1-5 Technical Transfer

Through the Metro Manila urban base mapping, the technical transfer was made as for the 1:10,000 contoured, planimetric, land use and land condition mapping.

1-5-1 Method

According to the work at each stage of the 1:10,000 contoured, planimetric, land use and land condition mapping, the technical transfer from the Japanese side was made at the technical discussions in the Philippines and at the time of participation of the Philippine counterparts in the field work as well as at the time of JICA training in Japan.

1-5-2 Outline

The outlines of technical transfer and training by work items were shown in Table 1-1.

Table 1-1 Outline of Technical Transfer and Training

	Contoured & planimetric maps	Land use map	Land condition map
1st year	(Field work) 1. Method of use of surveying instrument in ground control point survey, and planning of field work and assessment of survey results in the urbanized congested area. 2. Method of preliminary photo-interpretation and field identification, and assessment of their results. 3. Technical discussion (Indoor work) 1. Block adjustment computation by bundle method in aerial triangulation (Mr. Ponciano C. Ciceron) 2. Detailed plotting of congested housing, isolated buildings, roads, etc. in urbanized area, for the 1:10,000 urban base map. (Mr. Roland L. Alpajora Mr. Manuel M. Calibo)	(Field work) 1.Method of preliminary photo-interpretation and field identification, and assessment of their results. 2. Technical discussion	
2nd year	(Field work) 1. Field completion concerning correction using aerial photos and other data to incorporate changes after aerial photography. 2. Technical discussion (Indoor work) 1. Compilation of plotting results and incorporation of field identification according to the symbol specifications of 1:10,000 urban base map (Mr. Gavino C. Angeles, Jr.) 2. Color separation drafting according to the symbol specifications and compilation manuscripts of 1:10,000 urban base map. (Mr. Rodrigo R. Pascua) 3. Multi-color off-set printing (Capt. Renato B. Feir)		(Field work) 1. Methods of preliminary photo-interpretation and field identification, and assessment of their results. 2. Field data collection and assessment. 3. Technical discussion (Indoor work) 1. Methods of photo-interpretation and field identification, and assessment of their results. (Engr. Felisa M. Nepomuceno)

		(Indoor work) 1. Preparation of compilation manuscripts according to the 1:10,000 land use map symbol specifications and using the 1:10,000 contoured map as the base. (Mr. Pastor A. Estrada)	1. Preparation of compilation manuscripts according to the 1:10,000 land condition map symbol specifications and using the 1:10,000 contoured map as the base. (Lcdr. Rodolfo A. Agatori)
		(Mr. Dante M. Lopez)	
		(Field work) 1. Field completion concerning correction using aerial photos and other data to incorporate changes after aerial photography. 2. Technical discussion	(Field work) 1. Field completion concerning indistinct landform boundaries based on aerial photos and other data, and additional data collection. 2. Technical discussion.
3rd year		(Indoor work) 1. Color separation drafting according to the 1:10,000 land use map symbol specifications and compilation manuscripts. 2. Multi-color off-set printing (Indoor work) 1. Color separation drafting according to the 1:10,000 land use map symbol specifications and compilation manuscripts. 2. Multi-color off-set printing.	(Indoor work) 1. Color separation drafting according to the 1:10,000 land condition map symbol specifications and compilation manuscripts. 2. Technical discussion. (Indoor work) 1. Color separation drafting according to the 1:10,000 land condition map symbol specifications and compilation manuscripts. 2. Multi-color off-set printing.
		(Mr. Petronio A. Culala Mr. Ponciano C. Ciceron)	

2. CONTOURED AND PLANIMETRIC MAP

2-1 Outline of Work

2-1-1 Flow of Work

The 1:10,000 contoured map was prepared using the existing 1:32,000 aerial photographs taken in 1982 by the Philippine side, and the planimetric map was also prepared using the contoured map as the base for the use of designing and planimetry. The field work and technical discussions were conducted in collaboration with BCGS. During the course of such work, technical transfer was also conducted.

The work flow is shown in the following Fig. 2-1:

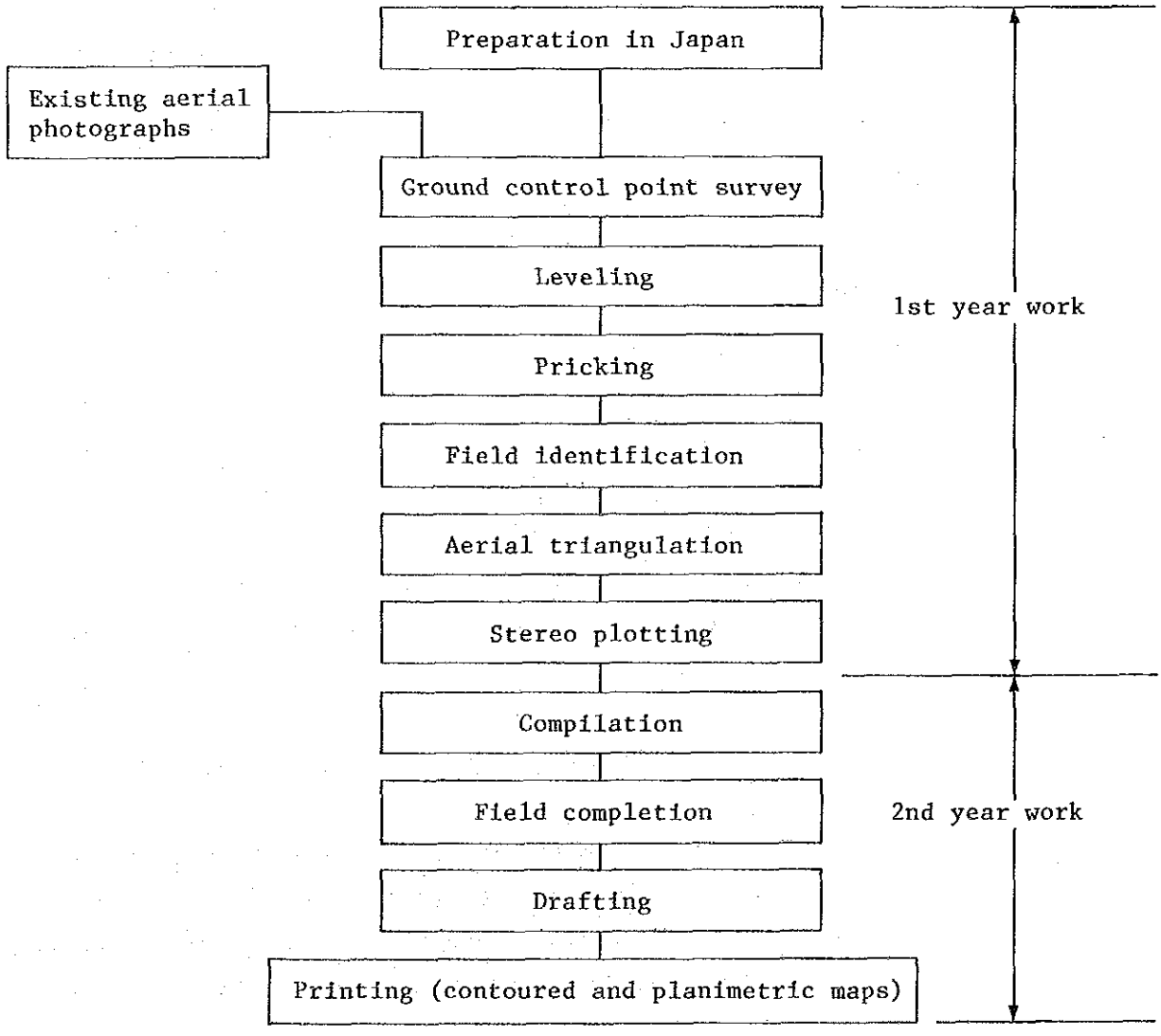


Fig. 2-1 Work Flow of Contoured and Planimetric Mapping

2-1-2 Contents of Work

Contoured mapping (1:10,000)	
Ground control point survey	12 points
Leveling	300 km
Pricking (ground control points)	28 points
Pricking (leveling points)	120 points
Field identification	1,500 km^2
Aerial triangulation	123 models
Stereo plotting	1,500 km^2
Compilation	1,500 km^2 57 sheets
Field completion	1,500 km^2 57 sheets
Original manuscript preparation	1,500 km^2 57 sheets
Scribing	1,500 km^2 57 sheets
Printing (5 colors)	57 sheets 1,000 copies per each
Planimetric mapping (1:10,000)	
Compilation	1,500 km^2 57 sheets
Field completion	1,500 km^2 57 sheets
Printing (2 colors)	57 sheets 1,000 copies per each

2-1-3 Design of Symbols

For the designing of Metro Manila contoured and planimetric map symbols, the following principles were taking into consideration:

(1) Both maps will be urban base maps which are basic materials to be used by national and public organizations for the development, preservation, etc. of Metro Manila region.

(2) Symbols will be prepared for contoured map and for planimetric map.

a) The contoured map symbols will be those for multi-purpose base map representing topography, river system, cities and towns, villages, roads, railways, administrative boundaries, geographical names, etc. in detail on the basis of surveying and aerial photogrammetry.

b) The planimetric map symbols will be those of two-color map, which is complied from the contoured map and prepared so as to be easy for entry of information necessary for planning and designing.

(3) Characteristics of printed contoured and planimetric maps

Categories	Contoured map	Planimetric map
Ground control point	Black	Blue (spot heights are not shown.)
Boundary	Black	Gray
Road	Blackish blue	Gray
Railway	Black	Gray
Building	Brown	Gray
Function symbol	Blue	Blue
Area	Blackish blue, green, black	Blue, gray (base colors are not shown.)
Small feature	Blue, brown blackish blue	Blue, Gray
Water body	Blue	Blue (base colors are not shown.)
Vegetation	Blue, green	Gray (base colors are not shown.)
Deformed land	Black	Not shown
Contoured line	Black	Not shown
Depth curb	Black	Not shown
Annotation	Blue, black	Blue

2-2 Preparation in Japan

2-2-1 Specifications of Ground Control Point Survey

The ground control point survey was decided to adopt closed traversing method using electromagnetic distance meter based on JICA specifications. According to the reference materials then obtained, the specifications, work

method, observation accuracy, etc. were studied along with the preparation of plan of operation and the selection of survey instruments and materials.

2-2-2 Study on Symbol Specifications

The study was made on map symbols and applications each by each based on the map symbol specifications specified in the Implementing Arrangement, taking the existing 1:10,000 map symbol specifications of Japan into consideration. The draft symbol specifications were thus prepared.

2-2-3 Preparation of Sample Map Sheets

As for the contoured and planimetric maps, the sample map sheets were prepared in Japan for technical discussions about detailed features to be represented in drafting and printing as well as about color tone and marginal information. (For reference of the 2nd year technical meeting.)

2-3 Utilization of Aerial Photographs

2-3-1 Outline

The aerial photographs necessary for field identification and mapping work of the contoured map were prepared by using the negative films taken in 1982 by BCGS. For the field completion, the aerial photo maps prepared in 1986 by the Philippine side were utilized.

2-3-2 Elements of Aerial Photography

(1) Aerial photographs taken in 1982 by the Philippines

o Camera:	RMK-A
o Photographing altitude:	16,050 - 16,720 ft.
o Focus length:	152.85 mm
o Scale:	1:32,000
o Time of photography:	February - April, 1982
o Overlap:	80 - 90%

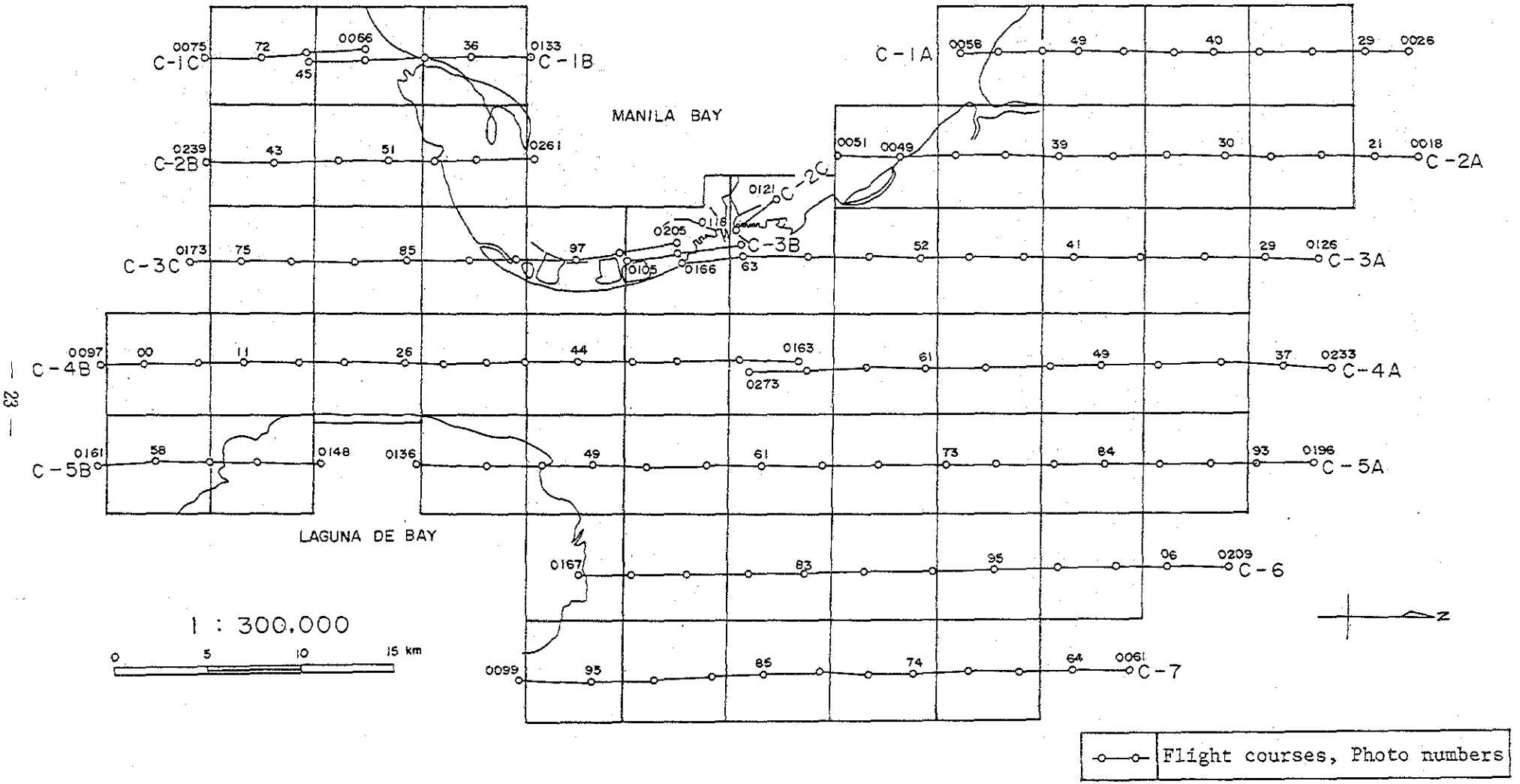


Fig.2-2 Index Map of Aerial Photography taken by BCGS in 1982

(2) Aerial photo map prepared in 1986 by the Philippine side

o Scale: 1:10,000

2-4 Ground Control Point Survey

2-4-1 Outline

In the course of planning ground control net work, new control points were planned for the establishment of a ground control network in the NCR coordinating with the existing triangulation points in the project area as well as for the preparation of picture points for aerial triangulation.

2-4-2 Specifications

(1) Class: 3rd order (JICA specs)

(2) Relative accuracy: Better than 1:25,000

2-4-3 Operation

(1) Particular attention was paid on selecting new points as follows:

o To be easily identifiable as picture point for aerial triangulation and stereo plotting, and located in the place convenient to pricking.
o To be situated at place for safe observation and for easy access.

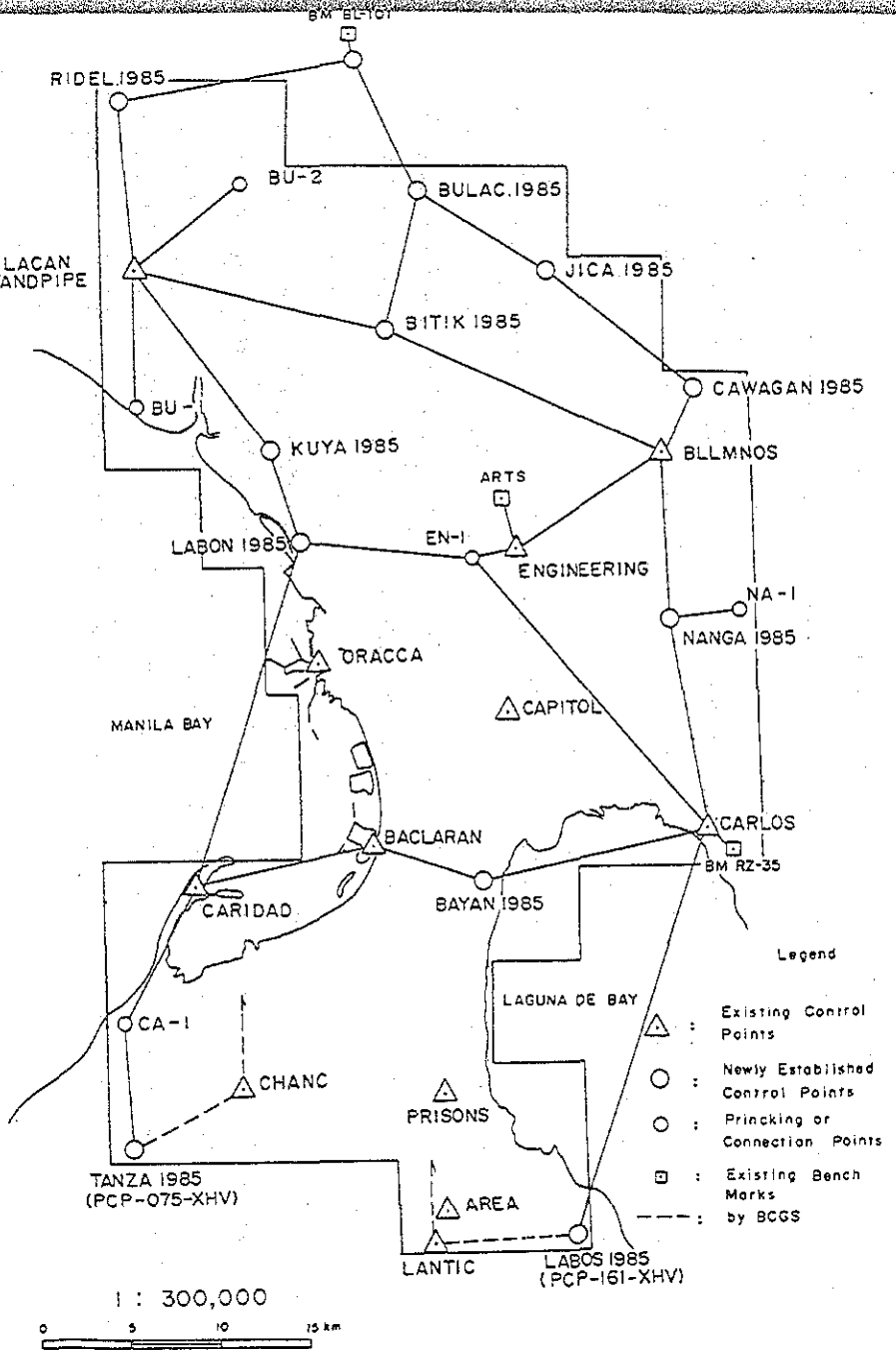


Fig.2-3 Network of Ground Control Points

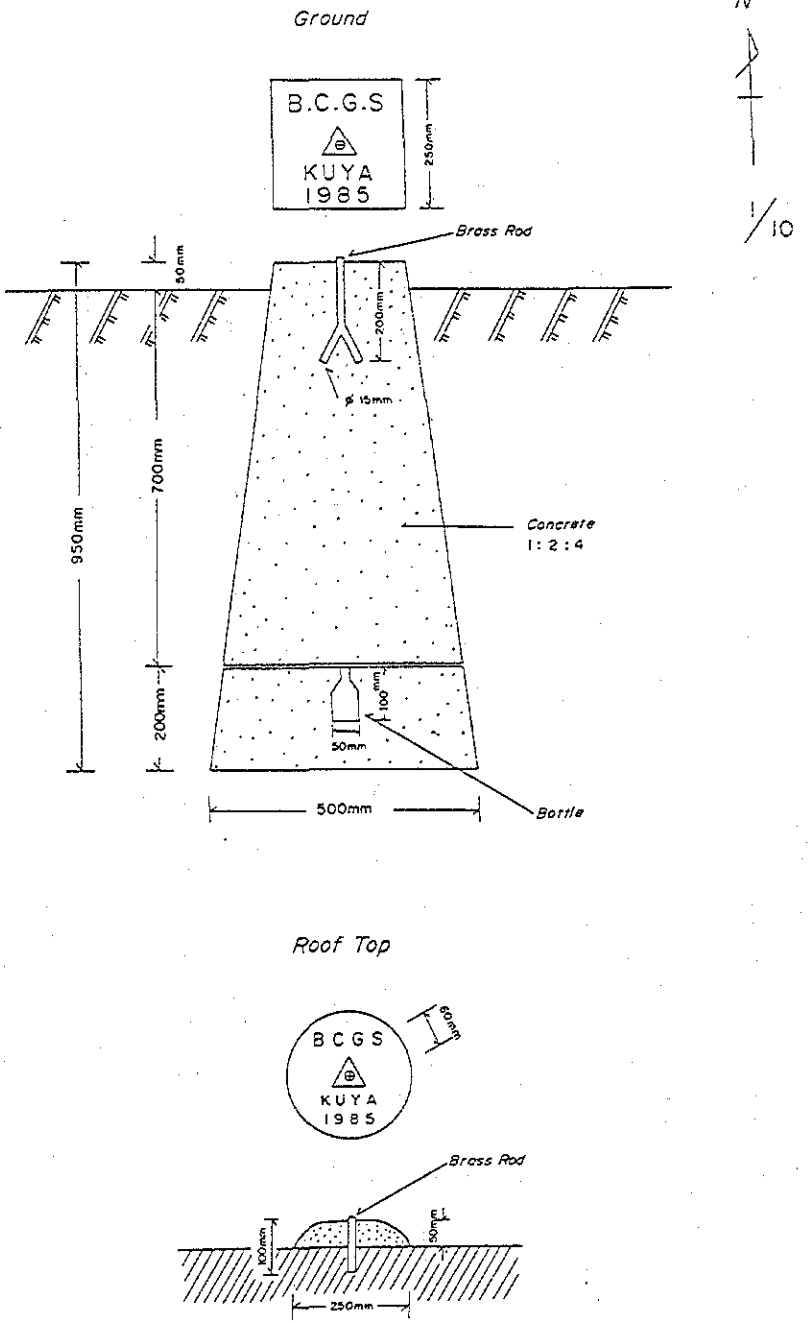


Fig.2-4 Monumentation of Ground Control Points

o To be easily available as ground control points in the future, and to occupy suitable location for permanent monumentation.

(2) Monumentation

The monumentation was conducted according to the BCGS specifications. (Fig. 2-4)

(3) Observation

a) Determination of distances

Rangemaster III and Hewllet Packard 3808A were used for measuring. Each side was measured twice and difference between the first measuring and the second was specified less than 1:40,000. In the case of long distance, meteorological observations on temperature and barometric pressure were made at both observation points.

b) Observation of horizontal angle

In the process of planning, distances among the proposed ground control points were predicted to exceed standard side-length of third-order traversing. Wild T2, therefore, was used for main observation on those long distances. Measurement were made twice at each observation. Observed results were subject to meet the accuracy of second-order traversing. Double angle difference was specified as 12" and observation error as 7". Mean observed value was unified to show up to one tenth of second. In case signals were far, helio-tropes and signal lamps were used to maintain good observation accuracy.

c) Observation of vertical angle

Two sets of observation were carried out simultaneously between two points targetting each other. One set consists of a pair of measurement. Time interval was 20 minutes in average. Descrepancy of altitude multipliers was specified within 10".

d) Leveling

Direct leveling was executed from existing bench mark to two triangulation points (IZURA 1985, CARLOS) to determine average elevation of existing triangulation points and new control points. Duplicate leveling line and less than 20 mm $\sqrt{S}$ (S: single line in km) of discrepancy were specified. Average elevation of triangu-

lation point ENGINEERING was obtained for enhancing accuracy of all elevations.

2-4-4 Computation

(1) Computation of coordinates

Computation of coordinates was carried out by fixing one triangulation point and one direction and using observed vertical angle and corrected distance in meteorological factor, grade and projection. The computation was done to verify closure of loop and confirmed as complete good results.

It was assumed that the existing triangulation points in the project area had approximate 20 cm of error, as value of the two sides of existing triangulation points CARIDAD-BACLARAN and ENGINEERING-BLLM No.8, which composed a part of proposed ground control net, were proven to be 28 cm and 22 cm respectively shorter than the value newly observed this time. Therefore, another computation for tying of existing triangulation points was carried out in addition to computation of closure to obtain the accuracy of each route. All of three existing triangulation points used for the proposed traversing net were considered as available given points in the net, since the accuracy of all the traversing routes met the specified accuracy of 1:25,000. (Table 2-1)

Factors used for precise computation are as follows:

Spheroid	:	Clarke 1866
Coordinate at origin:		N 0 m
		E 500,000 m
Scale factor	:	0.99995
Coordinate system	:	PTM III

The computation was carried out to check displacement of the existing triangulation points. Description of displacement is shown in Table 2-2.

Final results were developed by simultaneous elevation and adjustment computation of coordinates of traversing net, using 6 existing triangulation points as given points, because it was proven that the accuracy of those existing triangulation points were mostly same in accordance with the results of trials such as computation by free-net solution

method fixing coordinates of 6 existing triangulation points, fixing 4 existing triangulation points, etc.

Table 2-1 Results of Closure

Route No.	Length (km)	Direction angle		Coordinates		Coordinates		Elevations	
		Difference of closure (km)	Allowance (km)	Difference of closure (m)	Allowance	Ratio of closure (thousand)	Allowance (thousand)	Ratio of closure (m)	Allowance (m)
1	58.560	+0.7	+7.8	0.132		1/443.	1/25.	+0.02	+0.81
2	47.771	+2.1	∓7.8	0.143		1/334.	1/25.	-0.01	∓0.69
3	71.957	-6.7	∓9.2	0.294		1/244.	1/25.	-0.01	∓0.89
4	53.125	-5.2	∓7.8	0.301		1/176.	1/25.	-0.07	∓0.80
5	83.068	-1.5	∓8.5	0.228		1/364.	1/25.	-0.73	∓1.08

Table 2-2 Displacement of the Existing Triangulation Points

Name of points	4 points fixed	5 points fixed	6 points fixed
BULACAN	0.592 m	* 0.432 m	* 0.489 m
BLLMNOS	* 0.167	0.372	* 0.278
ENGINEERING	* 0.085	* 0.199	* 0.141
BACLARAN	* 0.153	* 0.074	* 0.090
CARIDAD	0.474	* 0.355	* 0.399
CARLOS	* 0.142	* 0.292	* 0.208

*: fixed point
vector : ΔS

(2) Elevation computation

This computation was executed in order to verify the closure of elevations of the loop not related to any existing triangulation point. All results were confirmed as good and acceptable.

On the other hand, the accuracy of closure was inspected by comparing the value of differences in elevations of traversing routes obtained from the above computation and the value of the existing bench marks. The results were as shown in Table 2-3.

The route starting at IZURA was 50 cm lower than others. This route, however, obtained sufficient accuracy regarding the closure of the loops. Therefore, the above difference of 50 cm was concluded as the discrepancy caused from the existing bench mark BL-101. All existing

bench marks were considered as given points, as the differences of all routes in this elevation computation were within the specified accuracy.

Final results of the elevations of existing triangulation points (no elevation) and newly established ground control points were obtained by simultaneous elevation and adjustment computation of traversing net, using elevations of existing triangulation points, IZURA 1985, ENGINEERING, and CARLOS, whose values of elevations were determined from existing bench marks.

Table 2-3 Difference of Elevation of the Existing Points

No.	Route	Difference of elevation	Existing results	Difference	Allowance
1	IZURA - BLLM - ENGI	- 9.53	- 9.12	-0.41	±0.59
2	IZURA - BULAC - ENGI	- 9.53	- 9.12	-0.41	±0.74
3	IZURA - BLLM - CARLOS	+84.41	+85.59	-0.58	±0.65
4	ENGI - BLLM - CARLOS	+93.94	+94.21	-0.27	±0.53
5	ENGI - EN-I - CARLOS	+93.99	+94.21	-0.22	±0.60

(3) New ground control points established by BCGS

BCGS conducted establishment of 2 new ground control points (LABOS 1985, TANZA 1985) in parallel with JICA survey team. As, fortunately, those points were able to join the traversing net developed by JICA team, they were tied to the traversing net by open traversing method and used in the computation of net adjustment. The results surveyed by JICA team were compared with BCGS' results.

2-5 Leveling

BCGS re-surveyed and revised approximate 300 km of existing leveling route. JICA team received and verified the revised leveling data and conducted pricking. Relation between the tidal station at PIER 15 of MANILA PORT and the original point of leveling route was checked to ascertain the relation between elevation value of mean sea level of Manila Bay and elevation values of existing bench marks. In addition, the relation between.

2-6 Pricking

2-6-1 Outline

Existing triangulation points, newly established ground control points and vertical control points were pricked on aerial photographs in order to be used for aerial triangulation and stereo plotting.

2-6-2 Pricking of Ground Control Points

Newly established ground control points were pricked eccentrically at clear points of aerial photographs taking aerial triangulation and stereo plotting into account. Eccentric elements were observed. 4-time enlargements were used for indication of pricked points. Description sheet of ground control points were compiled.

2-6-3 Pricking of Vertical Control Points

It was planned to prick vertical control points homogeneously in the project area. Pricking was carried out according to existing final result tables and description of vertical control points using 2-time enlargements.

Those points were transferred eccentrically to center of road, flats, etc. for easier orientation.

2-7 Aerial Triangulation

2-7-1 Outline

Aerial triangulation was conducted to obtain geodetic coordinates of pass and tie points necessary for stereo plotting based on the results of ground control points and leveling points. Adjustment was based on the block adjustment method.

(1) Specifications

Photo scale	:	1:32,000
Number of courses	:	10 courses
Number of models	:	123 models
Control points	:	28 points (horizontal), 116 points (vertical)
Adjustment computation	:	Bundle adjustment method with self-calibration

(2) Main instruments

Pricking device	:	PUG-III IV (Wild)
Coordinate measuring device	:	STECOMETER (ZEISS JENA)
Computer	:	ACOS 350 (NEC)

2-7-3 Point Selection and Observation

(1) Photo coordinates observation

Twice independent observation.
Discrepancy: less than 0.02 mm

(2) Relative orientation

Residual error: less than 0.03 mm on the positive film.

(3) Successive orientation

Difference between pass points in adjacent models: less than 0.05% of flight altitude on planimetry and height.

2-7-4 Computation

Simultaneous adjustment computation on coordinates and elevation was carried out, forming entire project area into one block. The program for

block adjustment was based on the bundle adjustment method with self-calibration.

Index map of aerial triangulation is shown in Fig. 2-5. The accuracy of aerial triangulation is shown in the following table:

Number of Courses	Number of Models	Number of Control Points		Residual of Control Points (Horizontal)		Residual of Control Points (Vertical)	
		Horizontal	Vertical	Mean square error	Maximum value	Mean square error	Maximum value
10 courses	123 models	28 points	116 points	0.78 m	1.99 m	0.68 m	2.94 m

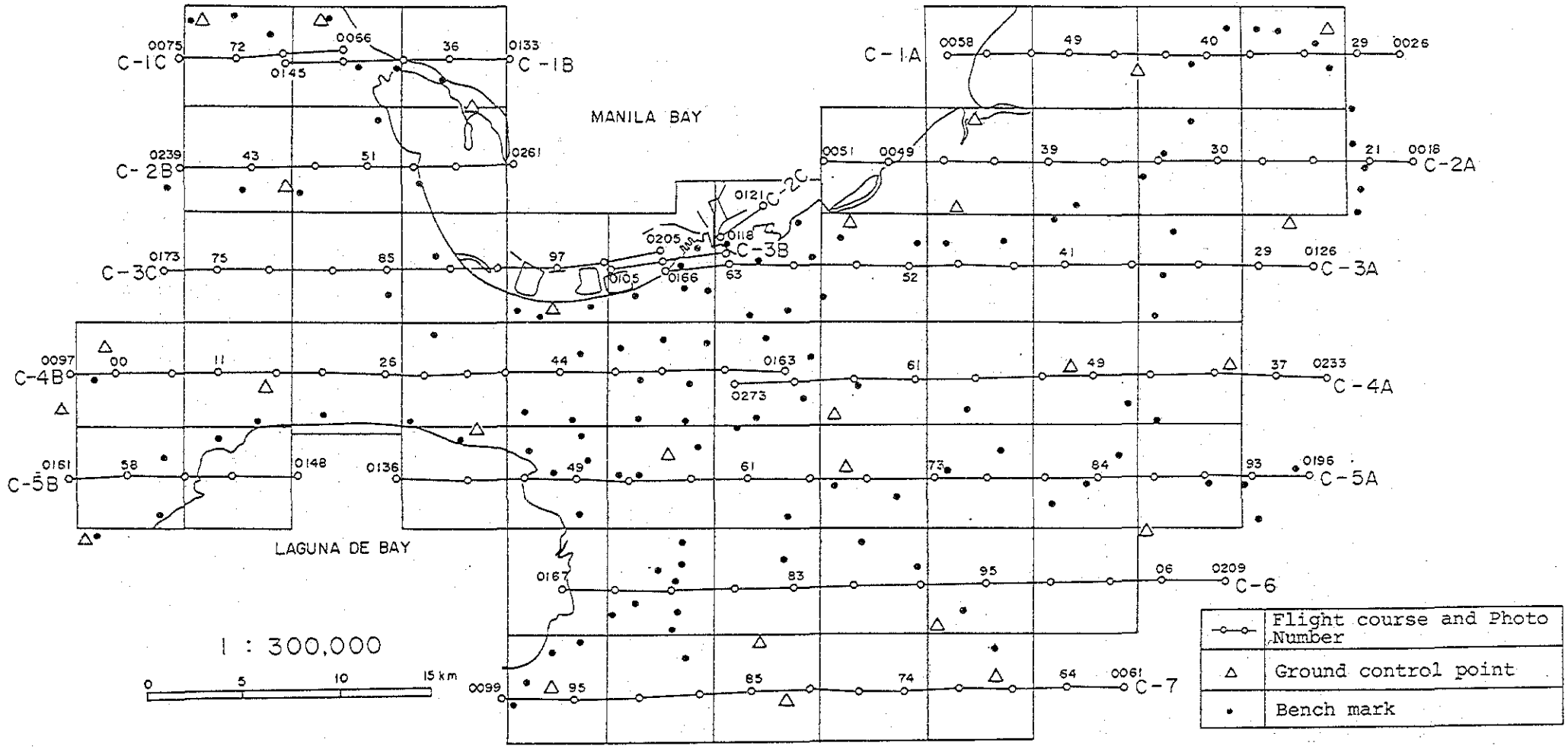


Fig.2-5 Index Map of Aerial Triangulation

2-8 Field Identification

2-8-1 Outline

The field identification was conducted for verification of various features, geographical names, etc. to be represented on the 1:10,000 contoured map. The results were incorporated on aerial photos and reference materials.

2-8-2 Preliminary Photo-interpretation

The preliminary study was conducted in Japan using the existing 1:50,000 topographic maps, guide maps, turist maps, etc. Public facilities, parks, historical monuments, etc. were marked on aerial photos. Survey area to be asigned to each operation party, survey routes, etc. were also studied.

2-8-3 Field Work

(1) Based on the results of preliminary study, the field work was conducted, based on the Metro Manila symbol specifications, with regard to unidentified features, road widths, function symbols, building names, small landmarks, vegetation, etc.

(2) Keys for interpretation were prepared to unify the representation of features.

(3) Views of the Philippine counterparts were taken into consideration in adopting function symbols, annotations, etc.

(4) When there was no space for names, annotations, etc. on the photographs, a list of annotation was prepared.

(5) Main items for identification are as follows:

o Roads : Grades, structures of sidewalks, separate zone, etc., widths

- o Railways : Single track, double track, siding, crossing with road
- o Buildings : Classification of independent or generalization in accordance with the map symbol specifications, and selection of annotations and symbols for buildings.
- o Specified areas and small landmarks: Names, areas and positions.
- o Rivers : Major rivers, routes and structures of main drainage canals.
- o Vegetation: Those not clearly identified by aerial photograph, vegetation boundaries.
- o Topography: Depressions, cliffs, rocks, banks, cuttings, etc., which are difficult to identify.

2-8-4 Items Surveyed by BCGS

As a result of technical meetings with BCGS upon the completion of the field survey, the following items were surveyed by BCGS.

(1) Effective clearances of overpaths, grade separations, bridges, tunnels, etc.

(2) Administrative and geographical names, administrative boundaries.

(3) Names of roads, rivers, bridges, railways, railway stations.

(4) Wrecks, sewerage outfalls, reefs, light houses.

(5) Depth curves of Manila Bay and estuaries.

(6) Edit of annotations, names and function symbols.

(7) Expression of defense facilities.

(8) Road surface classification.

(9) 6-categorization of plantation.

(10) Temporary housing area.

2-8-5 Work in Japan

After the field identification was completed, the following work was conducted in Japan:

o Preparation of annotation overlays.
o Supplement incorporation on the field identification photos.
o Matching of sheets.
o Collation with land use survey results.
o Collation of JICA team's field identification photos with those of BCGS team.

2-9 Stereo Plotting

2-9-1 Outline

Based on the ground control points survey results, leveling results, aerial triangulation results, etc., in accordance with specifications required items for topographic maps were plotted by stereo plotter.

2-9-2 Specifications

Mapping scale	:	1:10,000
Coverage	:	1,500 km^2 (57 sheets)
Contour line	:	Intermediate contour 4 m
		Index contour 20 m
		Auxiliary contour 2 m (flat area)
Plotting instruments	:	Autograph A-7, Stereoplotter A-8,
		Metrograph, Aviolyt BCI
Projection	:	UTM
Sheet lines	:	EW 3' x NS 3'
Plotting sheet	:	Polyester base #500
Plotting	:	High-speed automatic plotting machine
Accuracy	:	Planimetry A class (±1.0 mm)
		Vertical B class (spot height Δh/3)
		(Contour line Δh/2)
		Δh: contour interval (Intermediate contour 4 m)

2-9-3 Stereo plotting

(1) Plotting of control points, etc.

A high-speed automatic plotter was used for plotting sheet lines, grid lines, longitude and latitude lines, triangulation points, new points, pass points, tie points and bench marks on plotting base with a plotting error of less than 0.2 mm on map.

(2) Orientation

Six pass points were employed for relative orientation with a residual vertical parallax of not exceeding 0.02 mm on diapositives.
Pass points, tie points, pricked control points, pricked leveling points were used for absolute orientation with less than 0.3 mm of horizontal tolerable discrepancy and less than 1.0 m vertical tolerable discrepancy.

(3) Plotting

a) Based on field identification results, machine plotting was executed in order to draw roads, rivers and railway, building, vegetation and contour lines in those order.
b) Sheet names & number index of contoured map are given in Fig.-1.
c) Plotting was conducted in accordance with map symbols and application specified in I/A drafted after discussions and agreed to modify between Japan and the Philippines.
d) Generalization was made for the area where congested housing occupy more than 70% of the area. In case less than 70%, the areas were represented as congested area (isolated buildings and partitions were represented).
e) Temporary housing areas were plotted based on field identification data supplied by BCGS.
f) The measuring unit of spot height was 0.1 m. The measuring interval for spot height was approximately 5 cm on map.

2-10 Compilation

2-10-1 Outline

Utilizing the plotting manuscripts, results of the field identification and related data as well as according to the specifications and symbols for Metro Manila Contoured Map 1:10,000, compilation manuscripts were developed together with preparation of other materials necessary for the subsequent work (drafting and printing work).

2-10-2 Mechanical Plotting

Neatlines, ground control points, grid lines, longitudinal & latitudinal lines, etc. were plotted by using automatic plotting machine. Discrepancy of neatlines and diagonal lines in length were limited less than 0.3 mm and 0.4 mm respectively.

2-10-3 Compilation

(1) Compilation manuscripts were made based upon the JICA specifications and the Specifications and Symbols for Metro Manila Contoured Map 1:10,000.

(2) Compilation was made by overlay method. Planimetric features and contoured lines were drawn on the same sheet.

(3) Ground control point data sheets represented triangulation points, newly established control points, bench marks, spot heights, etc.

(4) Regarding annotation data sheet, two kinds of data sheets: general annotation data sheet (administrative names, geographic names, building names, destinations, etc); and road annotation data sheet (road names for contoured map and planimetric map) were separately prepared.
On the annotation data sheet, names or abbreviations were shown in consideration of the type of building and space availability.
Letter style, letter height, letter space, etc. of annotation were specified with marks.

(5) On road data sheet, administrative and road surface classification were shown.

(6) Uncertain items were marked for the convenience of confirmation to be made in the field completion.

2-11 Field Completion

2-11-1 Outline

In the field completion, checking and correction were made on important items regarding topography, land features, annotations and function symbols to be expressed on the compilation manuscripts as well as on uncertain items unable to confirm during the course of the compilation work. Further, supplementary survey was conducted on major changes after aerial photography.

2-11-2 Preparatory Work in Japan

(1) Plan of the field completion work was established in consideration of the contents of work, the amount of changes after aerial photography, the work period, the schedule of subsequent work, etc..

(2) Major changes after aerial photography for which supplemental survey was considered necessary were marked.

(3) Sample sheets for printed map and extension were prepared as a draft of the Japanese side.

2-11-3 Field Work

(1) For the field completion, the compilation manuscripts and their copies were carried into the project area, and checking and confirmation proceeded.

(2) As for major changes after photography, frame work of changes was surveyed by traversing and plane table method and supplemented on

diapositives using 1:10,000 aerial photos taken by Philippine side in 1986.

(3) Boundaries of squatter area, park, cemetery and military facilities were also confirmed.

(4) As for the Light Rail Transit shown based on data of the field identification, checking and confirmation were conducted.

(5) Origin and destination of main roads as well as abandoned railway were confirmed.

(6) Road surface and administrative classification was confirmed.

2-11-4 Succeeding Work in Japan

(1) Results of the field completion were incorporated in the compilation manuscripts for preparation of original manuscripts.

(2) Proof correction of ground control data sheets and annotation data sheets was carried out for the succeeding drafting work.

(3) Matching between each sheet on which results of the field completion had been incorporated, was inspected. Inconsistency which might exist among the related data obtained during field completion, was also inspected. Possible omission of features to be expressed on the compilation manuscripts was checked.

2-12 Drafting

2-12-1 Outline

Scribing was done for each color using completed compilation manuscript to develop original drafting manuscript in accordance with the Metro Manila map symbol specifications.

2-12-2 Preparation of Scribed Sheet

(1) Image printing on scribing base

Scribe plates were prepared by photo-processing of scribing base coated with diazo solution, on which the reversed image of the original manuscript were printed.

(2) Preparation of scribe plates

Scribe plates were developed respectively for each color in accordance with the specification of map symbol and specifications covering roads, railways, buildings, rivers, contour lines, longitudinal and latitudinal lines, etc.. For register on plate making and printing, cross mark was printed at each center of four sides of margin and "L" shape mark was printed at each of four corners of neat line.
To make the connection of features drawn by different color smooth, scribing was done in the following method:

- Scribing was done in the order of black, blue, blackish blue and brown sheets.
- Contents of already scribed sheet were printed in different color on the next sheet to be scribed.
- Then, scribing of the next sheet was done.

(3) Preparation of mask plates

To make accurate peeling, two kinds of materials were employed for masking, one was Daylight peel coat, on which vegetation boundary sheet of the original manuscript could be printed, and the other was the same but the vegetation boundary sheet could not be printed. The former was used for complicated vegetation boundary sheet. The latter was for not complicated one. And the marks for registration were printed at 8 points as same as the scribe plates were printed.

(4) Preparation of Zip-a-tone sheet

Zip-a-tone sheets for crop land, rice field, broadleaf, etc., whose size is same as the size of map sheet (3' x 3'), were prepared, based on the specifications of map symbols, by photo-processing of enlarging original smaller size of zip-a-tone sheet.

(5) Preparation of marginal information sheet and annotation sheet

Marginal information sheets were developed, based upon the sample sheet finalized through a series of discussions between both sides, with polyester base using photo-lettering for presenting common items of marginal information as well as compiling legend, diagram, etc..
Annotation sheet for black were prepared by reproducing positive film of each marginal information sheet. The polyester base with 8 marks for register was employed to produce the annotation sheet by stick-up of photo-typed symbols and letters for blue

2-12-3 Checking by BCGS

Checking was conducted by BCGS Chief Counterpart on contoured maps and planimetric maps on the surprints.

2-13 Printing

2-13-1 Outline

Printing of contoured maps was performed by off-set method of multicolor printing. Planimetric maps were printed by combining two colors of plate separation that were produced in the course of the contoured map printing.

As printing is the final stage for completing the entire work, proof prints were prepared to make the in-office quality inspection and BCGS checking for attaining perfection in prior to the final printing.

2-13-2 Printing of Contoured Map

(1) Preparation of printing plates

Scribe plates, mask plates and annotation plates were developed for each of five colors (black, blackish blue, blue, brown and green) by multiprinting of scribed bases on aluminum PS sheets.)

(2) Preparation of proof prints

Proof prints were prepared for each of five colors by using two-color lithographic printing press.

2-13-3 Printing of Planimetric Map

(1) Preparation of printing plates

Scribe plates, mask plates and annotation plates were combined by multi-printing into 2-color (black and blue) separation plates.

(2) Preparation of proof prints

Proof prints using 2 colors were prepared by 2-color lithographic printing press.

2-13-4 Inspection (Proof Prints)

Inspection was carefully conducted on whether the results of printing met the specifications or not, regarding color tone, meeting points between differently colored lines, etc. by using the proof prints. Also, those were checked by the BCGS Chief Counterpart and Surveying Technical Center.

2-13-5 Printing

The printing of contoured map (5 colors) and planimetric map (2 colors) was conducted by off -set method using each color separation plate.

2-14 Technical Meeting with BCGS

2-14-1 The 1st year

(1) Meeting at the ground control point survey and field identification (contoured and planimetric maps) (July 29 - October 1985)

a) Contoured and planimetric maps
Revision on supplement of symbols and specifications were proposed by BCGS. Both sides agreed to make further consideration on the matters so as to be convenient for map users. Concerning color scheme for printing map, both sides agreed to study on the basis of sample maps at next opportunity.

b) Ground control point survey
As for the existing ground control points and bench marks, the point distribution, present condition of maintenance, accuracy, etc. were reported by BCGS. Based on the report, the detailed operation plans for ground control point survey, pricking, etc. were established. Concurrently, the undertaking of BCGS was confirmed.

2-14-2 The 2nd Year

(1) Meetings at survey on general aspect (June 16 - 25 1986)

a) BCGS proposal regarding technical matters including classifications of road surface and plantation (6 items) were accepted by the Japanese side on the condition that BCGS would provide necessary data and materials by September '86.

b) Regarding the contoured and planimetric maps, representation of details, color tone, marginal information, etc. were discussed and finalized based upon the sample maps prepared by the Japanese side.

c) Discussions were also made on the matters including corrections of the major changes after aerial photography, possible measures for changes of names of roads, public facilities, administrative organizations which might be taken place due to the 1986 Philippine Revolution.

d) As for the acquisition of magnetic and true north data, and of the aerial photo maps of 1986, the cooperation of BCGS was confirmed.

(2) Meetings at the field completion (August 18 - October 7 1986)

a) Contoured map
The specifications for map symbols, annotation, sheet extension, printing, color tone, marginal information, etc. were finalized.

b) Planimetric map utilization of printing plates of the contoured map was agreed.

2-15 Cooperation of the Philippine Side

BCGS made close cooperation in the field work. BCGS experts were assigned to the field parties and conducted their duties.

In response to the request of JICA survey teams, at the same time, BCGS provided data and information as well as conducted independently the assigned field works.

2-16 Inspection of Results

(1) On the basis of surprints which were confirmed by BCGS counterpart, the final inspection was made by the surveying Technical Center of Japan Surveyors Association (an orthorized public inspection organization of Japan).

(2) After the printing, the whole printed copies of contoured and planimetric maps were also inspected by the Survey Technical Center.

3. LAND USE MAP

3-1 Outline of Work

3-1-1 Outline

The land use map is a multi-color map showing detailed classification of the existing land use, presented on the 1:10,000 base map. This will be used as a basic information of survey and planning for upgrading of land use.

The work flow is as shown in Fig. 3-1.

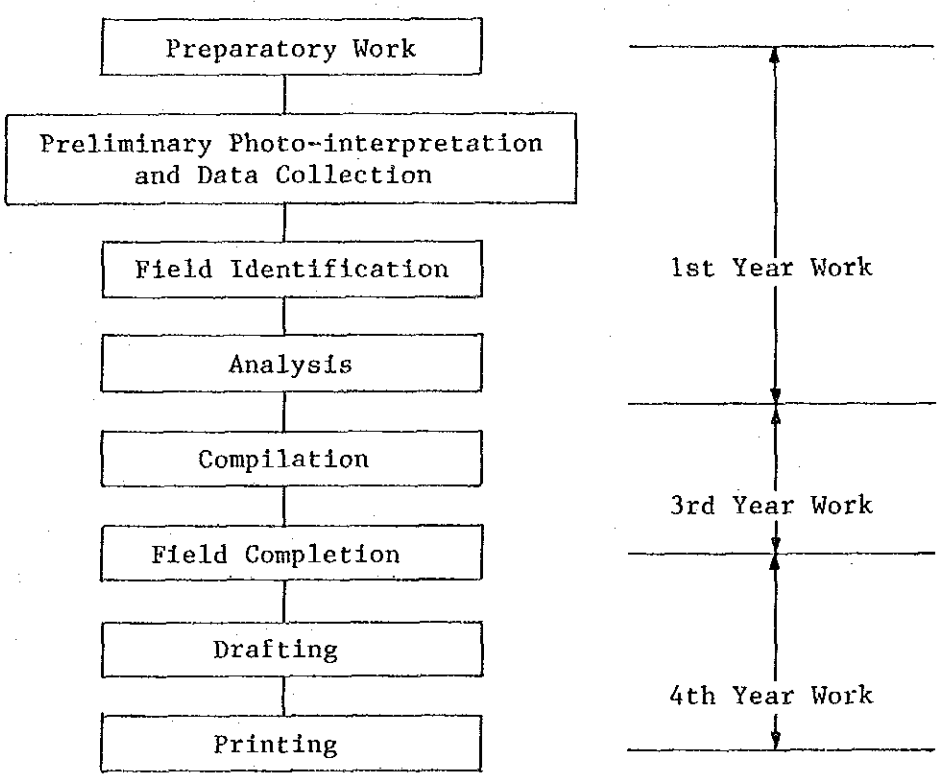


Fig. 3-1 Work Flow of Land Use Mapping

3-1-2 Achievement

Field survey	823 km^2	
Compilation	823 km^2	33 sheets
Field completion	823 km^2	33 sheets
Scribing	823 km^2	33 sheets
Printing	33 sheets	1,000 copies

3-1-3 Preparation of Symbols and Specifications

With regard to preparation of symbols and specifications, the following items were considered.

(1) Symbols and specifications shall be applied as a basic information for upgrading and developing project in Metro Manila area such as land development and preservation, disaster prevention, City planning, etc.

(2) On the basis of the object mentioned above, the existing land use of entire area shall be classified into minimum homogeneus land without exception.

(3) It shall be considered that there is difference in the regional land use characters such as built-up area, forest and farm area, water surface and others.

(4) In three (3) or more story tenanted building, where usage in each floor is different from each other, category "Mixed" shall be applied for classification.

(5) For consideration on the selection of the color to make land use features easily identifiable, reddish and brownish shall be applied for built-up area, greenish shall be applied for park, forest, etc.

(6) Topographic feautres printed on the base map shall be identified together with land use.

3-2 Preparatory Work in Japan

3-2-1 Outline

The preparation of criteria for compilation and review on symbols and specifications was carried out and the sample map for drafting and printing to be used for technical discussion to determine details was prepared.

3-2-2 Preparation of Criteria for Compilation and Review on Symbols and Specifications

On the basis of the draft symbols and specifications prescribed in the Implementing Arrangement (I/A), categories for classification of lands and buildings, definitions and applications were studied. Consequently detailed draft of symbols and specifications were prepared.

3-2-3 Preparation of Sample Map for Printing

Two typical areas presenting characteristic land usage in the project area were selected and the sample map were prepared for each area.

For the preparation of final sample maps, studies were made on several trial sheets, taking the following into considerations:

(1) Color scheme which enable clear classification
(2) Harmonious map presentation as a whole

3-2-4 Preparation of Information and Usage

To attain better and effective usage for map users, the information and usage of the land use map was drafted.

3-2-5 Preliminary Photo-interpretation

(1) Preliminary photo-interpretation at the time of field identification was conducted based on the aerial photographs taken in 1982. However, the result was not fully sufficient due to some changes brought about after photography.

(2) Uncertain items found in the course of compilation work as well as items to be confirmed in the field were marked.
Changes in the large-scale land use, the artificial deformation due to housing development, etc. were marked by referring to aerial photomaps made in 1986.

3-3 Field Identification

3-3-1 Outline

In conducting field identification for land use map, the specifications (draft) prepared by the Japanese side based on the land use classification prescribed in the I/A were discussed with BCGS. Based on the results of discussions, the present land use was surveyed and classified.

3-3-2 Field Identification

The field identification for land use was conducted in parallel with that for contoured mapping, taking the results of preliminary photo-interpretation conducted for contoured mapping into consideration. As the survey covered the built-up section of the Manila metropolitan area, a detailed land use classification had to be employed. Field identification was carried out by carrying the classification key prepared on the basis of the map specifications.

While virtually no problem was encountered in residential areas, identification of the use of buildings of two stories or more in commercial-residential areas and in industry-residential areas proved to be difficult as almost all the buildings in these areas were being used for multiple purposes. It was also difficult to ascertain the condition of those areas purposes. It was also difficult to ascertain the condition of those areas enclosed by fence, wall, etc. These areas were surveyed by means of interviewing conducted by counterparts.

The land use patterns were classified on the aerial photographs using the unified abbreviations, they were checked with the results of field identification for contoured mapping.

Changes in classification were proposed by BCGS when the survey was halfway through, it was necessary to survey motels, TV-radio stations, agricultural warehouses, animal food plants, etc. once again when supplementary identification was carried out. Also, it was requested just before the completion of the field work to add commercial-business areas to the classification.

3-4 Compilation

3-4-1 Outline

The compilation manuscripts for the land use map were prepared on the basis of the survey results in accordance with symbols and specifications.

3-4-2 Preparation of Base Map

(1) For the compilation, scribed sheets, which had been made for the contoured map production, were employed for the preparation of base maps which the land use boundary and classification symbols were printed in the black, and topography and the planimetric features in green and brown respectively.
Also, shrinkproof polyester base (#500) sheets were employed.

(2) For the easy correction of land use boundaries and symbols to be plotted on the surface of the base map, the topography and planimetric features were printed on the back.

(3) For the land use boundaries for vegetation, vegetation boundary lines were printed in black on the surface of the base map using the vegetation boundary plates of the contoured map.

3-4-3 Compilation

The compilation manuscripts of the land use maps were prepared using the base map on which the land use boundaries and land use classification symbols were plotted. The work was conducted using aerial photographs on which the results of the field identification were incorporated while being based on the symbols and specifications.

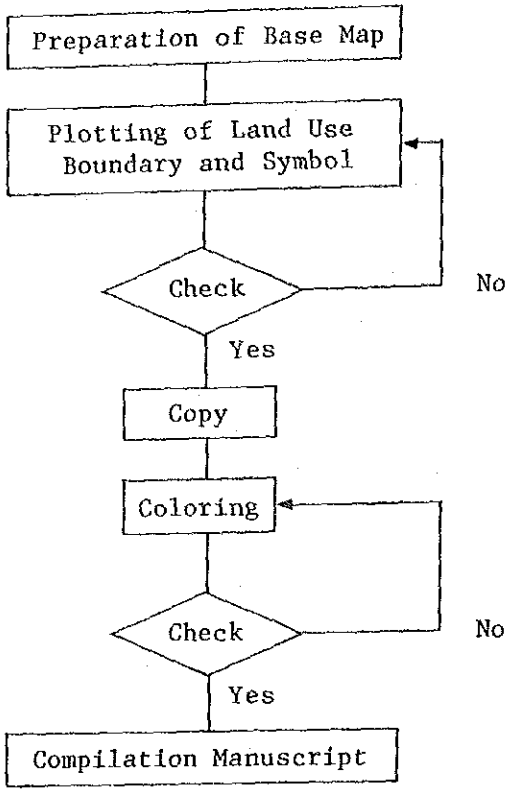


Fig. 3-2 Work Flow of Compilation (Land Use Map)

3-4-4 Items of Compilation

(1) Land use boundary

(2) Classification Symbols

3-4-5 Utilization of Contoured Map and Aerial Photographs

In the later part of the 1st year field identification as well as in the 2nd year work, the symbols and specifications for the land use maps were partly corrected. Therefore, some of the classification symbols plotted on the aerial photos used for the field identification did not correspond to those of the specifications. Furthermore, changes after aerial photography had not been corrected. Thus, in the compilation, the items to be possible to correct were compiled using the contoured map and the aerial photos, and other items to be surveyed in the field completion were marked on the manuscript copies.

(1) Utilization of contoured map

As to the contoured map, stereo-plotting were conducted on the basis of the aerial photographs taken in 1982 and the changes after aerial photography were corrected in the field completion in September 1986. Among the classification items for which the symbols and specifications were changed after the field identification for land use map (conducted in 1985), those items already surveyed in the contoured mapping were classified on the basis of the contoured map.

(2) Utilization of aerial photographs

It is so important for the land use map to present the state of detailed land use such as small-scale housing development that correction was made for even small changes of area, unlike for the case for contoured mapping.
Aerial photomaps (1:10,000) made in 1986 by the Philippine Government were utilized for selecting the changes of features to be corrected and for plotting them on the manuscripts.

3-4-6 Details of Compilation

(1) The vegetation boundaries printed on the surface of base map were used for plotting the land use boundaries.

(2) Land use boundaries were plotted as follows:

1) Distinct land use boundary ——— solid line
2) Under construction, artificial deformation ----- broken line

(3) Where land use boundary lines coincide with double line roads, alleys, railways, canals, embankments, revetments, salt beds, marine ponds, tops of landslides, walls and fences, etc., the land use boundaries were deleted.

(4) At the toe of landslide, cut and banked up slope, land use boundary was delineated if necessary.

(5) Only the area presented as temporary housing on the contoured map was presented as temporary housing area.

(6) Land use boundaries in the generalized area were delineated by tracing method, using aerial photomaps (1986).

(7) Land use boundaries in the built-up area was delineated following the outline of building presented on the base map as much as possible.

(8) Narrow foot-path and water way running between marine ponds or salt beds distributed in the coastal low land were included in the marine ponds or salt beds.

(9) In the compounds of parks or schools, facilities with different usage were classified according to each usage.

(10) Double line road was not colored.

3-4-7 Coloring

From the compilation manuscripts on which the land use boundries and classification symbols were completely plotted, copies (Delmina SSP) were prepared and colored in pencil, in accordance with the specified color assignment.

3-4-8 Inspection

The compilation manuscripts were checked and corrected on the overlaid papers through the collation with the aerial photos used for field identification and the contoured map.

For the colored compilation manuscripts, mistakes and omission of color were corrected on the overlaid papers.

3-5 Field Completion

3-5-1 Outline

The field completion was carried out for the clarification of

questionable matters brought out in the compilation of manuscripts as well as for the confirmation of classification items which might be revised according to change of classification criteria.

Final technical discussions with BCGS regarding the completion of the land use maps, including confirmation of the contents of information and usage (draft), were also conducted in Manila.

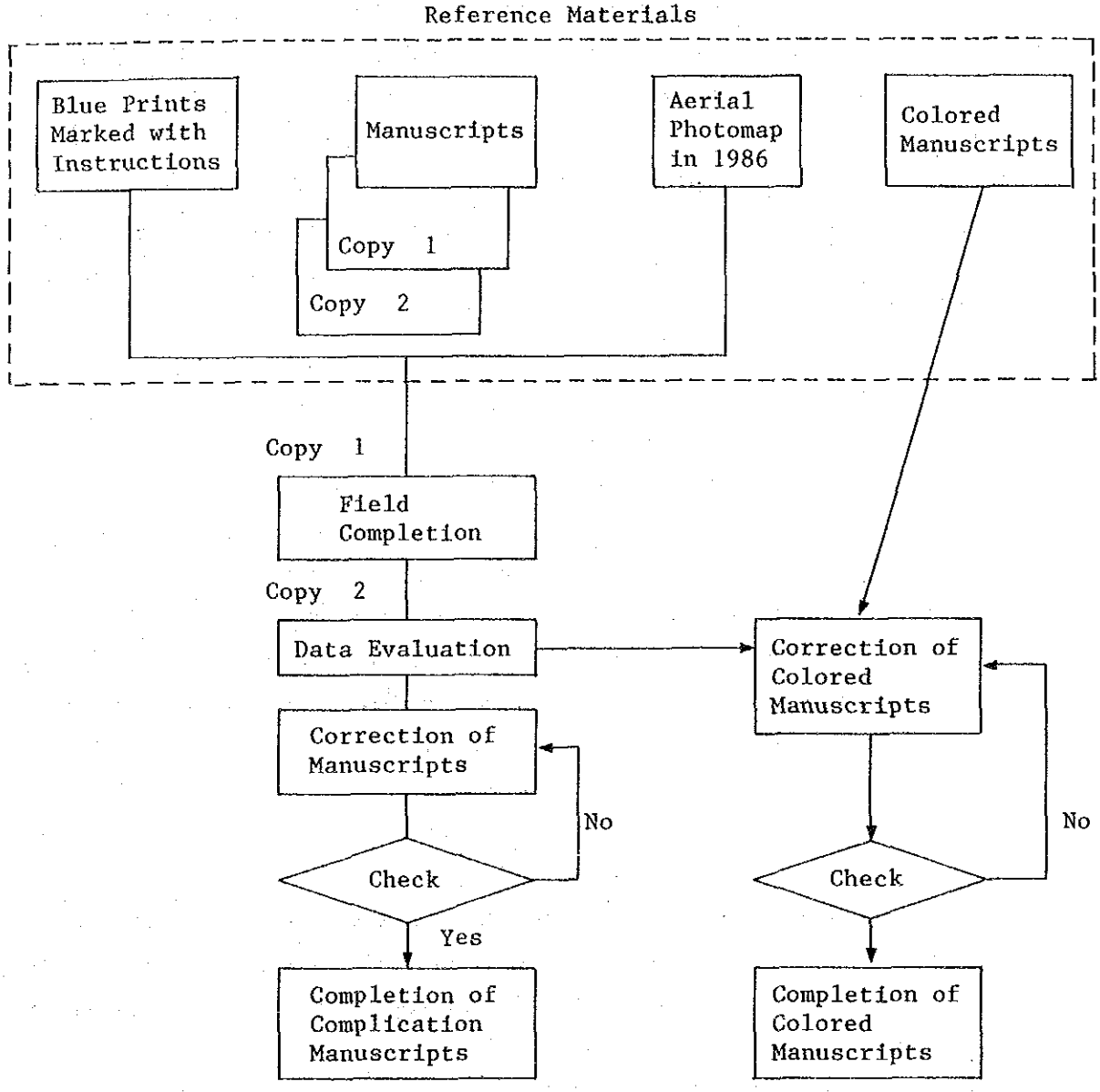


Fig. 3-3 Work Flow of Field Completion (Land Use Map)

3-5-2 Field Completion

Uncertain items and other items to be verified according to changes of classification criteria were marked on copies of the manuscripts prepared in Japan. Not only survey and verification on those items but also overall checks on the compilation manuscripts were conducted in the field completion.

To attain unified understanding on map symbols and uniformed accuracy of classification, the survey team members conducted field study on detailed criteria for classification at several sample areas.

Three (3)- or more story buildings were needed to survey one by one. Therefore, survey was conducted on foot in the areas where these 3- or more story buildings were located in such congested areas as Manila, Makati, Quezon City, etc., the central part of cities and towns in the surrounding areas, and the congested areas along the highways.

3-5-3 Changes after Aerial Photography

Regarding changes brought about until March 1986, results of the field indentification (1985) were corrected by photo interpretation of the aerial photomaps made in March 1986. Subsequent new changes in land use were surveyed and confirmed in the field completion as much as possible.

As a result, most of changes brought about during the period from the contoured mapping to the field completion (October, 1987) were corrected in respect with the central part of the city area.

3-5-4 Arrangements of Field Completion Results

Results of the field completion were filled in on copies of the compilation manuscripts. According the copies, the compilation manuscripts and the colored manuscripts were corrected and confirmed. These manuscripts were presented to and agreed with BCGS.

After the field completion, the following work was conducted in Japan:

(1) Compilation of the corrected items of changes after aerial photography

(2) Correction by the aerial photomap (1986)

Due to the fact that the correction of changes brought about after the contoured mapping was made based on the aerial photo map (1986), it became necessary to correct the printing plates of contoured map for the production of the base map.

Items to be corrected for the base map were arranged in consideration of conformity with the land use and land condition maps.

3-6 Drafting

3-6-1 Outline

Separation plates for multi-color press printing were prepared by color separation scribing method utilizing scribed sheet prepared for contoured and planimetric maps in the 2nd year work and compilation manuscripts prepared for land use map in the third year work.

As regard to information and usage of land use map printed on the back of each map sheets, details were discussed based on the draft prepared in the 3rd year work and finally agreed in the 4th year work.

3-6-2 Symbols and Marginal Information

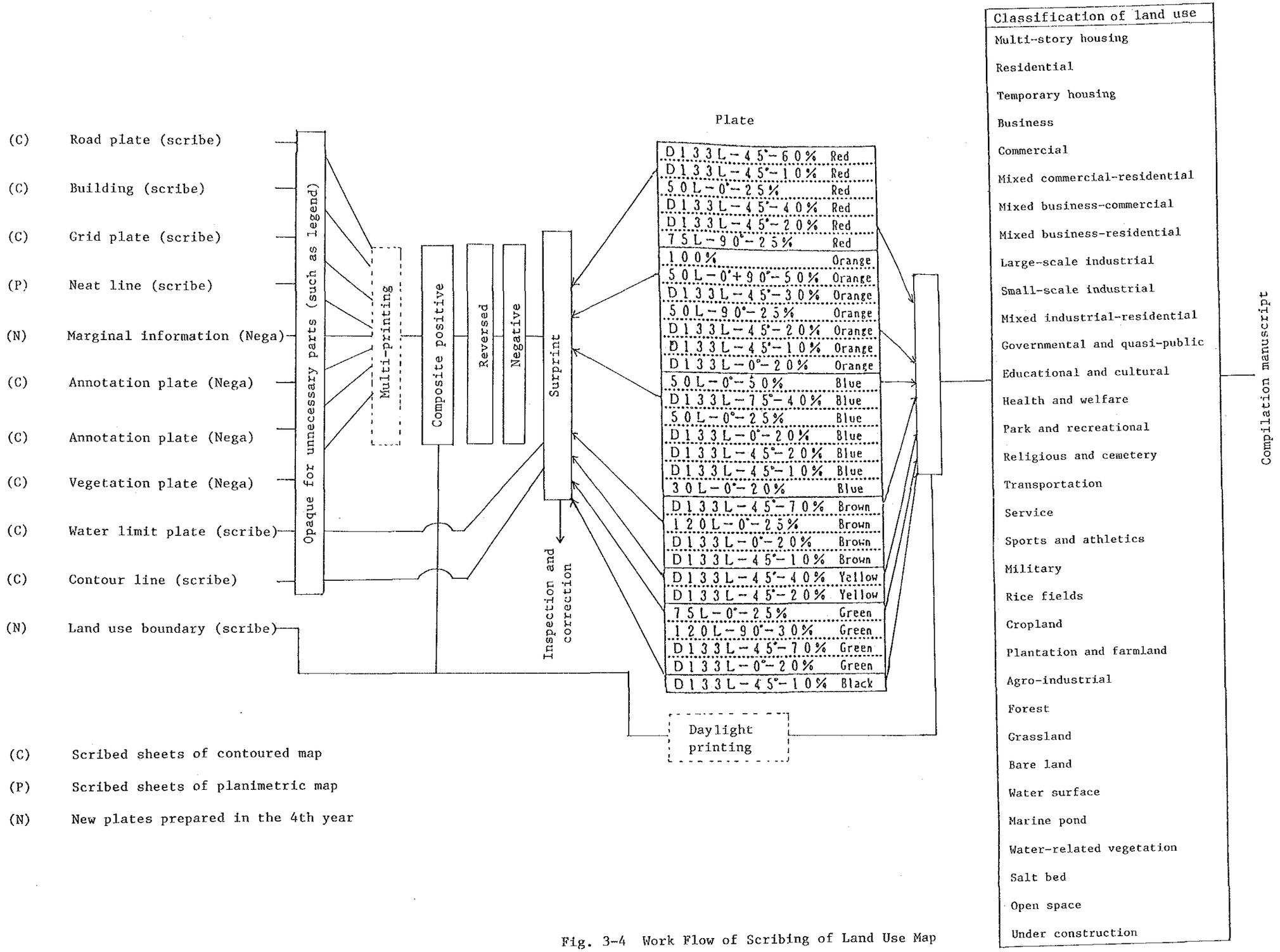
Symbols and marginal information were prepared in accordance with agreement of thechnical discussions confirmed with BCGS.

The work was carried out according to the work flow of scribing of land use map (Fig. 3-4).

3-6-3 Materials

Following shrinkproof were used for scribing.

a) Scribe base (0.12 mm thick) Yellow base of K & E
b) Mask base (0.12 mm thick) Red daylight peel coat of K & E
c) Mask base (0.12 mm thick) Red peel coat of Kimoto
d) Zip-a-tone nega (0.1 mm thick) Vo. 100 of Fuji Film
e) Negative film (0.1 mm thick) Vo. 100 of Fuji Film
f) Annotation sheet base (0.08 mm thick) Diamat of Kimoto



(C) Scribed sheets of contoured map

(P) Scribed sheets of planimetric map

(N) New plates prepared in the 4th year

Fig. 3-4 Work Flow of Scribing of Land Use Map

3-6-4 Drafting

As to the base maps, land use classification, information and usage, etc., the scribed sheets for 8 color (surface: 7 colors, back: 1 color) printing were prepared by scribing, masking, and photo processing.

(1) Preparation of base map for land use map

The base map was prepared using the scribed sheets of the contoured and planimetric maps completed in the 2nd year as well as using the plates of land use boundary, marginal information, etc. which were newly prepared.
The description of these plates were as follows:

1) Sheets used for the contoured and planimetric maps

a) Neat line plate (black annotation plate):
omit legend (mask) (Black)

b) Building plate:
omit legend (leave lighthouse) (Black)

c) Road plate:
omit legend (mask) (Black)

d) Vegetation plate (include symbols, sand, soil, etc.):
omit legend (mask) (Black)

e) Grid plate:
to be used as they are (Black)

f) Water limit plate and depth curve plate:
omit legend as well as radio, WT, SP, oil when they were scribed (Blue)

g) Contour line plate:
omit legend (mask) (Brown)

h) Annotation plate (blue):
omit legend, radio, WT, SP, oil (Black)

i) Annotation plate (black):
omit legend, title, note, index to adjoining sheets (mask) (Black)

j) Water sphere plate (include MP, salt Bed):
(Blue)

2) New sheets

a) Marginal information plate (legend, note, title, index to adjoining sheet, diagram):
Index to adjoining sheet shall be reduced to 5 cm width. (Black)

b) Water sphere plate:
(Blue)

c) Land use boundary plate:
(Red)

(2) Preparation of mask plates for land use classification

In order to representing 33 items of land use classification, the mask plates were prepared by combination of jip-a-tone plates, screen plates, etc. and using day light peel coat or strip coat. The land use classification was represented by combination of 31 kinds of zip-a-tone plates, screen plates, etc. on the basis of 7 colors. The combinations are shown in Table 3-1.

(3) Information and usage of land use map

The printing plates for "information and usage" were prepared by photo lettering, inking, etc.

(4) Matching

For matching, the direct matching to adjoining sheet, was conducted for both of scribed and mask plates.

(5) In-office inspection

In-office inspection of the scribed sheets of land use map was conducted as to the registration of each color plate, condition of mask plates, matching of adjoining sheets, etc. using the surprints (multi-color composite positives made by photo processing).
In comparison with the manuscripts, mistakes in writing, omission, etc. were checked in detail.

Table 3-1 Combination of mask plates for land use classification

Plates		Combination	No.	Usage of classification
D 133L −45° −60%	Red	1	1	Muti-story housing
D 133L −45° −10%	Red	2, 3, 6, 8	2	Residential
50L − 0° −25%	Red	7, 24	3	Temporary housing
D 133L −45° −40%	Red	9, 10	4	Business
D 133L −45° −20%	Red	11	5	Commercial
75L −90° −25%	Red	6	6	Mixed commercial-residential
100%	Orange	4	7	Mixed business-commercial
50L − 0° +90° −50%	Orange	5	8	Mixed business-residential
D 133L −45° −30%	Orange	7	9	Large-scale industry
50L −90° −25%	Orange	8	10	Small-scale industry
D 133L −45° −20%	Orange	18	11	Mixed industrial-residential
D 133L −45° −10%	Orange	20, 23	12	Public and government- Governmental and quasi-public
D 133L − 0° −20%	Orange	13	13	Educational and commercial
50L − 0° −50%	Blue	9	14	Health and welfare
D 133L −75° −40%	Blue	10	15	Park and recreational
50L − 0° −25%	Blue	11	16	Regions and cemetery
D 133L − 0° −20%	Blue	20, 25	17	Transportation
D 133L −45° −20%	Blue	28, 30	18	Service
D 133L −45° −10%	Blue	29, 31	19	Sports and athletics
30L − 0° −20%	Blue	31	20	Military
D 133L −45° −70%	Brown	12	21	Rice Field
120L − 0° −25%	Brown	17	22	Cropland
D 133L − 0° −20%	Brown	18, 19	23	Plantation and farmland
D 133L −45° −10%	Brown	22, 27	24	Agso-industrial
D 133L −45° −40%	Yellow	13, 26	25	Forest
D 133L −45° −20%	Yellow	15, 19	26	Grassland
		21, 22	27	Bare land
		24, 25	28	Water surface
75L − 0° −25%	Green	14	29	Marine land
120L −90° −30%	Green	15	30	Water-related vegetation
D 133L −45° −70%	Green	16	31	Salt bed
D 133L − 0° −20%	Green	26	32	Open space
D 133L −45° −10%	Black	32, 33	33	Under construction

(6) Preparation of plates of zip-a-tone, screen, etc.

As to the plates of zip-a-tone, screen, etc. according to Metro Manila land use map symbol specifications, new plates were prepared by photo processing except plates partly used for the contoured map.

3-7 Printing

3-7-1 Outline

(1) The printing of land use map was conducted on the basis of the sample maps which was agreed in the technical meetings with BCGS in the 3rd year.

(2) The land use map was printed using 7-color separation plates assigned for land use classification

(3) The "information and usage" of land use map was printed on the back of map sheets.

3-7-2 Printing

(1) The multi-color (surface: 7 colors, Back: 1 color) printing was conducted by off-set method.

Before the printing, the in-office inspection and check by BCGS counterparts were conducted on the basis of the proof prints.
The printing was carried out according to the work flow shown in Fig. 3-5.

(2) Printing paper

The paper used for printing was appropriate for folding endurance, tensile breaking strength, low expansion, etc. (90 kg/1000 sheets).

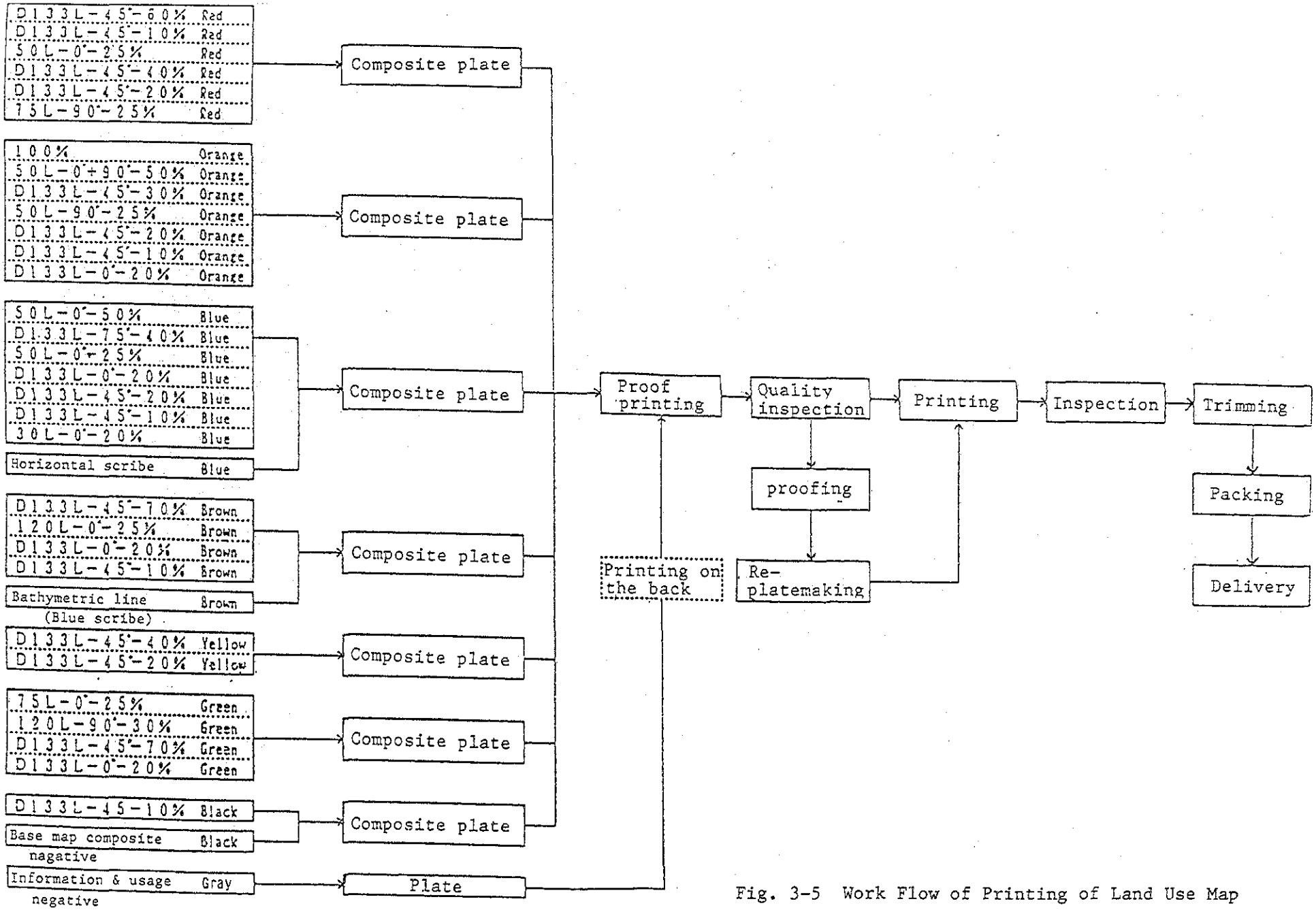


Fig. 3-5 Work Flow of Printing of Land Use Map

(3) Plate making

As for the plate making (8 colors), PS plates were prepared using the composite negatives reversed from the composite positives made from the scribed sheets.

(4) Proof printing

The proof prints were prepared using the printing plates and proof printer mainly for the purpose of inspection.

(5) Printing

The printing was conducted by off-set method using printing plates in 8 colors. (surface: 7 colors, back: 1 color)
The printing was made in red, orange, blue, yellow, green, brown, black and their combinations for the surface sheets, and silver gray for "Information and Usage" on the back.

(6) Protection of printing plates

For the protection of printing plates, plate protective liquid was applied for them after the printing.

(7) Trimming

The printed maps were trimmed to the specified size.

(8) Inspection

The inspection was conducted in detail as to the color tone, registration, size, plotted lines, etc. of the proof print and printed maps.

3-8 Technical Meeting with BCGS

3-8-1 The 1st Year

Meeting at the ground control point survey and field identification (contoured and planimetric maps) (July 29 - October 5 1985)

a) As for the existing land use classification of I/A, the definition, application and applicable symbols for land use map which were prepared by Japanese side were discussed.
Specifications of the preparation of land use map by the combination of color separation plates of contoured map were studied and the "symbols and specifications (draft)" were prepared.

b) As for the above draft, BCGS proposed revisions on the classification and application after commencing the field work. After discussions, some of revisions were accepted and the work was resummed.
The mixed area of business and commercial was added in the classification as new item.
Changes of classification items as for motels, TV stations, radio stations, agricultural warehouses, animal food factories, etc. were agreed to be surveyed at the time of field completion.

c) The standards for a minimum area for representation were discussed and confirmed.

3-8-2 The 2nd Year

Meetings at the field completion (contoured map)
(August 18 - October 7, 1986)

a) The "symbols and specifications (draft)" were further discussed about the definition of land use classification, features to be represented, minimum area for representation, etc.

b) As for color assignment for land use classification, both side agreed to make discussion at the time of field completion.

3-8-3 The 3rd Year

Meetings at the field completion (land use and land condition maps) (October 5 - December 4, 1987)

a) As to the symbols and specifications that had previously been agreed between both sides in general, the categorization, definition, application and the minimum area on the map, etc. were reconfirmed and finalized after partial additions and revisions through discussions between both sides.

b) For detailed specifications of the drafting and printing to be carried out in the 4th year, color scheme, marginal information, etc. were finalized on the basis of sample maps.

c) To attain better and effective usage of the land use and land condition maps, the information and the usage of the maps were discussed and drafted between both sides.

3-8-4 The 4th Year

In the 4th year, the results of the 3rd year discussions and the information and usage to be printed on the back of land use and land condition maps were discussed and agreed with Director Renato B. Feir of NAMRIA, the Philippines. The immediate printing of land use and land condition maps was also agreed.

3-9 Cooperation of the Philippines

During the field work close cooperation was made in the following work:

1) Assignment of qualified BCGS counterparts for the field work
2) Data collection and field confirmation of data

3) Check-up of the compilation manuscripts prepared by the Japanese side (JICA survey team paid particular attention to the opinions of the Philippine side on detailed application and criteria of land use classification.)

4) Technical meeting where active opinions of the Philippine side were presented on the formulation of map specifications for the land use mapping.

3-10 Inspection

(1) Following the inspection on compilation manuscripts in the 3rd year, the proof prints were inspected by the Survey Technique Center of Japanese Association of Surveyors, which is an authorized public organization for inspection of survey results and equipment.

(2) After the printing, the whole printed copies were inspected by the Survey Technique Center.

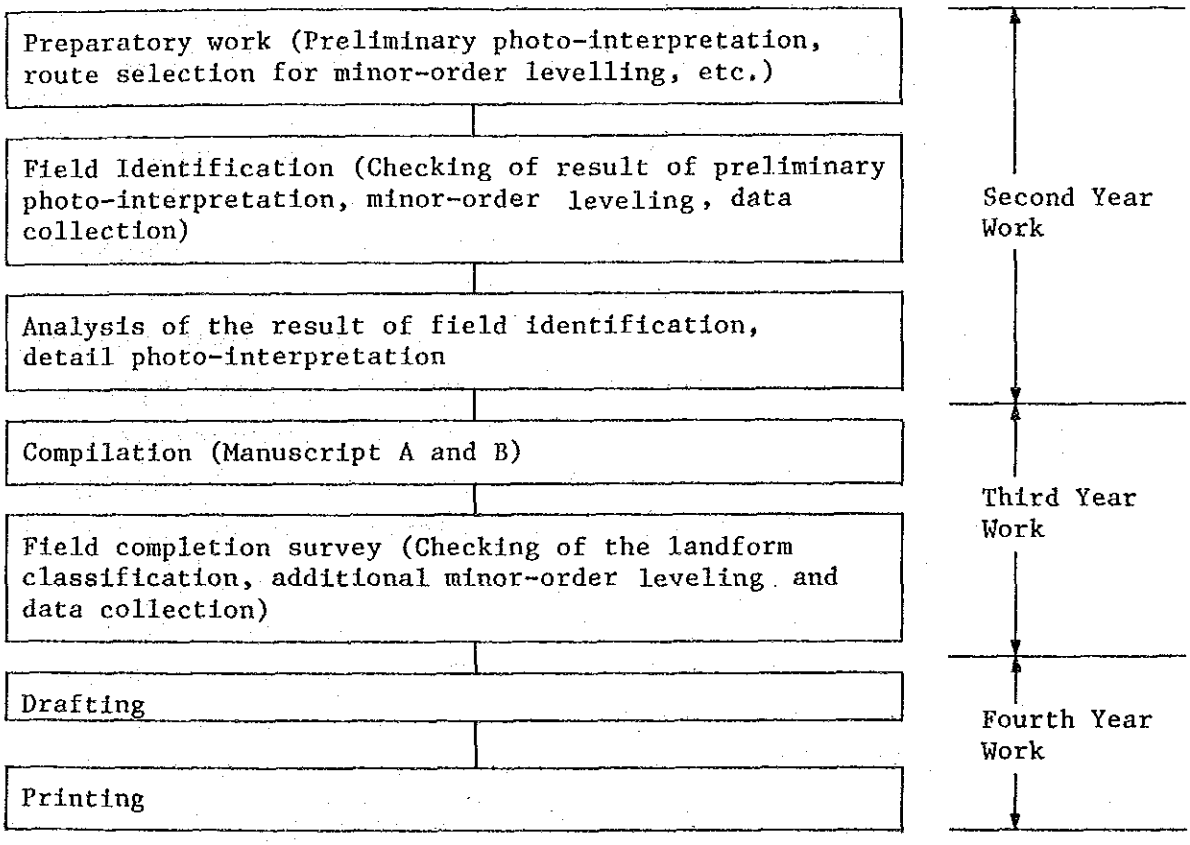
4. LAND CONDITION MAP

4-1 Outline of Work

4-1-1 Outline

The purpose of Land Condition Mapping is to map out the basic conditions of terrain, which are essential for disaster prevention, land conservation, developing planning, etc. Detail information of landform (landform classification, ground height, etc.), the locations of various organizations, agencies and facilities in relation with disaster prevention and development are surveyed and shown on the multi-color printed maps for which 1:10,000 topographic maps are used as base map.

Work-flow is as follow:



Note: Manuscript A: for landform classification and linear-objectives
Manuscript B: for Annotation and Symbols of organizations, agencies and facilities.

Fig. 4-1 Work Flow of Land Condition Mapping

4-1-2 Achievement

Field Identification	429 km^2
Minor-order Leveling	165 km
Compilation	476 km^2 16 sheets (including sea)
Field Completion Survey	429 km^2 16 sheets
Drafting	476 km^2 16 sheets (including sea)
Printing (12 colors for the front of sheet/1 color for the back)	16 sheets 1000 pcs/sheet

4-1-3 Preparation of Map Symbols and Specifications

Map Symbols and Specifications for Metro Manila Land Condition Mapping were constructed in accordance with the following basic policies.

(1) The symbols and specification shall be applied for various upgraded developing projects in the Metro Manila Area such as urban development, conservation, disaster prevention, urban planning, etc.

(2) Landform classification shall be done in such a manner that firstly the survey area is classified into Mountains, hills/plateau or low land as units of large categories, then secondarily respective large category is classified into small categories as detailed as possible in consideration of the regional characteristics of Metro Manila Area as well as the susceptibility for disasters. For example, even in the category of low land, Micro-relief shall be differentiated from other low marshy area according to a little difference in height and components of the surface materials, or how original landform was deformed artificially.

(3) The ground height of the low land mainly located north-west of Manila and in the bottom of Marikina Valley, which corresponds to the area of lower stream of Marikina River up to Laguna de Bay, shall be expressed as detail as possible to clarify the micro-relief topography and its susceptibility for disaster.

(4) The organizations and public facilities, which mainly relate to land development and disaster prevention/relief shall be shown in the map.

(5) For the selection of the color, brown, orange and yellow shall be applied for the landforms which are not so susceptible to disaster, green and blue shall be employed for the landform with susceptibility of disaster and violet shall be used to express escarpments.

(6) The original form of the artificially deformed land in the lowland shall be able to be interpreted from the map.

4-2 Preparatory Work in Japan

4-2-1 Preparatory Work for Field Identification

The following preparatory work were conducted before starting Field Identification.

(1) Preparation of landform classification categories and the draft of criteria for classification.

On the basis of available aerial photograph, topographic maps and other collected data, the landform classification categories and the criteria for its application were drafted. It was taken into account for the classification of landforms to express sufficiently local characteristics of the study area.

(2) Preliminary photo-interpretation

In accordance with the classification categories and the criteria (drafted), which are mentioned above, the interpretation of landform was carried out on 2-time enlargements (scale at 1:16,000) which were taken in 1982. In the course of photo-interpretation, some obscare boundaries of landform were identified mainly on the part of gently sloping hill and plateau with small amplitude as well as micro-relief topography in the low land. Extracted obscare boundaries were ordered as an item to be checked in the field.

(3) Preparation of minor-order leveling

Minor-order leveling was planned to survey the ground height around low land, on the basis of the interpretation of 1:10,000 topographic maps and the analysis of collected materials.
The planned route of minor-leveling covered the low area from Malabon to Bulacan, situated north-west of the City of Manila and another low area from lower part of Mariquina river to Laguna de Bay, where disasters are likely occurred among them by floods and high tides.

4-2-2 Preparatory Work for Field Completion Survey

(1) Preparation of the criteria for compilation and study for the map symbols and applications of Metro Manila Land Condition Map

The symbols and colors necessary for classification in compilation work were studied and decided on the basis of the map symbols and specifications of Metro Manila Land Condition Map which was prepared as a result of discussions held until end of 2nd year work. Revised symbols and specifications were developed based upon the said map symbols and specifications to simplify and clarify the expressions according to the result of serial discussions with Philippine side.

(2) Preparation of printed sample map

Two sheets of printed sample map were prepared which cover typical area where the characteristics of land condition map are able to be observed.

(3) Preparation of "Information and Usage (draft)"

Information and Usage was drafted for the purpose of effective usage of land condition maps by users.

(4) Extraction of the items to be confirmed in the period of field completion work

a) Check points for final determination of landform classification
b) Necessity of complementary survey on expression of ground heights and micro-relief lines in low land.
c) Public organizations and facilities to be confirmed in the field.
d) Other materials to be additionally collected.

4-3 Field Identification

4-3-1 Outline

As land condition map has to show landforms, ground heights, locations of facilities, etc. for disaster prevention measures, election of suitable site for development, etc., the following items were considered in the field work;

a) Checking of surface materials of each landform
b) Minor-order leveling for ground elevations in the low land
c) Collection of materials concerning public organizations and facilities
d) Interviewing and gathering data of boring survey, records on floods in the past, etc.

4-3-2 Field Work

(1) Detail survey of land classification

Observation of micro-relief topography, investigation of outcrops, minor-order leveling hand-augering, etc. were carried out as field work to clarify mainly uncertain spots and boundaries for classifying of lamdform which were extracted during preliminary photo-interpretation.
The observation of micro-relief topography was devoted to identify its physical conditions and components of surface materials.

In the investigation of outcrops, physical conditions of hill and plateau, mountains and mountain foot were mainly surveyed.
In the low land, the physical conditions of surface materials which compose the micro-relief topography were surveyed by hand-augering.
The topographical and regional characteristics of the entire survey area were also observed.
On the basis of the above mentioned detail survey, the obscure spots extracted during preliminary photo-interpretation, were clarified. And the materials collected in the field were analyzed.

(2) Minor-order leveling

a) According to the planned leveling route the final route for leveling was decided by field reconnaissance and in consultation with Philippine side.

b) Leveling was conducted in accordance with JICA Specs. (for developing survey). The basis for the survey are as follows:

Item	Allowance	Remarks
Discrepancy between one existing control point and another point	5 cm $\sqrt{s}$	
Error of closure	5 cm + 4 cm $\sqrt{s}$	S: in km
Max distance of observation	less than 80 m	
Min. reading unit	1.0 mm	
Accuracy of level	40 "/2 mm	
Number of observation	1	one way
Error of pricking	0.2 mm	

c) Minor-order leveling was conducted for about 115 km in the area north-west of Manila as well as about 50 km east of the city.

d) Observation for minor-order leveling

Some of the national bench marks, which were located north-east of Manila and used for contoured mapping as known vertical controls were recognized to have certain anomaly presumably caused by ground subsidence or other reasons. For this matter, the following measures were taken:

- o Inspection of the existing bench marks which were planned to be employed as known controls for the minor-order levelling was carried out by two-way observation. The existing bench marks were RI-2, D-2, BU-1, BU-4, BU-6, BU-7, BU-9, BU-10 and BU-12. (Fig. 4-2)

- o As the result of inspection was not satisfactory for use of those bench marks as known control points from and to which minor-order levelling starts and closes, further inspections among RI-2, GM-3G, GM-P4 and GM-P1 were held. As a result of the further inspection, GM-P1, BU-7 and BU-12 were employed for adjustment computation as known control points. (Table 4-1)

(3) Interviewing

In north-western and east-southern part of the survey area that were specially susceptible for disasters cause by flooding. The relations among flood-disasters, landforms, ground elevations, etc. were clarified by interviewing to the local people on the past disasters brought by flood.

(4) Collection of related materials

The materials, requested by JICA Survey Team to BCGS to prepare at the time of field completion survey for contoured mapping in October 1986, and other necessary data for detail expression were collected.

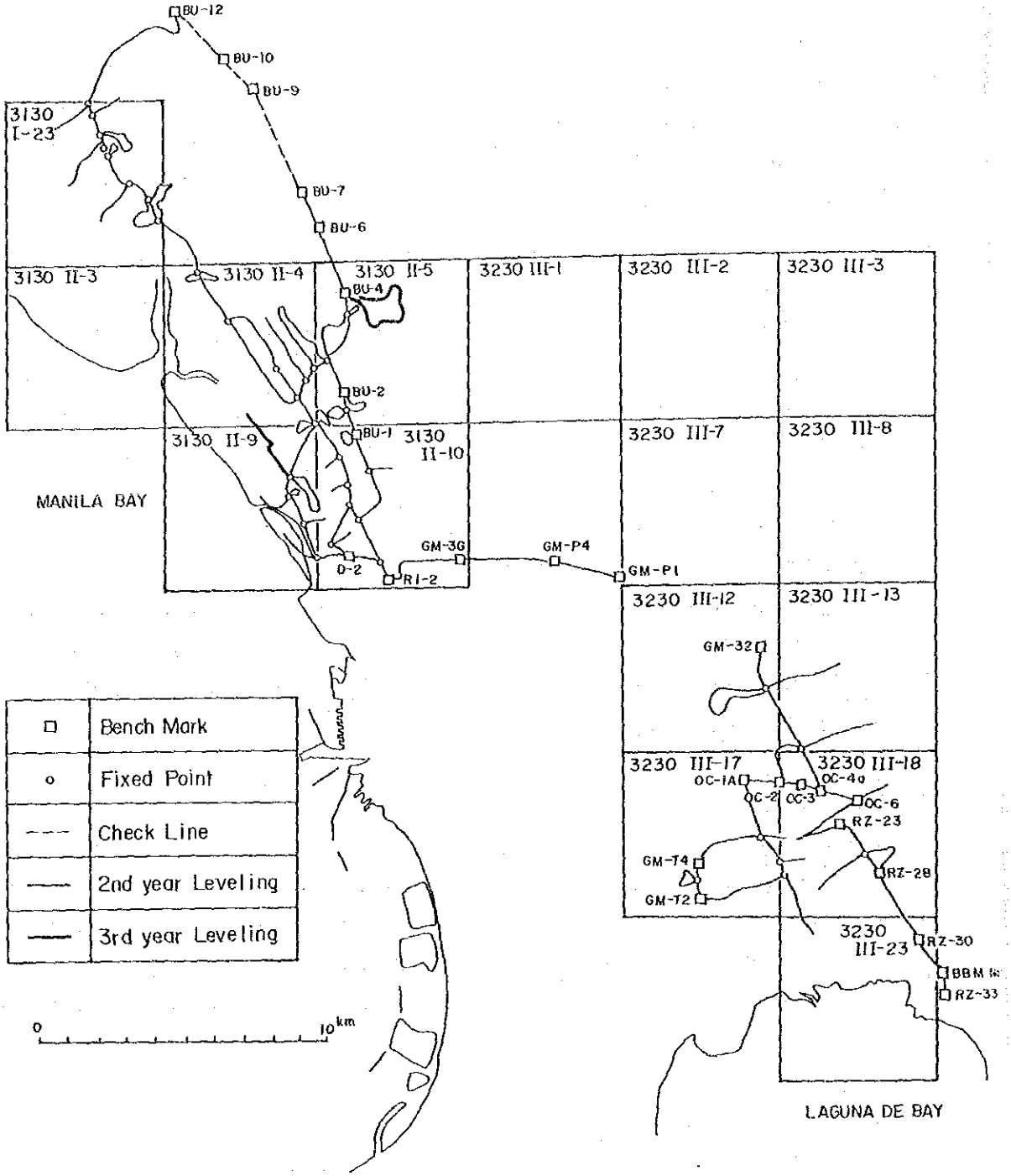


Fig.4-2 Route Map of Minor Order Leveling

(5) Based upon contoured (topographic) maps, various public organizations and facilities (the organizations, agencies and facilities for disaster prevention and development) were confirmed.

4-3-3 Analysis and Detail Photo-interpretation

The following were conducted as in-door work after completing the field work.

(1) Analysis of the results of observation of micro-relief topography, investigation of outcrops and hand-augering
(2) Analysis of collected related maps and literature/documents
(3) Analysis of the results of interviewing on the floods in the past
(4) Analysis of the results of minor-order leveling
(5) Analysis of various organizations and facilities
(6) Analysis of the related data on submarine topography along the coast
(7) Detail aerial photo-interpretation based upon the above listed analyses

Indistinct landform boundary and characteristics of each landform and its surface materials were clarified by the detail photo-interpretation. Then the boundaries for landform classification were ascertained. Old aerial photographs, collected in the field, were helpful among them. The old aerial photographs were taken 20 years ago in 1966-1968 in the scale of 1:15,000.

As the base of landform classification is to recognize orginal form developed naturally, efforts were made to acquire older aerial photographs as much as possible. Then actual landforms including artificially deformed topography, etc. were acquired by comparing them with new photographs.

Table 4-1 Comparison of Elevation of Leveling Points (North-east of Manila)

Points	Results of Minor Order Leveling			BCGS Results		① - ④	② - ③
	Distance	Differences ①	Adjusted Elevation ②	Elevation ③	Differences ④		
	km	m	m	m	m	m	m
GM-P1			43.988	43.988			± 0.000
	1.9	-11.740			-11.710	-0.030	
GM-P4			32.228	32.278			-0.050
	3.2	-9.077			-8.855	-0.222	
GM-3G			23.118	23.423			-0.305
	3.1	-11.042			-10.416	-0.626	
RI-2			12.044	13.007			-0.963
	8.0	-4.967			-4.473	-0.494	
BU-1			6.958	8.534			-1.576
	1.4	-4.609			-5.035	-0.426	
BU-2			2.328	3.499			-1.171
	3.7	-0.019			-0.725	+0.706	
BU-4			2.214	2.774			-0.560
	3.0	+2.391			+1.936	+0.455	
BU-6			4.572	4.710			-0.138
	1.5	-1.535			-1.690	-0.155	
BU-7			3.020	3.020			± 0.000
	2.8	+0.386			+0.373	+0.013	
BU-9				3.393			
	1.3	+0.390			+0.387	+0.003	
BU-10				3.780			
	2.8	-0.644			-0.566	+0.078	
BU-12			3.214	3.214			± 0.000
RI-2			12.044	13.007			-0.963
	2.3	-11.556			-11.832	+0.276	
D-2			0.464	1.175			-0.711

4-4 Compilation

4-4-1 Outline

In accordance with the results and data of the interpretation and field survey completed by previous year, compilation manuscripts A and B were prepared which were subject to the Symbols and Specifications of Metro Manila Land Condition Map.

4-4-2 Preparation of Base Map

The base map for compilation was developed by photographic printing method applying the combination of several printing plates, which were prepared in the course of contoured mapping, to express necessary topography and geographical objects in proper color convenient for succeeding work.

The polyester base (#500) was employed for map sheet, considering shrinkage of the materials.

Topographic features, geographical object, etc. were printed reversely in green on the back of base map to ease and simplify correcting of compiled landform boundary and symbols for various organizations and facilities in black on the front of base map.

4-4-3 Compilation

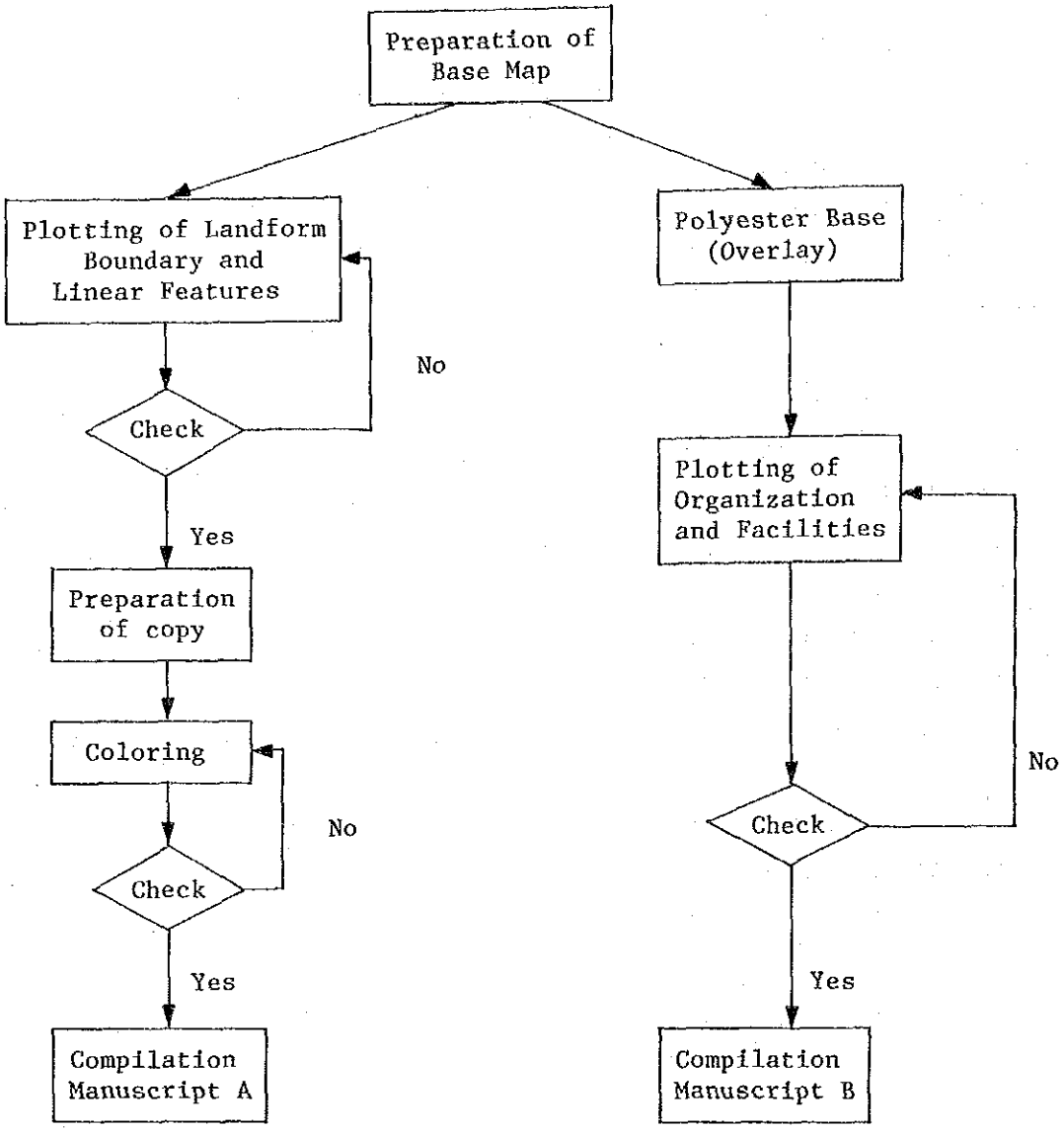


Fig. 4-3 Work Flow of Completion (Land Condition Map)

Compilation manuscript A was developed by describing landform classification boundary, linear objects and symbols for landform classification, based on the Symbols and Specifications of Metro Manila Land Condition Map and in accordance with the aerial photographs on which the results of landform interpretation.

On the other hand, the various organizations and facilities were mapped out on polyester base as the compilation manuscript B, those correspond to the features expressed in contoured maps.

Consequently coloring and symbolizing of classified landforms were carried out, according to specified colors and symbols, on copied sheets of compilation manuscript A to develop colored landform classification maps.

4-4-4 Items To Be Compiled

(1) Boundary and symbols for landform classification
(2) Extraction of public organizations, agencies and facilities
(3) Annotation plate

4-4-5 Detail Items To Be Compiled

(1) For expression, priority was given to linear objects e.g., main roads, railways, water boundary, protected banks, etc. In case these features overlap the boundary of land classification of the base map, the boundary was eliminated.

(2) According to the result of the field work, the classification boundaries of landforms, delineated on the aerial photographs, were transferred on to the base maps, subject to the Symbols and Specifications.

(3) Since land classification was conducted mainly on the basis of the interpretation of aerial photographs, two types of landform boundary were observed. One was distinctly classifiable which was interpreted clearly from turning points of slopes and the other was indistinctly classifiable which is located around gentle slopes and micro-relief topography in the lowland.
Solid line was employed for the photo-identifiable clear landform units and broken line was used for unclear landform units.

(4) Uncertain and/or doubtful boundaries of land classification were extracted to be checked in the filed completion survey.

(5) The organizations and facilities which are common with those of 1:10,000 contoured maps were extracted from them.

(6) The main roads were extracted from 1:10,000 planimetric maps for further discussion with Philippine side in the period of field completion survey.

(7) The following items on sea were set up to be considered in the compilation, those data were provided by Philippine side and selected:

1 Depth curve (1 m interval)
2 Tidal flat (mud)
3 Bar

4-4-6 Coloring

The copied map (Delmina SSP) of compilation manuscripts were produced sheet by sheet in sequence after completing boundarization and symbolization for landform classification. Consequently coloring was conducted with color ink and pencils according to specifications for color separations.

4-4-7 Inspection

The inspection on errors and omissions of landform classification boundary and symbols were carried out, making reference to interpreted aerial photos and collected materials.

4-5 Field Completion

4-5-1 Outline

Field completion was conducted in order to clarify uncertain things for expression of landform boundary which occurred during compilation of manuscripts and confirm the information in the field on various organizations and facilities which were provided by Philippine side.

Also, detail discussions were held with Philippine side for finalizing the Symbols and Specifications for Metro Manila Land Condition Map, matters on scribing and printing and confirmation of "Information and Usage (draft)", etc.

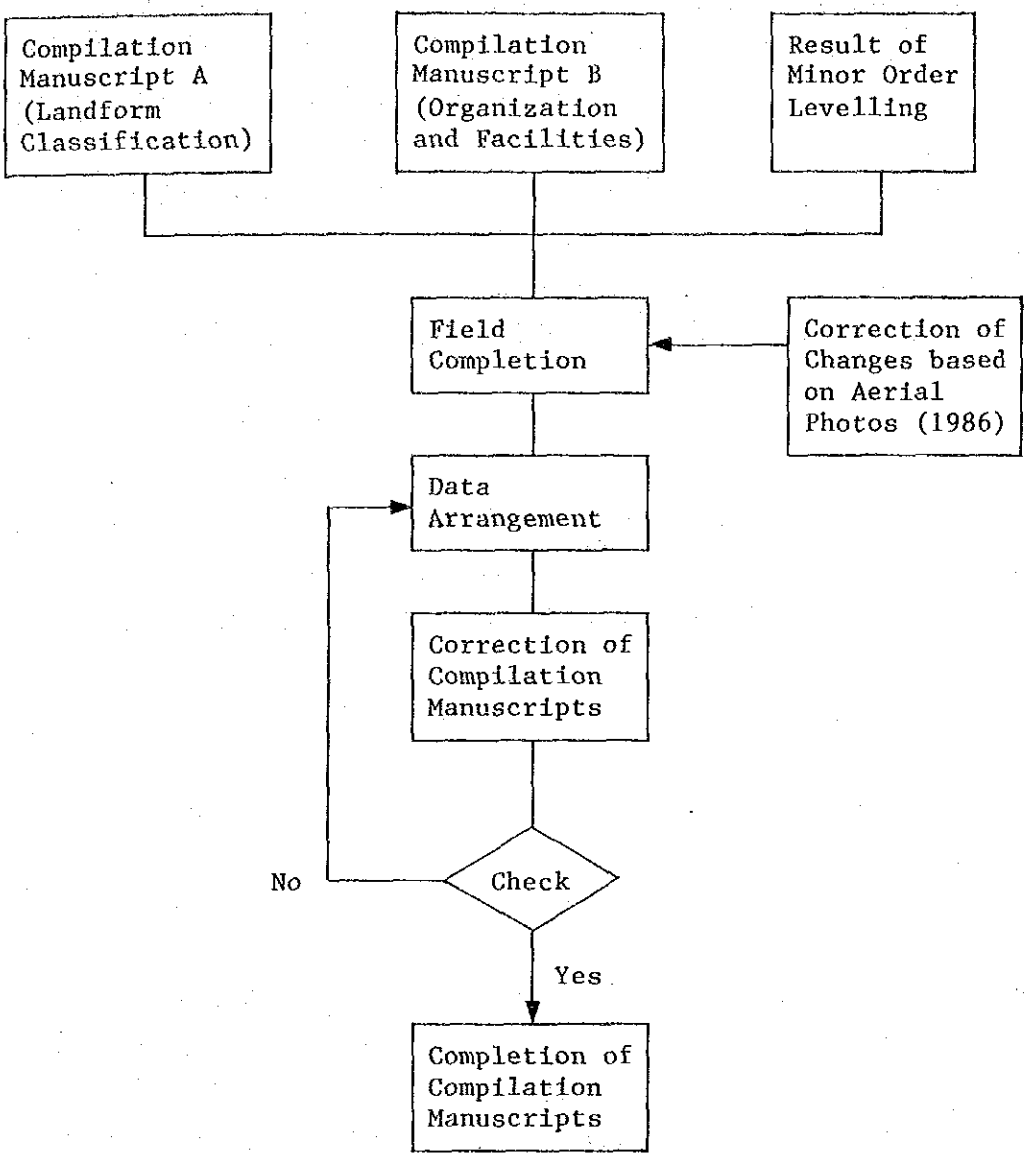


Fig. 4-4 Work Flow of Field Completion (Land Condition Map)

4-5-2 Field Completion (Landform Classification)

The following work was conducted:

(1) Supplemental survey on outcrops in the hill and plateau area
(2) Confirmation of form and distribution of the landform of the foot of mountain and the delta
(3) Confirmation of depth of banked-up surface of artificially deformed land
(4) Confirmation of depth of cut surface of artificially deformed land
(5) Confirmation of relative height of terrace scrap
(6) Confirmation of drainage system in built-up area
(7) Survey on general landform characteristics of each major category

4-5-3 Field Completion (Ground Elevation)

About 8 km of minor-order leveling was carried out, in addition to the volume of minor-order leveling conducted in the second year work, to supplement ground elevations and micro-relief lines in the lowland.

4-5-4 Field Completion (Organization and Facilities)

Data concerning organization and facilities for the land condition map were divided into as follows:

1) Data to be selected from the contoured map (1:10,000)
2) Data to be provided by BCGS

Government building, police station, hospital, church, school, dam, storage tank, etc., which can be selected from the contoured map were plotted on the compilation manuscripts.

Items to be provided by BCGS were water level gauge station, rain gauge station, earthquake observatory, river pumping station, restricted area, dumping area, etc.

The main roads, being considered important for refuge in disaster as well as for land development and conservation, were selected and compiled on the planimetric map (1:10,000) as a draft by and from Japanese side for discussion with BCGS.

In the field completion, emphasis was placed on the following work:

(1) Confirmation of the data provided by BCGS, and another confirmation of existence and locations of the organizations and facilities were conducted by visiting the government departments and authorities concerned.
(2) It was confirmed whether the main roads which had been selected in Japan were passable or not.

4-5-5 Data Collection

Survey reports related to geomorphology and geology in/around Metro Manila, data on organizations and facilities, etc. were collected during the field completion.

4-5-6 Changes after Aerial Photography

Among the changes which was corrected in the land use mapping, housing development area, etc. were classified as artificially deformed land in the land condition map.

4-5-7 Analysis

(1) Field work

Based upon the results of field completion, the compilation manuscript A and interpreted aerial photographs were collected and recompiled, having inspections on correlation between the interpreted aerial photographs and compilation manuscript A for avoiding any omission.
As to organization and facilities, the results of the field completion were plotted on the manuscript. These manuscripts and colored manuscripts were checked and agreed by BCGS.

(2) Indoor work

The following work was carried out in Japan:

a) The landform classification manuscripts and the aerial photographs used for photo-interpretation were checked in consideration of conformity with the changes which were corrected in the land use map.

b) Also, regarding location and symbols, etc. of the organization and facilities, final check was conducted.

c) In lowland areas, north-west and east of Manila and from lower stream of Marikina river to Laguna de Bay, ground elevation points and micro-relief lines (0 m and 1 m interval) were presented by photo-interpretation and stereo plotting employing the results of the minor order leveling and the aerial photographs used for the contoured mapping (Fig. 4-5). In principle, ground elevations were to be plotted in all lowland area covered by alluvium.

4-6 Drafting

4-6-1 Outline

Drafting of Land Condition Map was conducted by scribing method in order to develop original drafting manuscripts for multi-color printing.

In accordance with compilation manuscripts A and B developed in the third year work, the original drafting manuscripts were prepared to produce respective plate with a particular color for printing which correspond to respective symbol for a particular landform class, organization and facility, etc.

The original manuscripts of land use mapping, in which change was corrected, were employed for producing a plate for base map of the land condition map.

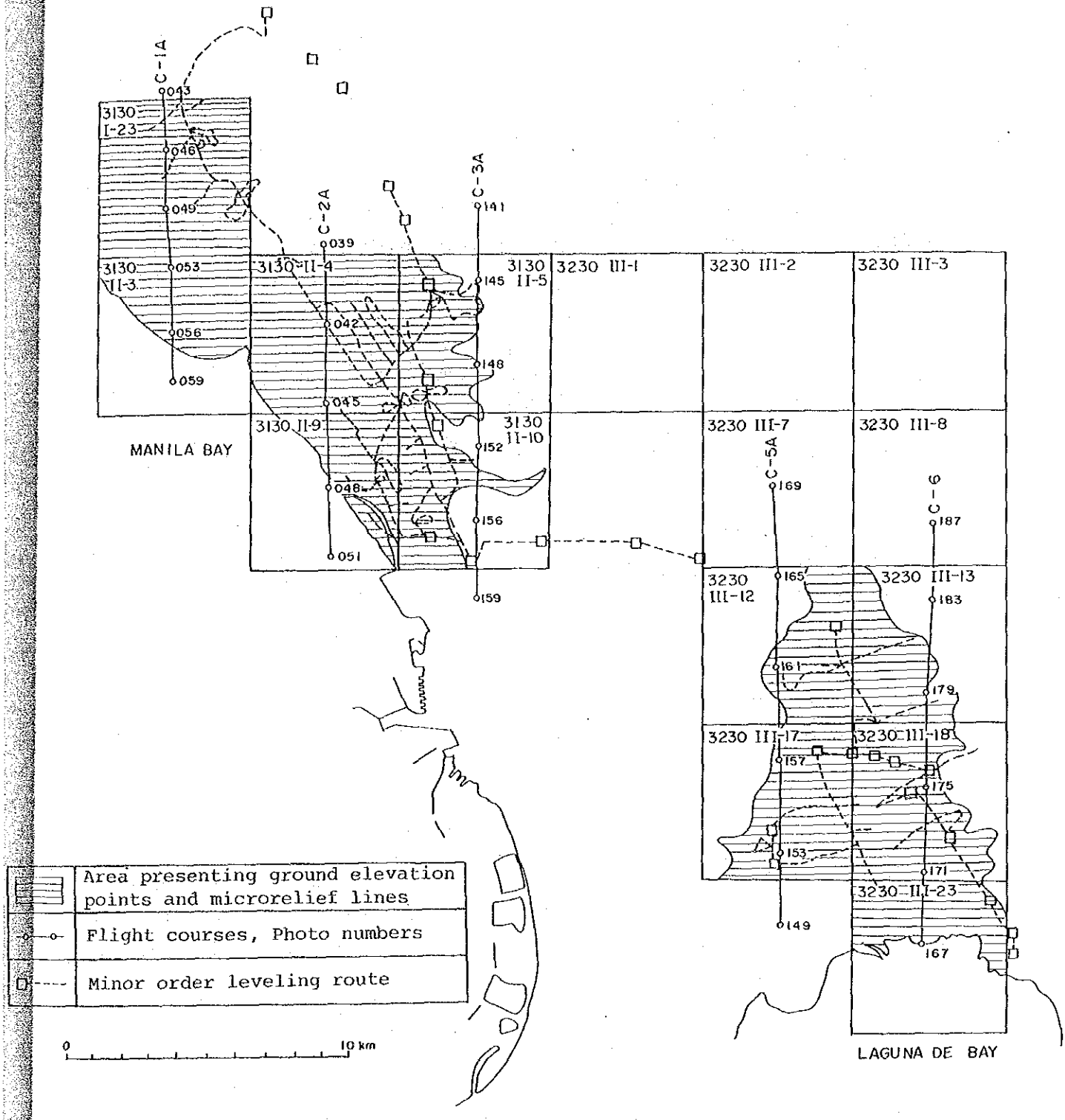


Fig.4-5 Areas Representing Ground Elevation Points and Microrelief Lines (Land Condition Map)

"Information and Usage" to be printed on the back of the map was discussed and finalized in the fourth year on the basis of the draft of it prepared in the third year.

4-6-2 Map Symbols and Marginal Information

Map Symbols and marginal information were based upon the Symbols and Specifications for Metro Manila Land Condition Map.

Drafting was conducted according to the work flow of scribing for land condition mapping. (Fig. 4-6)

4-6-3 Materials

The following materials, whose expansion ratio is extremely small at normal temperature were employed for scribing.

Scribe base	(0.12 mm thick)	Yellow base of K & E
Mask base	(")	Red daylight peel coat K & E
"	(")	Red peel coat of Kimoto
" (negative)	(0.10 mm thick)	Vo. 100 of Fuji Film
Negative film	(")	"
Annotation sheet base	(0.08 mm thick)	Diamat of Kimoto

4-6-4 Drafting

Separation plates for thirteen-color press printing were developed as original manuscripts by scribing, masking and photo-processing of base map, landform classes, "Information and Usage", etc. (12 colors on the front and 1 color on the back).

(1) Preparation of base map for land condition maps

Contoured and planimetric maps, which were developed in second year work and then corrected partly later, were employed for preparation of the base map.

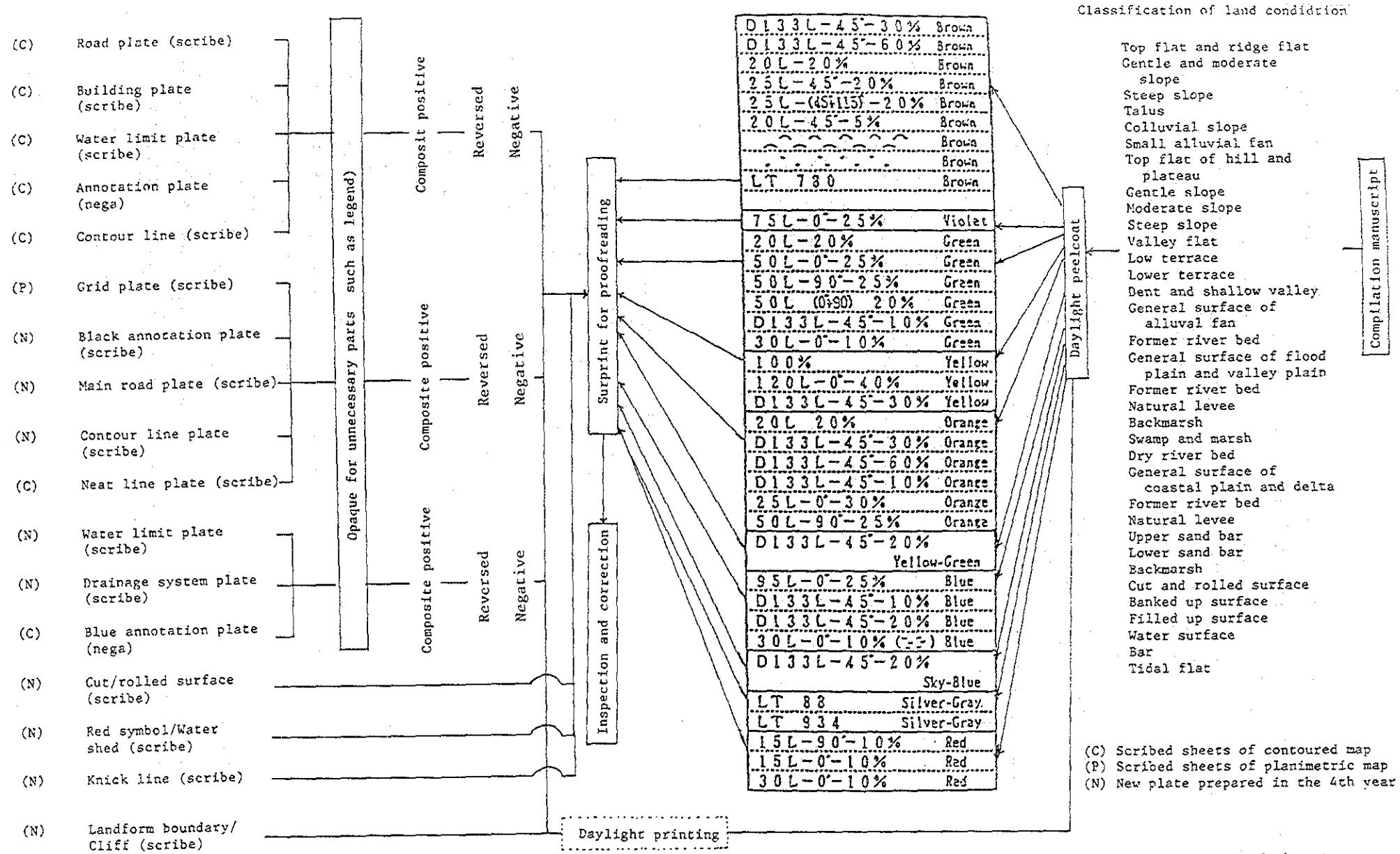


Fig. 4-6 Work Flow of Scribing of Land Condition Map

Employed separation plates from contoured map and planimetric map and newly developed plates are as follows:

1 Employed form contoured and planimetric maps

a)	road plate	: legend omitted	(dark gray)
b)	building plate	: "	(")
c)	Contour line plate	: "	(")
d)	Water limit plate	: "	(")
e)	Sand plate	: "	(")
f)	Mud plate	: "	(")
g)	Grid plate	: 30' grid (planimetric map)	(black)
h)	Water limit plate	: single-line river, salt bed boundary, MP boundary, radio, WT, SP and Oil are to be omitted	(blue)
i)	Neat line plate	:	(black)

2 Newly developed:

a) Dark gray annotation plate:

Two sheets of negatives were produced from a composite positive developed by combining neat plate for contoured map, black annotation plate and black annotation plate. Sticking-out of legend except unnecessary annotations (expressed in black) (dark gray)

b) Black annotation plate:

Sticking-out of ground elevations and marginal information on 2-a composite positive (black)

c) Blue annotation plate:

Legend except the annotations of salt bed and MP on the negatives (blue)

d) Main road plate: Scribing of the symbols of roads, railways, boundaries, etc. from source map of roads (black)

e) Red symbols plate: Scribing of the symbols of dam, wair, protected riverbank, water break, water gate, etc. (red)

f) Drainage systems plate:
Scribing of the symbols of drainage systems, bathymetric line
(blue)

g) Green plate: Scribing of nickline (green)

h) Brown plate: Scribing of the symbols of cut land, rolled land, rolled slope, micro-relief line (brown)

i) Violet plate: Scribing of the symbols of scrap, landform classification boundary, cut slope, area under construction. (violet)

j) Gray plate: Masking of the symbols of only bar and mud
(gray)

k) Water surface plate: (light blue)

(2) Preparation of mask plates for landform classification

The mask plates which differentiate 44 landform types for representation of landform classes were prepared newly by scribing. For nickline, scarp, slided site, cut and rolled slope, etc., scribing was applied for developing of mask plates. And for classification of landforms, the mask plates were developed by combining of screen and plates for symbols with daylight peelcoat or stripcoat.

Table 4-2 Combination of Mask Plates (Land Condition Map)

Type of Screen		No. of Plate	Classification of Land Condition		
			Category I	Plate No.	Category II
D133L-45°-30%	Brown	1, 3	Mountain	1	Top Flat and Ridge Flat
D133L-45°-60%	Brown	2		2	Gentle and Moderate Slope
20L-20%	Brown	6, 7		3	Steep Slope
25L-45°-20%	Brown	10		4	Knick Line (Green Scribe)
25L (45+135)° 20%	Brown	11	Piedmont landform	5	Talus
20L-45°-5%	Brown	16		6	Colluvial Slope
⌒ ⌒ ⌒ ⌒ ⌒	Brown	27		7	Small Alluvial Fan
. . . . .	Brown	28	Hill and plateau	8	Top Flat
LT 780	Brown	23		9	Gentle Slope
				10	Modrate Slope
75L-0°-25%	Violet	3		11	Steep Slope
				12	Valley Flat
20L-20%	Green	6	Terrace	13	Low Terrace
50L-0°-25%	Green	12		14	Lower Terrace
50L-90°-25%	Green	15		15	Dent and Shallow Valley
50L (0+90)° 20%	Green	21, 29	Alluvial fan	16	General Surface of Alluvial Fan
D133L-45°-10%	Green	22		17	Former River Bed
30L-0°-10%	Green	24	Flood plain and valley plain	18	General Surface of Flood Plain and Valley Plain
100%	Yellow	5, 6, 7		19	Former River Bed
120L-0°-40%	Yellow	16		20	Natural Levee
D133L-45°-30%	Yellow	20, 26, 27, 28		21	Backmarsh
				22	Swamp and Marsh
20L 20%	Orange	5		23	Dry River Bed
D133L-45°-30%	Orange	8, 10, 11		24	General Surface of Coastal Plain and Delta
D133L-45°-60%	Orange	9		25	Former River Bed
D133L-45°-10%	Orange	12		26	Natural Levee
25L-0°-30%	Orange	13		27	Upper Sand Bar
50L-90°-25%	Orange	14		28	Lower Sand Bar
				29	Backmarsh
D133L-45°-20%	Yellow-Green	18, 36	unstable slope	30	Cliff (Violet Scribe)
				31	Landslide Scarp (Red Scribe)
95L-0°-25%	Blue	17, 19, 25	Artificially deformed land	32	Cut and Roled Surface
				33	Banked Up Surface
D133L-45°-10%	Blue	24		34	Cut Slope (Violet Scribe)
D133L-45°-20%	Blue	43, 44		35	Banked Up Surface
30L-0°-10% (- - -)	Blue	22		36	Filled Up Surface
				37	Under Construction (Violet Scribe)
D133L-45°-20%	Sky-Blue	40	Others	38	Main Watershed (Red Scribe)
				39	Drainage (Blue Scribe)
LT 88	Silver-Gray	43		40	Water Surface
				41	Landform Boundary (Violet Scribe)
LT 934	Silver-Gray	44		42	Indistinct Landform Boundary (Violet Scribe)
15L-90°-10%	Red	32		43	Bar
15L-0°-10%	Red	33		44	Tidal Flat
30L-0°-10%	Red	36			(Violet Scribe)

Note: Numbers of the colum of "No. of Plate" corresponds to plate numbers for the "Category II."

The landform classes are expressed based upon twelve-color separation with combinations of thirty six screens and plates for symbols. The combinations are shown in Table 4-2.

(3) Printing manuscripts for the English version of "Information and Usage" were prepared by photo-lettering, inking, etc.

(4) Matching of adjacent sheet

Scribe plate, mask plate, etc. of each sheet were tied with corresponding adjacent sheet directly.

(5) In-office inspection

Inspection and proof correction were carried out on mistakes in writing and drawing, omission, deviation from the map format, etc. by using the color composite of whole color separations (surprint: polyester base printed by photo-processing with all color separation plates), which were able to be referred to the original manuscripts and annotation data sheets.

(6) Preparation of the plates for screen and symbols

The plates used for land use mapping, were employed together for preparation of the plates of screen and symbols in accordance with the Symbols and Specifications for Metro Manila Land Condition Map.
The plates only for the land condition map were prepared by photo-processing, etc.

4-7 Printing

4-7-1 Outline

(1) The printing of land condition maps were conducted on the basis of the agreement with Philippine side of sample maps in the 3rd year work.

(2) The land condition map was printed by employing twelve-color separation for classification of land conditions.

(3) The "Information and Usage" for the land condition map was printed on the back of map sheet.

(4) The printing of land condition map were completed after agreeing with Philippine counterpart for final printing by preparing and checking of proof prints of the maps.

4-7-2 Preparation of Plates and Printing

(1) Printing was conducted by off-set printing method of multi-color printing (twelve colors on the front of sheets and thirteen colors on the back). Before final printing, proof printing, in-office inspection and checking by Philippine counterpart were carried out. The work-flow of printing is shown in Fig. 4-7.

(2) Paper used for printing

Paper used for printing was duly appropriate for required specifications in its characters on folding endurance, tensile breaking strength, tearing strength, etc. and had good nature of low expansion (high quality paper for map-printing with weight of 90 kg/1000 sheets).

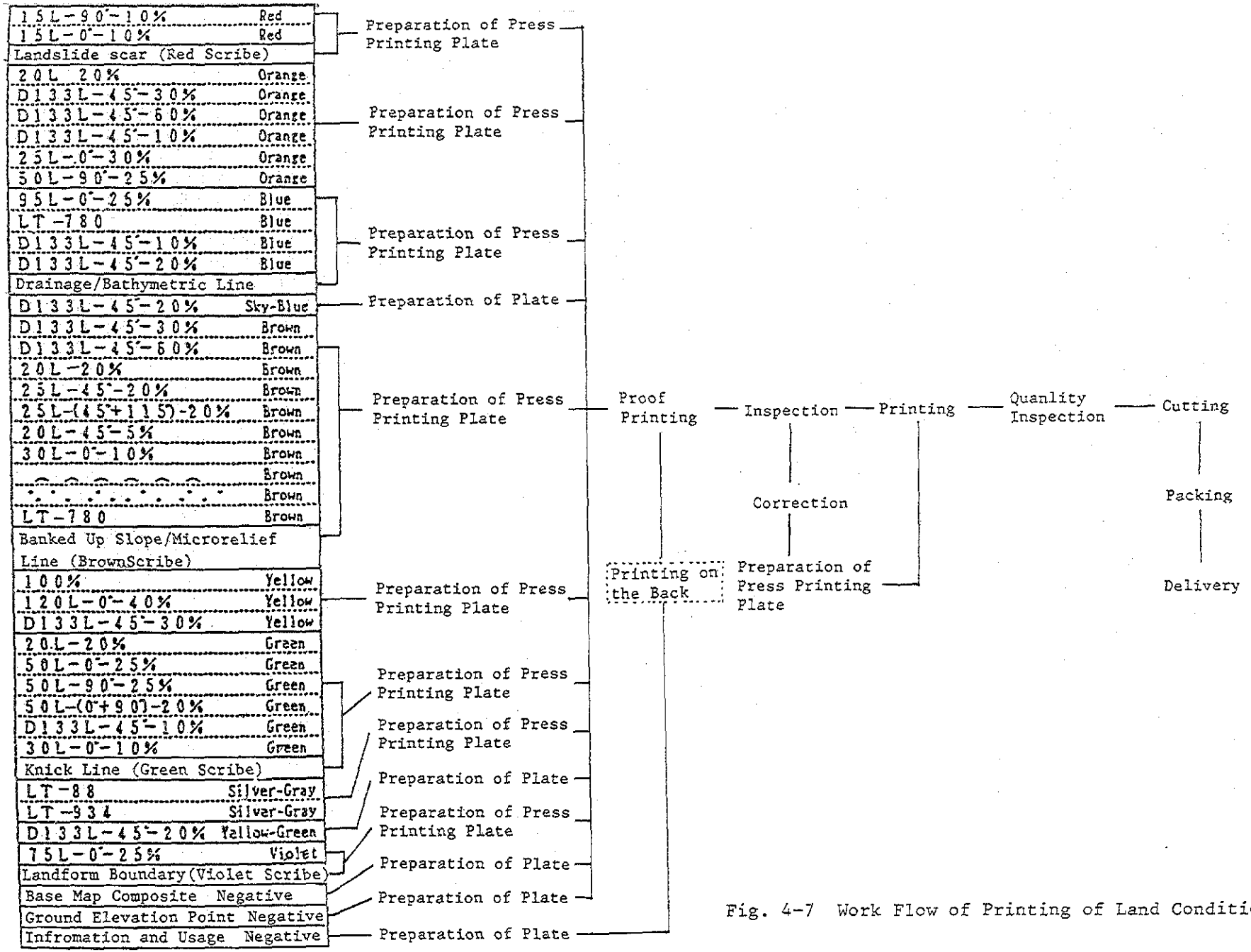


Fig. 4-7 Work Flow of Printing of Land Condition Map

(3) Preparation of printing plates

Scribe plates for each of thirteen colors were developed by press-printing of scribed bases on aluminum PS sheets.

(4) Preparation of proof prints

Proof prints were prepared mainly for inspection by off-set printing.

(5) Printing

Printing was carried out by off-set method using original plates to develop thirteen-color land condition map (twelve colors on the front of map sheet and one color on the back).

The colors employed were as follows:

o Base map	: dark gray
o Ground elevation	: black
o "Information and Usage"	: dark gray
o Landform classifications	: brown, violet, yellow-green yellow, orange, green, blue, light blue, silver gray, red

(6) Treatment for protection of printing plates

For custody of the printing plates, film coating was treated for the plates after completing of printing.

(7) Trimming and cutting

Printed maps were trimmed and cut into same size of the contoured maps.

(8) Inspection

Detailed inspection was carried out on colors, registering, size, neat lines for proof-printed maps and finally-printed maps.

4-8 Technical Meeting with Philippine Side

4-8-1 Technical Meeting in the First Year

Jul. 29, 1985 - Oct. 5, 1985: Meeting at the time of ground control point survey and field identification (contoured and land use map).

The change of mapping area for the land condition maps was agreed (the original sheet numbers stipulated in I/A of 20, 26, 31, 36 and 41 in total of 5 sheets were replaced with 21, 22, 24, 29 and 34).

4-8-2 Technical Meeting in the Second Year

(1) Aug. 18, 1986 - Oct. 7, 1986: Meeting at the time of field completion (contoured map)

a) Outline of the land condition map was explained by Japanese side. And its purpose of usage, etc. was confirmed by both Philippine and Japanese side.
Preliminary discussion was held on the draft of symbols and specifications for Metro Manila Land Condition Map, which was prepared by Japanese side.

b) The schedule for field survey of land condition mapping starting from January of 1987 was confirmed by both Philippine and Japanese side. Then both sides agreed that necessary data for the field survey would be collected and provided by Philippine side.

(2) Nov. 7, 1987 - Mar. 14, 1988: Meeting at the time of field identification (land condition map)

a) Definition, purposes and mapping process of the land condition map were confirmed.

b) Draft specification for landform classification including application and minimum area were confirmed.

c) Outline for preparation of symbols for field identification, compilation manuscripts A and B were confirmed.

d) Color scheme, marginal information, etc. were decided to be confirmed at the time of the filed completion in the third year.

4-8-3 Technical Meeting in the Third Year

Oct. 5, 1987 - Dec. 4, 1987: Meeting at the time of field completion (land use and land condition map).

a) Regarding symbols and specifications, classification, definition, application, etc. of the land condition map, which had been discussed through the second year, were finalized and agreed.

b) The matters related to drafting and printing such as color scheme, color tone, marginal information, etc. were discussed based on the sample map of printing which previously prepared in Japan and then confirmed and agreed by both sides.

c) "Information and Usage" of the land condition map for users was drafted to discuss its contents and presentation and generally agreed by both sides.

4-8-4 Technical Meeting in the Fourth Year

The matter discussed in the third year and the drafted "Information and Usage", which explains how to use the map, were further discussed with Philippine counterpar in Japan and finally confirmed after partial revisions.

Then, final printing was conducted in accordance with inspection and approval by the Philippine counterpart.

4-9 Cooperation of Philippine Side

(1) Assignment of qualified counterparts for the field completion.

(2) Data collection and field confirmation of data.

(3) Prior to the commencement of field completion by Japanese side, Philippine side collected data on organizations and facilities (bus terminal, government building, police station, fire station, church, school, etc.) to be presented on the land condition map, and conducted survey on the changes after aerial photography caused by the new establishment, removal, etc. of such organizations and facilities.

(4) Check-up of the compilation manuscripts prepared by the Japanese side.

(5) Vigorous and active discussions were held through the technical meetings.

4-10 Inspection

(1) Inspection was carried out respectively for minor-order leveling in the second year, compilation manuscripts in the third year and drafting, for which proof surprints were used, in the fourth year by the Survey Technique Center of Japanese Association of Surveyors, which is an authorized public organization for inspection of survey results and equipments.

(2) After printing, all printed maps were inspected again by the Survey Technique Center of Japanese Association of Surveyors and then qualified.

5. EXPLANATION FOR LAND USE MAP

5-1 Overview of Land Use in the Study Area of the Metro Manila Area

The survey area covers approximately 823 km^2 of the Metro Manila Area. Manila is located in the center and margin of the area is bounded by Blacan Province in the north, Laguna Province in the south, the northern part of Laguna de Bay and lower stream of Marikina River in the east and Manila Bay in the west.

The overview of land use is as follows:

1) Built-up area of central part of Manila around mouth of Pasig River, newly rising Makati Area, Quezon City, etc. are mainly occupied with commercial and business area.

2) Those built-up area is surrounded by residential area where on-going developing sites are involved.

3) North-western part of the area and south-western part along coastal line are represented by lowland where marine-ponds are prominantly observed.

4) Northern and southern part of the area are represented by hill and plateau. And the basin of Marikina River is occupied with agricultural land.

5) Eastern part of the area is characterized by forest in mountains.

An elevated railway runs along Manila Bay through Pasay City to Caloocan City as a main transportation network, and Philippine National Railways traverses south to north in the area.

Super highways run toward south and north as arteries, which are connected by other radial and circular road-net of which the center is old city area of Manila.

5-1-1 Residential Area

The residential area is expressed in two types in this study area, one is purely used as residence and the other is mixture of residential, commercial and business use.

Pure residential area is concentrated around the surroundings of the central part of Manila, Quezon City and Pasay City. While newly rising housing area is expanding in the lowland of lower stream of Marikina River, the vicinity of Laguna de Bay, southern Imus and Novaliches located north of Quezon City.

Mixed residential area is divided into commercial and residential, business and residential, and industrial and residential. Housing area of the mixed commercial and residential is concentrated along National Highway No.3 going towards north, around the built-up area, developed since old time, of San Nicolas, Binondo, etc. in Manila and along some roads existing Quezon City, Caloocan City, etc.

The mixed business and residential has totally small occupancy in the central area of Manila, Quezon City and Caloocan City. The mixed industrial and residential is rarely observed in the area.

5-1-2 Commercial and Business Area

The commercial area in this area is classified into pure commercial, mixed business and commercial and mixed commercial and residencial which mentioned in 5-1-1.

The pure commercial is observed as a mass in Ermita area of Manila, Makati and Cubao area of Quezon City. And along main roads radiating from Manila towards outskirt, these widely exist, forming narrow belt zone.

Occupancy of the mixed business and commercial is quite smaller than the pure commercial, distributed as small mass in San Nicolas of Manila and along the main roads as same as the pure commercial is situated.

Business area is also able to be classified into pure business, mixed business and residential mentioned in 5-1-1 and mixed business and residential mentioned in 5-1-2. The pure business in this area is observed intensively in the central part of Manila, coastal roads area, Makati area, Mandaluyong area and Quezon City.

Other existence is recognized as spots.

5-1-3 Industrial Area

Industrial area is divided into relatively larger industrial zone, relatively smaller industrial zone and the mixed industrial and residential mentioned in 5-1-1. The relatively larger industrial zone is distributed along Pasig River in Manila and Philippine National Railways in San Loga area, lower stream of Marikina River from Marikina area to Pasig area, etc.

Also, large extent of newly rising larger industrial zone is observed in Caloocan City, north of Manila and vicinity of Northern Superhighway.

On the other hand, in the southern part of the area, crowds of industrial plant are distributed along Southern Superhighway, around Laguna de Bay and in the vicinity of Montenlupa. Relatively smaller industrial zone is rarely located near the newly-rising large industrial zone in suburb, but coexist with the large industrial zone in Caloocan City, north of Manila and along Pasig River, which were built in old time.

5-1-4 Public and Official District

Public and official district is classified into governmental and public facilities, education and culture, health and welfare facilities, park and recreation facilities as well as cemetery and religion.

The governmental and public facilities in this area are intensively observed in the central part of Manila, where Pasig River penetrates, along the coastal road, around Quezon City Memorial Park, in Makati area and Mandaluyong area as well as in populated area in the outskirt.

The education and culture area is distributed constantly, diversifying its scale, in all around the area excepting grassland belt, paddy field belt and marine-pond belt. Prominent systematic education and culture area is observed in the vicinity of Sant Thomas University located north of Pasig River in the central area of Manila and in Loyola area and the surroundings of University of the Philippines in Quezon City.

As for the facilities for health and welfare (mainly hospitals), large scale facilities are mainly located in the vicinity of Manila and Quezon City, while small scale facilities are dotted in the suburb.

As for park and recreation facilities, large scale facilities are existing such as Rezal Park and Quezon City Memorial Park and in the

surroundings of said parks. While small scale facilities are observed sparsely in the residential area.

Chinese Cemetery, Laoka Cemetery and North Cemetery in the northern part of Manila, Manila Memorial Park in Parañaque area, Manila South Cemetery in Makati area, Loyola Memorial Park in Quezon City, etc. are recognized as large scale facilities for cemetery and religion.

On the other hand, small scale cemeteries are distributed homogeneously in each administrative unit located in entire area.

As for religious facilities, at any part of the area form built-up area to suburb, these facilities are observed quite often. From this it is felt that the life style is based upon religion.

5-1-5 Facilities

Facilities in this area are classified into transportation, service, sports and athletic, and military. As for the transportation facilities, Philippine National Railways traversing south through north, elevated railroad connecting Pasay City and Caloocan City, South and North Harbor of Manila Bay and Manila International Airport are prominently recognized.

Some other large transportation facilities such as oil storage tank along Pasig River in Pantabangan area are also observed.

As service facilities Novaliches Reservoir, water filtration plants in the southern and northern part of Quezon City and a power plant in the western part of Quezon City.

As the facilities of sports and athletic a lot of golf-course are observed along EDSA, in Makati area, Pasay City Montenlupa area Antipolo area, etc., these are situated on hill and plateau.

5-1-6 Farm Land and Forest

Farm land in this area is classified into rice field, crop land, plantation and agro-industrial facilities. The rice field is distributed widely in Bulacan through Maycauyan in the west-northern part of Manila, Montarban and San Mateo along Marikina River, Taitai in the eastern part of Manila and Cavite in the southern part.

On the other hand, in the suburb of Manila, Quezon City, etc., small scale rice fields are scattered, being altered themselves to housing area.

The occupancy of crop land is far smaller than rice field. Relatively large crop land is recognizable in upper stream of Marikina River in the northern part of Quezon City. However, in other area, only small scale crop lands are observed in the suburb of Manila, Quezon City and Pasay City.

As for plantation, large plantation is not observed in this area. Small plantations, where mainly banana, sugar cane and mango are cultivated, are distributed in surroundings of scattered barangays in the suburb.

Forest in this area is classified into forest, grassland and bare land. Large scale forest is only recognizable in the vicinity of Novaliches Reservoir located in the northern part of the area. In other area very sparsely forest is distributed. All of them are broad-lieved tree.

The grassland is distributed relatively in the vicinity of Novaliches Reservoir, mountains situated east of Marikina River and the surroundings of Montenlupa. In the central part of Manila, the grassland is rarely identifiable. However, in the suburb, small scale grassland is observed along rivers.

Bare land is recognizable of scarps along rivers, on cut-slopes of roads, etc.

5-1-7 Others

Others are composed by water sphere and open space. The water sphere includes marine pond, salt bed and water related vegetation. The marine pond is often observed in north-western part of Manila along Manila Bay and vicinity of Cavite City, especially the area in the part of the north-western Manila extend its lowland 8 km toward inland.

As for water related vegetation, mangrove is observed along coastal line in the north-western part of Manila, and water lily is recognized gregariously in marshy land of Laguna de Bay.

The bare land is seldom observed in the central part of Manila and Quezon City. In the suburb, post-levelled ground in housing development is recognized as bare land in the surroundings of newly rising housing area.

5-2 Information and Usage of Land Use Map

5-2-1 Utilization of Land Use Map

This land use map is prepared using the 1:10,000 contoured map as the base on which the existing land use patterns are printed in 7 colors.

It is possible to recognize the existing land use together with various features (roads, railways, buildings, contour lines, coastal lines, annotations and others) shown on the base map.

It is expected that this land use map will be utilized as follows:

(1) Administrative organizations can use this map for planning the redevelopment of built-up areas, development of suburban areas, improvement of transportation systems, housing development, disaster prevention, etc.

(2) Survey and research organizations (universities, institutes, etc.) can use it for academic researches on geography, regional planning civil engineering, etc.

(3) Public organizations and private enterprises can use it for the proper selection and development of sites for their activities.

(4) It can be more effectively used, together with a land condition map, for verifying the suitability of the present land use as well as for planning of the proper land development.

5-2-2 Classification of Land Use

The land use is classified into the following three major categories:

Built-up Area
Agricultural Land and Forest
Others

These are then divided into 33 sub-classifications.

(1) The category "Built-up Area" is classified into Residential, Commercial and Business, Industrial, Public and Government, Facilities, etc. on the basis of the main usage of the buildings.

(2) The category "Agricultural Land" is divided into Rice Field, Crop Land, Plantation, etc. and the category "Forest" is classified into Forest, Grassland and Bare Land. The warehouses for agricultural products and food processing factories are included in Agro-industrial.

(3) The category "Others" consists of "Water Related" and "Open Space," and the "Water Related" includes Marine Pond, Salt Bed and Water-related Vegetation.

5-2-3 Land Use Survey

(1) The classification of land use patterns was mainly carried out by the interpretation of the aerial photographs taken in 1982 and by field identification conducted in 1985.

(2) As for the major changes of land use patterns brought about after 1985, the interpretation of the aerial photographs taken in 1986 and the field completion conducted in 1987, were integrated.

5-2-4 Criteria for Representation of the Land Use Map

The criteria for representing the land use classification on the 1:10,000 land use map are as follows:

(1) Where buildings of facilities occupy a common compound, the land use classification in represented by the main usage of the compound.

(2) The minimum area for representation in the Built-up Areas is generally 3 mm x 3 mm on the maps. As for the Commercial and Mixed in the Built-up Areas, however, consideration is given to represent about

1.5 mm x 1.5 mm areas on the maps because of their important functions.

(3) The minimum area considered for the representation of the Military, Agricultural Land, Forest and Water Related is generally 5 mm x 5 mm.

(4) In 2-story buildings whose usages are both Residential and some other categories (Commercial, Industrial and Business), the classification is of the latter.

(5) In buildings of 3-story or more whose usages are multi-purpose, the classification is Mixed and falls under one of the following four categories according to the main usage of the buildings:

Commercial and Residential,
Business and Commercial,
Industrial and Residential,
Business and Residential

(6) The land use boundaries are represented by red colored lines. In case these boundary lines coincide with roads, railways, rivers, etc., the latter prevail.

(7) Printing was conducted with 7 color separation plates (red, orange, blue, yellow, green, brown and black) and their combinations to make the land use patterns easily identifiable.

Residential (Multi-story Housing, Residential, Temporary Housing, Mixed Commercial-Residential), Land Use Boundary:	Red
Business, Commercial, Public (Educational and Cultural):	Orange
Industrial (Large-scale Industrial, Small-scale Industrial, Mixed Industrial-Residential):	Blue-red

Mixed (Mixed Business-Commercial, Mixed Business-Residential):	Red-orange
Public and Government (Government and Quasi-public) and Facilities (Transportation, Service, Sports and Athletics):	Brown
Public and Government (Health and Welfare, Religious and Cemetery, Park and Recreational), Forest:	Green
Agricultural Land:	Yellow-brown
Water Related:	Blue
Base Map and Annotation:	Black

6. EXPLANATION FOR THE LAND CONDITION MAP

6-1 Landform of the Survey Area

6-1-1 Outline of the Landform

Generally the land features in the survey area shows characteristically north-south oriented distributions. The area is roughly classified into; (1) lowland along Manila Bay, (2) hill/plateau where Manila and Guezon City are situated, (3) lowland covering the Marikina River basin and Laguna de Bay and (4) mountain/hill located southwest of the Sierra Madre Ranges.

(1) Lowland along Manila Bay

The lowland, which is narrowly elongated from south to north along curved coastal line of Manila Bay, consists of coastal plain and delta. The area varies its width such like 7-8 km around Obando in the northern part, 2 km around Malabon, about 6 km around core of the built-up area of Manila that is outside of the survey area and about 1 km south of Manila.

The altitude alters from 0 m to several meters; the altitude is especially low in the area where Pasig River meanders in Manila and the area from Malabon to Obando and Bulacan in north. Those are often damaged by flood in the rainy season.

(2) Hill/plateau in Manila and Quezon City

The hill/plateau altered gradually from flat lowland is situated in the center of the study area. The earth surface is flat in the area covering the built-up area of Quezon City and its adjacent area in east and south. However, the further toward north from the built-up area, the amplitude of the surface gets higher showing broadly and dendritically incised valley.

The width of the hill/plateau is about 15 km in the northern part and 3 km around the area where Pasig River traverses the plateau. The altitude is 20 - 30 m around Pasig River and 40 - 50 m in the built-up

area of Quezon City and becomes gradually higher more north up to 80 - 100 m.

(3) Lowland in the Marikina River basin and Laguna de Bay

The lowland formed by external agency of Marikina River streaming down at the foot of eastern edge of the hill/plateau and Laguna de Bay has the extent of about 25 m in length, in width 4 km in north and 6 to 70 km in middle to south. The altitude varies from 1 m to several meters near Laguna de Bay where innundation occurs in every flooding.
In this lowland at both sides of the northern part of Marikina River, 2 to 3 river terraces with small relative height are recognizable which is subducting under the sedimentation surface of the flood plain in middle and south of the area.

(4) Mountain/hill

The mountain/hill in the study area consists of mountainous area with altitude of 200 - 300 m and hilly area with altitude of 50 - 100 m.
The mountainous area forms the west-sourthern fringe of Sierra Madre Ranges. The more north-east, the altitude becomes higher toward Sierra Madre Ranges. Steep slopes are observed remarkably in the north-eastern part. However, it can be said that the entire area is gently inclined with some flat crests scattered around middle and southern part.
The hilly area recognizable in the middle and southern part inclines gently toward west and submerges beneath the surface of alluvial plain.
In general terrain surface is composed by gentle slopes.

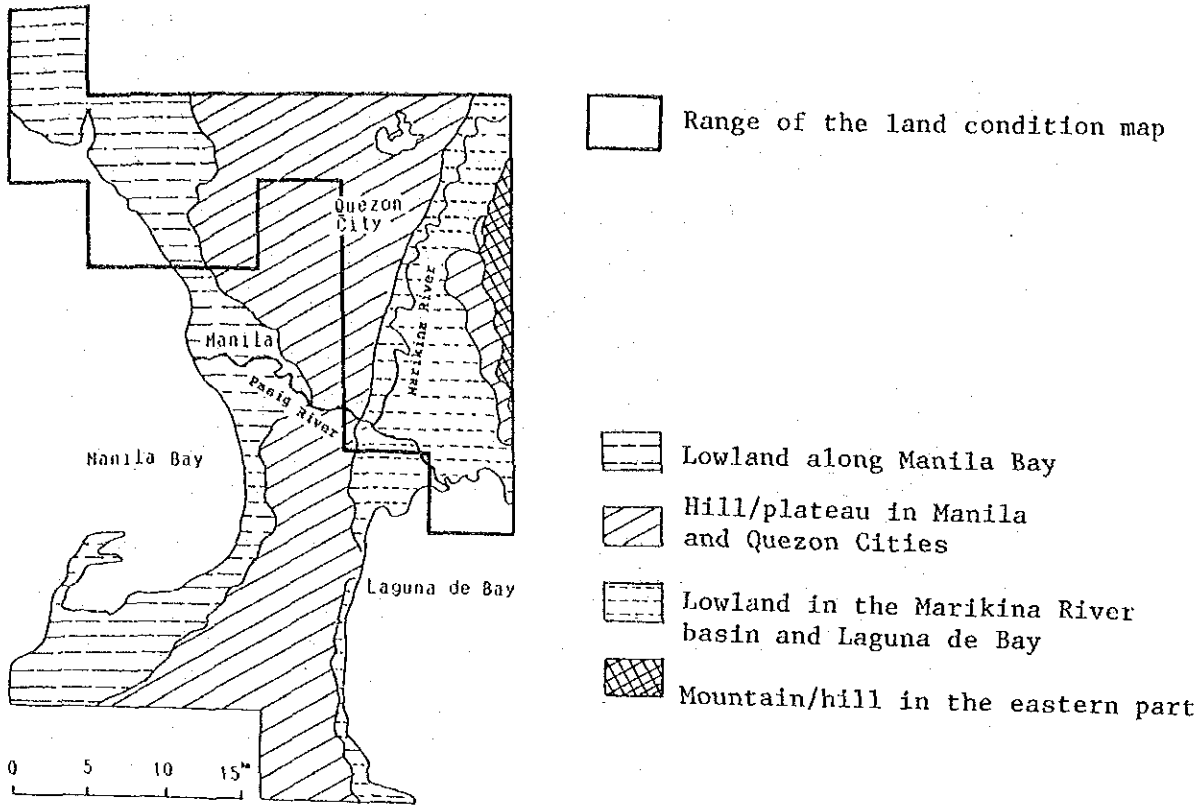


Fig.6-1 Outline of Landform

6-1-2 Details of Landform

The landform units explained in this chapter are shown in Fig. 6-2 Illustration of Landform.

(1) Mountain

The mountainous area existing in the study area extends to the ridges of Mt. Pagawakan (elevation 475 m) and Mataba (elevation 448 m) which are located in south-north direction in the eastern part of the survey area. The ridges becomes narrower towards north in the study area with steep slopes on its flanks showing deeply incised valley characterized with dendritic drainage lines. The middle and southern parts are characterized by a distribution of several blocked mass of mountains of which flat surface is recognized on the crests or ridges.

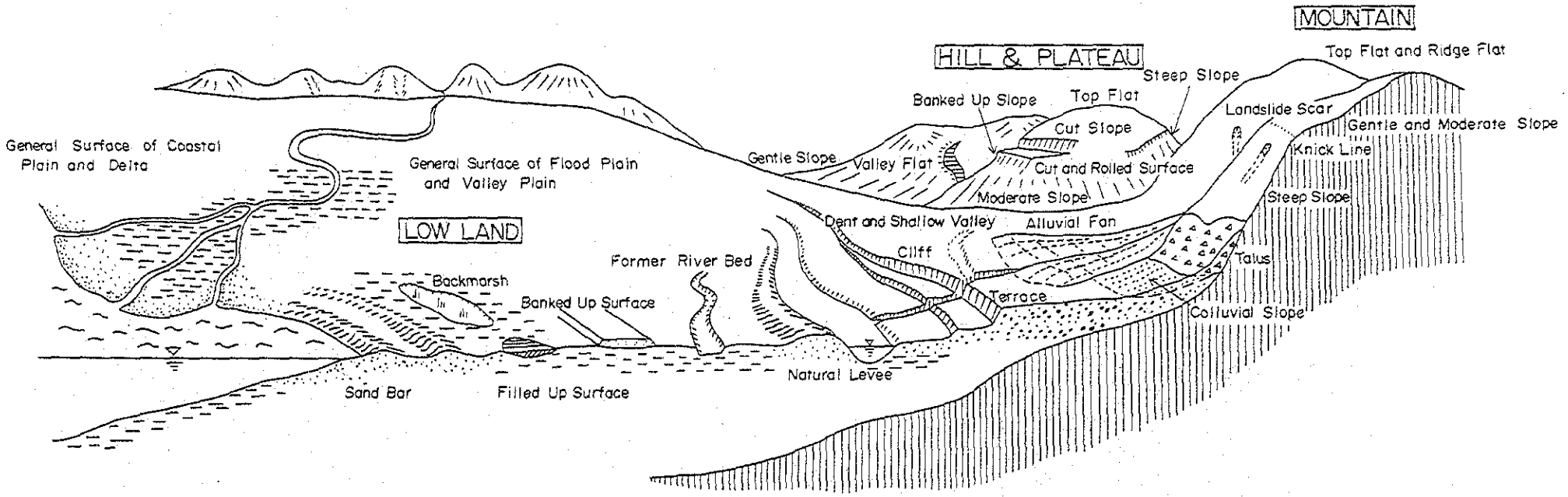


Fig.6-2 Illustration of Landform

The flanks of those mountains are gently sloping in general. The river incising the mountains forms V-shape valley with a narrow width and very poor river bed sediments.

The lithology is mainly basalt; the crop-out basalt at quarries and abandoned quarries is bluish grey to greenish grey. Those are relatively fresh. However, joints develop markedly and minerals have been altered in many cases. On the other hand, the crop-out basalt on the slope is yellowish grey to light brown, and has cracked into a 3 - 5 cm mass. The rock can be very easily broken with a hammer and becomes sandy.

The soil on the flat surface at the top and ridge of the mountain and the gently slope has been severly subjected to the red soil formation with a 0.5 - 3 m soil depth. The bedrock on the steep slope is so shallow with only less than 0.3 m soil depth in most parts.

(2) Piedmont landform

The piedmont landform extends intensively at the mountain foot on the east side of the study area, but in almost no other areas.

The major talus is located at the mountain foot east of Montalban and San Mateo which as situated along the fault line on the left bank of Marikina River. On the left bank of Marikina River, as the basalt which forms the mountains appears to be planar and is severely weathered, fault breccia forms relatively steep depositional landforms. A gently sloping colluvial slope consisting of silty sand mingled with semiangular-semiround basalt gravel are observed in front of the depositional landform.

In addition, small alluvial fan/talus can be seen slightly at exits of small and middle rivers flowing into the Marikina River lowland and at the foot of mountains along these rivers. Its major component is silty sand mingled with basalt gravel.

(3) Hill and plateau

From the eastern part of the built-up area of Manila to the built-up area of Quezon City, the hill and plateau extends with a wide and flat top, but towards the Novaliches Reservoir in the northern part, incision becomes more aggresive forming hilly topography with high amplitude.

The west side of the hill and plateau is cut by the Marikina fault, which slopes are formed by cliffs, steep slopes and moderate slopes.

The surface of the hill and plateau is sloping gently in general, and particularly in the northern part cuesta is remarkable with west or south-west oriented dip slopes. In the northern part, the narrow flat surface, the moderate slope, and the wide gentle slope spreads towards west, and the rivers in the area flow into Manila Bay, which flowing direction is prevailing towards west. In addition, the rolling incised valley has a narrow valley plain, of which most part is utilized as paddy fields.

On the other hand, the middle and southern part of the survey area which are located east and south of Quezon City consists of a wide and flat top and a gentle slope, which is undulating gently with west or west-south oriented dipping. San Juan River, only this river originated in the center of Quezon City, flows down into Pasig River near Mandaluyong.

Also hilly area is distributed in the Bayanbayanan-Cainta-Taytay area in the western foot of the eastern mountains bordered by Marikina River.

Around Bayanbayanan a mass of hill is formed with gentle slopes and flat top. From the south of this area to Taytay, the north-west or south-west oriented hills are dendritically distributed. On the front edge of these hills, remuants of hills are scattered.

The lithology composing the hill and plateau is mostly a Quarternary Guadalupe Formation excepting Novaliches Reservoir in the north and the hills on the left bank of Marikina River, where the lithology consists of basalt.

The details of the Guadalupe formation are described as 1) tuffaceous breccia prevailing bed, 2) alternation of tuffaceous sandstone and silt stone bed, and 3) conglomerate, tuffaceous sandstone and siltstone. In

the northern part, the formations of 1), 2) and 3) incline to the south-west direction with dip angle of 2-5. In the middle and southern part 2) occupies the most part. This makes a current topographic difference on the earth surface.

The above-mentioned Guadalupe formation consists of soft rock with low consolidation, but it provides good foundation for structures in general.

(4) Terrace

Flat surfaces of 2 to 3 different stages observed on both banks of the Marikina River traversing in the eastern side of the study area occupies the northern half of the lowland covering the Marikina River to Laguna de Bay. The low terrace has a relative height of approximately 6 m from the present stream surface. The lower terrace is located above approximately 3 m from stream surface that is the consequence of the incision of the low terrace.

The terrace surfaces are almost flat, dipping slightly from both edges to the Marikina River. On the terraces land use is mostly paddy fields. On the low surface on the left bank of the Marikina River, many communities have developed along a trunk road which extends in north-south direction along the Marikina River.

The materials which compose the terraces are gravel bed and silty, very fine sand beds. Then in the lower terrace at least 2 sedimentary cycles are recognized. It seems that the diameter of gravel becomes greater and the gravel bed becomes thicker towards the upstream.

Both terraces along the Marikina River around San Mateo-Montalban in the northern part of the area seem to have been intensely developed for quarrying by which those gravel beds were dug. Many abandoned quarries are seen in the entire area of which some are still continuing their operations.

(5) Alluvial fan

The alluvial fan in the study area distributes at the mountain foot in the eastern part of the area, with an altitude of approximately 20 -

40 m in the northern part and 5 - 20 m in the southern part.

The alluvial fan formed by small and middle rivers which flow the mountains has very gentle inclination with 1-3 degree at the fan foot. Traces of the former river-bed and micro-relief rides, which exist locally in parallel with the inclination direction are recognized on the surface of the fan.

The major materials are composed by silty sand mingled with semiangular-semiround basalt gravel. At the fan foot, silty fine sand is predominant. These materials are deposited on the low terrace surface and the flood plain.

The soil is brown to yellowish brown. The deposited materials were formed by redeposition of soil with well developed soil formation.

The present of land use indicates that the alluvial fan in the northern part has many orchards and henhouses from the fan apex to the middle part, and paddy fields extend toward the fan foot. The alluvial fan in the southern part is occupied by a part of Kainta and Taytay Towns where the land has been utilized mainly for paddy rice production. By an impact of recent urbanization the area has been drastically changed into residental area.

(6) Flood plain and valley plain

The flood plains and valley plains are situated in the eastern and western sides of the area of hill/plateau occupying the central part of the survey area. On the east side a flood plain extends along the Marikina River in the north-west of the study area, and in the lower reaches the flood plain spreads widely and triangularly towards Laguna de Bay. In addition, valley plains extend along the small and middle rivers flowing into the Marikina River.

The flood plain along the Marikina River forms the surface of lowland bounded by a terrace scarp on the both sides, and the materials of the flood plain seems to be as same as that of the terrace. As mentioned in (4) Terrace, in several parts of this area where quarrying was engaged in intensively a lot of ponded depressions are observed.

In the triangular flood plain extending from the Marikina River to Laguna de Bay, where a natural levee develops well, many communities have been developed since old days.

Furthermore, there is a former river-bed, which was formed by the Marikina River and the small to middle rivers, along the Marikina River and around Cainta and Taytay on its left bank. In present days, however, it is recognizable fragmentarily, as the surface of lowland has been developed mainly for housing.

The natural levee forms a microrelief ridges (0.5 - 1.0 m higher than the surroundings) which are composed of silty sand mingled with semiangular to semiround basalt gravel with a light yellow to light brown color on the whole.

The former river-bed has dark grey to dark brown clay in the upper part and a fine sand formation in the lower part, according to observation of the traces. The lower sand formation and the upper formation appear to be respectively former river-bed deposits and post-abandonment deposits.

The west side of the hill and plateau is mostly coastal plain and delta, but a flood plain extends in the lower reaches mainly along the Meycanayan River and the Tullahan River which are incising the hill and plateau. The flood plain, in which the lower basin is mainly characterized by backmarsh, lies in an environment that its exit is closed by a residual hill and sand bar.

(7) Coastal plain and delta

The coastal plain and delta are located in the western part of the study area, and extend from the present shoreline towards inland, approximately 9 km in width around northern Obando and 3 km around Malabon, south of Obando.

Several series of sand bars run in parallel with the present shoreline in this area.

The sand bar is low with elevation of 0.5 - 1.5 m above sea level, and mainly composed by fine sand, since the coastal current in nearly closed Manila Bay is not strong.

This area is a part of the Pampanga delta which widely exists behind Manila Bay. Several series of sand bars are penetrated in Buracan Town in the northern part of the study area by the rivers flowing into Manila Bay.

The town is located on the natural levee formed along meandering river flowing in the lowland area where a lot of former river-bed can be seen in its surroundings. The river forms a huge delta at the mouth of Manila Bay.

The entire area is low and flat where communities have developed since old time on the sand bars and the slightly elevated natural levees. The hinterland is utilized for rice-paddy.

On the other hand, the inter barnal slough and delta front are included in a tidal area where mangrove forest existed before but changed into marine ponds (salt beds) by cutting trees. At present, the mangroves extend in belt-like shape of 5 km in length along the present shoreline in the north of Malabon. In addition, a little of mangrove remains along rivers and creeks.

The major materials which compose the sand bar is yellowish brown sandy clay in the upper part, and yellowish brown - olive yellow fine sand in the lower part, while that of the inter barnal slough and delta front is black clay in the upper part and dark green clayish sand in the lower part. The difference in color tone of soil indicates that the inter barnal slough and the delta front are in reduction, while the bar area is in dry throughout the year even which is occasionally submerged.

(8) Unstable slope

As mentioned previously, in the survey area, there exist the hill and plateau in the center, the lowland on both sides of the hill and plateau, and the mountains in the east edge with gentle slopes in general.

Cliffs can be seen along the fault in the right bank of the Marikina River, the Marikina River itself and other small and middle rivers, such as the Nanga River, Amprid River, Bargas River as well as at abandoned quarries in the hill and plateau where pumice tuffaceous breccia is distributed.

Landslides can be seen locally on the steep slopes of the mountains in the eartern part of the study area where the surface material is basalt. The scale of the landslides are rather small showing the surface exfoliation type.

(9) Artificially deformed land

Recently, the Metropolitan Manila Area has expanded quickly from the saturated central part towards the surrounding area due to rapid growth of population. The development is expanding mainly in the hill and plateau area in the northern part of Manila and Quezon City, the mountain and hill extending to Antenporo east of the study area and the plateau extending from the Manila Airport to the south located beyond the study area. The development is expanding in the coastal plain in the northern part of Manila and the lowland covering Cainta, Taytay and Pasig Towns located in the area from Marikina River to Laguna de Bay.
The development mainly for housing has been executed in rolled surface area in large scale created by cutting or filling up the gently depressed land situated mostly on the top flat and gentle slopes of the hill and plateau. In the coastal plain and the flood plain, marine ponds and paddy fields were filled and banked up to create large scale artificial land.
In the landform classification mentioned here, rolled surface by cutting which was deformed in a relatively large scale with a large volume of cut soil was classified as cut and rolled surface. Strictly speaking, paddy fields and small scale deformed land for housing on the gentle slopes of the hill and plateau are also classified into artificially deformed land. However, they are not classified as a cut and rolled surface, since the volume of cut soil there is rather small and there is no great difference from the original landform,

(10) Others

Main ridges on the mountain and on the hill and plateau are symbolized as watershed boundary.
However, unclear watersheds on the small undulated surface in the hill and plateau were omitted.
Drainage lines were symbolized by broken line to indicate valleys which gather rain intensively to the rivers shown on the 1:10,000 contoured map.

In the study area, both the main watershed and the drainage systems are clear in the mountain and hill area in the eastern part and with dense distribution and dendritic pattern of drainage systems. In the hill and plateau in the center of the study area, both the main watershed and the drainage systems spread relatively densely in the hill and plateau in the northern part, in reflection of the topography. However, they are rather unclear for the most part in the central and southern parts of the plateau because gentle slope occupies predominantly. The hill and plateau in the central and southern parts is characterized by the major rivers running west to south-west and the westward drainage having a gentle gradient with a long drainage line while the eastward drainage line is steep with a shorter length.

(11) Marine area

Manila Bay, with a narrow mouth, is a shallow semi-closed bay with assumedly weak currents. Rivers which meander in the low and flat area to Manila Bay transport and spread very fine grain materials from their mouths into the bay that results to form muddy and shoal Manila Bay. Due to this condition, muddy sediments distribute widely in the coastal area to form tidal flats which expose during low tide.

In the west-northern part of Manila, several series of sand bar are formed nearly in parallel with the shoreline. The front of each sand bar corresponds to the former shoreline. Retreating of the shoreline has forwarded the location of sand bar and formed present sand bars which are still growing along the present shoreline.

A bar of approximately 1.7 km in length and 150 m in width is formed 100 - 200 m off from the present shoreline in north Nabotas. It can be called "an egg of a sand bar."

6-2 Information and Usage of the Land Condition Map

6-2-1 Utilization of the Land Condition Map

The land condition map was prepared using a 1:10,000 contoured map as the base map, on which the actual conditions of landform classification, ground elevation and organizations/facilities were printed in 12 colors.

One can assume the following by reading the land condition map:

(1) Low or marshy land where damage caused by flood/high tide is expected.

(2) Unfavourable conditions of surface layer where earthquake damage is expected.

(3) Alluvial plain where damage caused by ground subsidence due to pumping of excessive ground water.

(4) Artificially deformed land and unstable slopes such as mountain and hill where landslides are expected.

(5) Plateaus and gentle hills relatively safe against disaster, such as flood and landslide.

Therefore, the land condition map can be utilized as basic information not only for disaster prevention planning but also for land development planning, and its combined use with a land use map can be more effective.

6-2-2 Composition of the Land Condition Map

The land condition map is composed of the following 3 elements:
Landform classification, ground elevation, and organizations/facilities.
They are further divided into 91 items.

(1) Landform classification

In the landform classification, various types of landform composing the ground surface are grouped into mountain, hill, plateau, and lowland (such as flood plain, delta, and others) based on classification units where the form, formative process and surface material are homogenous. In the sub-classification, safety or susceptibility to disasters is also taken into consideration.

(2) Ground elevation

In order to show susceptibility to flood/high tide in lowland, ground elevation points and microrelief lines are shown.

(3) Organizations and facilities

As to organizations and facilities, organizations in charge of disaster prevention and development, facilities for rescue and relief, observatories, facilities for supply and processing, river and coastal structures and others are shown with special reference to those especially relating to disaster prevention, rescue and development.

6-2-3 Land Condition Survey

(1) Landform classification

1) The landform classification was made mainly based on photo-interpretation of the photos taken in 1983 and the field identification conducted in 1987 for major points.
2) With respect to artificially deformed land (mainly banked up) in lowlands which is more susceptible to disaster (such as flood plain, delta, coastal plain, and others), the landform before deformation was also clarified by comparing the aerial photographs taken in 1968 with those taken in 1986.

(2) Ground elevation

As to lowlands, minor order levelling was conducted to show the ground elevation points. In addition, spot heights and microrelief lines measured by photogrammetry were included based on the ground elevation points.

(3) Organizations and facilities

Organizations and facilities were presented based on items given in the

1:10,000 topographic map and information from BCGS and others, and field identification was conducted at some points.

6-2-4 Criteria for Presentation in the Land Condition Map

(1) Landform classification

1) The minimum size for the landform classification is approximately 2 mm x 2mm on the map, and the minimum size of linear symbols is approximately 5 mm on the map.
2) In the landform classification, sections where the boundaries between terrain units are difficult to be established are presented by broken lines.
3) Bars, tidal flats, bathymetric lines presented in the sea area are based on information provided by BCGS.

(2) Ground elevation

1) Ground elevation is presented in 10 cm units; ground elevation points obtained from the minor order levelling and those obtained from the photogrammetry are expressed in vertical print and slant print, respectively.
2) Ground elevation lines are presented at 1 m interval.

(3) Organizations and facilities

1) As to river and coastal structures, those relating to rivers with a width of more than 4 m or those of more than 50 m in length are presented.
2) Of transportation facilities, main roads of more than 1 km in length are presented.
3) Of facilities in coastal areas, ports/harbors and fishery harbors of different sizes are presented with variety of symbol size.
4) Facilities for rescue and relief, facilities for dangerous materials, observatories, and facilities for supply and processing are all presented.

5) Those not listed above are based on the presentation criteria of the 1/10,000 contoured map.

(4) Color scheme

Printing is made in different combinations of 12 colors (brown, purple, green, yellow, orange, yellowish green, blue, sky blue, silver grey, red, black and dark grey) so that various conditions can be easily understood.

Mountain ---------- Brown series
Piedmont landform ---------- Yellow series
Hill and plateau, and terrace ---------- Orange/brown series
Flood plain/valley plain ---------- Yellowish green series
Coastal plain/delta ---------- Blue/green series
Artificially deformed land/unstable slope (land slide scar)
----- Red series
Land form in marine area ---------- Silver grey series
Water surface ---------- Sky blue
Microrelief line ---------- Brown
Organization/facility ---------- Black and red
Ground elevation annotation ---------- Black
Boundary line, and unstable slope (cliff)- Purple
Base map ---------- Dark grey

7. EXAMPLES OF, APPLICATION OF THE LAND USE MAP AND THE LAND CONDITION MAP

Respective landform categories expressed in the land condition map can be used to assume disaster susceptible areas, the degree of difficulty for development, the stability of ground, and others. The land use map can tell the actual situation of land use, building use, and others.

Therefore, combined use of these two maps can clarify in what condition the present land use has been developed, and thereby the propriety of the present land use, selection of land for future development, and designation of areas which require special disaster prevention measures.

7-1 Evaluation of Land Use and Land Condition by Isometric Square Method (Lattice Method)

An example of an application of the land use map and the land condition map using the isometric square method can give a quantitative analysis of the degree of reasonable land use development of the present land use under various local inherent conditions.

7-1-1 Mesh-size of Lattice (Isometric Square)

The size of lattice shall be determined by latitudinal and longitudinal extent of 5" (lon) x 5" (lat); the land use and land condition of each mesh are evaluated for approximately every 150 m^2 and 300 m^2, respectively.

7-1-2 Criteria for Evaluation

There are various standpoints in adopting evaluation items and evaluation criteria depending on a purpose of the evaluation of land use and land conditions. The example shown in Table 7-1, 7-2 represents a case on the assumption of urban land use planning in the future.

(Note): For description of the above Chapter 7, reference was made to the following paper:

"A Study on Usage of Land Use Map and Land Condition Map by Isometric Square Method" by Mr. M. Takasaki and Mr. T. Oshima; CHIZU, Vol. 9, No.1, 1971

Table 7-1 Criteria for Land Use Evaluation

Criteria / Grade	Criteria for evaluation
Grade 5	Land use district where an unspecified large population concentrates and which is essential in daily life. Residential district, commercial district, and others.
Grade 4	Land use district where an unspecified large population use is fairly wide, or a specified population use in a high density and the productivity is high. Industrial district, transportation/public district, rural community, and others.
Grade 3	Land use district which has high productivity in agricultural land use, and has a rather low population density. Paddy field, plowed land, plantation, and others.
Grade 2	Land use district which has a rather low productivity in agricultural land use and a low population density. Forest, grassland, marine pond, and others.
Grade 1	District where population concentration is very unlikely as in rivers, lakes, and others.

Table 7-2 Criteria for Land Condition Evaluation

Criteria / Grade	Criteria for evaluation
Grade 5	District where the land form is flat, high and dried, with high ground durability and almost no potential danger of disaster such as earthquakes and landslides. Suitable for both urban land use and rural land use are plateaus, terraces, and others.
Grade 4	District where the landform is generally flat and dry, with ground durability and low risk of flood, earthquake, and landslide. Suitable in general for both urban land use and rural land use. Gentle hill slope, slightly rolled hill, fan, and others.
Grade 3	District where the landform is flat but with rather low ground durability and possible damage caused by big floods and earthquakes, such as lowland with relatively good drainage. Suitable for both urban land use and rural land use in general, but a tough disaster prevention facility is required in some places, such as natural levees, sand bars, and banked lands, with a ground level of higher than 2 - 3 m.
Grade 2	District with fairly rolled and sloped landform, and humid lowland with nearly no inclination. Suitable generally for agricultural land use, but for urban land use proper disaster prevention facility and measure are required depending on the land condition, such as embankment, breast wall, drainage works, and bank. General slope of hill, gentle slope of mountain, valley bottom plain, flood plain, and others.
Grade 1	District where the landform is very steep and development is difficult, and the district where the landform is low and humid and the ground is soft, with expected damage of flood and earthquake. Mountain, steep slope on a hill, delta, sand bar lowland, backmarsh, and others.

7-1-3 Result of Evaluation

According to the Table 7-1 and 7-2, grades read from the land use map and the land condition map are indicated as land use (U)/land condition (L) for each corresponding mesh, and a resultant value is used for the evaluation.

Table 7-3 Evaluation classification

U/L	Type	Evaluation
1.0	Balanced	Area where land use fits the land condition; including high level land use for the excellent land condition, moderate level land use for the moderate land condition, and extensive land use for the poor land condition.
1.25 - 2.0	Developing restricted slightly	Slightly excessive land use for the land condition; control or improvement of land use, or tightening of disaster prevention measures are required.
More than 2.1	Developing restricted	This type means an area where extreme high-level land use is conducted in a relatively poor condition and regulation or improvement of land use or tightened disaster prevention measures are urgently required.
0.8 - 0.6	Slightly developing accelerating	Extensive land use for the land condition, and future development (for higher level land use) is fairly possible.
Less than 0.5	Developing accelerated	Extremely extensive land use for the relatively excellent land condition; future development (for higher level land use) is quite possible.

Future land use is evaluated for these 5 divided land conditions. The concept of Table 7-3 is illustrated in Table 7-4, and Fig. 7-1.

Table 7-4 Distribution of Land Use (U) Land Condition (L) Values

5／5 (1.0)	5／4 (1.25)	5／3 (1.67)	5／2 (2.50)	5／1 (5.0)
4／5 (0.80)	4／4 (1.0)	4／3 (1.33)	4／2 (2.0)	4／1 (4.0)
3／5 (0.60)	3／4 (0.75)	3／3 (1.0)	3／2 (1.50)	3／1 (3.0)
2／5 (0.40)	2／4 (0.50)	2／3 (0.67)	2／2 (1.0)	2／1 (2.0)
1／5 (0.20)	1／4 (0.25)	1／3 (0.33)	1／2 (0.50)	1／1 (1.0)

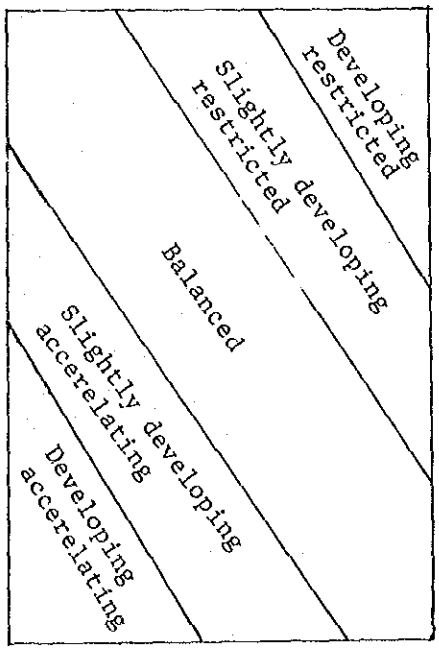


Fig. 7-1 Types of U/L Value

7-1-4 Futher Evaluation

The evaluation of 7-1-3 represents an evaluation of land use for the land condition for each mesh. Since the balanced type maps include various cases such as 5/5, 4/4, and 3/3, subdividing further can make the characteristics of the locality clearer, furthermore other information such as (population, socio-economic condition, and others) can be subjected to digital processing to conduct numerical analysis.

7-2 Evaluation of Land Use and Land Condition by Polygon Method (Superimposing Method)

The polygon method makes available to employ actual appearance of each classification boundary on the land condition and land use maps for evaluation of particalar area of both maps. The example of the evaluation by this method for future urban land use planning, for which the example was explained by Isometric Square Method in 7-1, is shown below:

7-2-1 Criteria for Evalucation

On the basis of the criteria for evaluation shown in Table 7-1 and 7-2, a five-grade classification plate is prepared individually for both of the land use and land condition maps using respective boundary for land use classes or land condition units.

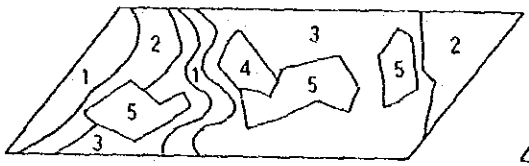


Plate for land use map

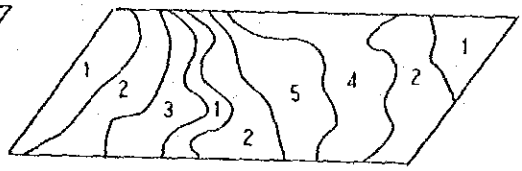


Plate for land condition map

7-2-2 Results of Evaluation

The numerical value of the evaluation is calculated by the equation as Land Use (U)/Land Condition (C) to represent each subdivided area that is delineated by either land use classification boundary or landform classification boundary by developing a composite plate of both five-grade classification plates.

The rated classes of the evaluation are explained in Table 7-3.

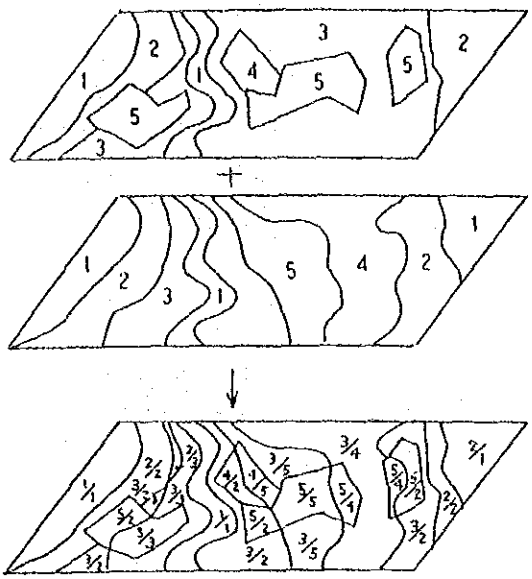


Plate for land use map

Plate for land condition map

Composite plate

7-2-3 Further Evaluation

In this method, the evaluation of land use in each subdivided area is able to be conducted by comparing with corresponding land condition status as detail classification. The different point from the Isometric Square Method is that it is possible in the Polygon Method to measure the extent of each subdivided small area as well as to make a higher-level numerical analysis by digital processing of measured data with other information e.g., population, soio-economic condition, etc., as the extent of those small area is able to be measured quite precisely.

As the principle object of usage of each series of urban base map, which was developed in this study is to be employed multi-purposely, it is expected to use those maps not only alone, but also in combination with other thematic maps and data.