THE REPUBLIC OF INDONESIA

WAY RAREM/ABUNG IRRIGATION PROJECT

MAPPING SURVEY REPORT

MARCH 1975

JAPAN INTERNATIONAL COOPERATION AGENCY

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FOREWORD

In compliance with the request of the Government of the Republic of Indonesia for technical assistance on the Way Rarem/Abung Area Irrigation Project, Lampung Province, Sumatra, the Government of Japan decided to conduct a feasibility study for the project and entrusted the study work to the Overseas Technical Cooperation Agency, the predecessor of the present Japan International Cooperation Agency.

The Agency organized the first survey Team consisting of six (6) members headed by Mr. Y. Uchiyama, chief of Tone River Basin Investigation Office, Regional Bureau of Kanto Agricultural Administration, Ministry of Agriculture and Forestry and conducted a pre-feasibility study covering the Way Rarem/Abung project area (approx. 120,000 ha) for a period of about 45 days from October 1973.

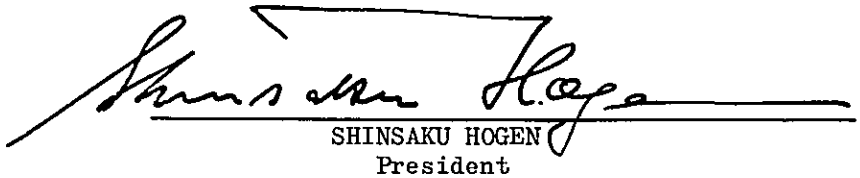
Upon its establishment in August 1974, the Japan International Cooperation Agency took over this cooperation programme with plans formulated for topographic mapping and preparatory work for the feasibility study and entrusted Japan Irrigation and Reclamation Consultants (Foundation) with their execution under a contract concluded in September 1974. This was ensued by the formation of a survey team comprising chiefly of the members headed by Mr. T. Nomoto from the said Consultants which conducted the field work for a period of about 90 days from September 10, 1974. The survey team further carried out a preparatory and follow-up survey for about two weeks from March 5, 1975 to pave the way for early and favorable execution of the feasibility study.

This report contains the outcome of topographic mapping as well as the findings of preparatory work which are related to hydrology, ground control survey, geology, soil, etc.

It is earnestly hoped that this report will prove instrumental for the Government of Japan as well as the Government of the Republic of Indonesia, in making the best step forward for early and successful completion of the feasibility study.

I take this opportunity to express my deep gratitude to the Government of the Republic of Indonesia, Japanese Embassy in Jakarta, Japanese Colombo Plan experts being assigned in Indonesia, Ministry of Foreign Affairs, Ministry of Agriculture and Forestry, Advisory Group, Japan Irrigation and Reclamation Consultants, and Asia Air Survey Co., Ltd. for their valuable and helpful assistance extended throughout the survey period.

March 1975



SHINSAKU HOGEN
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Mr. Shinsaku Hogen
President
Japan International Cooperation Agency

Dear Sir,

I have the honour to present herewith the comprehensive report of the field work consisting of the mapping survey on the Way Rarem-Abung irrigation project in Lampung province, the Republic of Indonesia, and the checking survey on the existing topographic map which were both conducted for a period 90 days from September 10 to December 8, 1974 as well as of the preparatory work performed in addition to these two surveys for 14 days from March 5 to 18, 1975.

All the above three surveys were carried out in compliance with the request of the Japan International Cooperation Agency on the strength of the prefeasibility study conducted in 1973 and they constitute part of the forthcoming feasibility study to be conducted in 1975 for the irrigation project in the southern part of Way Rarem-Abung area.

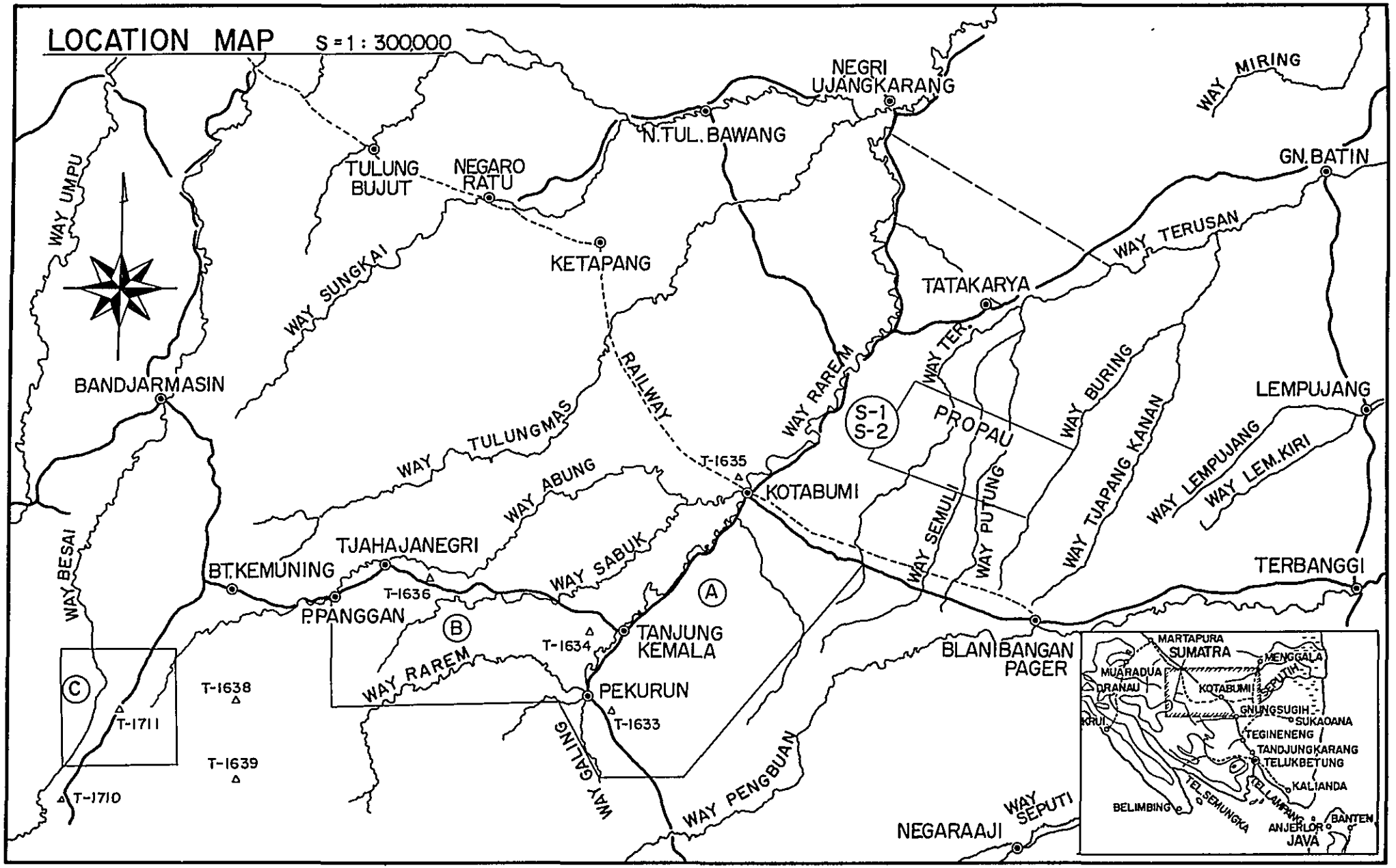
The objective of the surveys was to prepare a 1/10,000 topographic map covering an area of about 375 km^2 which embraces dam sites and driving canal and to check the existing 1/5,000 map of the adjacent area in order to facilitate the study of the proposed irrigation plan, as well as to conduct the general preparatory work for the purpose of the said feasibility study.

It will give me great pleasure if the data and information contained in this report are made full use of in implementing the forthcoming feasibility study which I hope will be initiated at the earliest possible date.

I avail myself of this opportunity to express my deep gratitude to Directorate General of Water Resources Development, Ministry of Public Works and Electric Power of the Republic of Indonesia, Ministry of Foreign Affairs, Embassy of Japan in Jakarta, Ministry of Agriculture and Forestry, and Asia Air Survey Co., Ltd. for valuable and unlimited cooperation and assistance rendered throughout the survey period and in the compilation of this report.

March 1975

SHIRO SASAKI
Director-General
Japan Irrigation and Reclamation
Consultants
(Foundation)


LOCATION MAP S = 1 : 300.000
NEGRI UJANGKARANG
WAY MIRING
N.TUL. BAWANG
GN. BATIN
TULUNG BUJUT
NEGARO RATU
WAY UMPU
KETAPANG
WAY SUNGKAI
TATAKARYA
WAY TERUSAN
WAY TER.
BANDJARMASIN
RAILWAY
WAY RAREM
S-1
S-2
PROPAU
WAY BURING
LEMPUJANG
WAY TULUNGMAS
WAY ABUNG
J-1635
KOTABUMI
WAY TJAPANG KANAN
WAY LEMPUJANG
WAY LEM. KIRI
WAY SEMULI
WAY PUTUNG
WAY BESAI
TJAHAJANEGRI
BT. KEMUNING
WAY SABUK
TERBANGGI
T-1636
P. PANGGAN
A
B
C
T-1634
TANJUNG KEMALA
BLANIBANGAN PAGER
T-1638
PEKURUN
T-1633
T-1711
T-1639
T-1710
WAY GALING
WAY PENGBUAN
WAY SEPUTI
NEGARAAJI
MARTAPURA
SUMATRA
MENGGALA
MUARADUA
KOTABUMI
KRUI
GNUNGSUGIH
SUKADANA
TEGINENENG
TANDJUNGKARANG
TELUKBETUNG
KALIANDA
BELIMBING
TELLAMPANG
BANTEN
ANJERLOR
JAVA

SUMMARY

This report shows the contents and results of following surveys which were carried out as a part of the feasibility study scheduled to be in 1975.

1. Mapping survey

On the basis of the recommendation of the pre-feasibility study which was implemented in 1973, the topographic maps in a scale of 1/10,000 necessary for the study of the irrigation plan were made. The objective area is divided into the following three areas.

(1) The area covering the Way Rarem dam site and its driving canal to the benefited area. (A area)

(2) The area covering the diversion weir site on the Way Abung and its linking canal to the Way Rarem. (B area, total of A and B areas : 325 Km^2)

(3) The area covering the basin-transfer dam site on the Way Besai and its linking canal to the Way Abung. (C area : about 50 Km^2)

The field work was conducted to prepare the data necessary for the topographic mapping and the topographic maps were made in Japan by photogrammetric method using the aerial photos in a scale of 1/50,000 taken by the Government of Indonesia.

The result of the survey is shown in the Chapter II in this report and by thirteen sheets of topographic map of polyester base.

2. Checking survey on the existing topographic map

This survey was carried out as a additional one to the above mapping survey in response to the request of the Directorate General of Water Resources Development, Ministry of Public Works and Electric Power of the Government of Indonesia.

The work was to check the existing topographic maps in scale of 1/5,000 which cover about 35,000 ha: the southern part of the Way Rarem Abung areas and the objective area of the feasibility study scheduled to be in 1975.

The checking was implemented by the field survey and the examination due to the aerial photos.

The result is described in the Chapter III in this report and shown by twelve sheets of approximate topographic map due to the aerial photos.

3. Preparatory works for the coming feasibility study

In order to arrange the smooth implementation of the coming feasibility study, its prospective contents and problems were consulted with the officials of the Government of Indonesia concerned with it. As a result, drilling survey, soil mechanical test, ground control survey and others will be undertaken by the Government of Indonesia and it became necessary that the contents and technical specifications are presented in advance due to the operation period with reference to the drilling survey, soil mechanical test and ground control survey.

In addition, several works such as the rough determination of driving canal route and the discharge observation were carried out as preparations for the coming feasibility study.

The results are described in the Chapter IV in this report.

CONTENTS

CHAPTER I. INTRODUCTION

1-1 Background of the Surveys

As for the agricultural development of the Way Rarem-Abung area in Lampung Province, the republic of Indonesia, the reconnaissance survey was carried out in August and September, 1972 during the feasibility study on the Umpu-Pengubuan area and the pre-feasibility study was implemented in October and November, 1973, by the Overseas Technical Cooperation Agency which is the antecedents of the Japan International Cooperation Agency.

The above pre-feasibility study was conducted for the Way Rarem-Abung area which was mapped out to cover approximately 118,000 ha and it is reported that a feasibility study should be implemented as soon as possible for early construction of irrigation facilities.

In accordance with the report, the Japan International Cooperation Agency has decided to carry out a feasibility study on the southern part of the Way Rarem-Abung area where it covers the area of about 35,000 ha (S-1, S-2 areas) in 1974. However, the basic data to decide the irrigation plan for the above objective area are deficient.

Accordingly, the following surveys were carried out in this fiscal year as a part of the feasibility study scheduled in 1975.

1-1-1 Mapping survey works and checking work of the existing topographic map

There is no sufficient topographic map available for the upstream area about 375 Km^2 covering diversion works, linking canals, driving canal and the basin-transfer dam on the Way Besai necessary for the decision of the irrigation system. Therefore, the mapping survey team was dispatched for a period of 80 days from September 10 to November 28, 1974 in order to make the topographic maps of the aforementioned area and to carry out the partial and preparatory works within the frame work of the feasibility study scheduled in 1975.

During the field work, however, the checking work of the existing

topographic map which covers the objective area, about 35,000 ha of the feasibility study was requested by the Directorate General of Water Resources Development, Ministry of Public Works and Electric Power of the Republic of Indonesia and the field checking work was implemented by extending the period for 10 days until December 8, 1974.

1-1-2 The preparatory survey works for the coming feasibility study

With reference to the topographic map, the field survey was carried out as aforementioned and the field works to collect other basic data were more or less discussed during the above mapping survey as the prospective contents of the coming feasibility study, and the scope of works of drilling survey and ground control survey were presented on the principle of the implementation of the Government of Indonesia.

However, there was a necessity to discuss and confirm the details of the method and content of these surveys again and also it is considered to be effective to discuss other field works such as soil mechanical survey and soil survey, and laboratory works such as soil mechanical test and rock test before the coming feasibility study.

In 1975 from March 5 to March 18 for a period of 14 days, the preparatory survey team was dispatched in order to arrange the efficient implementation of the coming feasibility study by discussing the above survey works.

1-2 Organization of the Survey Team and Assignment of Duties

1-2-1 Mapping survey team

1. Survey team

Leader (General Affairs)	Takeshi Nomoto	Japan Irrigation and Reclamation Consultants (Foundation)
Member (Technical Assistance)	Yoshitami Iseki	- ditto - (JIRCO)

Member (Surveying Supervision)	Shigeki Nozoe	Asia Air Survey Co., Ltd.
Member (Coordination)	Masaru Toshioka	- ditto -
Member (Field investigation)	Sadao Watanabe	- ditto -
Member (Leveling)	Tadashi Sasaki	- ditto -
Member (Leveling)	Kazuo Kashiyama	- ditto -
Member (Traversing)	Mikio Togashi	- ditto -
Member (Traversing)	Yasuhira Nara	- ditto -
Member (Traversing)	Tooru Nakamura	- ditto -
Member (Traversing)	Shozo Toyoda	- ditto -
Member (Traversing)	Fumio Ozawa	- ditto -

2. Advisory group

Advisor (Irrigation)	Kazutsugu Nakanishi	Design Supervisor, Design Division, Land Improving Bureau, Ministry of Agriculture and Forestry.
Advisor (Mapping)	Kazuo Yoda	Deputy Chief of Silviculture Devision, Forestry Agency, Ministry of Agriculture and Forestry.

1-2-2 Preparatory survey team for the coming feasibility study

Leader (General Affairs)	Takeshi Nomoto	Japan Irrigation and Reclamation Consultants (Foundation)
Member (Geology)	Torahiko Moritani	- ditto - (JIRCO)
Member (Mapping)	Masaru Toshioka	Asia Air Survey Co., LTD.

1-3 Names of Officials Concerned in the Government of Indonesia

1-3-1 Counterparts

Ir. Apep Sulaeman	Design & Planning Service, Directorate of Irrigation, Directorate General of Water Resources Development
Ir. Hartono	- ditto -
Ir. Yusuf Asep Permana	- ditto -
Ir. Giovani Wiyarto	- ditto -
Mr. Sumayono	- ditto -
Mr. Rizal Nama	B.P.P. Tri Tunggal, Bandung
Mr. Erries	- ditto -
Mr. Tosim	- ditto -
Mr. Kazuharu Uno	Colombo Plan Expert, Directorate of Irrigation, Ministry of Public Works & Power

1-3-2 Cooperators

Ir. S. Suyono Sosrodarsono	Director General of Water Resources Development, Ministry of Public Works & Power
Ir. Oesman Djojoadinoto	Director of Irrigation, Directorate General & Water Resources Development, Ministry of Public Works & Power

Ir. Sarwoko	Assistant Director of Irrigation, Directorate General of Water Resources Development, Ministry of Public Works & Power
Ir. Sadeli Wiramihardja	Chief of Design & Planning Service, Directorate of Irrigation, Directorate General of Water Resources Development, Ministry of Public Works & Power
Drs. Attamimi	Directorate of Planning & Programing, Directorate General of Water Resources Development
Ir. Tata Sukarta	- ditto
Drs. Sunaruso	- ditto -
Drs. Slameto	Directorate of Irrigation, Directorate General of Water Resources Development
Drs. Ruslan	- ditto -
Ir. Muhadi	Design & Planning Service, Directorate of Irrigation, Directorate General of Water Resources Development
Ir. Mashudi	- ditto -
Ir. A. Sadeli	Chief of Local Public Works Office, Lampung Province
Yoesmen, BIE	Local Public Works Office, Lampung Province
Ir. Rubini Yusuf	- ditto -
Machidiany, BIE	- ditto -
Sudjaswadi, BIE	P3. S. A. Office in Lampung Province
Mr. G. R. Thorpe	- ditto -
Ir. Nusyirwan Zen	Chief of Local Agriculture Office, Lampung Province
Drs. Djuaini Ahmad	Governor of North Lampung Regency
Ir. Djumli Hasan	North Lampung Regencial Office

Saefuddin Hasan, BRE	Chief of Public Works Branch Office in North Lampung Regency
Fahroeddin Guba, BIE	Public Works Branch Office in North Lampung Regency
Sri Poernomo, BIE	- ditto -
Mr. Takashi Hayashi	Colombo Plan Expert, Directorate of Irrigation, Ministry of Public Works & Power
Mr. Hirotaka Arai	- ditto -
Mr. Toshio Sakai	- ditto -
Mr. Takeshi Ishida	- ditto -
Mr. Yoshihiro Suzuki	- ditto -
Mr. Kazuma Nojima	Lampung Province Tani Makmur Project
Mr. Kootaro Nagai	- ditto -
Mr. Akira Shiraku	- ditto -
Mr. Kooji Hattori	- ditto -
Mr. Masaharu Matsui	- ditto -
Mr. Hiroshi Kitajima	- ditto -
Mr. Kenzo Takeuchi	- ditto -
Mr. Ryonosuke Goto	- ditto -

1-4 Itinerary of the Survey Team

1-4-1 Mapping survey team

The team was divided into two parties, the advance party arrived in Jakarta on September 10, 1974 and the later party on September 20, and the team immediately commenced their works.

The main activities of the team are as follows:

ACTIVITIES OF THE SURVEY TEAM

No.	Date	Day	Stay in	Activities
1	1974 Sep. 10	Tues.	Jakarta	The advance party of the Team consisting of three members arrived in Jakarta with two members of the Advisory Group.
2	11	Wed.	Bandung and Jakarta	Meeting with the Director general of Water Resources Development, Ministry of Public Works and Electric Power, the Director of Irrigation and their staffs on the memorandum and others. Paid a courtesy visit to the Embassy of Japan. One member of the Team and two advisors moved to Bandung. Other two members of the Team prepared for the survey in Jakarta.
3	12	Thurs.	- ditto -	Requested the data collection at Design and Planning Service, Directorate of Irrigation. Other party prepared for the survey in Jakarta.

4	Sep.	13	Fri.	Jakarta	Meeting with the Chief of Design and Planning Service and his staffs and moved to Jakarta. Other party prepared for the survey work.
5		14	Sat.	- ditto -	Meeting with the Director of Irrigation and his staffs on the Memorandum.
6		15	Sun.	- ditto -	Prepared for the survey.
7		16	Mon.	- ditto -	Discussion with the Director of Irrigation and his staffs concerning the prospective contents of the Feasibility Study in 1975.
8		17	Tues.	- ditto -	Prepared for the survey.
9		18	Wed.	- ditto -	Arrangement of the data collected and discussion with the advisors.
10		19	Thurs.	- ditto -	The advisors left Jakarta for Tokyo. Signature of the Memorandum, a courtesy visit to P3SA office and preparation for the Survey.
11		20	Fri.	- ditto -	Prepared for the survey. The later party of the team consisting of nine members arrived in Jakarta.
12		21	Sat.	- ditto -	The later party paid a courtesy call to the Embassy of Japan. Discussion with counterparts concerning the schedule and others.
13		22	Sun.	- ditto -	Meeting among the members of the Team.
14		23	Mon.	- ditto -	The later party paid a courtesy call on Director of Irrigation. Preparation for the movement to the field.

15	Sep.	24	Tues.	Jakarta	Preparation for the movement to the field.
16		25	Wed.	Telukbetung	Moved to Telukbetung. Meeting with the staffs of Local Public Works Office, Lampung Province on the schedule, etc. Paid courtesy visits to Local Agriculture Office and Transmigration Office.
17		26	Thurs.	Kotabumi	Paid courtesy visits to P3SA Office in Lampung and Lampung Tani Makmur project. Arrived in Kotabumi.
18		27	Fri.	- ditto -	Meeting with Chief of Public Works Branch Office in North Lampung Regency and his staffs. Carried out a general field survey.
19		28	Sat.	- ditto -	Carried out a general field survey.
20		29	Sun.	- ditto -	Checking and adjustment of instruments.
21		30	Mon.	- ditto -	Carried out ground control surveyings and a general field survey.
22	Oct.	1	Tues.	- ditto -	- ditto -
23		2	Wed.	- ditto -	Carried out ground control surveyings. Executed a general field survey on the river discharge observation facilities.
24		3	Thurs.	- ditto -	- ditto -
25		4	Fri.	- ditto -	- ditto - Two members of the Team left for Tokyo.

26	Oct.	5	Sat.	Kotabumi and Telukbetung	Carried out continual field works. Some members of the Team moved to Telukbetung to meet with the staffs of Local Public Works Office.
27		6	Sun.	Kotabumi	Arrangement of field notes.
28		7	Mon.	- ditto -	Carried out ground control surveyings. Conducted river discharge observation.
29		8	Tues.	- ditto -	- ditto -
30		9	Wed.	- ditto -	- ditto -
31		10	Thurs.	- ditto -	- ditto -
32		11	Fri.	- ditto -	- ditto -
33		12	Sat.	Kotabumi and Telukbetung	- ditto - Two members of the Team moved to Telukbetung
34		13	Sun.	Kobabumi and Jakarta	Arrangement of field notes. Two members of the Team moved to Jakarta for the discussion of the checking work and data collection.
35		14	Mon.	- ditto -	Two members of the Team informed the progress of the field survey to Directorate of Irrigation and the Embassy of Japan. Carried out continual field works.
36		15	Tues.	- ditto -	Requested the data collection to Design and Planning Service, and KLM aerophoto. Carried out continual field works.
37		16	Wed.	- ditto -	Arrangement of surveying results, etc.

38	Oct.	17	Thurs.	Kotabumi and Jakarta	Holiday (Lebaran)
39		18	Fri.	- ditto -	- ditto -
40		19	Sat.	- ditto -	Discussion the itinerary of an advisor at the Embassy of Japan. Arrangement of surveying results, etc. The advisor arrived in Jakarta.
41		20	Sun.	- ditto -	Arrangement of surveying results, etc. Discussion of the checking work with the advisor.
42		21	Mon.	Kotabumi and Bandung	Meeting with Director of Irrigation on the checking work, etc. Moved to Bandung. Carried out ground control surveyings and river discharge observation.
43		22	Tues.	- ditto -	Discussion with the Chief of Design and Planning Service and his staffs concerning the checking work, etc. Carried out ground control surveyings and river discharge observation.
44		23	Wed.	Kotabumi and Jakarta	Collected data and moved to Jakarta. Carried out ground control surveyings and river discharge observation.
45		24	Thurs.	- ditto -	The advisor and one member of the Team moved to Kotabumi and carried out a general field survey.

					One member of the Team made the draft of the memorandum of the checking work and the specifications on the geological survey and ground control survey for the feasibility study scheduled in 1975 in Jakarta.
					Carried out ground control surveyings and river discharge observation.
46	Oct.	25	Fri.	Kotabumi and Jakarta	The advisor carried out a general field survey.
					Carried out continual ground control surveyings.
					One member of the Team made the above memorandum and specifications in Jakarta.
47		26	Sat.	- ditto -	The advisor moved to Jakarta.
					Meeting with Director of Irrigation and submitted the above memorandum and specifications.
					Carried out ground control surveyings and river discharge observation.
48		27	Sun.	Kotabumi	The advisor left for Tokyo.
					One member of the Team moved to Kotabumi.
					Arrangement of surveying results.
49		28	Mon.	- ditto -	Carried out ground control surveyings and field surveys of the proposed sites of irrigation facilities such as driving canal.
50		29	Tues.	- ditto -	- ditto -
51		30	Wed.	- ditto -	- ditto -
52		31	Thurs.	- ditto -	- ditto -

53	Nov.	1	Fri.	Kotabumi	Carried out ground control surveyings and field surveys of the proposed sites of irrigation facilities such as driving canal.
54		2	Sat.	- ditto -	- ditto -
55		3	Sun.	- ditto -	Arrangement of surveying results.
56		4	Mon.	- ditto -	Carried out ground control surveyings and field surveys of the proposed sites of irrigation facilities.
57		5	Tues.	- ditto -	- ditto -
58		6	Wed.	- ditto -	- ditto -
59		7	Thurs.	- ditto -	- ditto -
60		8	Fri.	- ditto -	Carried out ground control surveyings and set new bench marks.
61		9	Sat.	- ditto -	Set new bench marks and carried out the river discharge observation.
62		10	Sun.	- ditto -	Arrangement of surveying results.
63		11	Mon.	- ditto -	Carried out ground control surveyings and data arrangement of river discharges, etc.
64		12	Tues.	- ditto -	Carried out ground control surveyings and river discharge observation.
65		13	Wed.	- ditto -	Carried out ground control surveyings and field surveys of the proposed sites of pumping station.
66		14	Thurs.	- ditto -	Carried out ground control surveyings and data arrangement.

67	Nov. 15	Fri.	Kotabumi	Carried out ground control surveyings and data arrangement.
68	16	Sat.	- ditto -	- ditto -
69	17	Sun.	- ditto -	Data arrangement.
70	18	Mon.	Kotabumi and Telukbetung	Carried out ground control surveyings. Hearing of hydrological observation system at Local Public Works Office and P3SA office in Telukbetung.
71	19	Tues.	Kotabumi	Carried out ground control surveyings and field surveys of the proposed diversion dam site. One member of the Team arrived in Jakarta from Tokyo.
72	20	Wed.	- ditto -	Carried out ground control surveyings and data arrangement.
73	21	Thurs.	- ditto -	One member of the Team moved to Kotabumi from Jakarta. Discussed the checking work. Carried out ground control surveyings and data arrangement.
74	22	Fri.	- ditto -	Carried out ground control surveyings. Prepared for the interim report.
75	23	Sat.	- ditto -	- ditto -
76	24	Sun.	- ditto -	Data arrangement

77	Nov.	25	Mon.	Kotabumi and Telukbetung	One member of the Team moved to Jakarta. Two members of the Team moved to Telukbetung for the preparations of movement to Jakarta. The remainder of the Team carried out ground control surveyings.
78		26	Tues.	Kotabumi	Carried out continual ground control surveyings.
79		27	Wed.	Kotabumi and Telukbetung	Data arrangement and preparations for movement to Jakarta. Informed the Completion of the Survey to the authorities concerned. Five members of the Team moved to Telukbetung.
80		28	Thurs.	- ditto -	One member of the Team left for Tokyo. Informed the general results of the Survey to Local Public Works Office. The remainder of the Team moved to Telukbetung.
81		29	Fri.	Jakarta	Moved to Jakarta.
82		30	Sat.	- ditto -	Informed the completion of the field works to the Directorate of Irrigation and the Embassy of Japan. Data arrangement.
83	Dec.	1	Sun.	- ditto -	Data arrangement.
84		2	Mon.	- ditto -	Data arrangement and preparations of the interim report and the memorandum of the checking work.
85		3	Tues.	- ditto -	- ditto -

86	Dec.	4	Wed.	Jakarta	Data arrangement and preparations of the interim report and the memorandum of the checking work.
87		5	Thurs.	- ditto -	- ditto -
88		6	Fri.	- ditto -	Explained the interim report and the memorandum of the checking work to the Director of Irrigation and his staffs.
89		7	Sat.	- ditto -	Seven members of the Team left for Tokyo. The remainder of the Team revised and submitted the interim report to the Directorate of Irrigation. Signed the memorandum of the checking work. Courtesy calls on the related authorities in Jakarta.
90		8	Sun.		The remainder (three members) of the Team left for Tokyo.

1-4-2 Preparatory survey team for the coming feasibility study

The team arrived in Jakarta on March 5, 1975 and immediately commenced their works.

The main activities of the team are as follows:

No.	Date	Day	Stay in	Activities
1	1975 Mar. 5	Wed.	Jakarta	Arrived in Jakarta.
2	6	Thurs.	Bandung	Moved to Bandung after meeting with the Assistant Director of Irrigation, Directorate General of Water Resources Development and a courtesy visit to the Embassy of Japan.

3	Mar.	7	Fri.	Jakarta	Meeting with the Chief of Design and Planning Service and his staffs and moved to Jakarta.
4		8	Sat.	Telukbetung	Moved to Telukbetung and discussed the schedule and others with the staffs of Local Public Works Office, Lampung Province.
5		9	Sun.	- ditto -	Preparation for the field survey.
6		10	Mon.	Kotabumi	Moved to Kotabumi after the collection of data at Local Public Works Office and P3.S.A. office.
7		11	Tues.	- ditto -	Carried out a general field survey on the proposed Way Rarem dam site and driving canal route.
8		12	Wed.	- ditto -	Carried out a general field survey on the proposed sites of a pumping station and irrigation tanks, and benefited area.
9		13	Thurs.	- ditto -	Carried out a general field survey on the proposed site of Way Besai dam and the Abung river.
10		14	Fri.	Jakarta	Moved to Jakarta from Kotabumi.
11		15	Sat.	- ditto -	Meeting with the secretary of the Embassy of Japan and counterparts.
12		16	Sun.	- ditto -	Data arrangement.
13		17	Mon.	- ditto -	Meeting with the Director of Irrigation and his staffs. Courtesy calls on the related authorities in Jakarta.
14		18	Tues.		Left for Tokyo.

CHAPTER II. MAPPING SURVEY

2-1 Working Plan and Results

2-1-1 Basic conditions for working plan

1. Mapping area (Refer to Fig. 2-1)

Area covering the Way Rarem dam site and its driving canal to the benefited area (Area A)	}	Approx. 325 km^2
Area covering the diversion weir site on the Way Abung and its linking canal to the Way Rarem (Area B)	}	
Area covering the basin-transfer dam site on the Way Besai and its linking canal to the Way Abung (Area C)		Approx. 50 km^2
	Total:	Approx. 375 km^2

2. Method and detailed specifications

Photogrammetric mapping was conducted using 1/50,000 aerial photos prepared by the Government of Indonesia in order to make the 1/10,000 topographic map.

In Areas A and B, ground control survey including leveling and traversing was newly carried out.

As for Area C, however, mapping was conducted by aerotriangulation using the existing aerial photos due to the difficulty in carrying out ground control survey.

In applying the method described above, the following detailed specifications were adopted.

Leveling:	Initial point	Existing control point T1635
	Accuracy	Accurate to within $10\ \text{mm}\sqrt{S\ (\text{km})}$
	New bench marks	5 places

Traversing:	Initial point	Existing control point T1635
	Accuracy	Ratio of error of coordinates closure of closed traverse - Less than 1/20,000. In case of open traverse, bearing observation was made at the middle and final points for control of azimuth.

Pricking point: More than 20 points (for Areas A and B).

Investigation of planimetric features:
Aerial interpretation key was prepared and field investigation was conducted for confirmation of important facilities and structures.
Geographic names and locations of public facilities were checked against the existing data or through interviews.

Aerotriangulation: Analytical method was employed.

Mapping:	Mapping scale	1/10,000
	Contour interval	5.0 m for main contour lines, with occasional indication of subcontour lines at intervals of 2.5 m.
	Contour accuracy	Accurate to within 1/2 of main contour interval.

2-1-2 Outline of working plan and results

The existing 1/100,000 topographic map was put to a careful study in order to formulate the basic plan for field work, and this served to grasp a general idea of the amount of each type of field work.

Prior to actual implementation of field work, however, virtually all survey routes were covered by the general field survey conducted by the survey team to check the validity of the basic plan and to finalize the working plan.

In the final working plan thus prepared, the following changes were effected.

The planned traverse route running south to north on the east of Area A (i.e., on the extreme eastern side of Area A) was found to reject free passage. This route was therefore abandoned and a road found further east of Area A was adopted as the traverse route since it allowed for the passage of the team. However, adoption of this new traverse route resulted in the total absence of control points in the central part of the area through which the driving canal is to flow. Accordingly, supplementary traverse and leveling routes branching off from the route along the Way Rarem were added.

Excepting these changes, the final working plan generally conformed with the basic plan. The amount of works estimated in the basic plan is compared below with that actually performed.

1. Works performed (Field work)

	Basic Plan	Results
Length of traversing	80 km	91.5 km
Length of leveling	44 km	49.7 km
Number of bench marks	5	6
Number of pricking points	20	21

Fig. 2-2 shows the locations of pricking points and the alignment of routes. In addition to the works listed above, field

classification and field identification were performed according to the basic plan.

Aerotriangulation and subsequent works were all carried out in perfect conformity to the basic plan and produced satisfactory results, although means were taken for better indication of the condition of land use on the map.

2. *Works performed (Home work)*

	Basic Plan	Results
Aerotriangulation	20 models	20 models
Mapping	375 km^2	375 km^2

2-1-3 Topographic map projection

In the case of projects like the present one whose area is planned to be expanded with the lapse of time, selection of an optimum topographic map projection is of great importance.

Accordingly, selection was made with account taken of the following conditions.

1. The projection should be a popular and widely used one.
2. It should produce a map that can be readily compared and correlated with other topographic maps.
3. It should be practical rather than intricate in principle.

As a result, it was determined that the entire area would be covered uniformly by the polyhedral projection of XXXIII-31 system (Refer to Fig. 2-1).

Selection of this projection was made by the decisive fact that the origin of projection of XXXIII-31 system is in the approximate centre of the project area, and that the existing topographic maps of S-1 and S-2 districts were prepared using the coordinates of the same system.

Notes: The existing 1/5,000 topographic maps of S-1 and S-2 districts are plotted on the grid lines of XXXIII-31 system, but the method of bearing measurement adopted for their preparation differs from that of the new 1/10,000 topographic map. It must therefore be noted that matching of the grid lines does not make the maps themselves adjoin each other.

2-2 Outline of Traversing

The control points were established by traversing using an electro-optical distance meter.

2-2-1 General condition

Since the route was selected along arterial roads, the team was enabled to use jeeps freely and carry out traversing in a very efficient way. The length between survey points averaged approximately 250 m, which was a little shorter than was originally expected. In general, the results proved to be quite satisfactory in both efficiency and accuracy.

2-2-2 Technical aspect

Bearing measurement was conducted by means of a gyro-compass at the initial and final points of the route as well as middle points selected at intervals of about 40 survey points in order to check the results of angle measurement on the route.

Results of direct leveling were compared with those of indirect leveling obtained by vertical angle observation for the purpose of indirect checking of the results of distance measurement.

In addition, T1635, T1633 and T1636 were connected to check the value of coordinates of these existing points, whereby the known value of coordinates was taken as the fixed value for adjustment computation.

Number of observations and the criteria for judgement of results are as shown below.

Horizontal angle observation:	Two pairs observation.	Difference between each pair - Less than 8 sec.
Vertical angle observation:	Min. two pairs observation.	
Distance measurement:	Three times observation.	Difference - Less than 10 mm.
Observation of azimuth by Gyro-compass:	Three pairs observation	Difference between maximum and minimum values - Less than 30 sec.
Ratio of closure:		Less than 1/20,000
Azimuth error of closure:		10 sec $\sqrt{N}$ (N : Number of survey points)

2-2-3 Formation of survey parties

Each party was composed of six members with the following assignments and equipment.

Assignment:

Observation	1 member
Field note taking	1 "
Selection of observation point	1 "
Assistant	3 members

Equipment:

Theodolite (WILD T2)	1 unit
Distance meter (Hewlett-Packard)	1 "
Jeep	1

Notes: One counterpart expert accompanied each party to extend cooperation throughout the survey period.

2-2-4 Traversing calculation

UTM system was applied uniformly for the purpose of easier calculation. This naturally made it an imperative to convert the coordinates of each existing triangulation point to UTM system and to give due consideration to prime meridian observation and scale coefficient.

As regards the closure traverse route in Area A, its ratio of closure was confirmed to be less than 1/20,000 and in addition, the results obtained by dividing the said route by the existing triangulation points were studied.

To be more precise, calculations were worked out for the section between T1635 and T1633 at first, which was followed by successive calculations performed for other routes. The following results were produced by these calculations.

Section	Length of Points	Error of Closure	
		X	Y
T1635 - T1633	21,563 m	-0.145 m	+2.735 m
(1)-58 - T1636	15,314	-3.291	+2.284
T1633 - (1)-13	35,286	+0.234	-0.917

Notes: 1. (1)-58 and (1)-13 are the middle points determined by the calculations for T1635 - T1633.

2. X in UTM system is in the direction of prime meridian and Y is along the line parallel with equator.

A closer study of the values shown above for comparison of the results of the present survey with the known values of coordinates of the existing triangulation points indicates the fact that the difference in the length of points is very small (approx. 30 sec.) and assignable to the method of azimuth observation.

Accordingly, the known values were adopted in the traversing calculations in which the existing triangulation points were connected as well as in the adjustment computation between respective points.

The value of error distributed to each 100 m for adjustment is shown below.

Section	Error per 100 m
T1635 - T1633	13 mm
(1)-58 - T1636	26 mm
T1633 - (1)-13	3 mm

2-3 Outline of Leveling

2-3-1 General condition

Leveling was conducted along the traverse route which runs on arterial roads as described earlier (Refer to Fig. 2-3). Concrete kilometer posts found in the greater portion of the roads were used as check stations, and they facilitated the leveling work to a great extent. Length of sight was taken at less than 60 m even at its maximum.

2-3-2 Technical aspect

The route started from T1635 (28.10 m) and linked it with T1633 and 1636, but no adjustment calculations between these points were worked out. Hence, the elevations obtained were the accumulated values derived from the medians of forward and backward leveling observation.

Difference between the new and old (known) elevations of T1633 and T1636 is as shown below.

	Old Elevation	New Elevation	Difference
T1633	72.50 m	70.92 m	1.58 m
T1636	120.80 m	119.70 m	1.10 m

Results of leveling observation were judged by the following criterion.

Accuracy of forward and backward leveling observation	Accurate to within 10 mm $\sqrt{S\text{km}}$

For the purpose of leveling observation, six concrete bench marks with riveted round head (20 cm x 20 cm) were newly installed.

2-3-3 Formation of survey parties

Each party was composed of five members with the following assignments and equipment.

Assignment:

Observation	1 member
Field note taking	1 "
Assistant	3 members

Equipment:

Level (SOKKISHA B2)	1 unit

Notes: One counterpart expert joined each party and offered cooperation throughout the survey period.

2-3-4 Results of observation

Observation was conducted with an accuracy higher than specified for the entire route since it was repeated whenever tbe error exceeded 10 mm $\sqrt{S}$. Results of observation are summarized below.

	Maximum	Minimum	Mean
Length of points	4.9 km	0.6 km	4.5 km
Error in observation	27 mm	1 mm	10 mm

2-4 Pricking

Pricking is intended to confirm and indicate the determined positions of control points or elevation points on aerial photos as accurately as possible. It is therefore an important technical process in which the results of field survey are reflected on aerial photos for perfect uniformity and integration of both. However, pricking is generally considered as a supplementary work to traversing and leveling.

Aerial photos used for the pricking work in the present project were those twice enlarged to a scale of 1/25,000 from the originals.

For each control point to be pricked, two supplementary control points were established in its vicinity and pricked.

Observation of these supplementary control points was conducted on the accuracy approximately equivalent to that employed in ordinary traversing.

2-5 Field Investigation

Images on aerial photos need to be classified by the established or newly adopted symbols and rules of expression. Field investigation is therefore required for confirmation of the images as well as for investigation and checking of village names and special facilities and structures.

2-5-1 Particulars of field investigation

Of a total of 375 km^2 of the objective area, approximately 180 km^2 was covered either by jeep or on foot. The investigation disclosed, among others, that notable secular changes had taken place in land use since 1960 when the aerial photos were taken. Hence, maximum effort was exerted to record these changes, together with other data, on the 1/25,000 aerial photos which were prepared for the field work.

During the investigation, the following items were confirmed.

1. Names of villages, roads, rivers and bridges.
2. Locations of government offices, public facilities, mosques, schools, hospitals, factories and other facilities.
3. Road width, bridge materials, distorted surface area, etc. which reject easy interpretation from aerial photographs.
4. Sampling survey regarding land use.

2-5-2 Formation of survey parties

Each party was composed of 2 to 3 members with the following assignments and equipment.

Assignment:	Engineer	1 - 2 members
	Guide	1 member
Equipment:	Jeep	1

2-6 Aerotriangulation

As its name suggests, aerotriangulation is a kind of triangulation. It is performed to increase the number of control points and consequently to produce the various elements which are required for setting the photos in the plotting machine for each model.

Aerotriangulation is the process that comes between control point survey and plotting, and it can never be dispensed with for economical execution of photogrammetry (Refer to Fig. 2-4).

2-6-1 Particulars of aerotriangulation

The analytical aerotriangulation method was applied.

1. Works performed

Areas A and B	3 courses	16 models
Area C	2 courses	4 models

2. Instrument

Wild PUG-4 Stereo pricking device
Wild STK-1 Stereo photocomparator
NEAC 2200-500 Electronic computer

3. Residual error of calculation

Course	Planimetric Position	Height
C-37	1.59 m	1.69 m
C-37A	1.68	2.86
C-38	4.04	1.03

2-7 Mapping

Type of plotting machine should be selected with account taken of the flight altitude at which the photos are taken and the contour interval of the topographic map to be prepared.

In the case of the present project, the flight altitude and contour interval were respectively 7,500 m and 5 m.

2-7-1 Instrument

Wild Autograph A8

2-7-2 Particulars of mapping work

Plotting ratio	1:5 (1/50,000 → 1/10,000)
Completed topographic map	Scale - 1/10,000, contour interval - 5 m, sheet line size - 80 cm x 60 cm, finished in black ink on polyester base plate
Number of sheets	13 in total (Refer to Fig. 2-4)

Fig. 2-1 **WAY RAREM/ABUNG AREA POLYEDER PROYEKTIE SYSTEM**

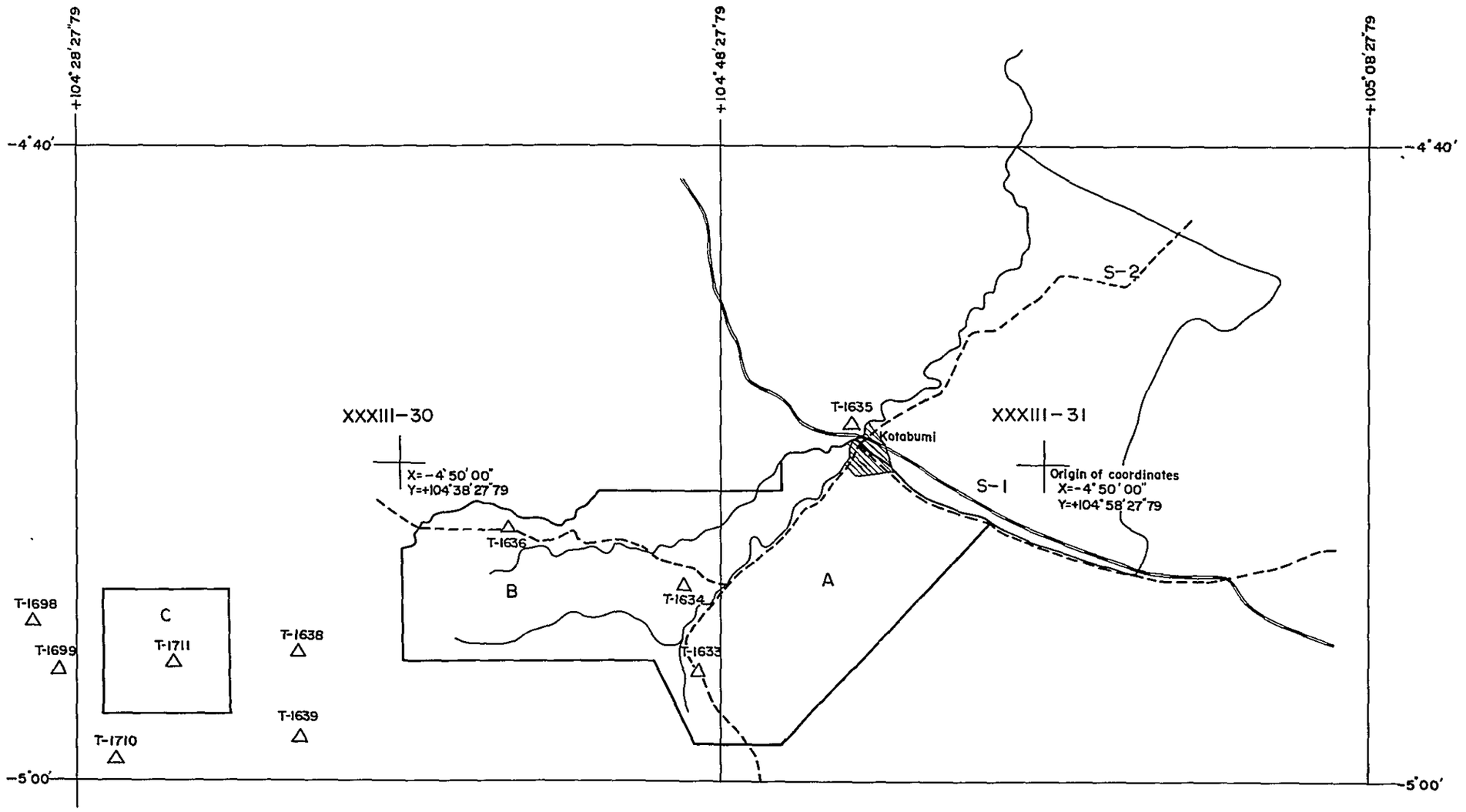


Fig. 2 – 2 TRAVERSE ROUTE of WAYRAREM / ABUNG

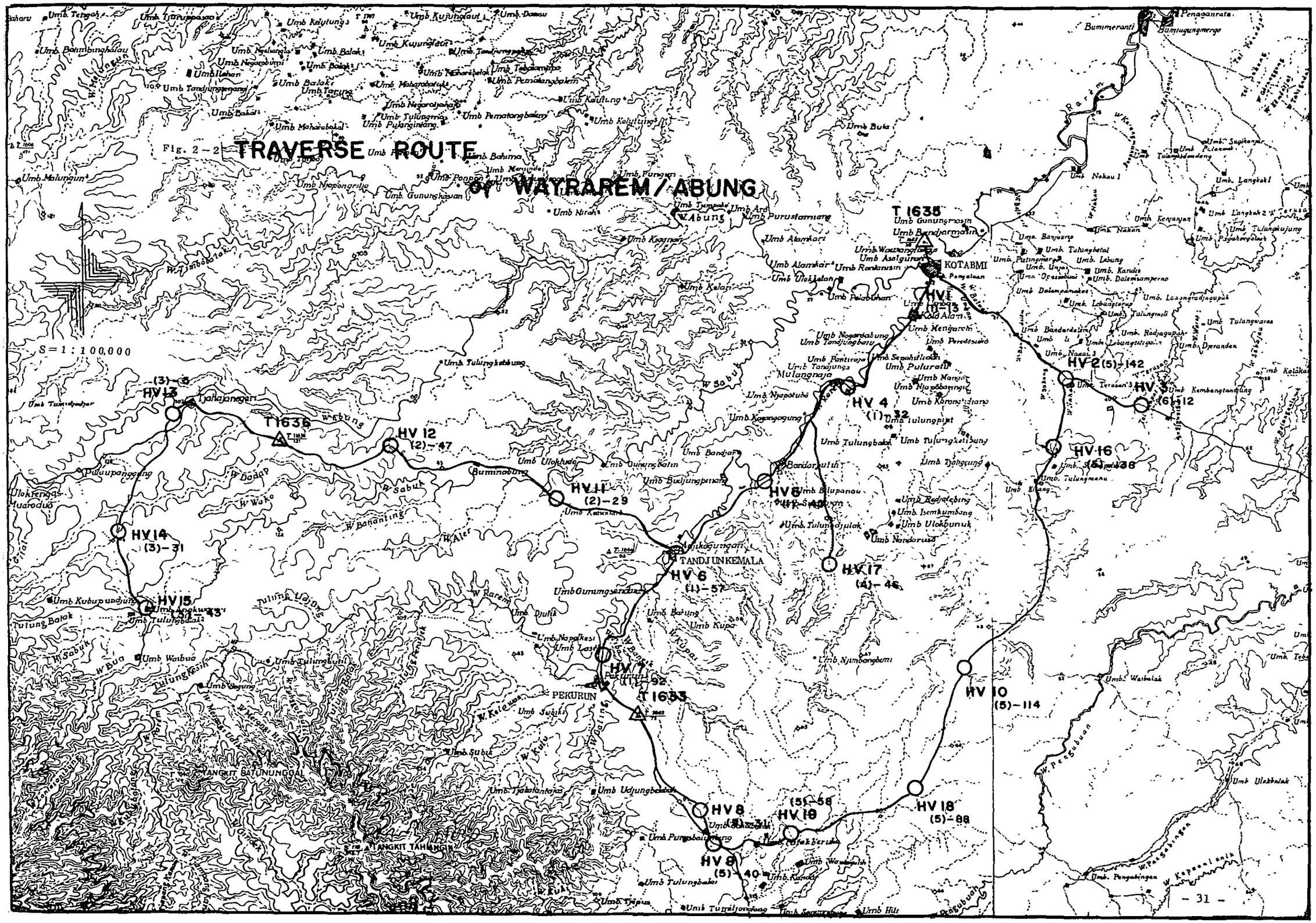


Fig 2-3 MAPPING PLAN OF WAY RAREM/ABUNG AREA (SHEET INDEX) AND LEVELING ROUTE

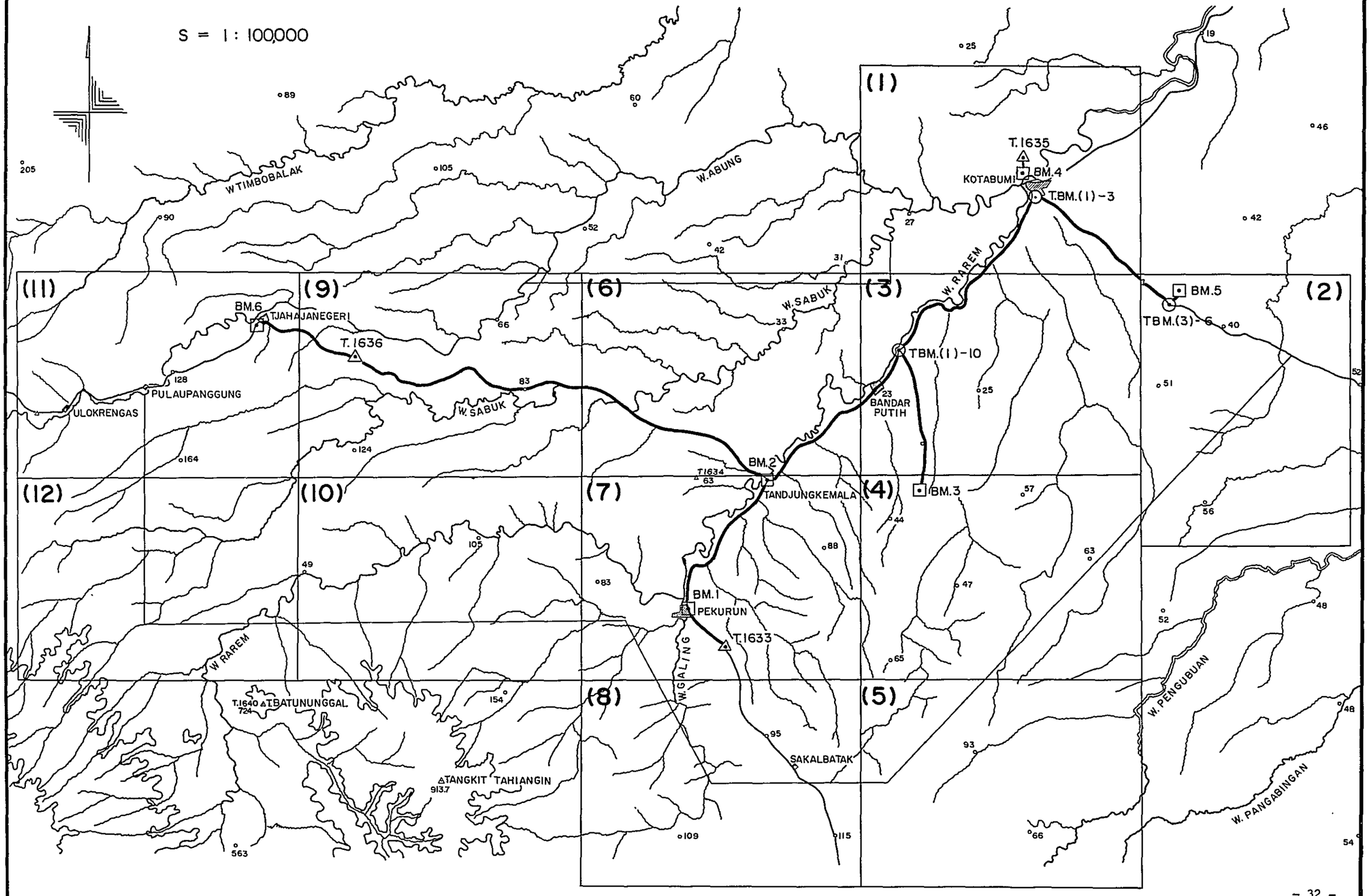
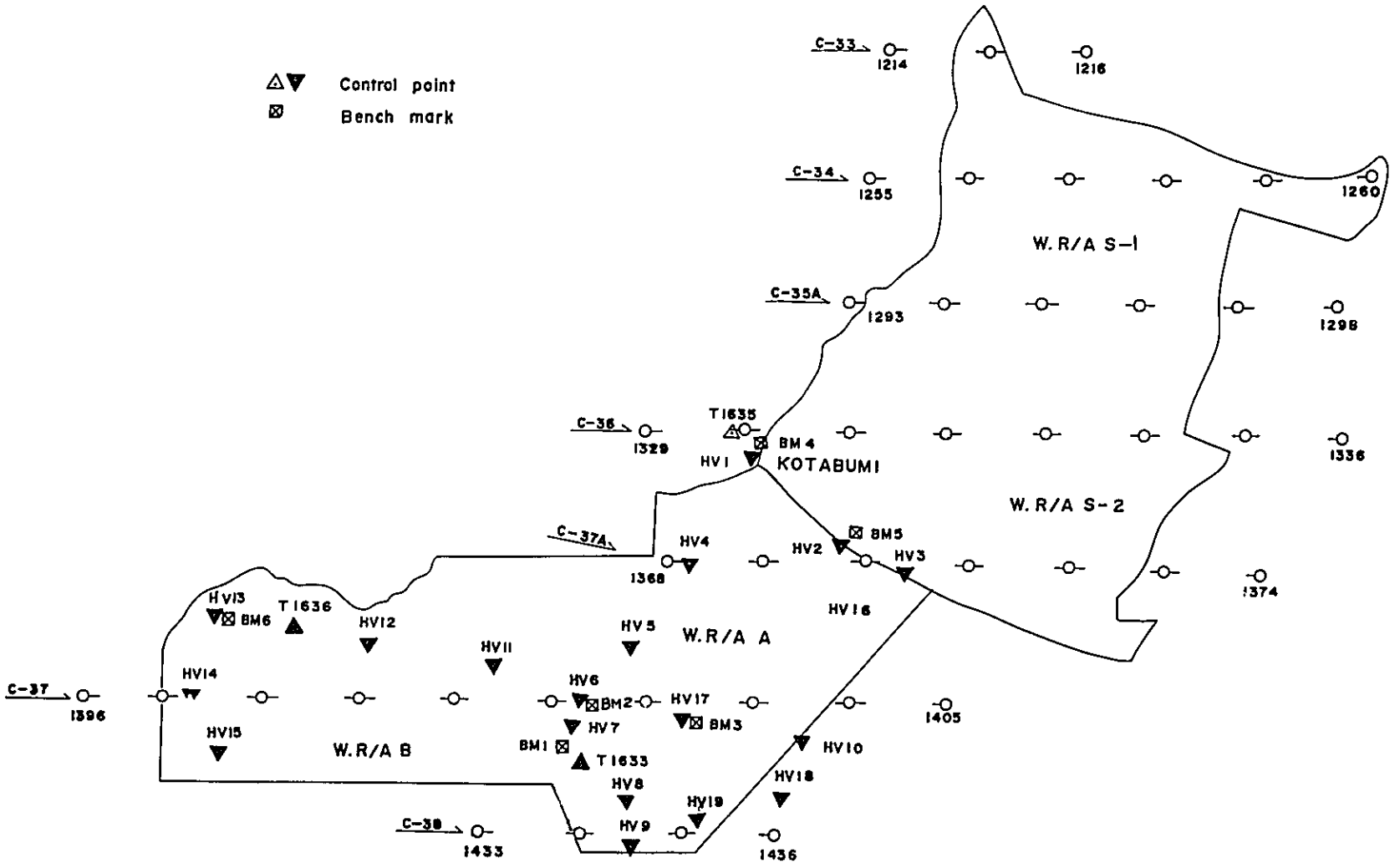


Fig. 2-4 Way Rarem Abung

Control point of orientation sketch



CHAPTER III. CHECKING WORK OF THE EXISTING TOPOGRAPHIC MAP

This chapter contains the results of the checking survey work of the existing topographic maps in scale, 1/5,000 of which the southern part of Way Rarem-Abung area is the objective area of the feasibility study scheduled to be in next fiscal year and covers the area of about 35,000 ha.

3-1 Conclusion

The following conclusions were obtained in accordance with the checking results.

(1) The existing topographic maps should be used under the condition that some problems they contained are grasped.

(2) Actually, it is desirable that the approximate topographic maps in scale 1/10,000 newly mapped due to the aerial photographs during the checking work are jointly used with the existing topographic maps.

(3) As for position and elevation, the both topographic maps should be taken as approximate.

(4) The approximate topographic maps due to the aerial photos may be used with greater safety, when there is a greater difference found in the both topographic maps in reference to geographic features; for example, the catchment area for the proposed site of irrigation tank.

(5) It is desirable to survey in more detail on the longitudinal section of the proposed main canal route and the plan of the proposed sites of irrigation tank in the objective area for the feasibility study.

3-2 Method of the Checking Survey Work

The topographic map does not, by nature, permit easy quality control, in large part because it is difficult to interpret in detail all the information contained in it by intensive analysis.

It is not practical to attempt to examine all comprehensive factual information contained in the topographic map. A practical approach to its proper interpretation would be analysis of general information about a specifically extracted area, analysis of specific information about the whole survey area or combination of both.

It should be determined according to the purpose and conditions of the checking survey work which type of analysis is to be employed.

In this checking survey work, the following procedures were followed as a rule so as to achieve high accuracy of topographic interpretation of the objective area.

(1) Leveling was carried out along the selected survey routes to check the accuracy of the vertical positions and traversing was performed at the selected points to test the accuracy of plane positions.

(2) The check of the general topographic features and positions mainly at an elevation between 25 m and 45 m was carried out by the photogrammetry of the existing aerial photographs.

3-3 Features and Limitations of this Checking Survey Work

(1) In general, uniform accuracy is difficult to obtain in the topographic map prepared by ground control survey.

(2) The photogrammetry can cover a vast expanse of ground and completely check the whole of objective area, and the photogrammetry not only affords a means to check the existing photographic maps, but also makes it possible to correct them to some extent.

(3) The results due to the photogrammetry show the uniform accuracy

within the scale of the existing aerial photos and can extract the big problems of the existing topographic maps.

(4) However, the high local accuracy especially about elevation can not be expected in the approximate topographic maps due to photogrammetry because of the scale of the existing aerial photos. Therefore, there are limitations in the checking work.

3-4 Checking Results

3-4-1 Scale accuracy

Scale accuracy is how accurately the real topography is represented in the existing topographic maps at the design scale of 1/5,000. When local detail is considered, the accuracy of representation of distances between two points on the map can be taken as a measure of scale accuracy.

3-4-2 Accuracy of absolute positions

This accuracy is whether the control points are projected and shown on the map with high accuracy in accordance with the mapping method employed. The existing topographic maps on the scale of 1/5,000 are projected as a whole within the framework of square sections of XXXIII-31 polyhedral system.

Since the ground control survey was carried out by treating the station T1635 as the initial point practically, this accuracy can be roughly taken as a measure of the accuracy of representation whether certain points on the map are represented by the accurate distance and direction to the station T1635, if minor problems of the principle are disregarded.

The checking results on the above accuracies are as follows:

The existing topographic maps show a tendency to rotate counter clockwise round the station T1635 and the angle of rotation ranges from 0^{o}-20' to 0^{o}-50'. Deviations of positions in directions other than the direction of this rotation seem attributable to errors of surveying, and such deviations are quite varied in direction and quantity, but

have far smaller quantities than the deviations in the direction of rotation. This fact does not conflict with the results obtained in the checking work carried out by traversing in the field.

Since the magnetic declination in this district is about 0°-35' to the east, this rotation of the topographic map seems attributable to the fact that the points were measured by the astatic needle starting from the station T1635 and projected on the section paper of XXXIII-31 polyhedral system without correction.

The use of this topographic map possesses the following problems resulted from the above fact.

(1) The rotation of the map must be taken into consideration, when it is connectively used with the new topographic map in scale, 1/10,000 of the neighboring area on the south side.

(2) If a field survey is to be carried out on the basis of the existing topographic map, it is necessary to use the azimuth and the co-ordinates referred to in the preparation for the map in this area. If this area is to be surveyed using the traverse points and co-ordinates of the new 1/10,000 map, it is necessary to make a correction to obtain uniformity of the co-ordinates in this area.

However, if the co-ordinates may be approximate to a extent of the interpretation on the map, they can be obtained on the map to unify the section line for mapping.

In either case, however, the problem is not much complicated from a practical point of view.

3-4-3 Topographic features

Generally, there are no great differences in topographic features represented by the existing topographic map and the approximate topographic map due to the photogrammetry. Major differences in local topographic features revealed by the checking work are mainly in the water courses and valleys.

In the area where the ground has small undulations in place, but has a gentle slope as a whole, it is extremely difficult to represent continuous strips of a specific feature like a watercourse on a map with high accuracy. Errors may result from the density of terminal stations depending on the method of ground control surveying, and even photogrammetry may fail to furnish information detailed enough about such a feature, because it does not accurately represent differences in elevation.

It appears that the position of the main river of the Way Rarem was added by an improper method, and its position on the map does not seem reliable enough.

The use of the existing topographic map possesses practically the following problems with respect to its topographic features.

(1) The approximate topographic maps due to photogrammetry may be used with greater safety, when interpreting the topographic features with greater differences as described in the above.

(2) If it is necessary to obtain more detail about the topographic features in question, the existing topographic map and the approximate topographic map due to photogrammetry should be closely compared to determine the method and scope of a further survey. This will help effect a saving in time and cost.

3-4-4 Altitude

Judging from the results of the field checking survey, the elevations at the bench marks seem represented with adequate accuracy.

Actually, however, judging from the comparison with the approximate topographic map due to photogrammetry, it is suggested that the elevations shown on the existing map should be taken as approximate, when the elevations are read at certain points shown on the map or especially from the contour lines. As far as this 1/5,000 map is concerned, it seems reasonable to interpret approximately the position of a certain point itself

in connection with its topographic features.

It is too difficult to examine the accuracy of representation of elevations and contour lines by the method employed in this checking survey work and this checking method is no better than the indirect check to have recourse to the comparison with the topographic features. Accordingly, the results of this checking work should be taken only as illustrative.

3-5 Detailed Description of the Checking Method

3-5-1 Field survey

The field survey of the selected points was carried out by traversing and direct leveling starting from the traverse points and bench marks of which the accuracy was confirmed in the adjacent area. These points were selected from the points of which the surveying pegs were still in place and the surveying results were confirmed.

3-5-2 Control points for aerotriangulation

An analytical method was employed for photogrammetry. Although control points are necessary in the objective area for this purpose, as part of the results of aerotriangulation in the adjacent area could be utilized, the photogrammetry basically depended on them and used supplementally the data on traverse points and bench marks in the objective area, and moreover, the data on the points read from the 1/5,000 map.

3-5-3 Analytical aerotriangulation

When the data obtained in the objective area are to be used as the control points for aerotriangulation, the accuracy of the data must be checked at first. Actually, however, as the above work has to be primarily based on trial and error, the aerotriangulation was carried out by simultaneous average of the data of the whole area, starting with the bench marks whose accuracy had already been confirmed and after several tentative calculations.

The average residual error in plane position became about 8 m.

3-5-4 Mechanical map drawing

A topographic map was mechanically drawn at a scale of 1/10,000 on the basis of the results of aerotriangulation, using the 1/50,000 aerial photographs. The contents of map drawing are mainly the contour lines of spacing of 5 m with the priority given to the topography.

3-5-5 Collation of maps

The reference map was separately prepared by reducing the existing 1/5,000 map to the map of a scale of 1/10,000 by photographic method.

As a crystal base was used in the two maps unified to the scale of 1/10,000, it is possible to compare the topographic features represented on them multilaterally, when the maps are overlapped.

Some measurements were taken on the maps to make a numerical comparison.

3-6 Summary of the Checking Results

3-6-1 Results of the field checking survey

The results of the field checking survey was described in the interim report. As a result of further study of the problems of the co-ordinate system, the following results were obtained concerning the traverse points.

(1) Differences of traverse points

Points	Value	Y	X
		m	m
BTT 149	Checking result	-1572.840	-7276.676
	Given co-ordinate	-1531.53	-7288.20
	Difference	- 41.310	+ 11.524
C-2	Checking result	-3559.033	-2482.948
	Given co-ordinate	-3449.36	-2519.75
	Difference	- 109.673	+ 36.802

Remarks: Co-ordinates were calculated by polyeder.

(2) Differences of leveling points

Point	Checking result	Given value	Difference
	m	m	m
K/75	24.577	24.538	0.039
M/61	18.982	18.954	0.028
N/69	29.451	29.421	0.030
BT/PU	33.819	33.748	0.071

3-6-2 Problems revealed by collation of maps

It is possible to check the problems of the topographic features revealed on the aforementioned two topographic maps in scale, 1/10,000, when the maps are overlapped.

3-7 Recommendation on Topographic Mapping

3-7-1 General

As a result of special photogrammetric checking survey, our impression is that for the area where topographic condition is complicated photogrammetry should be definitely applied and ground survey is not to be depended on. Of course, the weak point of photogrammetry is covered by ground survey. That is, we often experience the cases that forest area is all covered by tall trees and it is impossible to get precise land forms and ground elevations or the cases that we are unable to understand throughly the land form because it is in the shade of ground features. In this case, ground survey must be applied as supplementary survey.

Similarly, if drawing contours requiring high accuracy is necessary, it is desirable that ground survey is used together with photogrammetry.

Usually, appropriate contour intervals for the scales of topo maps in general are clarified by specification. For example, as follows,

Scale	Contour interval
1:10,000	10m or 5m
1: 5,000	5m or 2.5m
1: 2,500	2m
1: 1,000	1m

If accuracy of elevation is considered specially important for irrigation plan, it must be devised so that the volume of ground survey work is proportionally increased according to the degree of importance.

It seems that for irrigation plan 1/5,000 scale is usually applied and 1m contour interval is required.

Here, how to make topographic map for irrigation plan at lower cost will be specially expressed.

3-7-2 General plan

To make general plan, proper scale topo map which makes it possible to roughly understand condition of field is used and for that matter 1/50,000 scale topo map or the like is desired. Or instead of that, photos taken from ERTS Satellite are enlarged to 1/200,000 or 1/100,000 scale and used.

3-7-3 Photographing plan

Project area is noted down on the data (topo map) that is prepared beforehand and flight is also written in.

For accuracy sake, about 3 times as large scale as plotting scale is desired for photographing. So, if topo map scale is 1/5,000, photographing scale is 1/15,000. If elevation difference between high part and low part on the ground is so much, F=21cm normal angle camera is operated and if the ground surface is comparatively flat, F=15cm wide angle camera is used.

In this case, plotting accuracy of elevation is expected to be around $\pm$ 60cm on condition that altitude is assumed about 3,100m if F=21cm is used. If F=15cm is used, altitude is about 2,200m and it is empirically known that plotting accuracy of elevation is $\pm$ 40cm. So,

if photographing is carried out on the above-mentioned conditions, high accuracy result is generally obtained. Furthermore, if possible, it is desirable that aerial signals are established at the points that are expected to be used as control points for ground survey so as to have the positions of such points taken into photo clearly.

3-7-4 Ground survey

Control point survey that is necessary for aerial triangulation is carried out. At first, skeleton control point network covering all the project area is planned. In this case, it is desirable that triangulation is substantially the mainstay of making network.

However, if it is topographically impossible, the circumstances call for making network by traverse.

At the places in the network where plotting is considered difficult, stone monuments are buried and preserved so that they will be good enough for supplementary survey carried out later. At the same time, a sketch or terrestrial photos showing each place are kept as record.

The records in which coordinate values and elevations are written are filed. As measurement accuracy, 2nd order traverse is applied and 10mm $\sqrt{S}$ or so is considered for elevation accuracy. It is desirable that distance is measured by T2 and distance measuring instrument or steel tape. Distance measurement by indirect method such as stadia method and so on should be absolutely avoided.

3-7-5 Field check

Already-taken photos are enlarged at appropriate magnification and brought to the field for having field information to the photos. Around 1/10,000 scale photo is fit for such use.

3-7-6 Aerial triangulation

Since aerial triangulation is considered important, we will explain our view at another time.

3-7-7 Plotting

For making maps that require 1 m contour interval, it seems that accuracy needed generally can not be satisfactorily obtained. So, the following method will cut down expenses and save time.

Contour lines for project place, important structure and concealed part that can not be interpreted on the photo are covered by ground survey. Other points are plotted by photogrammetry. That is, whole topography is plotted beforehand by photogrammetry and contour lines are drawn for the area except important structure.

For cost reasons, 5 m interval would be enough. The places where structure is planned are plotted on photos taking advantages of established points (where stones are buried) by previous ground survey. Quite-detailed topography is also represented on maps and prepared as targets of supplementary survey on the field.

CHAPTER IV. PREPARATORY WORKS FOR THE COMING FEASIBILITY STUDY

4-1 Information and Problems about the Coming Feasibility Stusy

During the mapping survey and the checking survey on the existing topographic map from September 10 to December 8, 1974 and the preparatory survey on the coming feasibility study from March 5 to March 18, in 1975, the prospective contents of the coming feasibility study were discussed several times with the officials concerned with the Directorate General of Water Resources Development, Ministry of Public Works and Electric Power of the Government of Indonesia.

In this chapter, the information and problems about the technical items for the coming feasibility study are described.

4-1-1 General

1. The objective area of the coming feasibility study is the southern part: about 35,000 ha (S-1, S-2 areas) of the Way Rarem-Abung area, but the survey will be implemented in connection with the irrigation plan for the objective area: approximately 118,000 ha of the pre-feasibility study (specially with respect to the distribution of the river discharges).
2. With reference to the third stage development plan and the irrigation plan by pumping up which have been suggested by the pre-feasibility study, the study will be carried out roughly.
3. Numbers and places of irrigation tank will be reviewed.
4. At present, the Government of Indonesia is progressing the investigation and planning of the Abung area and Abung Hulu area, and the Government will select the first plan suggested by the pre-feasibility study for these areas.
5. Consequently, the importance of the coming feasibility study will be attached to the first plan until the second stage development.

4-1-2 Prospective field surveys

1. Collection of data, information and bibliography

The feasibility study team will collect data, information and bibliography necessary for the study in addition to the available data already collected by the preceding survey teams (Refer to Appendix I).

2. Field surveys

(1) General field survey

General field survey will be done prior to the field survey to grasp the prospective contents of survey works and to select the suitable sites for the proposed main irrigation structures roughly.

(2) Discharge observation (Refer to 4-3)

Discharge observation will be carried out at the rivers concerned with the Project to check the existing data.

(3) Drilling survey (Refer to 4-4)

The drilling survey including standard penetration test, permeability test and soil sampling for soil mechanical tests at laboratory has been decided to be undertaken by the Government of Indonesia.

The results of the survey will be provided to the feasibility study team including the analyses of data, geological log, etc.

(4) Geological survey (Refer to 4-4)

1) Technical advice for the drilling survey and soil mechanical survey.

2) Field survey on the surface geology at the proposed sites of main irrigation facilities, borrow pits, quarry and the benefited area by a portable seismometer.

3) Field survey on the proposed quarry sites:

Selection of the proposed sites, assumption of the rock amounts, strength test of the outcrop by a Shumitt hammer, sampling for rock test, etc.

(5) Soil mechanical survey (Refer to 4-4)

1) Field survey on the proposed sites of the main irrigation facilities by test pits, hand auger and cone penetrometer.

2) Soil sampling

3) Soil mechanical test at laboratory

This test has been decided to be undertaken by the Government of Indonesia.

(6) Survey on ground water (Refer to 4-4)

Ground water survey will be done in connection with the drilling survey and other surveys, if possible.

(7) Survey on the canal routes and main irrigation structures (Refer to 4-2 and 4-5)

Canal routes and the proposed sites and sizes of main irrigation structure will be determined roughly.

During this work, the ground control survey on the sites prospected to be necessary has been decided to be undertaken by the Government of Indonesia and the survey results will be provided to the feasibility study team.

(8) Water quality survey

Water quality survey has been decided to be undertaken by the Government of Indonesia and the test results will be provided to the feasibility study team.

However, the items of test will be shown before the test by the feasibility study team.

(9) Survey on water requirement

The survey on water requirement will be done at a few points to check the values due to calculation methods, if necessary.

(10) Soil survey

The field soil survey will be carried out on soil horizon, soil texture, field apparent density, the distribution of gravel, humus amount, soil color, hardness, the condition of oxidation leaching, stickness, plasticity, moisture content and others by digging the test pit of 1.0 - 1.5 m in depth at about 50 points and observing the soil profile.

(11) Soil analytical test

The soil analytical test has been dicided to be undertaken by the Government of Indonesia and the feasibility study team. The contents of the partial charge will be discussed during the feasibility study.

The items of the soil analytical test will be the mechanical composition, PH (H_2O, KCl), exchange acidity, cation-exchange capacity, exchangeable lime , phosphate absorption coefficient, material requirement for soil improvement (the amount of calcium carbonate and fused phosphate per 25 cm of soil horizon per ha) about the samples devided by soil horizon.

The soil analytical test of which the feasibility study team takes the partial charge will be conducted in Japan.

(12) Survey on vegitation condition

Vegitation survey will be done in the benefited area on it's variety, height, size, density, root length, etc.

(13) Agronomic survey

Agronomic survey on existing land use, agricultural inputs, cost of agricultural products, variety and yield of main crops, prevailing cropping pattern, existing livestock farming, etc.

Further, the interview to the farmers on actual farm management method, labor availability, utilization of farming equipments, distribution system of the agricultural inputs and seeds, control and processing of agricultural products, etc. to survey the existing agricultural conditions in the project area.

(14) Agro-economic survey

The present agro-economic conditions will be surveyed on the existing regional society, land ownership, farming acreage, farming population, income of household, marketing system and price, present level of life condition of transmigrants, etc.

4-1-3 Prospective work in Japan

1. Arrangement of the data collected.

The study team will arrange the data, information and bibliography which have been collected by the preceding survey teams and the feasibility study team.

2. Test and analysis of samples

The samples brought back from Indonesia will be tested and analyzed. The items of testing are as follows.

(1) Rack test

(2) Soil analytical test

3. Determination of the project plan

The project plan will be studied on the basis of the above data and the results of each test along the following items.

(1) Decision of discharge of water sources:

Run-off analysis on the Way Rarem, Way Abung, Way Besai and and rivers in the benefited area.

(2) Composition of soil map, land use map and land classification map.

(3) Confirmation of the existing farm management method

(4) Estimation of prospective farm management method:

Decision of cropping pattern, estimation of agricultural products, study on farm machinery, etc.

(5) Decision of water requirement and drainage discharge

(6) Decision of irrigation and drainage plan:

Estimation of the benefited area, selection of canal routes, study on irrigation method, and planning of city water supply, etc.

(7) Composition of geological plan and profile, and study on borrow-pit and quarry site.

(8) Design of irrigation facilities:

Dam, diversion weir, pumping station, irrigation tank, irrigation canal, drainage canal, farm road, city water supply works, etc.

(9) Study on construction plan and schedule.

(10) Composition of special specifications on construction plan.

(11) Estimation of construction cost.

(12) Study on farm household economy:

Present and future condition of farm budget.

4. Project evaluation

The project evaluation which consists of economic evaluation, financial appraisal, repayment plan and others will be studied on the proposed project plan.

5. Others

Besides the above works, recommendation, summary, conclusion, etc. of the feasibility study will be mentioned in the feasibility study report after the study on the operation and maintenance plan

of the facilities concerned, plan of water management, transmigration scheme, organization of farm household, marketing system, extension service, pilot scheme, and others.

4-2 Rough Determination of the Driving Canal Route and the Study on it's Hydraulic Profile

4-2-1 Field work

During the mapping survey, the following field works were carried out in order to coordinate the planning of irrigation system and the ground control survey for the mapping work:

1. General field survey on the planning route of the driving canal and the proposed sites of the main irrigation facilities related with it. (Way Rarem dam, intake, pumping station, crossed structure with the provincial road and railway, main canal route in the benefited area, etc.)
2. Instruction of the installation points of bench mark for the ground control survey prospected during the coming feasibility study.

4-2-2 Rough determination of the driving canal route

The ground control survey necessary for the coming feasibility study has been decided to be undertaken by the Government of Indonesia (Refer to 4-5).

For this survey, the driving canal route was roughly determined by using the new topographic maps in scale, 1/10,000. The outline of the result is as follows.

1. The driving canal which is designated to be the canal from Way Rarem dam to the crossed point with the railway will be proposed on the right side of the Way Rarem and it's length will be about 24.5 Km.
2. The left side has many areas which the ground elevation is lower than 35.0 m on the downstream part and the canal will need the high embankment at these sections.

3. The area which the driving canal is planned, has undulating topography and the driving canal generally runs at the mid-slope of hills.

   Crossed structure (aqueduct, etc.) with valley will be necessary at about 12 places.

4-2-3 Study of the hydraulic profile of the driving canal

The hydraulic calculation was roughly carried out by using the longitudinal section made by new topographic maps in scale, 1/10,000.

1. According to the 1/10,000 new topographic map, the elevation of the dam axis proposed by the pre-feasibility study relatively becomes higher by about 2.0 m in elevation. Therefore, it is possible to make the intake water level about 52.00 m.

2. If the water level at the crossed point with railway is assumed to be 46.00 m, the average slope of the energy head of the driving canal becomes as follows.

Total length of the canal	24,500 m
Intake water level	52.00 m
Water level at the railway	46.00 m
Total head	6.00 m
Average slope of head	1/4,000

3. If the average slope of the earth canal of which the discharge is about 20.0 m^3/S is assumed to be 1/6,000 (velocity: 0.65 m/s), the energy head which can be allotted to the canal structures (aqueduct: 12 places, siphon: one place, culvert: 2 places) will be about 2.00 m.

4. Economical hydraulic design should be done in connection with the dam height, intake discharge, the location and elevation of the benefited area, etc. during the coming feasibility study.

4-3 Result of the Discharge Observation and Information about Meteorological and Hydrological Data

4-3-1 Discharge observation at the rivers related with the feasibility study

1. Observation place

The velocity observation was carried out at the following six places by a current meter.

(1) the confluence of Way Rarem and Way Galing (Pekurun).

(2) the confluence of Way Rarem and Way Abung (Kotabumi).

(3) Way Rarem (near Propal bridge)

(4) Way Abung (Kp. Ogan VI)

(5) Way Besai (Bandjarumasin)

(6) Way Terusan (near Tatakaruya)

2. Results of observation

The discharges of each river obtained by the cross sectional area due to the river survey and the mean velocity are as follows.

Table 4-3-1 Observation Discharge

unit: m^3/S

Place	First		Second		Third	
	Date	Discharge	Date	Discharge	Date	Discharge
Way Rarem	Month·Day					
Pekurun	10·10	9.0	10.26	15.0	—	—
Kotabumi	10·8	38.0	10·23	8.0	—	—
Propal bridge	10·7,8	60.0	10·21	40.0	10.24	37.0
Way Abung	10·9	7.0	11·12	9.0	—	—
Way Besai	10·11	28.0	10.22	23.0	—	—
Way Terusan	10·12	0.7	11·9	1.6	—	—

4-3-2 Information about meteorological and hydrological data

The collection and analysis of the meteorological and hydrological data in Lampung province have been summarily carried out as a Lampung hydrological network project by P3.S.A. office which is one of the divisions under the Directorate General of Water Resources Development, Ministry of Public Works and Electric Power.

In addition, almost all data on the meteorology and the hydrology concerned with the Way Rarem-Abung area have been collected by the reconnaissance survey in 1972 and the pre-feasibility study in 1973.

According to the officials concerned with P3.S.A. office, the meteorological and hydrological observation system, the data collected and the results of analysis will be reported by July in 1975.

Therefore, the study of the meteorology and hydrology is considered to be possible by the above data and the collection of the successive observation data for the feasibility study. With reference to the hydrological analysis, however, it is supposedly necessary to compare the result of analysis with that of the Government of Indonesia by collecting the observation data of the Tulangbawan river basin (Way Rarem, Way Besai, Way Abung, etc.) including the successive observation data because the commencement time of the observation was around 1971.

The meteorological and hydrological data collected up to now are as follows.

Table 4-3-2 List of the meteorological data collected

Items	Location	Data collected	
		Mean Daily	Mean Monthly
1. Air temperature	Blanibang Pagar	Sep.72 - Apr.73	-
	Way Septih	May 71 - Mar.73	May 71 - Mar.73
	Astralsetra	-	1964 - 1968
	Tandjungkarang	-	1963 - 1967
	Glapan Sedadi	May 71 - Mar.72	May 71 - Mar.72
	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
2. Wind velocity	Astralsetra	-	1964 - 1968
	Tandjungkarang	-	1963 - 1967
	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
3. Relative humidity	Way Septih	May 71 - Mar.73	May 71 - Mar.73
	Astralsetra	-	1964 - 1968
	Tandjungkarang	-	1963 - 1967
	Glapan Sedadi	May 71 - Mar.72	May 71 - Mar.72
	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
4. Evaporation	Way Septih	May 71 - Mar.73	May 71 - Mar.73
	Glapan Sedadi	May 71 - Mar.72	May 71 - Mar.72
	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
5. Evapo-transpiration	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
6. Sunshine duration	Astralsetra	-	1964 - 1968
	Tandjunkarang	-	1963 - 1967
	Glapan Sedadi	May 71 - Mar.72	May 71 - Mar.72
	Rentang	Apr.71 - Mar.72	Apr.71 - Mar.72
7. Rainfall	Kasui	-	1917 - 1938, 1940 - 1941, 1952 - 1953

	Blanibangan Umpu	-	1917 - 1919, 1928 - 1938, 1940 - 1941, 1952 - 1960
	BT. kemuning	1959 - 1968, 1972 - 1973	1952 - 1960
	Tulung Bujut	1962 - 1973	1930 - 1938, 1940 - 1941
	Gahaja Negri	1972 - 1973	-
	Ketapang	1971 - 1973	-
	TT. Serdang	-	1930 - 1938, 1940 - 1941
	Tulangbawan	-	1917 - 1938, 1940 - 1941
	Kotabumi	1951 - 1972	1918 - 1938, 1940 - 1941, 1952 - 1960
	Negri Besar	-	1917 - 1938, 1940 - 1941
	Padangratu	1961 - 1962	1952 - 1960
	Gedung Ratu	1971 - 1973	-
	Tatakarya	1973	-
	Blanibangan Pagar	1972 - 1973	-
	GN. Batin	1972 - 1973	-
	Gunung Sugih	1961 - 1964	1917 - 1938, 1940 - 1941, 1952 - 1957
	Menggala	1971 - 1973	1917 - 1938, 1940 - 1941, 1954 - 1960
	Kayuparis	1972 - 1973	-
8. Isohyetal line map	Lampung Province		(1911 - 1940)

Table 4-3-3 List of the hydrological data collected

Items	Location	Data collected
1. River water level	Way Rarem:	
	Pekurun	Sep.72 - Oct.73
	Konang Bridge	Apr.71 - Oct.71, Jan.72 - July 72
	Tandjunkemala	Apr.71 - Oct.73
	Kotabumi	Oct., Nov.74
	Way Besai:	
	Banjarmasin	Apr.71 - Oct.73
	Way Abung:	
	Organ VI	Oct., Nov.74
	Way Turusan:	
	Tatakarya	Oct., Nov.74
	Way Pengubuan:	
	Negri Katun	Apr.71 - July 72
	Way Seputih:	
	Ng. Adji Baru	Sep.70 - Apr.71, Jun., July, Sep.71, Dec.71 - Jan.72
2. River discharge	Way Rarem:	
	Pekurun	Feb., Apr., July, Aug.73, Oct.74 (1973 - 1974)
	Tandjunkemala	Oct.74
	Kotabumi	Oct.74, 1974
	Way Besai:	
	Banjarmasin	Oct.74 1972 - 1974

	Way Abung:	
	Organ VI	Oct., Nov.74
	Way Turusan:	
	Tatakarya	Oct., Nov.74
	Way Pengubuan:	
	Trimodadi	1937 - 1940
	Way Seputih:	
	Negaraadji	Sep.1937 - Dec.1940
	Way Sekanmpung:	
	Argoguruh	July 59 - 61, 1964 - 1968, 1971 - Apr.1973
3. Ground water level	Lampung Province	Aug. 1974
4. Location map of wells	Lampung Province	Aug. 1974

4-4 Plan of Geological and Soil Mechanical Survey

4-4-1 Outline of topography and geology

The topography in the investigation area is composed of the plateau in the stage of youth. Consequently a large number of shallow valleys are scattered on the surface of plateau. When looking at the area on the whole, a lot of planes are still remained.

The geology in the west part of the investigation area is occupied with mountains which are constituted with granit. This granit is also scattered under the plateau. Schist in the age of the Pre-Tertiary and deposits in the Tertiary are distributed on the granit. All the investigation areas were covered with tuff which had been yield by volcanic activity in the age of the Quaternary.

These tuff deposited on the plateau. This fresh tuff deposited mainly on the west side of rail rode. In the old time of eruption, andesite was also blowed out.

The topography of the present investigation area mainly consists of the eruption volcano in the Quaternary and deposits of tuff accompanied with this.

The tuff on the ground surface at the east side of rail road has become red or red brown in colour by weathering and the degree of viscosity is high, the permeability being low. The thickness of strata is unknown, but being considered to be 30-50 m. or more.

The west side of rail road is covered with latest tuff. This tuff consists of andesite tuff and voids are big, the permeability also being high. The thickness of strata has been uncertain, however, in some places, it can be touched to andesite of bed rock at several meters under the ground surface.

This andesite forms blocks, being a hard rock. A number of swampy lands are found in the plateau side constituted with volcanic tuff and clay soil, gradually making a big stream due to these being gathered. Rarem river is one of these. The width of swamps becomes

fairly wide near the proposed dam site of Rarem river and alluvial valley planes are distributed, the thickness of this alluvium deposit being considered to be more than 30 m. The deposits consist of clay, gravel, sand, etc.

In the feasibility study, items to be considered from the nature of the topography and geology described above will be as follows:

(1) The permeability of foundation of the dam is high and the depth to andesite or granite of the bed rock is more than 30 m.

(2) Tuff having a big permeability is distributed along the driving canal between dam site and irrigation area.

(3) Red clay is distributed in the irrigation area and the permeability on the ground surface is low.

(4) The available value of water table groundwater is not very high. Unknown quantity will be applied for artesian groundwater, its expectation being not much.

4-4-2 Plan of geological and soil mechanical survey

In the results which have been consulted with the Government of Indonesia, the contents of the geological and soil mechanical survey for the feasibility study scheduled in 1975 have become as follows.

As for the drilling survey and laboratory soil test which have been decided to be undertaken by the government of Indonesia, proposal of technical specifications has been prepared in this report due to the work period as technical provisions for operations.

1. Division and assignment of the survey

The survey is divided into the drilling survey, geological survey and soil mechanical survey for convenience as follows.

(1) *Drilling survey*

1) Drilling, standard penetration test, field permeability

test and soil sampling at the proposed sites of Way Rarem dam, pumping station and irrigation tanks.

2) Reporting (including the analyses of data, geological log, etc.).

(2) Geological survey

1) Technical advice for the drilling survey and soil mechanical survey.

2) Field survey on the surface geology at the proposed sites of main irrigation facilities, borrow pits, quarry and the benefited area by a portable seismometer.

3) Field survey on the proposed quarry sites.

4) Rock test.

5) Reporting.

(3) Soil mechanical survey

1) Field survey on the proposed sites of the main irrigation facilities by test pits, hand auger and cone penetrometer.

2) Soil sampling.

3) Laboratory soil test.

4) Reporting.

In the above surveys, the drilling survey and laboratory soil test have been decided to be undertaken by the Government of Indonesia.

2. Technical specifications of drilling

(1) General

1) Scale of application

This specification will be applied for the technical

section of drilling survey on Way Rarem-Abung Irrigation project in Lampung Province.

2) Articles except provisions

When any questions about technical articles which have not been specified in this specification are entertained, the instruction of the geological engineer of the government shall be obtained for these.

3) General descriptions of drilling

Works will be divided into three classes as drilling work, tests at drilled holes and soil tests at laboratory. With respect to the soil test at laboratory, separate specifications will be provided.

Works of the above will be shown in Table 4-4-1.

Table 4-4-1 Plan of the Drilling Survey

No.	Location	Drilling length	Assumed geology	Tests at drilled hole		Soil sampling	Remarks
				Standard penetration test	Permeability test		
		m		times	times	pieces	
1	Proposed site of Way Rarem dam	30	earth & gravel	30	1	6	Soil sampling depends on the standard penetration test
2	- ditto -	30	- ditto -	30	1	6	
3	- ditto -	30	- ditto -	30	1	6	
4	- ditto -	30	- ditto -	30	1	6	
5	- ditto -	15	- ditto -	15	1	3	
6	Proposed site of pumping station	15	- ditto -	15	1	3	
7	Proposed site of irrigation tank	10	- ditto -	10	1	2	
8	- ditto -	10	- ditto -	10	1	2	
9	- ditto -	10	- ditto -	10	1	2	
10	Benefited area (survey on deep well)	60	- ditto -	-	1	Core drilling	no soil test at laboratory
Total		240		180	10		

Note; 1. Refer to the location map of drilling survey.

2. If the drilling reachs to the rock layer, the drilling shall be continued 3.0 m in depth for the rock layer. The instruction of the geological engineer of the government shall be obtained on this point.

3. The contractor shall provide the strainer pipes of 20 m and the pipes without strainer of 40 m for the permeability test of drilling hole, No.10.
The instruction of the geological engineer of the government shall be obtained on the depth for the permeability test of No.10.

4. As a rule, the soil sampling due to the standard penetration test shall be carried out at intervals of 5.0 m in depth and the surface layer of about 5.0 m can be omitted.

5. Refer to the technical specifications on other points.

4) Drilling equipment

The contractor shall provide such equipment as being satisfied by the survey which has been decided in this specification. The equipment to be used shall be a drilling machine of spindle type in principle. Cemented carbide bit shall be employed for bits.

5) Report

The contractor shall submit the following three matters to the government, which shall be approved by the geological engineer of the government before being submitted.

(a) Working report	size B5
(b) Geological log	size 29cm x 63 cm
(c) Soil samples	size B5

With refernce to (a), it shall be prepared daily to conform with the form-1, being submitted after concluded once in a week. (b) geological log shall be prepared for each drilling hole to conform with the form-2. Concerning (c) shall be referred to (2)-4). Each form is shown in Appendix II.

(2) Descriptions of works

1) Drilling

(a) Equipment

Rotary drilling machine of spindle type shall be adopted as drilling equipment and cemented cabide bit shall be used for bits. River water shall be used for drilling permeability test holes. Either river water or muddy water (bentonite water) shall be employed for other holes. Drill rods of JIS Standards (JIS G 3465) or of the same quality shall be adopted.

(b) Excavation

The diameter of drill holes shall be over 66 mm, being the most appropriated size for accomplishing the object of tests.
The protection of hole edges shall be made to drive pipes till the proper depth prior to the start of excavation. When arrived at the proposed depth, the excavation shall be stopped.
As to holes for permeability test, casing pipes and strainer pipes shall be inserted in till the bottom of holes immediately after the completion of excavation. The length and aperture of each pipe shall be shown in Fig. 4-4-1. The holes of strainer will be either round hole or slite hole. The area of opened hole section shall be more than 3% of that of the circumference of pipes. (Refer to Fig. 4-4-2).

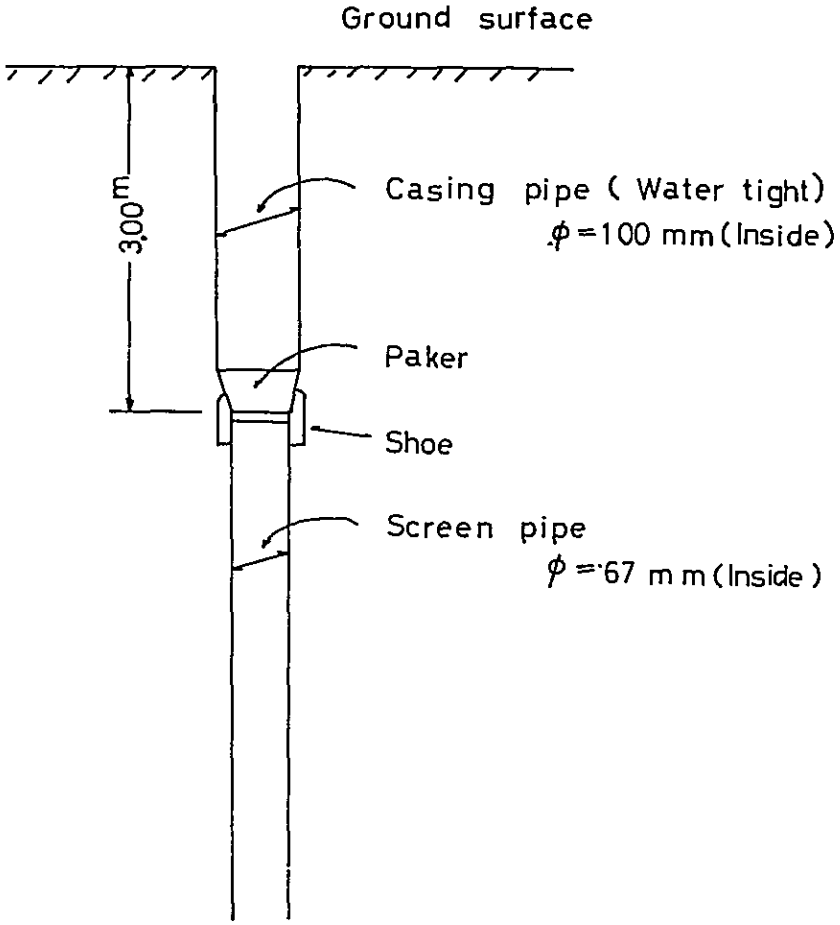
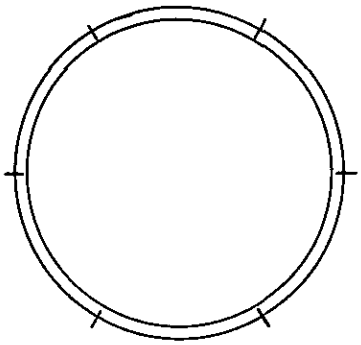
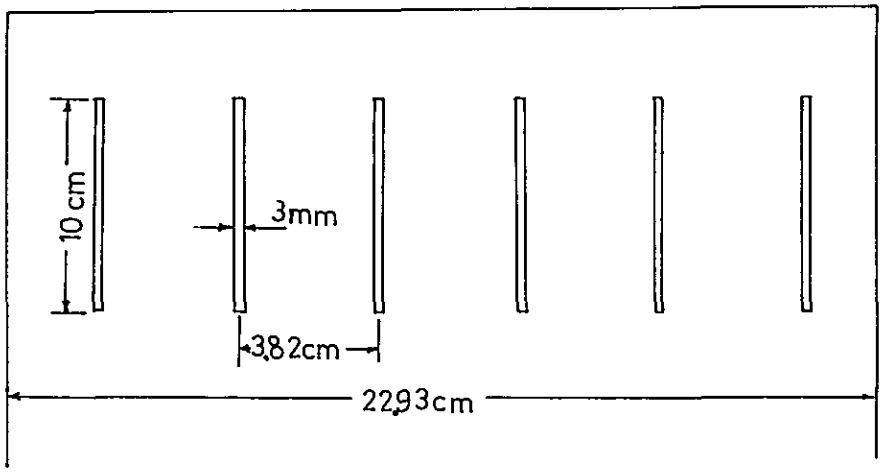


Fig. 4-4-1 DRILL HOLE FOR PERMEABILITY TEST

Section map



Spreading map



PIPE DIMENTIONS (JIS G 3465)

Out side diameter	73 mm
In side diameter	67 mm
Thickness	3 mm
Weight	5.18 kg/m

Fig. 4-4-2 SCREEN PIPE

2) Standard penetration test

This test shall be performed to know the bearing power of strata. Tests shall be executed to use a method specified by JIS A 1219-61 (Japanese Industrial Standard A 1219-61). Tests shall be undertaken each one time till the hole bottom per one meter from hole edge of each hole, being shown in Fig. 4-4-3.

3) Field permeability test

This test shall be executed to know the permeability of strata. The method of tests shall be in conformance with artificial recharge method. Tests shall be made one time per hole as contrasted with the whole depth. This test shall be performed under the supervision of the geological engineer of the government.
(Refer to Fig. 4-4-4).

4) Soil sampling

Samplings of soil shall be carried out for making soil tests in the laboratory. Samples, which have been entered into the split-tube sampler to be used in the standard penetration test, shall be taken out from the tube and immediately be received in the air-tight container. Container shall be sealed with paraffine or other suitable materials and kept in the sample box, one sample box being provided for one hole.

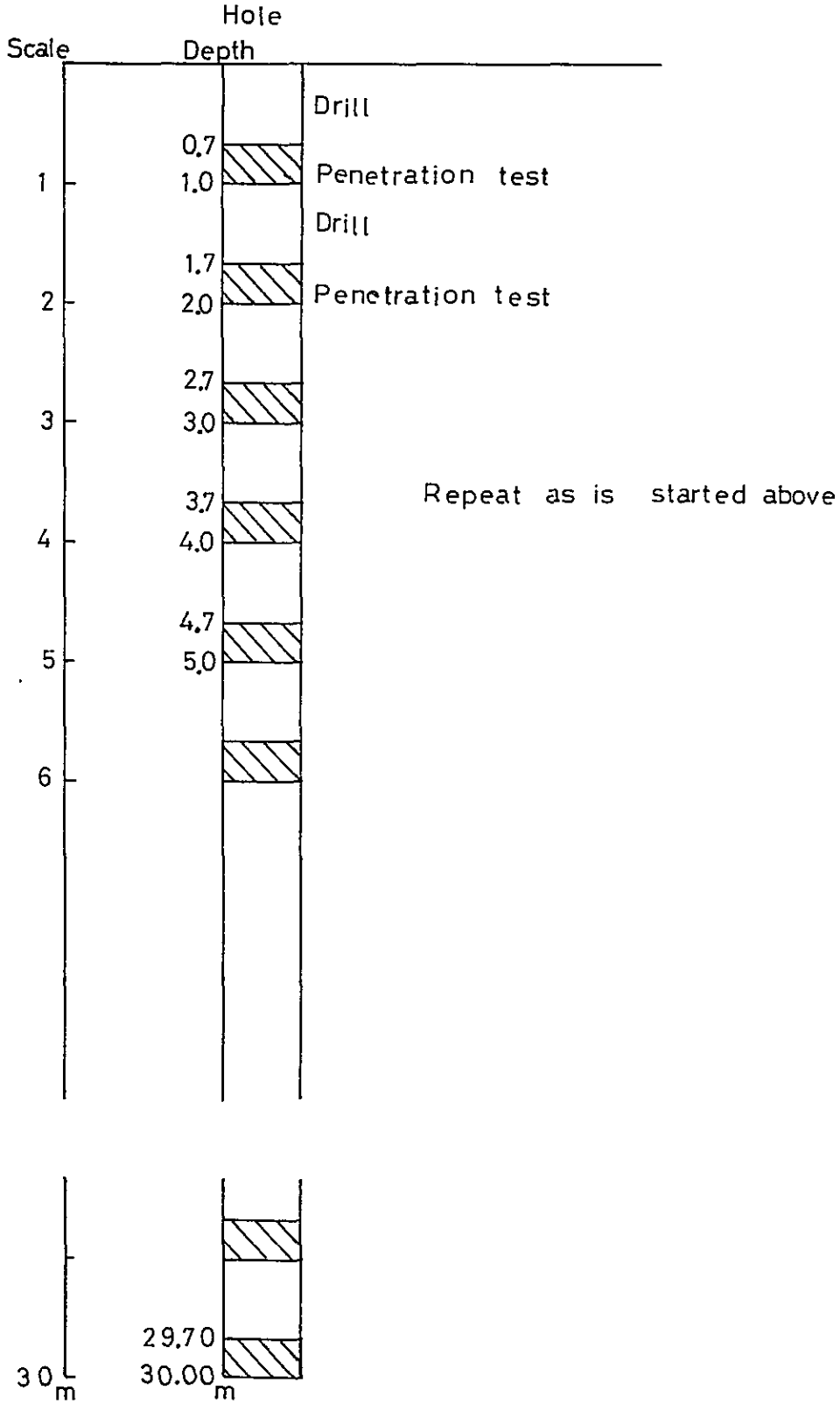


Fig. 4-4-3 STANDARD PENETRATION TEST

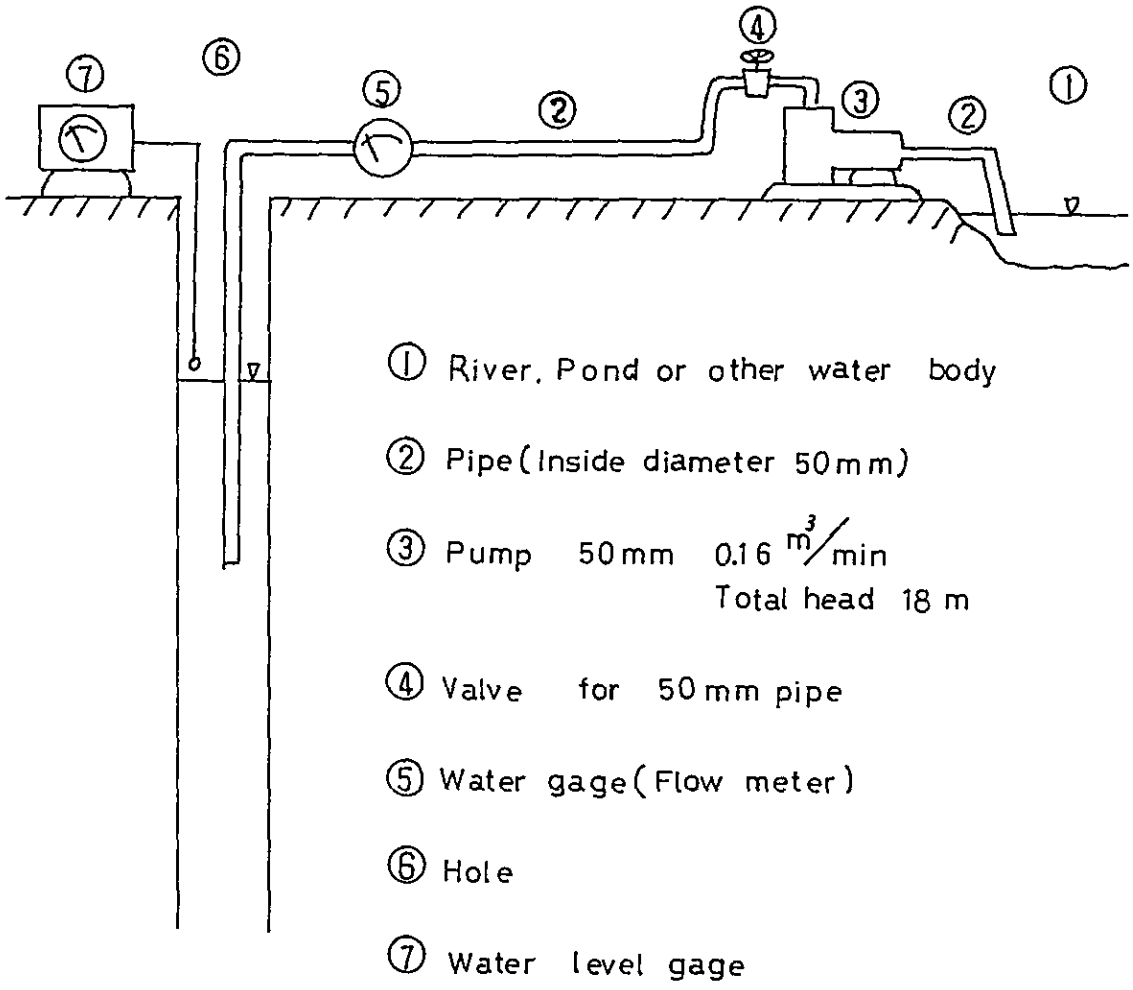


Fig. 4－4－4 PERMEABILITY TEST

3. Specifications of laboratory soil test

(1) Introduction

This Specifications are only described on technical items and quantity of soil mechanical test.

(2) Items of test

The items of test are as follows.

1) Grain-Size Analysis and Physical Test

a) Secific Gravity
b) Moisture Content
c) Unit Density
d) Grain-Size Analysis
e) Consistensy

i) Liquid Limit
ii) Plastic Limit
iii) Shrinkage Factor

2) Dynamical Test

a) Permeability
b) Direct Shear
c) Triaxial Compression(CU)
d) " " (UU)
e) Moisture-Density Relations of Soils Using Rammer (Compaction).
f) One-Dimensional Consolidation

3) Equipment

The contractor shall provide such equipment as being satisfied for the test which has been decided in the specification.

4) Test point and quantity

The test point and quantity are shown in Table 4-4-2.

Table 4-4-2 Plan of the Soil test at Laboratory

Unit : Pieces of sample

Structure	Location	Sample	Method of sampling	Purpose	Grain size analysis and physical test					Dynamical test					
					Specific gravity	Moisture content	Unit density	Grain size analysis	Consistency	Permeability	Direct shear	Triaxial compression (C.U)	Triaxial compression (U.U)	Moisture -Density relations	One-dimetional consolidation
					p	p	p	p	p	p	p	p	p	p	p
Rarem dam	Dam axis	disturbed	drilling	permeability	-	27	27	27	-	27	-	-	-	-	-
	-ditto-	undistrubed	sampler	foundation	2	2	2	2	2	-	-	2	-	-	2
	Borrow pit	disturbed	test pit	embankment	2	2	-	2	2	2	2	2	2	2	-
	-ditto-	undisturbed	sampler	swell factor	1	1	1	-	-	-	-	-	-	-	-
Pumping station	proposed site	disturbed	drilling	permeability	-	3	3	3	-	3	-	-	-	-	-
	-ditto-	undisturbed	sampler	foundation	2	2	2	2	2	-	-	2	-	-	2
Irrigation tank	Center	disturbed	drilling	permeability	-	6	6	6	-	6	-	-	-	-	-
	-ditto-	undisturbed	sampler	foundation	1	1	1	1	1	-	-	1	-	-	1
	Borrow pit	disturbed	test pit	embankment	2	2	-	2	2	2	2	2	2	2	-
	-ditto-	undisturbed	sampler	swell factor	1	1	1	-	-	-	-	-	-	-	-
Canal	Center	disturbed	test pit	bank	1	1	-	1	1	1	1	1	1	1	-
	-ditto-	undisturbed	sampler	cut	2	2	2	2	2	-	-	2	-	-	2
	structure	disturbed	test pit	foundation	1	1	-	1	1	1	1	1	1	1	-
	-ditto-	undisturbed	sampler	embankment	2	2	2	2	2	-	-	2	-	-	2
Total					17	53	47	51	15	42	6	15	6	6	9
Pieces of specimen per one sample					3	3	3	1	3	1	3	3	3	6	1

5) Procedure

Technical method of the test principally depends on EARTH MANUAL(United States Department of the Interior Bureau of Reclamation 1968) or METHOD OF SOIL TEST(The Japanese Society of Foundation Engineering 1969).
With respect to the dynamical test of soil materials for embankment, the samples shall be made by about 90% of the maximum dry bulk density obtained by the test of moisture-density relations of soils using Rammer.

4. Means of field permeability test

(1) Theory

This means will be made to calculate the permeability coefficient from the ascending water level and the recharged volume of water at that time.

(2) Procedure

1) Pipes fixed strainer will be entered into the bottom holes after the completion of drilling for the test hole.

2) The inside of holes shall be cleaned using water. Working for 12 hours shall be stopped.

3) Water level of the inside of holes (static level) shall be measured.

4) The constant amount of water shall be recharged, the recharged amount of water being measured.

5) Water level shall be measured by intervals of constant hour at the same time as the beginning of recharging water and all data obtained at the test shall be recorded on the field note form-3. This work shall be made to continue over 6 hours and/or until the water level beoomes constant.

6) Recharging water shall be stopped and the water level shall be measured at the interval of the constant hour. The measure shall be continued till restoring to the primary static level, being stopped when the water level was completely restored.

(3) Equipment

The apparatus shall consist of the following:

1) Pump 50mm, Total head 18m. 0.16m^3/mim or more.

2) Pipe inside diameter 50mm. The material is not specified.

3) Stop valve for 50 mm. pipe.

4) Water gage (flow meter).

5) Water level gage

The arrangement is shown in Fig. 4-4-4.

4-5 Plan of Ground Control Survey

4-5-1 Outline

In the results which have been consulted with the Government of Indonesia on the ground control survey necessary for the coming feasibility study, the detail operations of the ground control survey have been decided to be undertaken by the Government of Indonesia. The proposal of technical specifications is shown in this report due to the work period as technical provisions for operations.

4-5-2 Technical specifications of the ground control survey

1. General

(1) Scale of application

This specification will be applied for the technical section of the ground control survey for the feasibility study of Way Rarem-Abung Irrigation project in Lampung Province.

(2) Articles except provisions

When any questions about the technical articles which have not been specified in this specification are entertained, the instruction of the surveying engineer of the government shall be obtained for these.

(3) General descriptions of the ground control survey

Works will be divided into plan survey, longitudinal survey, cross sectional survey, leveling and sketching for the Way Rarem dam, pumping station, irrigation tank and canal.
Works of the above will be shown in Table 4-5-1.

2. Content of the works

(1) Survey on the Way Rarem dam site

1) The following work shall be carried out for making 1/500 scale plan with 0.5 m contour interval, longitudinal profile section and cross section of the river.

2) Longitudinal base line in parallel with a river course and crossing lines perpendicular to the base line shall be established and survey points at the intervals of 20 meters lengthwise and crosswise shall be established covering the area by grid.
No matter whether it is on land or on river bed, additional survey points shall be established on survey lines at place where slope gradient varies much.

3) Each survey point shall be measured by direct leveling. The leveling route shall be closed by means of using the frame of the area as main route or by other means like that.

4) Horizontal position and elevation shall be all connected with the datum of this project.

5) Accuracy standard

a) Horizontal accuracy

Errors in distances between arbitray survey points shall be within 1/2,000.

b) Elevation accuracy

Leveling survey closure error shall be within 3 cm$\sqrt{S(KM)}$ and error in contour position shall be within 0.25 m above or below the true contour position.

(2) Survey on the spillway of the Way Rarem dam

1) The following work shall be carried out for making 1/500 scale plan with 0.5 m contour intervals and longitudinal profile section of the proposed center of the spillway.

2) The content of the work shall be similar to that of the survey on the Way Rarem dam site.

(3) River survey for a pumping station

1) The following work shall be carried out for making 1/500

scale plan with 0.5 m contour intervals and longitudinal profile section of the river for a pumping station.

2) The content of the work shall be similar to that of the survey on the Way Rarem dam site, except that the approximate horizontal position shall be on a 1/10,000 scale map and the elevation shall be connected with the datum of the project.

(4) Survey on the center line of the pumping station

1) The following work shall be carried out for making longitudinal profile section of the center of the pipe line.

2) The I.P. position of the center line shall be selected in the field according to roughly made 1/10,000 scale route map which will be submitted separately.
A longitudinal profile survey shall also be carried out along the line.

3) The interval between longitudinal profile survey points shall be within 50 m, and, at places where slope gradient varies, additional establishment of survey points shall be required.

4) Both horizontal position and elevation shall be connected with the datum of the project. Accuracy standard shall be the same as that of the survey on the Way Rarem dam site.

(5) Survey on irrigation tanks

1) The following work shall be carried out for making 1/500 scale plan with 0.5 m contour intervals and longitudinal profile section.

2) The content of the work shall be similar to that of the river survey for the pumping station.

(6) Survey on the route of the driving canal and main canal

1) The following survey shall be carried out for making longitudinal profile section and cross section.

2) The content of the work shall be similar to that of the survey on the center line of the pumping station, except that cross sectional survey shall be applied at places where there are intersecting rivers, canals and valleys. In addition, a sketch showing views as seen from above shall also be made.

(7) Survey on the proposed sites of canal related structure

1) The following work shall be carried out for making 1/500 scale plan with 0.5 m contour interval.

2) The content of the work shall be similar to that of the survey on the Way Rarem dam site.

Table 4-5-1 Plan of Ground Control Survey

Structure	Location	Ground control survey						
		Plan			Longi-tudinal section	Cross section	Level-ing	Sketch
		Scale	Size	Area				
			mxm	m^2	km	m x place = m	km	place
Way Rarem dam	Dam site	1/500	600 x 400	240,000	1.0	500x5=2,500	2.0	---
	Spillway	-ditto-	400 x 400	160,000	1.0	---	---	---
Pumping Station	River	-ditto-	150 x 150	22,500	1.5	200x3=600	2.0	---
	Center	---	---	---	6.0	---	---	---
Irrigation tank	per one place	1/500		150,000	0.5	50 x 5 = 250	3.0	---
	10 places			1,500,000	5.0	2,500	30.0	---
Canal	Driving canal	---	---	---	20.0	200x50=10,000	---	20
	Main canal	---	---	---	30.0	100x60=6,000	---	
	Main structure	1/500	place 10x200x100	200,000	---	---	---	---
Total:				2,122,000	64.5	21,600	34.0	20

APPENDIX

I. AVAILABLE DATA

1. Maps

1)	Topographical Map of Way Rarem area	S=1: 100,000
2)	"	S=1: 5,000
		& S=1: 25,000
3)	Topographical Map of Way Abung area	S=1: 5,000
4)	Index Map of Aerial Photograph	S=1:1,000,000
5)	General Map of the confluence of Way Galing & Way Rarem	S=1: 2,000
6)	"	S=1: 5,000
7)	Geological Map of Sumatora	S=1:2,000,000
8)	Geological Map of Kotabumi & Gedongratu	S=1: 200,000
9)	Soil Map of Lampung province	S=1: 250,000
10)	Road Map of Lampung province	S=1: 250,000
11)	High Way Map between Kebunkaret, Rejat & kempung Kelapa	S=1: 5,000
12)	Map of Rainfall Observatory	S=1: 500,000
13)	Map of Water Level Observatory	S=1: 500,000
14)	Objek Transmigrasi Panaragan Lampung Utara Way Abung	S=1: 50,000
15)	Map of Transmigration's Data	S=1: 50,000
16)	Peta Kecamatan Propinci Lampung	S=1: 500,000
17)	Peta Tanah Objek Transmigrasi Panaragan Lampung Utara Kabupaten Kotabumi	S=1: 50,000
18)	Peta Tumbuh-Tumbuhan Objek Transmigrasi	S=1: 50,000
19)	Topographical map of Sumatora	S=1:1,790,000
20)	General map of Geology	S=1: 100,000
21)	Peta Quarry	S=1: 500,000
22)	Attached papers of Peta Quarry	
23)	Location map of wells	
24)	Map of Nakau plantation	S=1: 20,000
25)	Material list of D.P.U. laboratory	

26) Boring machine & boring materials

2. Irrigation

1) Transmigration Placement Viewed from the Irrigation Aspect
2) Proyek Irrigasi Way Abung Lampung Utara
3) Penyelidikan Geologi Teknik Dan Mekanika Tanah Rencana Bandung Way Abung (Hulu) Lampung Bagian Pertama: Geologi Teknik
4) Perhitungan Estimate Irrigation Requirement Dengen Perhitungan Evapotranspiration Methods Hargreaves
5) Perhitungan Evapotranspiration (Consumtive use) menurut Method Hargreaves
6) Capaciteit Skromme-Way Sekampung
7) Unit Cost Calculation
8) Setandar Perentjanaan Saluran dan Bangunan2nja Vol. 1,2,4,5,6,7,8
9) Reconnaissance Report Projek Irigasi Way Rarem
10) Reconnaissance Survey on Way Rarem/Way Abung Irrigation project
11) Feasibility Study on Way Umpu Irrigation Project
12) Feasibility Study on Way Pengubuan Irrigation Project
13) Prefeasibility Study Report on Way Rarem/Abung Irrigation Project
14) Ground water countour line

3. Farm Management

1) Lampung Dalem Angka 1972
2) Statistik Pertanian 1967-1971
3) Sensus Penduduk 1971
4) Rencana Pembangunam Lima Tahun Tahap Kedua: 1974/1975 - 1978/1979
5) Farm Land Area of Kabupaten and Kecamatan in Lampung Province 1971
6) Planted area and yield of Perennial crop in Lampung Province 1968 - 1973
7) Data on wages and working hours with each plant 1972

8) Data on production cost of crops with each Kabupaten or plant 1972

9) Data on yield and fertilization of low land rice with each Kabupaten 1969 - 1972

10) Data on extent and area which were damaged by blight and harmful insects or disaster with each plant in Lampung Province 1970-1972

11) Data in extent and area which were damaged by blight and harmful insects or disaster with each Kabupaten and fields 1972, 1973

12) Data on price of agricultural products with each month in North Lampung 1971.1972

13) Data on price of agricultural products with each Kabupaten May 1973

14) Settlement of transmigrations project in Lampung Province 1952-Feb.1973

15) Data on results of transmigration in survey area and planning in the future, and map concerned

16) The name of Ketjamatan and Desa in North Lampung

17) Report on Circulation and Production of Cassava

18) Agricultural Statistics in Indonesia

19) Transmigration Policy

20) Investigation of Farm Management: Questionnaires

21) Selintas Tinjiauan Tentang Transmigrasi, Way Abung

4. Hydrology

1) Climatological data

a.	Blambangan Pagar	Daily: Temperature	Sep.1972 - Apr.1973
b.	Way Septih	Monthly & Daily: Temperature, Humidity, Sunshine, Rainfall, Evaporation.	May 1971 - Mar.1973

c.	Astralsetra	Mean Monthly: Temperature, Humidity, Wind, Sunshine, Rainfall	1964 - 1968
d.	Tandjung Katang	ditto	1963 - 1967

2) Monthly Rainfall

a.	Way Septih	of. 1) b.	May 1971 - Mar.1972
b.	Lampung Province	Monthly: Rainfall, Rainfall days, Max. Rainfall	1952 - 1960
c.	Glan Sedadi	Monthly & Daily: Temperature, Humidity, Sunshine, Rainfall, Evaporation	May 1971 - Mar.1972
d.	Rentang	Monthly & Daily: Temperature, Humidity, Sunshine, Rainfall, Wind, Evaporation, Evapotranspirometer	Apr.1971 - Mar.1972
e.	Lampung Province	Mean Monthly Rainfall	1931 - 1960
f.	"	"	1917 - 1941
g.	"	of. 2) b. "	1952 - 1953

3) Daily Rainfall

a.	Bukitkemuning		1959 - 1968 1972 - Jul.1973
b.	Bandarjaya		1970 - 1971
c.	Kotabumi (DIPERTA)		1951 - 1972
d.	" (D.P.U.)		Jan.1959 - May 1961 Apr.1963 - Jun.1973
e.	Tatakarya		Apr.1973 - Nov.1973
f.	Cahaya Neteri		Jan.1972 - Jan.1973

g.	Gedung Ratu	Dec.1971 - Jan.1973
h.	PK. Tulung Buyut	Jan.1971 - Feb.1973
i.	Lempuyang - Kayuparis	Jan.1972 - Aug.1973
j.	Proyek Gula Gm. Batin	Nov.1972 - May 1973
k.	Menggala	Dec.1971 - Jan.1973
l.	Ketapang	Jan.1971 - Sep.1973
m.	P.T. Daya Itoh: Blambangan Pagar	Jan.1972 - Oct.1973
n.	Tulung Buyut: 220a, of. h.	1962 - 1970
o.	Padangratu	1961 - 1962
p.	Gunung Sugih	1961 - 1964
q.	Dusun Kenali	Jan.1972 - Apr.1972
r.	Liwa	Jan.1971 - Apr.1972
s.	Batanghari	Jan.1961 - Dec.1961
t.	Pekalongan	Jan.1964 - Oct.1964
		Jan.1966 - Apr.1967
		Jan.1968 - Jul.1968
u.	Dam Argoguruh	Jan.1961 - Dec.1962
		Jan.1966 - Oct.1970
v.	Sukadona	Jan.1962 - Dec.1963
		Jan.1966 - Dec.1970
w.	Metro	Jan.1961 - Dec.1970

4) Discharge Data

a.	Way Seputih in Negaraadji	Water Discharge	1939
b.	Way Rarem in Pekurun	"	Feb. Apr. Jul. Aug. 1973
c.	Way Rarem in Tandjung Kemala	Water Level	Apr.1971 - Oct.1973
d.	Confluence of Way Rarem & Way Galing (Pekurun)	"	Sept.1972 - Oct.1973
e.	Way Besai in Banjarmasin	"	Apr.1971 - Oct.1973

f.	Way Sekampung in Argoguruh	Water Discharge	Jul.1959 - 1961 1964 - 1968 1971 - Apr.1973
g.	Way Seputih	Water Discharge	Mar.1973 - Jun.1973
h.	Way Rarem; Way Konang Before Bridge 40m	Water Level	Apr.1971 - Oct.1971 Jan.1972 - Jul.1972
i.	Way Penguguan in Trimodadi	Water Discharge	Sep.1937 - Dec.1940
j.	Way Seputih in Negaraadji	Water Discharge	Sep.1937 - Dec.1940
h.	Calculation of water discharge at the upstream the dam site in the way Rarem		17th Jul. 1962 20th Jul. 1962
i.	Way pengubuan in Negeri katun	Water Level	Apr.1971 - Apr.1972 May 1972 - Jul.1972
j.	Way Seputih in Ng Adji Baru	Water Level	Sep.1970 - Apr.1971 Jun. Jul. Sep. 1971 Dec.1971 - Jan.1972

5) Cross Section

a. Cross section of Way Rarem at water level gauge site
Hadje Kagungan Scale 1:100
86m upstream from the bridge

b. DPUFVAK Way Rarem

c. PENAMPANG MELINTANG RENTJANA DAM WAY RAREM

6) Land capability apprisal Indonesia, Water availability apprisal

7) Meteorological note No.9, Rainfall atlas of Indonesia Sumatora 1911-1940

8) L.H.N.P. Water resources of Lampung province, Interim assessment

9) Rainfall data, Kotabumi

a. D.P.U. Sep.-Dec. 1974

b. Pertanian Kotabumi "

10) Discharge data

a. Way Besai, Bandjarumasin	1972-1974
b. Way Rarem, Pekurun	1973-1974
c. Way Rarem, Proper Bridge	1974

11) Cross section of River

a. Way Besai, Bandjarumasin	3 sections
b. Way Rarem, Pekurun	2 sections
c. Way Rarem, Kotabumi	1 section
d. Way Rarem, Proper Bridge	3 sections
e. Way Terusan, Tatakaruya	1 section

12) Lampung Hydrological Network Project Mar. 1974

APPENDIX II FORMS OF REPORTING ON DRILLING

FORM - 1 DAILY REPORT

FORM - 2 GEOLOGICAL RECORDS

FORM - 3 FIELD NOTE for Permeability Test

FORM-1

No.

DAILY REPORT(Drilling)

LOCATION _____ DATE _____

HOLE No._____ ELEVATION _____m

DRILLING_____ WATER LEVEL _____m

TODAY'S DEPTH_____m DIAMETER _____mm

TOTAL DEPTH_____m MACHINE _____

ENGINEER

LENGTH m	DEPTH m	THICKNESS m	LOG	COLLOR	GEOLOGY	DESCRIPTION	S・P・T DEPTH m	S・P・T N	S・P・T N/10cm			
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

S·P·T : Standard Penetration Test

FORM-2

GEOLOGICAL RECORDS OF DRILL HOLE

LOCATION _____ ELEVATION OF SURFACE _____m DATE _____

HOLE No. _____ WATER LEVEL _____m ENGINEER _____

	ELEV TOP OF STRATUM m	DEPTH m	THICKNESS m	FIELD OBSERVATION RECORD: LOG	CLASSIFICATION OF ROCKS	COLLOR	DESCRIPTION	STANDARD PENETRATION TEST: DEPTH m	N / cm	WATER LEVEL m	NUMBER OF BLOWS 0 10 20 30 40 50 60	SAMPLING: No.	METHOD
m													
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
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20													
21													
22													
23													
24													
25													
26													
27													
28													
29													
30													

METHOD OF SAMPLING
● THIN WALL SAMPLER
○ SPLIT SPOON SAMPLER

FORM-3

No._____

FIELD NOTE For Permeability Test

LOCATION _____ DATE _____

HOLE No._____

DEPTH_____m ELEVATION_____m

STATIC WATER LEVEL m ENGINEER

T	W·L	S	Q	Q	T	W·L	S	Q	Q
	m	m				m	m		

T : Time W·L : Water Level S : Draw Down Q : Quantity

APPENDIX III DATA ON MAPPING SURVEY

TRAVERSE

DESCRIPTION OF CONTROL POINT

COORDINATES OF CONTROL POINT

LEVELING

DESCRIPTION OF BENCH MARK

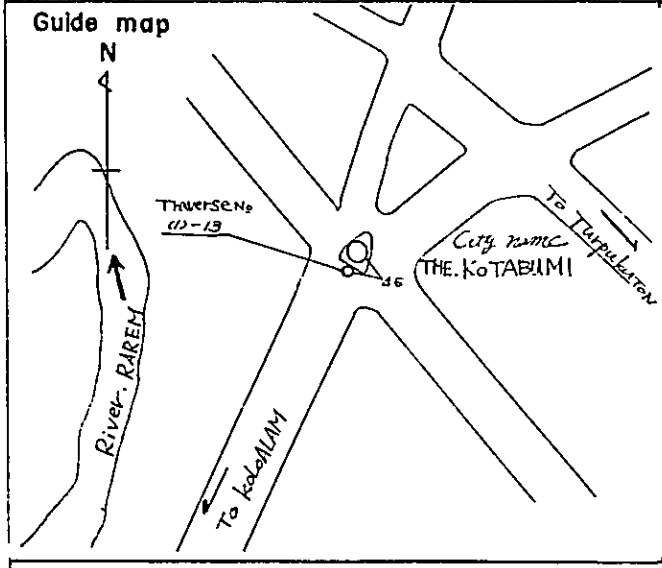
TRUE HEIGHT OF ELEVATION LIST

DESCRIPTION

Sheet No.		Station No.	BM-1	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 10, 929.74	+ 1, 193.63	28.66
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	There is a center island at the junction of 5 roads and this point is concrete road-post constructed on the island.			

Location

Guide map



Field photo

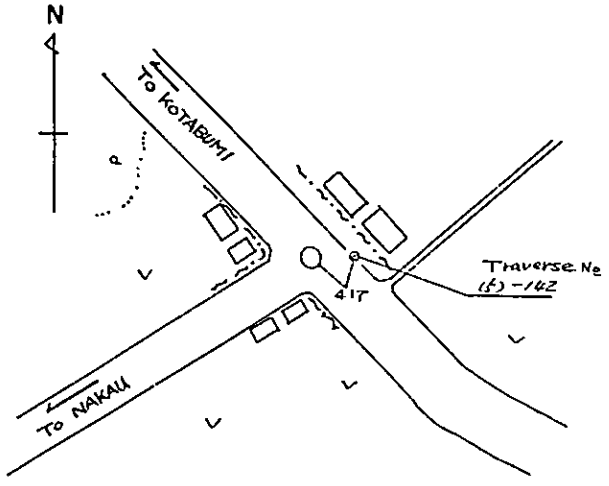
Aerial photograph

DESCRIPTION

Sheet No.		Station No.	PV-2	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 6, 151 29	- 2, 308 86	59 · 48
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This point is located at Triangle-shaped intersection which is 5m distance on the road from Kotabumi to Toruku uton. Other road leads to Nakau village.			

Location

Guide map

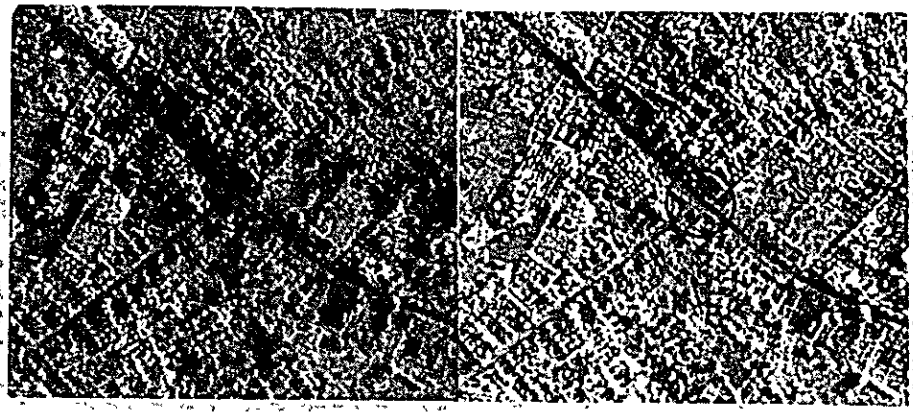


Field photo

Profile

Aerial photograph

C-37A No.1369 N ⇧ E C-37A No.1370

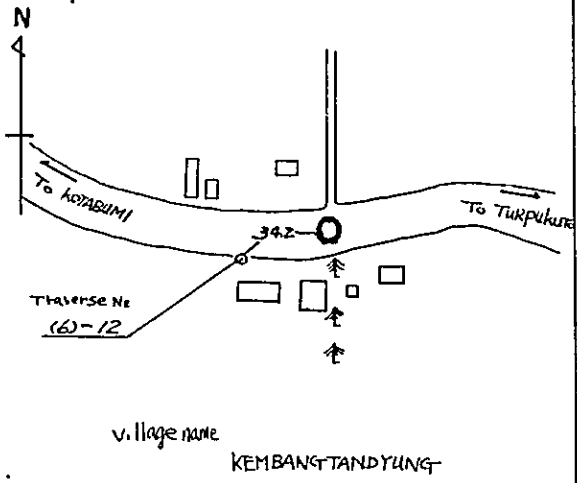


DESCRIPTION

Sheet No.		Station No.	HV-3	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 2 , 962 .98	- 3 , 663 .00	59 .02
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This point is located at center of intersection of track, on left side forward Torupukuton, and road, from Kotabumi in Kembangtandyung village which is about 7.5KM away from Kotabumi.			

Location

Guide map



Field photo

Profile

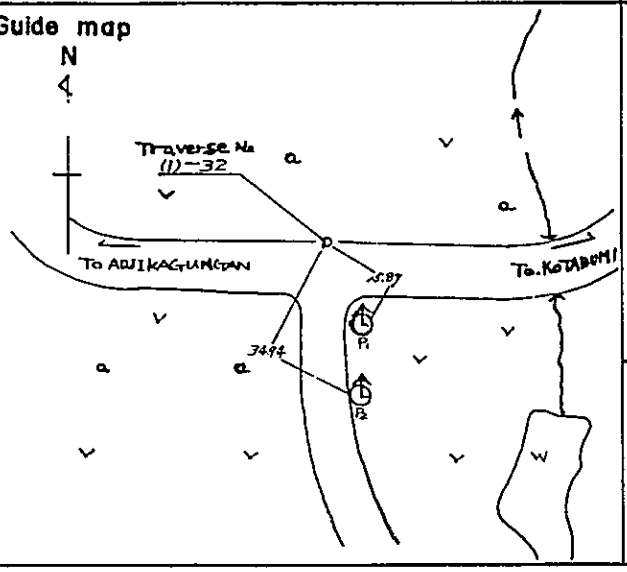
Aerial photograph

DESCRIPTION

Sheet No.		Station No.	EV-4	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 13,298 .27	- 2.143 .76	.
	Auxiliary point	- 13,285 .83	- 2.153 .62	24 .92(P1)
		- 13,292 .15	- 2 178 .17	24 .65(P2)
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	The point is located an road between Kotabumi and Mulangnaja village. Go South west from Kotabumi until you reach Triangle-shaped cross roads about 1KM before you get to Mulangnaja village. Point is at nouth side of road at Triangle-shaped cross roads.			

Location

Guide map

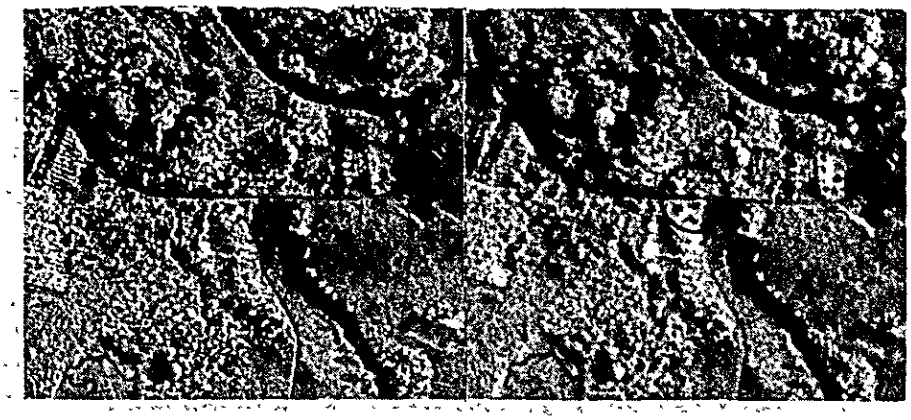


Field photo

Profile

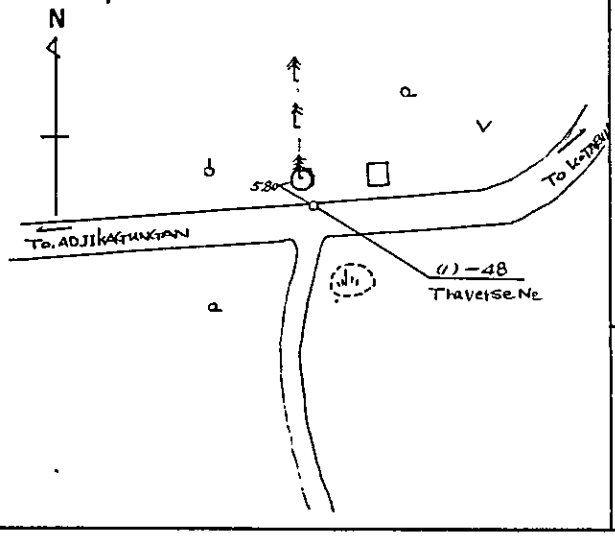
Aerial photograph

C-37A No.0368 N ⇧ E C-37A No.0369



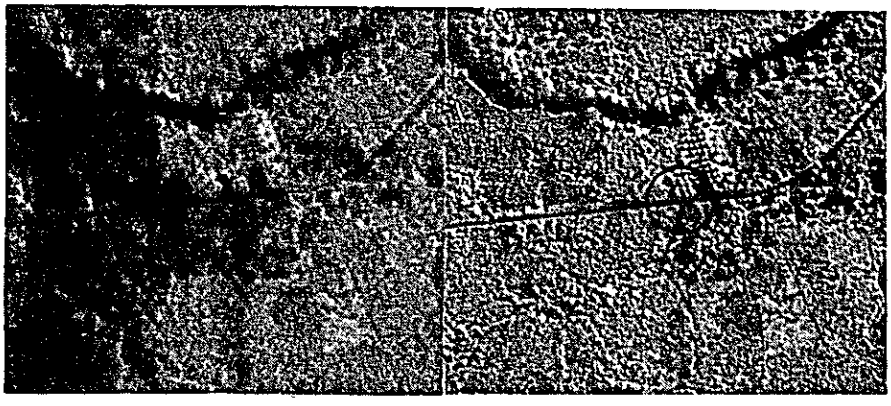
DESCRIPTION

Sheet No.		Station No.	HV-5	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 16 · 124 · 26	- 5 · 077 · 22	30 · 38
	Auxiliary point	, .	. .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Go 8KM south west from Kotabumi. You come to Bandarputi village. From this village go 1KM and you come to Triangle-shaped cross roads. The point is just off the road. It is the first tree of a row of trees forming founiry between 2 farms.			

Location	Field photo
Guide map 	Profile

Aerial photograph

C- 37 No. 1401 N ⇧ E C- 37 No. 1402

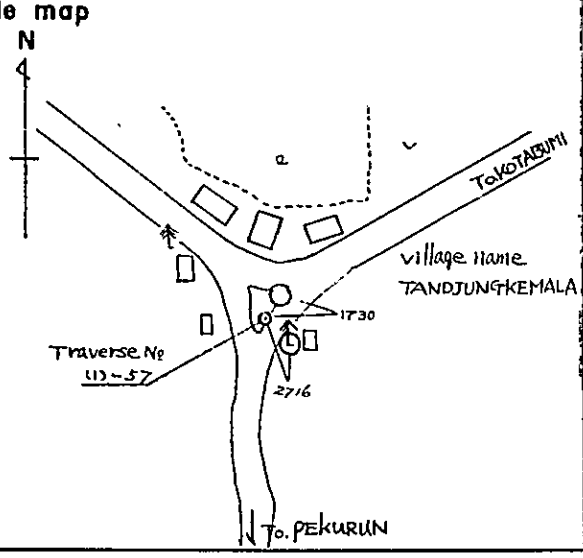


DESCRIPTION

Sheet No.		Station No.	HV-6 (1&2)	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 17. 748 .35	- 6. 459 .82	30 .83
	Auxiliary point	- 17. 749 .24	- 6. 419 .21	30 .69
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 12KM in a south-west direction from Kotabumi. You will reach a three-way intersection with a triangle-shaped piece of land at its center. This is in Tandjungkemala village. This traverse main point is on the south side of the triangle. Secondary point is a standing tree being 27.16M south-east of main point.			

Location

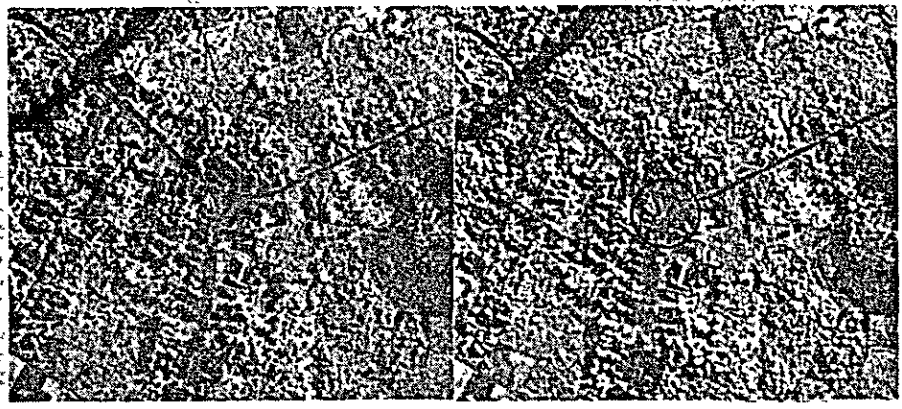
Guide map



Field photo

Aerial photograph

C- 37 No. 1401 N ⇧ E C- 37 No 1402

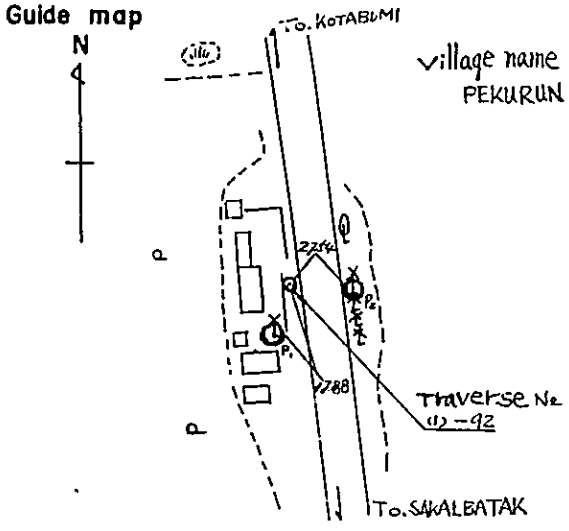


DESCRIPTION

Sheet No.		Station No.	MV-7(1&2)	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 20· 298 65	- 10· 783 ·83	64 ·07
	Auxiliary point	- 20· 315 49	- 10· 806 ·89	62 ·03
		· ·	· ·	·
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 16KM in a south-west direction from Kotaburi; you will reach Pekurun village. This traverse main point is on the west side of the road in this village. Secondary point is the standing palm tree on the east side of the road.			

Location

Guide map

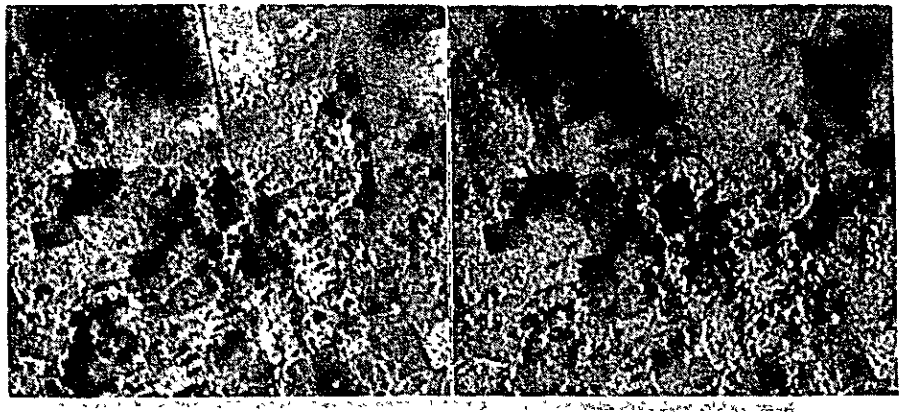


Field photo

Profile

Aerial photograph

C- 37 No. 1400 N ⇧ E C- 37 No. 1401

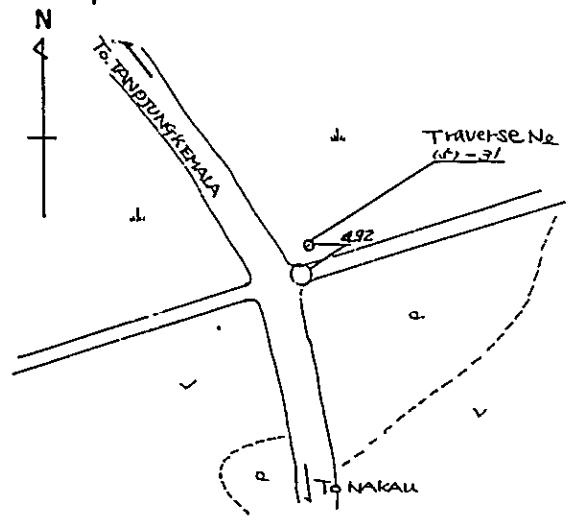


DESCRIPTION

Sheet No.		Station No.	HV-8	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 16, 982 .13	-16 , 226 .09	101 .92
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 22KM in a south-ward direction, from Kotabumi, passing through Tandjungkemala village; you will reach an intersection. This point is at the east side of the intersection, in the center of the narrow path.			

Location

Guide map



Field photo

Profile

Aerial photograph

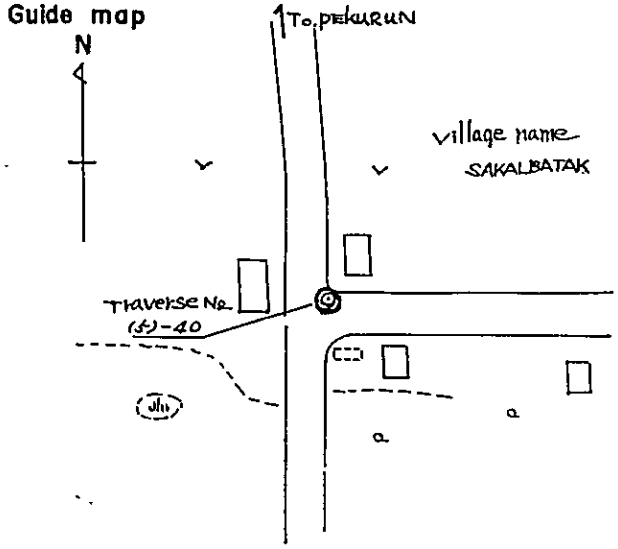
C- 38 No. 1434 N ⇧ E C- 38 No. 1435

DESCRIPTION

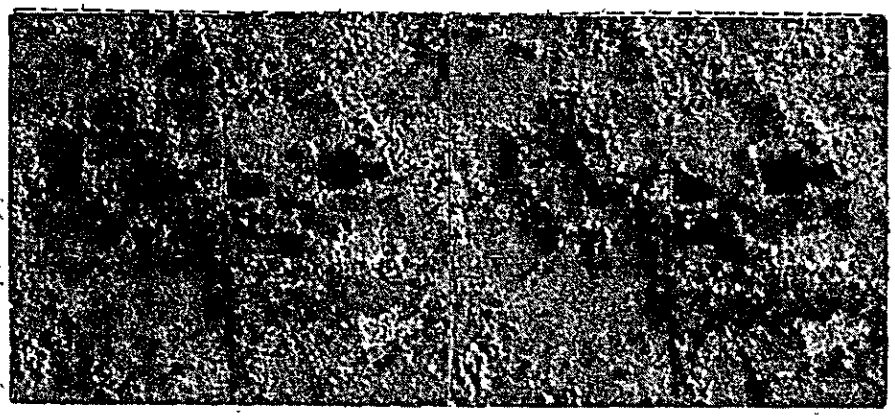
Sheet No.		Station No.	HV-9	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 16, 624.86	- 17, 555.59	110.92
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 23KM in a south-ward.direction, from Kotabumi (passing through Tandjungkemala village). You will come to Sakalbatak village. Go 500M before Sakalbatak village and you will come to a junction. The point is on the east side of the road at the junction.			

Location	Field photo

Guide map



Aerial photograph

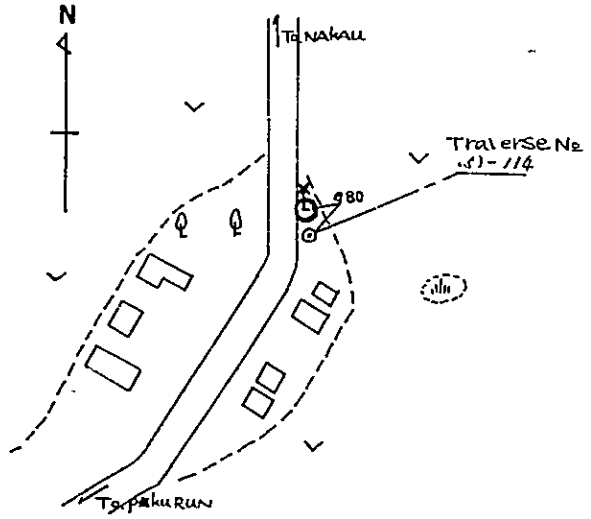


DESCRIPTION

Sheet No.		Station No.	HV-10	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 8, 392 .50	- 11, 135 .00	67 .57
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed in a south-east direction from Kotabumi, you will reach a three-way intersection in Nakau village. Then, turn right and advance 9.5KM further in a southward direction. You will come to a group of pauses. This point is on the east side of the road, this side of the bench in the road.			

Location

Guide map

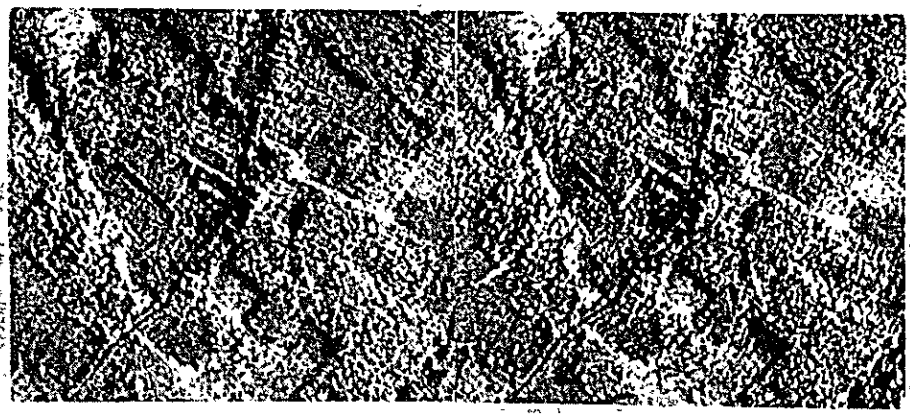


Field photo

Profile

Aerial photograph

C- 37 No. 1403 N ⇧ E C- 37 No. 1404

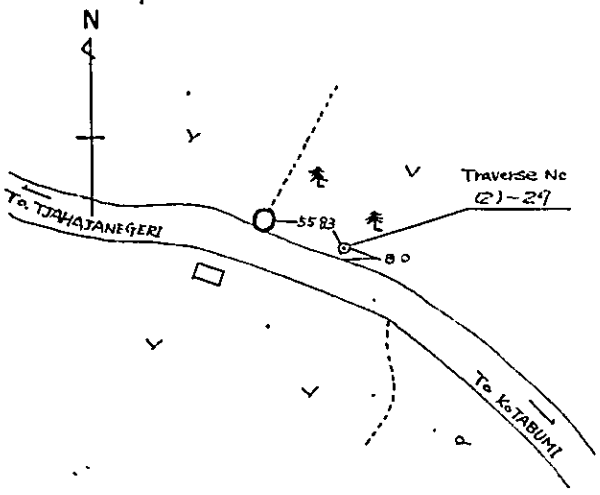


DESCRIPTION

Sheet No.		Station No.	"V-11	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 32, 341 61	- 4.699 .9'4	54 . 23
	Auxiliary point	. .	. .	.
		, .	, .	.
Monument	Type	ooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This point is a big tree at foundary between coffee plantation and farm, on west side of road. The coffee plantation is 4KM away from Triangle-shaped intersection of Tandjugkemala village. This intersection is in west direction from coffee plantation . This intersection is 12KM from Kotaburi on road between Kotaburi and Tjikajang ri.			

Location -

Guide map



Field photo

Aerial photograph

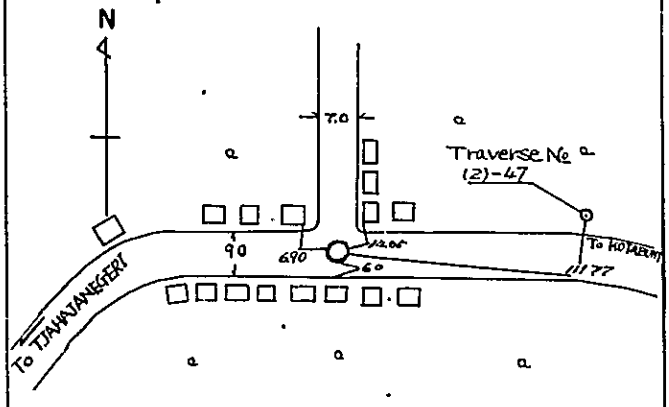
C- 37 No.1400 N ⇧ E C-37 No.1401

DESCRIPTION

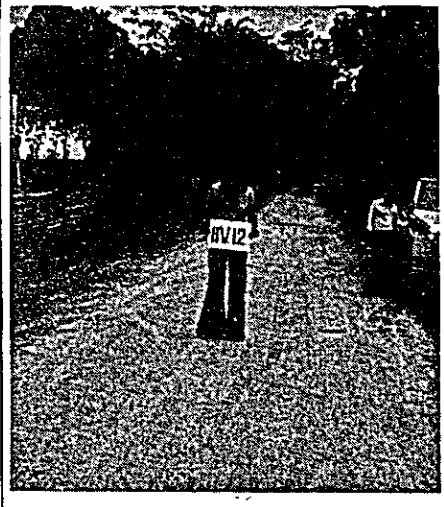
Sheet No.		Station No.	HV-12	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	27, 443.39	3, 752 .46	101 .68
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 12KM in a south-west direction from Kotabumi, you will come to a 3-way intersection in Tandjungkemala village. Go 9.5KM further in a west direction, you will come to another 3-way intersection with a row of houses by the side of the road. The point is at the center of the 3-way intersection in front of one of the houses.			

Location

Guide map

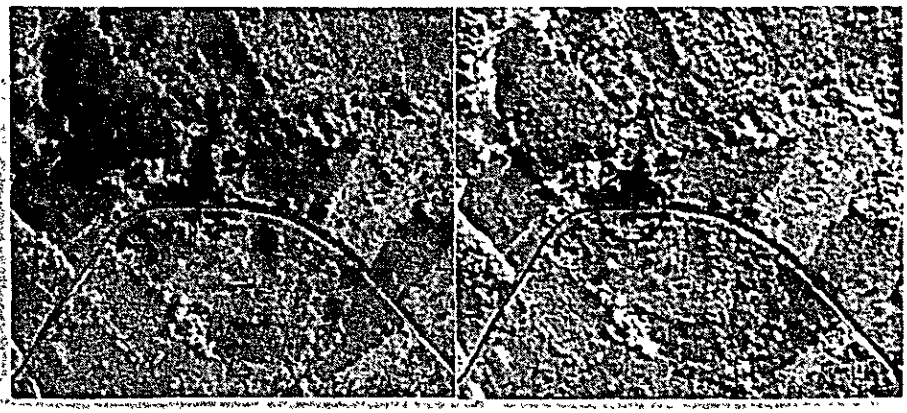


Field photo



Aerial photograph

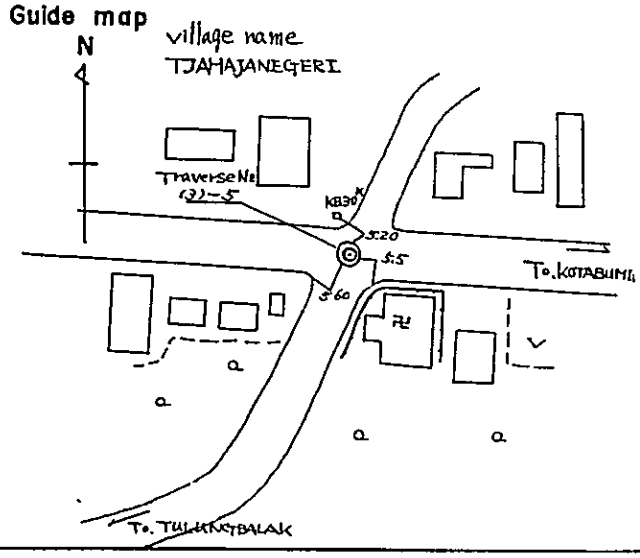
C- 37 No. 1399 N ⇧ E C- 37 No.1400



DESCRIPTION

Sheet No.		Station No.	HV-13	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 33, 987.40	- 3, 229.13	131.56
	Auxiliary point	. .	. .	.
		. .	. .	.
Monument	Type			
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 12KM in a south-west direction from Kotabumi. You will come to a 3-way intersection. Go approximately 16KM to the west; you will reach a crossroads in Tjahajanegeri village. The point is located at the center of this crossroads.			

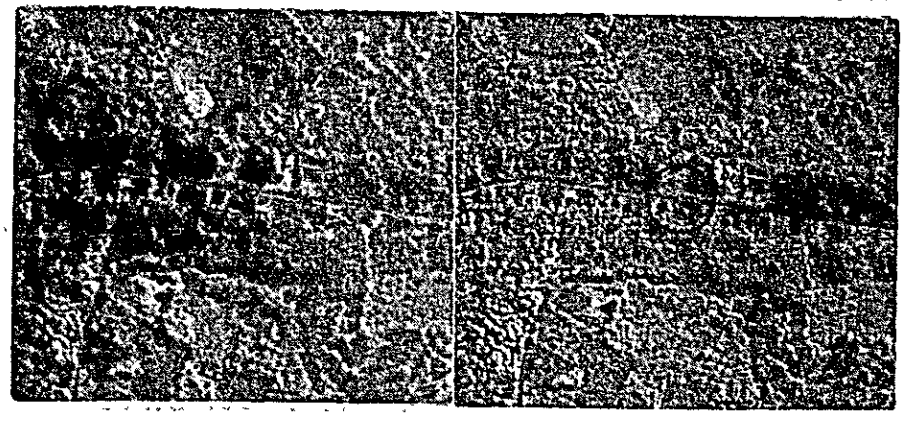
Location



Field photo

Aerial photograph

C- 37 No.1397 N ⇧ E C- 37 No. 1398

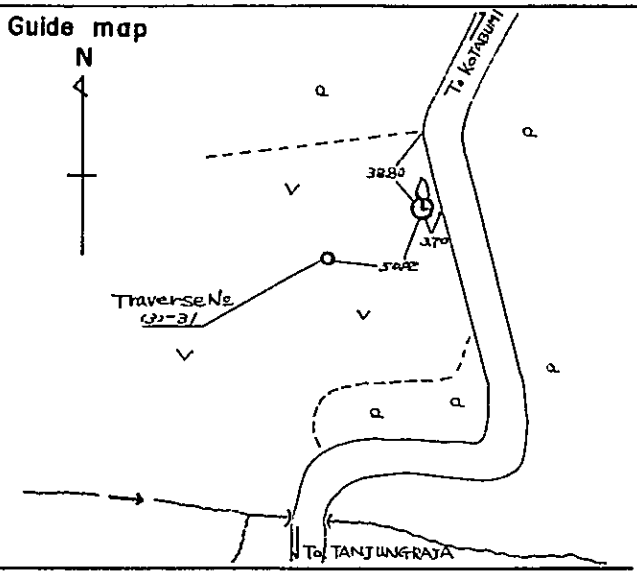


DESCRIPTION

Sheet No.		Station No.	HV-14	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	35 , 905 .31	- 6 , 555 .44	166 .06
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This point is the independent tree being in the field this side Tanjungraja village. Where we can get to go ahead 12m in the south-west direction from the Kotabumi to come to the trifurcated roads and 16m further in the west direction to get to the cross-roads of the Tanjungraja village and then advance south wards(turn left there) 4m moreover.			

Location

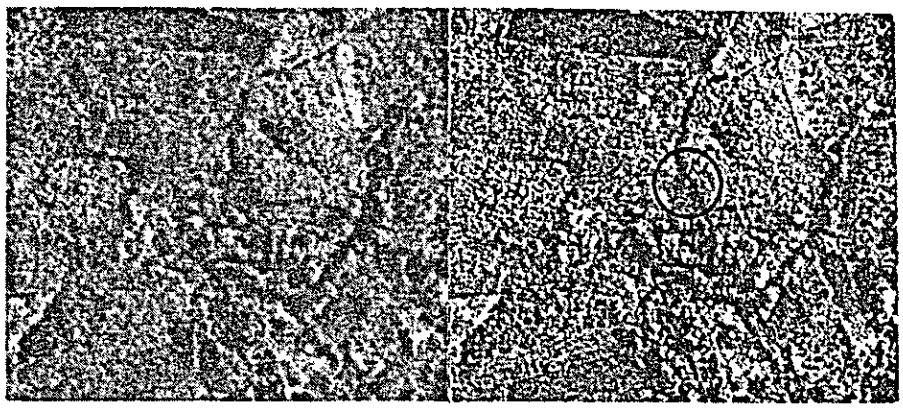
Guide map



Field photo

Aerial photograph

C- 37 No. 1396 N ⇧ E C- 37 No.1397

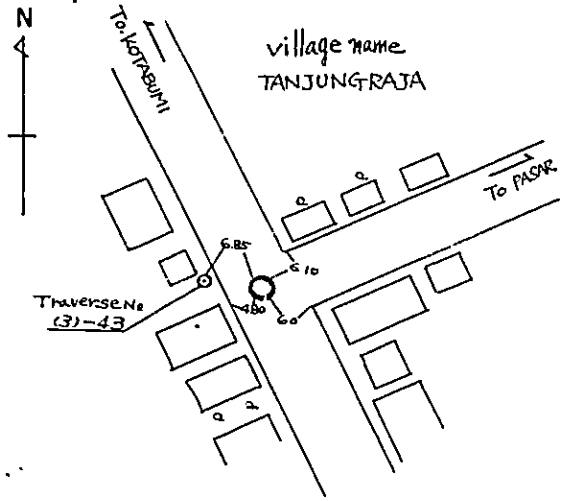


DESCRIPTION

Sheet No.		Station No.	HV-15	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 34 . 928 . 90	3.670 57	193 . 89
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Tjahajanegeri village is 20KM. away from Triangle-shaped intersection on road 12KM away from Kotatumi in a south-west direction.			

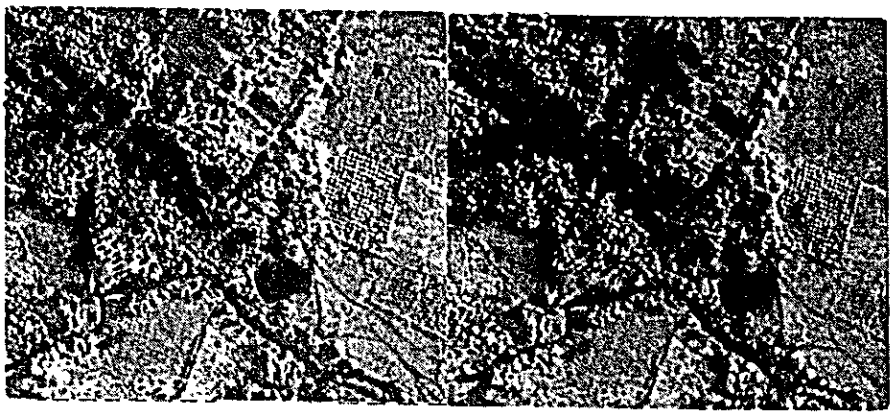
Location	Field photo

Guide map



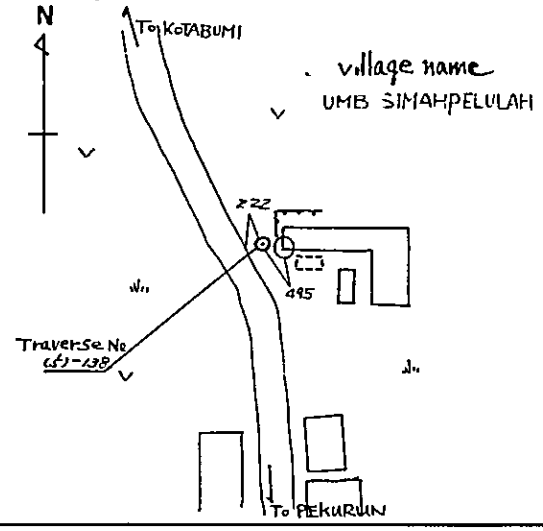
Aerial photograph

C- 37 No.1397 N ⇧ E C- 37 No. 398



DESCRIPTION

Sheet No.		Station No.	HV-16	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	7, 346 .16	- 4, 216 .01	56 .20
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This cirt is located at one corner of house in Simahpelulah village, 2.5KM in south direction from Pakau village which is 9KM in south-east direction from Petak Ai.			

Location	Field photo
Guide map 	Profile

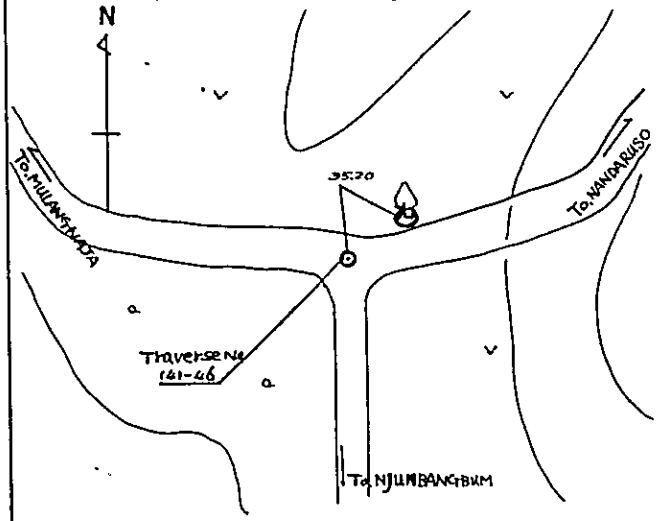
Aerial photograph

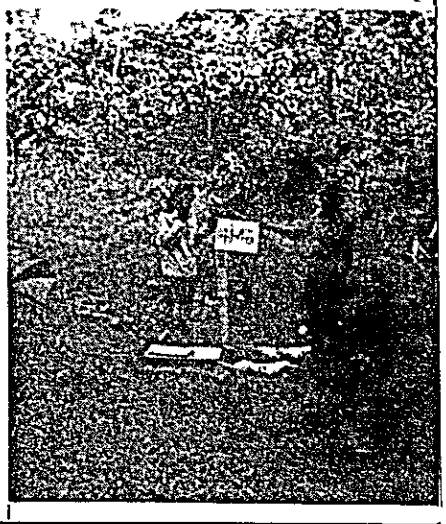
C- 37 No. 1403 N ⇧ E C-37 No.1404

DESCRIPTION

Sheet No.		Station No.	HV-17	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 13 . 976 . 13	- 7. 954 . 67	58 . 49.
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	..ooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	To reach the control points , proceed appropriate 6KM south west from Kotaburi. Then you will come to a Triangle-shaped cross roads. Go south towards Njimbangbum 4.5KM and you will come to another Triangle shaped cross roads. The primary control point is locate in the exact center of the Triangle-shaped cross roads. The secondary control point is a standing tree located by the side of the road-a little nouth east of primary control point.			

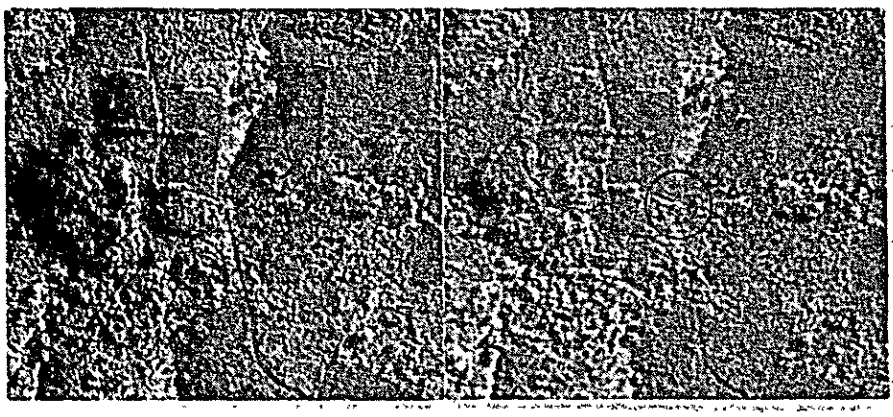
Guide map





Aerial photograph

C- 37 No. 1402 N ⇧ E C-37 No. 1403

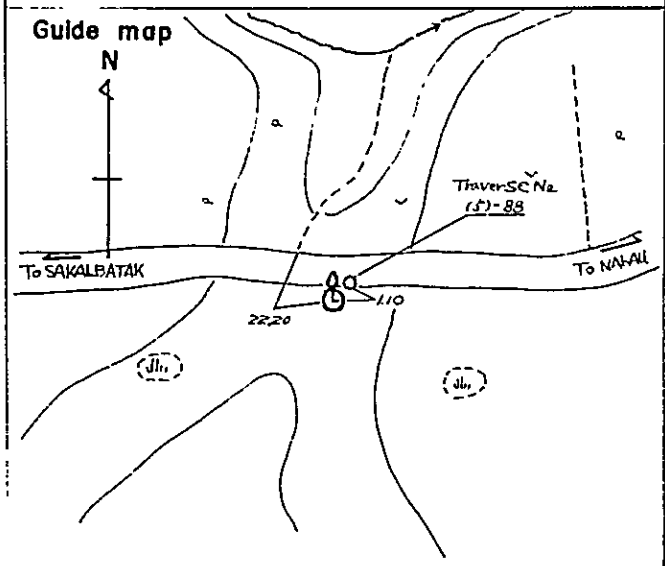


DESCRIPTION

Sheet No.		Station No.	HV-18	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 10,899 .86	-14 . 676 .54	77.11
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	Proceed 5KM in a south-east direction from Kotabumi. You will reach a three-way intersection in Nakau village. Then, turn right and advance about 14KM further in a south-ward direction. You will come to a swamp. The point is a big tree on the south-side of the road.			

Location

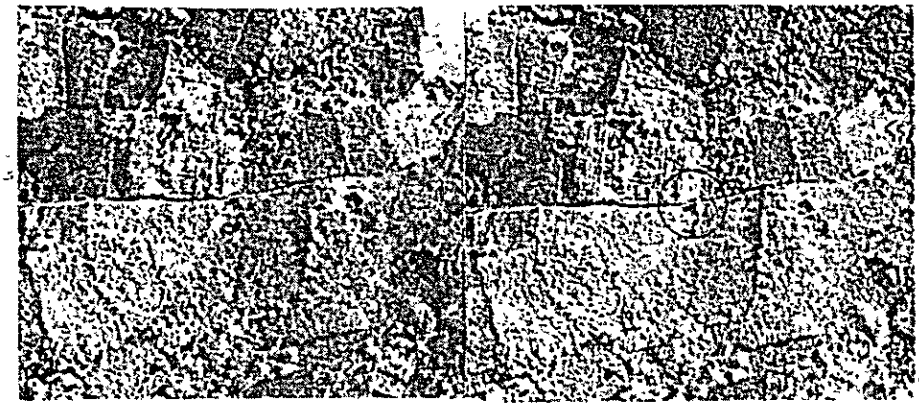
Guide map



Field photo

Aerial photograph

C- 38 No. 1435 N ⇧ E C- 38 No. 1436

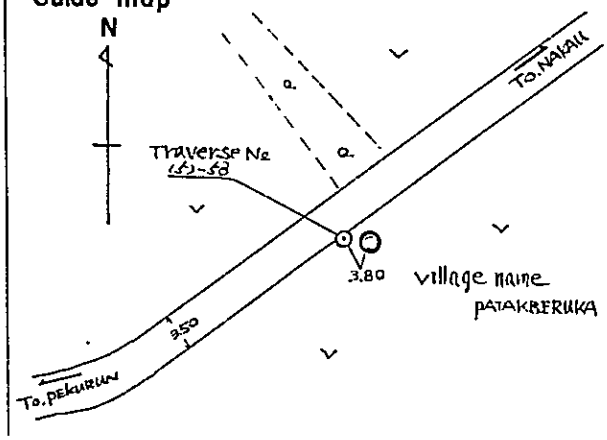


DESCRIPTION

Sheet No.		Station No.	PV-19	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 14,412.00	16,513.83	100.99
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Wooden		
Measurement	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark	This point is on the south side of the road, being about 1 KM east of Patakberuka village. To get there to advance 11.3KM in the south-east direction from Kotabumi to core to the trifurcated road and then 11KM further in the south wards to reach Patakberuka village.			

Location

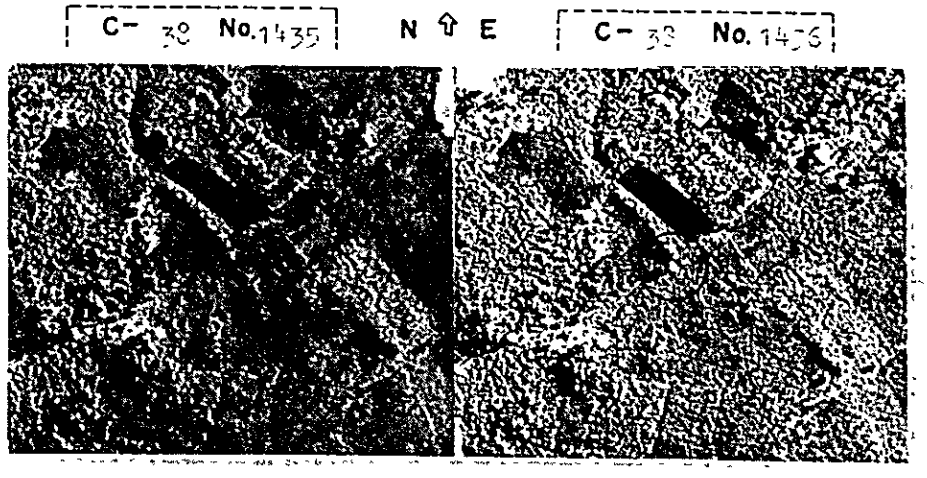
Guide map



Field photo

Profile

Aerial photograph

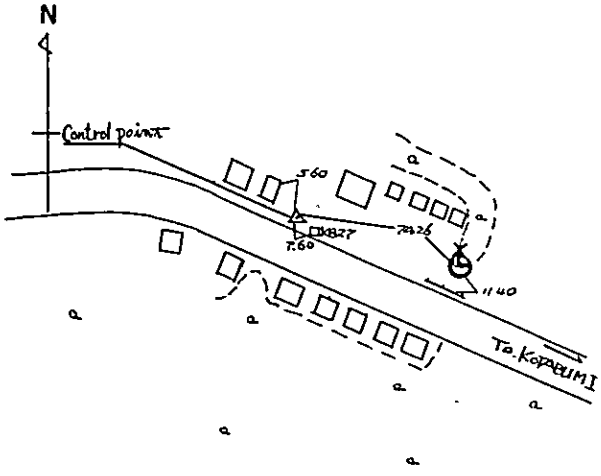


DESCRIPTION Road

Sheet No.		Station No.	T 1636	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- [illegible]	- 3.559 .17	.
	Auxiliary point	- [illegible]	- 3.[illegible] .15	119 .[illegible](P1)
		. .	. .	.
Monument	Type	Concrete		
Measurment	Date	November 1974		
	Organization	JAPAN INTERNATIONAL COOPERATION AGENCY		
Remark				

Location

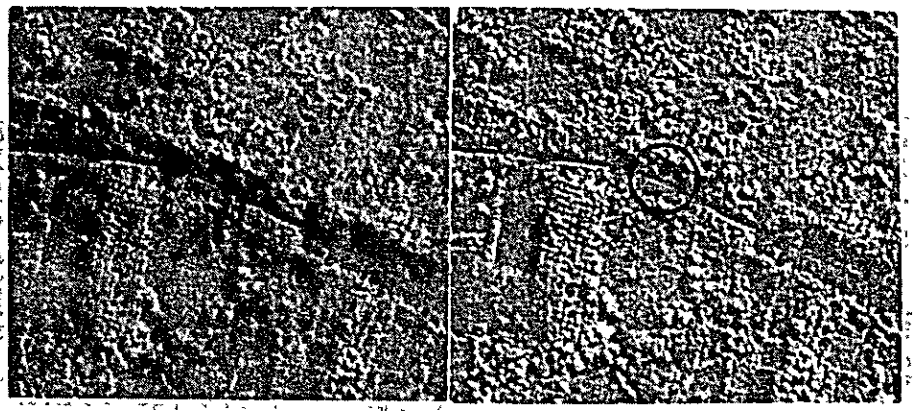
Guide map



Field photo

Aerial photograph

C- [illegible] No. [illegible] N E C- [illegible] No. [illegible]

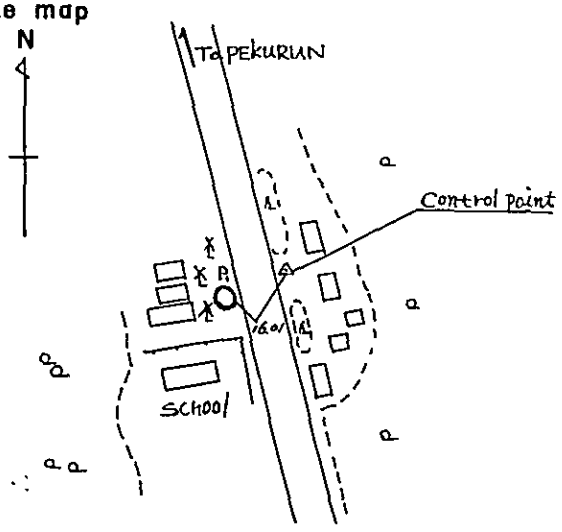


DESCRIPTION

Sheet No.		Station No.	T 1933	
Location				
Coordinate (Controlpoint) or (Bench mark)		N (X)	E (Y)	H
	Essential point	- 19. 209.39	-11 • 926 .79	.
	Auxiliary point	- 19. 219.00	-11 • 939 .60	72 .16(ES)
		. .	. .	.
Monument	Type	Concrete		
Measurment	Date	November 1974		
	Organization	[illegible]		
Remark				

Location

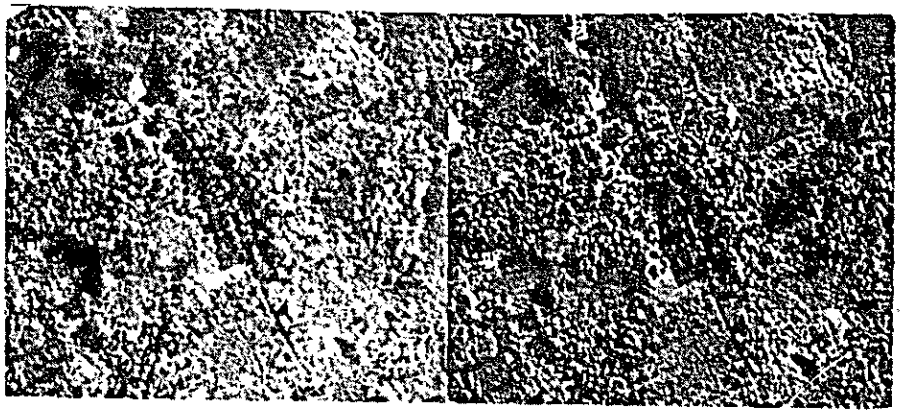
Guide map



Field photo

Aerial photograph

C- 38 No.1433 N E C- 38 No.1434



COORDINATES OF STATIONS

	U.T.M COORDINATES (ZONE = 48)			POLYEDER COORDINATES (ZONE=XXXIII-31)			GEOGRAPHICAL COORDINATES	
	N.S	E.W	C.A	Y	X	C.A	LATITUDE	LONGITUDE
	m	m		m	m			
(HV 1)	9457002.728	486234.784	- 0 0 38	1193.684	-10929.742	- 0 0 30	- 4 49 21 110	+104 52 33.041
(HV 2)	9463501 766	491011 166	- 0 0 25	-2308 857	-6151 288	- 0 0 17	- 4 51 15.164	1104 55 8.127
(HV 3)	9462148 280	494198 557	- 0 0 16	-3663.005	-2962 975	- 0 0 8	- 4 51 59.259	1104 56 51 614
(H)-32)	9463666 528	483867.320	- 0 0 44	-2143.759	-13298 273	- 0 0 37	- 4 51 .758	104 51 16.146
(HV4-1)	9463656 667	483879.754	- 0 0 44	-2153 624	-13285.834	- 0 0 36	- 4 51 10.080	104 51 16 549
(HV4-2)	9463632.133	483873.437	- 0 0 44	-2178.168	-13292 154	- 0 0 37	- 4 51 10.879	+104 51 16 344
(HV-5)	9460734.127	481042.568	- 0 0 52	-5077.222	-16124.255	- 0 0 45	- 4 52 45.248	+104 49 44.397
(HV6-1)	9459352 017	479419.168	- 0 0 57	-6459.822	-17748 350	- 0 0 49	- 4 53 30.251	104 48 51.669
(6-2)	9459392 611	479418.281	- 0 0 57	-6419 212	-17749 235	- 0 0 49	- 4 53 28.928	+104 48 51 640
(HV7-1)	9455029.633	476870.041	- 0 1 5	10783 832	-20298.647	- 0 0 57	- 4 55 51 010	104 47 28.846
(7-2)	9455006 580	476853.208	- 0 1 5	-10806 894	-20315.488	- 0 0 57	- 4 55 51.761	+104 47 28.299
(HV 8)	9449589.671	480185.461	- 0 0 56	-16226 091	-16982 129	- 0 0 48	- 4 58 48.226	+104 49 16 468
(HV 9)	9448260.713	480542 639	- 0 0 55	-17555.593	-16624.862	- 0 0 47	- 4 59 31 514	+104 49 28.057
(HV 10)	9451679.065	488771 483	- 0 0 31	-11134.997	-8392 501	- 0 0 23	- 4 56 2 518	+104 53 55.348
(HV 11)	9461111 007	474327.840	- 0 1 11	-4699.937	-22841 614	- 0 1 3	- 4 52 32.907	+104 46 6 356
(HV 12)	9462057.937	469727.824	- 0 1 23	-3752.455	-27413.390	- 0 1 16	- 4 52 2.009	+104 43 36 995
(T1636P1)	9462222 053	466469.676	- 0 1 32	-3588.150	-30702.795	- 0 1 25	- 4 51 56 618	+104 41 51.199
(HV 13)	9462580.811	463186 325	- 0 1 41	-3229.125	-33987.396	- 0 1 34	- 4 51 44.883	104 40 4.588
(HV 14)	9459255.748	461269.273	- 0 1 47	-6555.437	-35905.307	- 0 1 39	- 4 53 33.151	104 39 2.282
(HV 15)	9457141 392	462245.388	- 0 1 45	-8670.671	-34928.900	- 0 1 37	- 4 54 42.033	+104 39 33.945

ORDINATES OF STATIONS

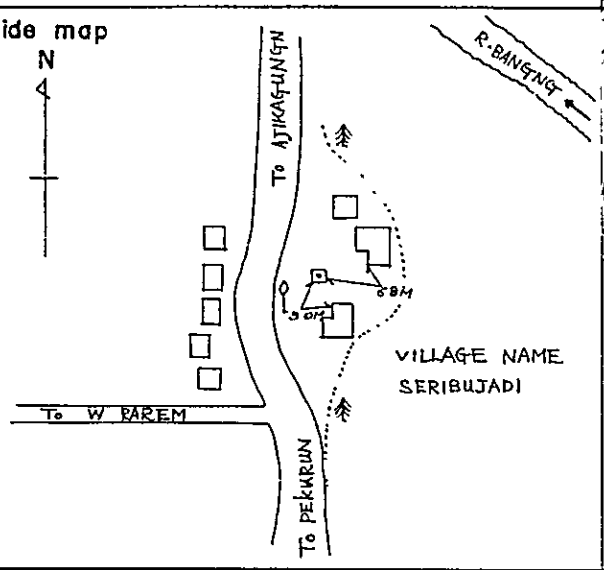
	U.T.M COORDINATES (ZONE= 48)			POLYEDER COORDINATES (ZONE=XXXIII -31)			GEOGRAPHICAL COORDINATES					
	N.S	E.W	C.A	Y	X	C.A	LATITUDE			LONGITUDE		
	m	m		m	m							
(HV 16)	9461595.327	489817.144	- 0 0 28	-4216.012	-7346.159	- 0 0 20	-4	52	17.254	+104	54	29.337
(HV 17)	9457857.917	483289.916	- 0 0 46	-7954.666	-13876.127	- 0 0 39	-4	54	18.946	+104	50	57.354
(HV 18)	9451138.837	486265.261	- 0 0 39	-14676.542	-10899.858	- 0 0 31	-4	57	57.813	+104	52	33.935
(HV 19)	9449297.148	482754.585	- 0 0 49	-16518.830	-14412.000	- 0 0 41	-4	58	57.774	+104	50	39.905
(T 1633)	9453887.149	477259.187	- 0 1 4	-11926.786	-19909.392	- 0 0 56	-4	56	28.225	+104	47	41.472
(T 1635)	9468255.356	485913.960	- 0 0 38	2446.824	-11250.646	- 0 0 31	-4	48	40.309	+104	52	22.631
(T 1636)	9462241.025	466397.882	- 0 1 33	-3569.168	-30774.616	- 0 1 25	-4	51	56.000	+104	41	48.868
(BTT149)	9464237.446	489886.499	- 0 0 28	-1572.540	-7276.676	- 0 0 20	-4	50	51.197	+104	54	31.600
(C2)	9462252.228	494678.389	- 0 0 15	-3559.033	-2482.948	- 0 0 7	-4	51	55.874	+104	57	7.195

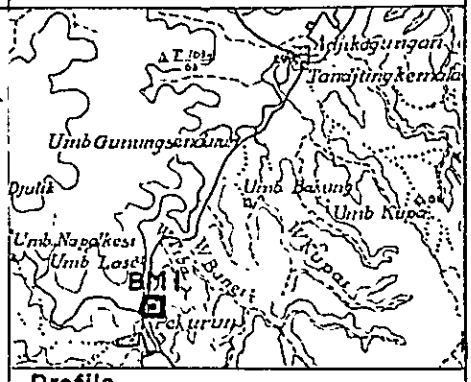
DESCRIPTION

Sheet No.		Station No.	BM 1	
Location	SERIBUJADI KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	. .	. .	54·227 M
	Auxiliary point	. .	. .	.
		. .	. .	.
Monument	Type	Concrete		
	Size	20 x 20		
Measurement	Date	Sep. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark	At east side of road as you go to Adjikagungan in Seribujadi Village.			

Location

Guide map





Profile

Side view photograph

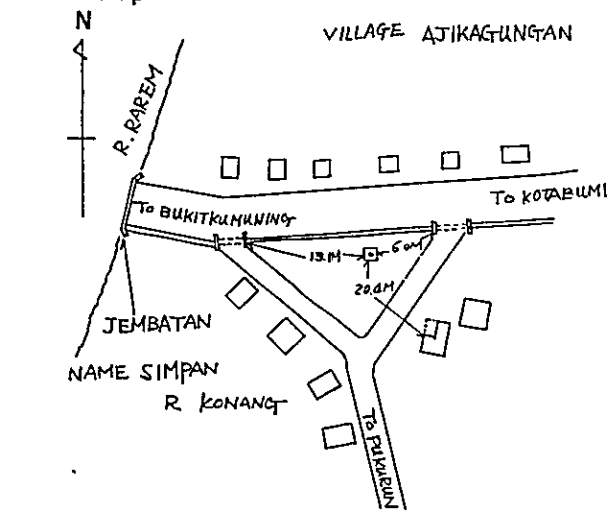
C- No. N ⇧ E C- No.

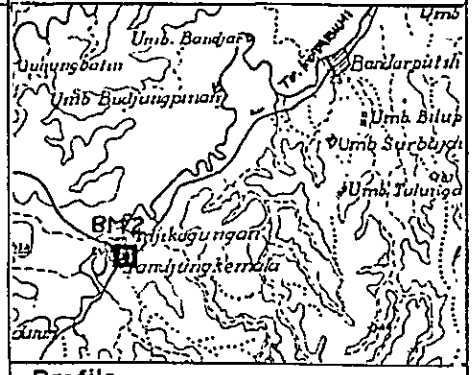
DESCRIPTION

Sheet No.		**Station No.**	B M 2	
Location	AJIKAGUNGAN KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	, .	. .	30.336 M
	Auxiliary point	, .	, .	.
		, .	. .	.
Monument	**Type**	Concrete		
	Size	20 x 20		
Measurement	**Date**	Sept. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark	At east side of triangle shaped island formed by intersection of 3 roads as you go to Kotabumi in Adjikagungan Village.			

Location

Guide map

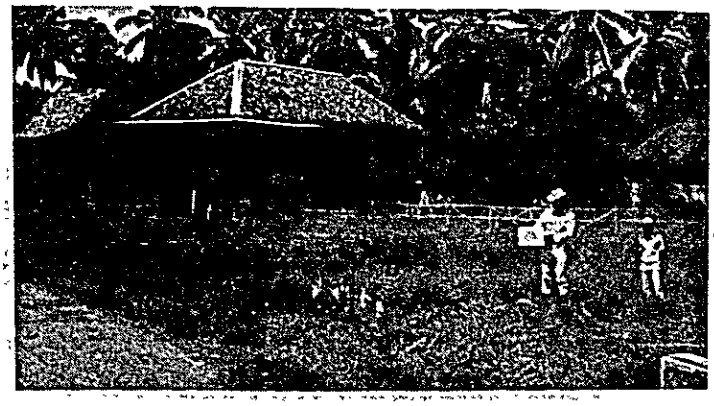




Profile

Side view photograph

C- No. N ⇧ E C- Nc

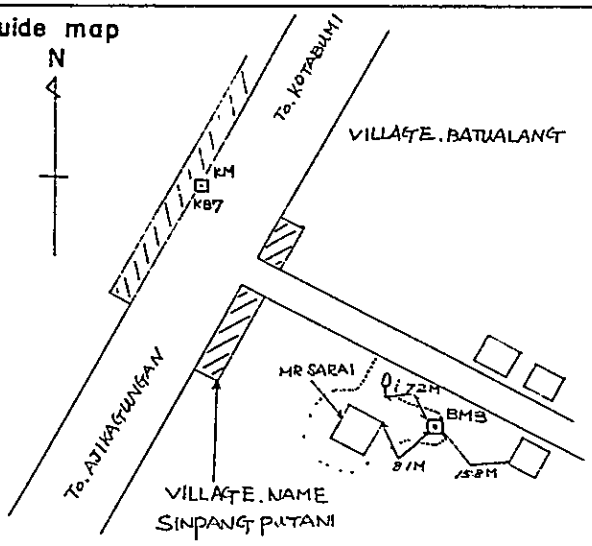


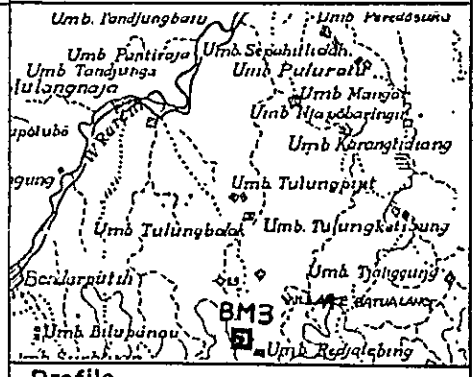
DESCRIPTION

Sheet No.		Station No.	BM 3	
Location	BATUALANG KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	, .	, .	68·522M
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Concrete		
	Size	20 x 20		
Measurement	Date	Sept. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark	At west side of foot path in Sinpang Putani village, 4 km from road between Kotabumi and Ajikagungan. The foot path is 30 m from KM marker (KB7) in south-west direction.			

Location

Guide map





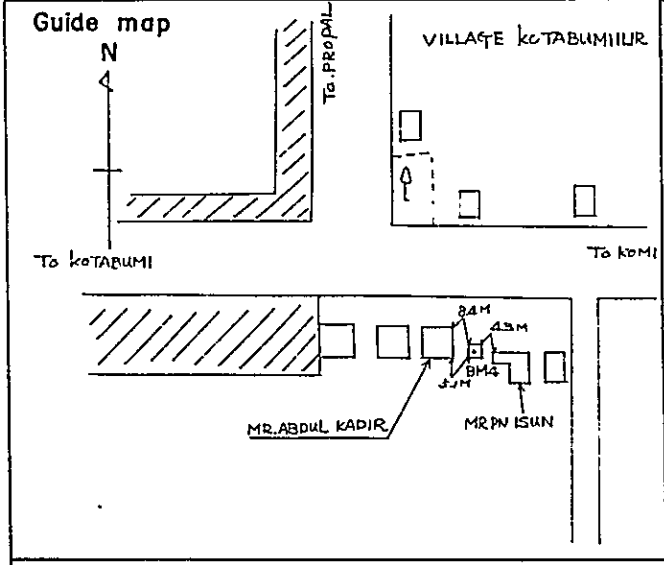
Profile

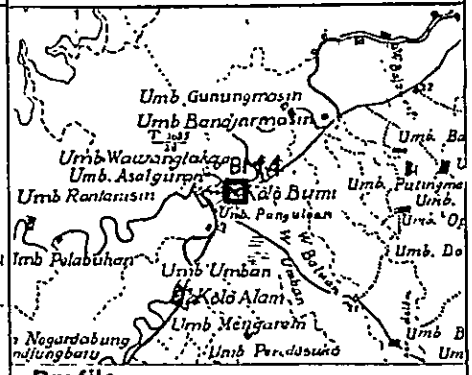
Side view photograph

DESCRIPTION

Sheet No.		Station No.	B M 4	
Location	KOTABUMI ILIR KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	, .	, .	27.275 M
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Concrete		
	Size	20 x 20		
Measurement	Date	Sept. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark	In the garden of Mr. P.N. Isun's house which is located at South side of road to Kotabumi in Kotabumi Ilir village.			

Location





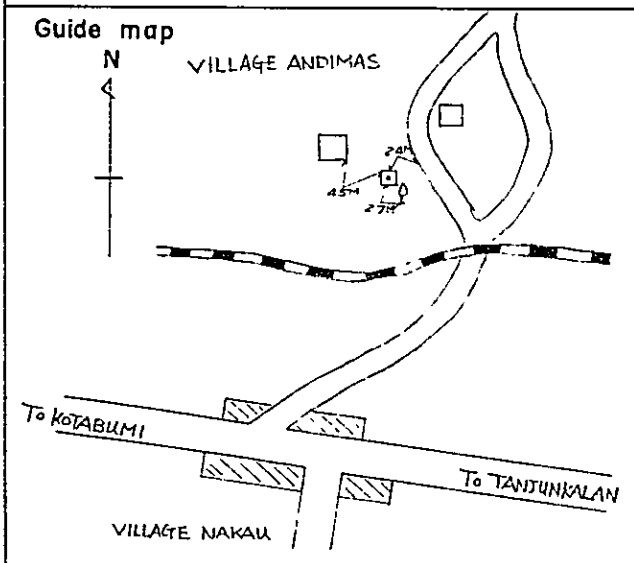
Side view photograph

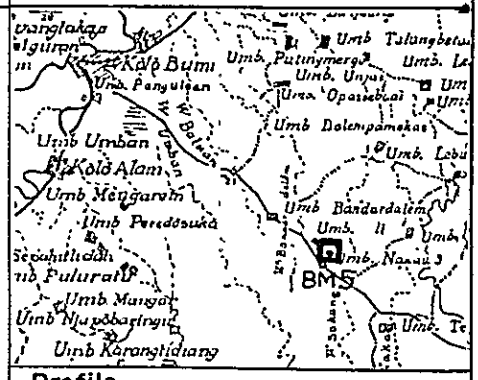
DESCRIPTION

Sheet No.		Station No.	BM 5	
Location	ANDIMAS KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	. .	. .	53.012 M
	Auxiliary point	. .	. .	.
		. .	. .	.
Monument	Type	Concrete		
	Size	20 x 20		
Measurement	Date	Sept. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark	On west side of left path (N-E direction) 100 m from a railway crossing is on a side road 300 m from road between Kotabumi and Tanjunkalan. Entrance of this side road is 200 m from triangle shaped intersection in Nakau village. Triangle shaped intersection is 5 km from Kotabumi.			

Location

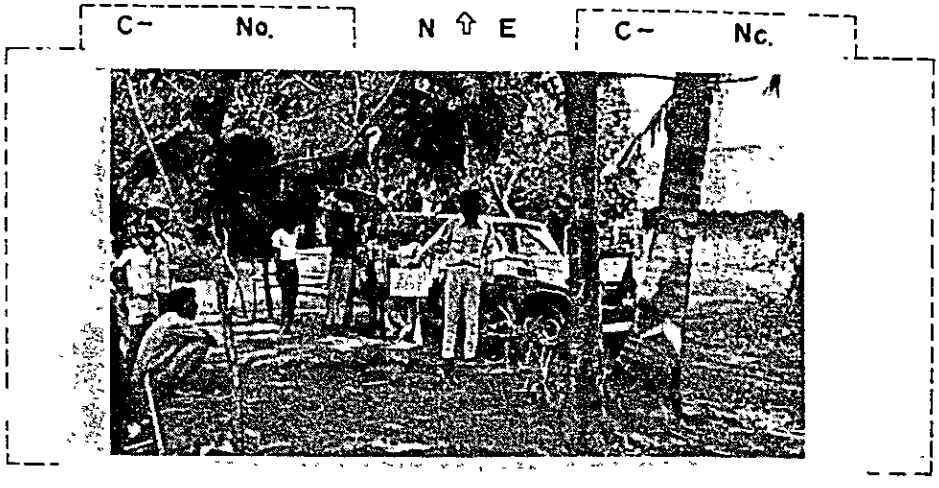
Guide map





Profile

Side view photograph

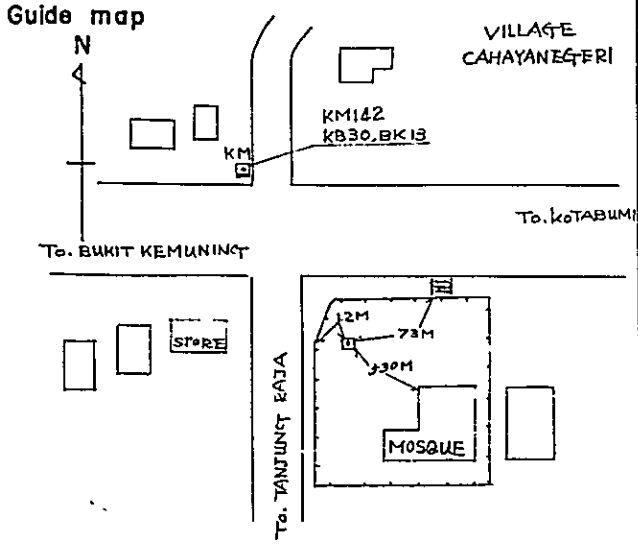


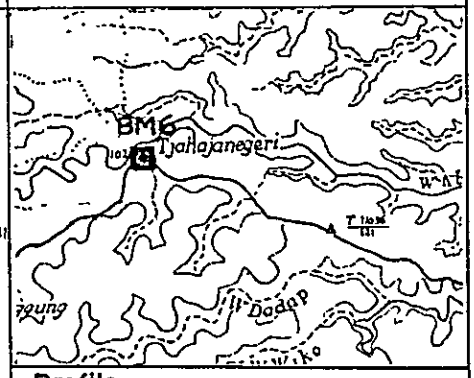
DESCRIPTION

Sheet No.		Station No.	BM 6	
Location	CAHAYANEGERI KOTABUMI LAMPUN UTARA			
Coordinate ~~(Controlpoint)~~ or (Bench mark)		N (X)	E (Y)	H
	Essential point	, .	, .	130.873 M
	Auxiliary point	, .	, .	.
		, .	, .	.
Monument	Type	Concrete		
	Size	20 x 20		
Measurement	Date	Sept. 1974 - Nov. 1974		
	Organization	Japan International Cooperation Agency		
Remark				
	In the garden of a mosque in Tjahajanegeri village.			

Location

Guide map





Profile

Side view photograph

C- No. N ⇧ E C- No.

TBM. BM ····· True height of elevation list

TBM. No.	KM post. No.	Elevation	Remark	TBM. No.	KM post. No.	Elevation	Remark
(1) — 1		23,566 m		(2) — 7	KB 19	70,347 m	
(1) — 2		26,605 m		(2) — 8	KB 20	80,871 m	
(1) — 3		26,827 m		(2) — 9	KB 21	88,151 m	
(1) — 4		25,104 m		(2) — 10	KB 22	96,155 m	
(1) — 5		25,473 m		(2) — 11	KB 23	101,865 m	
(1) — 6		23,065 m		(2) — 12	KB 24	103,620 m	
(1) — 7		27,277 m		(2) — 13	KB 25	107,006 m	
(1) — 8	KB 5	25,737 m		(2) — 14	KB 26	111,362 m	
(1) — 9		31,481 m		(2) — 15			
(1) — 10		26,093 m		(2) — 16	KB 28	118,969 m	
(1) — 11		32,823 m		(2) — 17	KB 29	127,049 m	
(1) — 12	KB 9	29,053 m		(2) — 18	KB 30	132,709 m	
(1) — 13		31,293 m		(3) — 1	TK106	25,333 m	
(1) — 14	KB 10	37,310 m		(3) — 2	TK105	29,195 m	
(1) — 15	KB 11	37,344 m		(3) — 3	TK104	37,799 m	
(1) — 16		30,568 m		(3) — 4		44,616 m	
(1) — 17		46,871 m		(3) — 5		47,180 m	
(1) — 18		48,809 m		(3) — 6		60,090 m	
(1) — 19		55,579 m		(3) — 7	TK100	53,588 m	
(1) — 20		57,423 m		(3) — 8	TB99	54,435 m	
(2) — 1		55,933 m		(3) — 9		57,205 m	
(2) — 2	KB 14	66,934 m		(3) — 10		49,583 m	
(2) — 3	KB 15	66,034 m		(3) — 11	TK96	57,643 m	
(2) — 4	KB 16	68,149 m		(3) — 12	TK95	57,668 m	
(2) — 5	KB 17	65,171 m		(3) — 13		49,665 m	
(2) — 6	KB 18	54,483 m		(3) — 14		59,503 m	

TBM. No.	KM post. No.	Elevation	Remark
(3) — 15		54,596 m	
(3) — 16		55,006 m	
(3) — 17		50,784 m	
	KB 2	25,756 m	
	KB 3		
	KB 4	28,926 m	
	KB 6	32,727 m	
	KB 8	34,066 m	
	KB 12	40,683 m	

BM. No.	Elevation
BM 1	54,227 m
BM 2	30,336 m
BM 3	68,522 m
BM 4	27,275 m
BM 5	53,012 m
BM 6	130,873 m