

CHAPTER 2.

OUTLINE OF THE STUDY

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Outline of whole study was as follows.

2-1. Study Objectives

This study aimed;

- To prepare digital Topographic maps with the scale of 1:100,000 and 1:25,000 for their application,
- To prepare the basic data for GIS to the Integrated Development Master Plan and future map data usage of other concerned organization and data users, and
- To transfer the latest technology of digital mapping and related technology for the creation of GIS basic data to the counterpart organization, SSGC.
- To secure transferred technology to produce digital map practically in future.

In the course of the Study, all works were executed for promotion of ownership in the future study and implementation.

2-2. Study Area

The Study area covered Issyk-Kul Lake watershed, and is located in the northeastern part of Kyrgyz Republic shown in figure 2-1.



Figure 2-1. Location of Issyk-Kul Lake

The Study area is approximately 14,000km². Surroundings are TienSian mountain range and its altitude is more than 3,500m. The altitude of water surface Issyk-Kul lake is 1,600m. The territory of the study area was set along the international border between Kazakhstan and Kyrgyz Republic in northern part. Project Demarcation of Eastern and Southern parts are set to the range of 1:100,000 topographic maps as shown in figure 2-2.

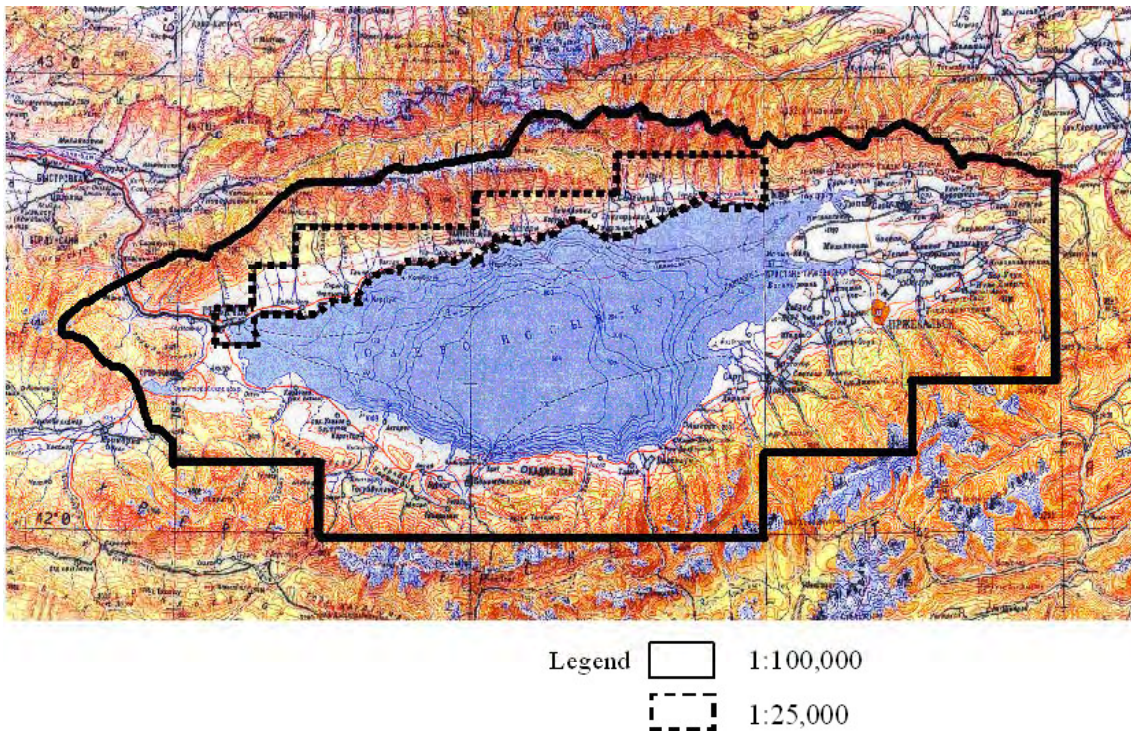


Figure 2-2. Study area

2-3. Topographic Map Production

Production of Digital Topographic mapping Data and Printed Maps corresponding to the individual scales was carried out. The list of produced topographic maps is shown in table following 2-1.

No.	Scale	Qty	Area	Sheets Number
1	1:25,000	30 sheets	2,300km ²	K43-47-v-v, K43-47-v-g, K43-47-g-v, K43-47-g-g, K43-48-v-a, K43-48-v-b, K43-48-v-v, K43-48-v-g, K43-48-g-a, K43-48-g-b, K43-48-g-v K43-48-g-g, K43-57-b-b, K43-57-b-v, K43-57-b-g, K43-57-v-b, K43-57-g-a, K43-57-g-b, K43-58-a-a, K43-58-a-b, K43-58-a-v, K43-58-a-g, K43-58-b-a, K43-58-b-b, K43-58-b-v, K43-59-a-a, K43-59-a-b, K43-59-b-a, K43-59-b-b, K43-60-a-a
2	1:100,000	19 sheets	14,000km ²	K43-45, K43-46, K43-47, K43-48, K43-56, K43-57, K43-58, K43-59, K43-60, K43-68, K43-69, K43-70, K43-71, K43-72, K44-37, K44-38, K44-49, K44-50, K44-61

Table 2-1. List of produced Topographic Map

2-4. Work Distribution

Work Distribution was done in order to carry out Technology Transfer by OJT taking into account the actual condition of SSGC. As the result, SSGC completed all work volume within planned schedule. This fact makes hope that SSGC has possibility to produce Topographic maps by themselves in the future. The following table 2-2 shows work distribution of the individual Topographic mapping Work for Study team and SSGC.

No.	Work Items	Scales	Study Team	SSGC
1	Production of Map Manuscript	1:100,000		14,000km ²
		1:25,000		2,300km ²
2	Digitizing of Map Manuscript	1:100,000	13,000km ²	1,000km ²
		1:25,000	2,100km ²	200km ²
3	Digital Compilation and Data Structuralization	1:100,000	13,000km ²	1,000km ²
		1:25,000	2,100km ²	200km ²
4	Symbolization	1:100,000	13,000km ²	1,000km ²
		1:25,000	2,100km ²	200km ²

Table 2-2. Work Distribution

2-5. Satellite Image Digital Mapping

The study enabled Kyrgyz Republic to develop new geographic data for other priority areas of Republic by using new satellite image data and the latest technology. This was to be achieved through technology transfer and supply of relevant equipment to Kyrgyz Republic whereby new map information could be generated in other areas in short period.

2-6. Work Stages

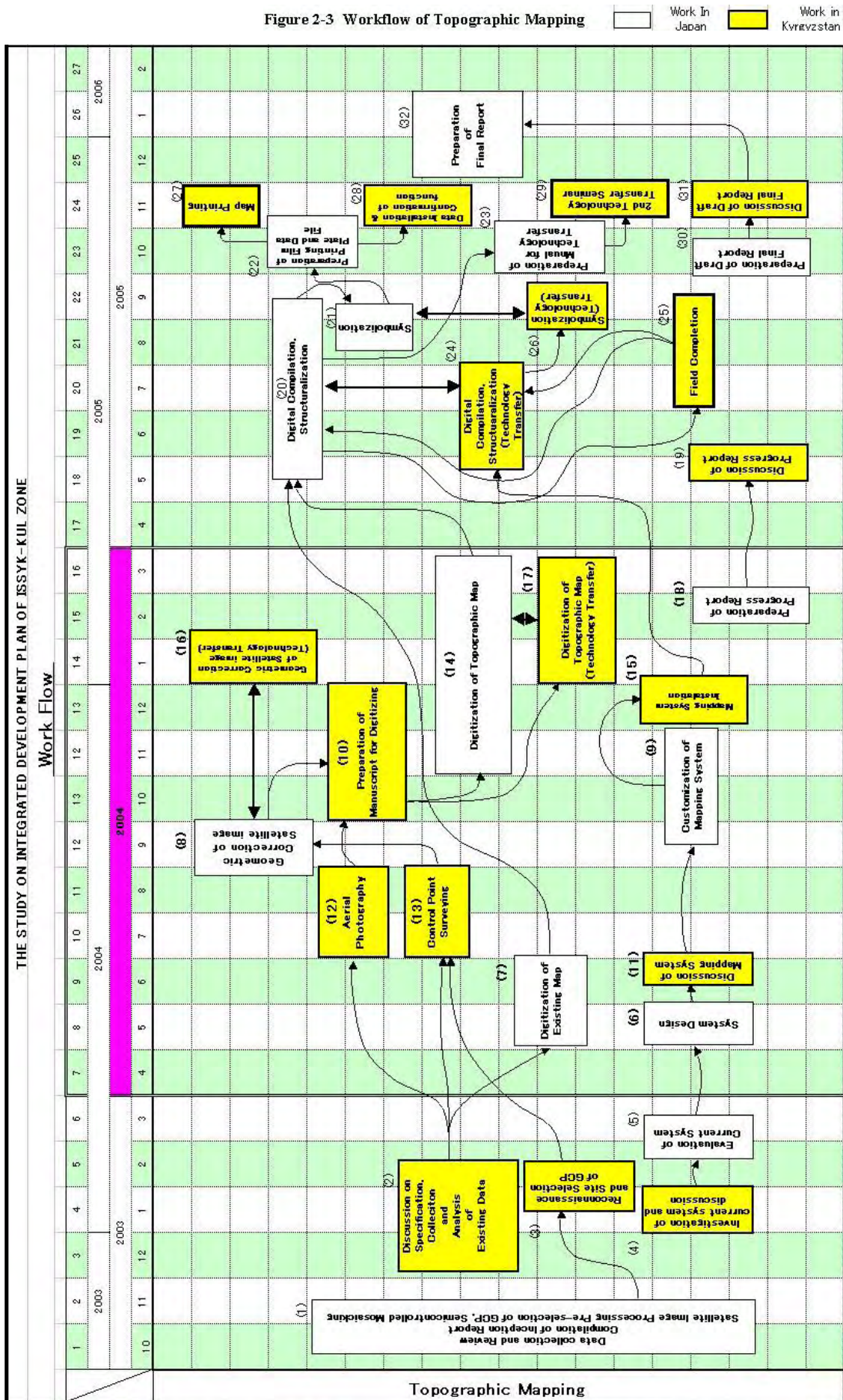
Topographic mapping work was carried out during the three Phases of Study executed in accordance with the following table 2-3.

Stage	From	To
First Phase	November 2003	March 2004
Second Phase	April 2004	March 2005
Third Phase	April 2005	February 2006

Table 2-3. Work Stages

The entire program for the execution of the Study is shown in the following figure 2-3, Work Schedule is shown in figure 2-4 and Assignment of Study Team member is shown in figure 2-5.

Figure 2-3 Workflow of Topographic Mapping



CHAPTER 3.

DESCRIPTION OF WORKS

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1. Works in First Phase

Following works were carried out in the First Phase.

1-1. Collection, Review and Analysis of Related Materials

The Study team collected, arranged and analyzed the existing data and material to understand well the actual situation of SSGC and the condition of Study area. Following materials were prepared based on the analysis:

- Plan of Study
- Draft of Specification
- Draft of Inception Report

1-2. Processing and Mosaicking of Satellite Image

The Spot satellite image was processed and simple mosaic images of approximately 1:500,000 scale were printed for the study to hold the condition of Study area.

1-3. Pre-selection of Control Point

Using the 1:200,000 topographic maps and mosaicked satellite image of 1:500,000 scale, suitable point for the ground control points were selected. High-resolution SPOT images of decided area were printed for GCP-GPS selection.

(1) Selection of GCP – GPS and GCP - MAP

Selected each point of GCP-GPS and GCP-MAP is shown in following table 3-1.

No.	Type of Points	Quantity of Selected Points
1	GCP – GPS	29 points
2	GCP – MAP	23 points

Table 3-1. Selected GCP-GPS and GCP-MAP

The categories of control point for Geometrical correction are as follows.

- a. Existing Triangulation Stations for checking : Triangulation station to be selected should be suitable as the known point for control point surveying. Eight stations

- were selected for checking coordinates of triangulation points simultaneously.
- b. GCP-GPS : New GCPs were selected at the suitable point around the pre-selected site. The site for GCP should meet to following conditions:
- Identifiable on the satellite image clearly.
 - Site without any obstacle to GPS observation.
 - Easy to access
 - Object could have visible sharp edged corner and flat
- c. GCP-MAP : In case the local condition of the GCP required area was difficult for GPS observation such as high attitude mountainous area, GCP MAP was selected. The site for GCP should meet following condition:
- Identifiable both on the satellite image and existing map clearly.
 - Object could have visible sharp edged corner and flat.

Distribution of selected GCP-GPS and GCP-MAP is as following figure 3-1.

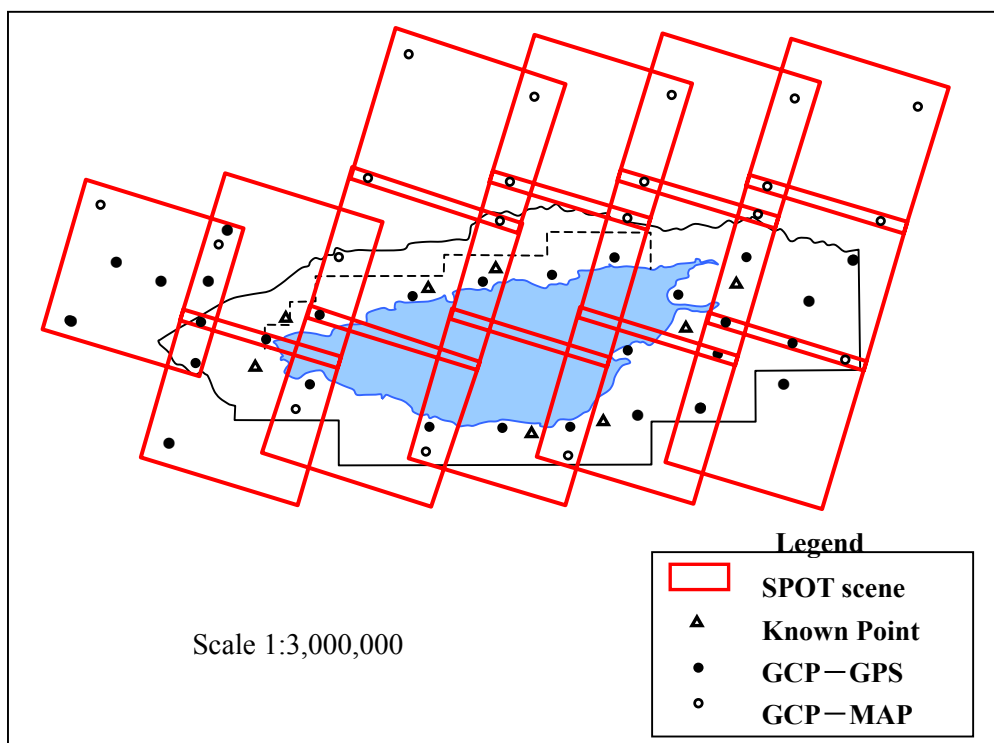


Figure 3-1. Distribution of selected GCP-GPS and GCP-MAP

(2) Preparation of Point description

Point description was prepared for 29 selected points of GCP – GPS before implementation of field work in Japan.

(3) Surveying plan and schedule

Reconnaissance plan in Kyrgyz Republic was prepared and submitted to SSGC before field work assignment for preparatory work such as instrument and transportation to Issyk-Kul area.

1-4. Evaluation of Actual Condition of SSGC

On the basis of the examination and discussion of system introduction to SSGC, the result was that suitable mapping system was to be introduced to the mapping system of SSGC. For instance, Design file for GIS and Printing work of SSGC are separated respectively. However the batch data processing could be done on mapping system of this Study for printing data production and GIS basic data with certain program simultaneously to get more progress after the technology transfer. With these points, promotion of streamlining of mapping work was considered to make data management easier. But for the achievement of such promotion of streamlining of mapping work, following several additional functions and extension were required.

- Additional function to input menu (Ex. Tracing of existing line)
- Additional function to Symbolization program. (Ex. Generate symbols at the corner of segment)
- Special input tool taking into account the function after the symbolization (Ex. housing block along the street, culvert or so)
- Application of Donut cognition method to the system as Donuts polygon element.

Abovementioned functions were added to the SSGC existing system, to make middle scale mapping work progress accelerate.

1-5. Collection of Existing Data and Materials

The work categories of collection of existing data and materials are as follows.

a) Collected data and materials

The Study team collected existing data from SSGC. Due to the remarkable change of geographical names after the independence, the latest data were needed for map updating work.

Following data and materials were collected from SSGC.

- Administration boundary
- Geographical name
- Contour line data

b) Preparation of duplicated original existing maps

Duplicated original of 1:25,000 and 1:100,000 Topographic maps were prepared for the acquisition of contour line and annotation.

c) Collection of Thematic map

Various types of Thematic maps were necessary to help the image interpretation together with aerial photograph but unfortunately most of the Thematic maps, such as Land use map were old and could not be used as reference data of satellite image identification work.

1-6. Discussion and Preparation of Specification for Topographic Mapping

The SSGC possesses the unified map symbols in the CIS countries. However, SSGC did not possess any specification of digital mapping. Study team discussed with SSGC and prepared a specification of digital Topographic mapping. The specification contained following items:

- Map symbol and marginal information (Appendix 3)
- Digital Topographic map data structure as GIS basic data
- Survey standard

Survey standard is as follows.

1. Reference Ellipsoid : Krassovsky 1940
Semi-Major Axis : 6378245.00m
Flattening : 1/298.26
2. Projection : Gauss-Kruger conformal projection
3. Coordinate System : CK1942

- Zone13(Central meridian E 75 degree)
Zone14(Central meridian E 81 degree)
4. Scale Factor : 1.000 on the central meridian
5. Elevation : from 1/25,000 and 1/100,000 existing topographic map's elevations, those were derived from Baltic Mean Sea Level
6. Contour Interval : 10 meter for 1/25,000
40 meter for 1/100,000
7. Unit : Meter

1-7. Scanning Work of Existing Map for Digitization

Overall map data of entire project area was necessary to implement the Study on the Integrated Development Plan. At the beginning of the study, raster data of existing 1:50,000 and 1:200,000 map was acquired by SSGC. The Study team supervised the scanning work to maintain required quality. The maps scanned are in following table 3-2.

Area	Map, scanned	Number of sheets
1:25,000 mapping area	1:50,000 Topographic map	Approx. 28 sheets
1:100,000 mapping area	1: 200,000 Topographic map	Approx. 7 sheets

Table 3-2. Number of scanned topographic maps

1-8. Field Reconnaissance and Selection of Control Point

Based on the pre-selected location of control points in Japan, reconnaissance of existing triangulation station and new GCP were carried out as follows.

(1) Preliminarily discussion

Study team had preliminary meeting with SSGC regarding the following work items.

- Plan of checking survey of existing triangulation points
- Observation plan and work execution
- Quality control

(2) Field reconnaissance

Study team visited to the site to make field reconnaissance of the existing control points with the guide of SSGC. The purpose of site visit was not only the checking of control point but also for the accommodation of field surveying parties, communication and condition of electric supply.

Following were the place of proposed base camp for surveying parties.

- Western Part of Issyk-Kul area was in Balykchy
- Northern Part of Issyk-Kul area was in Cholpon-ata
- Eastern Part of Issyk-Kul area was in Karakol
- Southern Part of Issyk-Kul area was in Tamga

(3) Accuracy checking of existing triangulation points by GPS observation

1) Observation plan

Observation plan was shown following figure 3-2. Eight (8) existing triangulation stations were used for checking survey surrounding of Issyk-Kul Lake.

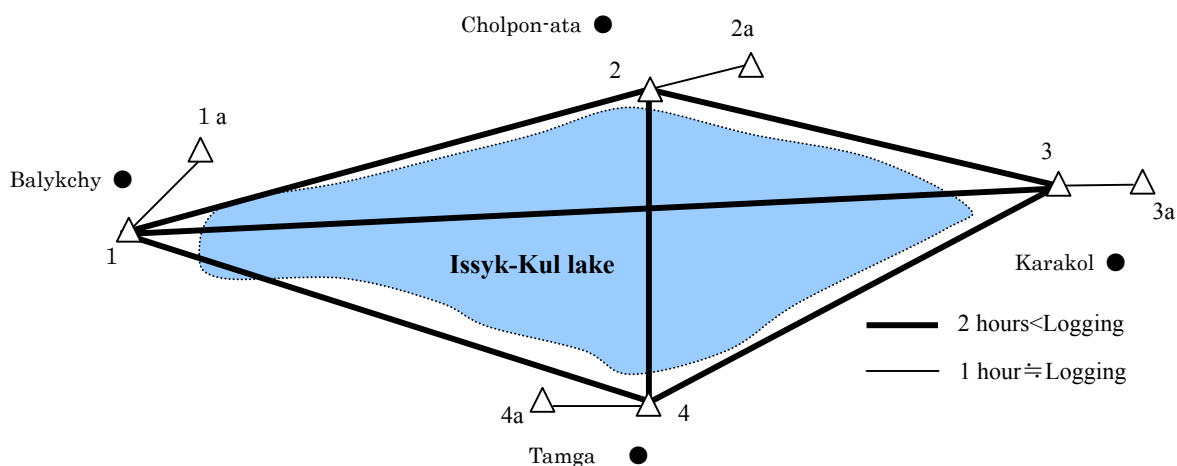


Figure 3-2. Check observation plan of existing triangulation station

1) Result of Checking survey

As a result, discrepancy of distance between GPS surveying result and existing triangulation points was 0.68m in minimum and 1.91m in maximum. Therefore the accuracy of existing triangulation point was judged that it was sufficient for map production of 1:25,000 and 1:100,000 of this study.

2) Transformation Parameter

Study team and SSGC agreed that Transformation parameter between WGS84 and SK42 was discussed when GCP-GPS observation was carried out.

3) Specification of GPS Observation

Specification of GPS observation is as following table 3-3.

No.	Items	Specification
1	GPS Instrument	LEICA SR520
2	Data acquisition	30 sec
3	Session No.	1
4	Logging time	1 hour < less than 50km
		2 hours < more than 50km

Table 3-3. Specification of GPS observation

4) Tolerate accuracy of GPS observation

Tolerate accuracy of GPS observation is as following table 3-4.

No.	Description	Accuracy
1	Closure of each base line vector element	45mm \sqrt{N} : number of side
2	Closure of duplicated each base line vector element	45mm

Table 3-4. Tolerate accuracy of GPS observation

5) Description of GCP-GPS

Filed checking of GCP-GPS was carried out based on prepared descriptions in Japan in January 2004. Fieldwork was limited along the coastline of Issyk-Kul Lake only due to the snow coverage in project area. As a result five (5) points were selected and confirmed for GCP-GPS.

6) Request to SSGC

Study team requested SSGC to prepare Surveying plan and schedule for GCP-GPS in Second work stage with submission of description of GCP-GPS, GCP-MAP and location of selected position by the end of June 2004.

1-9. Setting of the Goal of the Project and Confirmation of Evaluation Method and Index

This Study was carried out with mutual cooperation between the Study team and SSGC. At the beginning of the Study, the goal of project was discussed and set up. Method and index to evaluate were decided. The goal of the project was to lead that SSGC can produce map data in future. Project evaluation was done based on the Seminar as colligation of technology transfer. SSGC should take into action for all work criteria with the transferred technology and understanding the project by themselves. JICA Study team believed that Technology transfer was carried out properly in this project as long as created data was delivered and examined by Study team.

1-10. Examination and Discussion on Actual Condition of SSGC Related to the Computer Mapping

At he beginning of this project, Study team planed to apply actual computer mapping system to SSGC mapping system for the middle scale topographic mapping. But it was clear that the system level of SSGC was more than Study team expected when Study team checked a sample of 1:100,000 Topographic map data. It was therefore important that inspection of existing system and method of data production of SSGC had to be done carefully to direct the technology transfer and to find the equality between SSGC and Study team system. Following items are the result of examination.

(1) Digitizing Work in SSGC

Digitizing work of SSGC had been carrying out in both sections of GIS center and Photogrammetric section actually. SSGC produced only one sample of digitized 1:100,000 topographic map data. Study team examined and discussed with SSGC based on this sample data.

(2) System Structure

Study team investigated and examined system structure of digitizing work of SSGC. Actual condition of system structure of SSGC is as following table 3-5.

Works	Function	System	Remarks
Digitizing and Digital compilation Work	Engine	MicroStation95&SE	Bentley
		MGE	Intergraph
	Dialogue compilation	MicroStation Standard Function	
	Automatic Compilation	None	

Table 3-5. Existing system of SSGC

(3) Data Management in SSGC

Data management of the Mapping and Structuralization of SSGC are as follows.

- Design File is classified into feature attribute on each map sheet and also feature classification has been done in detail by level and symbology in each design file.
- MGE is used for the Setting of various information and Feature Code, such as Level, Co, Wt, Lc.
- Connection of Database is done by MsLink code (automatically created by MGE)
- Screen digitizing is done with the background of raster image.
- All works of allocation and rotation of symbol (Isolate or in polygon) are done manually.
- All symbolization is done by “pattern” commend and custom line category of standard function of MicroStation.
- Symbols being used are all cell symbols but font text is used for annotation only.
- Design file for printing and design file for GIS exist separately. (For instance, Road.dgn for GIS, Road1.dgn for printing)

Three licensed Russian Input menus were installed to existing system in SSGC but only for 1:500, 1:1,000, 1:2,500, 1:5,000 scale maps due to the symbol size determination at the side of input menu. In this case input menu denies the bigger input scale value.

Based on the result of examination and technology transfer plan of the study, the Study team explained the content of technology transfer plan and system design to SSGC. Technology

transfer plan and system design were discussed between the Study team and SSGC to determine the final technology transfer plan, system design and customization plan.

2. Second Phase

Second Phase Works consist of:

2-1. System Design

Based on the system design and customize plan, new mapping system was designed concretely taking into account the existing mapping system of SSGC. Principal composition of hardware is as follows:

- Desktop computer
- Scanner (SSGC possesses already)
- Printer (SSGC possesses already)
- UPS
- Network Server

Software was the one of the most important tools for digital topographic mapping. Principal applications systems and software are as follows:

- Operation system
- CAD (MicroStation)
- Graphic software

As market applications were developed with the account of worldwide use, least customization was done for special mapping operation.

2-2. Discussion of Mapping System

Based on the draft of mapping system design prepared in Japan, the Study team discussed with SSGC to prepare the final design of digital mapping system.

2-3. Vectorization of Existing Map

All information related to the elevation including contour lines was digitized in Japan based on scanned data of original existing maps. Work process was as follows:

- a) Production of duplicated original plate of Topographic map (This process was carried out in Kyrgyz Republic.)
- b) Amendment of interrupted part of contour lines
- c) Checking of adjoining sheets

- d) Acquisition of raster data of the duplicated Topographic map by scanning
- f) Vector data acquisition by screen digitizing
- g) Compilation of the vector for addition of elevation attribute for GIS basic data

2-4. Aerial Photography

Aerial Photography was achieved by the selected subcontractor through international tender. As a result, Aerial Photography Company of Republic of Kazakhstan, KAZAVIASPAS sub-contracted aerial photography works.

(1) Specification of Aerial Photography

The purpose of aerial photography was to supplement the identification and interpretation of features at mapping scales of 1:25,000 and 1:100,000 which could not be interpreted on satellite images due to their limited spatial resolution. B/W aerial photography covered about 14,000km² which constituted the whole study territory. The photography was completed in July and August 2004 the season of maximum vegetation cover.

- Subcontractor and equipment employed
Name of sub-contractor: KAZAVIASPAS, Almatinskaja region, Boroldai district, Airport, 480014, Almaty, microregion Dorozhnik 26B

- Aerial Camera : TAFA-10, Precision Photogrammetric Camera

Lens	: Ortogon-5A
Focal length	: 100,6943mm
Image format	: 18 x 18cm

- Platform : AN-30 Survey Aircraft

Serial Number of aircraft	: N30038
Navigation Method	: Autopilot, GPS Navigation System
Cruising time	: 5 hours and 30 minutes

- Plan of Photography

Due to the high mountainous area, flying heights had to be changed depending upon the altitude of mountain. The overlap and sidelap were taken into account to the big height difference. The photographed area and the outline of aerial photography are follows.

No.	Items	Details
1.	Area	: 14,000km ² (approx.)
2.	Scale	: 1:30,000 approx.
3.	Overlap (forward overlap)	: 65% (Due to the high mountainous area) approx.
4.	Sidelap (lateral overlap)	: 35% (Due to the high mountainous area) approx.
5.	Film type	: Panchromatic
6.	Angular field	: 180mm×180mm
7.	Number of flight lines	: 30 lines (general)
8.	Number of photographs	: 2,482 photographs
9.	Reproduction	Negative film : 1 set Contact prints : 2 sets

(2) Flight Line of aerial photography

Flight line is shown as following figure 3-3. Number of flight lines was 30 but there were some branch numbers in individual re-fly flight lines due to the clouds, less of side lap and over lap of the photographs. It was difficult to photography in mountain range due to big height difference of study area.

Flight report is shown in Appendix 4. The numbers of photograph is listed in the table 3-6.

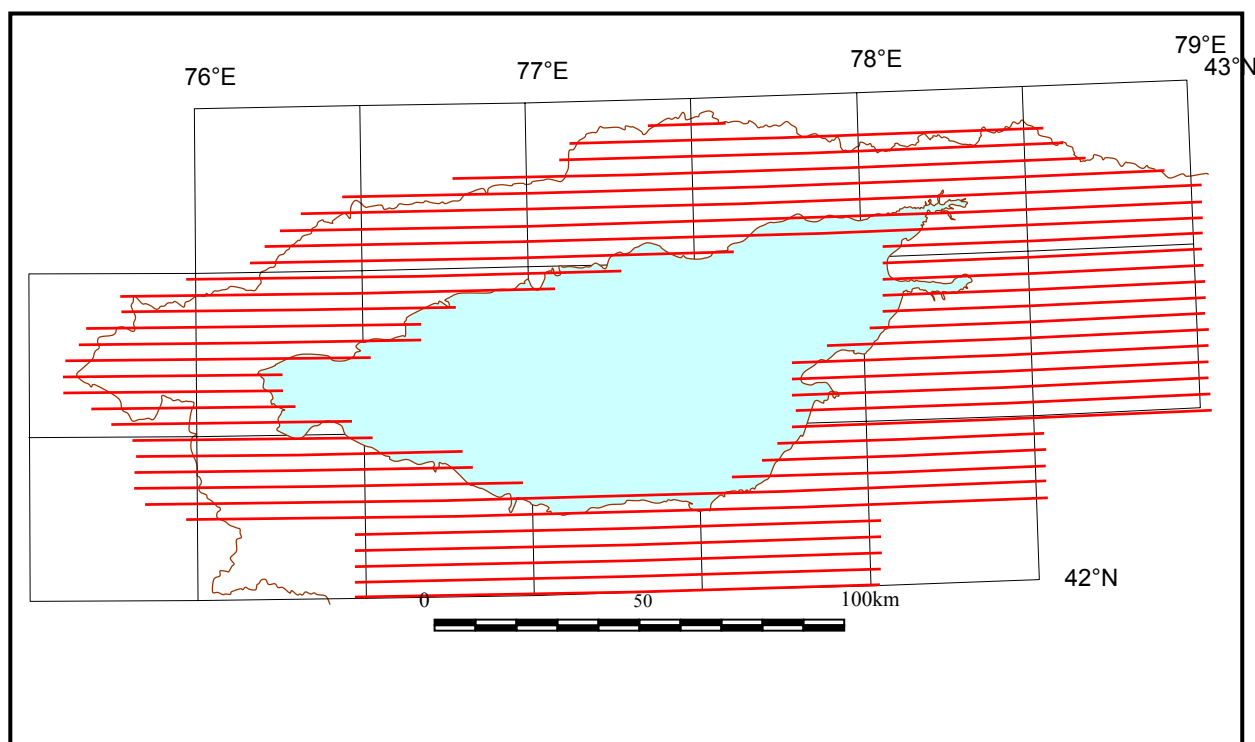


Figure 3-3. Flight Line

No.	Line No.	Photo No.		Qty	No.	Line No.	Photo No.		Qty	No.	Line No.	Photo No.		Qty
		Start	End				End	No.				End	No.	
1	1	1A	33A	33	36		1D	11D	11	71		1D	16D	16
2		1B	15B	15	37		6E	21E	16	72	20	1A	31A	31
3		2C	24C	23	38		1C	22C	22	73		1B	26B	26
4	2	1A	43A	43	39	12	1A	13A	13	74		1C	29C	29
5		1B	12B	12	40		1B	21B	21	75		1D	14D	14
6		1C	15C	15	41		1C	19C	19	76	21	1A	22A	22
7	3	1A	37A	37	42		1C	39C	39	77		2B	34B	33
8		1B	11B	11	43		5D	18D	14	78		1C	39C	39
9		1C	12C	12	44	13	1A	16A	16	79	22	1A	33A	33
10	4	2A	36A	35	45		3B	15B	13	80		2B	28B	27
11		1B	25B	25	46		1C	9C	9	81		1C	39C	39
12		2C	17C	16	47		1E	22E	22	82	23	1A	35A	35
13	5	1A	50A	50	48		1D	25D	25	83		1B	9B	9
14		1B	17B	17	49	14	1A	19A	19	84		3E	27E	25
15	6	1A	26A	26	50		2B	13B	12	85		37B	77B	16
16		1B	50B	50	51		1C	28C	28	86		1C	14C	14
17		1C	23C	23	52		1D	23D	23	87	24	1A	37A	37
18		1E	16E	16	53	15	1A	16A	16	88		1B	65B	65
19	7	1A	29A	29	54		1B	12B	12	89	25	1A	43A	43
20		1B	47B	47	55		1C	31C	31	90		1B	57B	57
21		4C	18C	15	56		1D	23D	23	91	26	1A	41A	41
22		1E	13E	13	57	16	2A	32A	31	92		1B	46B	46
23		1F	14F	14	58		1C	24C	24	93	27	1A	16A	16
24	8	1A	21A	21	59		1D	23D	23	94		1C	13C	13
25		1B	31B	31	60	17	1A	25A	25	95		21A	28A	8
26		3C	18C	16	61		1B	19B	19	96		1B	43B	43
27		1D	26D	26	62		1C	30C	30	97	28	1A	16A	16
28	9	1A	37A	37	63		1D	16D	16	98		9B	51B	43
29		1B	11B	11	64	18	1A	17A	17	99	29	3A	9A	7
30		1C	24C	24	65		1B	32B	32	100		1C	23C	23
31	10	1A	37A	37	66		5C	31C	27	101		24A	32A	9
32		1B	10B	10	67		2D	20D	19	102		1B	18B	18
33		1C	24C	24	68	19	1A	21A	21	103	30	1A	12A	12
34	11	1A	29A	29	69		1B	25B	25					
35		1B	9B	9	70		1C	29C	29	Total				2,482

Table 3-6. List of photographs

(3) Quality control of Aerial Photography

Photographs were checked after photographing flight immediately. In case the photographs did not meet to the required quality, re-flight was ordered to the subcontractor by the Study team. Quality Control Sheets are shown in Appendix 5.

2-5. Control Point Survey

GPS Control Point Survey was carried out to acquire the coordinates of GCP-GPS for the Geometric correction of Satellite Imagery. Technology Transfer of selection of GCP-GPS was carried out through the OJT.

(1) Work Volume

Work volume of GCP-GPS is shown in following table 3-7.

Category of points	Quantity
Ground Control Point(GCP)	: 29 points
Existing Triangulation Station (PTR)	: 12 stations
Existing Benchmarks (BM)	: 4 points
Existing Triangulation as a base station (BPTR)	: 8 stations (Used)

Table 3-7 Work Volume of GCP

Distribution of GCP and related existing control station is shown in figure 3-4.

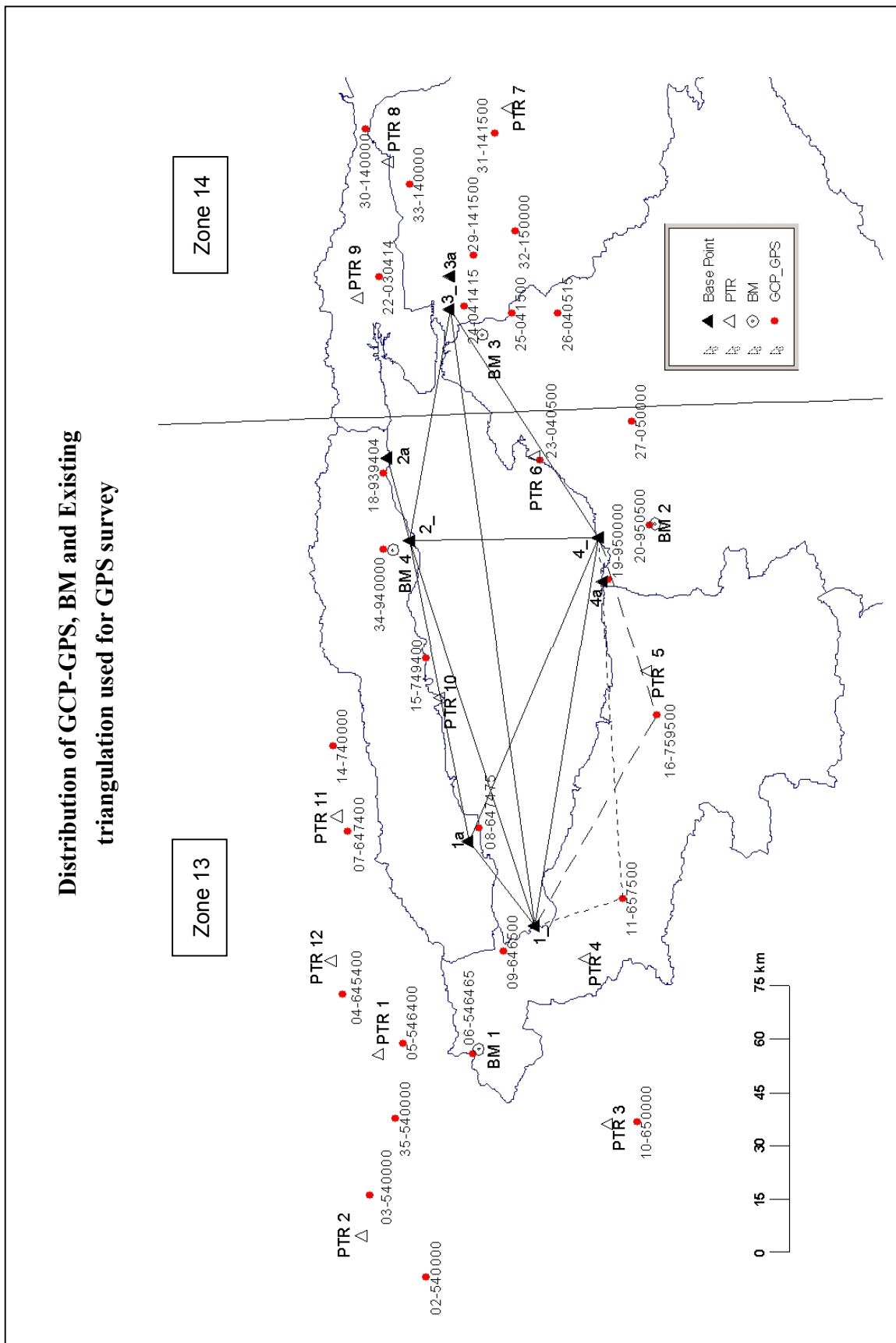


Figure 3-4. Distribution of GCP and related existing control station

(2) Instrument

Instrument used for GPS survey is shown in table 3-8.

Instrument	Qty	Unit	Remarks
GPS Receivers	6	sets	Leica, System500 (Dual Frequency)
GPS Cameras	4	sets	Konica Land Master
Digital Cameras	3	sets	Olympus (4.0M)
Cameras	2	sets	Konica
Transceivers	5	sets	Alinco DX-701(3~10MHz, 100W)
Computers	3	sets	TOSHIBA DAYNA BOOK
Vehicles	5	sets	UAZ-4WD
Generators	5	sets	SUZUKI (SV1000H)

Table 3-8. Used instrument for GPS survey

Before starting the Observation, GPS receivers were checked and result was approved for GPS work as follows.

(3) Observation

GPS observation was carried out in the period of July and August around 1.5 months by SSGC with supervision of Study team. The details of GPS survey are shown as follows.

Observation time	: GCP (New Control Point)	More than 2 hours
	: PTR (Existing Triangulation Station)	More than 3 hours
	: BM (Existing Benchmark)	More than 3 hours
Data acquisition	: EPOCH	10 second
	: Angle of elevation	More than 15 degrees
Quality Control	: 1) By Checking of closure	
	: 2) Checking Survey: 4 points	

(4) Quality Control of GPS survey

Quality control was done with computed elevation. Confirmation of standard deviation for elevation and horizontal position was done with the quality control computation shown in Appendix 6.

(5) Technology Transfer of GPS survey

The technology of GPS observation and related work of SSGC were transferred from Germany and Switzerland before this study. However its result hasn't been effectively utilized, stored and evaluated as national information consistently to the work for SSGC so far. Therefore, Study team made technology transfer to plan and execute the GPS observation work to the SSGC. The contents of technology transfer are as follows.

- Preparation of Work Plan
- Presentation of GPS Observation sheet in Russian
- Presentation of Description of Control Points
- Method of Accuracy Control
- Instruction of evaluation for the result

(6) Final Result of Control Point

Following result of control points was used for the Geometric correction of Satellite Imagery as GCP.

- Quality Control : 1 set (shown in Appendix 6)
- Description and Result table of GCP : 1 set (shown in Appendix 7)

Sample of GPS observation sheet is shown in figure 3-5.

ЖУРНАЛ НАБЛЮДЕНИЯ GPS

Название станции	08		Точка наблюдения	В = с		
Тип приемника	Leica GPS System 500 SR		Погода	<input type="checkbox"/> Ясная <input checked="" type="checkbox"/> Тучи <input type="checkbox"/> Дождь		
Серийный №	Приемник	0020439	Широта	42° 30' 38,3555"		
	Антенна	6254	Долгота	76° 34' 58,6935"		
Угол отсечки (маска)	15°	Интервал наблюдения	10"	Эллипсоидальная выс.	М 1560,306	
Код станции	08 - 647475		Несущая волна	<input type="checkbox"/> L1 <input checked="" type="checkbox"/> L2		
Сессия	1-я	2-я		3-я		
Название сессии	205					
Дата (День/Месяц/Год)	23. 07. 2004					
Наблюдатель	Киреев А. М.					
Позиция	<input checked="" type="checkbox"/> Земля <input type="checkbox"/> Высшая точка		<input type="checkbox"/> Земля <input type="checkbox"/> Высшая точка		<input type="checkbox"/> Земля <input type="checkbox"/> Высшая точка	
Высота антенны	1,705 М		М		М	
Время начала	10 ^ч 06 ^м	УТ. КТ	ч М	УТ. КТ	ч М УТ. КТ	
Время завершения	13 ^ч 08 ^м	УТ. КТ	ч М	УТ. КТ	ч М УТ. КТ	
Время наблюдения	3 ^ч 02 ^м		ч М		ч М	
Условия						
<p>Схема высоты антенны</p>						
Сессия	1-я		2-я		3-я	
Постоянные антенны	<input type="checkbox"/>	0,360 М	<input type="checkbox"/>	М	<input type="checkbox"/>	М
Высота инструмента	<input type="checkbox"/>	1,345 М	<input type="checkbox"/>	М	<input type="checkbox"/>	М
Высота антенны	<input type="checkbox"/>	1,705 М	<input type="checkbox"/>	М	<input type="checkbox"/>	М

@2004.05mk

Figure 3-5. Sample of Field note of GPS survey

2-6. Geometric (Orthogonal) Correction of Satellite Image

(1) Geometric (Orthogonal) Correction

Raw satellite image data contains distortion and does not coincide to Topographic map directly. Therefore, all of SPOT images were geometrically and orthogonally corrected for the production of map manuscript to be digitized. Geometric (Orthogonal) correction of SPOT5 images (15 scenes) was carried out using GCP-GPS, GCP-MAP and DEM derived from contour line data of existing map. The processing flow is shown in figure 3-6.

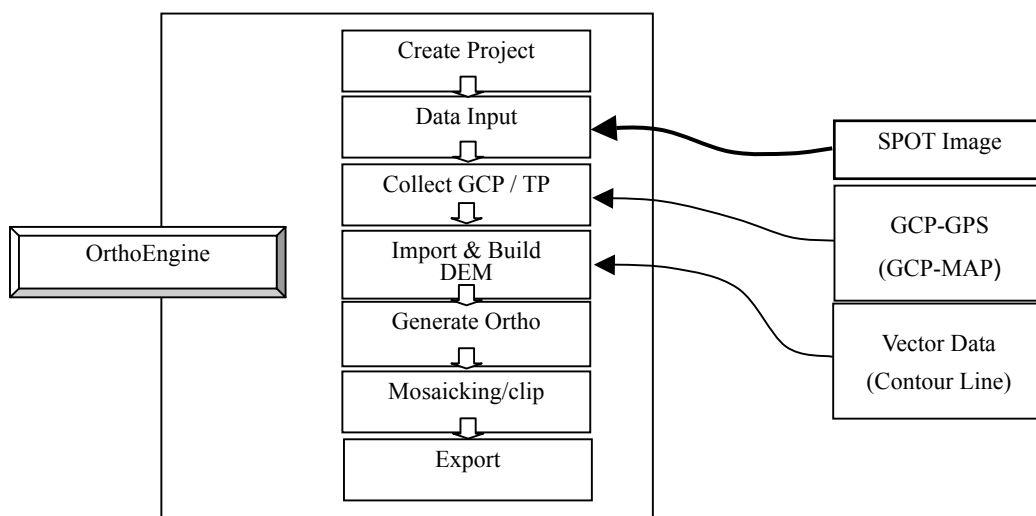


Figure 3-6. Processing flow of Geometric correction

SPOT5 images were obtained with Level 1A DIMAP format, which were applied for the minimum correction of satellite systematic radiation and geometric distortion. DIMAP data contains not only image data but also satellite orbital and attitude information as metadata. Orthogonal correction was executed with theses metadata, GCPs results and DEM.

For the control point reconnaissance in the field, suitable points for the ground control points, such as shown below were selected. For this work, simply geometrically corrected and geo-coded image was extracted from the satellite images and helped the interpretation of the control point in the field.

- Triangulation stations
- GCP-GPS
- GCP-MAP

Geometric (Orthogonal) correction was carried out using two types of Ground Control Point, and data of Digital Elevation Model.

- GCP-GPS : Point which can be identified clearly only on satellite image. The coordinates of GCP-GPS are the results of GPS control point surveying. Based on the reconnaissance results, GPS surveying plan was made.
- DEM : The majority part of the study area is high mountainous area. Thus, Geometric (Ortho) correction of these areas was carried out carefully. DEM was extracted from the digitization of existing map with 10 meters of resolution for the acquisition of sufficient accuracy of Geometric correction.
- GCP-MAP : Point which can be identified clearly both on satellite image and existing map. The coordinates of GCP-MAP were measured on the existing map.

(2) Accuracy of Geometric correction

As the interested area was divided into two zones, Orthogonal correction was carried out individually. Both errors of each zone are within one pixel resolution of SPOT5 image (2.5m), which has suitable accuracy of Geometric correction. The Result of adjustment of Geometric (Orthogonal) correction is shown in table 3-9 and 3-10. The Planimetric deviation shown as vector line of RMS error report is shown in figure 3-7.

*Study team evaluated the accuracy of GCP-MAP for Geometric correction. As a result, the Planimetric discrepancy of all GCP-MAPs was exceeding tolerance of 1 pixel of satellite image resolution. Therefore Study team decided to select the GCP-GPS as many as possible instead of GCP-MAP. Study team investigated the cause of such error exceed, the result was that error arose from negative film shrinkage and/or expansion. This checking was very useful and important for future map production work for SSGC.

Residual Error Report (Zone 13)											
No.	Point ID	Residuals	Res X	Res Y	Type	Photo ID	Ground X	Ground Y	Ground Z	Comp X	Comp Y
1	05	2.282	2.089	-0.917	GCP	196s			1268.05		
2	04	2.045	-1.557	1.326	GCP	196s			2135.21		
3	09	2.033	0.493	-1.972	GCP	196s			1636.42		
4	08	1.932	-1.039	1.629	GCP	196s			1609.10		
5	23	1.839	0.124	1.835	GCP	200s			1616.00		
6	24	1.690	-0.388	-1.646	GCP	200s			1693.06		
7	06	1.445	-0.958	1.081	GCP	196s			1509.15		
8	20	1.312	-0.164	-1.302	GCP	200s			2196.30		
9	20	1.218	0.260	1.190	GCP	199s			2196.30		
10	19	1.206	-0.264	-1.177	GCP	199s			1677.40		
11	07	1.173	0.852	-0.807	GCP	196s			2333.89		
12	14	1.053	-0.300	-1.010	GCP	197s			2733.23		
13	05	0.934	-0.221	-0.907	GCP	195264			1268.05		
14	18	0.920	-0.119	-0.913	GCP	200s			1623.19		
15	07	0.914	0.258	0.877	GCP	197s			2333.89		
16	34	0.881	0.244	0.847	GCP	199s			1812.21		
17	22	0.825	0.054	0.823	GCP	200s			1647.46		
18	25	0.575	0.573	0.045	GCP	200s			2170.70		
19	11	0.409	0.394	-0.112	GCP	196s			2176.83		
20	26	0.368	-0.257	0.264	GCP	200s			2534.41		
21	08	0.354	-0.090	-0.342	GCP	197s			1609.10		
22	06	0.345	0.084	0.334	GCP	195264			1509.15		
23	16	0.341	0.080	0.332	GCP	199s			2239.99		
24	10	0.248	-0.174	0.177	GCP	196s			2113.48		
25	35	0.153	0.029	0.150	GCP	195264			1161.49		
26	03	0.099	0.027	0.095	GCP	195264			862.76		
27	04	0.072	-0.018	-0.069	GCP	195264			2135.21		
28	02	0.056	-0.013	-0.054	GCP	195264			1300.09		
29	15	0.044	0.018	0.041	GCP	199s			1607.61		
30	27	0.038	-0.010	0.036	GCP	200s			2509.66		
31	18	0.029	-0.019	0.022	GCP	199s			1623.19		
32	15	0.022	-0.022	0.000	GCP	197s			1607.61		
33	11	0.016	0.001	0.016	GCP	197s			2176.83		
34	16	0.004	0.001	-0.004	GCP	197s			2239.99		

Table 3-9. Adjustment Result of Geometric correction in Zone 13

RMS (x, y) for worst 5% of points in list: 0.97, 3.13

* X,Y Ground Coordinates were not shown on the list due to security reason of GOK.

Residual Error Report (Zone 14)

No.	Point ID	Residuals	Res X	Res Y	Type	Photo ID	Ground X	Ground Y	Ground Z	Comp X	Comp Y
1	24-041415	1.314	-0.663	-1.134	GCP	200s			1693.06		
2	29-141500	1.121	0.296	1.081	GCP	201264			1867.08		
3	25-041500	1.066	1.063	0.081	GCP	200s			2170.70		
4	23-040500	1.045	-0.076	1.042	GCP	200s			1616.00		
5	33-140000	0.699	-0.154	-0.681	GCP	201264			1786.85		
6	20-059500	0.680	-0.003	-0.680	GCP	200s			2186.30		
7	24-140415	0.579	-0.115	-0.567	GCP	201264			1693.06		
8	27-050000	0.523	0.045	0.521	GCP	200s			2509.66		
9	24-150414	0.455	-0.170	-0.423	GCP	201265			1693.06		
10	22-030414	0.437	0.034	0.435	GCP	200s			1647.46		
11	26-150405	0.434	-0.140	-0.411	GCP	201265			2534.41		
12	22-140304	0.391	0.086	0.382	GCP	201264			1647.46		
13	25-150400	0.387	0.124	0.366	GCP	201265			2170.70		
14	26-040515	0.385	-0.371	0.102	GCP	200s			2534.41		
15	18-049394	0.356	0.015	-0.356	GCP	200s			1623.19		
16	29-151400	0.296	0.065	0.289	GCP	201265			1867.08		
17	30-140000	0.276	0.061	0.269	GCP	201264			1980.99		
18	31-141500	0.149	-0.044	-0.143	GCP	201264			2795.61		
19	32-150000	0.124	-0.039	-0.118	GCP	201265			2523.80		
20	31-151400	0.058	-0.014	-0.056	GCP	201265			2795.61		
RMS (x, y) for worst 5% of points in list: 0.78, 2.28											
* X,Y Ground Coordinates were not shown on the list due to security reason of GOK.											

Table 3-10. Adjustment Result of Geometric correction in Zone

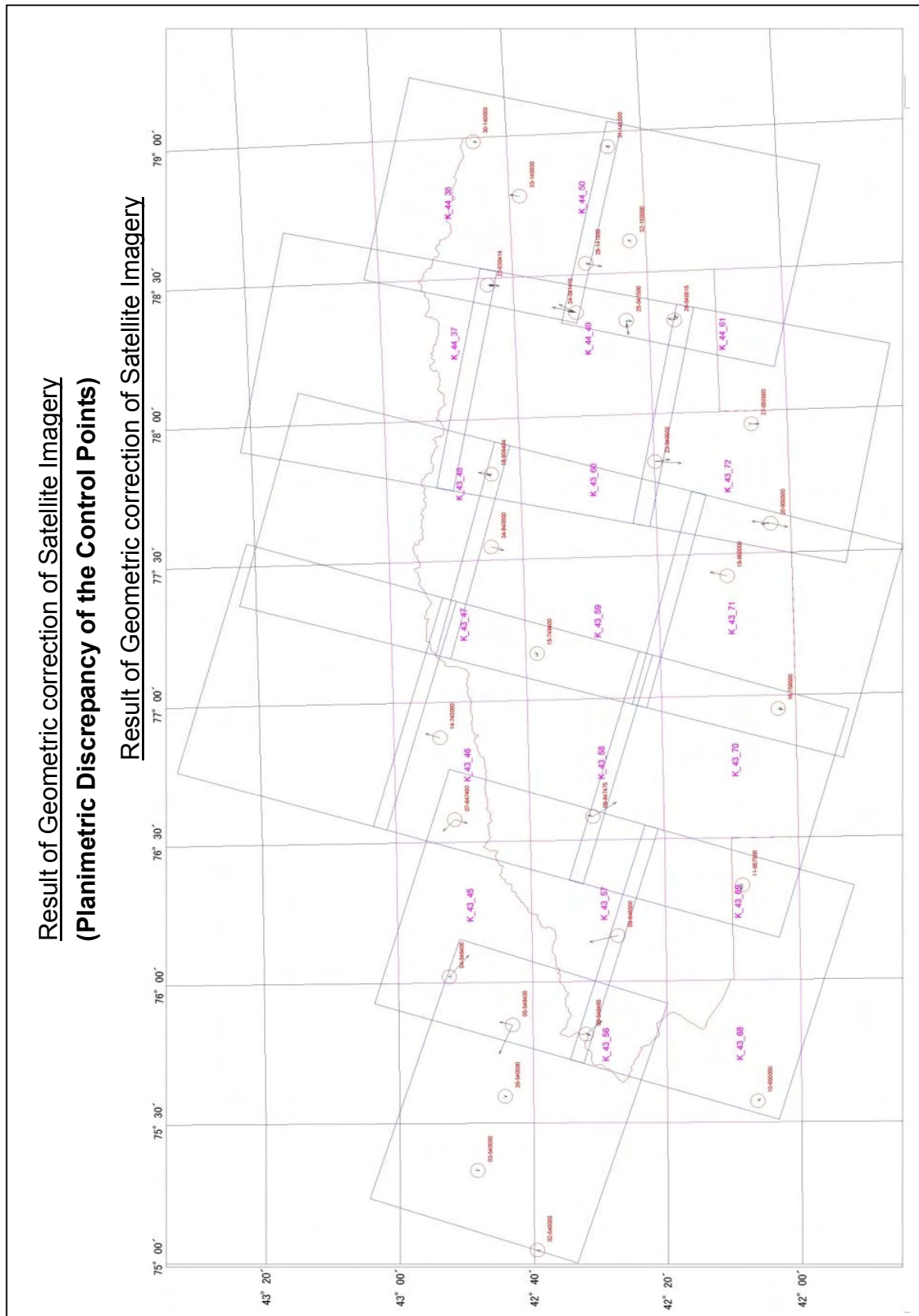


Figure 3-7. Discrepancy of GCP-GPS with vector arrow

(3) Development of sheet-unit images (mosaicking + clipping)

Forty nine (49) frames of sheet-unit image were developed. Spatial resolution of images was maintained at 2.5m, which was equivalent to the original data. Therefore such images were used for interpretation of digital geographic data corresponding to 1:25,000 and 1:100,000 Topographic map without problem of visibility which is occurred by pixel size.

(4) Development of Reseau marks

Numbers of Reseau marks were developed and given to corresponding Topographic map scales. Number of Reseau marks depended on the size of printed images for image interpretation. Number of Reseau Marks of each scale satellite imagery is as following table 3-11.

Map scale	Number of Reseau Mark
1/25,000	4 points
1/100,000	9 points

Table 3-11. Number of Reseau Marks

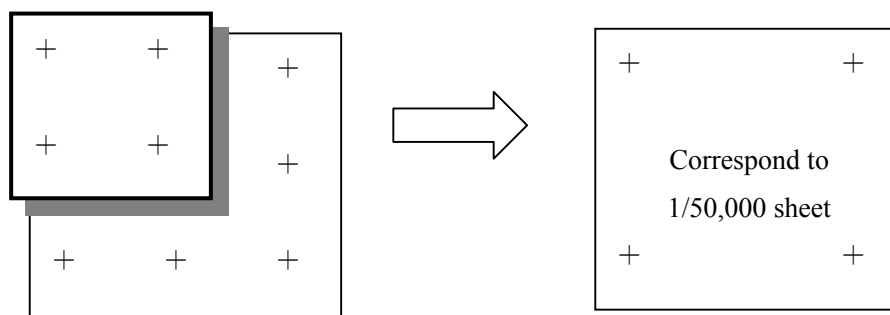
(5) Printing of images for images interpretation

Sheets, enlarged 2-times for image interpretation for 1:100,000 scale, were printed based on Reseau marks. Number of printed images is as following table 3-12. Each sheet was divided into quarters for 1:100,000. Concept of Satellite Images printing with Reseau mark is shown in figure 3-8.

Map Scale	Number of images
1:25,000	30 frames
1:50,000	54 frames

Table 3-12. Number of printed imagery

- For 1:100,000 Topographic map



- For 1:25,000 Topographic map

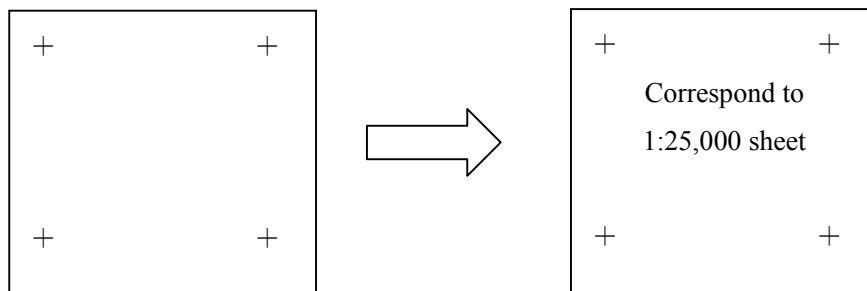


Figure 3-8. Concept of Satellite Images printing with Reseau mark

2-7. Preparation of Manuscript for Digitizing

To prepare the current geographic information used in digital Topographic mapping, two kinds of Topographic map manuscripts at scales 1/25,000 and 1/50,000 were produced with support of geometrically corrected satellite imageries and stereo pair of aerial photographs.

(1) Work organization

This work was centrally carried out by counterparts of the Aero Geodetic Complex Expedition of SSGC under the supervision of the Study team. The number of engineers engaged in this work was fifteen (15) including two inspectors.

(2) Manuscript sheets production

To transcribe map symbols and codes the following manuscript sheets were produced.

- Manuscript sheets at scale of 1/25,000 were copied on stable polyester films from their original printing plates. In all 30 sheets were produced.
- Manuscript sheets at scale of 1/50,000 were enlarged on stable polyester films from printing plate scale of 1/100,000. In all fifty-four (54) sheets were produced.

(3) Data interpretation and transcription

- Interpretation was carefully carried out with a comparison between mosaicked satellite imagery and the manuscript. The use of a set of overlapping aerial photographs was the great assistance for an interpretation of small and invisible objects on satellite image.
- In accordance with classified map symbols, all of interpreted topographic features were transcribed on the manuscript with their unique code so that data could be converted as readily as possible to digital form later. Sample of prepared manuscript is shown in figure 3-9.

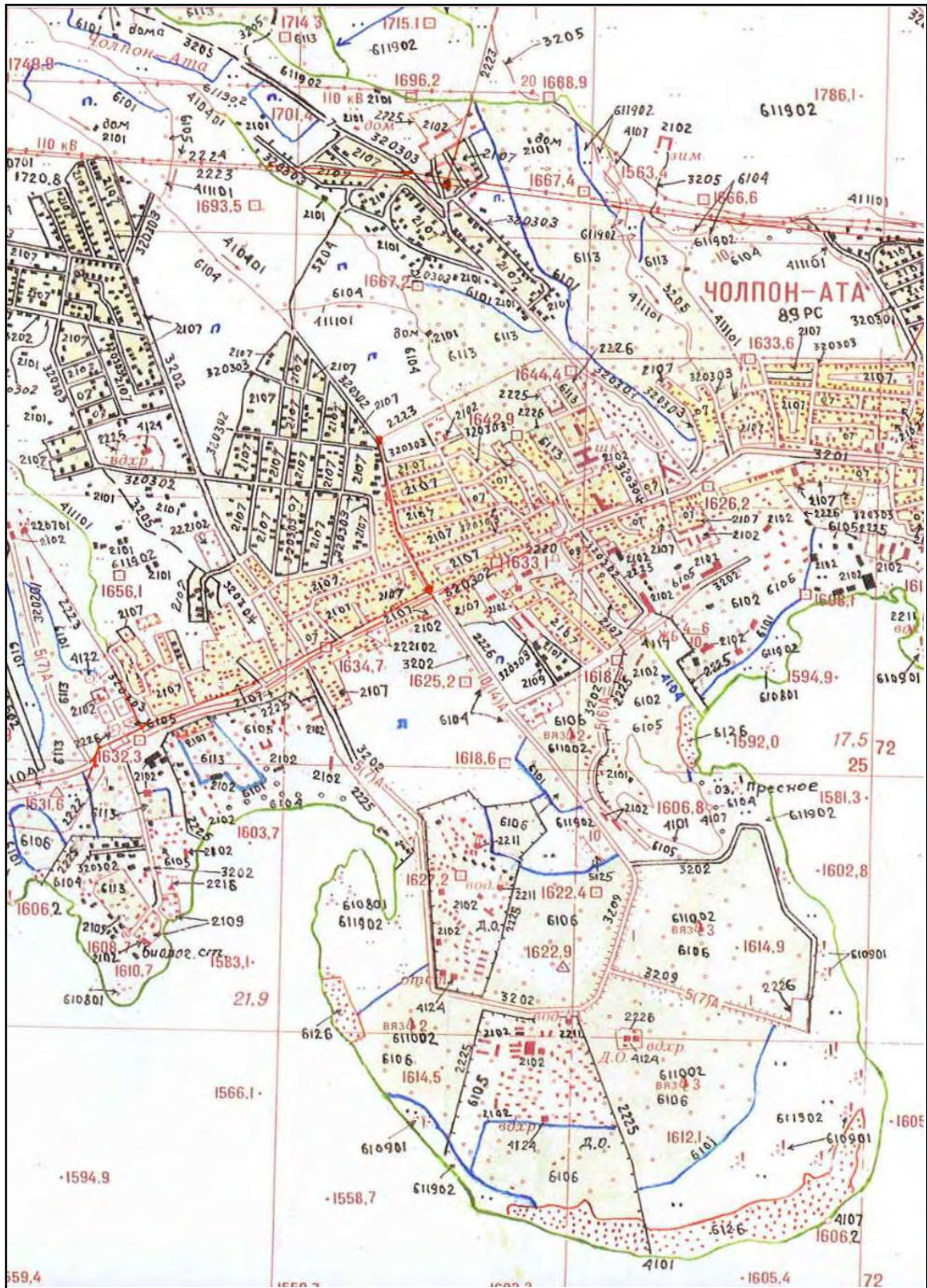


Figure 3-9. Sample of Map manuscript

(4) Data checking and correction

After the data completion, SSGC and Study team conducted visual inspection of the data using an overlay. The following items were checked as consistency and correctness of data; (1) omission of code, (2) miss-description of code and matching of adjacent sheets. Extracted correction items were carried out. Study team also checked the result and prepared the checking list for quality control of the work shown in Appendix 8.

(5) Data Scanning

After the data correction was carried out, map manuscripts were scanned in 24-bit color (TIFF) at 300dpi of resolution and rectified in RGB mode for giving an accurate geographic coordinates. Scanned image could be used as background raster data for data digitizing in MicroStation system.

(6) Used materials and data sources are as follows

- Mosaicked satellite imageries (Scale of 1/25,000, 30 sheets)
- Mosaicked satellite imageries (Scale of 1/50,000, 54 sheets)
- Aerial photographs (Scale of 1/30,000, 2,440 pieces approx.)
- Existing Topographic maps made by SSGC (scale of 1:50,000 Topographic map)
- Existing Topographic map printing plates with polyester films (Scale of 1/25,000, and 1/100,000 Topographic maps)
- Scanner-HP DesignJet CC800PS (max. 400dpi)
- Stereoscopes (handy type)
- Drawing pens with six colors

2-8. Customization of Mapping System

(1) System customization

Functions of the mapping application were customized adapting to the system of SSGC. Customized functions are as follows:

- Registration of map symbol to the MicroStation application
- Support processing to structuralizing of map data
- Support processing to symbolizing of map data
- Transformation from the MicroStation format to the GIS basic data
- Registration of map symbol to graphic drawing application

(2) Preparation of System Maintenance Manual

System Maintenance Manual was prepared for Technology transfer to the SSGC and for future work of SSGC. The Manual contains work method and the operation of the system. English was used for the customization. System Maintenance Manual is shown in Working Manual of Digital Topographic Mapping.

2-9. Mapping System Installation

Necessary software for digital mapping and updating of map data was set up and installed to the computer of SSGC. Installation of mapping system was done before the OJT of digital mapping work of SSGC.

2-10. Digitization of Topographic map

Digitization of Topographic maps was made with the account of following points based on the Map Symbol Specification. The work details have been reviewed in this paragraph from the first step of work procedure because of their importance.

(1) Review of map symbol specifications and their applications

1) Study of map symbols and their application

Based on the collected 1:25,000 and 1:100,000 maps published in the former USSR, the Study team reviewed topographic map symbols and their application to grasp features of map expression.

2) Main symbols for topographic maps

The main symbols for topographic maps were confirmed to the existing symbols of current 1:25,000 and 1:100,000 scale topographic maps.

3) A draft of symbols

A draft of symbols suitable for computers was prepared:

- a. Forms of computer symbols were discussed with Kyrgyz Rubric side. They corresponded to symbols selected at the consultation of symbols and their application.
- b. The suitable expression of computer symbol design was selected.
- c. The studied font was more appropriate than the existing one.
- d. Color of symbols was investigated with the account of film color-separation of

for printing plate production.

(2) Study of formalization of digital data

1) Based upon the draft of symbols and application prepared in Japan, the formalization of digital data was drafted.

2) Main draft items:

- Data format of digitized collected material (vector type)
- Data format of symbolized data for printing (raster type)
- Data format of structuralized data for GIS (vector type)
- Layer construction for GIS data (Feature code)

a. Feature code

- Feature codes were given for map symbols specified at the stage of map symbols study after consultations with Kyrgyz Republic side.
- Feature codes were unique numbers for each map symbol
- Feature codes were classified into three classes: class, subdivision class and figure division
- Class was classified with a code of two digits according to topographic property
- Subdivision class was classified with a code of two digits for each class of map symbols
- Figure division was classified with a code of two digits in case of necessity to make subdivision class more detailed.
- All things which were not necessary to be classified were represented as “0”

b. Digitalization of collected material

- The basic data for map data, supplied mainly by Kyrgyz Republic side:
 - Geographical names
 - Administrative boundaries
 - Facilities
 - Marginal information
- Arrangement and forms for description of collected materials were studied as the first stage of this work
- Digitized data of collected material was expressed in a vector and raster form
- Data structure of each map for digitization was determined

- Value unit of coordinates was expressed in meter
 - Exchangeable format of digitized data of collected material for Kyrgyz Republic and Japan was studied.
- c. Structuralized data
- Structuralized data was a digital data of layers, which can be used easily for GIS
 - Structuralized data was expressed in a vector form
 - Data structure of each map symbols for structuralization was determined
 - Value Unit of coordinate was expressed in meter
 - Exchangeable format of structuralized data for Kyrgyz Republic and Japan was studied.
- d. Symbolized data
- Symbolized data was the data, which plot pattern was equal to a print pattern.
 - Symbolized data was expressed in raster form
 - Color and representation of each symbolized map symbols were determined
 - Color of symbols was decided by considering color separation for printing
 - Pixel size of symbolized data was determined
 - Exchangeable format of structuralized data for Kyrgyz Republic and Japan was studied.

(3) Consultation on formalization of digital data with Kyrgyz Republic side

Sufficient discussion and coordination on formalization of digital data were held for smooth implementation of the succeeding digitalization of map information.

- 1) Survey of CAD and/or GIS
 - a. CAD and GIS systems, available in Kyrgyz Republic, the hardware and software composition, digitizing accuracy and methods were investigated. MicroStation with Windows was selected as Basic CAD System. It was decided to use 300dpi for digitalization of collected data/materials.
 - b. Investigation on the use of same computer character fonts in Kyrgyz Republic and Japan was made. The letters of Windows standard true type fonts, which shape of resemble font used in Kyrgyz Republic were adopted.

2) Data conversion

Format of CAD and GIS systems available in Kyrgyz Republic was investigated and possibility of data conversion to CAD used in Japan was studied. The process for data conversion was eliminated as the same GIS is used in Japan. It helped to preserve the accuracy and information of digitized data on collected materials.

3) Formalization of digital data

- a. Formalization of digital map data was discussed and determined. It was based on map symbols agreed at the consultation of map symbols with Kyrgyz Republic side.
- b. Formalization included:
 - Layer construction and structure for the GIS structuralized data
 - Data format for the GIS structuralized data
 - Data format of symbolized data for print (MicroStation DGN file)

(4) Digitalization of collected data/materials

The Digitalization of collected data/materials was done by the SSGC in Kyrgyz Republic.

1) Digitization category

- a. The categories of digitization were:
 - GCP map from 1/50,000 and 1/100,000 topographic map
 - Map symbols agreed with Kyrgyz Republic side
 - Unchanged map symbols, such as geographical names and administrative names on interpretation of SPOT image
- b. Map symbols on each 1:25,000 and 1/100,000 topographical maps were discussed.
- c. Main map symbols:
 - Geographic names
 - Administrative boundaries
 - Facilities
 - Annotations
 - Necessary items for Kyrgyz Republic side
- d. Modification of administration boundaries and boundary-lines was done before

digitizing.

2) Character font

Annotation character fonts used on Kyrgyz Republic and Japanese computers were investigated. The agreement to adopt the true type font of MicroStation was made.

3) Operation

- Copy of original printing plates was used as a base map for measurement
- Polyester base was used as a base map for digitizing, as it was dimensionally stable
- Raster data of a base map at 300dpi was prepared by using scanners
- Map sheet was the unit to be digitized. Data was digitized by classifying map items
- Digitized map categories were output by plotters in color and then inspected
- Content of inspected and collected map data was confirmed and arranged. Then the data was recorded to electronic recording device

4) Tying of sheet blocks

- a. During digitizing, tying of sheets, superimposing the data of adjacent sheets was done
- b. In case of unconformity it was coped by Kyrgyz Republic side

5) Data inspection

- a. Categorized data was collated with the collected data/materials by outputting by colors or lines
- b. Accuracy of map data positioning was checked by superimposing results on geometrically collected satellite images

6) Digitalization of contour lines

Contour lines were rasterized by scanners after editing. Raster data was vectorized by digitizers. It became GIS-ready data after being given attributes, height information and etc. DEM (Digital Elevation Model) was generated from ground elevation data. Inspection of contour lines was made by another contour line generated with DEM. Such data was stored as contour line file. The reproduced contour line plates, 1:25,000

and 1:100,000, were used in digital mapping for 1:25,000 and 1:100,000 scale as a base map.

7) Digitization of Topographic Maps

Digitalization of map categories was made with MicroStation, CAD software on the basis of satellite images using results of image interpretation. General workflow of digital mapping is shown in figure 3-10.

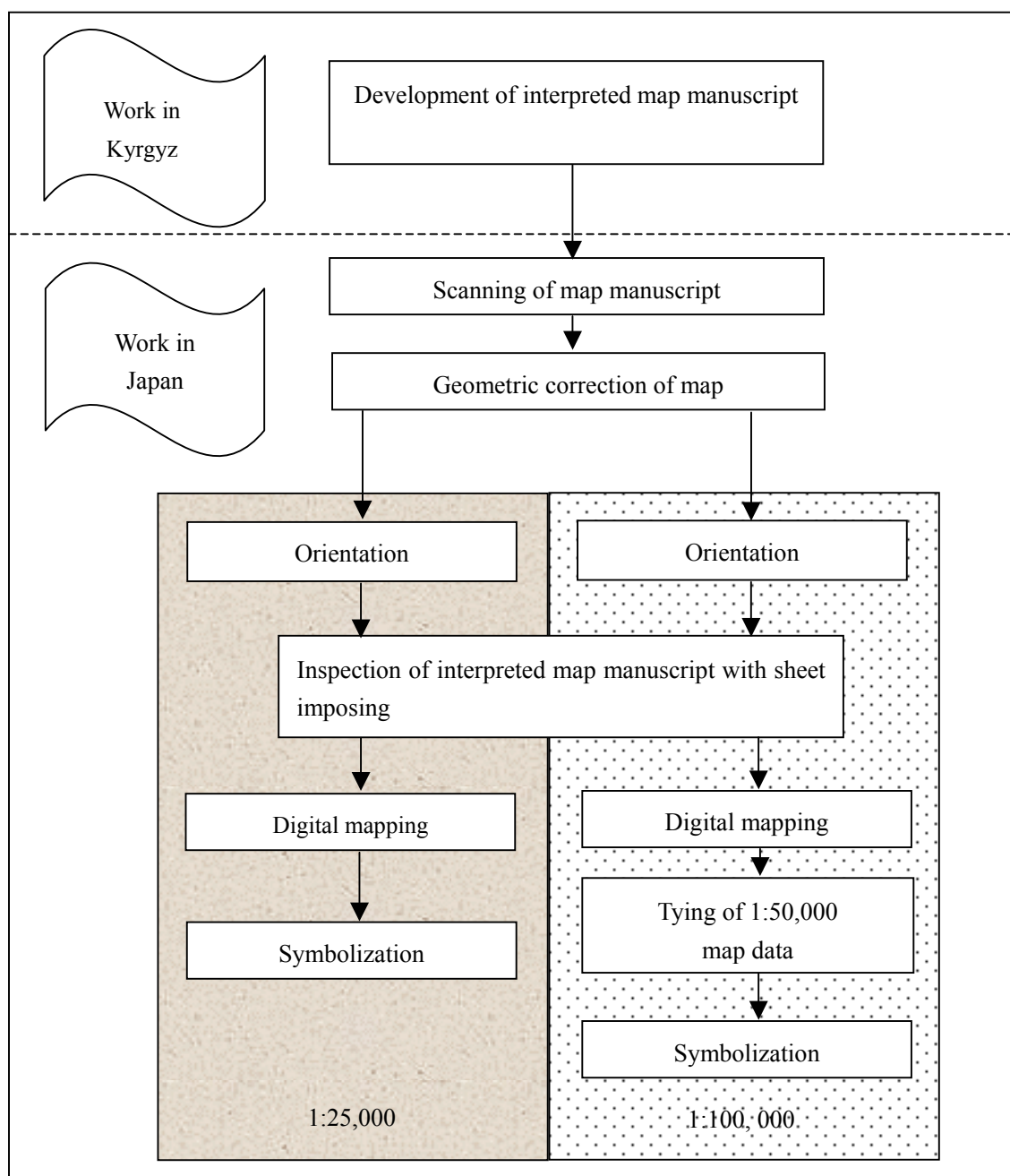


Figure 3-10. Workflow: Digitization of topographic maps

- a. Map symbol registration and development of compilation support software
 - Map symbols, agreed at the consultation of map symbols, were registered in CAD
 - The data structure of line and polygon map symbols was decided in order to generate symbol parts automatically and support post-processing symbolization. Line map symbols contained data of a line and part of a symbol, which stick to a line data. Polygon map symbol is represented by area patterns filling potential surface.
 - Support software recognizing digital map symbols with the account of data structure was developed
 - Software for error inspection, as expression classification and data structure, was developed

- b. Digital mapping
 - Value unit of a coordinate is expressed in meter
 - Satellite images, after Geometric correction and division into sheet blocks, were converted into MicroStation format
 - Ground control points and neat lines were input to MicroStation DGN files by a given coordinate system and specification
 - Digitized data of collected materials was input to MicroStation DGN files
 - Geometrically corrected images were oriented to neat line data of MicroStation DGN files
 - Oriented and geometrically corrected images were inspected with map features on the topographic map
 - Map categories were digitized using geometrically corrected satellite images, classifying map symbols with the result of interpretation. Geometrically corrected satellite images contain location information. Interpretation results were used for obtaining information classification
 - Digitized map data, including category of expression, data structure, etc. was inspected by inspection program developed in Japan
 - Symbolized data was plotted and inspected manually

(5) Data acquisition taking into account of further Symbolization work

Data acquisition was carried out with developed software in Japan. Following notes are examples of acquired data.

- Buildings along the highway and street were shifted to symbolized position
- Culvert along and across the river and road was shifted considering road symbolization.

(6) Data acquisition taking into account of Topology structure for GIS basic data.

Data acquisition of topology feature for GIS basic data was also carried out with developed software in Japan.

Following notes are examples when data was acquired as GIS basic data.

- Building block adjacent to the street was acquired as Polygon data.
- Data of road and street was acquired as centerline data for Network for GIS.
- Polygon data (Donuts polygon) such as vegetation, topography or other information was acquired as Duplicated polygon data.

The sample of Map Digitization is shown in figure 3-11.

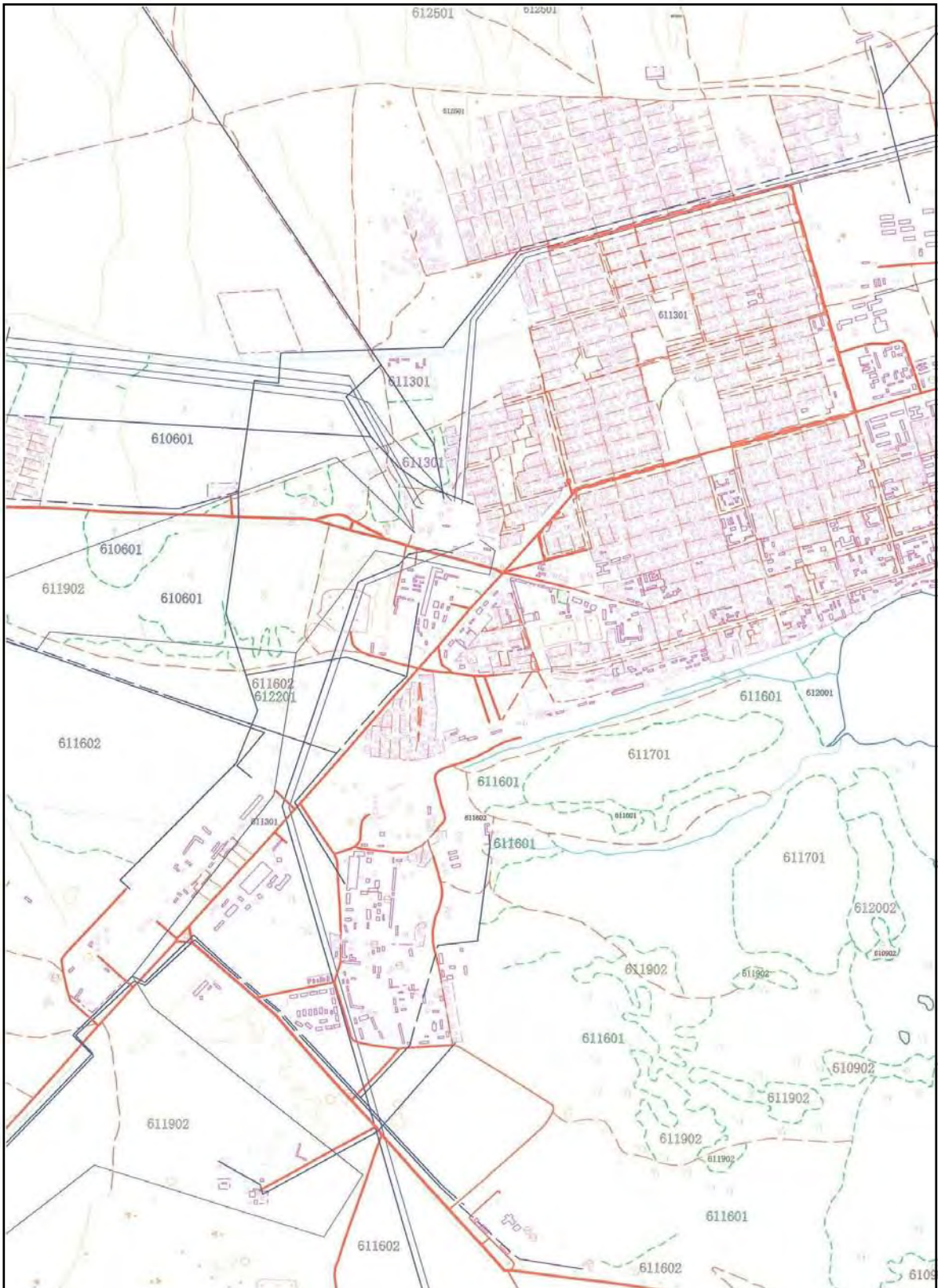


Figure 3-11. Sample of Map Digitization

2-11. Preparation of Progress Report

Progress report was prepared for the confirmation of work progress of the study and for the discussion on the Third Phase of the project.

3. Third Phase

Following works were carried out in the Third Phase.

3-1. Discussion of Progress Report

Progress report prepared of the second phase work was discussed with SSGC. Main part of modification was the result of GCP_GPS. According to the regulation of Kyrgyz Republic, the coordinates of existing triangulation are prohibited to disclose. Study team accepted this offer and deleted the result.

3-2. Digital Compilation and Data Structuralization

Digital compilation work, such as annotation, modification of digitized data, was carried out in Japan.

Digitized map data was structuralized to basic data used for GIS by application of MicroStation. Compilation of structuring data, such as connection of line feature and closing of polygon feature were carried out. Key points of Data structuralization were as follows.

- Data Structuralization was made only for the objects to be structuralized.
- Structuralized data was transformed to prescribed data format at each sheet unit and being arranged as Structuralization data file.

Classification of data as GIS basic data is shown in table 3-13.

Category	Classification	Code	Data Type
Boundaries	National boundaries	710101	Line
	Boundaries of Regions	710201	Line
Control points	CP of national geodetic network	110101	Point
	The same as above on the hill	110102	Point
	The same as above on buildings	110201,110202	Point
	CP of surveying network	110301	Point
	The same as above on the hill	110302	Point
	Tidal Gauge, BM	110401	Point
	Road network		
	Repaved road (Automotive)	320101	Line
	Paved road (Automotive)	320201	Line
	Unpaved road (non-rehabilitated)	320301	Line

	Streets in built-up areas (wide)	320302	Line
	Streets in built-up areas (narrow)	320303	Line
Railroad network	Railroad	310101	Line
Shorelines/rivers	Shoreline	410101	Polygon
	Rivers, Streams (single line)	410401	Line
	Rivers, Streams (double line)	410402	Line
	Rivers, Streams (at scale)	410403	Polygon/Line
Inhabited areas	Buildings (at scale)	210201	Polygon
	Built-up areas (fire proof)	210601	Polygon
	Built-up areas (non-fire proof)	210701	Polygon
Life-line	Transmission lines	222201	Line
	Power T/M lines (less than 14m)	222301	Line
	Power T/M lines (more than 14m)	222401	Line
Contour lines	Index contour lines	510101	Line
	Index contour lines (glacier)	510102	Line
	Index contour lines (landslide)	510103	Line
	Primary contour lines	510201	Line
	Primary contour lines (glacier)	510202	Line
	Primary contour lines (landslide)	510203	Line
	Intermediate contour lines	510301	Line
	Intermediate contour lines (glacier)	510302	Line
	Altitude of spot heights (point)	510601	Point
Annotation	Name of cities		Text

Table 3-13. Data classification for GIS basic data

3-3. Symbolization

Symbolization was made after the digital compilation work. As the map scale was small, most of ground features were expressed by map symbols.

Symbolization consists of following steps:

- (1) Preparation of marginal information

Common information for all sheets (Marginal Information) was prepared as graphic data by SSGC. Following note was expressed as one of the marginal information for all map sheets.

This map was prepared jointly by the Japan International Cooperation Agency (JICA) under the Japan Governmental Technical Cooperation Program and the Government of Kyrgyz Republic.

- Individual information for each sheet as sheet name etc. was added to prepare the marginal information file of each sheet.
- (2) Work categories of Symbolization editing
- Compiled data was recompiled according to the results of field completion. The recompiled data was transformed for the first step compilation data, which was suitable for symbolization by using MicroStation application.
 - Vector data after the first step compilation was transformed to raster data
 - Map symbols, determined by discussion between Study team and SSGC were registered to the graphic processing application.
 - Being the raster data as reference background, map symbols was transcribed and compiled by using graphic processing application.
 - Symbolized data was combined with marginal information file.
 - Combined data was plotted and checked visually.
 - Checked and completed symbolized data was transformed for prescribed data format and arranged as symbolized data file..

3-4. Preparation of Film for Printing Plate and Data File

After symbolization works were completed, output result of topographic maps were checked by JAPAN ASSOCIATION OF SURVEYORS and modified before creation of printing data.

By using of DGN file data after the modification, data was processed and converted to raster data for printing. Film for printing plate was prepared by following process:

- Reseau marks used for the orientation of film were digitized in all plates for printing when the data are separated into distinct color plate.
- Data of the printing plate film were prepared as separating the symbolized data according to the corresponding color.
- Printing plates of each color were prepared plotting the data of the printing plate using laser plotter.
- Polyester base film was used as the materials of printing plates.
- Plotted films were checked visually whether there are blemishes or not.

Outline of the preparation of data file was as follows:

- Structuralized vector data, symbolized data and orthogonal satellite image data were checked individually. The checked data were arranged in the data file according to

the prescribed format and structure. Meta data for topographic map data was attached.

- Data files were arranged at each sheet file unit.

3-5. Preparation of Manual for Digital Mapping System

The work procedures including Geometric correction, Production of map manuscript, Digitizing works and system maintenance works were compiled as work manual in order that SSGC could produce and/or could make updating of Topographic map quickly and rightly. The contents of the manual were preparation of work, working method, system operation method in each process and system designing.

3-6. Field Completion

Field Identification work was not carried out due to its onerous consumption of time and manpower resources and the limited amount of time available for completion of the whole study. The topographic features, which are difficult to be interpreted were investigated in the field after the stage of Digital compilation work. Field completion was carried out based on the material in which the doubtful point and un-interpreted points exist. This process was carried out by SSGC under the Study team instruction and supervision. Using the results of Field completion, the corresponding part of digitized data was compiled.

3-7. Printing of Topographic map

Printing works of 1:25,000 and 1:100,000 topographic maps were carried out by sub-contractor of Kyrgyz Republic with printing plates prepared in Japan. Five hundred and three (503) pieces per each sheet of topographic maps were developed by offset printing method. Followings are the detail of sub-contracting.

(2) Sub-contactor:

Sub-contractor of printing works was the MAGIC BOX COMPANY, Ak-Chi, FEZ, Bishkek, and Kyrgyz Republic.

(2) Quantity:

The quantity of printing of Topographic Map is shown in following table 3-14.

Topographic Map	Original Qty	Number of set	Total
1:25,000 Topographic Map	30 sheets	503 sets	15,090 sheets
1:100,000 Topographic Map	19 sheets	503 sets	9,557 sheets
Total			24,647 sheets

Table 3-14 Quantity of Map printing

(3) Work Execution

The work was executed with German printing equipment ROLAND 700 taking into account the following cautions and inspection procedure.

Printed maps were inspected by naked eyes visually. The inspection was performed to detect errors in contents, deviated print, color tone, dirtiness and such defects by referring to proof sheets. The number of passed maps was checked and recorded for Quality Control.

(4) Delivery:

All final printed products was delivered with complete packing, free from dirtiness and dust and with printing positive film after checking and quality control have been completed. PS plates for printing was delivered.

3-8. Data Installation and Confirmation of Function

Digital map data prepared by both Japanese and Kyrgyz side were installed into the mapping system of SSGC. The function of the system was checked finally using the installed digital map data.

3-9. Preparation of Draft Final Report

Draft of final report was prepared for the discussion with SSGC before 2nd Technology Seminar.

3-10. Discussion of Draft Final Report

Draft Final Report prepared in Japan was discussed with SSGC to finalize the Final Report. Commented points of SSGC and amended parts were as follows.

- a. Chapter 2. Outline of Study
 - 2-1. Objective of Study

Add paragraph concerning to practical technology.

b. Chapter 3. Final Results

- Paragraph 5) Table 3-1

Add work item to be prepared in manuals concerning to Working Manual.

c. Chapter 4. Technology Transfer

- Add the paragraph of “Disclosure of Topographic Map Data” as 4-6.
- 4-6. Technology Transfer

Add explanation of data exchange between each governmental organization to the Objectives of the seminar as paragraph 4.

d. Chapter 5. Recommendation

- Paragraph 5-1. Recommendation Related to Topographic Map Production to SSGC, Paragraph (3) Future production of Topographic map data.

Add following explanation;

The SSGC will design the Topographic mapping production plan with transferred technology of utilizing of satellite image. The Study Team will provide information regarding the satellite image, including the cost and how to procure it to SSGC.

3-11. Preparation of Final Report

Final report was prepared according to the result of the discussion on Draft Final Report with SSGC.

CHAPTER 4.

TECHNOLOGY TRANSFER

CHAPTER 4. TECHNOLOGY TRANSFER

Technology transfer was carried during study implementation by OJT through actual works as well as in Seminars. The evaluation of Technology transfer can be made (implemented) through results of seminars. The technology transfer in Japan was carried out on counter part training.

4-1. Geometric Correction of Satellite Image

OJT on orientation and geometric correction of satellite images was held in (to) SSGC, Kyrgyz Republic. Training was conducted with the use of soft-and-hardware supplied by JICA. The flow of the procedure is shown in the following figure 4-1.

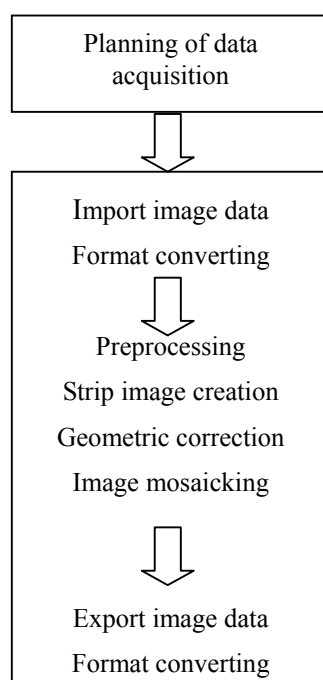


Figure 4-1. Workflow of Geometric Correction Technology Transfer

Technology transfer included:

- Basic knowledge of satellite imagery
- Acquisition of satellite image data
- Import of data into systems
- Geometric correction of satellite imagery
- Mosaicking
- Image processing

Technology transfer by OJT was carried out with the Manual prepared beforehand. After

explaining the whole practical process with SPOT5 data, the counterpart agency processed orthogonal correction without assistance of the Study Team. The result of orthogonal correction was within one pixel size of SPOT5 image, which was sufficiently accurate for the purpose of topographic mapping data acquisition.

The SSGC was familiar with digital aerial orthogonal photo correction and knew basics of digital image processing. This experience made understanding of satellite image processing easier and faster.

4-2. Digitization of Topographic Map

Based on the result of digitization work of Topographic maps in Japan, technology transfer on the preparation of digital mapping data was carried out through OJT. The detail of work procedure and key points are mentioned in paragraph of Digitization of Topographic map, Chapter 3. The work volume of the SSGC is in the following table 4-1.

No.	Map scale	No. of sheets	Sheet number	Area (sq. km approx.) (w/o water Part)
1	1:100,000	1 sheets	K-43-57	1,000
			(Balykchi)	Total 1,000km2
2	1:25,000	3 sheets	K-43-57-G-a	25
			K-43-58-B-a	83
			K-43-57-B-g	94
				Total 202km2

Table 4-1. Digitization Work volume of SSGC under technology transfer program

Outline of work process and main points of the work were as follows:

- Basic knowledge of customized MicroStation
- Operation of customized MicroStation
- Structure of MicroStation system file
- Acquisition of digital vector data from the raster data of Topographic map manuscript
- Conversion of MicroStation data for the GIS basic data

4-3. Digital Compilation and Structuralization

Technology transfer on the digital compilation and structuralization were carried out by OJT. Outline of the process is as follows:

- Consideration (Concerning) of the data (objects) for Structuralization
- Connection of line features, closing polygon feature
- Method of transformation of structuralized data to prescribed data format

4-4. Symbolization

Technology transfer on the symbolization was done by OJT. Outline of the process is as follows:

- Preparation of marginal information
- Preparation of marginal information files at each map sheet
- Compilation of structuralized data (first step compilation)
- Transformation of vector data to raster data
- Plotting of each map sheet
- Visual checking
- Transformation of symbolized data for prescribed data format and arrangement at each map sheet unit

4-5. Counterpart Training in Japan

To confirm the transferred technology to the SSGC, SSGC Director, Mr. Tzurkov Valery Egorovich, in the period from 26th September to 5th October and SSGC Deputy Director, Mr. Obidenko Vladimir Ivanovich, in the period from 26th September to 18th October, visited Japan as trainees. Training classes were related to the Study work. Questionnaires were submitted in advance by trainees. Training schedule is shown on the following table 4-2. Digital Mapping, Symbolization and Data Structuralization with customized program. were the main issues of training

No. of Day	date	day	Contents of Training	
			Director, Mr. Tsurkov	Deputy Dir. Mr. Obidenko
1	9/25	Sun	Bishkek - London (BA6586)	
2	9/26	Mon	London - Narita (JAL402)	
3	9/27	Tue	Briefing in JICA	
4	9/28	Wed	Observe & Lecture in Geographic Survey Institute	
5	9/29	Thu	Visit to Map Center, Survey Association of Japan, IDI	
6	9/30	Fri	Aero Asahi Corporation, Briefing of Training	
7	10/1	Sat	Holiday	
8	10/2	Sun	Holiday	
9	10/3	Mon	Move to Osaka, Visit to GSI Kinki Regional office	GIS Data Structuralization
10	10/4	Tue	Verification of Map use for Tourism in Kyoto	- do- GIS Application
11	10/5	Wed	Narita (SU576) 12:00~16:05	- do- Digital Mapping
12	10/6	Thu	Moscow(SU179) 22:05~04:10	Digital Mapping
13	10/7	Fri		Aerial Triangulation • Orthophoto
14	10/8	Sat		Evaluation of training
15	10/9	Sun		Holiday
16	10/10	Mon		National Holiday
17	10/11	Tue		Aerial Triangulation • Orthophoto
18	10/12	Wed		Acquisition of Geoid
19	10/13	Thu		System maintenance
20	10/14	Fri		Digital Mapping
21	10/15	Sat		Holiday, Evaluation of Training
22	10/16	Sun		Holiday
23	10/17	Mon		Digital Mapping
24	10/18	Tue		Appraisal meeting in JICA
25	10/19	Wed		Narita (SU576) 12:00~16:05
26	10/20	Thu		Moscow(SU179) 22:05~04:10

Table 4-2. Training schedule in Japan

4-6. Disclosure of Topographic Maps and Data

SSGC will disclose and transfer printed Topographic Maps and digital data to the organizations which activities are related to the development of Issyk-Kul zone and the local government, depending on their needs and free of charge. But in case of data conversion necessity, the corresponding work will be charged accordingly.

4-7. Distribution of Topographic Maps

SSGC will distribute printed Topographic Map to the organizations related to the development of Issyk-Kul zone. The list of proposed and expected organizations is shown in following table 4-3.

No.	Name of organization	Qty.
1	Ministry of Emergency of the Kyrgyz Republic	15
2	Ministry of Defense of the Kyrgyz Republic	2
3	State administration of the Issyk-Kul region	7
4	Architecture of Issyk-Kul region	3
5	The State Agency on Registration of Rights to Immovable Property (Gosregistr) under the Government of the Kyrgyz Republic	16
6	Issyk-Kul office of Gosregistr	3
7	Project Realization Department of Gosregistr	2
8	Kyrgyz State Institute of Earth-Planning (Kyrgyzgiprozem)	2
9	State Agency on Architecture and Construction under the Government of the Kyrgyz Republic	2
10	Kyrgyz Scientific-Research Institute of Architecture and Town-Planning	5
11	State Agency on Geology and Mineral resources under the Government of the Kyrgyz Republic	5
12	State Agency of Environmental Protection and Forestry	2
13	State Agency on Water Resources and Energy of the Kyrgyz Republic	2
14	State Agency of Environmental Protection of the Kyrgyz Republic	2
15	Kyrgyz-Russian Slavic University	2
16	Kyrgyz Agricultural University	2
17	Cartographical company "Geoid"	4
18	The University of Applied Research of the Earth in Central Asia	2
19	Institute of Water Problems and Hydroenergy of National Academy of Science of the Kyrgyz Republic	2
20	Institute of Geology of National Academy of Science of the Kyrgyz Republic	2
21	Institute of Seismology of National Academy of Science of the Kyrgyz Republic	2
22	Institute of Physics and Mechanic of Rocks of National Academy of Science of the Kyrgyz Republic	2
23	Institute of Seismology of National Academy of Science of the Kyrgyz Republic	2
24	Biological Station of National Academy of Science of the Kyrgyz Republic, Cholpon-Ata	2
25	Tourist company "Turkestan"	2
26	Tourist company "Tien-Shan Travel"	2
27	Tourist company "Dostuk-Trekking"	2
28	Association of Touroperators of Silk Road	2
29	Issyk-Kul steamship	2
	Total:	100

Table 4-3. List of proposed and expected organizations for Map distribution

4-8. 2nd Technology Transfer Seminar

The second technology transfer seminar was held to present the result of this project at the end of the 3rd stage. Invitation was announced to the officials of authorities and organizations, personnel and so on, concerning to the Study. Presentation of the Study was carried out by SSGC with the support of Study team.

(1) Objective of Seminar

The objectives of Seminar were;

- To explain the necessity of sharing data and information among governmental organizations and research institutes. (To urge along making data common information among the governmental organizations and research institutes.)
- To show the final result of the Study and how to use map data in various fields especially GIS basic data.
- To confirm the result of Technology transfer through the seminar.
- To make contents and significance of the Study for SSGC clear to the concerned personnel and other staff who didn't participate in this Study.

(2) Agenda of the Seminar

The Agenda of Seminar was following.

I. Registration:		9:30 – 10:00
II. Honorable Speeches		
2-1 Opening speech:	A.ZH. ZHOLDOSHEV Director of the State Agency on Registration of Rights to Immovable Property (Gosregistr) under the Government of the Kyrgyz Republic	10:05 – 10:10
2-2 VIP-guest's salutation:	KASAI TATSUHIKO Charge d'affaires ad interim of Japan Embassy of Japan in Kyrgyz Republic	10:10 – 10:15
2-3 Guest of honor's Salutation:	NAKANO SATOSHI Resident Representative, Kyrgyz Republic Office Japan International Cooperation Agency (JICA)	10:15 – 10:20

2-4 Salutation: TSURKOV V.E. 10:20 – 10:25
Director of the State Service of Geodesy and
Cartography (Goscartography) under Gosregistr
of the Kyrgyz Republic

III. Technical Speech A

3-1 Outline of Project V.I. OBIDENKO 10:30 – 10:40
Deputy director of the State Service of Geodesy
and Cartography (Goscartography) under
Gosregistr of the Kyrgyz Republic

3-2 Topographic Mapping 10:40 – 11:10

- Mapping Work Procedure
- Creation of Satellite Orthophoto image
- Technology Transfer
- Results of Study

Question and Answer 11:15 – 11:30

IV. Technical Speech B

4-1 Application of Topographic map Data in GIS 11:45 – 12:15
ALEXANDR BOBROVSKY
Head of GIS Department, The State Service of
Geodesy and Cartography (Goscartography)

4-2 Demonstration of GIS Application 12:15 – 12:30
Fly Through in Issyk-Kul area

Question and Answer 12:30 – 12:45

(3) Participants to the Seminar

Number of Participants attended to the Seminar was 100 approximately from around 30 authorities, organizations and media. The list of participants is shown in table 4-4.

No.	Name of Organization	Remarks
1	Embassy of Japan	1. Tatsuhiko Kasai, Charge f d'affairs as Interim
		2. Tsutomu Shibata, #rd Secretary
2	JICA	3. Satoshi Nakano, Resident Representative
		4. Horoe Komiya. Project Formulation Advisor
		5. Bajalieva Aidai, Assistant Program Officer
		6. Masakatsu Abe, Technical Advisor
		7. Yasuyuki Kuroda, JICA Expert
3	JICA Study Team	8. Takashi Harada, Deputy Team Leader
		9. Kiichiro Nishioka, Project Member
		10. Yuji Ouchi, Project Coordinator
		11. Gainanov Timur, Office manager
		12. Saparov Nurbek, Interpreter
4	Government of the Kyrgyz Republic	13. Alamanov Salamat Kulembekovich, Head of Dept.
		14. Umurzakov Murat Sadybakasovich
5	Ministry of Economy and Finance of the Kyrgyz Republic	15. Azykov Bolot Borievich, Head of Dept.
		16. Klimakova Galina Nikolaevna
6	Central Election Committee	17. Itebaev I. O., official
7	Ministry of Emergency of the Kyrgyz Republic	18. Rustanbekov Zhanish Sultankulovich, Minister
8	Ministry of Defense of the Kyrgyz Republic	19. Yazenko Mikhail Dmitrievich, Senior officer of Topographic Service
9	State administration of the Issyk-Kul region	20. Omuraliev Esengul Kasymovich, Governor
		21. Aidaraliev Ezhigit Tashtanovich
10	Gosregistration	22. Zholdoshev Adamzhan Zholdoshevich, Director
		23. Dzhusupekov Bakytbek Asanbekovich, Head Dept.
		24. Shershenov O.Sh., Head of Administration
		25. Asanov Nurbek Torgoevich, Director of Issyk-Kul Branch.
		26. Isakova Erkingul Sadybakasovna, Head of PIU
		27. Zhalalov Ysakhzhan Zhalalovich, PIU
		28. Palmquist Hosta, SWEDESURVEY, WB of GosRegistration.
		29. Tashtemirov Adam Tashtemirovich, Eng. SIEP
11	Goscartography (SSGC)	69. 40 persons
12	State Agency on Architecture and Building under the Government of the Kyrgyz Republic	70. Kadyrbekov Ishenbai Dushenbievich, Director of State Agency
		71. Nazarov Bolot Nazarovich, Deputy Director
		72. Alykulov Kanybek Mamyrovich, Director KSRIATP

		73. Stryzhachenko Alina Timofeevna, Eng. KSRIATP
		74. Stryzhachenko Tatjana Olegovna, Leader of Archtect of KSRIATP
13	State Agency on Geology and Mineral resources under the Government of the Kyrgyz Republic	75. Eshnazarov Nabi Asanovich, Deputy Director
		76. Meng Svetlana, Chief Specialist
14	State Agency of Environmental Protection and Forestry	77. Abdykaimov Mamatshyli Erkinovich
15	Kyrgyz Agricultural University	78. Denisov Vitaliy Victorovich, Prof. of EPD
		79. Sultanalieva Tursunbubu Sultanalievna, Head of GCD
		80. Medvedev Valentin Valentinovich Senior Lecturer
16	Kyrgyz-Russian Slavic University	81. Nifadjev Vladimir Ivanovich, Rector of NASKR
		82. Gromova Svetlana Mikhailovna, Assistant
		83. Frolova Galina Petrovna, Senior Lecturer
		84. Belenko Victor Alekseevich, Senior Lecturer
17	The University of Applied Research of the Earth in Central Asia	85. Mihalev Vasiliy, Plenipotentiary of German side
		86. Moldobekov B., Director
18	Institute of Water Problems and Hydroenergy of National Academy of Science of Kyrgyz Republic	87. Mamatkanov Duishen Mamatkanovich, Director
		88. Yakimov Victor Mikhailovich, Head of Ecology and WRML
19	Institute of Geology of National Academy of Science of Kyrgyz Republic	89. Akhmedov Stanislav Manabdzhanovich, Researcher
		90. Sankova Valentina Pavlovna, Researcher
20	Institute of Seismology of National Academy of Science of Kyrgyz Republic	91. Abdrahmatov Kanatbek Ermekovich, Director
21	Institute of Physics and Mechanic of Rocks of National Academy of Science of Kyrgyz Republic	92. Nikolskaya Olga Victorovna, Head of FC&ID
		93. Kozhogulov Kamchybek Chonmurunovich, Director
22	Institute of Mining and Rock Technology	94. Tazhibaev Kushbakali Tazhibaevich, Director
23	Kyrgyz Scientific-Research Institute of Agriculture	95. Fedichkina Irina Grigorjevna, Head of Dept.
24	“OSCE “ Assistance to Administration of Internal Affairs”	96. Fedichkina Irina Grigorjevna, Head of Dept.
		97. Zhaparov Ulan
25	Project “Development of local Administration in Central Asia”	98. Akmatov Abdirasul, Specialist
26	International Scientific and Technical Center	99. Kovalenko Vitaliy Akimovich, Director
		100. Dolgushev Vjacheslav Grigorjevich, Manager
27	German Development Cooperation GTZ	101. Roesler Urlike, Chief of the project
		102. Bauch Reiner, Assistant
28	KATOS	103. Orozobaeva Anar Bakirdinovna

29	Kyrgyztelecom	104. Kayikov Bakyt
30	Katel	105. Iskakov Salavat Turduhodzhaevich, General Dir.
31	Bitel	106. Umurzakov Danijar Mukhtarovich, General Dir.
32	Tourist company "Tien-Shan Travel"	107. Birjukov Vladimir Nikolaevich Director
33	Association of Tour-operators of Silk Road	108. Komisarov Vladimir Anatoljevich, President of Association.
34	National Space Agency on Geodesy and Cartography of Republic Tadjikistan	109. Zakirov Makhmadtoir Zokirovich, Head of Agency
35	NBT	110. Tugusheva Nelli Rustamovna, Coordinator
36	KOORT	111. Kaparov Sanzhar Askarbekovich, General Director
37	Pyramid	112. Isakov Sh.E., New section
38	"Vecherniy Bishkek"	113. Denisenko Eugeniy Vladlenovich, Head
39	"Slovo Kyrgyzstana"	114. Malevanniy Alexandr Ivanovich, Editor in Chief
40	The Time of Central Asia	115. Sartbaeva Aisulu Nurbekovna, Correspondent
41	Ala-Too (KTR)	116. Satarov A.A. Producer
42	National radio	117. Saryeva, Correspondent
43	MINDEKO	118. Belousova Alexandra, Official
44	Aero Asahi Corporation	119. Kalikova Raushan, Office Manager Almaty Branch

Table 4-4. Participants to the seminar

(4) Questions and Answers at the Seminar

Following table 4-5 shows main answers to the questions during the Seminar. Most of questions relate to data disclosure and possibility of topographic data provision.

No.	Question	Answer
1	Will the topographic maps, scale of 1:100, 000 and 1:25, 000 created in the Project (printed on a paper) distributed free-of-charge?	Yes, it will be distributed to all organizations participating to the development of Issyk-Kul zone.
2	Will the topographic map data (digital form) scale of 1:100, 000 and 1:25, 000, created in the Project, disclosed and how much is it?	Yes, it will be disclosed but data is not ready yet. After delivery of final result (February 2006), it will be distributed to the state organization and organizations participating in the development of Issyk-Kul zone free of charge.
3	In case there is demand for the creation of a map of one settlement on Issyk-Kul zone, will the Goscartography help us?	Yes, we are pleased to do it. Please address to Goscartography, we shall help you to solve the problem.

4	What format will be GIS- basic data?	The basic data for GIS will be created in ArcView format, but it can be converted to others formats on request of consumers.
5	We are carrying out digitizing of topographic maps independently. Is what we are doing correct?	Basic data for GIS (Ex. road, river, settlements, etc.) should be digitized by Goscartography. But organizations which are interested in carrying out digitizing data, can create thematic layers independently based on a common data.
6	Is it possible to receive digital data of Kyrgyz Republic border and borders of administrative units from Goscartography?	Yes, it is possible.

Table 4-5. Questions and the answers set at a seminar

(5) Distribution of JICA_Net CD_ROM

By the courtesy of JICA Kyrgyz Republic offices, JICA_Net CD_ROM were distributed to the organizations participated in the seminar The contents of CD_ROM aims at promotion Remote sensing and GIS for the sustainable development of natural resources and environment in the developing countries.

4-9. Comparison of Result of Technology Transfer to the SSGC

SSGC estimates the results of Technology transfer for individual related works as following table 4-6.

	Old technology	New technology	Advantage of new technology
1	<p>There was no system of coding of objects of a map and corresponding to it library of symbols.</p> <p>Each time the operator should adjust style, thickness and color of a line for each new map object .</p>	<p>There is a special system of coding of objects of a map and library of symbols corresponding to it.</p> <p>For digitizing a new map object it is necessary to choose only a code of a map object.</p>	<p>Process of digitizing of a map is accelerated dramatically.</p> <p>The greater convenience of work.</p>
2	<p>As a result of digitizing it is necessary to prepare 2 files manually: File for printing of a map on a Plotter (PLOT-file); File for GIS</p>	<p>Only 1 DGN-file is created Preparation of a file for a printing of a map (PLT-file) and file for GIS is carried out automatically in the process of symbolization and structuralization accordingly.</p>	<p>Process of digitizing of a map accelerates dramatically.</p> <p>The greater convenience of work.</p>
3	<p>The initial original of a map had no codes</p>	<p>The initial original of a map (manuscript) has codes.</p>	<p>Process of digitizing of a map accelerates dramatically.</p> <p>Process of digitizing becomes simpler.</p> <p>Operators of lower qualification can carry out digitizing.</p>
4	<p>30-40 days were required for digitizing 1 map sheet</p>	<p>25 days are required for digitizing 1 map sheet.</p>	<p>Productivity of digitizing has increased minimum 1.5 times.</p>

Table 4-6. Result of Technology Transfer

4-10. Trekking Map

SSGC prepared Trekking map at the south vicinity of Karakul city with the help of transferred technology as the one of the topographic data application. SSGC worked on the most of data collection and processing work. Deserving special mention is that SSGC produced digital data of 1/3 of data shortage part by themselves. Study team did nothing except other than provision

of three dimensioned shadow data of that area. SSGC expects this technology will help further mapping mission in their future. The detail is mentioned in **Chapter 7. Recommendation. (5)**.

CHAPTER 5.

**DONATED EQUIPMENT
&
SOFTWARE**

CHAPTER 5. DONATED EQUIPMENT & SOFTWARE

Equipment and software were donated in first and second stage respectively. Donated equipment and software to SSGC are shown in following table 5-1.

No.	Items	QTY	Unit	Production & Remarks
1	Personal Computer	1	set	MicroSoft Office XP-Professional
2	Transceiver	5	sets	GPS survey, Alinco
3	Generator	5	sets	GPS survey, SUZUKI
4	Uninterruptible Power Supply	1	sets	For Personal Computer
5	CAD software	1	set	MicroStation J, Bentley
6	GIS software	1	set	ArcView 8.3, ESRI
7	Image Processing software	1	set	Satellite Image, PCI
8	Car Battery	5	sets	For GPS Surveying

Table 5-1. Donated equipment and software

CHAPTER 6.

FINAL PRODUCT

CHAPTER 6. FINAL PRODUCT

Final products to be delivered is shown in the table 6-1.

1) Aerial Photography	
Negative film	1 set
Contact print	1set for 1:100,000 scale mapping area (for GOK)
	1set for 1:25,000 scale mapping area (for GOK)
2) Digital Mapping Data	
Digital Topographic map data file	2 sets (CD-ROM) for GOK
DEM data file	2 sets (CD-ROM) for GOK
3) Topographic map	
Printing film for offset prints	1 set (for GOK)
Printed Map	503 sets of each Topographic map (500 sets for GOK, 3 sets for GOJ)
Printed Maps by inkjet printer	2 sets (for GOK)
4) Final Report & Summary	1 set
5) * Working Manual	1 set

Table 6-1. Final product

* Working manual includes following work items.

- Geometric Correction
- Production of Map Manuscript
- Digital Mapping (includes Digitizing of Map Manuscript, Digital compilation, Symbolization and Data structuralization)

All the intermediate materials acquired in the study process as satellite images, control points survey result and etc, were donated to the SSGC, Kyrgyz Republic. Figure 6-1 and 6-2 shows the Topographic Maps of each scale for final result.

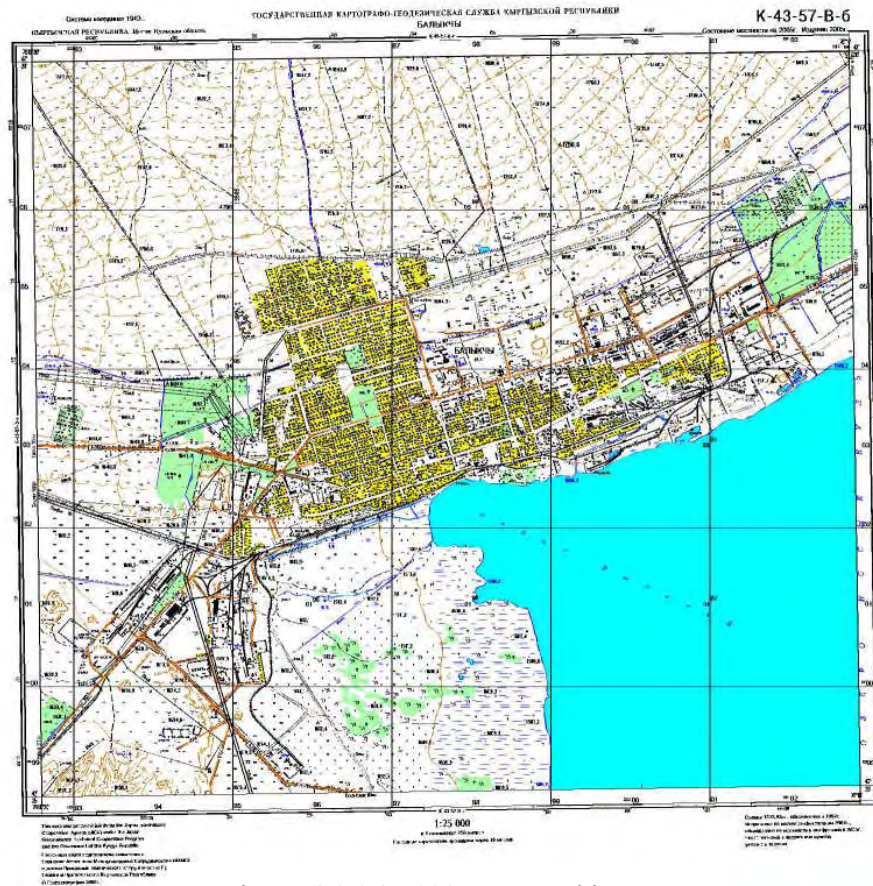


Figure 6-1 1:25,000 Topographic map

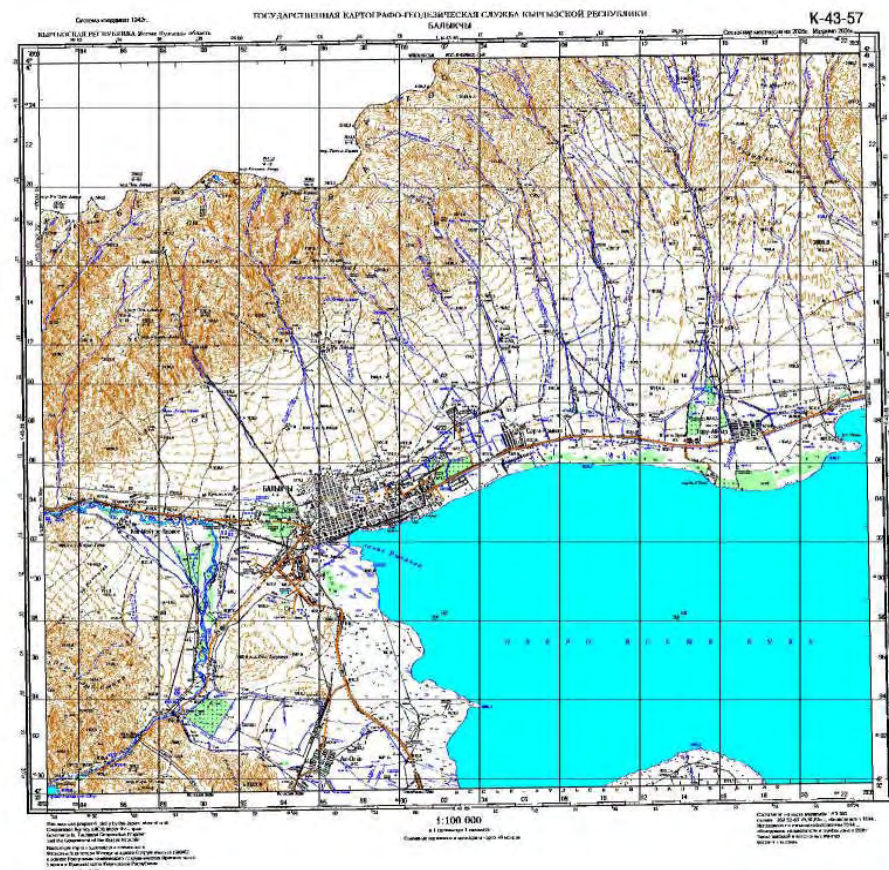


Figure 6-2 1:100,000 Topographic map