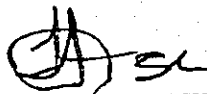


5-5 Minutes of meeting at the start-up of the 3<sup>rd</sup> year field work (Oct. 7,1997)



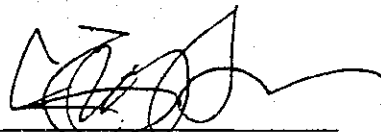
MINUTES OF MEETINGS  
FOR  
THE TOPOGRAPHIC MAPPING  
OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA  
BETWEEN  
SURVEY DEPARTMENT OF GHANA  
AND  
JICA STUDY TEAM

ACCRA GHANA, 7<sup>th</sup> OCTOBER 1997



for

NA AL-HAJI IDDRISU ABU  
DIRECTOR OF SURVEYS  
SURVEY DEPARTMENT OF  
GHANA  
MINISTRY OF LANDS AND  
FORESTRY



TOKIHIKO KAMINISHI  
LEADER  
JICA STUDY TEAM

The JICA Study Team headed by Team Leader Mr. Tokihiko KAMINISHI visited the Republic of Ghana from 29<sup>th</sup> September, 1997 to carry out the third year programme for the Study on Topographic Mapping of Southern Part of Ghana.

Prior to the commencement of the third phase survey work, a series of meetings were held from 1<sup>st</sup> to 7<sup>th</sup> October, 1997 and the following items have been confirmed and agreed by Survey Department of Ghana (SDG) and JICA Study Team.

1. Twenty (20) copies of Second Year Reports were submitted to SDG by JICA Team.
2. Twenty (20) copies of Third Year Plan of Operation were submitted to SDG by JICA Team. The Third Year Plan of Operation was discussed and accepted by both sides.
3. Both sides agreed that the recommendation for improvement of management and operation systems and maintenance system of control points and maps should be made by JICA Team in the final report.
4. SDG requested that digital data of final maps should be added and delivered to SDG at the final stage and JICA Team took note for conveying this request to JICA Head Office of Tokyo.

## LIST OF ATTENDANTS

### 1. Ghanaian Side (SDG)

Na Al-haji Iddrisu Abu	Director of Surveys	Headquarters
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. Marcus Tabil	Examiner	Examinations Section
Mr. K.N.Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I. Andoh-kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R. Tetteh	Chief Lithographer	Lithographic Section
Mr. Jones Ofori Boadu	Assistant Staff Surveyor	Great Accra Region
Mr. Jerry Awambigo	Senior Survey Technician	Great Accra Region
Mr. Nii Quarshie Quartey	Senior Survey Technician	Great Accra Region

### 2. Japanese Side (JICA Study Team)

Mr. Tokihiko KAMINISHI	Team Leader
Mr. Kouichi MIKI	Deputy Team Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor
Mr. Hideaki SAKAI	Coordinator



ATTACHMENT

PLAN OF OPERATION  
FOR  
TOPOGRAPHIC MAPPING OF SOUTHERN PART  
OF  
THE REPUBLIC OF GHANA  
  
( THIRD YEAR )

SEPTEMBER, 1997

JAPAN INTERNATIONAL COOPERATION AGENCY

## I. INTRODUCTION

In response to the request of the Government of the Republic of Ghana (hereinafter referred to as Ghana), the Government of Japan (hereinafter referred to as Japan) has decided to conduct the topographic maps of southern part of the Republic of Ghana (hereinafter referred to as the Study) in accordance with the relevant laws and regulation in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as JICA), the official agency responsible for the implementation of the technical cooperation programs of Japan, will undertake the Study in close cooperation with the authorities concerned in Ghana.

Survey Department of Ghana (hereinafter referred to as SDG) shall acts the counterpart agency to the JICA Study team and also as the coordinator in relation to other governmental and nongovernmental organizations concerned of Ghana for the smooth implementation of the Study.

The Plan of Operation (P/O) for the Third Year's Study is proposed with the tentative schedule for succeeding years as shown in Fig. 1, and the flowchart for the production of topographic map is as shown in Fig. 2.

## II. OBJECTIVE OF THE STUDY

The objective of the Study is to prepare the 1/50,000 topographic maps covering an area of approximately 25,500 square kilometers (see attached map) and to transfer technology to the counterparts personnel of Ghana.

## III. SCOPE OF WORK

The scope of work to achieve the captioned objective is stated in a document entitled "Scope of Work for Topographic Mapping of Southern Part of the Republic of Ghana" agreed between SDG and JICA on 17th March 1995. It covers :

- Aerial photography, Ground control point survey, Leveling, Pricking,
- Field verification, Aerial triangulation, Stereo plotting & Compilation,
- Field completion, Drafting and Printing.

The work volumes and standards for respective work items are shown in Table 1 and Table 2.

Table 1. Work volume of the Study

ITEM	VOLUME	REMARK
1. Aerial photography (scale 1/60,000)	approx. 25,500 km <sup>2</sup>	See Fig.3 progress.
2. Ground control point survey (GPS)	74 points	Completed.
3. Leveling	1,230 km	Completed.
4. Pricking GPS point	74 points	35 points finished.
Leveling point	1,230 km	approx. 580km finished.
Existing BMs	102 points	Completed.
5. Field verification	approx. 25,500 km <sup>2</sup>	3rd year's work.
6. Aerial triangulation	approx. 680 models	-ditto-.
7. Stereo plotting	approx. 25,500 km <sup>2</sup>	-ditto-. S=1/50,000
8. Compilation	approx. 25,500 km <sup>2</sup>	4th year's work.
9. Field completion	approx. 25,500 km <sup>2</sup>	-ditto-.
10. Drafting	approx. 25,500 km <sup>2</sup>	4th & 5th year's work.
11. Printing	40 sheets	-ditto-. 1,000 copies each.

Table 2. Standard of the Study

Reference ellipsoid :	Clarke 1880
Map projection :	Ghana Modified Transverse Mercator
Datum of height :	M. S. L. (Based on the existing BMs)
Map scale :	1/50,000
Neat line :	15' x 15'
Contour interval :	10meters (Mountainous area 20meters)
Map style & application rule :	One adopted by SDG
Ground control point survey :	1/100,000 (Relative accuracy)
Leveling :	5cm /s ( s : km )
Number of colors :	5 colors



#### IV. GENERAL UNDERTAKINGS

The Study shall be conducted in close cooperation between the two countries of Ghana and Japan. Responsibilities of each side set forth in S/W are summarized as follows :

1. Ghana side :

-Necessary arrangement to ensure the entry, exit and stay of the team members as well as personnel of an aerial photography company contracted by the Team for the Study together with related materials and equipment to bring in and out of Ghana.

-Assistance to facilitate issuance of permit necessary for implementation of the Study.

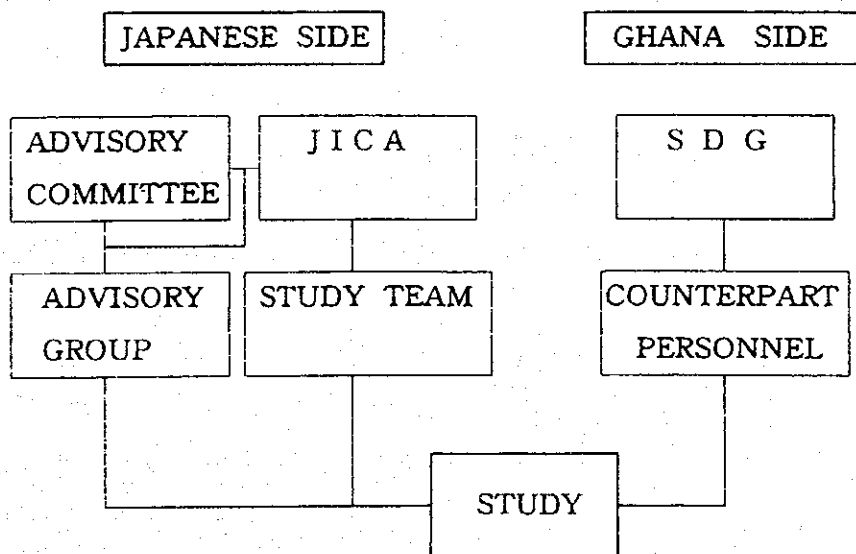
2. Japanese side :

-Implementation of the Study in Ghana and Japan.

-Technology transfer through the execution of the Study.

3. Organization :

Parties involved in this Study shall be organized as follows ;



#### V. STUDY SCHEDULE

The Study shall be planned five years from January,1996 to June,1999 as shown in Fig.1. The flowchart for the production of topographic map is as shown in Fig. 2.

## VI. REPORT AND FINAL PRODUCTS

An annual report shall be prepared by Study team at the beginning of field survey stage II, III and IV. The report on the final year (fiscal) shall cover all of the activities in this Study.

The final products to be delivered to the Government of Ghana are as follows ;

- (1) Aerial photo original negatives ----- 1 set
- (2) Aerial triangulation diapositives----- 1 set
- (3) Contact prints (including aerial triangulation photos)----- 2 sets
- (4) Photo index map ----- 1 set
- (5) GPS control points descriptions & results ----- 1 set
- (6) Vertical control (leveling) results ----- 1 set
- (7) Pricked & field verified aerial photographs (enlarged) ----- 1 set
- (8) Aerial triangulation results ----- 1 set
- (9) Color separation scribed sheets ----- 1 set each
- (10) Color separation combined negatives or positives ----- 1 set each
- (11) 1/50,000 topographic maps -----1,000 copies each

## VII. PROGRESS OF SECOND YEAR WORK

The progress and details of second year work are described in Report II.

## VIII. PLAN OF OPERATION FOR THIRD YEAR WORK

The field work and the laboratory work in Japan for the third year (aerial photography III, pricking II, field verification, aerial triangulation and stereo plotting) shall be carried out for a period from September,1997 to March, 1998.

The members of the Study team and their assignment for the third year's field work are as shown in Table 3.

### 1. Preliminary Work in Japan

Prior to the start of the work as above, chief engineer together with other responsible engineers shall be prepared a detailed plan and equipment for each work process so as to facilitate the field work.

## 2. Preliminary Work in Ghana

Upon arrival in Ghana, the Study Team shall start preparing for field operations. Team Leader and his staff shall discuss administrative matters same as previous year's work with SDG.

## 3. Aerial Photography III

Aerial photography shall be carried out continuously based on the previous year's progress. One Japanese engineer is assigned to Ghana to supervise the operations and check the results.

### 3-1 Specifications for aerial photography

Main specifications for the aerial photography shall be as follows (work volume includes previous year's):

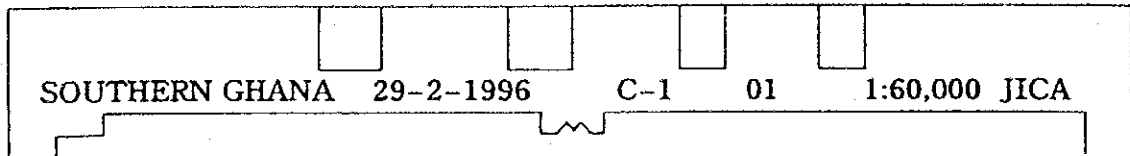
- Camera : Super wide angle camera
- Photo scale : approx. 1/60,000
- Coverage : approx. 25,500Km<sup>2</sup>
- Flight course : 24 courses
- Flight length : approx. 3,500km
- Film : Panchromatic film
- Forward overlap: 60 ± 5%
- Lateral overlap: 30 ± 10%
- Crab : Less than 10 degree
- Tip & tilt : Less than 5 degree
- Cloud coverage: Amount of cloud shall not exceed approx. 3% in successive 5 photos. However, important areas for orientation and cartography shall not be covered with clouds.

### 3-2 Implementation of photography

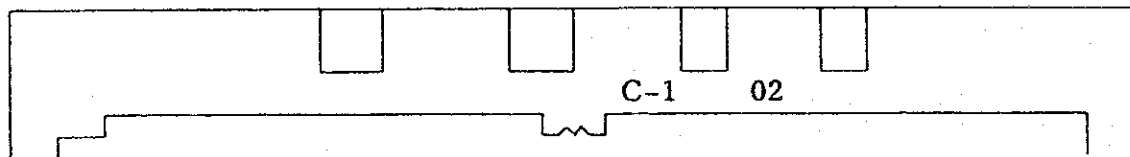
- Base air port : The flight plan shall be made with Accra Airport as the base.
- Test flight : Test flight and test photographing shall be made over the site before launching the scheduled operations.
- Checking : Supervisor for aerial photography inspects developed photos to ensure sidelaps, overlaps and other specified items. If the results do not fulfill the specifications, the aerial photography company shall re-fly the same portions.

- Film editing : Course numbers and photo numbers, etc. shall be annotated on the negatives as follows ;

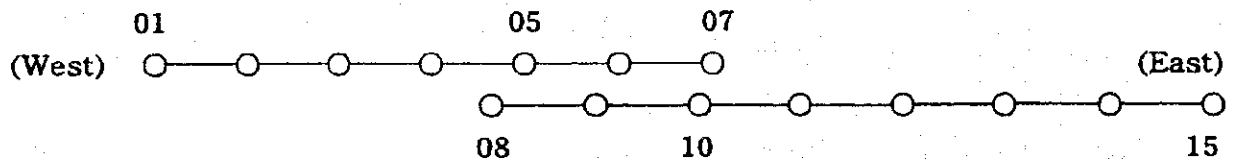
(1) Both end photographs in each strip



(2) Other inside photographs



- Index map : The photo index map shall be prepared on the existing 1/500,000 topographic map by assigning principal points of photos as follows;



#### 4. Pricking II

Pricking work shall be performed for GPS points and new leveling points using enlarged photos same as previous work for aerial triangulation control.

##### 4-1 Work volume

Pricking work volume are as follows ;

Horizontal & vertical control	39 points (GPS & Existing control)
Vertical control points	650 km (leveling points)

##### 4-2 Implementation

- Horizontal and vertical control points shall be carefully pricked on the enlarged aerial photos in the field.
- Eccentric points for horizontal control shall be selected and pricked at clear points on the aerial photos, and the eccentric elements shall be measured using EDM, theodolite, plane-table, etc..
- Pricking of new leveling points shall be done at intervals of 3~4 km for the succeeding aerial triangulation and stereo plotting orientation.

## 5. Field Verification

In compliance with the map symbol's specification, necessary items to indicate on the map shall be collected and identified in the field using aerial photos.

Map symbols and application rules shall be used as agreed to by SDG (see Attachment).

The results shall be inscribed on the two times enlarged aerial photographs for succeeding plotting and compilation works.

### 5-1 Planning and preparation

Prior to the survey, preliminary study for photo interpretation shall be made to the best possible extent fully utilizing aerial photos and other available materials.

Administrative boundaries and place names, etc. necessary for annotation on the map shall be based on the information to be supplied by SDG.

### 5-2 Implementation

Following items shall be investigated and/or confirmed in the field.

- Confirmation of the results of pre-interpretation.
- Keys for photo-interpretation of topography and geographical features.
- Items difficult to interpret on the aerial photographs.
- Items necessary for the application of map symbols, such as road, railways, rivers, buildings, specified area, vegetation, etc..
- Collection of materials at local administrative offices.

## 6. Aerial Triangulation

Based on the ground control point survey data and the scale of 1/60,000 aerial photos, coordinates of pass points and tie points necessary for stereo plotting orientation shall be determined by aerial triangulation.

Pass points and tie points shall be selected at such locations that are adequate for photogrammetric orientation and accurate determination of coordinates on the photographs.

Pass points, tie points and control points as pricked on the diapositives using pricking device shall be measured by stereo comparater or equivalent, and adjustment computation shall be performed using block adjustment program.

Orientation elements of each model on the stereo plotting machine shall also be computed.

The tolerance (discrepancy) for pass points, tie points, and also limits of residuals of ground controls as used for adjustment shall be less than JICA procedural rules.

Layout of control points are as shown on Fig. 4.

## 7. Stereo Plotting

Based on the results of aerial triangulation and field verification, all items to be indicated on the scale of 1/50,000 topographic maps shall be measured from scale 1/60,000 aerial photos and delineated at 1/50,000 by plotting machine to produce restitution manuscript.

Detailed terrain features and vegetation shall be carefully measured, and also contour lines shall be drawn every 10 meters (mountainous area 20 meters).

Main specifications for stereo plotting are as follows ;

- Stable polyester sheet shall be used for plotting materials.
- Neat lines, grid lines and control points for plotting orientation shall be plotted on the polyester sheet using an automatic coordinategraph.
- Neat lines shall be 15' (longitude) x 15' (latitude)
- Map projection shall be Ghana modified transverse mercator.
- After the absolute orientation of horizontal, the discrepancy between the plotted points and their model points shall not exceed the values specified in the JICA specifications.
- For the absolute orientation of height, vertical controls pricked on the photos shall be used as much as possible for the sake of accuracy of height in the map.
- Stereo plotting shall be executed in accordance with the map symbols and their application rules in the order of linear elements, such as roads, rivers, buildings, vegetation and contour lines.
- Contour lines shall be drawn every 10 meters (20 meters for mountainous area).
- Care must be taken of the representation of micro topography, like hills, plains, forests, seasonal rivers, cultivated lands , etc..
- Density of spot height on the map shall be discussed with SDG.

## IX. TENTATIVE WORK PLAN FOR SUCCESSIVE WORK

Following is the work plan covering successive work. It is tentative at this time because it is subject to change depending on the progress of a preceding process or due to unexpected reasons (see Fig.1).

### 1. Compilation

On the basis of the plotted manuscript, compilation shall be carried out using the results of field verification with the symbols and specifications as agreed between the Study team and SDG.

Main specifications for compilation are as follows;

- For the compilation work, stable synthesized polyester sheet shall be used and the specifications shall be same as the stereo plotting.
- Care must be taken to keep the density of drawn lines uniform and avoid error or omission during compilation work following the rules for map representation.
- If any doubtful point arises during compilation, it shall be noted to clarify it at the time of field completion.
- On the basis of plotted sheet, control point data sheet and materials collected in the field, various kind of data sheets shall be prepared as follows;
  - \* Compiled manuscript.
  - \* Annotation data sheet.
  - \* Road information sheet.
  - \* Vegetation data sheet.
  - \* Water information data sheet.
  - \* Forest information data sheet.
  - \* Marginal information data sheet.

### 2. Field Completion

Field completion shall be carried out on the items which are unidentified in the process of plotting and compilation. Also important changes that have happened in the meantime, if any, shall be incorporated and modified.

At the time of the field completion, test printed sample sheet shall be prepared for discussion with SDG to finalize the colors and other matters.

### 3. Drafting

Based on the original manuscripts, scribing shall be carried out on the stable polyester base for five color separation plates. Map style and symbols shall be those adopted by SDG.

The original maps shall consist of scribed sheets, masking sheets, annotation sheets and marginal information sheets.

Annotation shall be in English (Latin alphabet). Every map sheet to be product in this survey work shall have the following annotation printed at the lower margin the following ;

“This map was prepared jointly by Japan International Cooperation Agency (JICA) under the Japanese Government Technical Cooperation Programme and Ministry of Land and Forestry, Survey Department of the Government of Ghana”

### 4. Printing

Printing plates shall be prepared by photo lithography using 1/50,000 scribing negatives. Color applied for printing shall be five, and 1,000 final copies shall be printed for each map sheet.

Specification of printing paper to be used shall be determined through talks with SDG.

### 5. Recommendations

Recommendations for improvement of management and operation systems and maintenance system of control points and maps shall be provided.

### 6. Work Flow

The flow of the entire work is schematically shown on the Fig. 2.



TABLE 3. MEMBERS OF STUDY TEAM AND THEIR ASSIGNMENT IN THE THIRD YEAR

NAME	ASSIGNMENT	DURATION	CONTENTS
Tokihiko KAMINISHI	LEADER	28 <sup>th</sup> Sep.'97 ~ 9 <sup>th</sup> Oct.'97 25 <sup>th</sup> Nov.'97 ~ 4 <sup>th</sup> Dec.'97 1 <sup>st</sup> Mar.'98 ~ 16 <sup>th</sup> Mar.'98	1. Total Management 2. General Discussion
Koichi MIKI	SUBLEADER	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Nov.'97 6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	1. Sub Management 2. General Discussion 3. Assistance of Leader 4. General Supervision
Kozo OKUMURA	MAPPING PLANNER	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Nov.'97 6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	1. Fundamental Map Planning 2. General Coordination 3. Reporting
Hitoshi YOSHIDA	CHIEF SURVEYOR	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Nov.'97 6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	1. Planning of Implementation 2. Supervision of Works 3. Coordination of Works 4. Quality Checking
Daikichi NAKAJIMA	PHOTOGRAPHER	6 <sup>th</sup> Oct.'97 ~ 4 <sup>th</sup> Dec.'97	1. Inspecting of Photograph & Photo Process
Shinpei ISHIWATA	MECHANICAL ENGINEER	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Nov.'97 6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	1. Management of Vehicle 2. Maintenance of Vehicle
Masahiko OHASHI	SURVEYOR	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Nov.'97 6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	1. Field Verification 2. Pricking
Kouzou ASANO	'	'	'
Tuyoshi YAMASAKI	'	'	'
Michio SATOJI	'	'	'
Masaru TERADA	'	'	'
Kensuke KIMURA	'	'	'
Sanenori OHNAKA	'	6 <sup>th</sup> Jan.'98 ~ 16 <sup>th</sup> Mar.'98	'
Tsuyosi NEMOTO	'	'	'
Hideaki SAKAI	COORDINATOR	28 <sup>th</sup> Sep.'97 ~ 12 <sup>th</sup> Oct.'97 2 <sup>nd</sup> Mar.'98 ~ 16 <sup>th</sup> Mar.'98	1. Coordination

FIGURE 1 TENTATIVE WORKING SCHEDULE

YEAR ITEMS MONTH	1ST YEAR 1996			2ND YEAR 1996 - 1997			3RD YEAR 1997 - 1998			4TH YEAR 1998 - 1999			5TH YEAR 1999											
	2	3		4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	
GROUND CONTROL SURVEY																								
AERIAL PHOTOGRAPHY																								
LEVELLING SURVEY																								
PRICKING SURVEY																								
AERIAL TRIANGULATION																								
FIELD IDENTIFICATION																								
PLOTTING																								
COMPILATION																								
FIELD COMPLETION																								
DRAFTING																								
MAP REPRODUCTION																								
REPORT																								
INSPECTION																								
DELIVERY OF GOODS																								

LEGEND — PREPARATION [diagonal lines] FIELD SURVEY [horizontal lines] WORK IN JAPAN [empty box]

Fig. 2 Flowchart for Production of Topographic Map

Item	Main Work	Main Results
Phase 1 1st year (1996)	<pre> graph TD     A[Aerial photography I] --- J1(( ))     B[Ground control point survey I] --- J1     J1 --- P1[P/O]     J1 --- R1[Report]                     </pre>	Aerial photographs. GPS results I. Report I.
Phase 2 2nd Year (1996~1997)	<pre> graph TD     A[Aerial photography II] --- J1(( ))     B[Ground control point survey II] --- J1     J1 --- L[Leveling]     L --- P1[Pricking I]     P1 --- P2[P/O]     P1 --- R2[Report]                     </pre>	Aerial photographs. GPS results II. Leveling results. Pricking results. Report II.
Phase 3 3rd Year (1997~1998)	<pre> graph TD     A[Aerial photography III] --- J1(( ))     B[Pricking II] --- J1     B --- FV[Field verification]     FV --- AT[Aerial triangulation]     AT --- SP[Stereo Plotting]     SP --- P3[P/O]     SP --- R3[Report]                     </pre>	Aerial photographs. Pricking results.  Aerial triangulation results. Report III.
Phase 4 4th Year (1998~1999)	<pre> graph TD     A[Compilation] --- J1(( ))     B[Field completion] --- J1     J1 --- D1[Drafting I]     D1 --- P1[Printing I]     P1 --- P4[P/O]                     </pre>	Draft of compilation map.  Original manuscript.
Phase 5 5th Year (1999)	<pre> graph TD     A[Drafting II] --- J1(( ))     B[Printing II] --- J1     J1 --- FR[Final report]                     </pre>	Scribed sheets. Color separation combined sheets. Topographic maps. Recommendations. Final report.

Remarks:  Field works in Ghana.  Works in Japan.

Fig. 3 PHOTO INDEX MAP

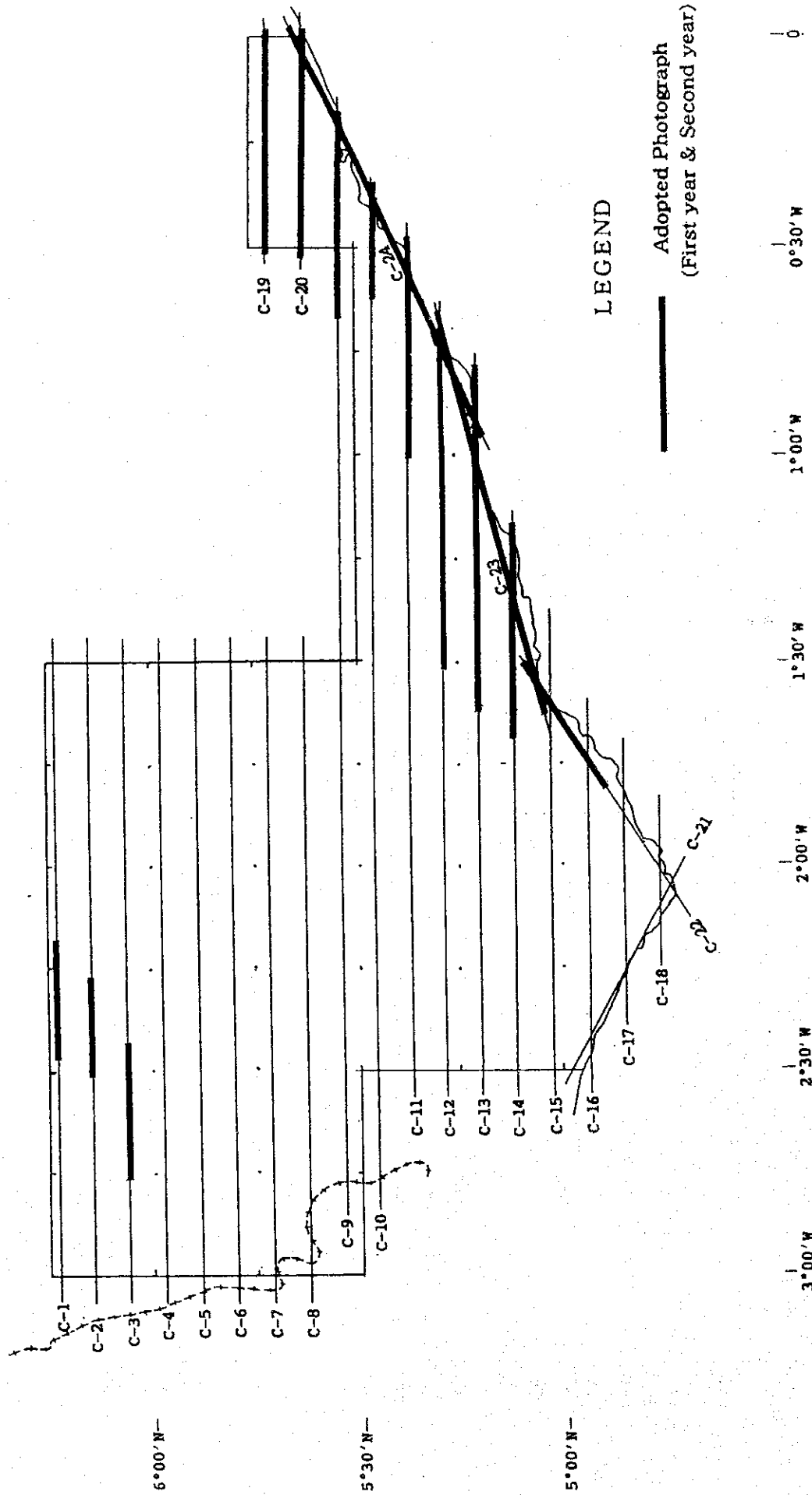


Fig. 4 Aerial Triangulation Control Points

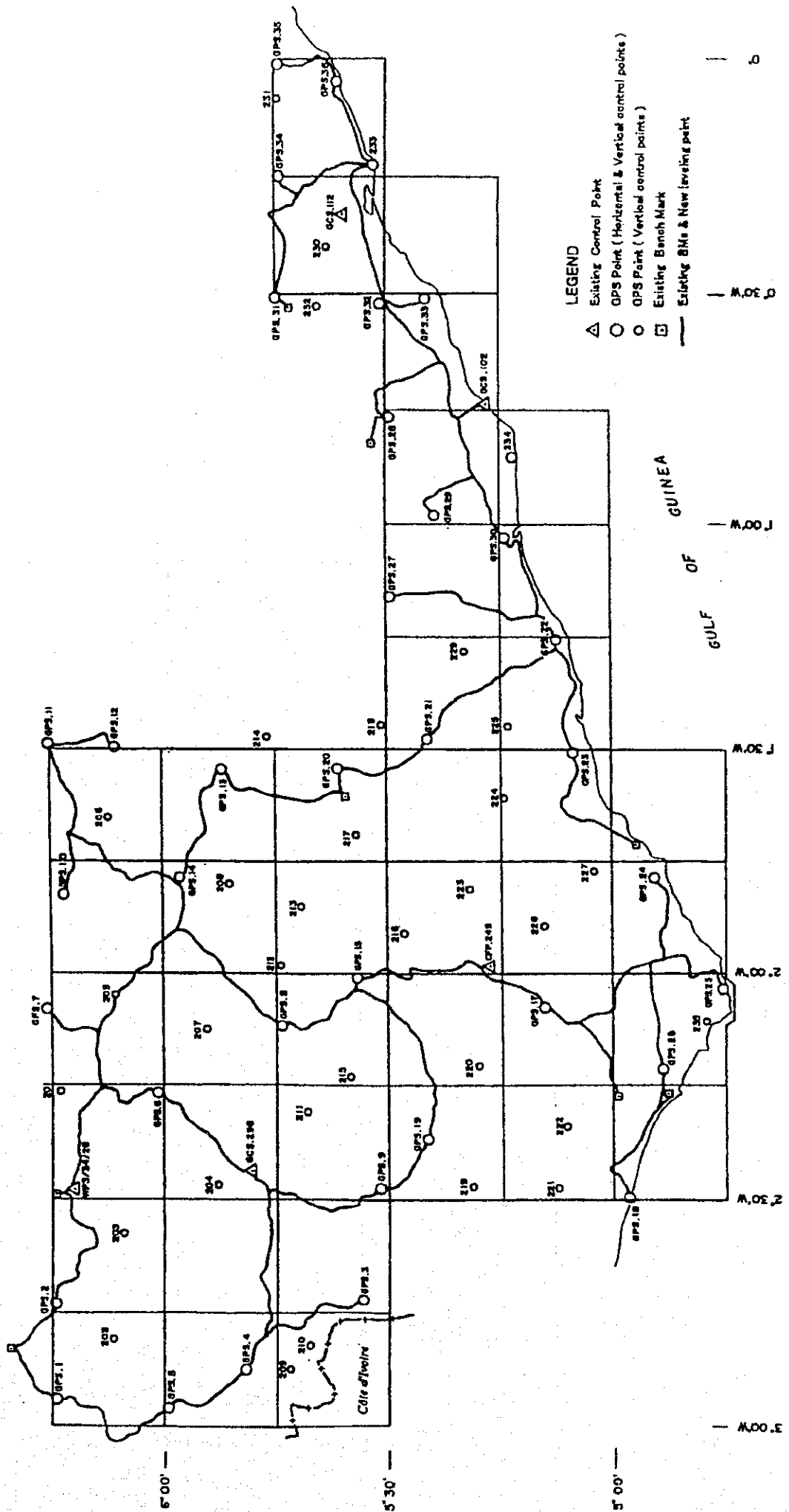
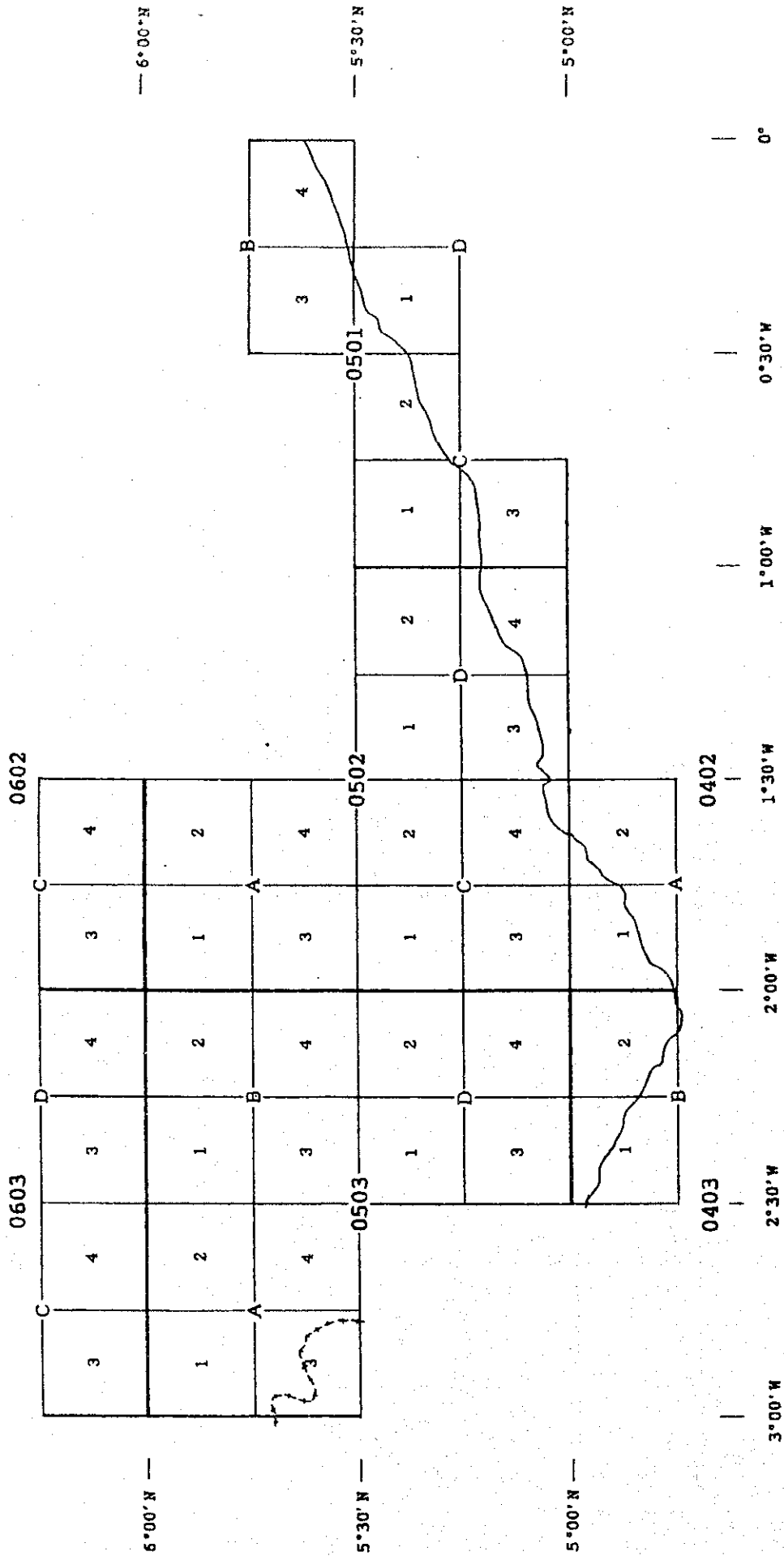


Fig. 5 SHEET INDEX MAP





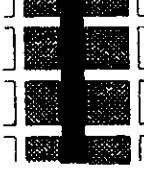

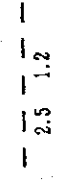
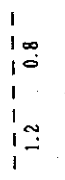


ATTACHMENT

MAP SYMBOLS AND APPLICATION RULES

- REVISED -

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現況記号	PLOTTING 図化記号	COMPILATION 編集記号	APPLICATION RULES 適用規定
	1	Motorway (dual carriage) 自動車道 (片側2車線以上)		1.2  0.25 0.08	black red-sc reen 100% 黒 赤網 100%				*Apply symbol to four lanes or more with central reserve. *中央分離帯を持つ片側2車線(計4車線)以上の道路に適用する *モータウェイに適用する
	2	Roads: Class 1 Motorable throughout the year 1級道路: 通年自動車通行可		0.8  0.2	black red-sc reen 100% 黒 赤網 100%				*Apply symbol to paved road. *Route No. shall be indicated on both ends of each map sheet. *SDG shall provide route No. *舗装道路に適用する *路線番号を道路の両端付近に表示する *SDGが道路番号を提供する
	3	Roads: Class 2 Motorable, occasionally closed 2級道路: 自動車道 (特により通行不可)		0.6  0.15 50%	black red-sc reen 50% 黒 赤網 50%				*Apply symbol to unpaved road (maintained) *Route No. shall be indicated on both ends of each map sheet. *SDG shall provide route No. *未舗装であるが、維持管理されている道路に適用する *路線番号を道路の両端付近に表示する *SDGが道路番号を提供する
	4	Roads: Class 3 Motorable in dry seasons only 3級道路: 自動車道(乾期のみ通行可)		0.6  0.15	black 黒				*Apply symbol to unpaved road (not maintained) *SDG shall provide route No. *未舗装で維持管理もされていない道路に適用する *SDGが道路番号を提供する
	4	Street & main roads passing through the city and town. 街路及び貫通道路		0.4  0.4 0.4 0.4 0.4	black 黒				*Apply symbol to street in the city and town. *A Street width less than 20m shall be plotted as 0.4mm. The actual scale shall be plotted for a street width more than 20m. *Main roads through the city and town shall be indicated as No.1 or No.2 *市内街内の道路に適用する *街路の幅小端は0.4mmとするが、道幅20m以上の場合は縮尺化して表示する *No.1とNo.2の貫通街路は記号道路で表示する
	5	Road under construction 建設中道路		0.6  0.15 3.0 0.5	black 黒				
	6	Tracks and Major Footpaths 小道及び主要な歩道		0.3  2.5 1.2	black 黒				
	7	Other Footpaths その他の歩道 (踏み分け道)		0.15  1.2 0.8	black 黒				



SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA











CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現像記号	PLOTTING 図化記号	COMPILED 編集記号	APPLICATION RULES 適用規定
	8	Railway (Standard gauge): (a) double line (b) single line (c) Discontinued railway  鉄道 (標準軌道): (a) 複線 (b) 単線 (c) 廃線			Black 黒				(c) Discontinued railway shall be annotated as "Abandoned" (shall not apply annotation to temporary closed railway)  (c) 廃線は Abandoned と注記をす (運行休止中の路線には Abandoned の注記はしない)
	10	Cable ways, Conveyer belt 索道, ベルトコンベア			Black 黒				
	11	Power transmission line  送電線			Black 黒				(a) Apply symbol to 1 or 2 line running parallel with each other. (b) Apply symbol to 3 line running parallel with each other. (c) Apply symbol to 4 line running parallel with each other.  (a) 本又は2本の送電線が平行の場合に適用する (b) 3本の送電線が平行の場合に適用する (c) 4本の送電線が平行の場合に適用する (送電線相互の間隔は考慮しない)
	12	Telephone line 電話線			Black 黒				
	13	Boundary: International  境界: 国界			Black 黒				* SDG shall draw international border on the map (manuscript) * Red screen shall be put in the Ghana side. * 現地補測時に測量局が編集案図に表示する * 補点は方格子図例に表示する
	14	Boundary: Regional			Black 黒				* SDG shall draw boundary on the map (manuscript) if necessary.
	15	Boundary: District (Local council)			Black 黒				
	16	Boundary: City, Municipal or town			Black 黒				* 現地補測時に測量局が編集案図に表示する
	17	Boundary: National park, Forest Reserve, Hunting area, Other boundaries 境界: 国立公園, 保護林, 狩猟区域その他特定界			Green screen % 緑網 %				* SDG shall draw boundary on the map (manuscript). * Annotation shall be put in the center of its area. * 現地補測時に測量局が編集案図に表示する * 中等位置に国立公園, 保護林等の注記をす
	19	Cut line 伐開線 (防火線)			Black 黒				* Annotation shall fittingly be put along the lines.
	21	Pence Concrete or block wall コンクリート壁又はブロック壁			Black 黒				* 適直の位置に注記する * Apply symbol to fence or wall which is more than 500m long. * 長さが500m以上の圍及び壁に適用する

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

note: A.A. (abbreviated Annotation)

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現稱記号	PLOTTING 図化記号	COMPILATION 編纂記号	APPLICATION RULES 適用規定
2 2		City, Town 市街			black screen 黒の網				<ul style="list-style-type: none"> <li>* If there is any prominent building in the congested (generalized) area, it shall be indicated (protted) as such.</li> <li>* 総稱地域内に記号等を表示すべき建築物がある場合、当該建築物が独立建築物で表示できる場合は建築物を表示し、その建築物が小さい場合は+を真位置を表示する</li> </ul>
2 3		Village 村落			black screen 黒の網				<ul style="list-style-type: none"> <li>*ditto.</li> <li>* 総稱地域内に記号等を表示すべき建築物がある場合は、上記に準ずる</li> </ul>
2 4		(a) Compound & Huts. (b) Prominent Building (c) 小屋 (村落部の建物) (b) 著名な建物		(a) $\phi 0.6$ (b)	black 黒				<ul style="list-style-type: none"> <li>(a) Apply symbol to soil/aud house etc.</li> <li>(b) Apply symbol to Concrete and block house etc.</li> <li>(a) 土壁等の建物の適用する</li> <li>(b) コンクリート及びブロック建築の建物の適用する</li> </ul>
2 5		Market 市場		Hkt	black 黒				<ul style="list-style-type: none"> <li>* Big market shall be indicated with building. If building can't be drawn, A.A. shall be indicated on the center.</li> <li>* 大規模なものを表示し、独立建築物を表示できない場合はその地域の中等位置に表示する</li> </ul>
2 6		(a) Hospital, (b) Clinic (a) 病院, (b) 医院		(a) + Hosp (b) + Clin	black 黒				<ul style="list-style-type: none"> <li>(a) If building can be drawn, cross symbol shan't be indicated.</li> <li>(b) Apply A.A. also to the prominent clinic.</li> <li>(a) 独立建築物が表示できる場合は+を表示しない</li> <li>(b) 著名なものを表示する</li> </ul>
2 7		(a) Hotel, (b) School (c) Police Station (d) Court house (e) Barrier (a) 学校 (b) 警察署 (c) 裁判所 (d) 校門所		(a) H + Sch (c) + PS + Ct H (e) Barrier	black 黒				<ul style="list-style-type: none"> <li>(a) Apply A.A. to the prominent hotel only.</li> <li>(b) University, polytechnic, college, institute etc shall be indicated with building and its full name shall be annotated in principle.</li> <li>(b)... (d) If building can be drawn, cross symbol shan't be indicated.</li> <li>(e) Barrier shall be annotated as "Barrier".</li> <li>(a) 著名なホテルに適用する</li> <li>(b) 総合大学、技術大学、単科大学、研究所等は建築物を表示し、(c) 独立建築物が表示できる場合は+を表示しない</li> <li>(b)... (d) 校門所は、Barrier と注記する</li> </ul>
27-1		Military Station (a) Barracks (a) 軍施設 (b) 兵舎		(a) HS (b) Bks	black 黒				<ul style="list-style-type: none"> <li>(a) Apply A.A. also to the big chapel.</li> <li>(a) (b) If building can be drawn, cross symbol shan't be indicated.</li> <li>(c) Actual position shall be center of base line. Symbol direction shall be set at right angle to the road.</li> <li>(a) 大きいChapel (礼拝堂) は教会の記号を適用する</li> <li>(a) (b) 独立建築物が表示できる場合は+を表示しない</li> <li>(c) 軍施設(軍用中隊)に適用する場合は+を真位置に表示する (記号の向きは不定)</li> </ul>
2 8		(a) Church, (b) Mission (c) Temple (a) 教会, (b) 伝道本部 (c) 寺院		(a) + Ch + M (c)  1.5	black 黒				

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現物記号	PLOTTING 図化記号	COMPILATION 編纂記号	APPLICATION RULES 適用規定
	29	Sillas サイロ			black 黒				
	31	Mosque イスラム教寺院			black 黒				*Actual position shall be bottom of black circle. Symbol direction shall be set at right angle to the road. *真位置(円の真下点)に標示し、道路に対し直角に標示する(記号の向きは不定)
	32	Cemetery 墓		Cem	black 黒				*Large one: Indicate limits with black solid line. *Small one: Indicate its position by cross symbol. *大規模な墓は境界を黒実線で標示して中央に表示し、小規模な墓は境界を十字記号で示す
	33	(a) Post Office (b) Telecommunication office (c) Post & Telecommunication office (a) 郵便局 (b) 電信局 (c) 郵便・電信局		(a) P (b) T (c) P-T	black 黒				(a)...(c) Indicate its position by cross symbol, if building can't be drawn. * Shall apply (c) to common use of post & telecommunication. * 独立建築物を標示出来ない場合は、十字記号を適用する * 郵便局と電信局を兼ねている場合は(c)を適用する
	34	Electricity substation 変電所			black 黒				*Very big one shall be drawn to actual size.
	36	Sports ground 競技場			black 黒				*この記号より大きい場合は実形で表示する
	37	Shed 集荷場		+ Shed	black 黒				*shall apply annotation to storage/yard for Cocoa, Coffee, etc. * ココア, コーヒー等農産物の集荷場、貯蔵所に適用する
	38	(a) Light house (b) Navigation beacon (a) 灯台 (b) 航路標識		(a)  (b) 	black 黒				
	39	(a) Fort, (b) Castle (c) Palace (a) 砦 (b) 城 (c) 宮殿		(a) Fort (b) Castle (c) Pal	black 黒				* shall not apply (a) & (b) to present use. (c) Very big palace shall be annotated with full name. (a) (b) 現在は別の目的で使用されている場合でも、これを適用する (c) 大きい場合は注記する
	40	Tower 高塔			black 黒				*shall apply symbol to clock tower etc. * 時計台のような高塔に適用する
	41	(a) Ruin, (b) Ancient wall (c) Ancient site (a) 遺跡 (b) 城壁 (c) 史跡		(a)  (b)  (c) 	black 黒				

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現物記号	PLOTTING 図化記号	COMPILATION 編集記号	APPLICATION RULES 運用規定
	4 2	(a) Jetty, (b) Quay (c) Wharf (a) 防波堤, (b) 埠頭 (c) 浮橋		(a) 0.3 (b) 0.6 (c) 1.8 	black 黒				*shall apply symbol also to TV/telecommunication tower, etc. *テレビ送塔, マイクロウェーブ, 無線中継塔等にも適用する
	4 3	Radio transmission station ラジオ送信所		2.0 1.3 	black 黒				
	4 4	Mine 鉱山		2.0 2.0 	black 黒				
	4 5	(a) Aerodrome, (b) Airstrip (a) 小型空港, (b) 滑走路		(a)  3.5 (b)  4.0	black 黒				*International airport shall be annotated with full name. *国際空港はフルネームを注記し、記号は表示しない
	4 7	Geodetic point 測地基準点		CGS-1Z 1.2 1.3 	black 黒				*shall indicate symbol with the name and number. (no elevation) *New GPS points shall not be indicated. *三角点には標高を表示せず、点名、点番号を表示する
	4 8	(a) Spot Height (b) Photo Principal Points (a) 標高点 (b) 写真主点		(a) 8.0 1.3 4.0 (b) 0-25 1.5 1.5 	black 黒				(b) Line number shall be indicated on both ends of each map sheet. (b) 写真主点のコース番号, 写真番号は各コースの両端の主点のみに表示する
	4 9	Bench mark 水準点		2.0 +FBH 	black 黒				*shall indicate fundamental bench mark only. (no elevation and no damaged bench mark) *基準水準点のみ表示し、標高は表示しない
	5 0	(a) Contour line (b) Index contour (a) 等高線 (b) 計曲線		計曲線の入れ方 (10, 20m) 	brown 茶				
	5 1	(a) Depression (b) Basin, shallow Depressio (a) 凹地 (b) 浅い凹地		(a)  0.5 (b)  2.0 minimum length 0.5	brown 茶				
	5 2	Rocky areas: (a) Outcrop Rock (b) Steep slopes (c) Cliffs 岩地帯: (a) 露岩 (b) 斜面 (c) 断崖		(a)  0.5 (b)  0.5 (c)  0.5	black 黒				
	5 3	Embankment 堤防		1.0 0.5 0.1 minimum length 0.5mm	brown 茶				
	5 4	Mine Dump ズリ捨場		0.5 minimum length 0.5mm	brown 茶				


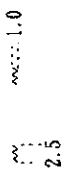
SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現況記号	PLATTING 図化記号	COMPILED 編集記号	APPLICATION RULES 適用規定
	5 5	Sand of bank 砂地又は泥地	内陸と海岸の砂(67)を区 分するか?		brown 茶				
	5 6	Dunes 砂丘			brown 茶				
	5 7	Quarry 採石場			black 黒				
	6 0	Water courses: (a) Indefinite stream (b) Rapids (c) Waterfall 河川: (a) 不変河川 (b) 急流, (d) (e) 滝			blue Rapide water- fall black 青, 黒				
	6 1	(a) Area liable to flood (b) Marsh or Swamp {a} 浸水し易い地域 {b} 沼地又は低湿地	浸水し易い地域の調査方 法?		blue 青				
	6 2	Trench, Gutter 溝, 用水路(灌溉, 排水用)			Blue 青				
	6 3	(a) Lake, (b) Pond, (c) Dam (a) 湖, (b) 池, (c) ダム			blue bl. scr 湖沼用				
	6 3	Salt Ponds 塩田			black 黒				*Salt ponds shall be indicated with check embankment and shall be annotated as "Salt Ponds".  *塩田はせき止め用堤防を表示し、Salt Pondsと注記する
	6 4	Waterhole, Well, Spring (Borehole) 小池, 井戸, 泉(試底穴)			blue 青				
	6 4	Water tower 給水塔			blue screen 青網				

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名 称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現例記号	PLOTTING 図化記号	COMPILATION 編集記号	APPLICATION RULES 適用規定
	65	Water pipe 送水管		<p>1.5 0.8      0.3</p>	blue 青				
	66	(a) Bridge, (b) Footbridge (c) Culvert, (d) Ford (e) Ferry (a) 橋, (b) 徒歩橋 (c) カルバート, (d) 徒歩所 (e) フェリー		<p>1:01.0</p>	black 黒				(a) shall apply symbol also to train bridge. (b) shall apply symbol to footbridge and bridge upon double lines river on the map. (Excluding small bridge on the single line river on the map) (a) 鉄道橋にも適用する (b) 原則として、2線河川には表示するものとし、歩道橋にも適用する(1線河川には表示しない)
	67	Coastline (Sand or Mud) 海岸線 (砂又は泥地)			own 茶				
	67-1	Flat Rock (a) Boulder Rock (b) 平らな岩石海岸 岩塊の海岸			Black 黒				
	68	Thick Forest (樹木の多い森林)		<p>Q 2.0</p>	Green 100% 緑 100%				*Limits shall not be indicated.
	69	Light Forest (樹木の少ない森林)			Green- screen % 緑網点 %				
	71	Savannah 草原		Non-symbol					*植生界は表示しない

SYMBOLS FOR 1:50,000 TOPOGRAPHIC MAP OF GHANA

CLASS 分類	NO	NAME 名称	SYMBOL 記号	ENLARGED 拡大図	COLOUR 色	INTERPRETATION 現物記号	PLOTTING 図化記号	COMPILED 編纂記号	APPLICATION RULES 適用規定
	72	Plantation 農園			Green Green- screen 緑色 緑色網 緑色網 緑色網				* Indicate limits with green solid line, and anno- tate product's name in the center.  * 外周を緑の実線で表示し、ココア、ゴム等の種類を中 央に注記する
	77	Cultivation (As for 72) 耕地			black 黒				* Limits shall not be indicated. (Put the symbol in the area suitable)  * 植生界は表示しない (範囲内に記号を適宜表示する)

ATTACHMENT

PROGRESS REPORT

OF

THE FIELD WORK OF THE THIRD YEAR ( FIRST STAGE )

FOR

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

7<sup>th</sup> NOVEMBER, 1997

STUDY TEAM

OF

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

JAPAN INTERNATIONAL COOPERATION AGENCY



## 1. INTRODUCTION

The topographic mapping of the southern part of the Republic of Ghana started in January, 1996, in a five years plan, as a technical cooperation program of JICA.

In compliance with the Scope of Work agreed between the Survey Department of Ghana and JICA on 17th March, 1995, the JICA Study Team arrived in Accra on 29th September, 1997, for implementation of the first stage of third year's field work. After consultation with the SDG, the team set up the field headquarters in Accra for the aerial photography III and a part of field verification work.

Meanwhile Ghana counterparts from the SDG joined the work from time to time.

In accomplishing the field work of first stage of the third year, hereinafter, the summary of the progress of the work is reported.

## 2. OUT LINE OF THE THIRD YEAR WORK ( First Stage )

### 2-1 Objective

The objective of the Study are : (1) To prepare 1/50,000 topographic map covering an area of approximately 25,500 km<sup>2</sup> in the southern part of the Republic of Ghana, (2) To transfer technology to the counterparts personnel of SDG through the implementation of the work, and (3) To promote the friendship between Ghana and Japan through the implementation of the Study.

The first stage of third year's work is consisting of the aerial photography III, field verification (in part) and office work.

### 2-2 Period of Survey Work

#### Field work

( Aerial photography III )	6 <sup>th</sup> October, '97	~	6 <sup>th</sup> December, '97
( Field verification )	28 <sup>th</sup> September, '97	~	12 <sup>th</sup> November, '97

### 2-3 Formation of the Study Team

Leader	Mr. Tokihiko KAMINISHI	28 <sup>th</sup> Sep.'97	~	9 <sup>th</sup> Oct.'97
Deputy Leader	Mr. Koichi MIKI	28 <sup>th</sup> Sep.'97	~	12 <sup>th</sup> Nov.'97
Mapping Planner	Mr. Kozo OKUMURA		,	
Chief Surveyor	Mr. Hitoshi YOSHIDA		,	

Photographer	Mr. Daikichi NAKAJIMA	6 <sup>th</sup> Oct.'97	~	4 <sup>th</sup> Dec.'97
Mechanical Engr.	Mr. Shinpei ISHIWATA	28 <sup>th</sup> Sep.'97	~	12 <sup>th</sup> Nov.'97
Surveyor	Mr. Masahiko OHASHI		,	
	Mr. Kouzou ASANO		,	
	Mr. Tuyoshi YAMASAKI		,	
	Mr. Michio SATOJI		,	
	Mr. Masaru TERADA		,	
	Mr. Kensuke KIMURA		,	
Coordinator	Mr. Hideaki SAKAI	28 <sup>th</sup> Sep.'97	~	10 <sup>th</sup> Oct.'97

#### 2-4 Amount of the Survey Work (Plan and Results)

Progress, until 6<sup>th</sup>Nov.'97, are as follows.

ITEM	ORIGINAL PLAN	RESULTS
Aerial photography III		
Scale	approx. 1/60,000	approx. 1/60,000
Flight length	approx. 2,454 km	approx. 177 km
Photo No.	approx. 490 photos	40 photos
Field verification (in part)	approx. 4,270 km <sup>2</sup>	approx. 4,270 km <sup>2</sup>

#### 2-5 Counterparts of SDG

Headquarters ;

Na Al-haji Iddirisu	Abu	Director of Surveys	Headquarters
Mr. J. Dotse		Asst. Director	Great Accra Region
Mr. Marcus Tabil		Examiner	Examination Section
Mr. K.N.Arku-Lawson		Chief Cartographer	Cartographic Section
Mr. I.Andoh-Kesson		Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R. Tetteh		Chief Lithographer	Lithographic Section

Field Work ;

Mr. J. Ofori-Boadu		Asst. Staff Surveyor	Great Accra Region
Mr. Jerry Awambigo		Senior Survey Technician	,
Mr. Nii Q. Quartey			,

### 3. FIELD WORK

#### 3-1 Aerial Photography III

Aerial photography was started again after the rainy season. The team contracted with Aircraft Operating Company(Pty) Ltd.(A.O.C., South Africa) same condition as first and second year's for all aerial photography. Unfortunately due to the bad weather condition, until now, little progress was made in aerial photography.

##### (1) Base for aerial photography

KOTOKA International Airport was used for the base for aerial photography.

##### (2) Aircraft and Camera

Details of aircraft and camera are as follows ;

Aircraft	: CESSNA 404, ZS-KUZ
Aerial Camera	: WILD RC-10, Sag II 2067 Super wide angle lens cone
Navigation equipment	: Garmin 100 GPS

##### (3) Photographic work

Test flight was made on 10<sup>th</sup> October, '97 and full scale aerial photography was commenced from 11<sup>th</sup> October, '97.

##### (4) Materials of aerial film

Panchromatic film was used for aerial photography, and details are as follows.

Film type : AGFA AVIPHOT PAN 200 PEI & KODAK DOUBLE X

#### 3-2 Photo Processing

##### (1) Development

The instruments and materials to be used were as follows ;

Developer	: ILFORD PQ UNIVERSAL
Paper	: ILFORD Gr2+3 44M
Film development	: ZEISS REWIND No.111079
Contact printer	: ZEISS KG-30
Drier	: ZEISS TG-24 No.20209

(2) Printing and inspection

After printing and inspection of the aerial photos, reflight was made, in case of necessity.

Items to be inspected were as follows ;

- ① Forward overlap & lateral overlap
- ② Cloud, cloud shadow, and uneven development
- ③ Deviation of flight course
- ④ Halation, Haze, and smoke of field fire, etc.

(3) Film annotation

The form of film annotation and numbering on each frame of aerial photos shall be same as previous study.

(4) Amount of work ( until 6<sup>th</sup> November '97 )

Film roll : 1 roll  
Available photographs : 40 photos

The list of photographs in this period is shown as follows, and coverage is shown in Fig. 1.

Run No.	Frame No.	Available Photos	Photo No.
C-09	0013 ~ 0023	non	—
'	4847 ~ 4857	4849 ~ 4857	supplementation
C-10	0001 ~ 0011	non	—
'	4859 ~ 4881	4866 ~ 4871	6 photos
C-11	4842 ~ 4843	non	—
'	5061 ~ 5071	5062 ~ 5067	6 photos
C-15	5036 ~ 5060	5051 ~ 5059	9 photos
C-17	5017 ~ 5028	5017 ~ 5021	5 photos
C-18	4883 ~ 4888	4883 ~ 4887	5 photos
C-21	4982 ~ 4994	non	—
'	5030 ~ 5034	non	—
C-22	4890 ~ 4900	4890 ~ 4898	9 photos
'	4971 ~ 4980	4971 ~ 4976	supplementation

3-3 Field verification

Field verification (first stage ; Accra ~ Cape coast) was started by the team

members and SDG counterparts on 2<sup>nd</sup> of October 1997 in compliance with the map symbols and their application rules.

Confirmation and investigation of various expressions and names specified by map symbols were conducted. The survey results were described on two times enlarged aerial photographs to be used as data for succeeding stereo plotting and compilation work.

(1) Discussion with SDG for Map Symbols

Survey work was started based on the map symbols and their application rules agreed between SDG and JICA study team on 20<sup>th</sup> Jan. '97. At the meantime of survey work, amendment/modification for map symbols and application rules were discussed continuously between SDG and JICA.

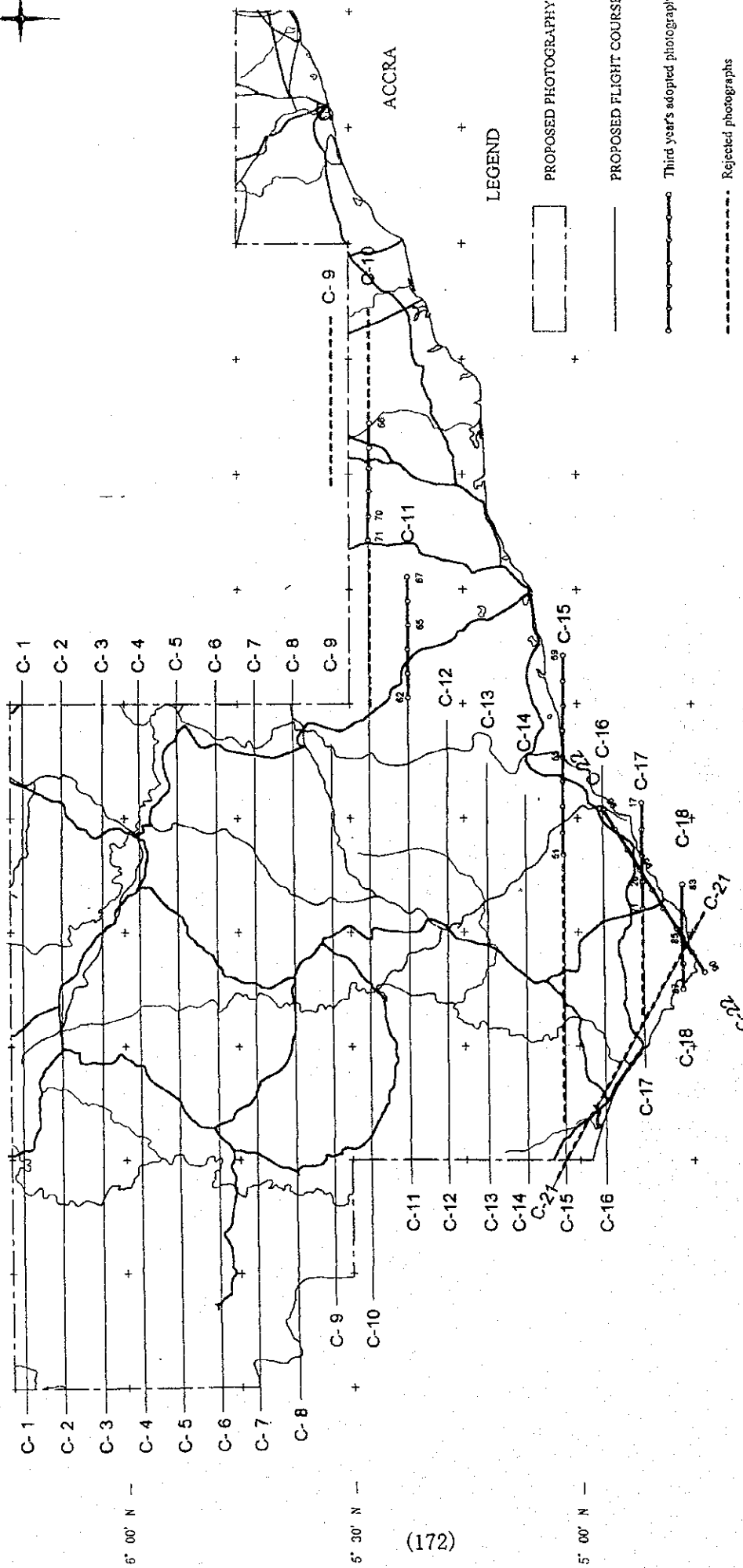
(2) Implementation

Main items verified in the field are as follows, and the results were indicated on the enlarged aerial photographs.

- ① Classification of roads and their attributes.
- ② Public buildings and structures.
- ③ Linear structures (railway, power transmission line, etc.).
- ④ Key for photo-interpretation of vegetation and topographic features.
- ⑤ Collection of toponomy and designation of ground features (village, mountain, river, etc.).
- ⑥ Other necessary items for map representation in accordance with the map symbols and their application rules.

The above progress report covered the period from 28<sup>th</sup> September, 1997 to 6<sup>th</sup> November, 1997.

Fig. 1 PHOTO INDEX CHART



ATTACHMENT

(ADDENDUM)

PLAN OF OPERATION  
FOR  
TOPOGRAPHIC MAPPING OF SOUTHERN PART  
OF  
THE REPUBLIC OF GHANA  
( THIRD YEAR )

FEBRUARY, 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

## I. INTRODUCTION

Based on the progress of third year's aerial photography and the additional request from Survey Department of Ghana (SDG) for the digital mapping works, the Japan International Cooperation Agency (JICA) sent a Mission to Ghana in the middle of December 1997, to discuss its feasibility with SDG. And subsequently on December 18th, 1997, the Minutes of Meeting was agreed to between the two governments.

In compliance with the Minutes of Meeting, the survey procedure and time schedule shall be changed and the Plan of Operation (P/O) for the third year's latter work is proposed as follows.

## II. DETAILS OF THE THIRD YEAR'S LATTER WORK

### 1. Additional Ground Control Point Survey

Based on the aerial photography progress and the aerial triangulation's new amount, four (4) additional horizontal control points shall be surveyed to keep aerial triangulation accuracy.

Observation shall be made simultaneously via plural units of GPS equipment to form an observation network connected to Phase 1 and 2 new control points. Observation, computation, allowable errors, etc., shall be the same as in Phase 1 & 2 work procedure.

### 2. Pricking (continuation)

Control point pricking necessary for the third year's new photographed and aerial triangulation area shall be performed using enlarged photos in the same manner as previous work procedure. Additional pricking work volumes are as follows;

Horizontal & vertical control	20 points (GPS & Existing control)
Vertical control points	230 km (leveling points)

### 3. Field Verification ( West zone )

In compliance with the map symbol's specifications, necessary items to indicate on the map shall be collected and identified in the field under the same specifications as for the former part of work (East zone). The work volume



shall be 6,830 km<sup>2</sup>, and the total volume including the former part of work shall be 11,100 km<sup>2</sup> (20 sheets).

#### 4. Aerial Triangulation

Based on the ground control point survey data and the scale of 1/60,000 aerial photos, coordinates of pass points and tie points necessary for stereo plotting orientation shall be determined by aerial triangulation.

Pass points and tie points shall be selected at such locations that are adequate for photogrammetric orientation and accurate determination of coordinates on the photographs.

Pass points, tie points and control points as pricked on the diapositives using pricking device shall be measured by stereo comparater or equivalent, and adjustment computation shall be performed using the block adjustment program.

Orientation elements of each model on the stereo plotting machine shall also be computed.

The tolerance (discrepancy) for pass points, tie points, and also limits of residuals of ground controls as used for adjustment shall be less than the JICA procedural rules.

Aerial triangulation work volumes are as follows;

East zone 147 models

West zone 176 models. Total 323 models (for 20 sheets mapping)

#### 5. Digital Stereo Mapping

Based on the results of aerial triangulation and field verification, all items to be indicated on the scale of 1/50,000 topographic maps shall be digitized using 1/60,000 scale aerial photos and analytical stereo plotters.

Detailed terrain features and vegetation shall be carefully measured, and contour lines shall be measured every 10 meters. Main specifications for digital stereo measurement are as follows ;

- Neat lines shall be 15' (longitude) x 15' (latitude)
- Map projection shall be Ghana modified transverse mercator.
- After the absolute orientation of horizontal, the discrepancy between aerial triangulation pass point's coordinates and their model coordinates shall not exceed values as specified in the JICA specifications.
- For the absolute orientation of height, vertical controls pricked on the

photos shall be used as much as possible for the sake of accuracy of height in the map.

- Digital stereo measurement shall be executed basically in accordance with the SDG's map symbols and their application rules in the order of linear elements, such as roads, rivers, buildings, vegetation and contour lines.
- Contour lines shall be measured every 10 meters.
- Care must be taken of the representation of micro topography, like hills, plains, forests, seasonal rivers, cultivated lands, etc..
- Density of spot heights on the map shall be 5 ~ 7 cm on the map.

## 6. Topological Data Structure

Based on the Ghana Environmental Resource Management Project (GERMP) code table and SDG's map symbols & application rules, JICA study team produced tentative new code as attached. These new code application rules shall be discussed with SDG and JICA study team to finalize. (See Appendix)

## 7. SPOT Image Production

The existing SPOT images shall be prepared for the succeeding updating work for the area 1/60,000 scale aerial photographs did not fully cover. (approx. 14,400 km<sup>2</sup>, 20 sheets).

Printing photo scale shall be 1/30,000 ~ 1/40,000, or an appropriate the field verification work and so on.

## 8. Time Schedule

The field survey of third year's latter part of work and members are as shown in Table-1, and the time schedule including subsequent 4th and 5th fiscal year's work are as shown in Fig.-1.

TABLE 1. MEMBERS OF STUDY TEAM AND THEIR ASSIGNMENT IN THE THIRD YEAR ( LATTER )

NAME	ASSIGNMENT	DURATION	CONTENTS
Tokihiko KAMINISHI	LEADER	3 <sup>rd</sup> Mar.'98 ~ 18 <sup>th</sup> Mar.'98	1. Total Management 2. General Discussion
Koichi MIKI	SUBLEADER	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98	1. Sub Management 2. General Discussion 3. General Supervision
Kozo OKUMURA	MAPPING PLANNER	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98	1. Fundamental Map Planning 2. General Coordination 3. Reporting
Hitoshi YOSHIDA	CHIEF SURVEYOR	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98	1. Planning of Implementation 2. Supervision of Works 3. Quality Checking
Fujio ITO	D/M PLANNER	1 <sup>st</sup> Feb.'98 ~ 15 <sup>th</sup> Feb.'98	1. Digital Mapping Data Discussion & Design
Shinpei ISHIWATA	MECHANICAL ENGINEER	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98	1. Management of Vehicle 2. Maintenance of Vehicle
Masahiko OHASHI	SURVEYOR	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98	1. Ground Control Survey (GPS) 2. Pricking 3. Field Verification
Kouzou ASANO			
Tuyoshi YAMASAKI			
Michio SATOJI			
Minori OHNAKA			
Masaru TERADA			
Takesi NEMOTO			
Masaaki MIZUOCHI			
Hideaki SAKAI	COORDINATOR	4 <sup>th</sup> Mar.'98 ~ 18 <sup>th</sup> Mar.'98	1. Coordination

Fig. 1 REVISED TENTATIVE WORKING SCHEDULE

YEAR MONTH	1ST YEAR 1996			2ND YEAR 1996			3RD YEAR 1997			4TH YEAR 1998			5TH YEAR 1999			2000														
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3			
CHORD CONT- ROL SURVEY																														
AERIAL PHOTOGRAPHY																														
LEVELING SURVEY																														
PIECING SURVEY																														
AERIAL TRANGULATION																														
FIELD VERIFICATION																														
SPOT IMAGE PRODUCTION																														
SPOT IMAGE PRE INTERPRETATION																														
ADDITIONAL PHOTOGRAPHY																														
STEREO PLOTTING																														
EXISTING MAP/ DATA REVISING																														
DIGITAL CORRELATION																														
FIELD COMPLETION																														
DATA REVISING																														
ORIGINAL MAP OUTPUT																														
MAP PRINTING																														
REPORT																														
INSPECTION																														
DELIVERY OF GOODS																														

LEGEND — PREPARATION    ▨ FIELD SURVEY    □ WORK IN JAPAN

Fig. 2 PHOTO INDEX CHART

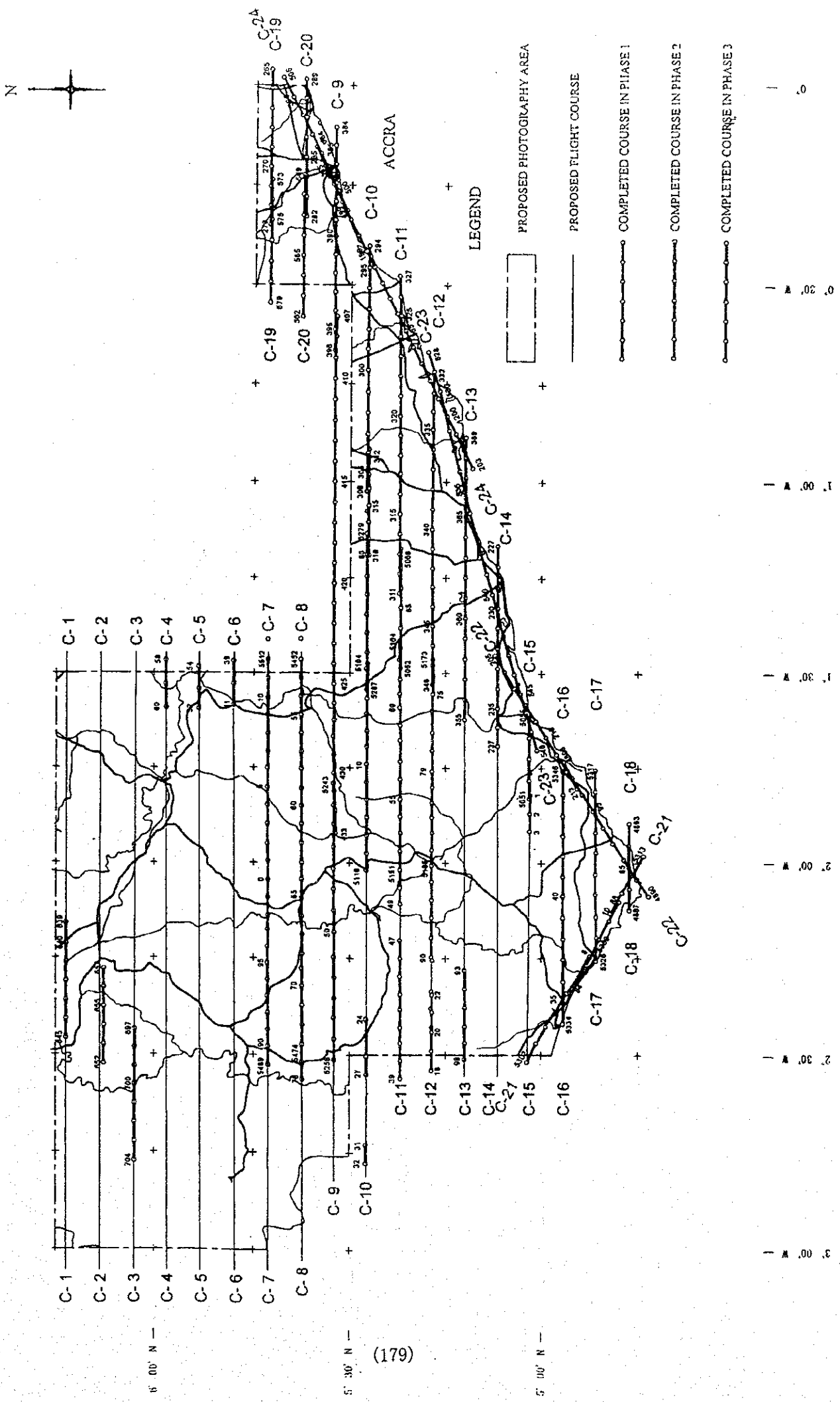
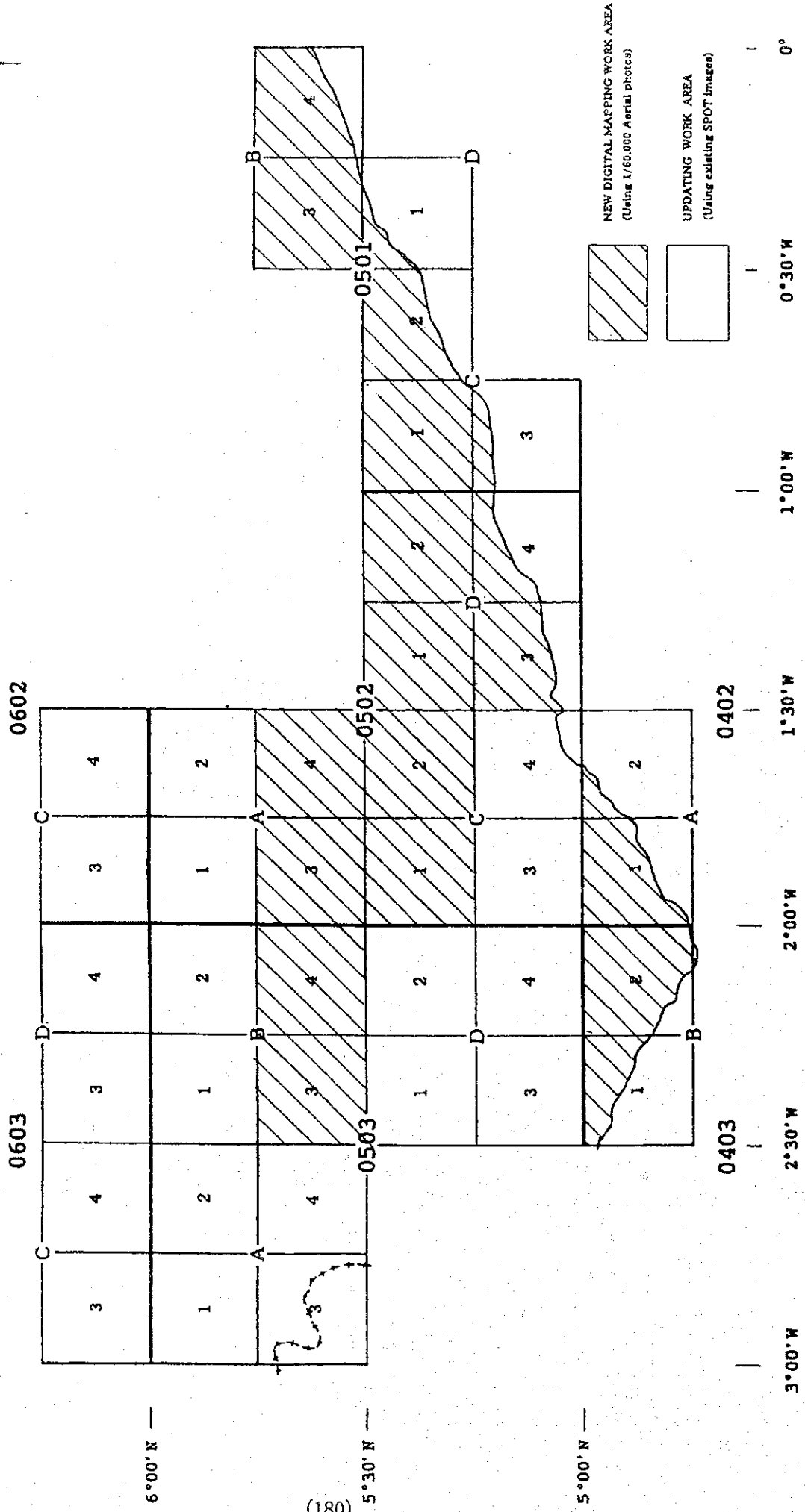


Fig. 3 TOPOGRAPHIC MAPPING AREA



APPENDIX

CODE TABLE FOR THE TOPOGRAPHIC MAPPING OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA

-DRAFT-

## GHANA

( new code X1XX)

Layer	Feature	Code	Name	名称	No of Symbol	Attributes	Remarks
01 Cult-poly	Line	2006	City, Town	市街	22		
01 Cult-poly	Centroid	2051	City, Town	市街	22		old code-2006,2051
01 Cult-poly	Line	2121	Village	村落	23		
01 Cult-poly	Centroid	2122	Village	村落	23		
01 Cult-poly	Centroid	3101	Mine Dump ( Mineral Working Centroid?)	ズリ捨て場	54		
01 Cult-poly	Line	3102	Mine Dump ( Mineral Working Area?)	ズリ捨て場	54		
01 Cult-poly	Line	3007	Quarry(Line)	採石場	57		Line→Poly
01 Cult-poly	Centroid	3103	Quarry(Centroid)	採石場	57		
02 Cultural	Point	1001	Waterhole,Well, Spring (Borehaole)	小池、井戸、泉(試掘穴)	64		
02 Cultural	Point	1028	Water tower (works)	給水塔	64'		
02 Cultural	Line	3104	Embankment	堤防	53		
02 Cultural	Point	2001	Navigation beacon	航路標識	38(b)		
02 Cultural	Point	2003	Compound & Huts	小屋	24(a)		Symbol(small circle)
02 Cultural	Point	2004	Prominent Building	著名な建物	24(b)		Symbol(small square)
02 Cultural	Point	2008	Church	協会	28(a)		
02 Cultural	Point	2009	Court House	裁判所	27(d)		
02 Cultural	Point	2012	Hospital	病院	26(a)		
02 Cultural	Point	2015	Market	市場	25		
02 Cultural	Point	2016	Barracks	兵舎	27-1(b)		
02 Cultural	Point	2019	Mosque	イスラム寺院	31		
02 Cultural	Point	2020	Police Station	警察署	27(c)		
02 Cultural	Point	2021	Post Office	郵便局	33(a)		
02 Cultural	Point	2022	Station	鉄道駅	8		
02 Cultural	Point	2024	Hotel	ホテル	27(a)		
02 Cultural	Point	2025	School	学校	27(b)		
02 Cultural	Point	2037	Clinic	医院	26(b)		
02 Cultural	Point	2043	Cemetery	墓	32		
02 Cultural	Point	2101	Barrier	検問所	27(e)		
02 Cultural	Point	2102	Military Station	軍施設	27-1(a)		
02 Cultural	Point	2103	Mission	伝導本部	28(b)		
02 Cultural	Point	2104	Temple	寺院	28(c)		



02 Cultural	Point	2105	Silo	サイロ		29	
02 Cultural	Point	2106	Telecommunication Office	電話局		33(b)	
02 Cultural	Point	2107	Post & Telecommunication Office	郵便 電話局		33(c)	
02 Cultural	Point	2108	Electric substation	変電所		34	
02 Cultural	Point	2109	Sports ground	競技場		36	(Angle)
02 Cultural	Point	2110	Shed	集荷場		37	
02 Cultural	Point	2111	Light House	灯台		38(a)	
02 Cultural	Point	2112	Fort	砦		39(a)	
02 Cultural	Point	2113	Castle	城		39(b)	
02 Cultural	Point	2114	Palace	宮殿		39(c)	
02 Cultural	Point	2115	Tower	高塔		40	
02 Cultural	Point	2116	Ruin	遺跡		41(a)	
02 Cultural	Point	2117	Ancient site	史跡		41(c)	
02 Cultural	Point	2118	Radio transmission station	ラジオ送信所		43	
02 Cultural	Point	2119	Aerodrome	小型空港		46(a)	
02 Cultural	Point	2120	Aerodrome	国際空港		46(a)	Name
02 Cultural	Line	3002	Cut line	伐開線		19	
02 Cultural	Point	3004	Mine	鉱山		44	
02 Cultural	Line	3105	Cable ways, Conveyor belt	索道、ベルトコンベヤー		10	
02 Cultural	Line	3106	Fence, Concrete or block wall	柵、塙		21	
02 Cultural	Line	3107	Ancient wall	城壁		41(b)	
02 Cultural	Line	3108	Jetty	防波堤		42(a)	
02 Cultural	Line	3109	Quay	埠頭		42(b)	
02 Cultural	Line	3110	Wharf	浮き棧橋		42(c)	
02 Cultural	Line	3111	Sports ground ( to Scale)	競技場		36	
02 Cultural	Line	3112	Airstep	滑走路		46(b)	
02 Cultural	Point	7002	Photo Principal Points	写真主点		48(b)	Course & No
03 Forest	Line	4006	Boundary : Forest Reserve	保護林		17	
03 Forest	Centroid	4021	Boundary : Forest Reserve	保護林		17	
04 Hydrog-Poly	Line	1006	Area liable to flood	浸水しやすい地域		61(a)	
04 Hydrog-Poly	Centroid	1007	Area liable to flood	浸水しやすい地域		61(a)	
04 Hydrog-Poly	Centroid	1009	Lake ( Centroid)	湖		63(a)	
04 Hydrog-Poly	Line	1010	Marsh or Swamp	沼地又は低湿地		61(b)	
04 Hydrog-Poly	Centroid	1011	Marsh or Swamp (Centroid)	沼地又は低湿地		61(b)	
04 Hydrog-Poly	Line	1014	Sand or Mud (Flats)	砂地又は泥地		55	
04 Hydrog-Poly	Centroid	1015	Sand or Mud ( Centroid)	砂地又は泥地		55	

04 Hydrog-Poly	Line	1016	Lake ( Shoreline)	湖	63(a)		
04 Hydrog-Poly	Line	1023	Water courses(Line)	2条河川	60		
04 Hydrog-Poly	Line	1042	Pond	池	63(b)		
04 Hydrog-Poly	Centroid	1101	Dunes ( Centroid)	砂丘	56		
04 Hydrog-Poly	Line	1102	Dunes ( Area)	砂丘	56		
04 Hydrog-Poly	Centroid	1103	Water courses(centroid)	2条河川	60		Line→Poly
04 Hydrog-Poly	Centroid	1104	Pond( Centroid)	池	63(b)		
04 Hydrog-Poly	Line	2034	Salt Ponds	塩田	63'		
04 Hydrog-Poly	Centroid	2044	Salt Ponds (Centroid)	塩田	63'		
05 Hydrographic	Line	1018	Coastline	海岸線	67		
05 Hydrographic	Line	1024	Water courses(indefinite streams)	不定河川	60(a)		
05 Hydrographic	Line	1105	Trench Gutter	溝、用水路	62		
05 Hydrographic	Line	1106	Dam	ダム	63(c)		
06 Hypsographic	Line	8001	Approximate Index Contour	不確定等高線	50(a)	elevation	
06 Hypsographic	Line	8002	Approximate Intermediate Contour	不確定計曲線	50(b)	elevation	
06 Hypsographic	Line	8004	Depression Index Contour	凹地	51(a)	elevation(direction)	
06 Hypsographic	Line	8005	Depression Intermediate contour	凹地計曲線	51(a)	elevation(direction)	
06 Hypsographic	Line	8006	Index contour	計曲線	50(b)	elevation	
06 Hypsographic	Line	8007	Contour line	等高線	50(a)	elevation	
06 Hypsographic	Point	8008	Spot Height	標高点	48(a)	elevation	
06 Hypsographic	Point	8101	Geodetic point (Triangle)	三角点	47	elevation,Name,No	
06 Hypsographic	Point	8102	Geodetic point	測地基準点	47	elevation	
06 Hypsographic	Point	8103	Bench mark	基準水準点	49	elevation	
06 Hypsographic	Line	8104	Basin,shallow Depression	浅い凹地	51(b)	elevation(direction)	
07 Landform	line	1012	Water courses Rapids	急流(1条)	60(b)		
07 Landform	line	1021	Waterfall	滝	60(d)		
07 Landform	line	3001	Cliffs	断崖	52(c)	(direction)	
07 Landform	line	3113	Steep slopes	斜面	52(b)	(direction)	
08 Landform-Poly	Line	1003	BoulderRock	岩塊の海岸	67-1(b)		Line(1003)→POLY
08 Landform-Poly	Line	1004	Flat Rock	岩石海岸	67-1(a)		Line(1004)→POLY
08 Landform-Poly	line	1013	Water courses Rapids to Scale	急流	60(c)		line(1013)→Poly
08 Landform-Poly	line	3008	Outcrop Rock(outline)	露岩	52(a)		Line→Poly
08 Landform-Poly	Centroid	3114	Thick Forest(Centroid)	樹木の多い森林	68		
08 Landform-Poly	Line	3115	Thick Forest(area)	樹木の多い森林	68		

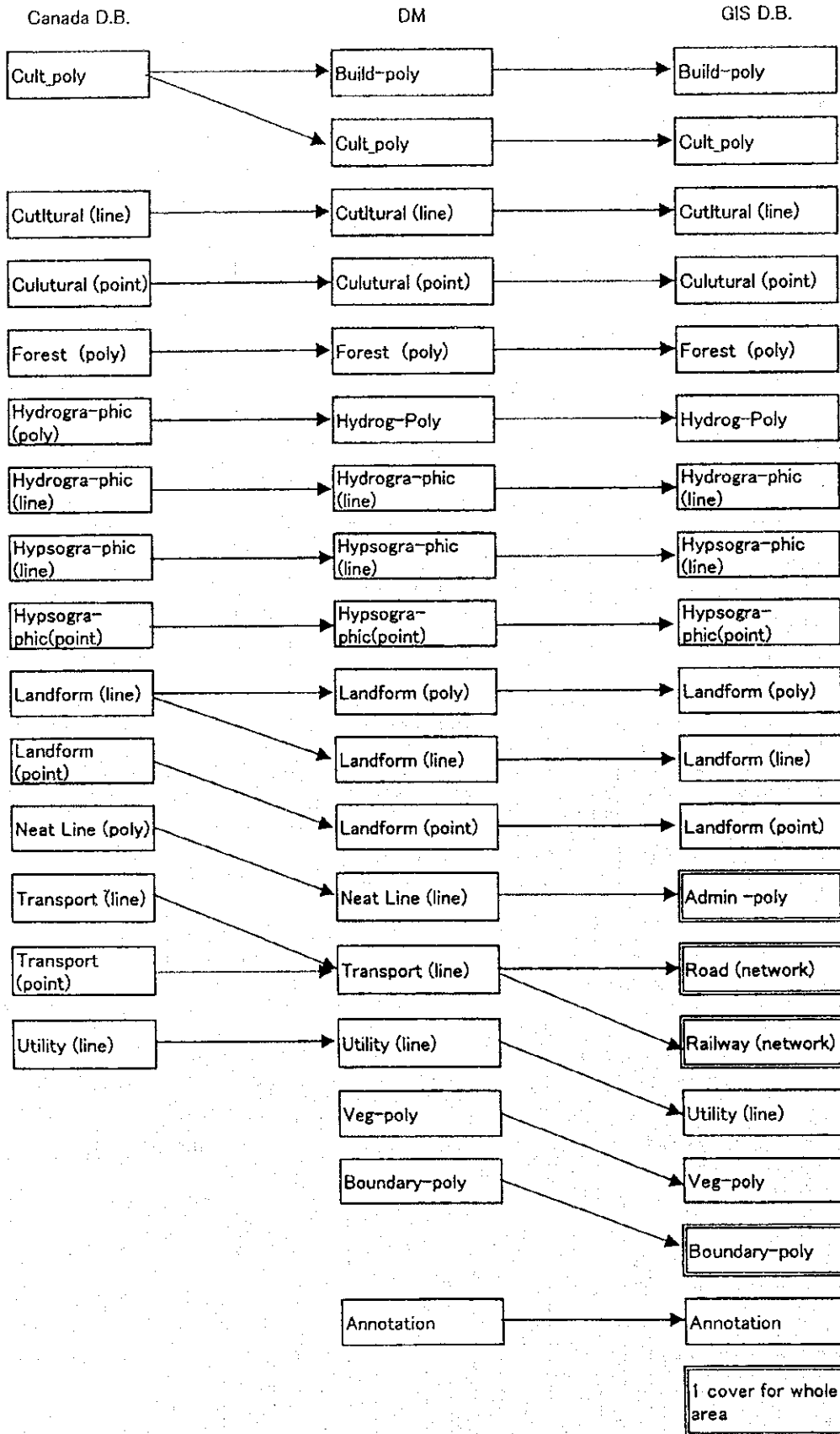
08 Landform-Poly	Centroid	3116	Outcrop Rock(Centroid)	露岩		52(a)	
08 Landform-Poly	Centroid	3117	Water courses Rapids to Scale (Centroid)	急流		60(c)	
08 Landform-Poly	Centroid	3118	Flat Rock (centroid)	岩石海岸		67-1(a)	
08 Landform-Poly	Centroid	3119	BoulderRock(Centroid)	岩塊の海岸		67-1(b)	
08 Neat Line	Line	4007	Boundary : International	国境		13	Poly→Line
08 Neat Line	Line	4101	Boundary : Regional			14	
08 Neat Line	Line	4102	Boundary : District			15	
08 Neat Line	Line	4103	Boundary : City,Municipal or town			16	
09 Transport	Line	5001	Ford	徒渉所		66(d)	
09 Transport	Line	5002	Ferry	フェリー		66(e)	
09 Transport	Point	2002	Bridge	橋		66(a)	
09 Transport	Point	5102	Footbridges	徒歩橋		66(b)	
09 Transport	Point	2039	Quivert	カルバート		66(c)	
09 Transport	Line	5104	Railway (double line)	鉄道(複線)		8(a)	Standard guage
09 Transport	Line	5007	Roads : Class 1	1級道路		2	Motorable throughout the year
09 Transport	Line	5008	Roads : Class 2	2級道路		3	Motorable,occasionally closed
09 Transport	Line	5009	Roads : Class 3	3級道路		4	Motorable in dry seasons
09 Transport	Line	5012	Tracks and Major Footpaths	小道及び主要な歩		6	
09 Transport	Line	5105	Motorway	自動車道		1	centerline of dual carriage
09 Transport	Line	5106	Street & main roads	街路及び貫通道路		4'	passing through the city and towns
09 Transport	Line	5107	Road under construction	建設中道路		5	
09 Transport	Line	5108	Other Footpaths	その他の歩道(踏み分け道)		7	
09 Transport	Line	5109	Railway (single line)	鉄道(単線)		8(b)	Standard guage
09 Transport	Line	5110	Railway (Discontinued)	鉄道(廃線)		8(c)	Standard guage
09 Transport	Point	5111	Rotary	円形交差点			Symbol
10 Utility	Line	6101	Water pipe	送水管		65	
10 Utility	Line	6001	Telephone line	電話線		12	
10 Utility	Line	6003	Power transmission line	送電線(a)		11(a)	1 or 2 line running parallel
10 Utility	Line	6102	Power transmission line	送電線(b)		11(b)	3 line running parallel
10 Utility	Line	6103	Power transmission line	送電線(3)		11(c)	4 line running parallel
11 Veg-Poly	Centroid	9101	Light Forest(Centroid)	疎林		69	
11 Veg-Poly	Line	9102	Vegetation boundary	植生界			
11 Veg-Poly	Centroid	9103	Savannah(Centroid)	草原		70	

11 Veg-Poly	Centroid	9105	Plantation (Centroid)	農園	72		
11 Veg-Poly	Centroid	9107	Cultivation(Centroid)	耕地	77		
12 Boundary-Poly	Centroid	9109	Boundary : National Park	国立公園	17		
12 Boundary-Poly	Centroid	9110	Boundary : Hunting area	狩猟区域	17		
12 Boundary-Poly	Centroid	9111	Boundary : Other	その他特定界	17		
12 Boundary-Poly	Line	9112	Boundary : National Park	国立公園	17		重複？
12 Boundary-Poly	Line	9113	Boundary : Hunting area	狩猟区域	17		重複？
12 Boundary-Poly	Line	9115	Boundary : Other	その他特定界	17		重複？
13 Build-Poly	Line	2005	Prominent Building	著名な建物	24(b)		to scale
13 Build-Poly	Centroid	2050	Prominent Building	著名な建物	24(b)		to scale

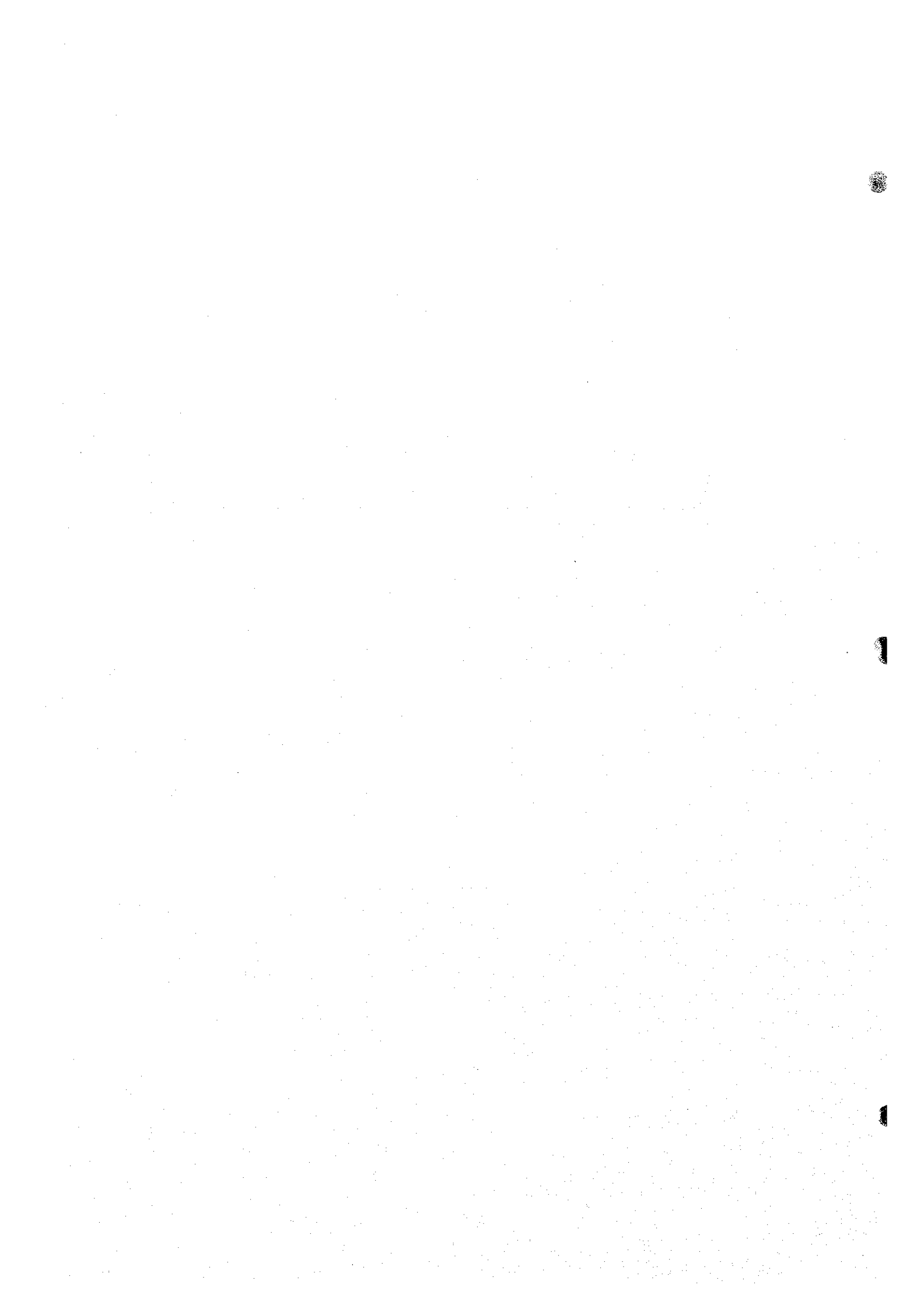
Only In Existing DB

Layer	Feature	Code	Name	名称	No of Symbol	Attributes	Remarks
		1002	Boulder Area	転石			
		1005	Flat Rock Area	平石			
		1008	Island Centroid	島			
		1017	Shoreline Virtual Segment				
		1019	Coastline Virtual Segment				
		1025	Watercourse Virtual				
		1027	Reservoir	貯水池			
		2002	Bridge	橋			Point
		2033	Wireless Station	無線局			
		2036	Health Point				
		2039	Culvert Symbol	カルバート			Point
		2040	Tank Symbol	タンク			
		2041	Dry Dock	乾船渠			
		2042	Pipeline	パイプライン			
		3005	Mineral Working Centroid	鉱物採掘場			Mine Dump Centroid?
		3006	Mineral Working Area	鉱物採掘場			Mine Dump Area?
		3009	Sand Bar	砂州			
		3010	Sand/Mud Outline	砂地・泥地			
		3012	Feature Outline ( Misc.)	地物外郭線			
		3015	Gravel Pit Centroid	砂利坑			
		3016	Gravel Pit Outline	砂利坑			
		4002	Boundary Pillar	境界杭			
		4008	Mile Post	マイル標			
		4012	Survey Pillar	測量杭			
		4016	Trig Station				
		4022	International Centroid	国境中心点			
		5003	Level Crossing	高架部			
		5005	Railway L.G.				
		5006	Railway U/C				
		5010	Siding	引込線			
		6002	Telegraph V/S	受信所			
		7001	Neatline	図郭線			

Coverage



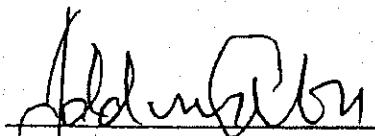
5-6 Minutes of meeting at the end of the 3<sup>rd</sup> year field work (Mar. 12, 1998)



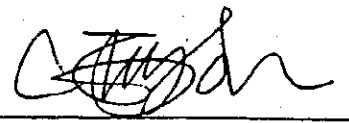


MINUTES OF MEETINGS  
AT  
THE END OF THE THIRD YEAR (SECOND STAGE) FIELD WORKS  
FOR  
THE TOPOGRAPHIC MAPPING  
OF  
SOUTHERN PART OF THE REPUBLIC OF GHANA  
BETWEEN  
SURVEY DEPARTMENT OF GHANA  
AND  
JICA STUDY TEAM

ACCRA GHANA, 12<sup>th</sup> MARCH 1998



NA AL-HAJI IDDIRISU ABU  
DIRECTOR OF SURVEYS  
SURVEY DEPARTMENT OF  
GHANA  
MINISTRY OF LANDS AND  
FORESTRY



TOKIHIKO KAMINISHI  
LEADER  
JICA STUDY TEAM

Survey Department of Ghana (SDG) and JICA Study Team (Team) had a series of meetings at the end of the third year's field works for the "Topographic Mapping of Southern Part of the Republic of Ghana" from March 9<sup>th</sup> to 12<sup>th</sup> 1998.

At the meetings the following items were confirmed by both sides.

1. Twenty (20) copies of Addendum Third Year Plan of Operation were submitted to SDG by the Team. The Plan of Operation was discussed and accepted by both sides.
2. Team reported briefly the progress of the third year field work for the study, and presented the "Progress Report of the Field Work of the Third Year (Second stage) for Topographic Mapping of Southern Part of the Republic of Ghana" prepared by the Team (attachment), SDG accepted the report.
3. Both sides have promised to continue the discussion of the digital mapping code production.
4. SDG requested that the representation of contour lines in the updating work area (20 sheets, approx. 14,400 km<sup>2</sup>) should be indicated in metric (contour interval 10 meters, mountainous area 20 meters) based on the existing contour lines represented in feet.  
Team promised to convey the request to Tokyo JICA Head Office.

LIST OF ATTENDANTS

SDG side

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. E.S. Sai	Ag. Deputy Director	'
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. R. Brimah	Asst. Director	Headquarters
Mr. J.A. Abbosey	Headquarters Staff	'
Mr. Marcus A.Tabil	Examiner	Examination Section
Mr. K.N.Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I.Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R.Tetteh	Chief Lithographer	Lithographic Section
Mr. S.Oppong-Antwi	D.M. Planner	Digital Mapping Sec.
Mr. E.Addo-Tawiah	D.M. Planner	Digital Mapping Sec.
Mr. J. Ofori-Boadu	Data Examiner	Great Accra Region
Mr. Ian K. Isaacs	Observer	Terra Surveys

Team side

Mr. Tokihiko KAMINISI	Team Leader
Mr. Koichi MIKI	Deputy Leader
Mr. Kozo OKUMURA	Mapping Planner
Mr. Hitoshi YOSHIDA	Chief Surveyor
Mr. Hideaki SAKAI	Coordinator

ATTACHMENT

PROGRESS REPORT

OF

THE FIELD WORK OF THE THIRD YEAR ( SECOND STAGE )

FOR

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

MARCH , 1998

STUDY TEAM

OF

TOPOGRAPHIC MAPPING OF SOUTHERN PART

OF

THE REPUBLIC OF GHANA

JAPAN INTERNATIONAL COOPERATION AGENCY

## 1. INTRODUCTION

The topographic mapping of the southern part of the Republic of Ghana started in January, 1996, in a five year plan, as a technical cooperation program of JICA.

In compliance with the Scope of Work and the Minutes of Meeting agreed between the Survey Department of Ghana and JICA on 18th December, 1997, the JICA Study Team arrived in Accra on 2nd of February, 1998, for implementation of the second stage of third year's field work. After consultation with the SDG, the team set up the field headquarters in Accra for the field verification and a part of ground control survey works. Meanwhile Ghana counterparts from the SDG joined the work from time to time. In accomplishing the field work of second stage of the third year, hereinafter, the summary of the progress of the work is reported.

## 2. OUT LINE OF THE THIRD YEAR WORK ( Second Stage )

### 2-1 Objective

The objective of the Study are : (1) To prepare 1/50,000 topographic map covering an area of approximately 25,500 km<sup>2</sup> in the southern part of the Republic of Ghana, (2) To transfer technology to the counterparts personnel of SDG through the implementation of the work, and (3) To promote the friendship between Ghana and Japan through the implementation of the Study.

The second stage of third year's work is consisting of the additional ground control survey, field verification (west zone) and office work.

### 2-2 Period of Survey Work

#### Field work

( Ground control survey )      1<sup>st</sup> February, '98 ~ 11<sup>th</sup> February, '98  
( Field verification )          11<sup>th</sup> February, '98 ~ 20<sup>th</sup> March, '98

### 2-3 Formation of the Study Team

Leader	Mr. Tokihiko KAMINISHI	3 <sup>rd</sup> Mar.'98 ~ 18 <sup>th</sup> Mar.'98
Deputy Leader	Mr. Koichi MIKI	1 <sup>st</sup> Feb.'98 ~ 18 <sup>th</sup> Mar.'98
Mapping Planner	Mr. Kozo OKUMURA	,
Chief Surveyor	Mr. Hitoshi YOSHIDA	1 <sup>st</sup> Feb.'98 ~ 20 <sup>th</sup> Mar.'98



D.M. Planner	Mr. Fujio ITO	1 <sup>st</sup> Feb.'98	~	15 <sup>th</sup> Feb.'98
Mechanical Engr.	Mr. Shinpei ISHIWATA	1 <sup>st</sup> Feb.'98	~	18 <sup>th</sup> Mar.'98
Surveyor	Mr. Masahiko OHASHI	1 <sup>st</sup> Feb.'98	~	20 <sup>th</sup> Mar.'98
'	Mr. Kouzou ASANO			'
'	Mr. Tuyoshi YAMASAKI			'
'	Mr. Michio SATOJI	1 <sup>st</sup> Feb.'98	~	27 <sup>th</sup> Feb.'98
'	Mr. Minoru OHNAKA	1 <sup>st</sup> Feb.'98	~	20 <sup>th</sup> Mar.'98
'	Mr. Masaru TERADA			'
'	Mr. Masaaki MIZUOCHI			'
'	Mr. Takesi NEMOTO			'
Coordinator	Mr. Hideaki SAKAI	4 <sup>th</sup> Mar.'98	~	20 <sup>th</sup> Mar.'98

#### 2-4 Amount of the Survey Work ( Plan and Results )

Survey progress are as follows.

Item	Original plan	Results
Ground control survey		
Additional GPS survey	4 points	4 points
Pricking (GPS points)	20 points	20 points
' (leveling points)	230 km	230 km
Field verification (West zone)	6,830 km <sup>2</sup>	6,830 km <sup>2</sup>

#### 2-5 Counterparts of SDG

Headquarters ;

Na Al-haji Iddirisu Abu	Director of Surveys	Headquarters
Mr. E.S. Sai	Ag. Deputy Director	'
Mr. J. Dotse	Asst. Director	Great Accra Region
Mr. R. Brimah	Asst. Director	Headquarters
Mr. J.A. Abbosey	Headquarters Staff	'
Mr. Marcus A.Tabil	Examiner	Examination Section
Mr. K.N.Arku-Lawson	Chief Cartographer	Cartographic Section
Mr. I.Andoh-Kesson	Chief Photogrammetrist	Photogrammetric Sec.
Mr. E.R.Tetteh	Chief Lithographer	Lithographic Section
Mr. S.Oppong-Antwi	D.M. Planner	Digital Mapping Sec.

Mr. E.Addo-Tawiah	D.M. Planner	Digital Mapping Section
Mr. J. Ofori-Boadu	Data Examiner	Great Accra Region
Mr. Ian K. Isaacs	Observer	Terra Surveys
Field Work ;		
Mr. Paul Essien	Surveyor	Western Region
Mr. Daniel Asiedu	'	'
Mr. Seth Korangteng	'	'
Mr. Francis Sodokey	'	'

### 3. FIELD WORK

#### 3-1 Additional Ground Control Survey

Additional ground control point survey was executed by satellite geodesy applying Global Positioning System (GPS). Three Trimble 4000SSE instruments of dual frequency model were used for the simultaneous observation at the control points.

##### (1) Placement

Four additional control points were established in the field based on the enlarged aerial photographs. Each point was selected for easier location for succeeding pricking work for the aerial triangulation.

##### (2) Observation

GPS observation was executed at three points (two known points & one new point) simultaneously. To take account of obtaining height accuracy, five or six satellites were observed two hours and the elevation angle of satellites were adopted more than 15 degrees.

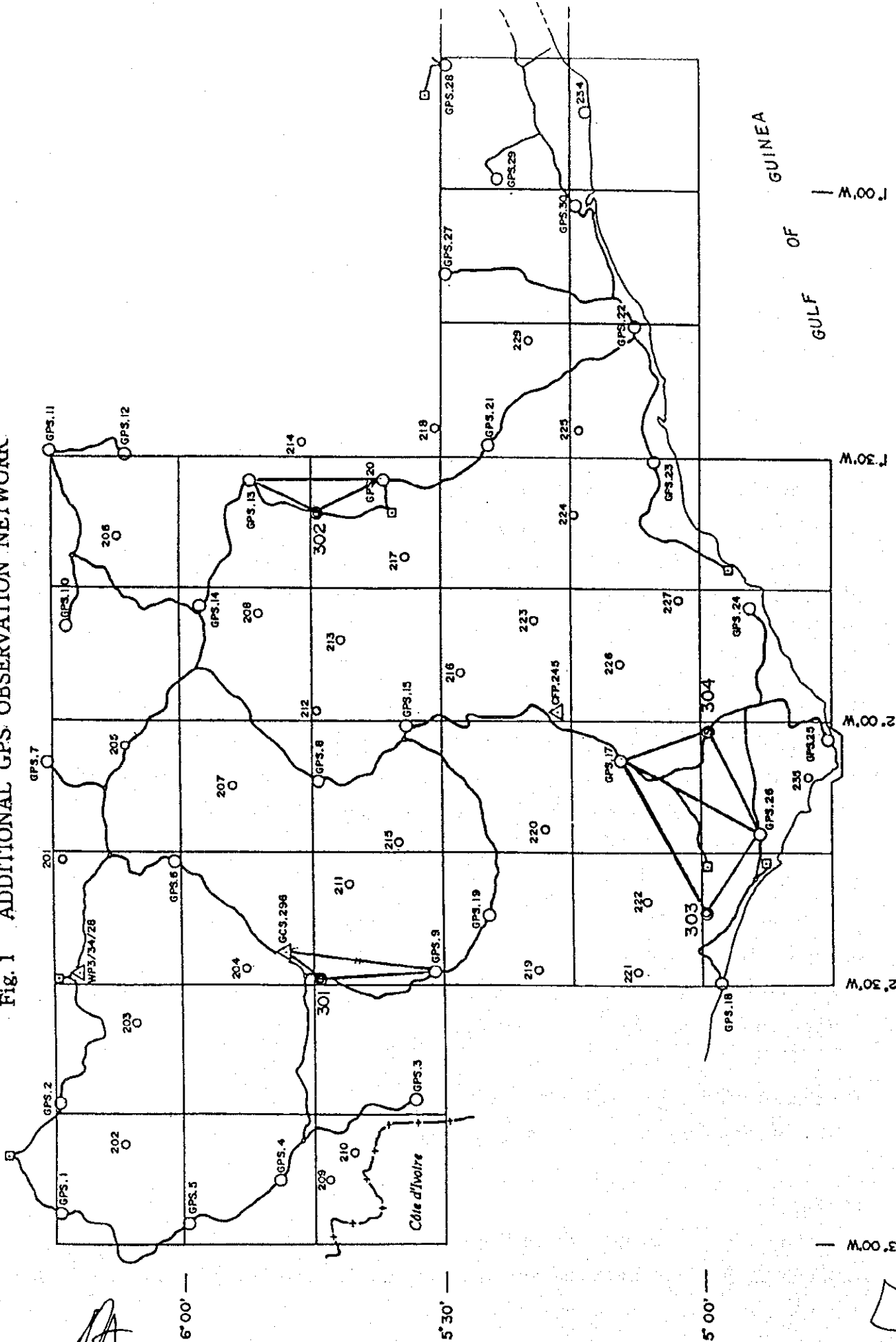
##### (3) Observation scheme

The observation network is shown in Fig. 1.

##### (4) Results

The coordinate closures of each group were calculated in the field to check the reliability of the observation. The results are tentatively obtained as follows

Fig. 1 ADDITIONAL GPS OBSERVATION NETWORK





Closure error

Observation st.	Station	Distance	Closure error
301/296/9	301 ~ 296	9,178.465m	Total dist.=66,231.011m dx=-0.0114m, dy=+0.0132m dz=-0.0325m Ratio=0.5562ppm
	296 ~ 9	32,022.304m	
	9 ~ 301	25,030.241m	
302/13/20	302 ~ 13	15,197.265m	Total dist.=59,631.815m dx=-0.0046m, dy=-0.0077m dz=+0.0114m Ratio=0.2433ppm
	13 ~ 20	28,382.447m	
	20 ~ 302	16,052.102m	
303/17/26	303 ~ 17	33,460.373m	Total dist.=82,975.844m dx=+0.0069m, dy=-0.0076m dz=+0.0069m Ratio=0.1494ppm
	17 ~ 26	32,855.475m	
	26 ~ 303	16,659.996m	
304/26/17	304 ~ 26	25,348.159m	Total dist.=78,018.068m dx=+0.0128m, dy=-0.0045m dz=-0.0162m Ratio=0.2708ppm
	26 ~ 17	32,855.475m	
	17 ~ 304	19,814.434m	

Double observation difference

Station (year)	dx	dy	dz
296 ~ 9 ('96)	+ 2,899.106m	- 4,136.354m	-31,621.387m
('98)	+ 2,899.124m	- 4,136.386m	-31,621.407m
difference	- 0.018m	+ 0.032m	+ 0.020m
13 ~ 20 ('96)	+ 2,837.442m	+ 396.848m	-28,237.463m
('98)	+ 2,837.456m	+ 396.844m	-28,237.469m
difference	- 0.014m	+ 0.004m	+ 0.006m
17 ~ 26 ('96)	+ 1,950.879m	-15,277.521m	-29,021.966m
('98)	+ 1,950.883m	-15,277.534m	-29,021.944m
difference	- 0.004m	+ 0.013m	- 0.022m
17 ~ 26 ('98)	+ 1,950.883m	-15,277.534m	-29,021.944m
('98)	+ 1,950.920m	-15,277.534m	-29,021.949m
difference	- 0.037m	0.000m	+ 0.005m

### 3-2 Pricking ( continuation )

Pricking of the horizontal and vertical control for aerial triangulation was executed using third year's first stage aerial photographs.

#### (1) GPS points

Positions of twenty(20) GPS points were pricked on the enlarged aerial photos, and the eccentric elements were measured by sun azimuth observation method, if necessary.

#### (2) Leveling points

Leveling points (approx.230 km) conducted period of second year's work were pricked on the enlarged aerial photos at every 4 to 5 km interval for aerial triangulation vertical control.


### 3-3 Field Verification

Field verification (second stage ; West zone ) was started by the team members and SDG counterparts in compliance with the map symbols and their application rules agreed between SDG and JICA study team on the first stage of the third years work.

Confirmation and investigation of various expressions and names specified by map symbols were conducted. The survey results were described on two times enlarged aerial photographs to be used as data for succeeding digital stereo plotting and compilation work.

#### (1) Implementation

Main items verified in the field are as follows, and the results were indicated on the enlarged aerial photographs.

- ① Classification of roads and their attributes.
- ② Public buildings and structures.
- ③ Linear structures (railway, power transmission line, etc.).
- ④ Key for photo-interpretation of vegetation and topographic features. 
- ⑤ Collection of toponomy and designation of ground features (village, mountain, river, etc.).
- ⑥ Other necessary items for map representation in accordance with the map symbols and their application rules.



### 3-4 Topological Data Structure

Based on the Ghana Environmental Resource Management Project ( GERMP ) code table and SDG's map symbols and application rules, new application rules were discussed with SDG and JICA study team.

The above progress report covered the field work period from 1<sup>st</sup> of February, 1998 to 20<sup>th</sup> March, 1998.

