

8.1.13 Analyze regional water demand and supply balance.

8.1.14 Carry out necessary topographical survey, geological and engineering soil investigations for the proposed dams and reservoir sites, diversion intakes, transfer canals and other major structure sites proposed in the National Water Resources Study.

8.1.15 Carry out necessary topographic survey for the river improvement sites and flood prone areas including, if necessary, flood mapping.

8.1.16 Carry out necessary reconnaissance, technical and cost comparisons of various alternatives for the proposed dams, transfer canals, river improvement works, pollution abatement and other major facilities and select the most suitable plan.

8.1.17 Prepare layout design of the selected facilities.

8.1.18 Study probable adverse and beneficial impacts of the proposed dams/diversions/barrages development.

8.1.19 Prepare outline cost estimates of the proposed facilities and determine the priority order for the implementation of proposed projects to cope with the water demand.

8.1.20 Evaluate the benefits of the selected facilities from the economic, social and environmental veiwpoints resulting from the increase of irrigation, domestic and industrial water supplies, flow regulation, flood mitigation, hydropower and pollution abatement.

8.1.21 Prepare proposals for the integrated operation and management of the existing and proposed source facilities including Pedu-Muda reservoirs.

8.1.22 Study and recommend institutional arrangements including organizational structure and responsibility for implementing and managing the proposed water resources system in accordance with policies and principles of the Federal and State Governments.

8.1.23 Study and recommend an appropriate legal framework for the effective implementation of water resources development.

8.1.24 Prepare a master plan report for regional water resources development.

8.2 Part 2 - Feasibility Study

8.2.1 Carry out necessary topographic survey, geological and engineering soil investigations for the proposed dam project or projects including dams, tunnels and other pertinent works, and other major structure sites.

8.2.2 Locate and investigate suitable sites for borrow materials for construction works.

8.2.3 Set up additional meteorological and hydrological stations, if necessary, and collect additional data for hydrological study. Estimate design flood discharge and sediment deposit at the proposed damsites.

8.2.4 Prepare feasibility cost estimates based on the breakdown of quantities and unit price analysis.

8.2.5 Evaluate the benefits of the selected scheme from the economic and social viewpoints resulting from the increase of irrigation,

domestic and industrial water supplies hydropower, pollution control and flow regulation.

8.2.6 Study the probable environmental impact of the dam project or projects.

8.2.7 Prepare a feasibility report to the standard suitable for appraisal by international financing agencies incorporating economic, financial, social and environmental analysis as well as sensitivity analysis.

9. Reports

The Consultants shall commence work within fifteen days upon the receipt of Notice to Proceed and shall prepare and submit the following reports.

9.1 Inception Report

The report shall be submitted within one month from the date of the commencement of the work in thirty copies and shall contain detailed statement of the proposed work procedures and work schedule for both Part 1 and Part 2 Studies.

9.2 Interim Report

This report shall be submitted within nine months from the date of the commencement of the work in fifty copies and shall contain the following:

(1) Water demand projections for 1990 and 2000 including irrigation and domestic and industrial water within the region.

(2) Recommendation on feasibility study on a dam project or projects to be implemented at the early stage.

(3) Recommendation on additional studies for subsequent project implementation.

9.3 Draft Final Regional Study Report

This report shall be submitted within twenty-four months and shall contain the summary of all works performed for the Regional Water Resources Study and the findings and recommendations of the Consultants, including

maps, plans and diagrams.

9.4 Final Regional Study Report

This report shall be prepared and submitted within one month after the receipt of the comments on the Draft Final Regional Water Resources Study Report by the Government of Malaysia, incorporating all the revisions deemed appropriate after considering the comments. The final report, however, shall be submitted within 28 months.

9.5 Draft Final Feasibility Study Report

This report shall be submitted within twenty-six months and shall contain the summary of all works performed for the Feasibility Study and the findings and recommendations of the Consultants, including maps, plans and drawings.

9.6 Final Feasibility Study Report

This report shall be prepared and submitted within one month after the receipt of the comments on the Draft Feasibility Study Report by the Government of Malaysia, incorporating all revisions deemed appropriate by the Consultants after considering the comments. This report shall be suitable for presenting to an institution for the purpose of project financing and shall be submitted within 28 months.

10. On-the-Job Experience

The Government may wish to assign one or more professional staff to the Consultants for on-the-job experience with the project. A decision will be made on this matter at the time of contract negotiations and the Consultants should be prepared to accomodate the Government's requirements in this regard.

WORKS TO BE UNDERTAKEN BY GOVERNMENT

Where possible, the Government of Malaysia will endeavor to undertake the following works:-

2.1 Preparatory Works and Access Roads

The Government will provide the Consultants with an explosive licence for conducting ground control and seismic surveys and other work as required and will construct temporary access roads to the proposed damsites and other major structure sites for the purpose of the Study.

2.2 Survey

Longitudinal and cross-section survey

Cross-section will be taken at 500 m intervals.

Part 1

Certain stretches of Perlis, Kedah, Muda, Perai and Pinang rivers and Merbok and Perlis conveyance channels.

Part 2

Facilities to be developed under Feasibility Study

2.3 Laboratory Test

The Government will carry out through its agency or by employing a contractor the laboratory test for earth materials and concrete aggregate for feasibility level designs.

2.4 Forestry Survey

The Government will conduct necessary survey and evaluate the need for clearing the storage reservoirs and other major construction sites.

2.5 Data, Materials and Facilities

The Government will endeavor to make available and/or assist the Consultants to obtain all existing relevant records, data, reports, plans, topographic maps and aerial photographs required for the Study.

In connection with work by the Consultants that requires cooperation with other Government and quasi-government departments, authorities and agencies, liaison will be provided to enable the Consultants to gain access to all information required for the completion of his services.

The Government will assist in the provision of immigration clearance and work permits for expatriate personnel assigned to the project.

22 Sep. 1982 from Mr. Sieh

2） 地形図作成に関する基本資料

Name of Dam: Beris Catchment Area: 115 km^2 Grid Ref.: QT054610
Access: Accessible by footpath

Grid Ref.	Sheet No.	Trig Station (ft)	Spot Height (ft)	Bench Mark
QT092525	8	Bt. Dada Ayam (1,467)		
QT197563	9	Bt. Jelutong II (3,291)		
QT047604	8		750	
QT052594	8		Bt. Jeram Katam (833)	
QT064597	8		Bt. Damar (1,108)	
QT067589	8		Bt. Serunai (1,185)	
QT068563	8		Bt. Pdg. Tiras (1,007)	
QT076557	8		593	
QT083567	8		304	
QT096563	8		294	
QT109567	8		341	
QT109638	8		Bt. Damar (806)	
QT118580	8/9		241	
QT129549	9		1,359	
QT131561	9		844	
QT139628	9		319	
QT137647			1,337	
QT136543	9		1,875	
QT148528	9		Bt. Wu Semerliang (2,443)	
QT153546	9		1,463	
QT152593	9		Bt. Sayap (2,119)	
QT152608	9		817	
QT158639	9		1,069	
QT159587	9		1,977	
QT166548	9		2,394	
QT178572	9		2,890	
QT173626	9		1,568	
QT188612	9		1,652	
QT182617	9		1,630	
QT198598	9		Bt. Teientang Batong (2,118)	
QT207584	9		2,838	

Name of Dam: Sari Catchment Area: 61 km^2 Grid Ref.: QN933060
Access: Accessible by Motorable track

Grid Ref.	Sheet No.	Trid Station (ft)	Spot Height (ft)	Int. Stage Boundary
QN858072	1		1,897	
QN869089	1		Bt. Damar Tox Mat (1,716)	
QN867103	1		1,535	
QN876066	1		1,550	
QN886110	1		1,405	
QN901061	1		716	
QN901118	1		1,913	
QN095902	1		1,030	
QN912152	1		o 2,409	
QN913049	1		783	
QN919162	1			o 2,331 (28A)
QN917129	1		1,580	
QN926152	1		o 2,063	
QN922048	1		857	
QN933083	1		637	
QN933117	1		1,060	
QN941148	1			o Chong 96 Baping (Way) (29)
QN961134	1	Bt. Kon Man (2,499)		

Name of Dam: Durian Catchment Area: 75 km² Grid Ref.: QO022065
Access: Accessible by motorable track and ffotpath

Grid Ref.	Sheet No.	Trig Station (ft)	Spot Height (ft)	Int. Stage Boundary
QO966119	1		1,921	
QO976137	1		2,340	
QO988082	1		Bt. Ngukm (1,261)	
QO991126	1		1,725	
QO933142	1		1,756	
QO994142	1		1,885	
QO992112	1		690	
QO993072	1		914	
QO991131	1		1,540	
QO011153	1		615	
QO018131	1		Gemting Paling (876)	
QO017088	1		616	
QO017156	1			No. 30
QO019161	1		Khuam Ghu (714)	
QO024120	1		Bt. Goh Lembu (1,492)	
QO025112	1		1,231	
QO024100	1		1,258	
QO029069	1		534	
QO031161	1			No. 31
QO042180	1		Khukm Pheaw (971)	
QO047088	1		1,167	
QO047079	1		1,364	
QO050188	1			No. 32
QO056199	1		637	
QO052137	1		Bt. Badong (672)	
QO056103	1		1,299	
QO062208	1	Khukm Met (1,057)		
QO062202	1			No. 33
QO062130	1		1,178	
QO061121	1		1,158	
QO069162	1			Geming Pahat No. 34 (S20 ft)
QO070142	1		1,281	
QO071157	1		1,182	
QO073152	1			No. 35
QO070142	1		1,281	

Name of Dam: Badak Temin Catchment Area: 114 km^2 Grid Ref.: QN757133
Access: Accessible by road

Grid Ref.	Sheet No.	Trig Station (ft)	Spot Height (ft)	Int. Stage Boundary
QN766217	152			No. 25 (348 ft)
QN961217	152		Bt. Tangga (718)	
QN758175	152		Guar Siring (287)	
QN754156	152		Bt. Bucuh Telang (579)	
QN759142	152		206	
QN772201	152		608	
QN773172	152		353	
QN779140	152		Bt. T. Genting (205)	
QN786221	152		265	
QN787221	152			No. 26 (2,714)
QN792160	151		431	
QN393143	152		255	
QN810187	152			No. 27
QN805167	152		190	
QN805157	157		270	
QN803137	152		261	
QN812183	152		602	
QN820127	1		814	
QN820110	1		1,123	
QN827181	1		882, Khuam Ko Pie	
QN826149	1		771	
QN838156	1		369	
QN839120	1		248	
QN831085	1		2,333	
QN849183	1		Khgo Hua Lkm (1,176)	
QN843137	1		1,196	
QN847131	1		1,411	
QN843100	1		1,470	
QN843067	1	Bt. Lebam Husein (2,472)		
QN853178	1		1,243	
QN858149	1		1,012	
QN857119	1		1,252	
QN857072	1		1,897	
QN269150	1		1,823	
QN868101	1		1,535	
QN867070	1		Bt. Dkwar Tok Mat (1,716)	
QN878151	1		1,265	
QN880176	1		2,063	
QN886120	1		1,405	

Name of Dam: Badak Temin Catchment Area: 114 km^2 Grid Ref.: QN757133
Access: Accessible by road

Grid Ref.	Sheet No.	Trig Station (ft)	Spot Height (ft)	Int. Stage Boundary
QN896170	1			1,460, 28 (TS)
QN899137	1		1,887	
QN901112	1		1,913	
QN904150	1		2,067	
QN910160	1		2,409	

Name of Dam: Tawar Muda Catchment Area: 135 km^2 Grid Ref.: QT112708
Access: Accessible by footpath

Grid Ref.	Sheet No.	Trig Station (ft)	Spot Height (ft)	Bench Mark
QT075821	8	Bt.		Masjid
QT092821	8		1,010	
QT096804	8		708	
QT095745	8		828	
QT103841	1		775	
QT100833	8		804	
QT108819	8		692	
QT109789	8		698	
QT104766	8		780	
QT119841	1		1,208	
QT112772	8		214	
QT115746	8		164	
QT123780	9		604	
QT136833	9		1,558	
QT139775	9		1,243	
QT138733	9		871	
QT135716	9		1,373	
QT136698	9	Bt. Terbil (860)		
QT148807	9		1,713	
QT149789	9		982	
QT143760	9	Bt. Tenevi (1,312)	1,312	
QT153769	9		1,223	
QT156754	9		1,072	
QT166807	9		1,033	
QT166736	9	Bt. Hangus (944)		
QT175789	9		1,366	
QT184776	9		1,061	
QT178121	9		1,163	
QT198742	9		1,199	
QT195725	9		1,414	
QT216724	9		1,844	

Name of Dam: Rui Catchment Area: 250 km^2 Grid Ref.: QY363147
Access: Accessible by footpath and river

Grid Ref.	Topo Sheet No.	Trig Station (ft)	Spot Height (ft)	Bench Mark (ft)
QY199008	30	G. Bintang (6,110)		
QY201033	30		(5,574)	
QY200046	18	G. Birtang Utara (6,020)		
QY209065	18		(5,014)	
QY216087	18	Bt. Baubak (3,934)		
QY219081	18		(4,043)	
QY217992	30	G. Bintang South (5,118)		
QY226013	30		(4,275)	
QY228997	30		(4,284)	
QY234033	30		(3,766)	
QY231088	18		(3,655)	
QY241077	18		(3,526)	
QY249038	18		(2,694)	
QY242024	30		(3,746)	
QY247990	30		(3,278)	
QY247967	30		(3,862)	
QY257004	30		(3,525)	
QY254063	18		(3,272)	
QY258084	18		(3,294)	
QY264068	18	(3,105)		
QY263016	30		(3,162)	
QY269957	30		(4,505)	
QY261948	30	G. Bintang False		
QY279975	30		(3,424)	
QY271102	18		(1,556)	
QY275116	18		(1,711)	
QY277127	18		(1,880)	
QY284143	18		(2,389)	
QY279152	18		(1,503)	
QY277167	18		(2,447)	
QY289186	18		(2,990)	
QY281107	18		(1,640)	
QY288046	18		(1,161)	
QY285027	30		(1,407)	
QY289012	30		(1,832)	
QY281998	30		(3,198)	
QY296964	30		(3,568)	
QY290986	30		(3,206)	

Name of Dam: Rui Catchment Area: 250 km^2 Grid Ref.: QY363147
Access: Accessible by footpath and river

Grid Ref.	Topo Sheet No.	Trig Station (ft)	Spot Height (ft)	Bench Mark (ft)
QY299038	18		(2,582)	
QY294106	18		(1,177)	
QY299199	18	Bt. Damar II (2,956)		
QY301088	18		(1,218)	
QY303078	18		(1,362)	
QY307031	30		(2,721)	
QY317977	30		(2,835)	
QY311009	30		(2,880)	
QY313073	30		(1,021)	
QY327193	18		(2,639)	
QY321102	18		(1,274)	
QY322066	18		(1,358)	
QY327990	30		(2,844)	
QY334033	30		(1,170)	
QY331039	30		(1,386)	
QY344185	18		(1,949)	
QY346142	18		(647)	
QY346135	18		(695)	
QY342120	18		(758)	
QY342101	18		(1,519)	
QY345103	30		Garting Kekabu (1,302)	
QY359073	18		(1,950)	
QY354110	18		(1,920)	
QY363102	18		(1,625)	
QY373095	18		(1,614)	
QY378027	30		(2,281)	
QY384058	18		(2,285)	
QY383068	18		(2,605)	
QY390037	18		(2,634)	
QY397030	30		(2,880)	

Appendix 1 RESERVOIR SITES AREAS AND REQUIRED AERIAL PHOTO MAPPING AREAS

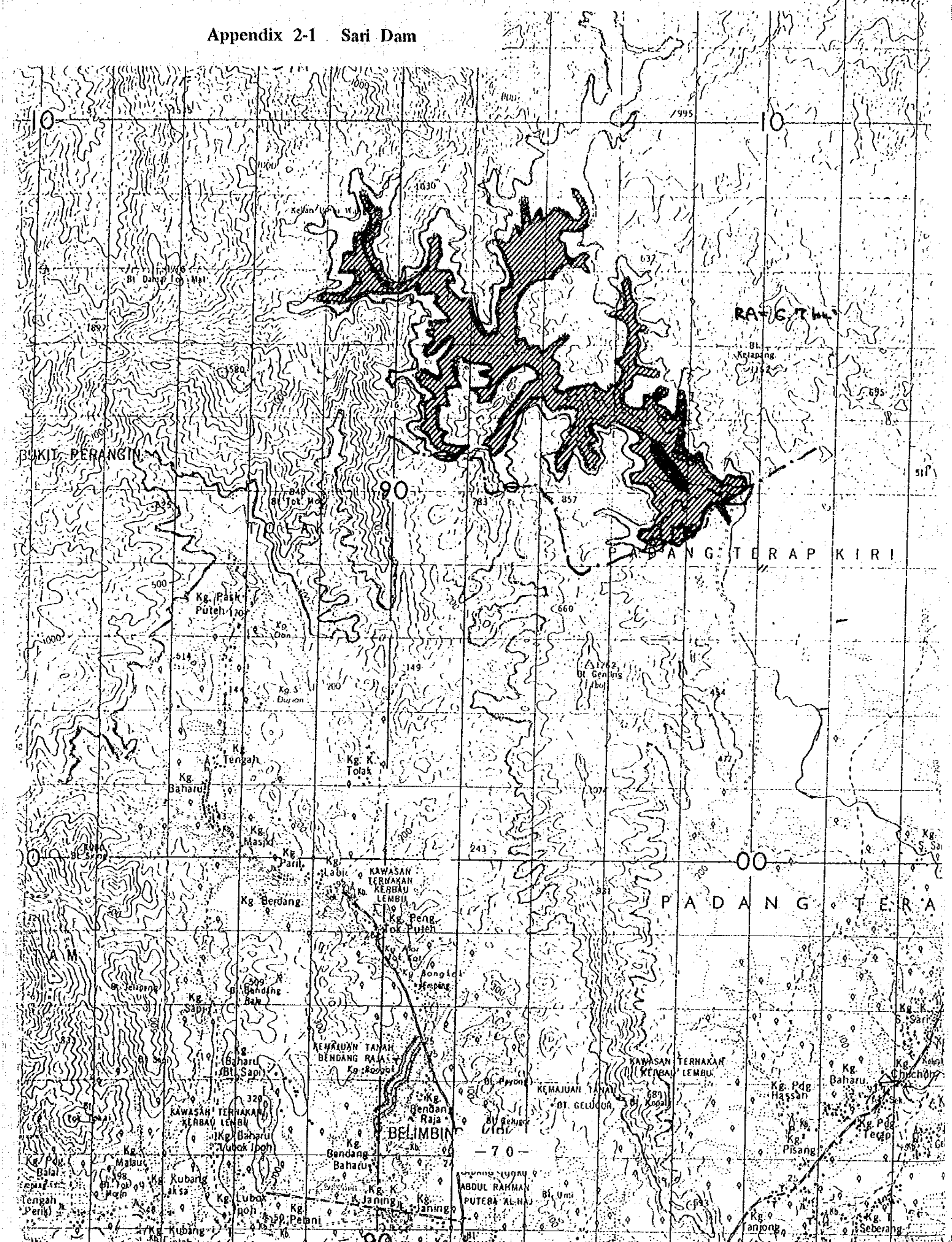
Name of dam	Length of Dam Axis (km)	Proposed Reservoir Area (km^2)	Required Mapping Area (km^2)	Elevation (ft)
Badak-Temin	1.3	4	4	100
Sari	1.1	3	6.7	300
Durian	0.3	3	6	200
Beris	0.3	6	10	200
Tawar Muda	0.9	7	10	250
Rui	0.8	4	32	900
Total		27	69	

Remarks; (1): Length of the dam axis is the sum of the length of main and saddle dam axes in case of Sari and Tawar Muda dams and the sum of the length of main and alternative dam axes in case of Badak-Temin and Rui dams.

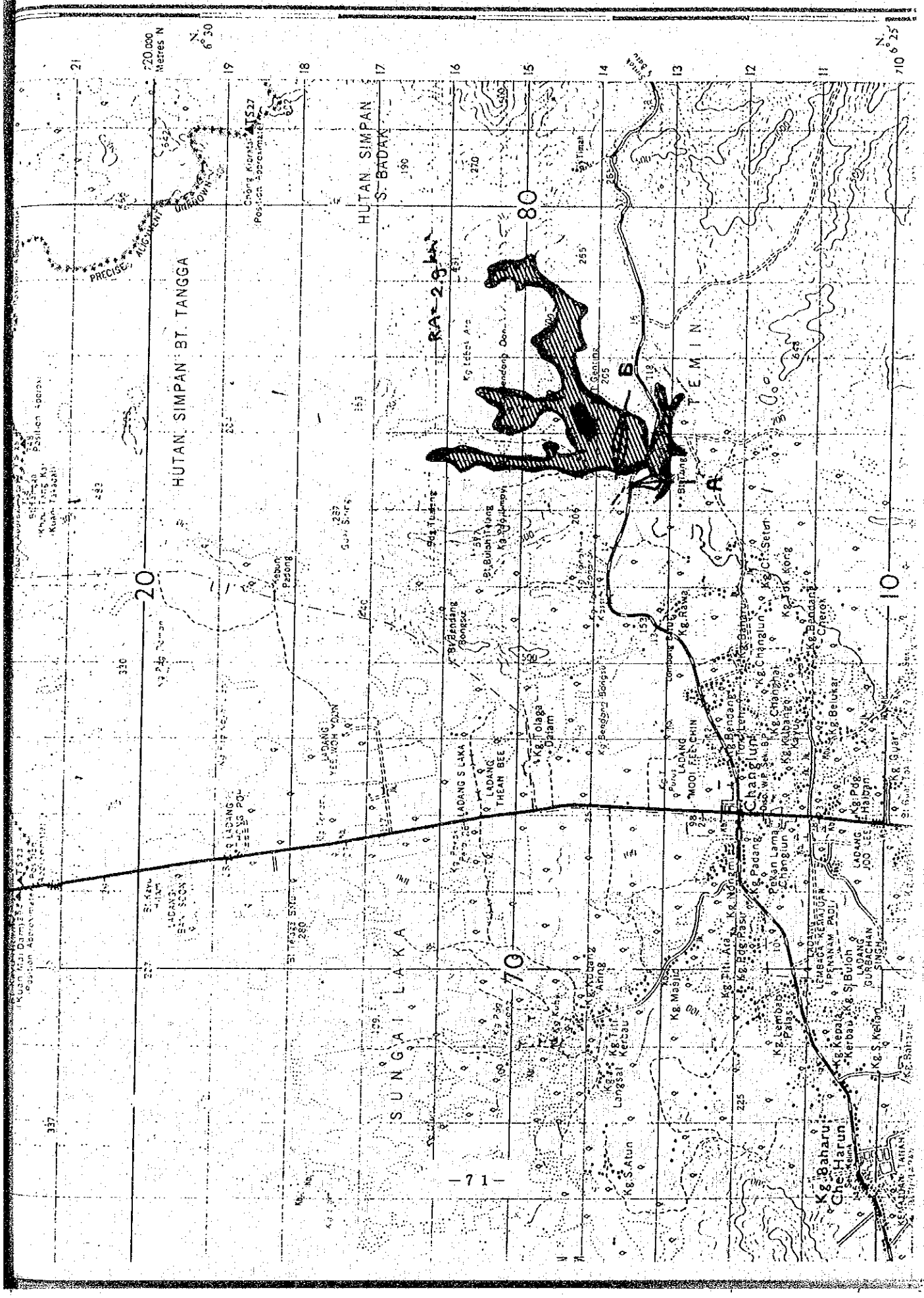
(2): The above costs are as of 1982 and inclusive of all cost components.

Appendix 2 DAMS AND RESERVOIRS AREAS

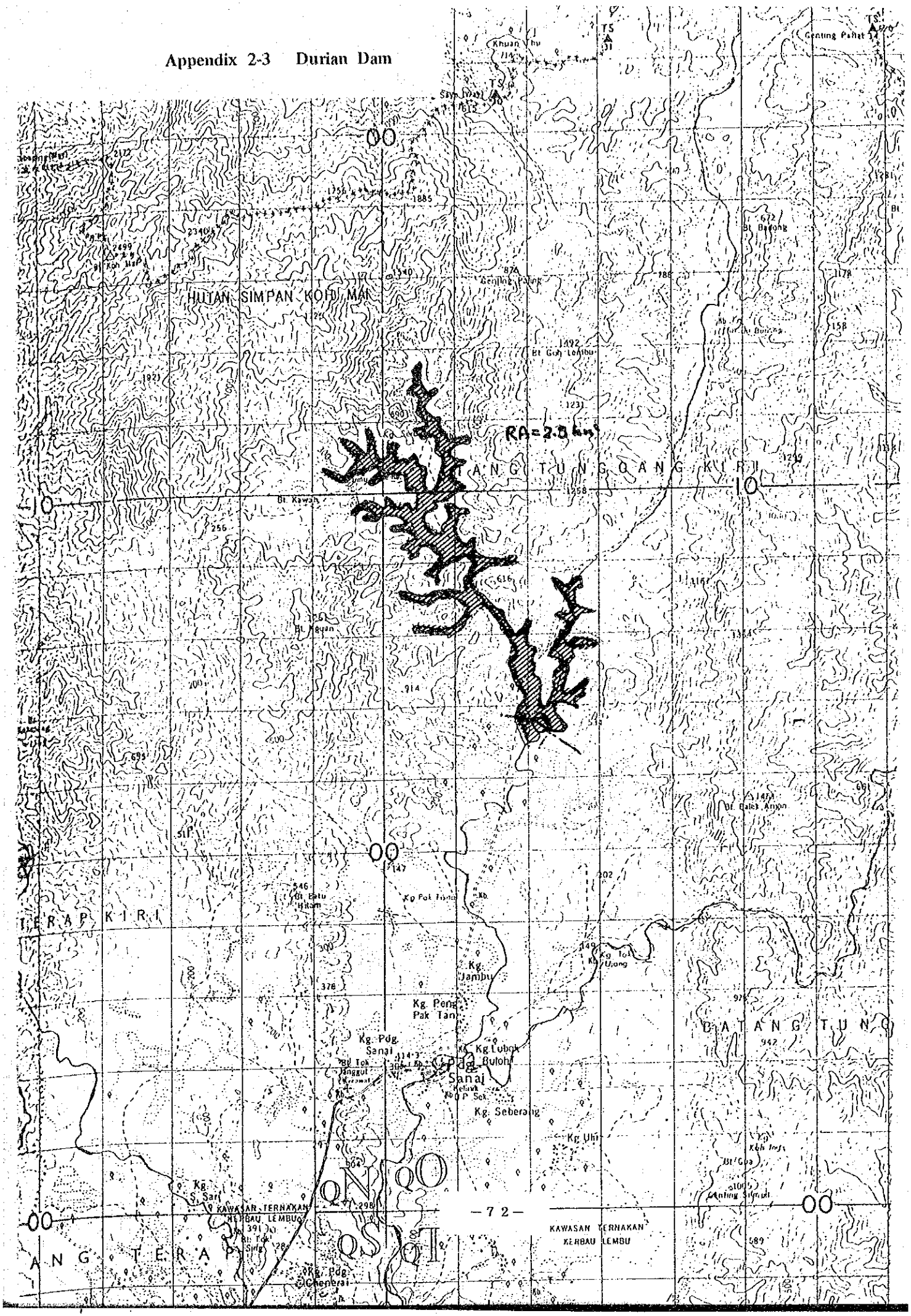
Appendix 2-1 Sari Dam



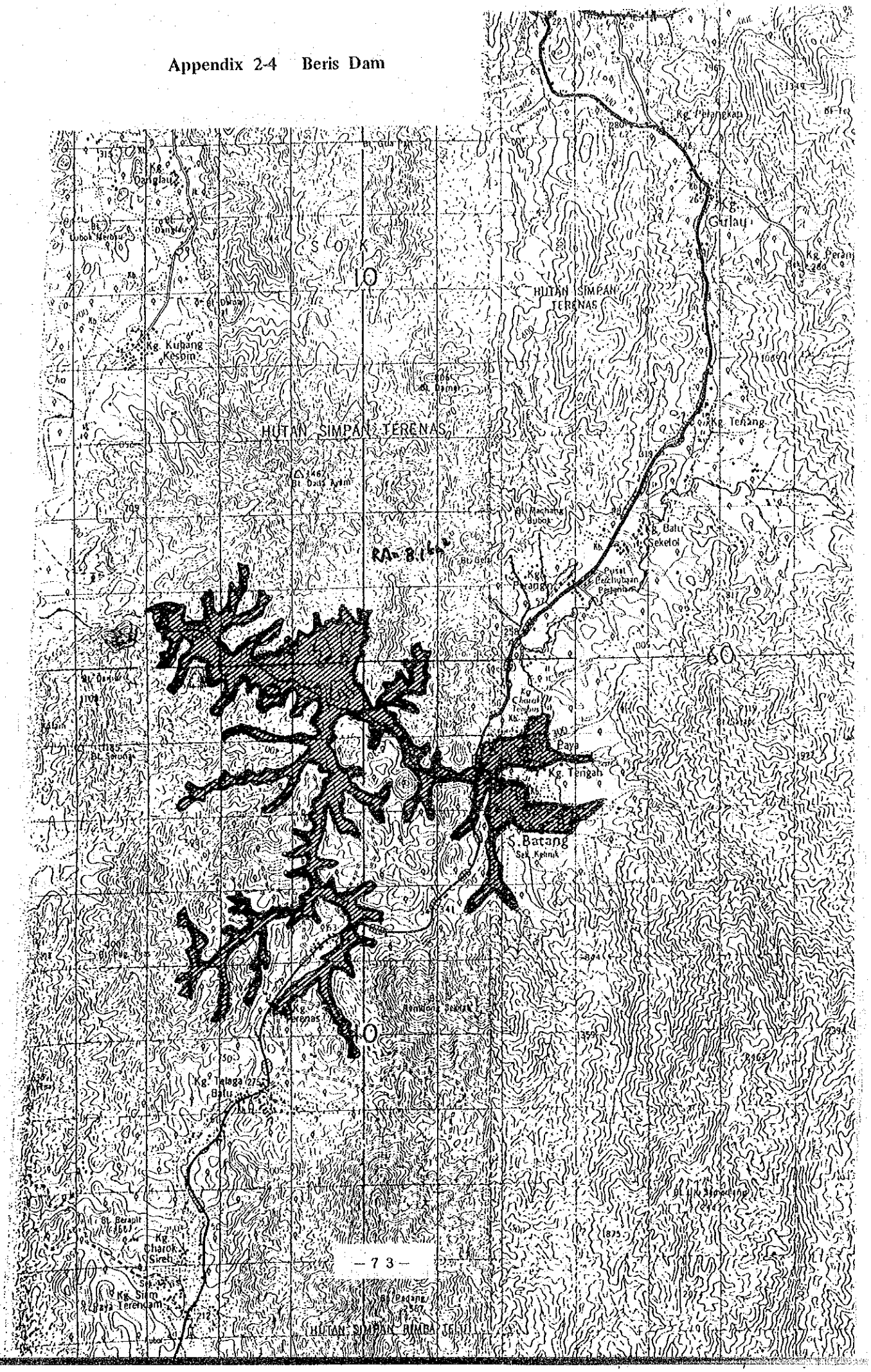
Appendix 2-2 Temin Dam



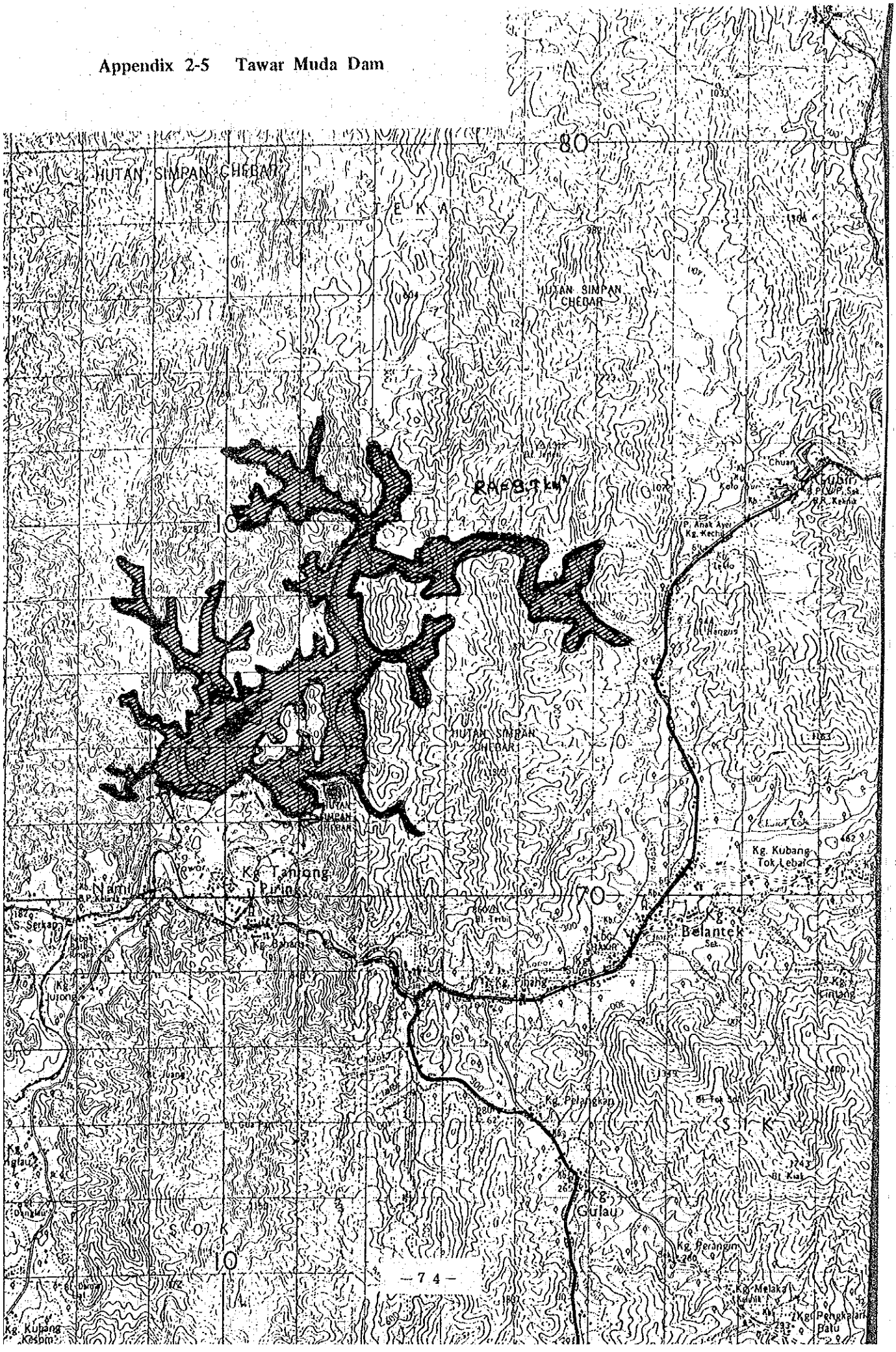
Appendix 2-3 Durian Dam



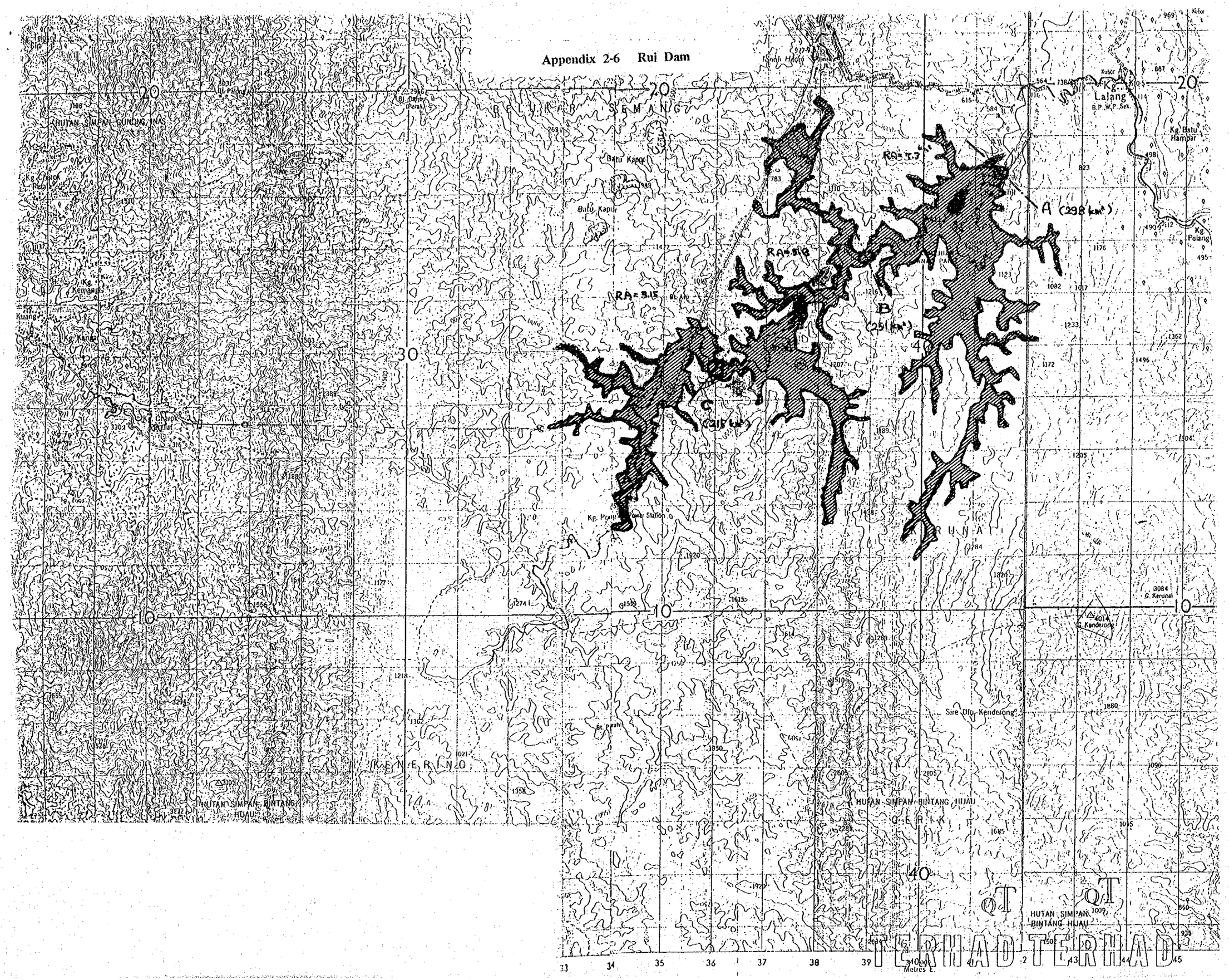
Appendix 2-4 Beris Dam



Appendix 2-5 Tawar Muda Dam



Appendix 2-6 Rui Dam



TERHAD TERHAD

DAM SITES TOPOGRAPHICAL SURVEY

	Dam Height (ft)	HWL (ft)	Topo. Survey for Dam Site (ha)	Longitudinal Survey for Alternative Sites (km)	Seismic Survey for Dam Site (km)
Badak-Temin	10	100	45 = 300 m (B) x 1,500 (H)	2.0 = 1.0 (A1) + 1.5 (A2)	2.5
Sari	100	300	40 = 400 m (B) x 1,000 m (H): Main 12 = 4@ x 100 m (B) x 300 (H): Saddle	–	2.2
Durian	40	200	30 = 300 m (B) x 1,000 (H)	–	1.0
Beris	70	200	28 = 400 m (B) x 700 m (H)	–	0.7
Tawar-Muda	60	250	30 = 300 m (B) x 1,000 m (H): Main 15 = 300 m (B) x 500 m (H): Saddle	–	1.5
Rui	170		80 = 800 m (B) x 1,000 m (H)	2.4 = 1.0 (A1) + 0.7 (A2) + 0.7 (A3)	2.4
	–	–	271	4.4	10.3

Remarks;

(1) Dam height signifies the height above mean sea water level.
(2) B signifies the length of the dam axes and H the width required for survey.
(3) A1, A2 and A3 signify the alternative dam sites.
(4) The scale and the contour interval of the map to be prepared are 1 to 1,000 and 2 m, respectively.
(5) It was assumed that the nearest existing bench mark was located 10 miles from each dam site.
(6) For the alternative dam sites, only longitudinal survey will be carried out.
(7) Seismic survey will be carried out for all the main and saddle dam sites as well as for the alternative dam sites.

COST FOR CROSS-SECTION SURVEY OF RIVER

1. Assumption

C Cross-section survey was assumed to be carried out at 1 km interval along the whole river length.

2. Cost

200 cross-section x M$ 1,350/cross-section = M$ 270,000

Remarks; (1): Assuming that the Muda river will be considered for flood mitigation study, taking into account the flood damage and number of affected people by the past maximum flood.

(2): The above costs are as of 1982 and inclusive of all cost components.

UNIT COST FOR CORE DRILLING WORKS

Unit: M$/m

Diameter (mm)	Material	
	Soil	Rock
66	120	280
76	130	350

Remarks; (1): Quoted by Kookenshisui, Malaysia.

(2): The above costs are as of 1982 and inclusive of all cost components.

TOTAL CORE DRILLING COST FOR DAM SITES

1. For Preliminary Feasibility Study

   (1) Total length

   3 holes/site x 30 m/hole x 6 sites (Main dam sites)
   +1 hole/site x 30 m/hole x 5 sites (Saddle dam sites) = 690 m

   (2) Cost

   (M$120/m + M$280/m)/2 x 690 m = M$138,000

2. For Feasibility Study

   (1) Total length

   1,000 m

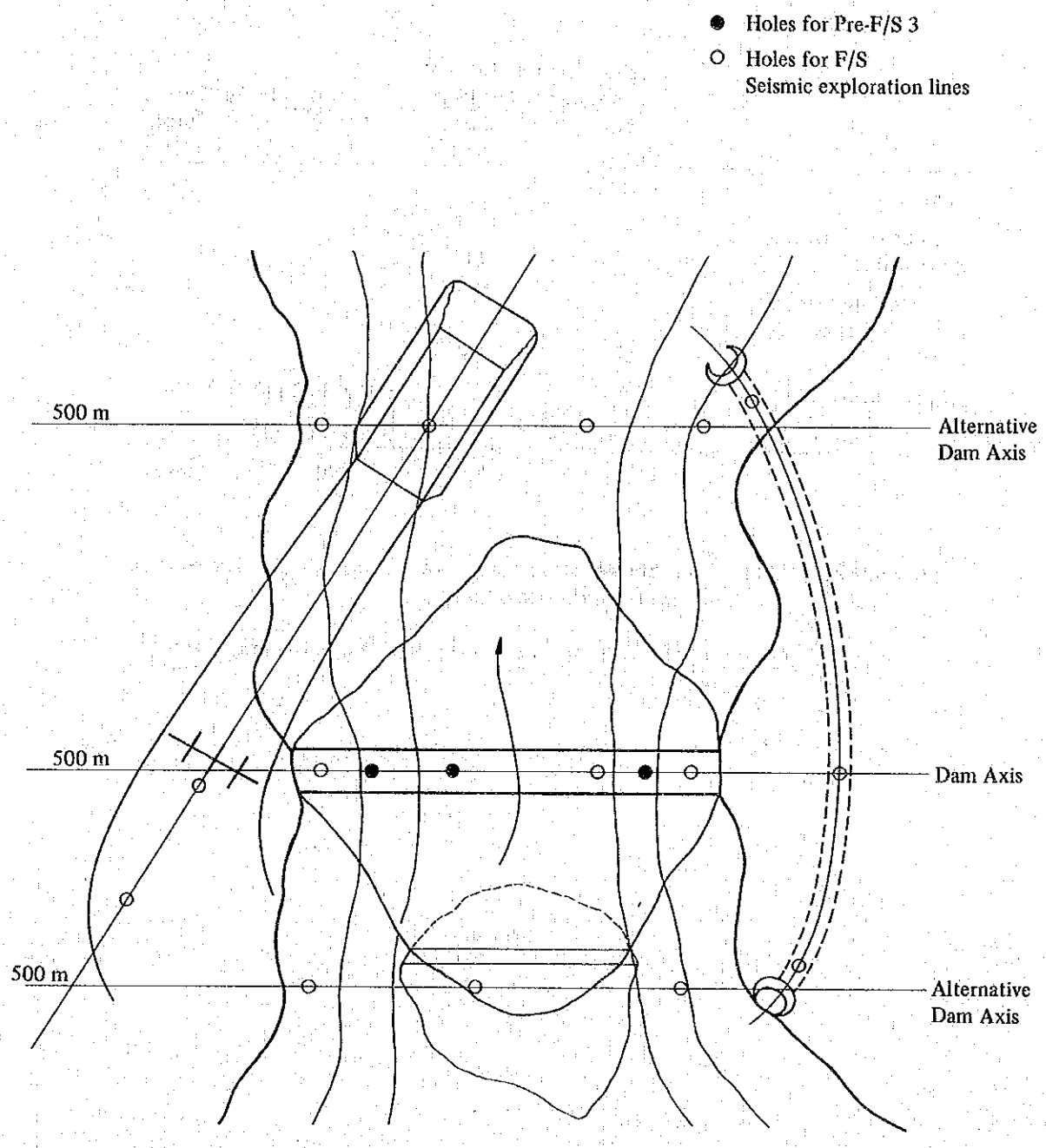
   NB. Assuming that Rui dam will be selected for feasibility study (Cf. Appendix 7).

   (2) Cost

   (M$120/m + M$280/m)/2 x 1,000m = M$200,000

Remarks; The above costs area as of 1982 and inclusive of all cost components.

LOCATION OF CORE DRILLING HOLES FOR RUI DAMSITE



COST FOR SEISMIC SURVEY AND CORE DRILLING FOR DIVERSION TUNNEL AND OTHER RELATED STRUCTURES

	Topographical Survey for Seismic Survey		Core Drilling	
	Length (km)	Cost (M$10^3)	Length (m)	Cost (M$10^3)
Intake	1.0	7		
Diversion Tunnel Near Adit	1.5	11		
Diversion Tunnel Near Regulating Pond	2.0/1	14/1		
Power House			90(3 holes)	18
Regulating Pond			90(3 holes)	18
	4.5	32	180	36

Remarks; (1): The above costs are as of 1982 and inclusive of all cost components.

/1 : Including power house and regulating pond sites.

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