

REPORT ON TOPOGRAPHIC MAPPING PROJECT  
FOR  
CAGAYAN VALLEY,  
THE REPUBLIC OF THE PHILIPPINES  
(SECOND YEAR)  
CONTROL POINT SURVEY  
PRICKING WORK

JUNE, 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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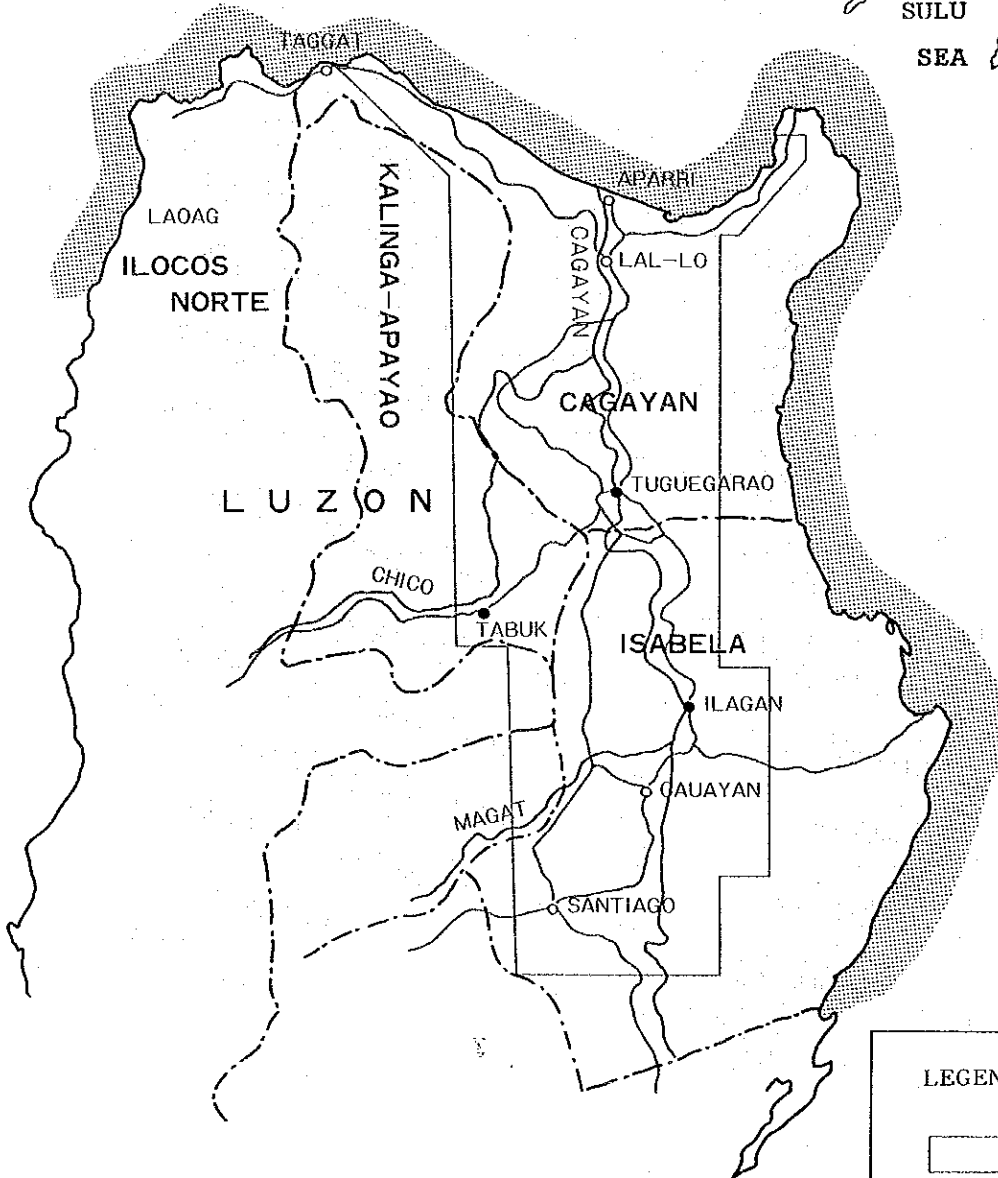
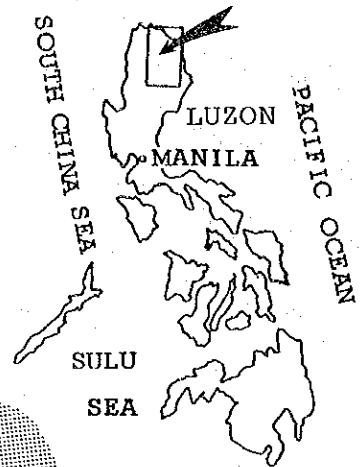
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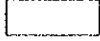
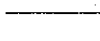
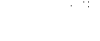


JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団	
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**CAGAYAN VALLEY  
MAPPING PROJECT  
LOCATION MAP**



**LEGEND :**

-  : Mountainous Area
-  : Provincial Boundary
-  : Road
-  : River
-  : Project Area





LETTER OF TRANSMITTAL

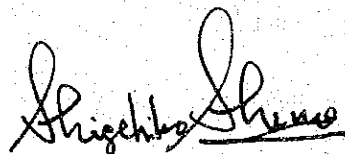
Mr. Keisuke Arita, President  
Japan International Cooperation Agency

The Report on the Second Year Survey Work of the Topographic Mapping Project of the Cagayan Valley, the Republic of the Philippines, conducted from January through May 1980 in compliance with your request, is herein submitted to you.

This Report describes the details of the second year work (control point survey and pricking work). We feel confident that the second year survey work has set a significant step forward to expediting the subsequent year's survey works, as well as contributed to the advancement of the surveying standard of the Republic of the Philippines through providing guidance and supervision during the course of field work.

On behalf of the survey group, I would like to express my wholehearted appreciation to the project inspectors, the officials of the Japanese Embassy in the Philippines, the Manila Office of the Japan International Cooperation Agency, the Bureau of Coast and Geodetic Survey, and those of other agencies concerned for their guidance and cooperation. At the same time, it is hoped that the survey projects for subsequent years will be conducted without delay.

July 1980



Shigehiko Shino  
Leader, Topographic Mapping  
project of the Cagayan  
Valley, the Republic of the  
Philippines,  
International Engineering Consultants  
Association





Cagayan Valley



Meeting for Survey Work with BCGS

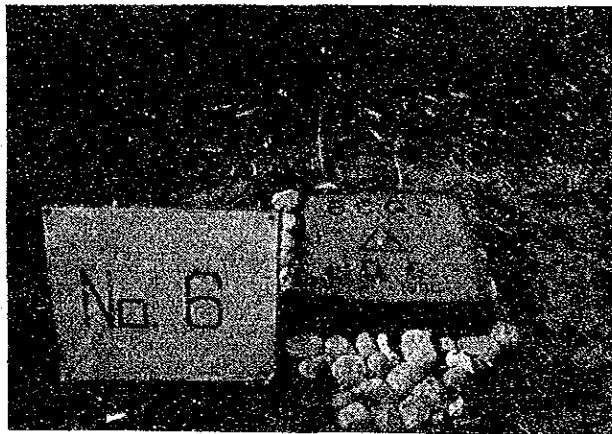




Reconnaissance



Monumenting



Monumented Marker (Point No. 6)



AGA Geodimeter 600



Observation from the Tower





Foundation Work for Erection  
of Observation Tower



Erected Observation Tower  
(approx. 24m high)



Front-yard View of Head Office in Tuguegarao



Affixing Signature to the Minutes





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## 1. Outline

### 1.1 Background of Project

In December 1976, the Government of the Republic of the Philippines made a request to the Government of Japan for technical cooperation in the preparation of a topographic map required for the development of the Cagayan Valley River basin in northern Luzon.

In response, the Japanese Government dispatched a preliminary survey team in January 1978 for consultation with the Bureau of Coast and Geodetic Survey (BCGS), the survey department of the Philippines Government, as well as for the inspection of the proposed project site. Based on the findings of the preliminary survey team, the Japanese Government decided to undertake this project starting from fiscal year 1978.

The scope of work as decided for implementation is as follows:

Project Area	:	Approx. 15,000 km <sup>2</sup> of the Cagayan Valley Region in northern Luzon.
Project Period	:	5 years from January 1979
Work Description	:	Aerial photography 1/30,000 scale covering approx. 15,000 km <sup>2</sup> 1/25,000 topographic map covering approx. 11,000 km <sup>2</sup> 1/10,000 orthophoto map covering 300 km <sup>2</sup>

From January through May 1979, aerial photographing and photo processing were conducted as the first year phase of the project. However, since the security regulations of the Philippines provide that aerial photographing must be conducted by a Philippines private business firm, F.F. Cruz & Co., Ltd. was contracted to conduct the both works under the supervision of the engineers dispatched by the International Engineering Consultants Association (IECA).

For this year, control point survey and pricking work were conducted as the second year phase of the project.

## 1.2 Objective

Execution of the control point survey and pricking work to produce a 1/25,000 topographic map and 1/10,000 orthophoto map required for the development of the Cagayan Valley Region in northern Luzon, the Republic of the Philippines.

Both the control point survey and pricking work were conducted to establish a control network and to provide ground controls for aerial triangulation.

## 1.3 Outline of the Work

### (1) Project area

The area, mostly plains, in the Cagayan Valley river basin in the northern part of Luzon, encompassing approximately 11,000 km<sup>2</sup>. (See attached figure.)

(2) Work description

1) Aerial photography

1/30,000 scale covering approximately 15,000 km<sup>2</sup>

Note: The scale was determined with due consideration given to the preparation of a 1/10,000 orthophoto map.

2) Mapping

1/25,000 topographic map covering approximately

11,000 km<sup>2</sup> ..... 72 sheets

1/10,000 orthophoto map covering approximately

300 km<sup>2</sup> ..... 12 sheets (urban districts only)

3) Project period

5 years, from 1979 to 1983.

1.4 Project Area

The project area, mostly plains is, in the Cagayan Valley north of 16°30' North Latitude and between 121° and 122° East Longitudes, encompassing approximately 11,000 km<sup>2</sup>. This area faces the Babuyan Channel to the north and is demarcated by the Cordillera Central Mountains in the west and the Sierra Madre Mountains in the east.

The plains covered with fertile alluvial topsoil are especially suitable for rice production. The central part and southern mountainous area of up to 400 m altitude are overgrown mostly with weeds and trees are scarce. On the other hand, the northern mountainous area is woody with trees grown to the height of over 20 m.

Also, the plains, except for paddy lands, are mostly covered with coconut palm trees. These trees obstruct visibility in this area.

1.5 Work Conducted during the Second Year Phase (Types and volume)

Types of Works

- (1) Control point survey
- (2) Pricking

Work Volume

(1) No. of control points established	45
(2) No. of JMR points observed	4
(3) No. of control points pricked	45
(4) No. of JMR points pricked	13

The aerial photographs produced during the first year phase were used for pricking work.

Photographing scale: 1/30,000 (produced during the first year phase)

Photographs for pricking: 1/15,000 (enlarged to twice the scale of the aerial photographs)

1.6 Work Period

Preparations:

November 29, 1979 - December 16, 1979

Control point survey and pricking work:

January 7, 1980 - Survey team departed Japan

May 28, 1980 - Survey team returned to Japan.



## 1.7 Survey Team Members

Leader (General control) : Shigehiko Shino  
Jan. 15, 1980 - Jan. 29, 1980  
May 8, 1980 - May 28, 1980

Deputy Leader (General survey) : Toshimasa Nagashima  
Jan. 7, 1980 - May 28, 1980

Coordinator : Toshimine Miyashita  
Nov. 29, 1979 - Dec. 16, 1979  
Jan. 7, 1980 - May 28, 1980

Mechanic : Isamu Saito  
Jan. 7, 1980 - May 20, 1980

Chief Surveyor  
(Control point survey) : Chuji Misawa  
Jan. 7, 1980 - May 20, 1980

Surveyor : Chifuyu Horiuchi  
Jan. 7, 1980 - May 20, 1980

Surveyor : Shigeo Ono  
Jan. 17, 1980 - May 20, 1980

Surveyor : Yoji Matsui  
Jan. 7, 1980 - May 20, 1980

Surveyor : Fumiaki Sato  
Jan. 17, 1980 - May 20, 1980

Surveyor : Takashi Harada  
Jan. 7, 1980 - May 28, 1980

Surveyor : Takayoshi Masuda  
 Jan. 7, 1980 - May 20, 1980  
 Surveyor : Katsuhiko Kato  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Katsuhiko Yamashita  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Keiji Hirasawa  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Kiyotaka Miyoshi  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Shogo Shimakage  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Yoshiharu Katamine  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Ryoji Moriwaki  
 Jan. 17, 1980 - May 20, 1980  
 Surveyor : Kazuhiro Chiba  
 Jan. 17, 1980 - May 20, 1980

#### 1.8 Materials and Equipment Used for Field Survey

##### Laser distance meters

1. AGA GEODIMETER 600 ..... 1 set
2. AGA GEODIMATER 6BL ..... 1 set
3. H.P. 3800B DISTANCE METER ..... 1 set

##### Theodolites

1. WILD T3 ..... 4 sets
2. WILD T2 ..... 2 sets

Generators

HONDA EM300 ..... 2 sets

Voltage stabilizer

SHOWA DENSI EDM-1208 ..... 2 sets

Thermometers

TAMAYA TA-1 ..... 8 sets

Barometers ..... 8 sets

Heriotropes ..... 8 sets

Signal lamps ..... 8 sets

Level

SOKKISHA-B2 ..... 1 set

Tranceivers

ANY (5W) ..... 9 sets

Land cruisers (TOYOTA) ..... 7 vcls

Belongs to J.I.C.A. (2 vcls with winches)

Truck (TOYOTA) ..... 1 vcl

Electronic computer

MELCON-COSMO 500 ..... 1 set

1.9 Weather Conditions during Work Period

Favorable weather conditions continued throughout the work period, except for four rainy days. As the work period (January through May) fell on the "dry season," the temperature remained moderate from January to mid-February, with weather conditions optimum for field survey. Thereafter, the temperature gradually rose by the day until mid-April. In mid-April, the temperature

daily registered over 40°C. From late April, however, we were often overtaken by thunderstorms, and the field survey work was frequently interrupted by sudden changes in weather conditions.

The statistics of weather conditions in the period at the survey sites are listed below.

	Jan.	Feb.	Mar.	Apr.	May	Total
Clear	20.0	18.5	23.0	25.0	15.0	101.5
%	83.3	63.8	74.2	83.3	55.6	72.0
Cloudy	3.5	10.5	5.5	4.0	11.0	34.5
%	14.5	36.2	17.7	13.3	40.7	24.5
Rain	0.5	0.0	2.5	1.0	1.0	5.0
%	2.2	0.0	8.1	3.4	3.7	3.5
Total	24.0	29.0	31.0	30.0	27.0	141.0
%	100.0	100.0	100.0	100.0	100.0	100.0

Remarks: The days for travelling to and back from the Philippines are excluded from this statistics.

#### 1.10 Summary Progress Record of Work

- November 29, 1979 : Miyashita, a team member, and Mr. Saito, a member of J.I.C.A., arrived in Manila.
- December 10, 1979 : Observation towers received.
- December 12, 1979 : Eight survey vehicles (land cruisers and trucks) received.
- December 16, 1979 : Team member Miyashita left Manila for Japan.

- January 7, 1980 : Deputy leader Nagashima and team members Miyashita, Saito, Misawa, Horiuchi, Matsui, Harada, and Masuda arrived in Manila.
- January 8, 1980 : Preparations for field survey started.
- January 11 - 13, 1980: Team members Miyashita and Harada started preparations at Tuguegarao.
- January 15, 1980 : Leader Shino arrived in Manila.
- January 16, 1980 : Mr. Kitani, director of Survey Guidance Division, Ministry of Construction, and Mr. Murayama, a member of J.I.C.A., arrived in Manila.
- January 17, 1980 : Team members Ono, Sato, Yamashita, Kato, Miyoshi, Katamine, Hirasawa, Shimakage, Moriwaki, and Chiba arrived in Manila.
- January 20, 1980 : Mr. Kitani, Mr. Murayama, leader Shino, and deputy leader Nagashima conducted field inspection.
- January 23, 1980 : 17 team members entered the survey site by land.
- January 24, 1980 : Survey office opened at Tuguegarao.
- January 25, 1980 : Reconnaissance started.
- January 26, 1980 : Mr. Kitani and Mr. Murayama left Manila for Japan.
- January 29, 1980 : Leader Shino left Manila for Japan.

January 31, 1980 : Reconnaissance started.

February 5 - 19, 1980: Team A stayed at Aparri for reconnaissance and monumenting.

February 19 -

March 4, 1980 : Team B stayed at Cauayan for reconnaissance and monumenting.

February 26 -

March 1, 1980 : Deputy leader Nagashima and team member Miyashita reported the progress of work at Manila.

March 3, 1980 : Team A started control point survey in Tuguegarao district.

March 3 -

April 2, 1980 : Team A stayed at Aparri for reconnaissance and monumenting.

March 10 - 15, 1980 : Team member Harada instructed and supervised BCGS for photographic processing.

March 20, 1980 : Teams A and B jointly conducted control point survey at Aparri.

April 10 - 21, 1980 : Teams A and B stayed at Cauayan for control point survey.

April 16 - 20, 1980 : Team member Miyashita reported the progress of work and also made arrangements with BCGS at Manila.

- May 1 - 3, 1980 : Team member Miyashita reported the progress and made consultation with BCGS at Manila.
- May 8, 1980 : Leader Shino arrived in Manila.
- May 10, 1980 : Field inspection completed.
- May 13, 1980 : All the team members returned to Manila by land.
- May 14, 1980 : Mr. Shirai, a member of the Geographical Survey Institute, Ministry of Construction, and Mr. Kimura, a member of J.I.C.A., arrived in Manila.
- May 15 - 16, 1980 : A conference was held with BCGS on the results of the Second Year Survey and the schedule for the Third Year Survey.
- May 19 - 22, 1980 : Mr. Shirai, Mr. Kimura, leader Shino, and deputy leader Nagashima made on-site inspection.
- May 20, 1980 : Team members Misawa, Horiuchi, Matsui, Ono, Masuda, Yamashita, Sato, Kato, Shimakage, Hirasawa, Katamine, Saito, Miyoshi, Moriwaki, and Chiba left Manila for Japan.
- May 26 - 27, 1980 : A minute concerning the results of the Second Year Survey and schedule of the subsequent Third Year Survey was prepared.

May 27, 1980 : The minute was signed by both parties.  
May 28, 1980 : Leader Shino coordinator Nagashima,  
team members Miyashita and Harada,  
Mr. Shirai, and Mr, Kumura left  
Manila for Japan.

#### 1.11 Field Inspectors

The following Japanese officials came to the Philippines for inspection and guidance of the work during the work period, consultation with the Philippines Government, and witnessing the reception and storage of land cruisers and trucks.

Mr. Yukio Kitani

Director, Survey Guidance Division,  
Planning Department,  
Geographical Survey Institute,  
Ministry of Construction  
(January 16 - 26, 1980)

Mr. Kenichi Shirai

Deputy Director, Planning & Coordination Division,  
Planning Department, Geographical Survey Institute,  
Ministry of Construction  
(May 14 - 28, 1980)

Mr. Hideki Murayama

Development Survey Division,  
Social Development Cooperation Department,  
Japan International Cooperation Agency  
(January 16 - 26, 1980)



Mr. Hiroshi Kimura

Development Survey Division,

Social Development Cooperation Department,

Japan International Cooperation Agency

(May 14 - 28, 1980)

#### 1.12 Work Conducted by BCGS

Based on the implementing arrangements for this Project, the BCGS conducted the following work:

- (1) JMR observation 13 points
- (2) 1st order levelling (restoration) 457.1 km

Since the plotting area has been planned along the coastline in the east and west of Aparri due to topographical restrictions, the JMR points were mainly fixed in this district. With reference to the control network extending approximately 200 km north and south, the JMR points were fixed eastwards and westwards at intervals of approximately 30' latitudes.

Regarding the 1st order levelling, some of the existing bench marks established along Routes 3 and 4 national highways were found to be missing as a result of the past improvement work. Especially the preliminary inspection results revealed that nearly 80% of the bench marks along Route 3 national highway were lost.

BCGS reestablished them on both highways.

Also, in order to facilitate on-site survey work, two BCGS coordinators accompanied Japanese survey team throughout the work period.

## 2. Preparations for Survey Work

### 2.1 Preparations for Survey Work

For 18 days from November 29 to December 16, 1979, the team member Miyashita mainly engaged in reception and storage of the observation towers shipped from Japan and negotiations for renting an office and lodging houses.

Mr. Saito dispatched from J.I.C.A. engaged in reception and storage of seven land cruisers and a truck during the same period. Both the observation towers and vehicles were received in cooperation with BCGS. It was decided to store observation towers at the BCGS and vehicles at a warehouse company in Manila after registration.

Also, Miyashita jointly investigated with BCGS on the schedule for field inspection, driver employment, banking system, and procurement of materials and equipment, as well as negotiated for renting an office in Tuguegarao.

### 2.2 Setting-up Head Office, Base Camp, and Sub-camps

#### 2.2.1 Head Office

The head office was set up in Tuguegarao at the address given below. Tuguegarao, the capital of Cagayan Province, is a focal point in terms of culture and transportation and is located at the center of the project area.

There management of the work, storage and procurement of materials and equipment, inspection of vehicles,

coordination with Manila and Japan, and accounting were carried out during the work period.

Address: Perez Compound, Dalzain, Tuguegarao,  
Cagayan 1101

Telephone: Tuguegarao 446-1768

#### 2.2.2 Base camp and sub-camps

The base camp was set up at a boarding house only 7 to 8 minutes walk from the head office.

Since the project area extends north and south (approx. 200 km x 60 km), the sub-camps were set up at Aparri located at the mouth of Cagayan river and Cauayan in the southern part of the project area.

The head office and sub-camps were set up at a location approximately 100 - 200 km away from National Highway Route 5.

#### 2.3 Organization of Survey Teams

Under survey party leader Chuji Misawa, senior surveyor, two survey groups, A and B, were organized and surveyors Horiuchi and Matsui were appointed leaders respectively. Each group was further divided into three teams.

While the group A led by Horiuchi engaged in survey work mainly in the Aparri district, the group B led by Matsui focused its survey efforts primarily in the Cauayan district.

Initially, the survey work in the Tuguecarao district was conducted jointly by the two survey groups, and whenever the group A moved to the Aparri district, the survey work in the Tuguecarao district was carried out by the group B alone. However, due to local terrain restrictions, observation towers were later erected in both the Aparri and Cauayan districts, and both groups thereafter carried out survey work together with flexibility in team set-up.

The coordinators from BCGS accompanied the survey groups and rendered assistance in negotiating and coordinating with local officials. They also put many hours in learning the art of survey.

#### 2.4 Communications

Prior to starting the survey work, permission to use the radio equipment brought from Japan was received through BCGS from the Bureau of Telecommunications in accordance with the Implementing Agreement. An antenna was set up at the headquarters in Tuguegarao to maintain radio communications with each survey team. Because of poor radio communications with the sub-camps in Aparri and Cauayan, communications with these sub-camps were maintained by telephone.

## 2.5 Issuance of ID Cards and Personnel Safety Measures

An ID (identification) card was issued to every survey party member by the Philippines government, and the members were instructed to keep the ID card in possession at all times.

Whenever it became necessary to carry out survey work in the mountains, local police was so notified, and the survey work was conducted under escort of either policemen or local citizens.

### 3. Field Work

#### 3.1 Control Point Survey

##### 3.1.1 Planning of control points distribution

While giving due consideration to the proposed JMR points distribution to be effected by BCGS, control points which can be readily used as given points were selected along the principal roads within the survey area. Also, since control points were already established within the survey area by triangulation, three control points, excluding lost points confirmed by preliminary inspection, were added to the traverse network to correlate the network with the geodetic coordinates systems.

##### 3.1.2 Locating of the control point

Locating was conducted in accordance with the planning of control points distribution. Where there is an existing triangulation point, observations were made, as a rule, from the top of the monumented marker. In establishing new control points, locating was conducted while taking into account the following matters:

- (1) Selection of appropriate locations where monumented markers can be found as well as maintained.
- (2) Selection of appropriate locations offering easy discrimination as picture points for aerial triangulation and as well as ease of pricking work.

(3) Adoption of eccentric observation depending on local conditions.

(The need for an observation tower was confirmed in advance by preliminary survey.)

With due consideration given to the area shape (long and narrow), topography, and vegetation, the survey area was subdivided into the following three districts:

- A. Aparri - Alcala area (Northern part)
- B. Alcala - Ilagan area (Central part)
- C. Ilagan - Santiago area (Southern part)

These three districts are outlined below.

A) Aparri - Alcala area

The district is contained within the province of Cagayan, except for the northern part which belonging to the province of Kalinga-Apayao. The northern half of the area is rich in paddy fields and coconut palm trees standing approximately 15 - 20 m tall.

The southern part is mostly a hilly country. A branch of the Sierra Madre extends from the eastern part to the central portion of the district.

Found in the hilly and mountainous districts are scattered forests with trees grown to approximately 20 m high. The Cagayan River flows through roughly the center of this district. National Highway Route 5 runs parallel to the Cagayan river on its east side and National Highway Route 3 runs east and west in the northern sector of the district.

The rooftop of a school was used as an observation point in the vicinity of Aparri. There are many coconut palm tree plantations in the municipality of Abulug and Buguey, the sight was disturbed by 20m-tall coconut palm trees, necessitating erection of observation towers. In the hilly land near Allacapan, as large trees, 20 m to 25 m tall, disturbed the sight, certain trees were cut down with permission of the land owners.

B) Alcala-Ilagan area

The boundry line of two provinces, Cagayan to the north and Isabela to the south, crosses the eastern half of the district at its center sector. The western sector of the district is occupied by the mountainous province of Kalinga-Apayao. A low folded hill extends north and south through the center of the district. Also, many large sugar cane plantations exist to the west of Tuguegarao. In general, the district is a hilly country and trees are scarce. The Cagayan River flows through the eastern sector of the district, and National Highway Route 5 runs along its east side. The Chico River flows through the western sector of the district.

The smoke from burning weeds or brushes on the farms and in the mountains occasionally disturbed intervisibility.



C) Ilagan-Santiago area

The greater parts of the area is in the province of Isabela, with a limited area in the southwestern sector extending into the province of Quirino. National Highway Route 5 runs through the center of the district. The rice is the principal agricultural product of the district, and an expansion of paddy fields can be seen on both sides of the highway, with scattered trees in villages. The rice fields are provided with well-maintained irrigation ditches and farm roads, allowing easy traveling by motor vehicles. To the south of Santiago, a long stretch of hills exists.

The field survey in the area was carried out in accordance with the planning of control points distribution.

3.1.3 Monumenting

In monumenting new control points, the main control points (40 m x 40 m x 70 cm) and supplemental control points (30 m x 30 m x 50 cm) were classified by size in accordance with the specification agreed upon during preliminary meeting with BCGS. (See attached figure.) Prior understanding was received from the counterpart to use existing monuments whenever found in the area concerned during the preliminary survey.

Prior to starting monumenting, we anticipated preservation of the monuments will become a problem. However, through negotiations between the counterpart's coordinator and municipal mayors, Barangai captains, and Barangai peoples, their understanding was received on maintenance of such monuments.

#### 3.1.4 Survey work

Upon calibrating and adjusting instruments and equipments, the survey work started from the vicinity of Tuguegarao. Descriptions of the following five survey works are given in the subsequent pages:

- A) Distance measurement
- B) Horizontal angle observation
- C) Vertical angle observation
- D) Astronomical observation
- E) Leveling

##### A) Distance measurement

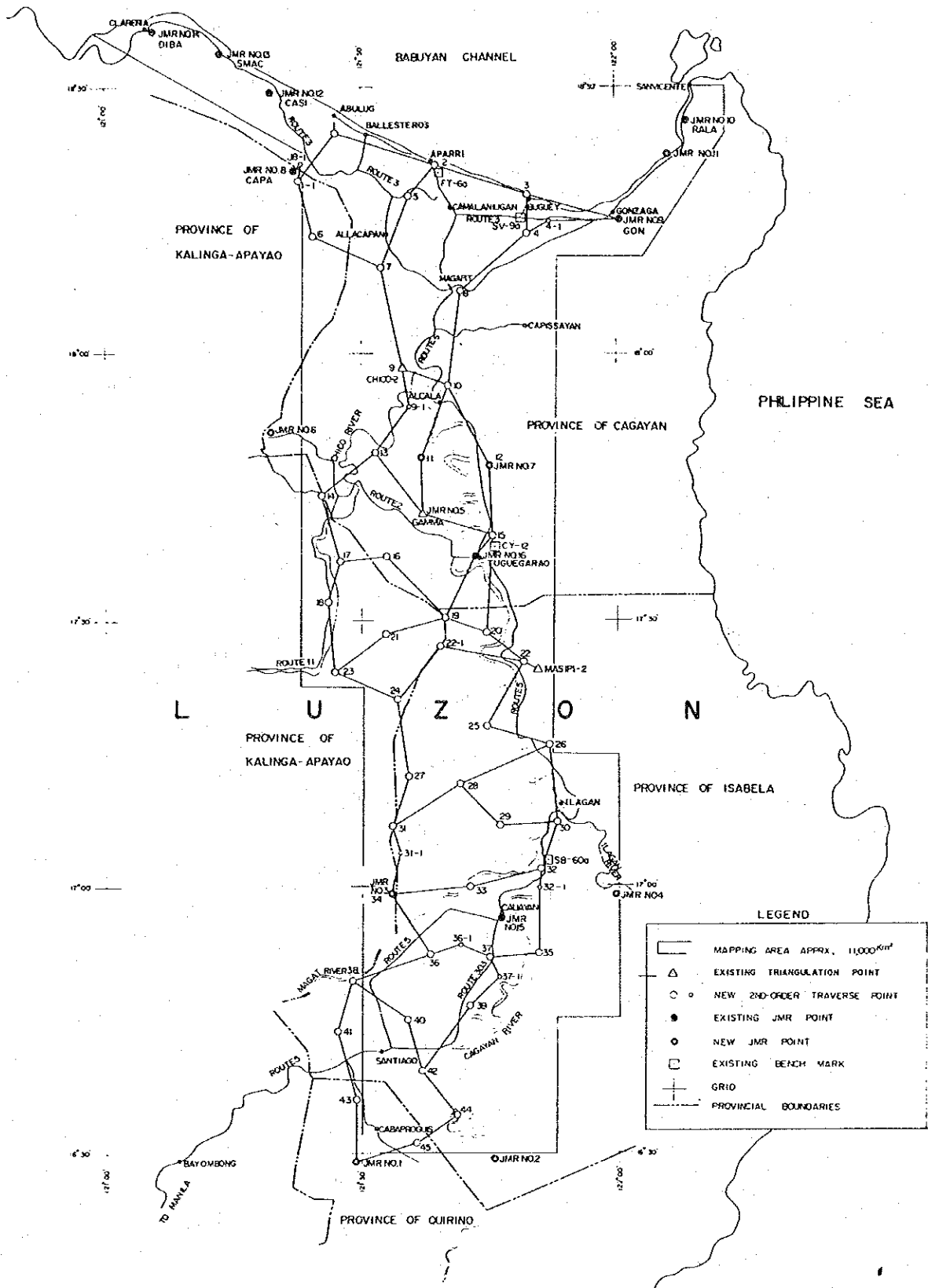
An AGA Geodimeters was used for distance measurement.

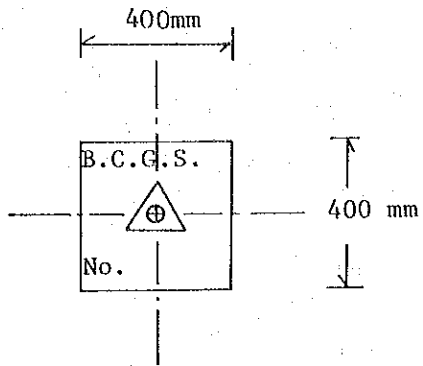
In this instance, the length of each side was measured in two sets. Discrepancy of no more than  $1/75,000$  was allowed for two measured sets.

When discrepancy exceeded the tolerance, that distance was remeasured. For large discrepancies not exceeding the tolerance, the lengths were also measured again. To ensure high accuracy, distance measurement was conducted with intervals of

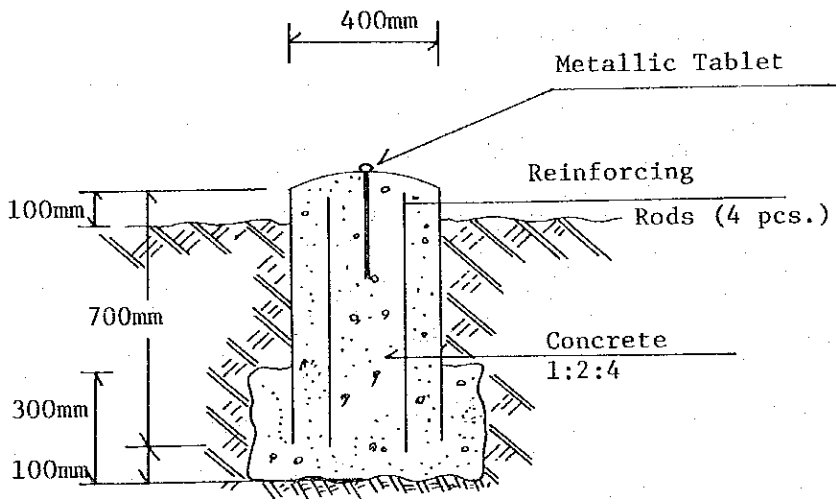
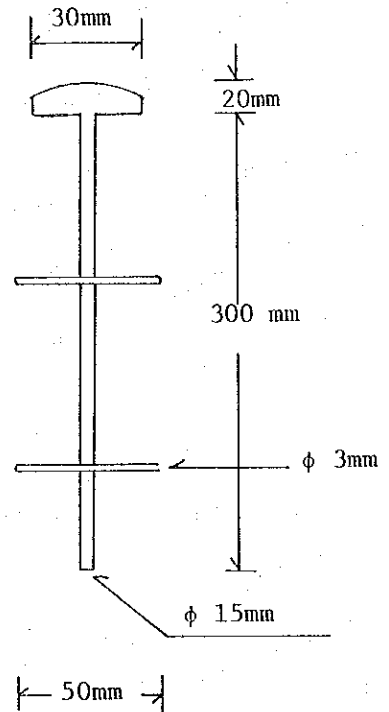
# CAGAYAN VALLEY TOPOGRAPHIC MAPPING

SECOND STAGE SURVEY      SCALE 1:1,000,000.





Metallic Tablet



over 30 minutes between sets.

For long distance measurement, close attention was paid to the atmospheric conditions to ensure measurement accuracy. Specifically, to prevent heat radiation from the ground, a thermometer was placed at a height of 3 m above the ground level.

B) Horizontal angle observation

A WILD T3 was used for observing horizontal angles. Three sets of observations with each set observed at  $0^\circ$ ,  $60^\circ$ , and  $120^\circ$  were made. The maximum allowable double angle difference was 12" and the maximum allowable observed difference 7". For any observation exceeding these limits, reobservation was conducted.

Because a long distance measurement involved, a heliotrope and signal lamps were used for observing signal targets.

C) Vertical angle observation

Four sets of simultaneous observations (two pairs make up one set) were conducted. The intervals of over 10 minutes were provided for each set of observation. The allowable variations in instrumental constants was limited to 10". Observations were made between 9:00 AM and 4:00 PM.

D) Astronomical observation

For the purpose of azimuth correction, a astronomical survey by polaris observation was conducted at three points

located within the survey area with reference to the polar star. Using a WILD T3, four pairs of observations were made at 0°, 45°, 90°, and 135°. The observation points were No. 2 (azimuth marker No. 5), No. 15 (azimuth marker JMR No. 16), and No. 36 (azimuth marker JMR No. 36-1).

E) Levelling

In order to determine altitudes of newly established control points, the levelling was conducted from the existing 1st order bench mark on the principal roads at four points (No. 2, No. 3, No. 15, and No. 32). The duplication discrepancy was limited to 10 mm $\sqrt{S}$  km.

### 3.1.5 Computation

(A) Approximate computation at site

Coordinates and elevations were computed by using observed data such as horizontal angles, vertical angles, and distances corrected for weather conditions, grade, and projection.

This computation was conducted to certify accuracy of the traverse circle. All the results of this trial computation were acceptable. (See Appendix.)

(B) Precise computation

(1) The adjustment of the net and the coordinate were computed in the following:

- i) JMR #5 (GAMMA) was assumed fixed and the azimuth was determined by azimuth observations at Stations Nos. 2, 15, & 36.

- ii) The net was connected to triangulation stations No. 9 (CHICO<sub>2</sub>), MASIPI<sub>2</sub> & JMR No. 5 (GAMMA) and adjusted by least square method.
- iii) The net was connected to JMR Station Nos. 8, 9 (GON) & 16 (CAG) and then adjusted by least square method.

First, three types of solutions mentioned above were computed by means of homogeneous net adjustment of coordinates in accordance with the items specified in the minutes.

The values obtained by item ii) were adapted as the final results.

The following parameters were used for these computations:

Reference Ellipsoid:	Clarke Spheroid of 1988
Projection:	Transverse Mercator
Point of Origin:	Northing                      0 m
	Easting                      500,000 m
Scale Factor:	0.99995
Zone Number:	III

- (2) The determination of elevation was conducted based on homogeneous net adjustment computation using the elevations of directly levelled control points No. 2, No. 3, No. 15, and No. 32 as the given data.

ACCURACY

No.	$\Sigma S$	$d\alpha$	$dx_l$	$dy_l$	$dhl$	$dH$
1	8 <sup>k</sup> .52	$\pm 6.12$ -3.26	m -0.064	m +0.242	1/340	$\pm 1.08$ -0.78
2	120.2	$\pm 7.07$ -5.86	+0.505	+0.268	1/210	$\pm 1.34$ +0.96
3	49.1	$\pm 5.00$ +3.30	+0.371	+0.126	1/125	$\pm 0.79$ -0.26
4	76.7	$\pm 6.12$ +4.37	-0.007	-0.329	1/233	$\pm 0.96$ -0.20
5	75.8	$\pm 5.59$ -1.27	+0.233	+0.211	1/241	$\pm 1.02$ +0.18
6	105.3	$\pm 7.07$ +0.24	+0.248	-0.314	1/263	$\pm 1.15$ -0.07
7	76.1	$\pm 6.12$ -1.17	+0.136	-0.344	1/313	$\pm 0.95$ -0.36
8	90.9	$\pm 6.61$ +3.63	+0.479	+0.439	1/139	$\pm 1.05$ -0.14
9	125.0	$\pm 7.07$ +1.68	+0.010	+0.147	1/850	$\pm 1.34$ +0.65
10	59.9	$\pm 5.00$ +3.59	+0.206	+0.257	1/182	$\pm 0.92$ +0.17
11	96.3	$\pm 7.07$ -0.08	+0.185	-0.269	1/295	$\pm 1.06$ -0.43
12	87.6	$\pm 7.07$ +0.93	-0.285	+0.072	1/297	$\pm 1.00$ +0.66
13	86.0	$\pm 7.07$ -2.11	-0.339	-0.376	1/169	$\pm 0.98$ +0.19
14	98.2	$\pm 7.07$ -1.54	+0.402	+0.311	1/193	$\pm 1.04$ -0.26
15	48.5	$\pm 5.00$ +3.50	+0.369	+0.026	1/131	$\pm 0.79$ +0.35

Remarks: Above: Allowable error

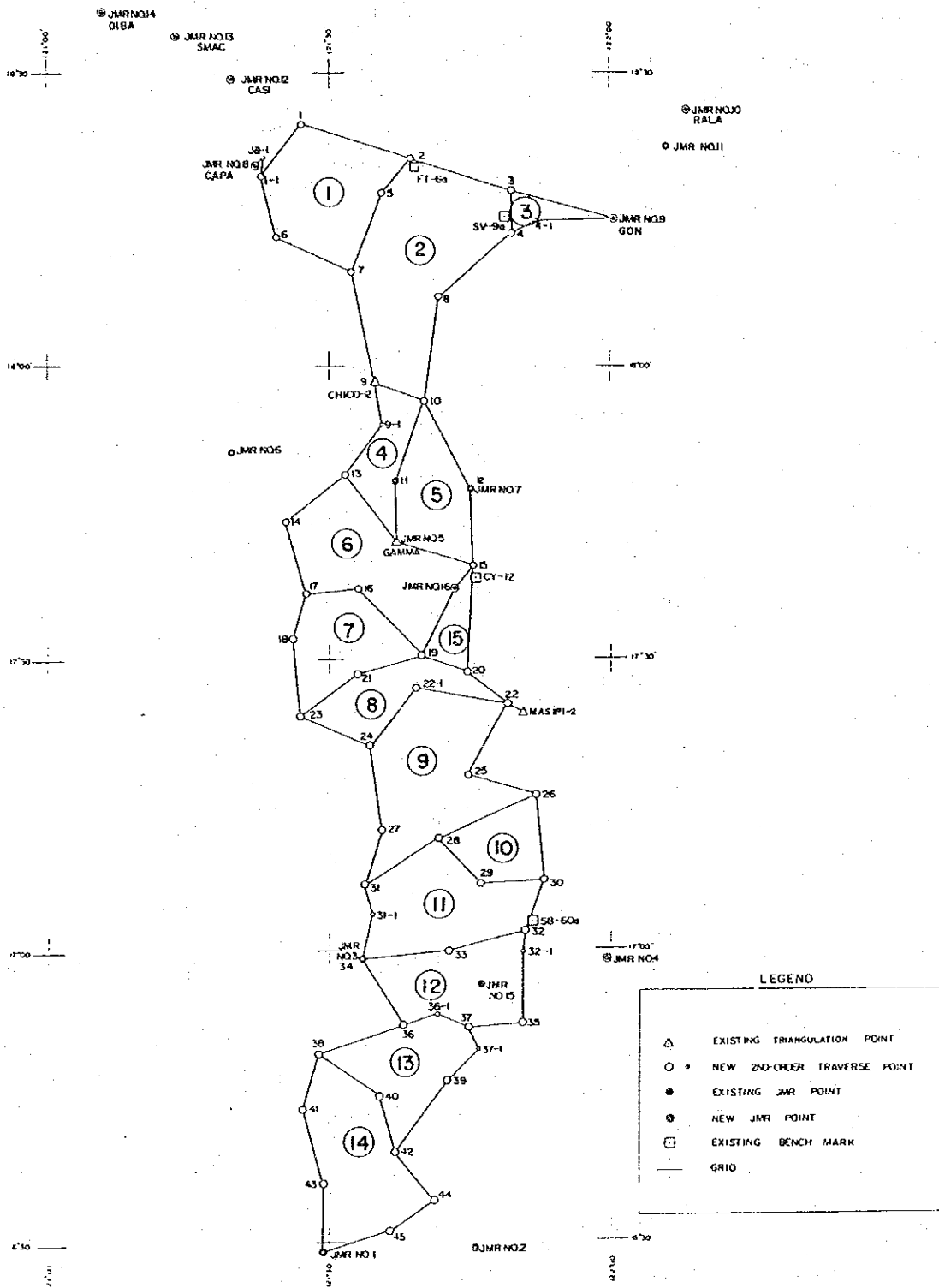
Bottom: Closure error



# CAGAYAN VALLEY TOPOGRAPHIC MAPPING

SECOND STAGE SURVEY

SCALE 1:1,000,000



### 3.1.6 JMR observation

The BCGS made observation of 13 JMR points as listed below. The distribution of JMR point was determined through discussion, between Mr. Kitani and BCGS.

JMR Points Observed by BCGS				
No.	Year	JMR point	Remarks	
1	1980		Tied to traverse net	Pricking
2	1980			Pricking
3	1980			Pricking
4	1980			Pricking
5	1972	CAPA	Tied to traverse net	Pricking
6	1972	GON	Tied to traverse net	Pricking
7	1978	PALA		Pricking
8	1980	PORT	Re-establishment	Pricking
9	1978	CASI		Pricking
10	1978	SMAC		Pricking
11	1980	DIBA	Re-establishment	Pricking
12	1972	CAUAYAN		Pricking
13	1972	CAG	Tied to traverse net	Pricking

### 3.2 Pricking Work

#### 3.2.1 Photographic processing

Stereoscopic photographs (two times enlargement) for pricking were prepared by BCGS.

No. of processed photographs: 116 sheets (including 7 sheets of full enlarged photographs) for newly established control points 45  
JMR points 13

#### 3.2.2 Pricking work

The pricking work was conducted for the newly established control points and JMR points. With due consideration given to the subsequent aerial triangulation, eccentric observations were made as much as possible.

Newly established control points	45
JMR points	13
Total	58

### 3.3 Miscellaneous Items

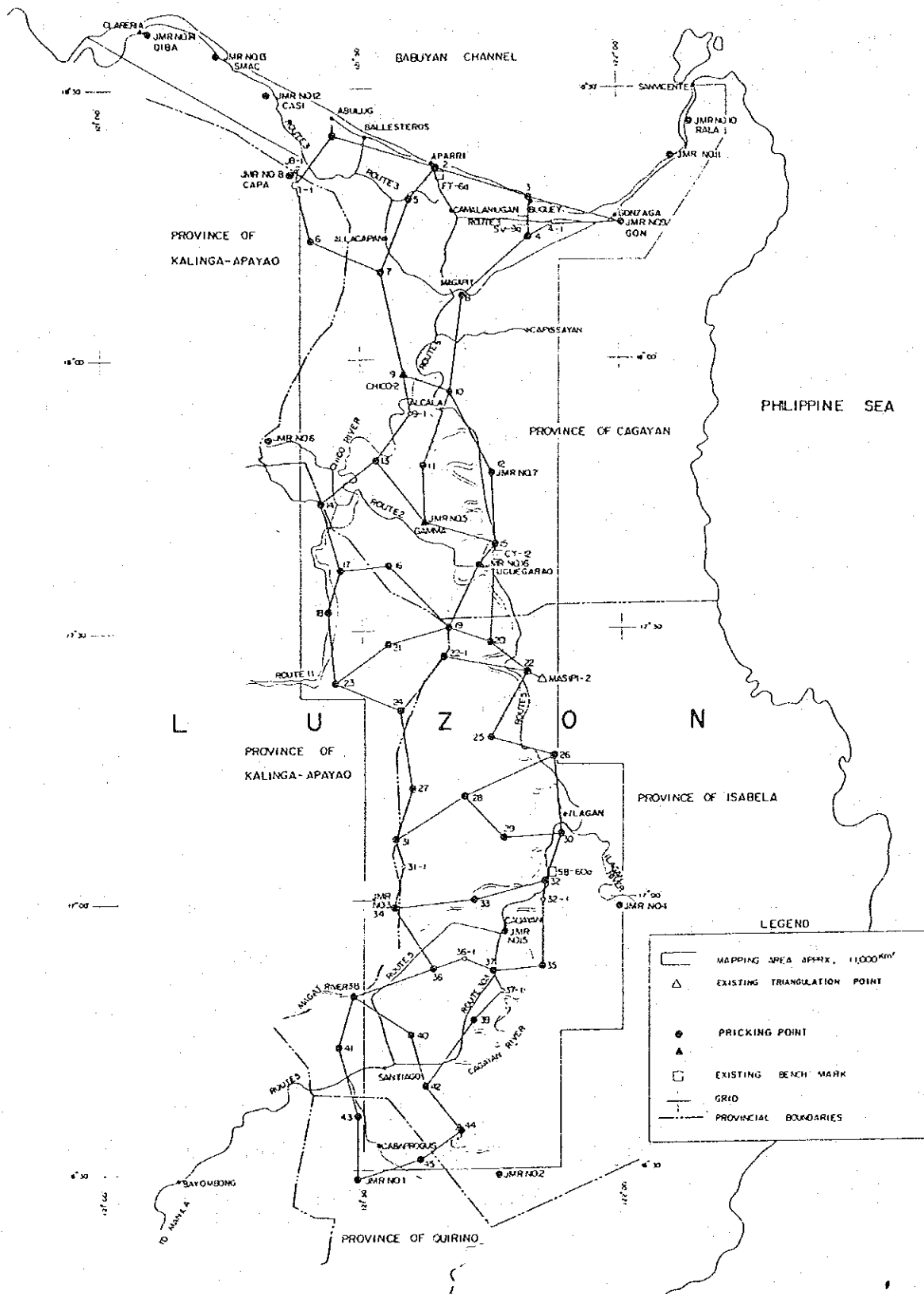
#### 3.3.1 Negotiations with lot owners

Prior to using any piece of land, an investigation was conducted without fail to determine whether the land concerned is owned by the state or a private property. In case of private property, the lot owner was contacted in advance to obtain his permission. For absentee owners

# CAGAYAN VALLEY TOPOGRAPHIC MAPPING

SECOND STAGE SURVEY SCALE 1:1,000,000

PRICKED GEODETIC CONTROLS



living far away, a barangai captain concerned assisted the survey party in obtaining permission. The coordinator from the counterpart dealt with lot owners and their permissions were normally obtained without any difficulty. Of 45 control points newly established, 22 points are located on the private lots.

### 3.3.2 Employment of local personnel

#### 1) Manual laborers

A large number of manual laborers were required for clearing observation points, constructing observation towers, and transporting materials and equipment. Manual workers were employed at Tuguecarao, Aparri, and Cauayan with the assistance of the coordinator from the BCGS.

#### 2) Guides

As the surveyors were not familiar with local terrains and situations, a guide was employed as necessary for reconnaissance and survey work in the mountains.

#### 3) Guards

Guards were locally employed for safety and security of the materials, equipment, and vehicles stored at the head office and sub-camps.

#### 4) Drivers

Drivers were employed through BCGS. As a rule, the survey team members were prohibited from driving vehicles on the ground that the traffic regulations

and conditions in the Philippines differ from those of Japan.

### 3.3.3 Erection of observation towers

As a result of preliminary survey, the need for observation towers was recognized, and three sets of scaffolds used for construction of buildings were prepared.

Although the standard height of each tower is 17 m, the modular structure consisting of identical blocks allows adjustment of the height as necessary. (See attached figure.)

The observation towers were erected at the following locations:

No. 1	11.62 m (Aparri)
No. 3	23.49 m (Aparri)
No. 37	8.41 m (Cauayan)
No. 42	2.87 m (Cauayan)

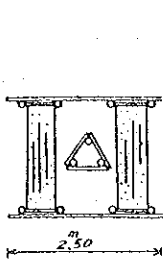
### 3.3.4 Movement and transportation

Since the principal road (National Highway Route 5) runs north and south through the survey area, the survey party encountered no difficulty travelling and transporting materials and equipment to various survey areas.

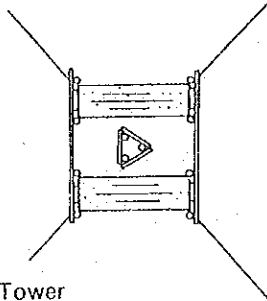
The region has a fairly good network of gravel-surfaced branch roads. However, since Cagayan and Chico rivers are in the way of branch roads running east to west and few bridges span these rivers. This geographic restriction

Tower For Observation

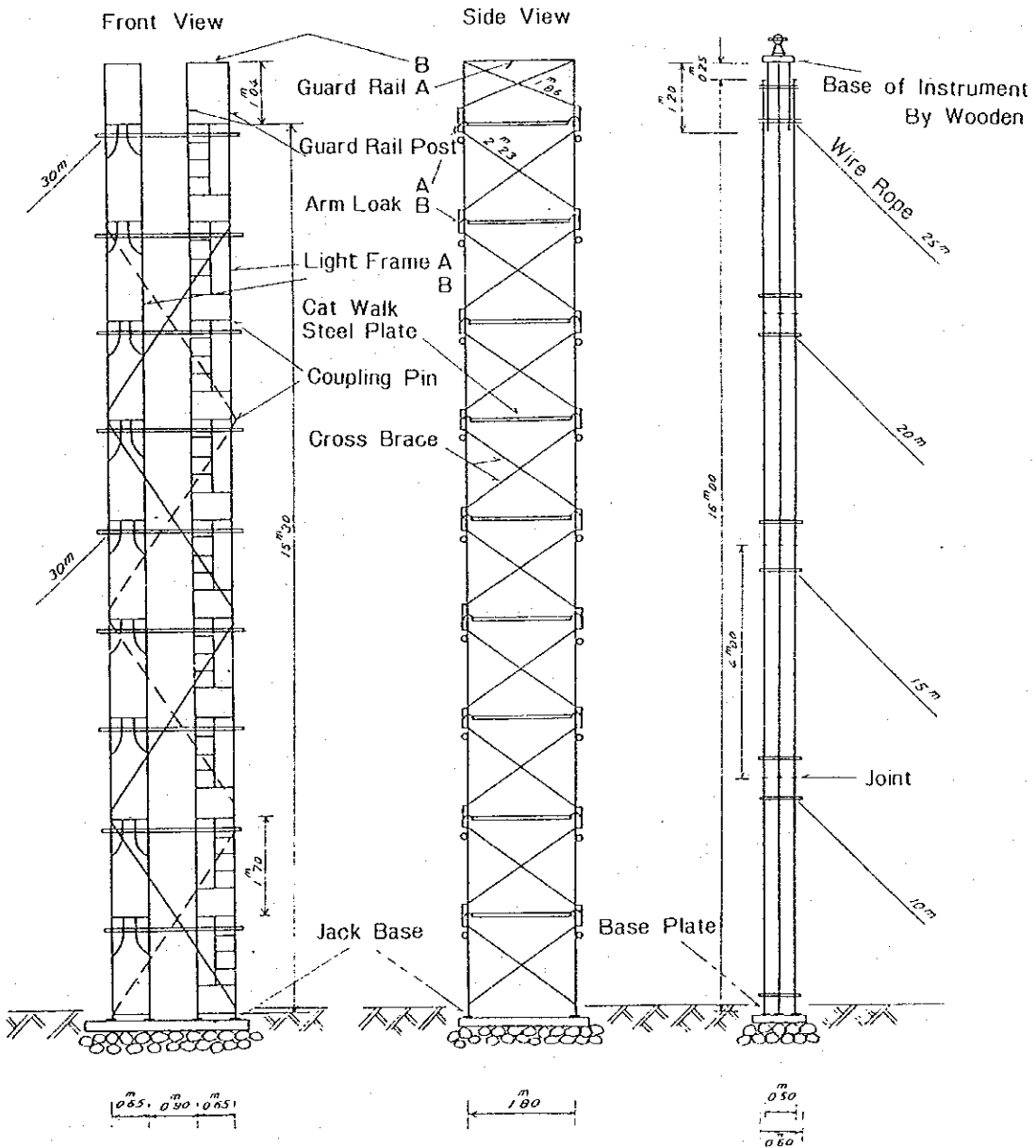
scale 1 : 100



Out Side of Tower



Inside of Tower



often forced the survey party to use ferry boats or take roundabout routes.

Both survey party members and materials were transported mainly by land cruisers. However, the materials for observation towers erected in the Aparri and Cauayan districts were transported by two-ton trucks.



4. Comments for The Third Year Work

Works subsequent to the second year project includes leveling and field inspection. Since the temperature rises sharply from mid-April, leveling in this season, will be obstructed due to heat waves. Therefore, leveling must be conducted not only in the dry season, but also in the wet season. Fortunately, since it will not be raining all day long during the latter part of the rainy season, the field work during that period is possible. In this instance, however, travelling on certain roads is impossible as vehicles tend to slip, though this problem can be solved by selecting the appropriate period and area. The survey party was able to complete the second year phase of the project, thanks excellent corporation of BCGS. Further cooperation and mutual understanding will be highly appreciated for the subsequent third year phase.

## 5. Conclusion

The survey area for the second-year phase covered a narrow, confined area stretching north to south along the Cagayan River in northern Luzon. The Cagayan River flows through roughly the center of the survey area. Except for the National Highway Route 5, there are only three bridges that span the river. Due to such restrictions, the survey party spent much time crossing the river. With the completion of the Magapit Bridge (in the Aparri area), however, we were able to carry out survey work without loss of time at the west side of Aparri. The survey party completed the entire work scheduled for the year without any member taken ill or injured, trouble with local peoples or interruption of the survey work due to poor weather conditions.

We would like to express our wholehearted appreciation to the technical adviser from Geographical Survey Institute, the officials of the Japanese Embassy in the Philippines, the Manila Office of the Japan International Cooperation Agency, the Bureau of Coast and Geodetic Survey, and those of other agencies concerned for their guidance and cooperation.

Republic of the Philippines  
Ministry of National Defense  
BUREAU OF COAST AND GEODETIC SURVEY  
M a n i l a

MINUTES OF THE MEETINGS ON CAGAYAN VALLEY  
TOPOGRAPHIC MAPPING PROJECT

Date : 15, 16, 23 & 26, May 1980

Place : Bureau of Coast and Geodetic Survey  
Ministry of National Defense, Manila

Attended By :

Antonio P. Ventura, Commodore, BCGS - Director  
Oliver F. Castro, Capt., BCGS - Asst. Director  
Mr. Mario C. Manansala  
Claudio S. Ramos, Ens., BCGS  
Mr. Ponciano C. Ciceron  
Basilio D. Apostol, Lt., BCGS

JICA SURVEY TEAM

Mr. Shirai - Geographical Survey Institute  
Mr. Kimura - JICA  
Mr. Shino - Survey Team Leader  
Mr. Nagashima - Deputy Survey Leader  
Mr. Miyashita - Staff, Survey Team  
Mr. Harada - Staff, Survey Team

BACKGROUND :

- JICA Survey Team explained its 2nd year activities for the establishment of geodetic controls which had been conducted in the region from January to May 1980.

- BCGS explained its work in the establishment of JMR controls and 1st order levelling.

- JICA Survey Team also briefed the work plan for the 3rd year program which is expected to start from December 1980.

- The following matters were discussed and confirmed by both parties.

2

I. The Second Year Work (Geodetic Control)

1. Work carried out by BCGS :

- a. 1st order levelling has been run in the project area along Highway No. 3 & 5 totaling 457.1 km. length. A copy of the results have been handed over to the JICA survey team in January 1980.
- b. JMR observations were conducted on thirteen (13) stations; The precise processing results on six (6) points have been submitted to the JICA survey team and the results on four (4) points are to be submitted around July 1980.
- c. The BCGS sent three (3) officers as counterparts to coordinate activities with JICA in the project area.

2. Work carried out by JICA (ANNEX " A " ) :

- During the period from January to May 1980, JICA Survey Team had accomplished the following :
- a. Established forty - five (45) geodetic control stations,
  - b. Tied four (4) stations to BCGS JMR stations,
  - c. Pricked forty - five (45) geodetic controls and thirteen (13) JMR stations.

3. Outline of the results of the preliminary computation by JICA, Annex " B ". These results have been found to be within limits of Geodetic Control Specification and therefore, it can also be concluded that the results of the final computation will also be within limits.

4. Treatment of the azimuth of the net and discrepancy with existing triangulation and JMR geodetic control :

- Considering that the net established by the JICA survey team is rigid, the following alternatives have been considered to connect the net to BCGS existing geodetic control points.

- a. JMR # 5 (GALMA) is assumed fixed and the azimuth will be determined by azimuth observations at Stations Nos. 2, 15 & 36.
- b. The JICA net will be connected to triangulation stations No. 9 (CHICC<sub>2</sub>), MASIP 1<sub>2</sub> & JMR No. 5 (GALMA) and adjusted by least square method.
- c. The JICA net will be connected to JMR Station Nos. 8, 9 (GON) & 16 (CAG) and then adjusted by least square method.

- Both parties (BCGS & JICA) agreed to adapt alternative " b " and the results will be compared to the results using alternative " a " and " c " for evaluation.

Note : The Station JMR No. 5 has been occupied by the JICA Survey Team; but no JMR observations had been made at this station.

5. Submission of Annual Report on the progress of the work by JICA to BCGS.

- Annual report on the progress of the work by JICA, including the final results of the computations and other data, will be submitted to BCGS by the end of September 1980.

## II. The Third Year Work (Minor Vertical Controls and Field Identification)

### 1. Outline of the Work :

- a. JICA will undertake establishment of auxiliary vertical controls and field identification,
- b. BCGS will gather data on administrative boundaries, highway or road classification, and geographic names.

- 2. Submission of Map Symbols and detailed specifications to JICA by BCGS.

- Because of the importance of symbols in field identification, discussions on the specification for the 1/25,000 maps, particularly in symbolization, have been made. Draft of the specification has been submitted to the JICA Survey Team. (ANNEX " C ") A final revision on the specification will be submitted on July 1980.

- 3. Enlargement of aerial photo for use in the field identification and pricking for vertical controls.

- Uncontrolled mosaic is most suitable tool for field identification and placing geographic names, administrative boundaries, and road classification. BCGS agreed to send aerial negatives to Japan through diplomatic channels for the production of such uncontrolled mosaic, enlargement and the diapositives.

- Two (2) security officers (one from BCGS and one from J - 2) will accompany the film negatives and stay in Japan during the duration of the production of the mosaics. JICA will accept the security officers as trainees under the Colombo Plan.

- 4. Field Identification and Establishment of Vertical Control Points by JICA.

- Area to be covered :

- Auxilliary Vertical Control : App. 1,000 km.

- Field Identification : App. 11,000 Km<sup>2</sup>.

- In remote or inaccessible areas establishment of auxilliary vertical controls maybe indirect method.

- First - order benchmarks will be pricked for purposes of placing them on the map, and photo control points will be pricked for aerial triangulation purposes.

5. BCGS will send counterparts to the project area to act as liaison officers.
6. BCGS will take the necessary measures to ensure the safety of the JICA survey team.
7. BCGS and JICA agreed that less completeness of field identification in remote and hardly accessible area will be tolerated.

III. Other Items :

1. Availability of JICA Vehicles :

- Relating to the 3rd year work, BCGS requested JICA Manila Office to make some kind of arrangement on the availability of JICA'S Land Cruiser Station Wagon (2 Vehicles) to be used for the preliminary survey (data collection of administrative boundaries and geographical names) until the arrival of JICA Survey Team.

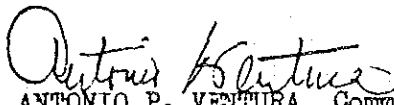
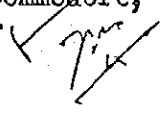
- In connection with the request, discussions were made and BCGS proposed the following conditions :

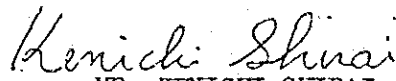
1. The Vehicles shall solely be used for the Project,
2. All the expenses related to maintenance and operation shall be borne by BCGS,
3. In case of accident, BCGS shall promptly inform all the details to the JICA Manila Office and follow its directions,
4. BCGS shall, when necessary, bear the Minimum Charge for repairs, as the JICA Vehicles are all insured,
5. BCGS shall prepare Log Book for maintenance and operation of each vehicle.

-- Availability of the vehicles will be realized as soon as JICA Headquarter's approval.

2. A copy of the format of the 1:25,000 topographic map ANNEX " D ", and a copy of the work flow diagram ANNEX " E " for the production of the 1:25,000 maps were furnished to the JICA survey team.

APPROVED :

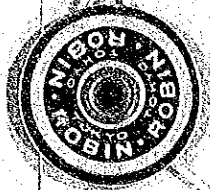
  
ANTONIO P. VENTURA, Commodore, BCGS  
Director 

  
MR. KENICHI SHIRAI  
Geographical Survey Institute

Date : 27 May 1980







MINUTES OF THE MEETING

MINUTES OF THE MEETING ON TOPOGRAPHIC  
MAPPING PROJECT FOR CAGAYAN VALLEY

Date : 17 January 1980 Time : 14:00 To 17:00 P.M.

Place : Bureau of Coast and Geodetic Survey

Attended By : Bureau of Coast and Geodetic Survey

Commodore, ANTONIO P. VENTURA - Director, BCGS

Captain, OLIVER F. CASTRO - Assistant Director

Commander, MAMERTO S. GLER - Chief, Operations Division

Mr. MARIO M. MANANSALA - Chief, Planning Division

Japanese Government and JICA

Mr. KENJIRO IZUMI - Embassy of Japan

Mr. TOSHKAZU MIURA - JICA Manila - Resident Representative

Mr. YUKIO KITANI - Geographical Survey Institute

Mr. HIDEKI MURAYMA - JICA, Tokyo

Mr. SHIGEHICO SHINO - Survey Team Leader

Mr. TOSHIMASA NAGASHIMA - Survey Team Deputy - Leader

BACKGROUND :

JICA Survey Team has explained in detail the Work Scheme (2nd Year) and both party agreed.

BCGS had explained present status of their contribution such as the 1st-Order Levelling and JMR control point survey and has submitted the names of two liason officers their counterparts.

The following matters were confirmed by both parties

1. To ensure the safety of the survey teams while working in dangerous or critical areas. The Director, Commodore ANTONIO P. VENTURA, BCGS has prepared a letter of introduction for the Team Leader to Commanding General Northeast Command, Brig. Gen. ROMEO G. GATAN, AFP.
2. Present status of the 1st-Order Levelling :
  - a. Field survey has been completed by BCGS.
  - b. Computation and adjustment are now in progress and the final data will be submitted to the survey team by the end of April.

3. Present status of the JMR observation :

- a. JMR observation has been completed on 6 points in the northern part of the area.
- b. The remaining Seven (7) points will be observed beginning January.
- c. The Survey Team requested that the remaining Seven (7) points be established in the vicinity as indicated on the attached map, Scale 1:250,000.
- d. BCGS field parties will point out the JMR stations at site to Japanese survey team during FEB. 1980 so that Japanese survey team can work on geodetic control and pricking.
- e. The final data of JMR stations will be submitted to the Japanese survey team by the middle of May 1980 for final computation and adjustment of geodetic controls.

4. BCGS Counterparts :

Lt. (j.g.) MANOLITO L. DE LA CRUZ

Ensign, SALVADOR A. MARTINEZ, JR.

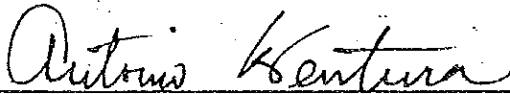
5. Detailed Work Scheme :

As per attached specifications.

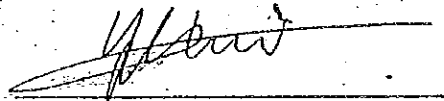
APPROVED BY :

For the Bureau of Coast and Geodetic Survey

For Japan International  
Cooperation Agency



ANTONIO P. VENTURA  
Commodore  
Director, BCGS



YUKIO KITANI  
Head of Survey Guidance Division  
Geographical Survey Institute

Topographic Mapping Project For  
Gagayan Valley  
Detail Work Sheme ( The Second Year )

1. Work quantities:

- A) Establishment of geodetic control stations: 45 stations
- B) Tie to J.M.R. stations: 4 stations
- C) Pricking of geodetic control and J.M.R. stations: 58 stations

2. Work duration in the Philippines:

From January 7th, 1980 to May 23rd, 1980 ( 138 days )

3. Major instruments to be used:

Name	Type	Qts.
Electro-Optic Distance measuring instruments	AGA Geodimeter 600.	1 set
	AGA Geodimeter 6BL	1 set
	Hewlett Packard 3800B	1 set
Theodolite	WILD T3	4 sets
	WILD T2	2 sets
Level	Automatic Level	1 set

4. Brief plan of the work:

- A) Geodetic control net:  
Most of geodetic control station will be located along the primary road in the project area.
- B) Selecting the station:  
Geodetic control stations are chosen where keeping good sight and also well-preserved location.
- C) Monumentation:  
40 by 40 centimeter square and 70 centimeter length concrete monument will be used as standard.  
Mark is the top center of the metal rod which is flushed to the concrete top surface with the inscription of triangle, point number and BCGS. ( as per attached figure )

D) Observation:

\* Horizontal Angle

Three sets of directional angle observation by WILD T3.

\* Tolerance

difference of observation: 7 seconds  
double angle difference: 12 seconds

\* Vertical Angle

One set simultaneous observation by WILD T3  
Tolerance of altitude constance: 10 seconds

\* Levelling

Levelling will be done for some stations from the  
First order levelling stations.

\* Distance measurement

Distance is measured by electro-optic distance measuring instrument,  
with two set measurments.  
Tolerance of each set: 1 / 75,000.

E) Description of the station

The description is made in the field and append a photograph  
of the station.

F) Computation

Preliminary computation is done in the Philippines and  
final computation and adjustment is done by Electronic  
Computer in Japan.

G) Pricking of the station

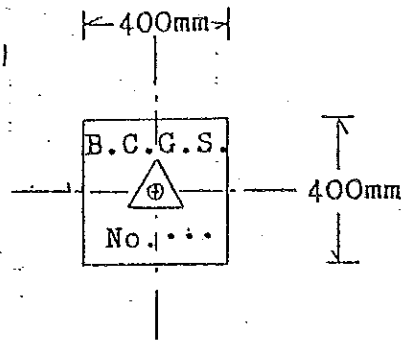
Geodetic control points is pricked on two times enlarged  
aerial photographs.

H) Final products

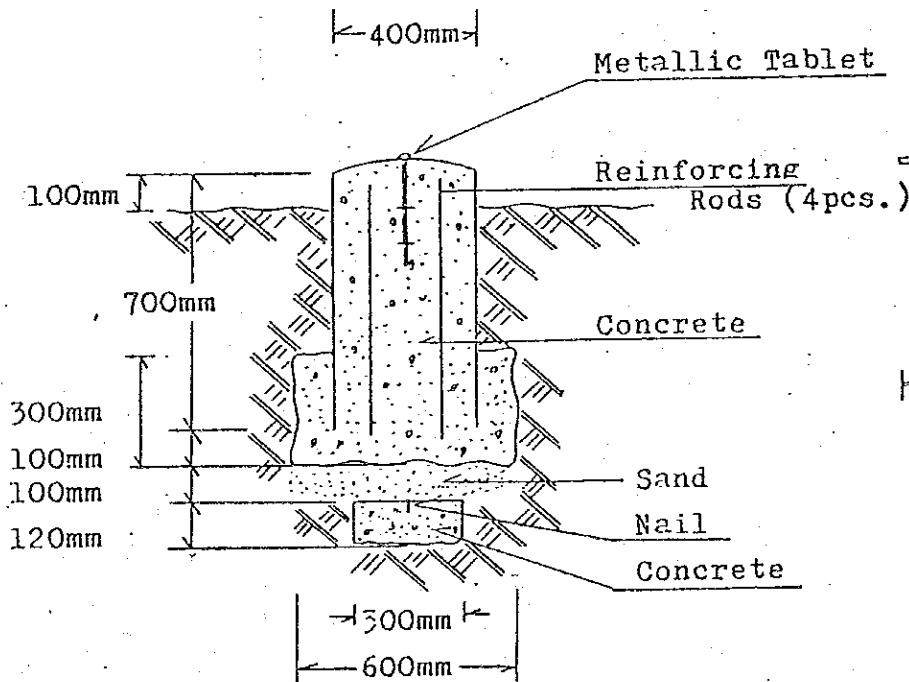
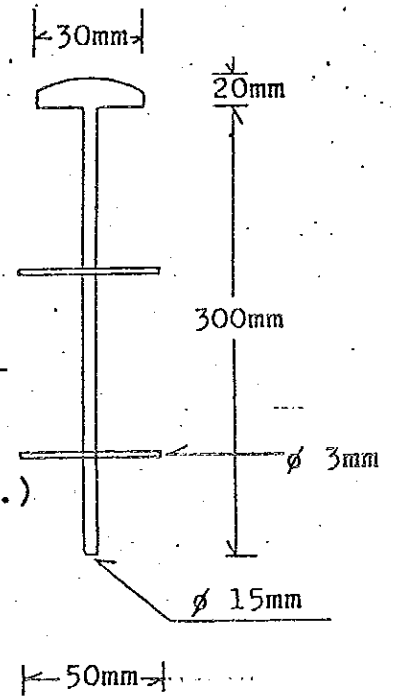
Field notes	1 set
Computation sheets	1 set
Data list of stations	1 set
Description of stations	1 set
Net of stations ( Scale 1 : 250,000.)	1 set
Description of pricking stations	1 set
Record and source material	1 set



TRAVERSE POINT



Metallic Tablet



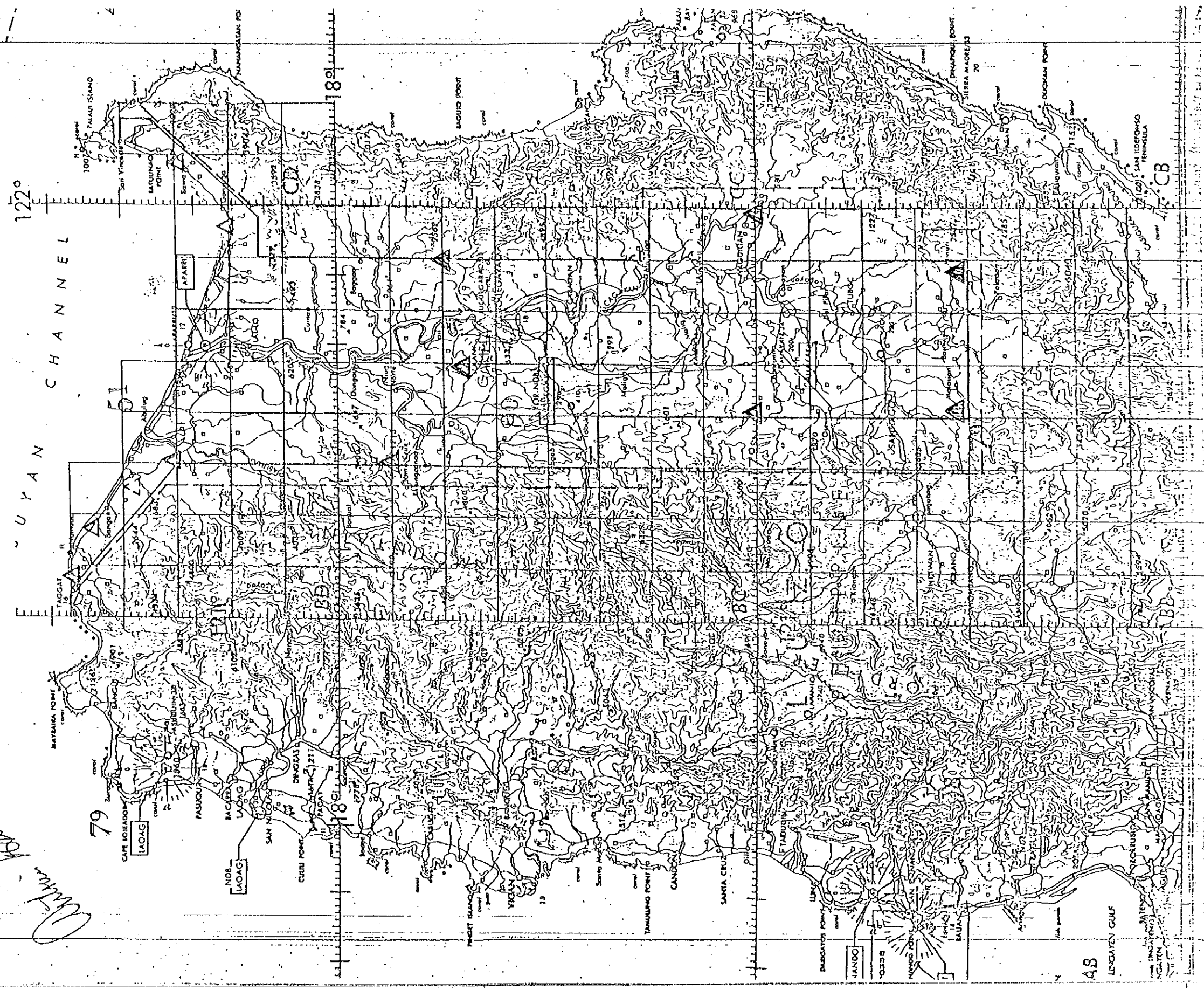
DRAWING FOR ITEM III-1 OF MEMORANDUM

1:25,000 TOPOGRAPHIC MAPPING COVERAGE

1:30,000 PHOTOGRAPHIC COVERAGE

▲ EXISTING DOPPLER STATION

▲ DOPPLER STATION TO BE ESTABLISHED



*Handwritten signature and scribbles*

