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Japan InternationalCooperation Agency

State Committee for Land and Cartography
The Republic of Azerbaijan

The Study on National Digital Mapping

in

The Republic of Azerbaijan

Final Report

February 2003

Pasco Corporation, Japan

Exchange Rate

US Dollar (US$)	Japanese Yen (¥)	Manat	Date
1.00	109.70	4,562	March 2000
1.00	126.65	4,660	July 2001
1.00	121.70	4,880	January 2003

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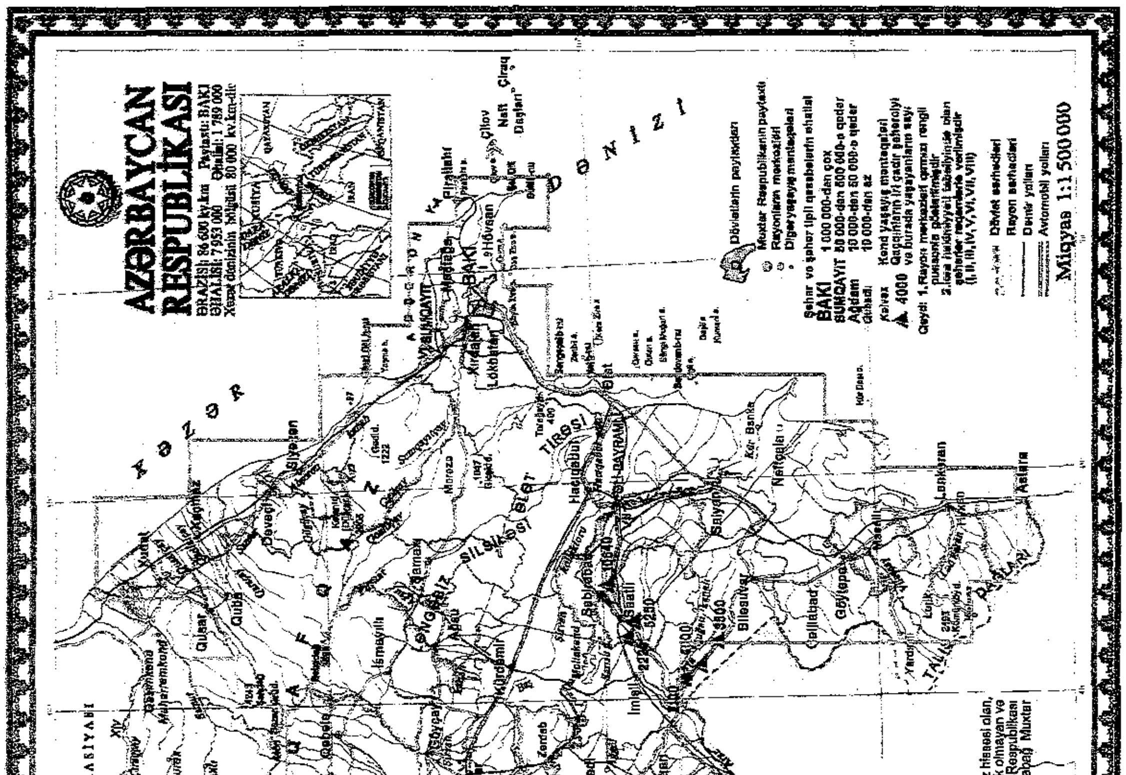
Location Map of the Study Area



PREFACE

In response to a request from the Government of the Republic of Azerbaijan, the Government of Japan decided to conduct the Study on National Digital Mapping Project in the Republic of Azerbaijan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.Takeshi Hirai (March 2000-January 2001) and Mr.Yoshiaki Otoku (February 2001- February 2003) of Pasco Corporation to Azerbaijan, four times between March 2000 and February 2003.

The team held discussions with the officials concerned of the Government of Azerbaijan and conducted the field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Azerbaijan for their close cooperation extended to the team.

February 2003

川上隆朗

Takao Kawakami
President
Japan International Cooperation Agency

Letter of Transmittal

February 2003

Mr. Takao Kawakami
President
Japan International Cooperation Agency

Dear Sir,

It is a great honor for me to submit herewith the Final Report on the Study on National Digital Mapping in the Republic of Azerbaijan.

The Study Team, which was organized by Pasco International Inc. and headed by myself, was dispatched to Azerbaijan four times from March 2000 to February 2003 to conduct the study works for national digital mapping in Azerbaijan under the contract for implementation of the said Study with Japan International Cooperation Agency (JICA) and to arrange for subcontracting the work of aerial photography and make the presentation on the digital topographic map data. In the meanwhile, the Study Team also conducted the works of digital plotting and compilation in Japan and wrapped up the results of these works in this Report.

On behalf of the Study Team, I would express my sincere appreciation of the unsparing favor and close cooperation that the Government of the Republic of Azerbaijan and its related agencies extended to all the Team members during their stay in Azerbaijan.

I also wish to express our deepest gratitude to JICA, Ministry of Foreign Affairs, Ministry of Land / Infrastructure and Transport, Embassy of Japan in Azerbaijan and other related governmental authorities for their invaluable advice and supports.

Yours faithfully,

Yoshiaki Otoku
Team Leader
The Study on National Digital Mapping
in the Republic of Azerbaijan

INTRODUCTION

Azerbaijan declared itself independent on 28 May 1918 and the Azerbaijan Democratic Republic (ADR) was formed. ADR was suppressed by Russia's Red Army on 28 April 1920 and Azerbaijan was transformed to the Azerbaijan Soviet Socialist Republic (AzSSR).

Later, on 30 December 1922 AzSSR joined the Union of the Soviet Socialist Republics (USSR). From the time of joining the Soviet Union, AzSSR was under the centralized control from the socialist regime of the USSR.

On the eve of the dissolution of the USSR on 18 October 1991 the Supreme Council of the AzSSR passed the Constitution Act on the Independence of the Azerbaijan Republic. On 12 November 1995 the Constitution of the Azerbaijan Republic was adopted.

It should be noted that yet being AzSSR beginning from February 1988 a violent conflict erupted between Azerbaijan and Armenia regarding the independence of the Nagorno-Karabakhskaya Autonomous Area, which was the part of the Azerbaijan Republic.

Strife against separatists who tried to grab the Karabakh area from the Azerbaijan Republic consolidated the Azeri nation and raised its national self-consciousness. Armenian aggression resulted in the occupation of 20% of Azerbaijan's territory. Over a 1 mln. of Azerbaijan's citizens became refugees, and, nowadays, they suffer a great hardship. In May 1994, there was signed a temporary cease-fire agreement between Azerbaijan and Armenia.

The collapse of the Soviet Union negatively reflected on the Azerbaijan's economy. Taking account of the fact that the Soviet Union's economy was based on the inter-republic cooperation it had to rebuild almost all the home industry.

Beginning from 1994, there in the Azerbaijan Republic started up development and implementation of macroeconomic reforms aimed at stabilizing country's economy.

In July 1996, the meetings on policies between three Caucasian countries including Azerbaijan and the Government of Japan was held and Azerbaijan publicized its important future development sectors: a) Energy sector; b) Development of agricultural infrastructure; c) Development of transport and telecommunications infrastructure (roads, railways, telecommunications, water transportation in Caspian Sea); d) Social sector (including health and medical care, education, employment social security etc.); and e) Development legislation and systems necessary for market economy (including financial and monetary laws, foreign capital introduction laws etc.).

Also, the Government of Japan publicized its diplomatic policy for the "Silk Road Areas" in the address of former Prime Minister Hashimoto in August 1997. He said that it was necessary to establish a large extent of these areas as the organic structural parts of the diplomacy for Eurasia and to develop the diplomacy more fastidiously than ever. Further, he said that he was looking at the efforts of the Japanese industry to participate in the energy resource development in the countries such as Azerbaijan and Kazakhstan. In this sense, Azerbaijan is one of the countries to which the Government of Japan attaches great importance in its diplomatic policies.

Among the countries of the former Soviet Union, Azerbaijan possesses a high technology in the conventional analog mapping for the precise topographic maps that are used for various purposes such as national land development reform.

In the Soviet Union two agencies were concerned with topographic map production: High Division for Geodesy and Cartography under the USSR's Council of Ministers (HDGC under USSR's CM) and Ordnance Survey (OS) under General Commandment of USSR's Military Forces. Topographic work was distributed between these agencies depending on the scale, type and territory. The territory of Azerbaijan was covered by 1/50,000-scale topographic maps prepared by Ordnance Survey. Therefore, the last updating for 1/50,000 scale was made in 1988. In spite of hard economic situation, lack of the finances, there in Azerbaijan were carried out works on the National Geodetic Network establishment, updating city plans on the scale of 1/2000, 1/5000, 1/10,000, updating the 1/10,000 and 1/25,000-scale topographic map of Azerbaijan. However, the lack of advanced technologies to meet the present-day standards was considered as a serious obstacle on the way to digital mapping development.

Azerbaijan surely possesses existing topographic maps, but these had been created for the main purposes of military and security, so that the 1/50,000-scale topographic maps covering the entire country have not been disclosed publicly.

In recent years, the interest in Azerbaijan and preference for investment in oil field development in the continental shelf of the Caspian Sea have been increasing not only among the enterprises in Azerbaijan but also in overseas countries including Japan. Thus, it is a pressing need to develop the spatial information on the national geography and topography for the national development and infrastructure redeployment, and to promote the civil use of the developed geographic and topographic information.

In this background, the Azerbaijan Republic made the request for the new technical secular change and correction in the existing 1/50,000-scale topographic maps and digitization of the topographic maps to Japan in October 1998.

In response to this request, the Government of Japan dispatched the Preliminary Study Team to Azerbaijan and signed the Scope of Work with the recipient agency in Azerbaijan, SCGC (State Committee for Geodesy and Cartography) to implement the "Study on National Digital Mapping in the Republic of Azerbaijan" in December 1999.

After that, SCGC was unified into SCLC (State Committee for Land and Cartography) in April 2001 and restructured as State Aerogeodesy Corporation, one of the departments of SCLC.

The former SCGC (current SCLC) was in the leading position in the geodesy and mapping fields among the republics of the former Soviet Union and furnished technical guidance to the then communist countries in Asia and Africa as well as in some republics within the former Soviet Union. SCGC had a very high potential level of technology, but it suffered substantial financial and technical problems. In the former Soviet Union era and nowadays, SCLC creates and updates a number of map series that were deemed to be in the world's level, including detailed topographic maps, such as 1/10,000, 1/25,000 and 1/50,000-scale topographic maps, lifeline management maps, cadastral maps, a wealth of theme maps and atlases. However, this work is carried out by old technology and therefore this type of work is found to be expensive and time-consuming. Due to lack of equipment and facilities SCLC couldn't switch to the introduction of the advanced computer-aided mapping technology. So, the mapping techniques have remained in the level before the 1980's though the level of map products is high. The computer, peripheral equipment and associated software have been developed rapidly these past 10 years, and the environment comfortable enough to support the mapping technology is easily available at present. The digital map data created by using computer technology can also be used effectively in various fields that are supported by computers.

Therefore, SCLC desires to enhance the productivity in the mapping work through introduction of technologies such as the GPS survey as the latest survey technology and kinematics GPS aerial photography, digital photogrammetry, and computer-aided map compilation and production, and to establish the system in which map development projects can be implemented to a certain extent by a smaller number of engineers. This desire is one of the factors in the background of the request for this Study by Azerbaijan.

In Azerbaijan, the reconstruction of the economic structure is an impending issue, and it is needed to develop the latest fundamental maps to serve for formulating and implementing national development programs and various projects in the private sector, including foreign capital, as well as in the public sector. The fundamental map series in the forms of 1/10,000, 1/25,000 and 1/50,000-scale topographic maps were maintained in the former Soviet Union era as described above, but it is financially difficult to maintain all these maps in the future. In this Study, therefore, the 1/50,000-scale topographic maps have been determined as the appropriate fundamental maps in consideration of the available budget scale and organizational capacity, and the technical cooperation to ensure the introduction of the new digital mapping technology has been implemented.

The existing 1/50,000-scale topographic maps were specified for governmental purposes such as mainly for security and limited to governmental use. In updating the 1/50,000-scale topographic maps, the map symbols have been subjected to a substantial change to ensure that the maps can be reproduced for the civil use.

In the future, it is expected that the fundamental maps so completed in this Study will be disclosed not only for governmental use but also for civil use, contributing to the national development through introduction of private vitality.

1 OUTLINE OF THE STUDY

1.1 Objectives of the Study

This Study has the following objectives:

(1) To correct the secular changes in the existing topographic maps (of 1/50,000 scale) to convert them into maps for civil use. And to make digital maps by digitizing the topographic and geographic map data for a total area of approximately 60,000 km^2 of national land, in order to support the socioeconomic development of Azerbaijan Republic.

(2) To make the transfer of technology in digital mapping to State Committee of Land and Cartography (SCLC), the counterpart on the side of Azerbaijan through implementation of this Study.

1.2 *Study Area*

The area for the Study covers a total area of approximately 60,000 km^2 of Azerbaijan, exclusive of the Armenia-occupied area, Nakhichevan area and the national border areas.

1.3 Outline of the Study

This Study was implemented on the following items;

1.3.1 Aerial photography

In the aerial photography, the black/white aerial photographs to cover the entire study area were newly taken. The photographic scale was 1/40,000 and the survey of the photographic principal points was made using the kinematics GPS. The confidential items of the planimetric features in the photographed area were deleted on the SCLC side and the photographic films were saved as the digital image data in a CD-ROM.

1.3.2 Digitization of existing maps

The existing topographic maps were digitized in accordance with the map symbol specifications as determined by SCLC. In this case, the existing contour lines were not used as vector data, but finally used as raster data. The contour films for map printing were produced from the raster data.

About 100 items of symbols were used for vector digitization from the existing topographic maps.

1.3.3 Creation of DEM

DEMs (Digital Elevation Models) of the study area were created. For this purpose, the contour lines of 10m in the plain area and those of 50m in the mountainous areas were vectored from their existing maps.

1.3.4 Correction of secular changes

The points of secular changes were interpreted from the aerial photos that were recently taken and the corresponding planimetric features were corrected through the field survey and the stereo plotting.

Based on the correction data, the raster data and the vector data acquired from the existing topographic maps were corrected.

The field survey necessary for correcting the secular changes were implemented by SCLC under the supervision of the Japanese Study Team.

1.3.5 Creation of the films for color map printing plates

For 134 map sheets covering the area of approximately 52,000km^2 worked in Japan and Azerbaijan in the total study area (165 maps / 60,000km^2), the maps were compiled by a high-precision plotter and the films outputted through an image setter at a resolution ranging from 2000 dpi to 3000 dpi. The make-up films prepared were separated into 6 color plates for black, blue, orange, , green and brown, as determined through the discussions on symbols. Therefore, 6 make-up film plates for each map sheet were outputted.

1.3.6 CD-ROM production

The final data created in this study were duplicated on CD-ROM as their metadata for a various future use in the GIS field.

1.3.7 Transfer of technology

It was planned that SCLC would implement the digital mapping of 20% of the study area through OJT (on-the-job training) as the technology transfer, under the supervision of the Japanese Study Team.

The items of technology transfer are followings:

① GPS survey

② Image scanning

③ Image digitization

④ Digital photogrammetry

⑤ Vector data correction

⑥ Raster data correction

⑦ Inspection of digital maps

⑧ Creation of the films for color map printing plates

1.3.9 Equipment for the Study

It was planned that the Japanese side would purchase the following equipment and software necessary for the technology transfer to the Azerbaijan side, which would be installed at SCLC:

① GPS receivers

② Digital photogrammetry workstation

③ Image setter for out-put film making

④ Scanner

⑤ Stereo-plotter

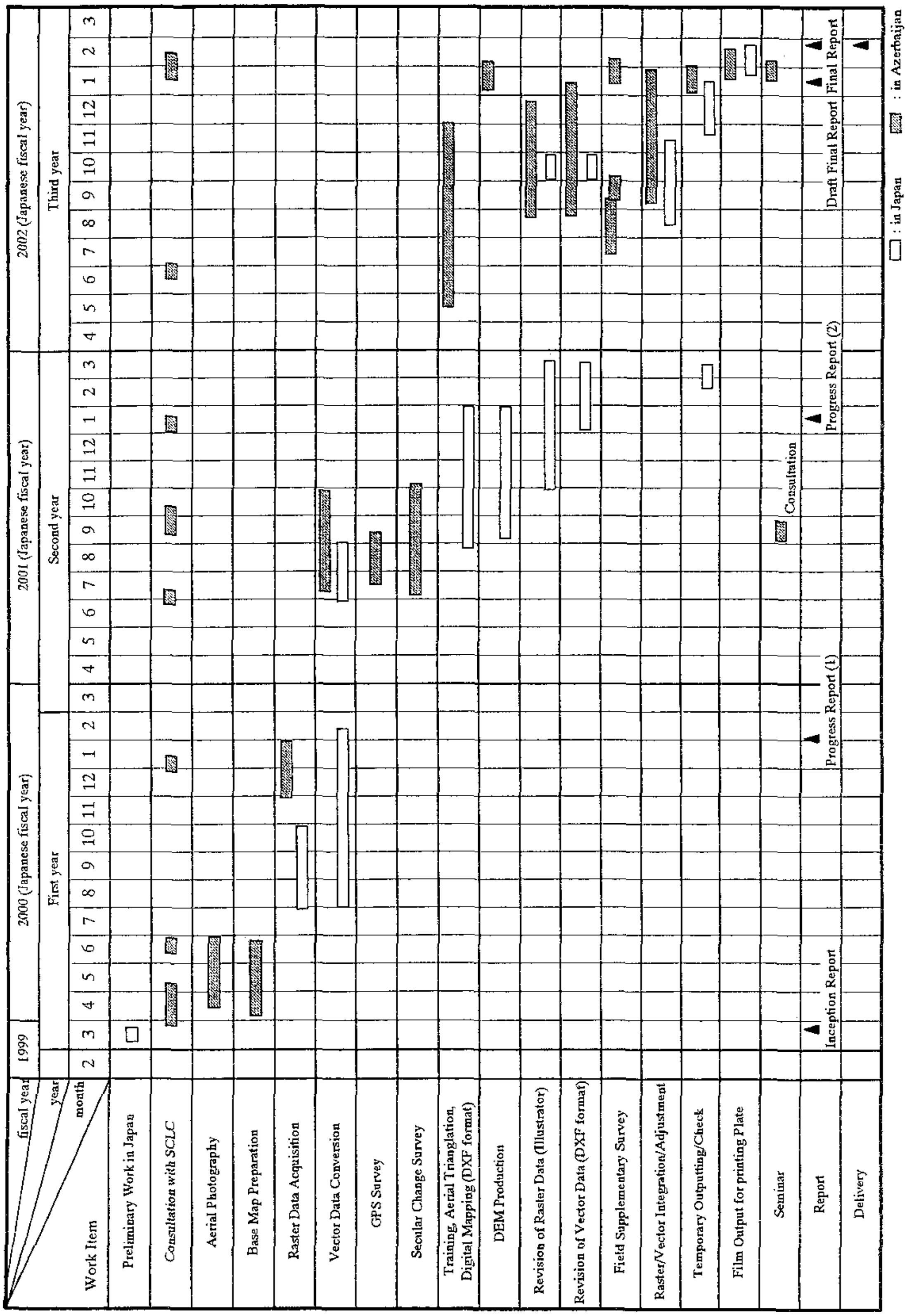
⑥ PCs and related software for map digitizing, compilation and data analysis

1.3.9 Study period

This Study was scheduled to start around the end of March 2000 and complete its original processes for the period of about 33 months as requested by Azerbaijan, but the period for implementation of the Study was about 36 months until March 2003 because the transportation of a part of the equipment and other materials necessary for the technology transfer in Azerbaijan was delayed for the reason that was attributed to the Japanese side. (Table 1)

Table 1 Whole Annual Procedure

Work Process



2 BASIC SPECIFICATIONS OF THE STUDY

This Study was implemented in accordance with the specifications as agreed in the Inception Report. For the other matters as not agreed between both sides of Japan and Azerbaijan, the JICA Overseas Work Specifications applied to those matters. (Table 2)

Table 2 Basic Specifications of the Study

Item	Description	Remarks
Aerial photography	Black and White wide-angle camera Scale 1 : 40,000 Overlap:60% Sidelap:30%	S/W JICA Instructions
Topographic map	scale 1:50,000 Digital maps approx.165 sheets approx.60,000km^2 Plate making film: 1 set of 4 colors	S/W
Map symbols and their rule	Revised map symbols based on the ex-USSR map symbols: 1:50,000	S/W
Surveying standards	Reference ellipsoid: Krasovsky Projection: Gauss-Krüger Neatline: 10' × 15' Contour interval: Principal contour 20m	S/W JICA Instructions
Precision	fixed in consultation with SCGC	JICA Instructions
Special annotation	The following notes shall be annotated in place of the Marginal information: This map was prepared jointly by Japan International Cooperation Agency(JICA) under the Japanese Government Technical Cooperation Program and Government of the Republic of Azerbaijan	S/W

The following items were the specifications agreed between Japan and Azerbaijan.

(1) General planimmetric accuracy of new maps

The new digital maps should be based on the accuracy of existing 1/50,000-scale maps

(2) Index precision of stereo plotting

Horizontal position: less than 0.3mm on a map

Height: less than 1.0m

3 COMPOSITION OF STUDY WORKS

3.1 Study Implementing Organizations

This Study was implemented by Pasco Corporation under contract with Japan International Cooperation Agency (JICA) and study works were conducted by JICA Study Team organized by Pasco Corporation under the work instruction of JICA. The work contract for each single fiscal year of Japan (12 months beginning in April) was created into between JICA and Pasco Corporation.

The Infrastructure Development Institute – Japan executed the technical assessment in each work process in this Study under the contract awarded by JICA.

3.2 Yearly Study Items

The yearly Study items instructed by JICA to Pasco Corporation for this Study were as follows:

(1) The First-year Study
Study period (March 22, 2000 to March 25, 2001)

1) Preliminary study in Japan
   ① Preparation of the Inception Report
   ② Collection of the related information and materials
2) The first stage work in Azerbaijan
   ① Discussion of Inception Report
   ② Consultation on the Study
   ③ Collection of related information and materials
   ④ Aerial photography (local subcontract)
   ⑤ Preparation of the base map for the digitizing
   ⑥ Preparation of the base map for DEM
   ⑦ Raster data acquisition 1
3) The first stage work in Japan
   ① Raster data acquisition 2
   ② Vector data acquisition 1
   ③ Preparation of the Progress Report 1

(2) The Second-year Study

Study period (July 22, 2001 to March 25, 2002)

1) The second stage work in Azerbaijan

① Explanation and discussion on the Progress Report 1

② GPS survey

③ Vector data acquisition 2

④ Secular change field survey

⑤ Discussion on the seminar

2) The second stage work in Japan

① Vector data acquisition 3

② Plotting 1

③ DEM production 1

④ Revision of the raster data 1

⑤ Revision of the vector data 1

⑥ Preparation of the Progress Report 2

(3) The Third-year Study

Study period (June 7, 2002 to March 20, 2003)

1) The third stage work in Azerbaijan

① Explanation and discussion of the Progress Report 2

② Plotting 2

③ Revision of the raster data 2

④ Revision of the vector data 2

⑤ DEM production 2

⑥ Supplemental field verification

2) The third stage work in Japan

① Revision of the vector data 3

② Raster and vector data integration and adjustment 1

③ Pre-outputting and inspection 1

④ Film preparation for plate-making 1

⑤ Metadata creation

⑥ Preparation of the Draft Final Report

3) The fourth stage work in Azerbaijan

① Raster and vector data integration and adjustment 2

② Pre-outputting and inspection 2

③ Preparation of materials for the seminar

④ Film preparation for plate-making 2

⑤ Seminar

⑥ Draft Final Report explanation and consultation

4) The fourth stage work in Japan

① *Preparation of the Final Report*

3.3 Dispatched personnel for the Study in Azerbaijan

The member of the Study Team and their periods dispatched from Japan to Azerbaijan for this Study are as follows:

(1) The first stage work in Azerbaijan

Member of Study Team	Assignment	Period of Dispatch
Takeshi Hirai	Team leader	Mar.28, 2000 ~ Apr.26, 2000 June 8, 2000 ~ June 28, 2000
Fujio Ito	Aerial photography	Apr.6, 2000 ~ July 12, 2000
Takashi Shimono	Map-compilation	Mar.28, 2000 ~ July 2, 2000
Daikichi Nakajima	Digital mapping	Mar.28, 2000 ~ July 2, 2000 Dec.12, 2000 ~ Feb.9, 2001
Kazunobu Kamimura	Coordination	Mar.28, 2000 ~ Apr.12, 2000
Hideaki Sakai	Coordination	Feb.1, 2001 ~ Feb.14, 2001

(2) The second stage work in Azerbaijan

Member of Study Team	Assignment	Period of Dispatch
Yoshiaki Otoku	Team leader	Sep.22, 2001 ~ Oct.12, 2001 Jan.12, 2002 ~ Jan.26, 2002
Kentaro Usuda	Field verification	July 9, 2001 ~ Nov.2, 2001
Daikichi Nakajima	Digital mapping	July 9, 2001 ~ Aug.7, 2001
Takashi Shimono	Digital compilation	Sep.4, 2001 ~ Nov.2, 2001
Yutaka Nakada	GPS survey	July 23, 2001 ~ Sep.20, 2001

(3) The third stage work in Azerbaijan

Member of Study Team	Assignment	Period of Dispatch
Yoshiaki Otoku	Team leader	June 17, 2002 ~ July 6, 2002
Kentaro Usuda	Supplemental survey	July 3, 2002 ~ Aug.31, 2002
Daikichi Nakajima	Digital mapping Digital compilation	June 17, 2002 ~ Aug.5, 2002 Aug.28, 2002 ~ Oct.28, 2002
Hidetoshi Kakiuchi	Coordination	Aug.19, 2002 ~ Sep.2, 2002

(4) The fourth stage work in Azerbaijan

Member of Study Team	Assignment	Period of Dispatch
Yoshiaki Otoku	Team leader	Jan.22, 2003 ~ Feb.20, 2003
Daikichi Nakajima	Supervision/Seminar	Jan.20, 2003 ~ Feb.20, 2003
Takashi Shimono	Film preparation/Seminar	Jan.22, 2003 ~ Feb.20, 2003
Hidetoshi Kakiuchi	Coordination	Feb. 7, 2003 ~ Feb.20, 2003

4 RECEPTIONS OF TRAINEE IN JAPAN

The trainees of Azerbaijan and their period of training in Japan for digital mapping technology through the entire period of the Study were as follows:

Name	Organization	Period of Training
Mr. Adil S. Soultanov	Chairman State Committee for Geodesy and Cartography	Nov.14, 2000 ~Dec.1, 2000
Mr. Alovsat S. Guliyev	Chief Photogrammetric Section State Aerogeodesy Corpo- ration / SCLC	May 14, 2002 ~ June 16, 2002

Building of former State Committee for Geodesy and Cartography is presently occupied by State Aerogeodesy Corporation / SCLC

5 STUDY WORK PLANS AND RESULTS

The work plans and the results for the main study items relating to the quantities of products in this Study are shown in Table 3 and the Workflow for the Study is in Figure 1.

Table 3 Work Plans and Results

F/Y	Items of Work	Planned Work Volume	Work Result Volume	Remarks
First-year	Aerial photography B/W 1/40,000-scale	60,000 km2 (79 flight lines)	60,000 km2 (99 flight lines)	
	Base map preparation For digitizing	60,000 km2 (165 sheets x 2 films)	60,000 km2 (160 sheets x 2 films)	
	Base map preparation For DEM	60,000 km2 (165 sheet x 1 film)	60,000 km2 (160 sheet x 1 film)	Fiscal Year 2000
	Raster data acquisition 1	12,000 km2 (35 sheets)	12,000 km2	
	Raster data acquisition 2	48,000 km2 (130 sheets)	48,000 km2 (130 sheets)	
	Vector data acquisition	38,000 km2	45,250 km2	
Second-year	GPS survey	20 points	23 points	
	Vector data acquisition	12,000 km2 (35 sheets)	12,000 km2 (35 sheets)	
	Secular change field survey	60,000 km2 (165 sheets)	60,000 km2 (165 sheets)	
	Vector data acquisition 3	2,750 km2	2,750 km2	FY2001
	Plotting 1	48,000 km2	48,000 km2	
	DEM production	48,000 km2	48,000 km2	
	Revision of raster data 1	48,000 km2	48,000 km2	
	Revision of vector data 1	48,000 km2	48,000 km2	
Third-year	Plotting 2	12,000 km2 (35 sheets)	12,000 km2 (35 sheets)	
	Raster data revision 2	12,000 km2	12,000 km2	
	Vector data revision 2	12,000 km2	12,000 km2	
	DEM production 2	12,000 km2	12,000 km2	
	Supplemental field Verification	60,000 km2 (165 sheets)	60,000 km2 (165 sheets)	
	Vector data revision 3	48,000 km2	48,000 km2	FY2002
	Raster & vector integration And adjustment 1	48,000 km2 (130 sheets)	48,000 km2 (130 sheets)	
	Pre-outputting & inspection 1	130 sheets	130 sheets	
	Film preparation for Plate making 1	130 sheets	130 sheets	
	Metadata creation	130 sheets	130 sheets	
	Raster & vector integration And adjustment 2	12,000 km2 (35 sheets)	12,000 km2 (35 sheets)	
	Pre-outputting & inspection 2	35 sheets	35 sheets	
	Film preparation for Plate making 2	35 sheets	35 sheets	

Figure 1 Work Flow of the Study

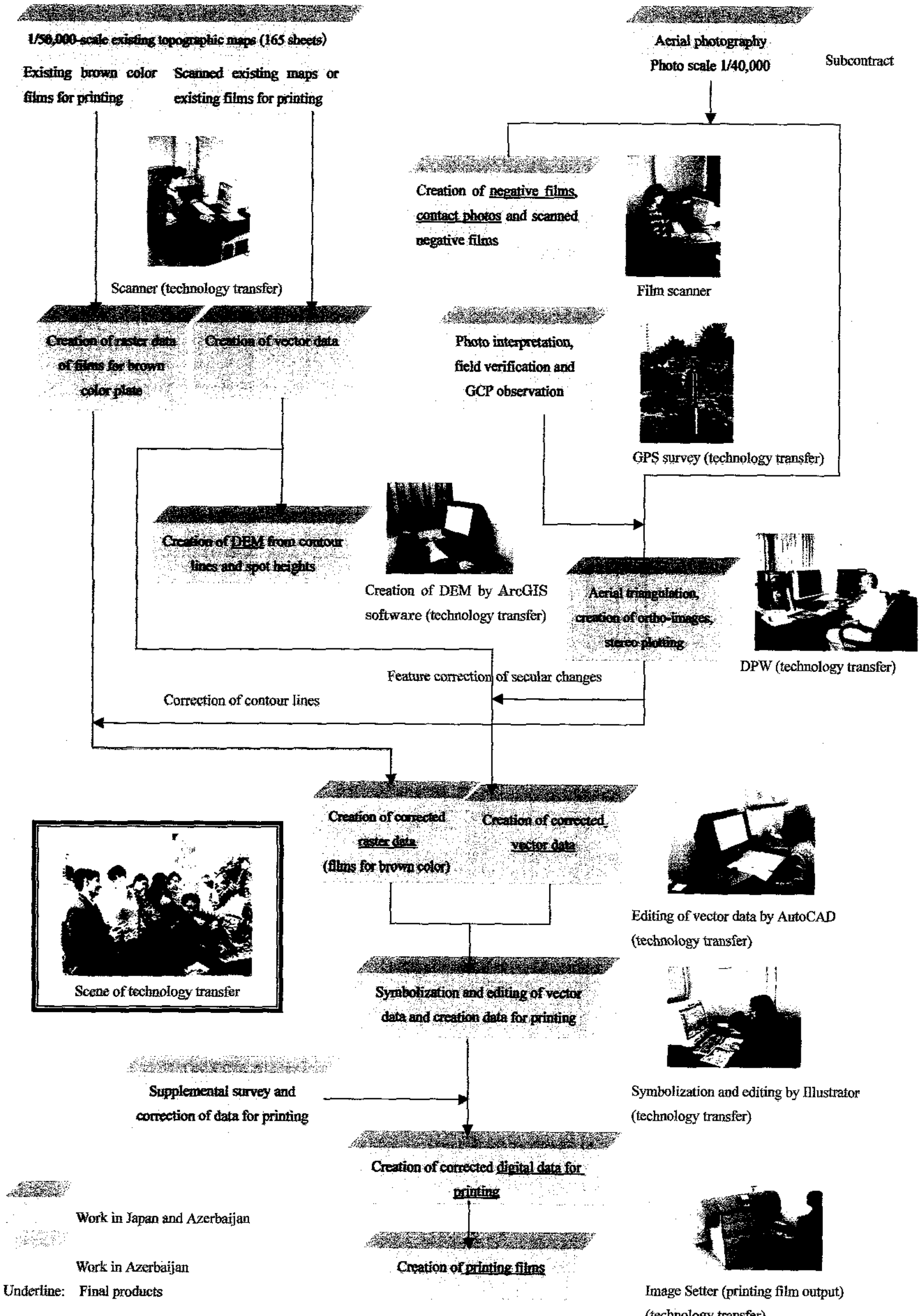
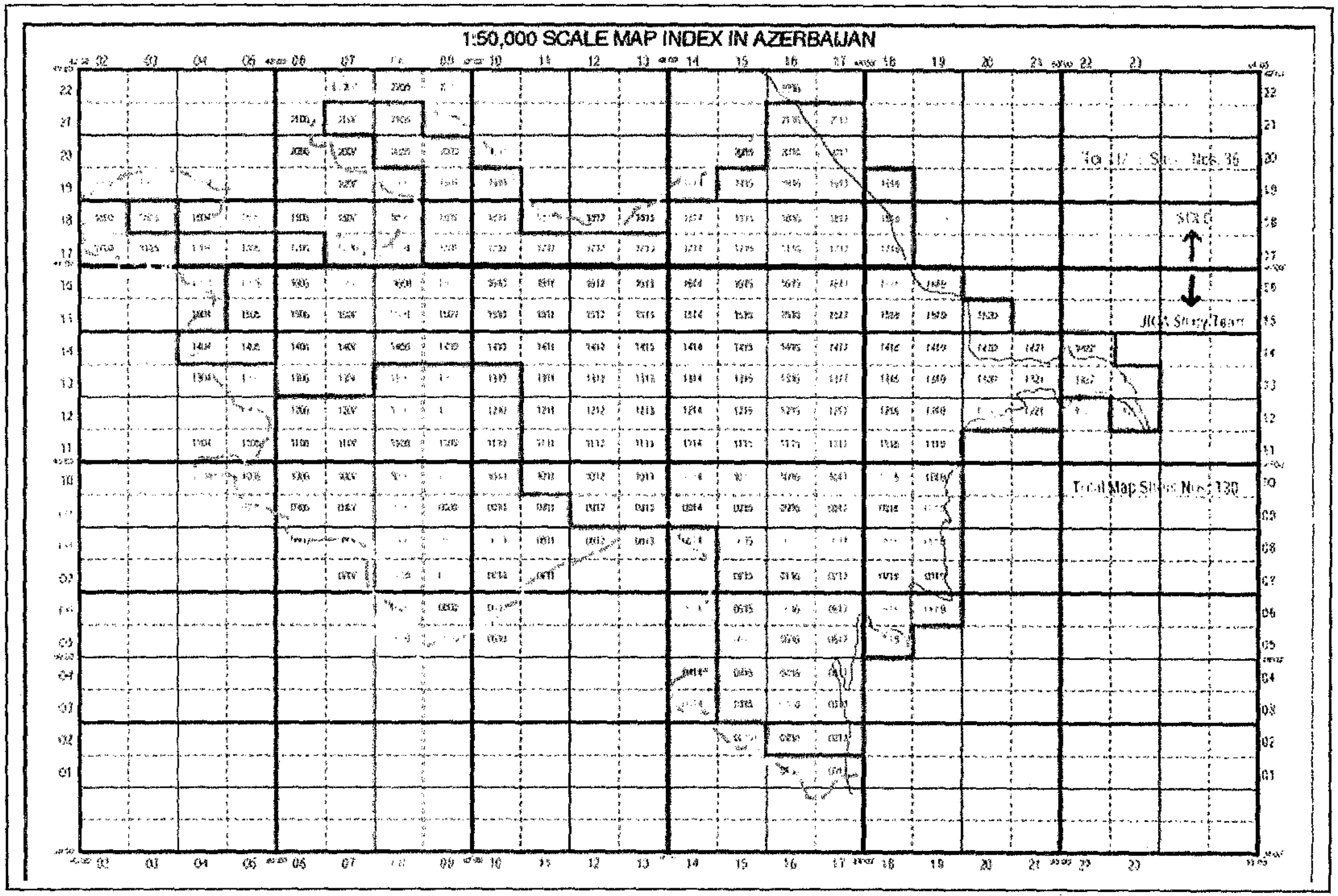


Figure 2 Details of the Study Area and Map Index



6 CONTENTS OF THE STUDY

The JICA Study Team headed by Mr. Takeshi Hirai had a consultation with SCLC for the methods of procedure, the survey standard and the techniques for technical transfer to SCLC of the Study on the Inception Report prepared by the JICA Study Team in June 2000, before commencement the Study. The contents of the Inception Report have accepted at SCLC in consequence.

As for the Study area, the area comprising approx. 60,000km2, total 165 map sheets at a 1/50,000-scale shown on Figure 2 were confirmed and it was decided that the OJT area by the JICA Study Team should be 35 map sheets covering 12,000km2 located the northern area of 41° north latitude in 165 sheets.

The printing plate original films of the existing 1/50,000-scale maps were collected for 160 map sheets excluded 5 map sheets and reproduced as the base maps for this Study.

The color printed maps, which could not collected the original films were scanned with color. These scanned data normalized, rectified, were used as the base maps also.

The existing 1/50,000-scale maps have been based on the application standard of the old Soviet Union's Map Symbols Specifications, therefore the classification of the Map Symbols was for a strategy purpose in great measure.

Having consultation with SCLC, the category of the Map Symbol Specifications in this Study was more simplified decreasing to around the half of original symbol's volume for the civil use.

The "Digital Map Symbols for 1/50,000-scale" on Figure 6.2 shows the legend of map symbols adopted in this Study. The symbols, which were not used in new digital maps, were indicated as "excluded" in existing "1/50,000-scale Topographic Map Symbols Specifications" herein attached. About 85 symbols were not used and some similar symbols were combined also into one symbol.

Azeri annotations instead of Russian annotations on the existing maps were adopted in this Study according to the request of SCLC. SCLC side at the site implemented the survey for the annotations, then the annotation overlay for each digital map was prepared also.

6.1 Aerial Photography

Aerial photography was subcontracted to FINNMAP FM-International Oy. Aerial photography was conducted to focus on the area of 60,000 km^2 in accordance with the following specifications:

Photo scale:	1:40,000 B/W
Photographing courses:	79 courses, approx. 2,900 photographs
Camera :	Wide-angle camera (focus: 150mm, frame: 23cm × 23cm)

Flight height:	6,000 m ± 5%
Forward overlap:	60 ± 5%
Side-lap:	30 ± 10%
Special requirement:	GPS kinematics.

Result

Aerial photography of the study area had been completed before July 6, 2000 except the national borders and the area occupied by Armenia.
The flight of aircraft was stopped 5km before the border of Russia, Iran, Georgia and 15km in front of the occupied area by Armenia for the security reasons.

Necessary annotations such as course numbers and photograph numbers were noted on the negative films.
Aerial photographed area was divided into 7 blocks; Baku F(2), C, G, H, A, B and DE.
(See Figure 6.1 : Aerial Photography Block)

The results of aerial photography are shown below (provisional):

Block	Course	Line km	Photographs
Baku F (2)	18 courses	2670 line km	739 photographs
Block C	21 courses	2055 line km	529 photographs
Block G	11 courses	775 line km	218 photographs
Block H	11 courses	502 line km	149 photographs
Block A	6 courses	298 line km	87 photographs
Block B	6 courses	430 line km	122 photographs
Block DE	26 courses	2523 line km	700 photographs
Total	99 courses	9253 line km	2544 photographs

The report on the aerial photography (GPS Kinematics) is shown as Appendix-5.

Inspection

Technical inspection was done by the Study Team and the staff of SCLC in accordance with the specifications using rush prints. The security inspection on the confidential items was conducted by military personnel and the opaque work was also conducted by them.
Scanning of aerial photographs was made at a precision of 28 microns by a high accuracy photo-scanner and recorded onto digital media (DLT tape). Photo scanning images was opaqued by FINNMAP FM- International Oy after the security inspection.
The final contact prints were prepared after the security inspection.

Undertaking work by SCLC

The aerial signals (pre-marking) were installed on 9 ground control points by SCLC before aerial photographing.
These pre-marked points were used for the aerial triangulation.

Figure 6.1 Block names of Aerial photography

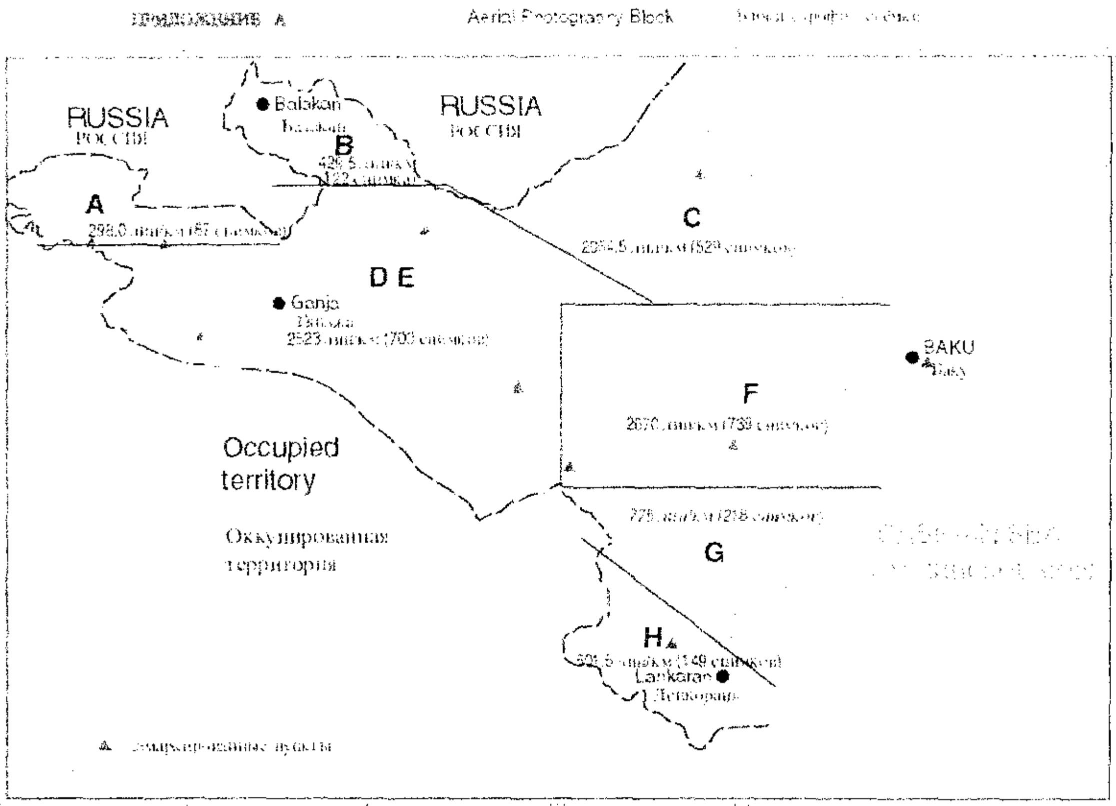
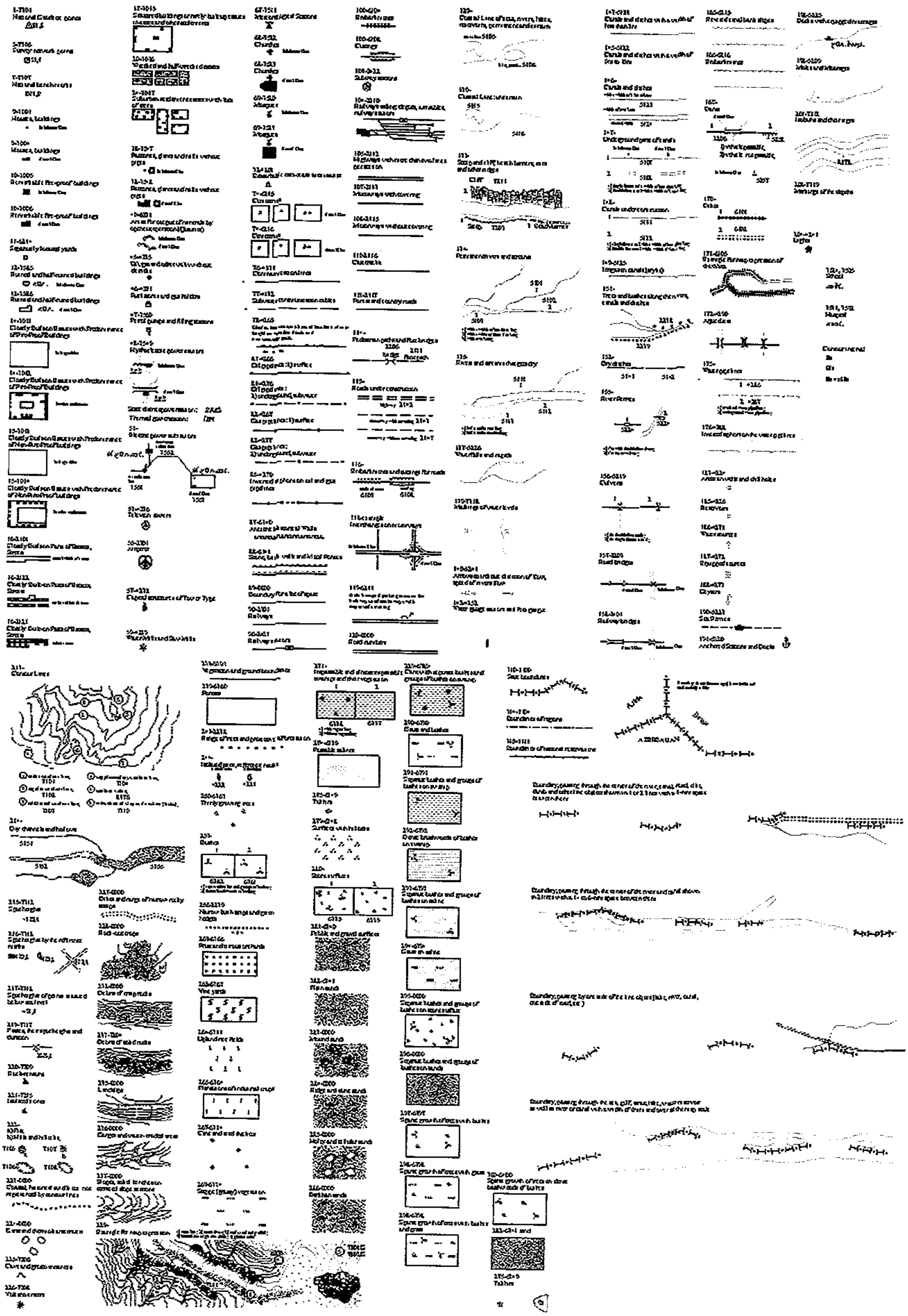


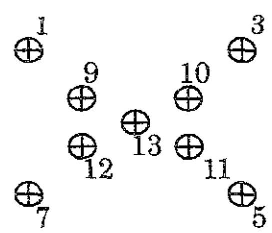
Figure 6.2 Digital Map Symbols for 1/50,000-scale



6.2 Preparation of Base Maps for Digitizing and DEM in Azerbaijan

Color separate positive films for printing plates are in five colors of black, brown, blue, yellow and green. Only required films (black, brown and blue) were duplicated for the raster image acquisition followed by the map digitizing process. Duplicated positive film images were put on the face side of each film in order to easily scratch out useless symbols and information. Color quality of duplicated positive films was high density black.

By putting black film under the blue and brown films respectively, five cross grids and four corner points were copied from the black film on the duplicated brown and blue films as control points in order to normalize expansion and distortion. Transfer error of each control point was less than 0.1mm.



The width of each cross mark line was 0.1mm and its size was 5mm by 5mm. Map sheet number is attached to the upper right side of each duplicated positive film.

Confidential items and useless symbols were eliminated from duplicated positive films by the film scratching method.

6.2.1 Preparation of base maps for digitizing

Reproductive positives were prepared from color separate film bases in black, brown, blue and yellow for vectorization. After examination, only black, brown and blue film bases were duplicated. For the map digitizing, 9 cross grids were drawn on the duplicate positive film bases in order to normalize expansion and distortion.

Confidential items were erased by the SCLC and the reproductive positives were handed over to the Study Team. 129 map sheets were made by SCLC. In other words, 387 positive film bases in total were duplicated for the area for which the Study Team is responsible.

6.2.2 Preparation of base maps for DEM

By using the brown positives film bases, the preparation of base maps for DEM was carried out to scratch out the confidential items by the SCLC. As the result of examination, it was decided not to remove a deformation area because of the time schedule.

6.3 Raster Data Acquisition

6.3.1 Raster data acquisition in Azerbaijan

Required materials: Plastic positive films (black, blue, brown),

Existing 1/50,000-scale printed maps	35 sets
Coordinates table of 9 cross marks	1 set

35 sets of existing 1/50,000-scale printed maps, black plastic positive films, blue plastic positive films, brown plastic positive films were scanned on a drum scanner for vectorization purpose. Vectorization of the 1/50,000-scale maps was performed based on the raster image data.

The raster image data were stored in the TIFF standard base line format on CDs.

Resolution of images was 300dpi (black and white). Sheet number of the raster image data was inputted as follows:

Type of Material and Color	File Name
Black positive film:	2116bk
Blue positive film	2116be
Brown positive film	2116bn
Printed map	2116pt

Quality control of scanning errors in raster image acquisition was done based on the acceptable offset distance of less than 4 meters in the case of resolution of 300 dpi. This value of less than 4 meters was accepted based on the offset distance table of REGISTER command.

Raster data acquisition for DEM creation (vectorization of contour lines) shall be done in the above-mentioned method (by SCLC) and using a vacuum-type table scanner for preparing topographic maps (by the Study Team in Japan).

6.3.2 Normalization of raster data in Azerbaijan

Since the scanned raster image data has some distortions caused by scanning, normalization of the raster image was performed by REGISTER and RECTIFY commands of ArcInfo. REGISTER and RECTIFY commands were used to create a new georeferenced raster image. The raster image must be represented in one of the formats supported by the IMAGE INTEGRATOR such as TIFF format for registration.

REGISTER uses a six-parameter (scale for the x- and y-axes, shift in the x- and y-directions, any shear (skew) factor and any rotation) affine transformation to georeference the raster images. (Azerbaijan map coordinate system: Krassovsky for geodetic datum and equiangular transverse-cylindrical Gauss-Krueger projection calculated for a six-degree zone – The Study Team used Azerbaijan Transverse Mercator, zones 8 and 9 as map projection.) After completing the registration, the transformation parameters were written in a World file, namely an ASCII file that contains the six parameters necessary to perform the affine transformation.

The registration process is normally followed by rectification. The RECTIFY program applies the transformation to the raster image, hereby creating a new georeferenced raster image.

Note that the affine transformation does not apply a 'rubber-sheet' to an image (allow for differentially scaling and rotating an image), but uniformly rotates, translates and scales the image. Thus, REGISTER is designed to georeference images where the six parameters do not vary the image differentially.

Using the 9 links as control points, REGISTER applies the affine transformation to the calculation of the amount of the parameters and the translation required to convert the raster image to map coordinates. The affine transformation requires at least three links.

Given three links, REGISTER can exactly align the three image locations onto their corresponding map locations. In some instances, three links might be adequate to georeference an image. However, more links can be used as necessary (up to 60) to allow better alignment. When more than three links are used, REGISTER cannot exactly map all the image locations at their corresponding map locations. In this case, a least squares method is used to yield the best possible registration by minimizing the sum of the offset distances (difference values between image locations and map locations) for each link.

The acceptable offset distance (control point errors) is less than 4 meters in the case of resolution of 300dpi.

Quality control of raster data was made based on the checklist of rectification. The list consists of the date of rectification, name of operator, locations of control points (approximately 9 points, delete some control points with an error of larger than 4m) by numbers, and control points location error values. The list was approved by the responsible persons.

6.3.3 Raster data acquisition 1 in Japan

This work was not done from Dec. 2000 using SCLC's scanner with 700 dpi resolution. The work will be done in Japan. Before the main work, the Study Team made an experiment for raster acquisition of the brown positive base. Some graphic editing was carried out using Adobe photo-shop. The result is shown below.

Scanned Raster Data

After cleaning by Photo Shop

As the result of the experiment, several shadows were recognized at the dense contour line area. It is supposed that the shadows were caused by some noises in the transparent positive film when it was scanned. The Study Team reported this problem to JICA and find a solution in Japan.

6.3.4 Raster data acquisition 2 in Japan

The raster data acquisition and data normalization were conducted in Japan under the same specifications finalized by SCLC and the Study Team, as mentioned in 6.3.3.

6.4 Vector Data Acquisition

The existing topographic maps and corner coordinates table in the maps were collected for the vector data acquisition for digital map preparation to be conducted in Japan by Study Team in accordance with the layer specification of the map automation table (Table 6.1: Layer Specifications-Azerbaijan 1:50,000-Scale Map Automation) and standards as below. Vector data acquisition of the 20% northern part of the study area shall be done by SCLC.
Vector data acquisition work on this project in Japan is comprised of Vector data acquisition 1 in the First Year Study and Vector data acquisition 3 in the Second Year Study.

6.4.1 Vector data acquisition 1 and 3 in Japan

Required materials: Blue copies (black, blue, brown plates), existing 1/50,000-scale printed map copies, index chart of printed maps, coordinates table of 9 cross-marks.

(1) Group of digital data

Transformation (normalization) of acquired draft vector data is made according to 9 crossmarks (control points) on each map. And the digital database of this project consists of the following 5 groups:

I) vector data group;
II) raster data group;
III) text data group;
IV) unified symbols group;
V) excluded symbols group.

Group III (attributive information of GIS objects) is used as GIS data in the future.

Group I (vector data group) consists of 12 subgroups:

- Control points
- Buildings and built-up areas
- Land use
- Wells
- Utilities
- Railways
- Roads
- Hydrography
- Contour lines
- Administrative boundaries
- Vegetation
- Cartography

Each subgroup data input must be made on step-by-step basis (first, one subgroup data is inputted, then a new one, etc.).

There are two types of edition, one is "SYMBOLS BEFORE 1982", the other is "SYMBOLS FROM 1983". The symbol No. column in "Table of Symbols for Digital Mapping" contains symbols with the numbers based on the "Symbols From 1983".

a) SYMBOLS BEFORE 1982:

Symbols No. 170-2 (coastal banks), 129 (lakes) are not represented in "SYMBOLS FROM 1983".

b) SYMBOLS FROM 1983:

Symbols No. 3, 68b, 69b, 70b, 17, 18, 19, 46b, 48, 50, 51b, 71-1, 77, 80, 84, 85, 89, 82-2, 83, 118,119, 117, 146, 147-1, 148-1, 149, 136-2, 170-1a, 164-3, 138, 169, 176, 167-2, 190-2, 223, 239, 254-1, 380-1, 280-1 are not represented in "SYMBOLS BEFORE 1982".

c) Difference between "SYMBOLS BEFORE 1982" and "SYMBOLS FROM 1983":

Symbols No. 36, 37, 44, 49, 51a, 52, 53, 54, 55, 56, 65, 66, 71, 90, 91, 97, 98, 115, 112, 116-1, 132-1, 132-2, 132-3, 133, 144, 145, 147-2, 148-2, 145, 150, 143, 151, 152, 170, 164, 165, 173, 310 (shape changes);

Symbol No. 40, 108, 150, 152, 140, 168, 275-b, 279 (color changes);

Symbol No. 20, 137, 167, 214, 254 (additional parts of symbols);

Symbols No. 7, 10, 45, 93, 94, 104, 116, 244 (other changes in symbols).

d) Sheet numbers of "SYMBOLS FROM 1983" are as follows :

1605, 1606, 1610, 1611, 1613, 1510, 1410, 1419, 1420, 1421, 1312, 1319, 1320, 1321, 1323, 1211, 1216, 1221, 1112, 1113, 1114, 1117, 1011, 1014, 1015, 1017, 1018, 1019, 0912, 0913, 0914, 0915, 0916, 0918, 0817, 0715, 0615, 0616, 0617, 0618, 0515, 0516, 0416, 0316, 0317, 0217.

e) Symbols No. 40-a, 40-b, 152, 275-b, 279 have two types of edition, "SYMBOLS FROM 1983" (brown object) and "SYMBOLS BEFORE 1982" (black and blue objects). Raster images of brown objects shall be acquired using Illustrator for preparing maps. Both black and blue objects shall be inputted for vector data acquisition.

(2) Map digitizing (1/50,000-scale)

Vector data acquisition for preparing 1/50,000 scale maps was performed based on the raster data in the map digitizing method.

Several symbols such as bridges (road bridge, railway bridge, aqueduct bridge, dam bridge), underground parts of objects (watercourse, utility lines) and over crossing objects (bridges, utility lines) belong to two Groups. These objects shall be inputted once in principle. In the case of road bridges over rivers, a road bridge will be inputted using the code number of the road combined with B. Do not input the bridge again during river data input.

In case of lines (black, blue) and green, orange, brown, blue, yellow fillings creating the shape of an object, shifting between those lines (and filling) that may occur during printing shall be avoided with the first priority during data input of the object.

In case of the objects divided by neat lines, adjoined map sheets should be matched by 100% object overlapping.

Every object should not be inputted more than once except in some special cases.

All the information about the way of inputting 6 object groups is give below:

a) Object with coordinates

The coordinates of map sheet control points (neat lines) must be entered in accordance with Azeri Transverse Mercator projection, and the parameters for zones 8 and 9 in the Krasovsky ellipsoid (coordinates values) should be inputted with up to three decimal places of meter. Map sheet control points (9 crossmarks) are to be inputted under No. 9990 code number (normalization of data by Arc/Info).

b) Numerical characters

Numerical annotations will not be inputted as attribute information.

Each map sheet number is to be put in the right upper corner over the neat line. A given map sheet number is inputted under No. 9002 code number.

c) Line Object

Vegetation boundary symbols (dotted lines) shall be inputted as lines using code number 6301. And Closed polygonal vegetation symbols (filled (green) and (blue) colored pattern symbols) will be inputted as polygons using the outer polygon boundaries (code Number 6301). After that, closed polygonal boundary lines shall be configured as polygonal objects with topology by Arc/Info.

All road objects except streets in a closely built-up area to be inputted as a polygon (true size, width = more than 0.8mm, symbol No. 16) and single-line and parallel double-line rivers (with a fixed width) will be inputted along the centerlines of those objects. In case the width of a river is partly changed, it should be inputted as a polygon.

Contour lines (index plus intermediate contour lines) for flat area shall be entered in 10m intervals, and contour lines (index contour lines) for a mountainous area be entered in 50m intervals based on your professional visual imagination ignoring breaks in the basemap like elevation values or other symbols (steep slope and cliff). The contour value of every contour line shall be entered as attribute information for creation of a digital elevation model.

The crossing point of line objects (node) must have its coordinates, which is the same for those line objects. OSNAP command should be used.

d) Polygonal Object

Black buildings (point and polygon) located in the built-up area polygons (except orange and yellow polygons) shall also be inputted.

There are some cases where in a base map there are overlaps between closed polygonal objects (built-up area, land-use area, vegetation area as a closed filled color/blue colored pattern, hydro-polygon area) and line objects (tracks, single-line/polygonal rivers, single-line/polygonal canals, railways, other vegetation boundaries, etc.). We must follow these cases. In the case of such base map that an overlap between closed polygonal objects and the sides of a wide road (two parallel lines) is shown, polygonal objects shall be defined using the centerline of the road (double lines' river and canals are not the same as the wide road).

Inner doughnut polygon data is inputted counterclockwise (e.g. in case of a small island in a pond or a river, the small island shall be represented as an inner doughnut polygon).

Vegetation boundary symbols have two data inputting methods. In one method, a boundary symbol is inputted as a polygon-type object. In the other method, a boundary symbol is inputted as a line-type object. In this project, vegetation boundaries are inputted as line-type objects using code number 6301.

e) Point Object

In the case of control points, symbols and their height values are to be inputted under different code numbers. In the case of triangulation poi for instance, the triangulation point is inputted as a triangle under No. 7301 code number. The triangulation point's elevation value is inputted as a cartographic annotation under No. 8174 code number.

Control points should be inputted based on the raster data of existing printed maps.

Vegetation symbol numbers 264-1, 267, 269-1, 253-1, 250-1 shall be inputted as points.

f) Cartographical Information

Geodetic ticks (2 mm length, one minute interval) must be based on the raster image and inputted under No. 9004 code number.

Contour line values as cartographic annotations in the photogrammetric mapping (updated) areas are inputted as code No. 8176.

Elevation values of control points and photogrammetric points are inputted as cartographic annotations under No. 8174 code number (8175 for water level values, 8176 for contour values, 8177 for depths of sea, 8178 for contour values of isobaths).

(3) Objects to be inputted in the near future

The under-mentioned items shall be inputted after acquiring their related information from SCLC (some items of which shall be obtained during the field verification work).

- Water depth of the Caspian Sea (КАСПИЙСКОЕ МОРЕ): code No. 7319, 8177 .
- Isobaths value of the Caspian Sea (КАСПИЙСКОЕ МОРЕ): code No. 7112 , 8178 .
- Schools: code No. 3524, 3525.
- Hospitals: code No. 3531, 3532
- Plants, factories and mills: code No. 3548
- Attribute information of cemeteries: M, X, Q
- Distinction of oil (Нефтепроводы) and gas (Газопроводы): code No. 4266,4267, 4276, 4277.
- Text for cartographical annotations: code No. 8100 to 8173

(4) Check-plot

Draft plotting of the map with all map objects shall be prepared for visual checking whether there is any data omitted during the inputting. Point symbols shall be symbolized on the check prints before plotting. SCLC should prepare a checklist (for each corresponding map sheet) for quality control purpose, which consists of map sheet number, name of object with symbol number and columns for checking by each person in charge. SCLC should prepare a list of persons to be engaged in map sheet digitizing and indicate dates of work. During checking, it is needed to use a draft plotted-out map sheet and a existing printed map sheet, making comparison between them by object.

Table 6.1-1 Layer Specifications - Azerbaijan 1 : 50,000-Scale Map Automation

Symbol No.	Group	Type	Code No.	BD-Code	Attribute	Description
310	ADMIN	LINE	1100			National boundaries
314			1104			Provincial boundaries
315			1111			National reservation boundaries
16	ROAD	POLY	2101			Streets in the closely built-up area (true size)
105		LINE	2112			Highways
107			2113			Paved motorways
108			2115			Unpaved motorways
110			2116			Unpaved country roads
111			2117			Field, forest and caravan roads and paths
16			2121			Streets in the closely built-up area (Narrow)
16			2122			Streets in the closely built-up area (Wide)
115			2142			Roads under construction (Highways)
115			2143			Roads under construction (Paved)
115			2147			Roads under construction (Unpaved)
114			2131			Footpaths
190			5223			Ferries (Ocean)
155			5224			Ferries (River)
157			Road code	2203		Bridges
114			Road code	2205		Footbridges
167			Road code	2206		Road-Dam bridges
116			Road code	6103		Roads on the embankment
90	RAILWAY	LINE	2301			Railways
158			Rail code	2401		Bridges
100			Rail code	6104		Railways on the embankment
104			2310			Railway depots and sidetracks
96			2421			Railway stations
103		POIN	2422			Subway stations
14	BUILT-UP	POLY	3011			Closely built estates with fireproof buildings
14			3012			Built estates with fireproof buildings
15			3013			Closely built estates with non-fireproof buildings
15			3014			Built estates with non-Fireproof buildings
17			3015			Rarely built-on estates in cities
20			3016			Dilapidated building areas
24			3017			Houses surrounded by trees
9	BUILDING	POLY	3004			Houses, buildings (true size)
10			3006			Remarkable Fireproof Buildings (true Size)

Table 6.1-2 **Layer Specifications - Azerbaijan 1 : 50,000-Scale Map Automation**

Symbol No.	Group	Type	Code No.	BD-Code	Attribute	Description
69			3521			Mosques (true size)
68			3523			Churches (true size)
			3525			Schools (true size)
			3532			Hospitals (true size)
38			3548			Plants, factories and mills (true size)
51			3552			Substations (converter)
51			3553			Substations (true size)
12			3586			Ruins (true size)
9	BUILDING	POIN	3001			Houses, buildings (minimum size: 0.4 x 0.6mm)
10			3005			Remarkable Fireproof buildings (minimum size)
67			3511			Meteorological stations
69			3520			Mosques (minimum size)
68			3522			Churches (minimum size)
			3524			Schools (minimum size)
			3531			Hospitals (minimum size)
38			3547			Plants, factories and mills (minimum size)
48			3549			Hydropower stations
51			3551			Substations (transformer)
12			3585			Ruins (minimum size)
185			4226			Reservoirs
53			4236			Television and radio towers (masts)
55			2701			Airports and hydro-airports
47	WELL	POIN	3560			Petrol pumps and filling stations
183			4224			Water wells
45			4225			Oil, gas and other wells
46			4231			Oil and gas tanks (fuel stores and gasholders)
57			4232			Tower-type capital constructions
186			4271			Sources (springs)
187			4272			Spring with facilities
188			4273			Geysers (hot springs)
76	UTILITY	LINE	4131			Communication lines
77			4132			Underground (subwater) communication cables
78			4265			Electro-transmission lines
81			4266			Ground oil pipelines
82			4267			Ground gas pipelines
85			Util. code	4270		Underground part of oil and gas pipelines
81			4276			Underground oil pipelines
82			4277			Underground gas pipelines

Table 6.1-3 Layer Specifications - Azerbaijan 1 : 50,000-Scale Map Automation

Symbol No.	Group	Type	Code No.	BD-Code	Attribute	Description
175			4286			Ground water pipelines
175			4287			Underground water pipelines
176			4288			Underground part of water pipelines
134	HYDRO-POLY	POLY	5103			Wide rivers (shore line)
129			5105			Lakes, ponds
129			5106			Permanent coastal lines
135			5113			Seasonal dry Rivers and Streams (Shore Line)
130			5115			Non-permanent and indefinite lakes, ponds
130			5116			Non-permanent coastal lines
			5124			Canals double lines (width= more than 0.7mm)
172			Hydro code	4290		Aqueducts
147			Hydro code	5108		Underground canals (shore line)
156			Hydro code	5219		Culverts
171			Hydro code	6105		Watercourses on the embankment
134	HYDRO-LIN	LINE	5101			Rivers single-lines
134			5102			Wide rivers (parallel lines)
135			5111			Seasonal dry rivers and streams (single line)
135			5112			Seasonal dry rivers and streams (parallel lines)
143			5121			Canals single-lines (line width: 0.15mm and 0.2mm)
145			5122			Canals double-lines and Single-lines
146			5123			Canals double-lines (width=0.7mm, parallel lines)
149			5125			Irrigation canals overhead (above ground)
148			5131			Canals under construction (single line)
148			5132			Canals under construction (shore line)
172			Hydro code	4290		Aqueducts
147			Hydro code	5107		Underground canals (single line)
147			Hydro code	5108		Undeground canals (parallel lines)
156			Hydro code	5219		Culverts
171			Hydro code	6105		Watercourses on the embankment
241	CARTO-LIN	LINE	2238			Narrow strips of forest and protective afforestation
256			2239			Lines of bushes
193			5209			Waterbreaks and moorages (true size)
165			5215			Revetments (along the canals)
166			5216			Concrete revetments (in the canal)
137			5226			Waterfalls (minimum size)
140			5241			Flow directions with velocity numbers
167			5257			Impassable dams (small)
167			5258			Impassable dams (large)

Table 6.1-4 Layer Specifications - Azerbaijan 1 : 50,000-Scale Map Automation

Symbol No.	Group	Type	Code No.	BD-Code	Attribute	Description
170			6101			Dikes (minimum size: less than 3m)
170			Road code	6101		Dikes with road (minimum size: less than 3m)
170			6102			Dikes (true size: more than 3m)
170			Road code	6102		Dikes with road (true size: more than 3m)
100			6108			Cuttings for railways or roads
87			6140			Ancient historical walls
88			6141			Stone, brick walls and metal fences
72	CARTO-PNT	POIN	4203			Permanent statues and monuments
244			4221			Independent trees (broad leaf)
244			4222			Independent trees (needle leaf)
59			4239			Watermills and saw mills
204			4241			Lights and signs
142			4252			Flow gauge stations (water gauge stations)
191			5220			Anchored stations and docks
192			5225			Equipped docks
225			7206			Cave and grotto entrances
226			7208			Muddy volcano craters
220			7209			Rock-Remains
221			7215			Stones 1) separately located stones;2) stone clusters
271	VEGE-POL	POLY	6337			Swamps
271			6338			Cane swamps
274			6339			Passable saline lakes (salt)
239			6360			Forests
253			6361			Dense bushes
265			6364			Tea plantations (bush type)
261			6366			Fruit and citrus gardens (orchards)
262			6367			Vineyards
			6380			Inner doughnut open or empty area
264	VEGE-PNT	POIN	6311			Water rice fields
267			6314			Cane and reed thickets
269			6334			Grass
253			6362			Shrubs
250			6363			Scattered trees
238	VEGE-LIN	LINE	6301			Vegetation boundaries
74	LANDUSE	POLY	6215		M/X/Q	Cemeteries (M=muslim, X=christian, Q=Mix)
74			6216		M/X/Q	Cemeteries with trees (M=muslim, X=christian, Q=Mix)
229-10		6235			Boundaries of glacier snows	
119		POIN	6211			Parking areas (minimum size)
11			6214			Separate yards with houses
213	CONTOUR	LINE	7101	3270	E	Index contour lines (Glacier, elevation)

Table 6.1-5 Layer Specifications - Azerbaijan 1 : 50,000-Scale Map Automation

Symbol No.	Group	Type	Code No.	BD-Code	Attribute	Description
213			7102	3270	E	Intermediate contour lines (Glacier, elevation)
201			7112			Isobaths
1	CONTROL	POIN	7301			Horizontal control points
5			7305			Horizontal control points (ground survey points)
7			7307			Vertical control points (bench marks)
215	SPOTHGT	POIN	7312			Spot heights of photogrammetry
219			7317			Passes (spot heights)
139			7318			Markings of water-level height
202			7319			Markings of water depth
40	LANDUSE	LINE	6231			Quarries (Symbol before 1982, black line symbol)
152	HYDRO-LIN	LINE	5141			Dry ditches (blue dash single line)
152			5142			Dry ditches (blue dash shore line)
279	LANDFORM	POLY	6348			Surfaces with hillocks (Symbol before 1982)
275			6349			Takhirs
348	ANNOTATION	Text	8174			Elevation values of ground control points (symbol No. 1, 2, 5, 6, 7)
349		Text	8174			Elevation values of photogrammetry (No. 215, 216, 217, 218, 219)
348-2		Text	8175			Water-level values of rivers and lakes (No. 139)
352-2		Text	8176			Contour values (numerical characters)
352-3		Text	8177			Depths of sea (symbol No. 202)
		Text	8178			Contour values of isobaths (numerical characters)
	Marginal Design	Line	9990			Neat line
		Point	9991			Cross mark (grid) points
		Text	9002			Map sheet number
		Line	9004			Geodetic coordinates number

CODE = Map Feature Codes; BD-CODE = Bridge/Dike Codes

6.4.2 Vector data acquisition 2 in Azerbaijan

Based on the raster data acquired in Azerbaijan in the First-Year Study, the work of creating the vector data on 1/50,000 scale maps was carried out in Azerbaijan covering the OJT area of about 12,000km^2. The work was carried out by a formation of counterpart in Azerbaijan, three operators are as follows:

Station 1: Mr. Latif Guseynov

Station 2: Mr. Yusif Akhadi

Station 3: Mr. Emil Bayramov

Chief of computer section: Mr. Goyushov Elkhan

Work materials: normalized raster data (positive films for black and blue plates) Existing 1/50,000 scale printed maps, index chart of printed maps, coordinates table of 9 cross-marks.

With regard to the digitizing of the existing 1/50,000 scale maps, the special attention was paid for Azerbaijani experts to enable the enough understanding particularly for the working methods, procedures, digital code numbers and standardization of each map symbol because they had the first experience for the work of digitizing at that time.

For their OJT, the materials of the working instructions, digital code numbers and standardization of each map symbols employed for work of Vector Data Acquisition 1 in Japan were used by translating from Japanese to Russian simplified versions. (See Progress Report 1)

(1) Work Procedure

Auto CAD Map software was employed for the digitizing of the map symbols on the existing 1/50,000 scale maps with normalized scanned data, i.e. raster image data on the background by headup digitizing method. Considering paper elasticity of the printed 1/50,000 scale maps, SCLC used the film positives instead of color printed maps for preparing the scanned data.

1) In order to improve efficiency and quality of the work, procedure of the data input was taken as follows:

a. Control Point

b. Map Neat Line with Coordinates

c. Numerical Characteristics

d. Line Object

e. Polygonal Object

f. Point Object

g. Other Cartographic Information

Details of the procedure are shown in the Technical Specifications of the Vector Data Acquisition.

2) Map symbols excluded from the present digitization

Following items from "a." to "f." were to be excluded prior to the digitization.

Item "g." was excluded due to the two reasons: 1;- large amount of secular changes, and 2;- bad condition of the black and white scanner belonging to SCLC and employed for the digitization. Data of these items will be inputted during the succeeding plotting of the secular changes by the photogrammetric mapping.

a. Regarding the brown objects, the vector data were not acquired because the raster data will be utilized to prepare the topographic maps (except sheet Nos. 1803, 2107 and 2116 have no brown plates).

Code numbers of brown objects: 5141, 5142, 5151, 5152, 5155, 6231, 6235, 6339, 6340, 6341, 7101, 7102, 7103, 7104, 7105, 7106, 7107, 7108, 7110, 7203, 7211, 7202, 8176.

b. Attribute data of control point and contour line elevation values were not inputted to prepare DEM.

c. Data of the water depth of the Caspian Sea was not inputted because the depth has been changed for about 1.5m. This will not be shown in the final vector data.

Code numbers of water depth of the Caspian Sea: 7319, 8177

Isobath values of the Caspian Sea: 7112, 8178

d. Data of cemeteries has been temporarily inputted with code numbers beginning with M. This may change depending on the result of field verification as following classification:

Attribute information of cemeteries: "M" for Muslim, "X" for Christian and "Q" for mixed.

e. Regarding annotation including the administrative names and geographical names, the next Study Team is preparing it as the digital data. That will be transferred when the symbolization is processed by Illustrator software.

Text for cartographic annotation : code No. from 8100 to 8137

f. Additional information of building classification symbols will be inputted depending on the result of field verification.

g. Polygonal vegetation symbols were not inputted because there were too many secular changes and input of the vegetation data from the film positives would be difficult.

Code numbers of polygonal vegetation symbols: 6337, 6338, 6339, 6340, 6361, 6364, 6363, and 6367.

(2) Quality Control

Creating the complete data by inputting the vector data only at once, which is a principle for quality control, was set as a goal. All works were carried out the following work procedures. Any problem found during the work of input were asked to report, to share by all staff not to repeat the same problems.

1) Quality Control during data input

a. Planimetric features at polygonal object

Whether or not planimetric features at polygonal object have correct code numbers, and are drawn circle by continuous lines, were inspected by coloring of each applied code number color.

b. Planimetric features at point and linear object

Planimetric features at point and line object first went through the symbolization process, then inspected that code numbers were correctly inputted, and linear planimetric features were inputted with continuous lines. Map symbols classified with code numbers for each feature, provided by such as blocking of CAD software prior to the work, were employed to inspect.

2) Visual Quality Control by Output Sheet

Regarding internal inspection of the final result, experts who have not taken part in input inspected the output by each sheet, in consideration that experts for computer operation were limited, then prepared 11 pages of accuracy control sheet as per attached as Annex 5. Method of quality control is also instructed.

With regard to the sheet No. 1704, the inspection was carried out based on the accuracy control sheet. As a result, matters on items above 1) b. were found to be missed. That was because that printed sheet for inspection and raster image for input had the different publishing years.

Details of the inspection result are as follows. (See attached four-page Quality Control Maps, Figure 6.3)

a. A line of linear planimetric feature, a railway, was not continuous.

b. Four roads by code No. 2113 were missed due to secular change.

c. One road by code No. 2116 was missed due to secular change.

d. Sixty-five roads by code No. 2117 were missed due to secular change.

e. Two single-line streams were missed. One part of them, code number was wrongly marked as code No. 5121KC.

f. Shape of a stream code No. 5103 is not quite correct at five parts in its width due to secular change.

g. One stream by code No. 5111 was missed.

h. Two streams by code No. 5112 were missed due to secular change.

i. Two culverts by code No. ****C were missed.

j. Two watercourses on the embankment by code No. ****K were missed.

k. Five power transmission lines by code No. 4265 were missed due to secular change.

l. Four parts by code no. 2238 and code No. 2239 were miswritten because those symbols on topographic maps were similar.

m. Three new revetment symbols by code No. 5216 were missed due to secular change.

n. Three steep mountainous areas by code No. 6108 were miswritten of code number due to misjudgment.

o. Two symbols of vegetation were missed due to secular change.

p. Polygonal vegetation symbols have not yet been inputted, and needs to be inputted later.

q. One cemetery by code No. 6215M was mistakenly inputted.

r. One built-up area by code No. 3012 was missed due to secular change.

s. One built-up area by code No. 3015 was missed.

t. Ten buildings of code No. 3001 were missed due to secular change.

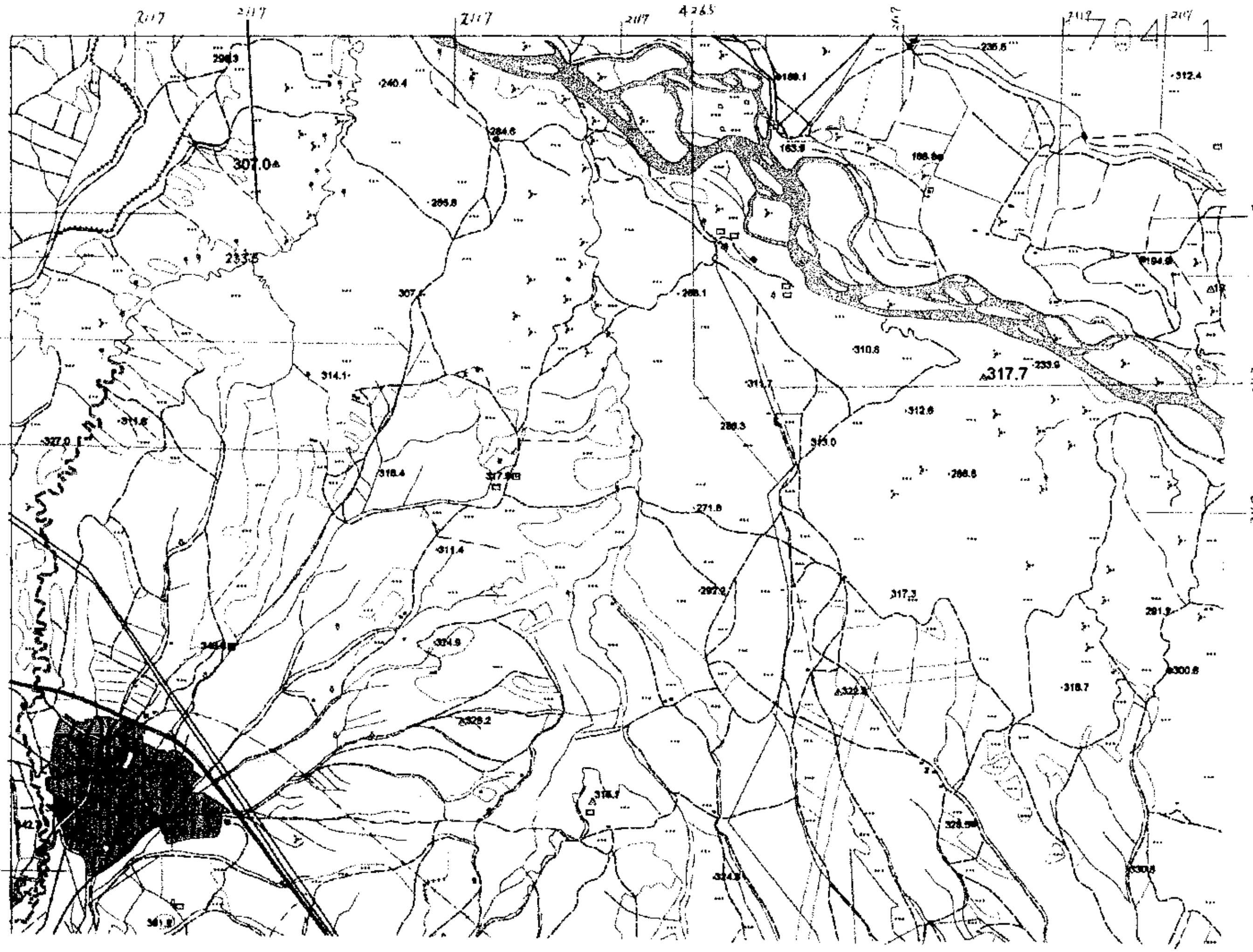
u. One transformer substation of code No. 3551 was missed due to secular change.

v. In order to provide DEM, elevation values of control points and contour lines as attribute items are needed to be inputted.

w. With regard to sheet No. 1803, No. 2107 and No. 2116, brown objects of planimetric and topographic features are needed to be inputted.

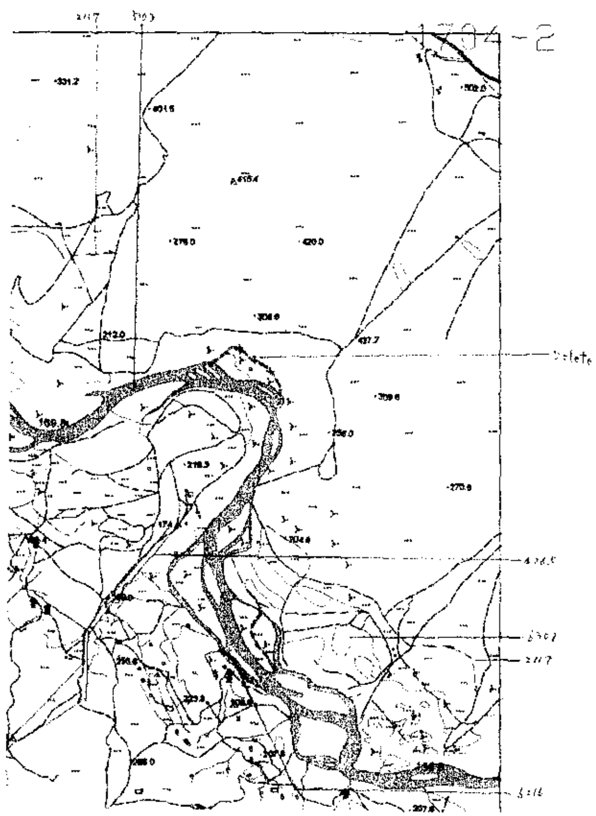
What was recommended on the quality control is that "respective checking division" would be established to visually check the outputs.

Figure 6.3-1 Quality Control Map of Vector Data Acquisition.



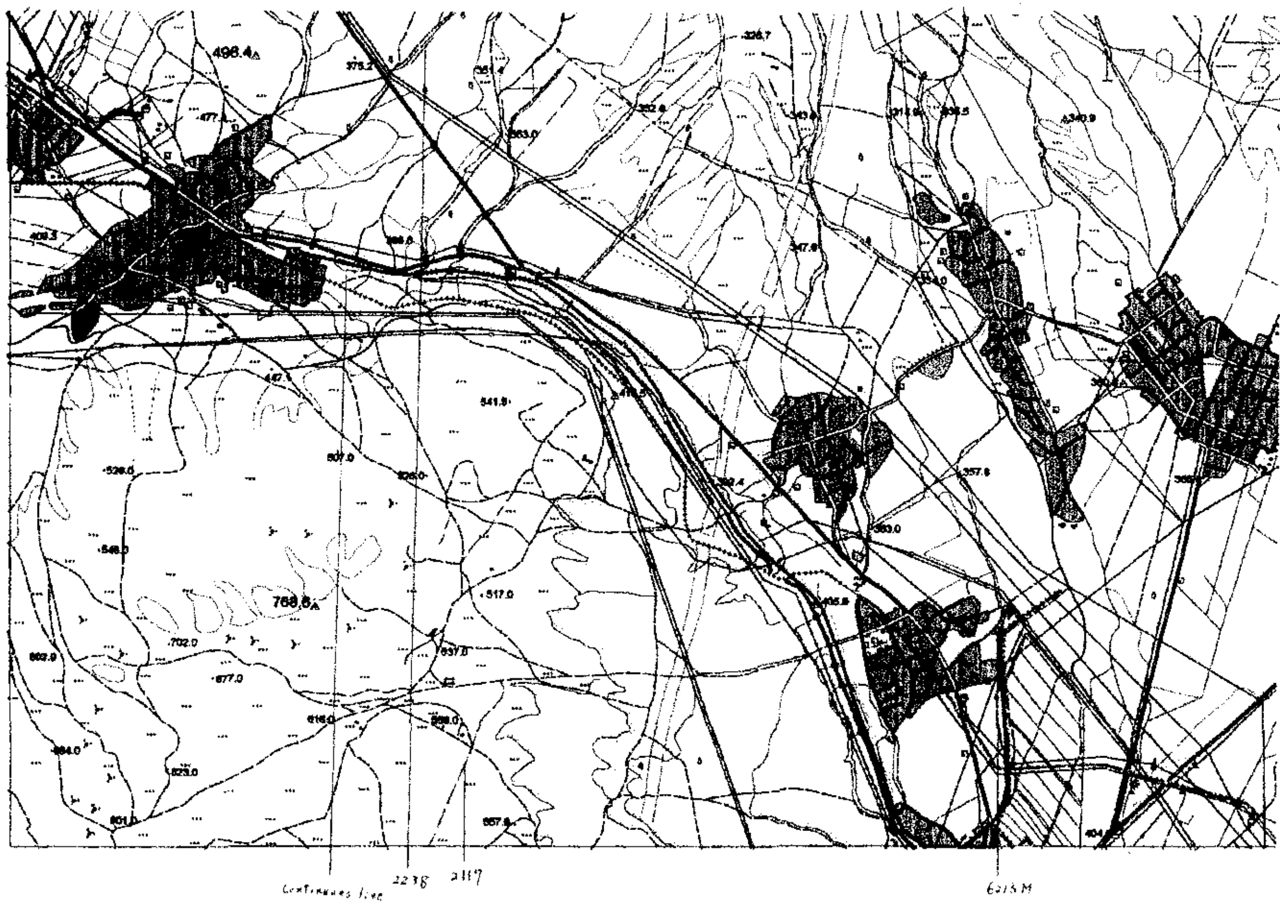
Sheet No. 1704-1

Figure 6.3-2 Quality Control Map of Vector Data Acquisition.



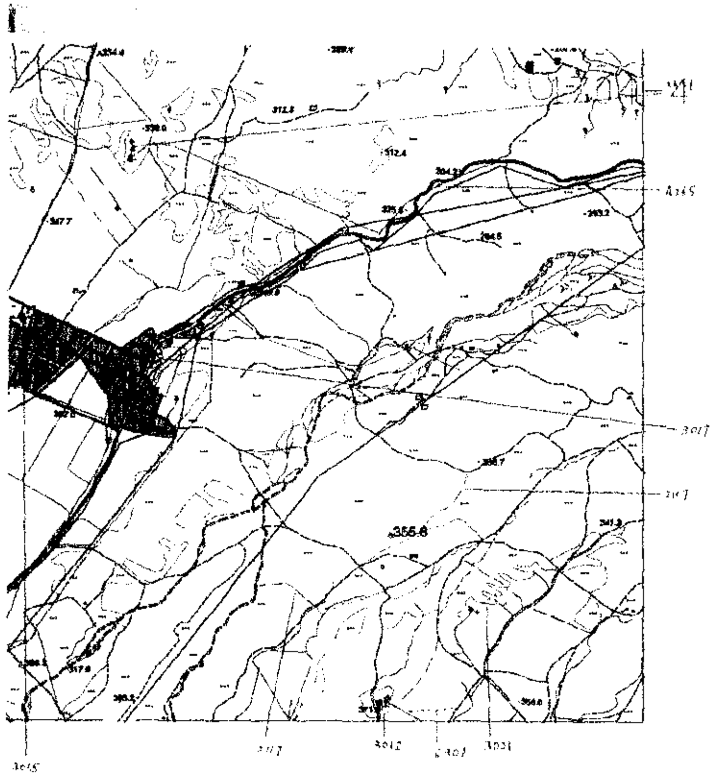
Sheet No. 1704-2

Figure 6.3-3 Quality Control Map of Vector Data Acquisition.



Sheet No. 1704-3

Figure 6.3-4 Quality Control Map of Vector Data Acquisition.



Sheet No. 1704-4

6.5 GPS Survey

GPS survey was executed to confirm the geodetic reference system of Azerbaijan. 23 points of the existing control points distributed widely on the project area were selected for the observation network (Figure 6.4-1). Observation was made simultaneously at four points in one session (Table 6.2-1). The calculated conversion parameter was used to decide local coordinates of the center position of the aerial-photographs, which had been taken in first phase.

(1) Equipment and Surveyor

Survey Team composed of four groups from the geodetic section in SCLC had executed observation using 2 sets of LEICA 200 Geodetic GPS receivers and 2 sets of LEICA 300 Geodetic GPS receivers.

(2) Base line processing and accuracy

After the observation had been completed, the primary processing for the decision of base line in all sessions was done (Figure 6.4-2). The processing result had been satisfactory enough within 1ppm more than the provided accuracy in all the stations (Figure 6.4-3 & Table 6.2-2).

(3) Network Adjustment

After the processing of the base line, the network adjustment, which included all points, was executed. Station Kechaldag was fixed as a reference point for the network adjustment.

(4) Calculation of 7-Parameter

The 7 parameter shift values for datum transformation was computed by using the KENQ7PRM program developed by Dr. K. Harada who was an engineering advisor of PASCO.

For this computation, coordinate values for 23 points of the WGS84 system processed by the network adjustment software and the local coordinate values at the same points prepared by SCLC were used as input data. A result of processing output is attached as Annex 3.

The computed 7 parameters shift values from WGS84 system to Local system are as follows.

dX= -37.05185	dY= 109.76625	dZ= 64.30513
RX= -0.25409	RY= -0.53506	RZ= -0.36370
Scale= 1.00000420061		

(5) Coordinates Transformation

The coordinate transformation from the WGS-84 system photo center point coordinates, which were captured by using the Airborne-Kinematics GPS technique in the first phase, to the local system was executed by using Trimble GPSurvey V.2.2 software application with the calculated 7 parameters (Figure 6.4-6.).

Figure 6.4-1 GPS Station Location Map

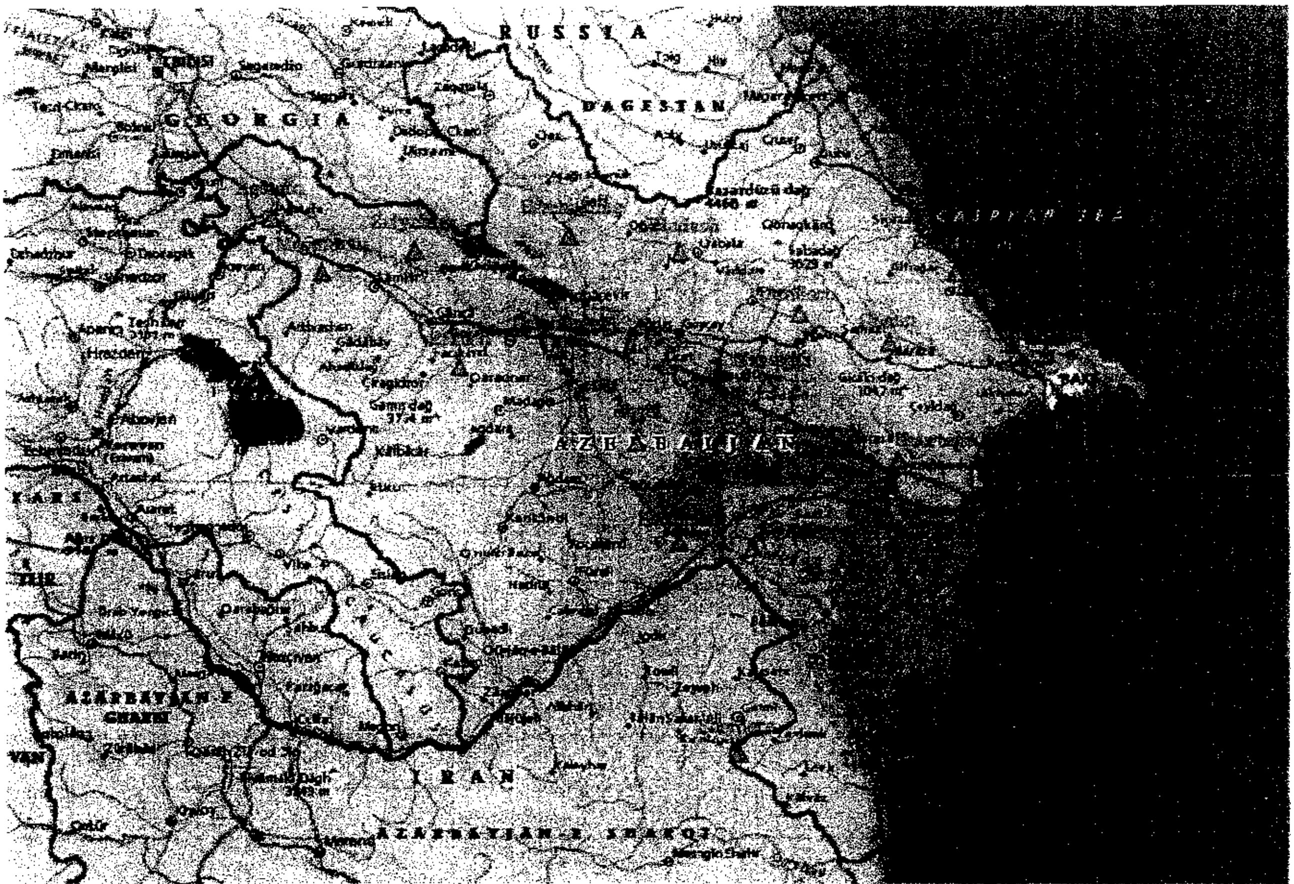


Figure 6.4-2 GPS Observation and Base-Line Processing Diagram

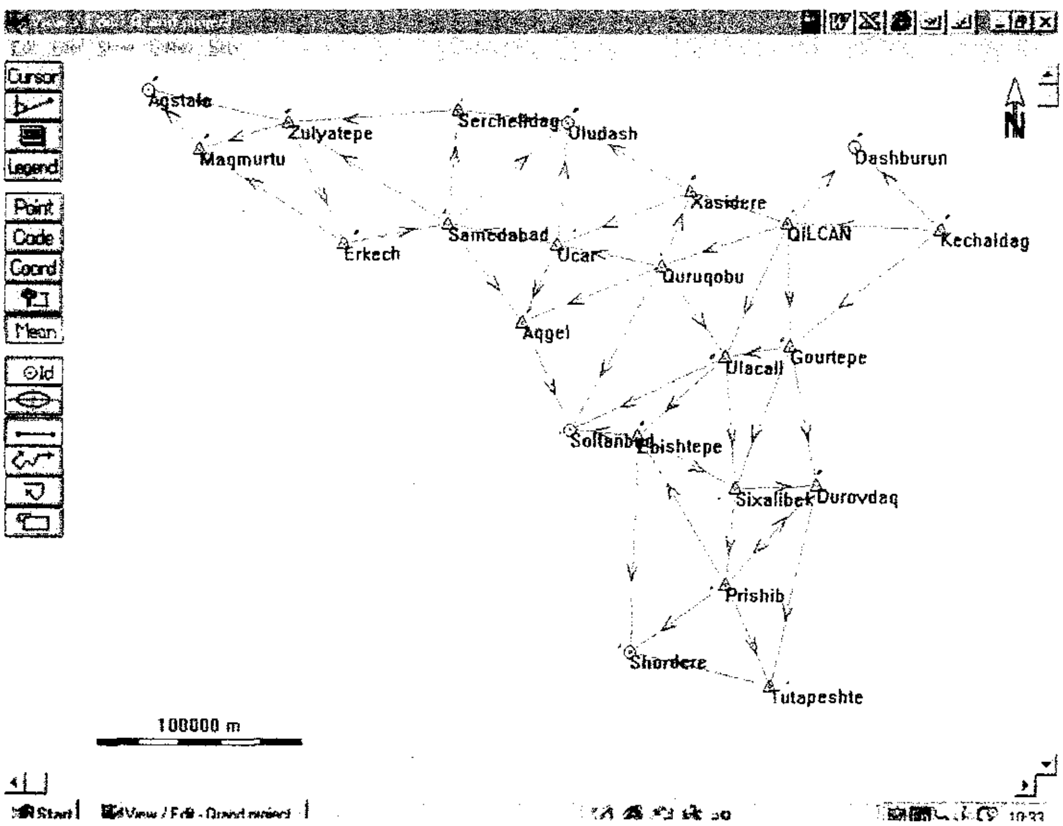


Figure 6.4-3 Ellipsoid Height Separation between WGS84 datum and 42-il datum

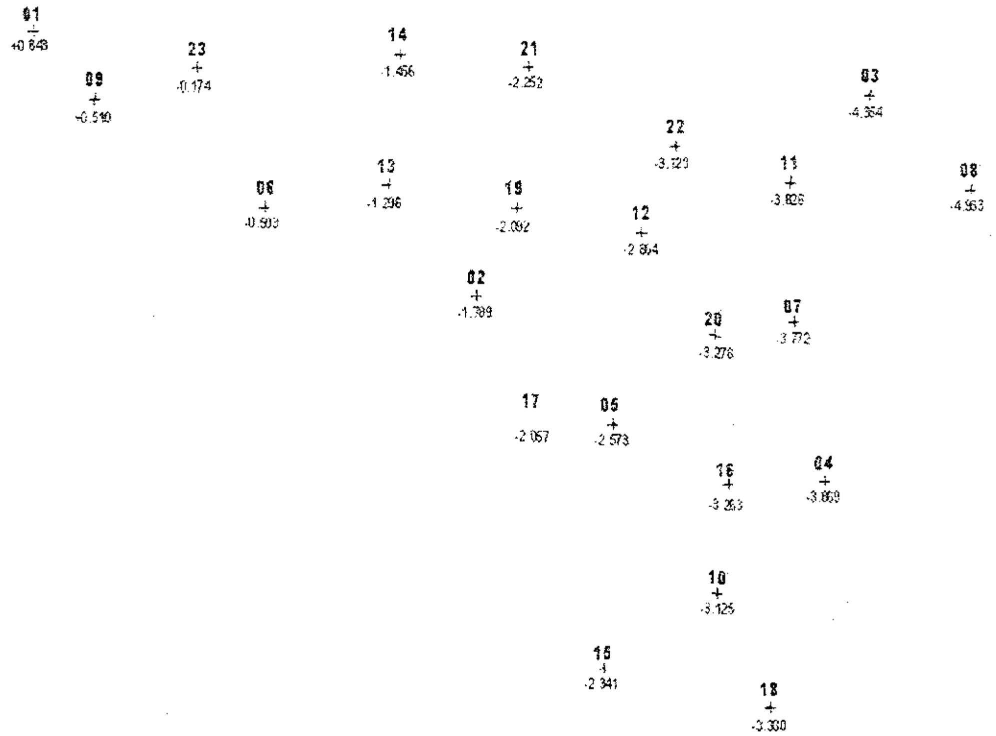


Figure 6.4-4 Geoid Height Difference between Ellipsoid Height and Ortho Height

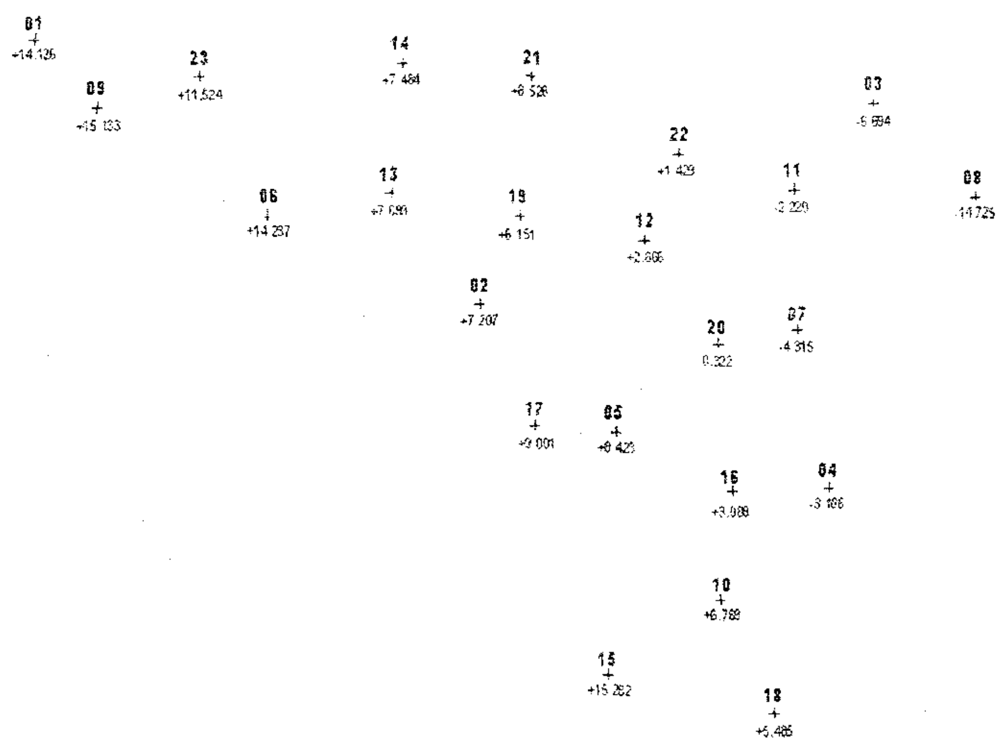


Table 6.2-1 Observation Session

Session No.	Station Combination			
	1	2	3	4
1	Kechaldag	Dashburun	Qlican	Gourtepe
2	Ulacali	Quruqobu	Qlican	Gourtepe
3	Ucar	Quruqobu	Qlican	Xasidere
4	Ucar	Samedabad	Uludash	Xasidere
5	Zulyatepe	Samedabad	Uludash	Serchelidag
6	Zulyatepe	Samedabad	Maqmurtu	Erkech
7	Zulyatepe	Agstafa	Maqmurtu	
8	Ucar	Samedabad	Quruqobu	Aqgel
9	Ulacali	Soltanbud	Quruqobu	Aqgel
10	Ulacali	Soltanbud	Ebishtepe	Sixalibek
11	Prishib	Durovdaq	Sixalibek	Gourtepe
12	Prishib	Durovdaq	Tutapeshte	
13	Prishib	Shordere	Ebishtepe	Tutapeshte

Figure 6.4-5 Summary of Closing Error Check

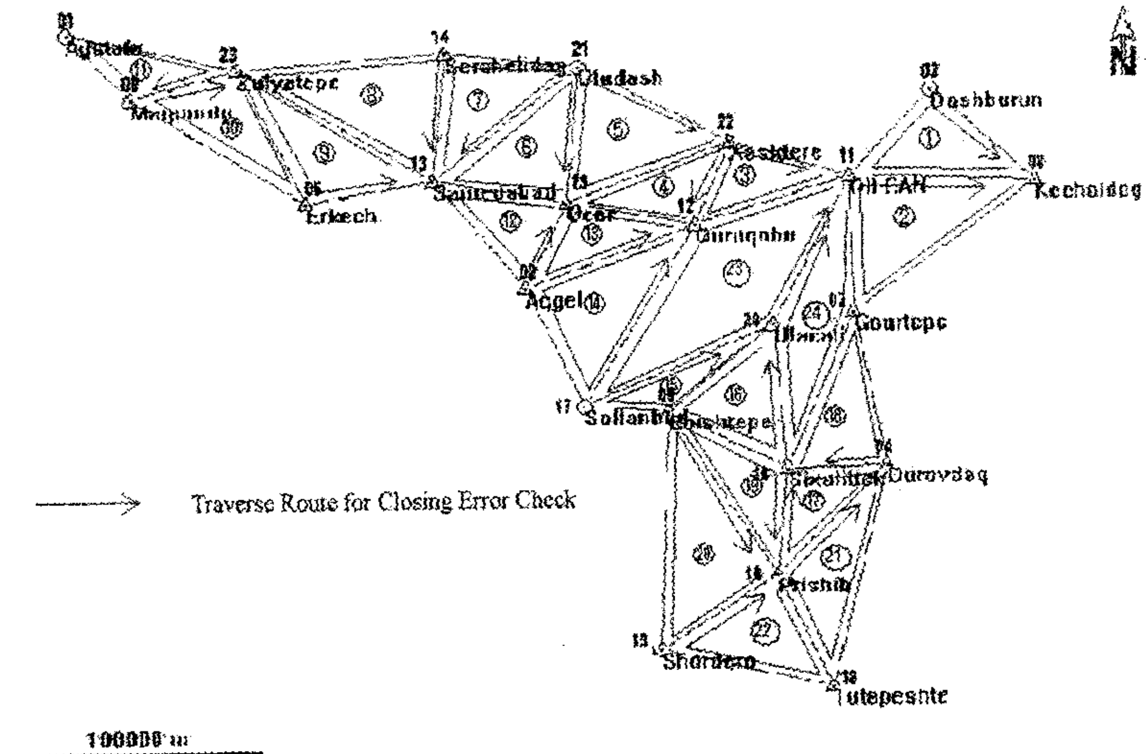


Table 6.2-2 Values of closing error (Cartesian Coordinates)

Loop No.	error X	error Y	error Z	Slope Distance	Closure Error (PPM)	dH
1	-0.0014	0.0025	0.0013	171972.3635	0.018	0.0016
2	0.0194	-0.0073	0.0064	214458.0071	0.101	0.0097
3	0.0068	-0.0814	-0.0357	146478.2710	0.609	-0.0660
4	0.0857	0.0975	0.0560	154457.8308	0.915	0.1354
5	0.0897	0.1139	0.0549	188675.3301	0.822	0.1452
6	0.0650	0.0117	0.0477	179008.0698	0.455	0.0709
7	0.0090	-0.0002	-0.0015	174266.0263	0.052	0.0035
8	-0.0064	-0.0018	-0.0010	217856.9313	0.031	-0.0050
9	0.0030	-0.0334	0.0383	196949.2085	0.258	0.0079
10	0.0018	0.0035	0.0016	183216.2739	0.023	0.0038
11	0.0259	0.0208	0.0097	144675.9524	0.239	0.0313
12	0.0030	0.0201	-0.0287	146497.4003	0.240	-0.0056
13	-0.0382	-0.0351	-0.0191	158581.3725	0.349	-0.0519
14	-0.0125	-0.0373	-0.0497	208995.2080	0.303	-0.0594
15	-0.0470	-0.0673	-0.0569	167931.1532	0.595	-0.0989
16	-0.0130	0.0030	-0.0051	165118.9603	0.087	-0.0081
17	-0.0044	0.0033	0.0021	143653.2094	0.041	0.0010
18	0.0093	-0.0001	-0.0008	170728.2394	0.055	0.0041
19	0.0546	-0.0007	0.0371	174002.0977	0.379	0.0514
20	0.0294	0.0608	0.0097	231364.6253	0.295	0.0567
21	-0.0439	0.0342	0.0066	205768.4040	0.272	0.0021
22	-0.0247	0.0151	-0.0033	176014.2364	0.166	-0.0059
23	0.0018	0.0628	0.0266	296194.8242	0.230	0.0536
24	-0.0999	0.0756	-0.0179	250617.3312	0.505	-0.0180

Table 6.2-3 Coordinates from GPS Observation (WGS84)

Station Name		Geodetic			Cartesian			Remarks
		Latitude (N)	Longitude (E)	Ellip.Height	X	Y	Z	
01	Agstafa	41 6 42.967151	45 25 3.405397	366.4867	3378200.2280	3427808.1622	4172037.9816	Adjusted
02	Aqgel	40 10 19.778829	47 29 7.506589	1.9178	3298065.7278	3597368.7164	4092612.1045	Adjusted
03	Dashburun	40 53 2.056287	49 19 19.215729	72.8855	3147638.6364	3662311.5800	4152732.0798	Adjusted
04	Durovdaq	39 30 43.595233	49 6 34.305231	-4.2802	3225515.9018	3724889.0432	4036338.1482	Adjusted
05	Ebishtepe	39 42 48.468583	48 7 29.530853	13.1503	3279545.0469	3658305.9588	4053571.4769	Adjusted
06	Erkech	40 29 17.944062	46 29 44.146391	1277.1339	3344743.9969	3524082.2398	4120202.6081	Adjusted
07	Gourtepe	40 4 27.375705	48 58 11.063302	127.8157	3208436.4594	3686949.4087	4084381.7659	Adjusted
08	Kechaldag	40 32 54.55127	49 47 37.478240	114.5140	3133084.3427	3706683.6223	4124527.0057	**Fixed**
09	Maqmurtu	40 52 22.785205	45 41 49.646378	1187.7425	3374029.5519	3457149.3518	4152545.6595	Adjusted
10	Prishib	39 6 47.316842	48 36 46.681869	9.4804	3276236.8920	3717857.1859	4002076.7748	Adjusted
11	Qlican	40 34 31.265819	48 57 15.819695	1070.7924	3186250.0323	3659474.3947	4127415.4436	Adjusted
12	Quruqobu	40 24 3.830986	48 15 10.207061	22.8975	3238655.6963	3628968.6082	4112014.6307	Adjusted
13	Samedabad	40 34 12.702645	47 4 4.427594	56.9026	3304720.8368	3552309.5718	4126321.0218	Adjusted
14	Serchelidag	41 1 48.655008	47 7 38.547102	760.8279	3278683.2912	3531665.6623	4165451.7314	Adjusted
15	Shordere	38 50 20.590144	48 4 46.114737	1796.6875	3324428.9238	3702467.6281	3979542.4498	Adjusted
16	Sixalibek	39 30 12.089703	48 39 42.597765	-18.1855	3254923.7925	3700028.1814	4035579.6446	Adjusted
17	Soltanbud	39 44 8.575598	47 44 30.833888	58.5440	3302885.7910	3635160.7591	4055500.7146	Adjusted
18	Tutapeshte	38 41 45.461158	48 51 33.046138	-9.3814	3279356.3674	3753794.6736	3966024.6109	Adjusted
19	Ucar	40 29 7.052396	47 40 6.080430	13.7591	3271415.5150	3591252.1401	4119126.7912	Adjusted
20	Ulacali	40 2 4.480238	48 36 9.717184	-18.2213	3233790.9201	3668364.1605	4080914.2190	Adjusted
21	Uludash	40 58 49.670809	47 43 43.441363	616.3741	3243799.8032	3568482.9260	4161189.8100	Adjusted
22	Xasidere	40 42 9.240663	48 24 58.356440	867.8665	3214272.9639	3622386.4627	4138004.7782	Adjusted
23	Zulyatepe	40 58 44.309204	46 11 11.607979	318.9602	3338582.3627	3479806.8931	4160869.8950	Adjusted

Table 6.2-4 Coordinates form Catalog (42-il system, Krassovsky Ellipsoid)

Station Name		Geodetic			Cartesian			Ortho Height
		Latitude (N)	Longitude (E)	Ellip.Height	X	Y	Z	
01	Agstafa	41 6 43.14291	45 25 7.72363	365.6437	3378182.1446	3427933.1447	4172115.2715	351.5180
02	Aqgel	40 10 19.93232	47 29 11.68361	3.7068	3298046.8028	3597494.3677	4092689.4775	-3.5000
03	Dashburun	40 53 2.15010	49 19 23.34273	77.2395	3147619.1209	3662437.1649	4152810.1754	83.9330
04	Durovdaq	39 30 43.73216	49 6 38.37863	-0.4112	3225496.3013	3725015.1717	4036415.6304	2.6950
05	Ebishtepe	39 42 48.62693	48 7 33.65954	15.7233	3279525.8358	3658431.8820	4053648.8095	7.3000
06	Erkech	40 29 18.11136	46 29 48.38337	1277.6369	3344725.4690	3524207.6319	4120279.8859	1263.4000
07	Gourtepe	40 4 27.50885	48 58 15.17430	131.5877	3208416.9788	3687075.2888	4084459.4476	135.9030
08	Kechaldag	40 32 54.64818	49 47 41.58080	119.4470	3133064.6150	3706809.4029	4124605.0755	134.1720
09	Maqmurtu	40 52 22.96404	45 41 53.93666	1187.2325	3374011.3489	3457274.4746	4152622.9149	1172.1000
10	Prishib	39 6 47.49472	48 36 50.75790	12.6054	3276217.4285	3717983.4168	4002153.9728	5.8360
11	Qlican	40 34 31.38140	48 57 19.95026	1074.6184	3186230.6186	3659600.0672	4127493.3298	1076.8380
12	Quruqobu	40 24 3.96121	48 15 14.36030	25.7615	3238636.5167	3629094.2640	4112092.2785	22.8960
13	Samedabad	40 34 12.84933	47 4 8.63955	58.1986	3304702.1068	3552435.0045	4126398.4640	50.5000
14	Serchelidag	41 1 48.78403	47 7 42.78184	762.2839	3278664.5897	3531790.9140	4165529.3797	754.8000
15	Shordere	38 50 20.81733	48 4 50.20544	1799.0285	3324409.6310	3702593.9070	3979619.4093	1783.7470
16	Sixalibek	39 30 12.24703	48 39 46.69434	-14.9225	3254904.3573	3700154.2583	4035657.0164	-18.0100
17	Soltanbud	39 44 8.73572	47 44 34.98289	60.6010	3302866.7236	3635286.6238	4055577.9661	51.6000
18	Tutapeshte	38 41 45.65392	48 51 37.07895	-6.0014	3279336.7596	3753921.1050	3966101.6934	-11.4860
19	Ucar	40 29 7.18787	47 40 10.26455	15.8511	3271396.5576	3591377.6861	4119204.3372	9.7000
20	Ulacali	40 2 4.61701	48 36 13.84268	-14.9433	3233771.5696	3668490.0114	4080991.7970	-15.2650
21	Uludash	40 58 49.78594	47 43 47.64654	618.6261	3243780.8793	3568608.2762	4161267.5767	610.1000
22	Xasidere	40 42 9.34273	48 25 2.51436	870.9955	3214253.7606	3622512.0158	4138082.5904	869.5670
23	Zulyatepe	40 58 44.47094	46 11 15.88905	319.1342	3338563.9923	3479932.0379	4160947.3049	307.6100

Table 6.2-5 Transformed Coordinates using computed 7 parameters

Shift values to WGS84 system

DX= +37.05185m, dY=-109.76625m, dZ=-64.30513m, RX=0.25409", RY=0.53506", RZ=0.36370", Scale=0.99999579939

Station Name	Geodetic Coordinates			Cartesian Coordinates		
	Latitude (N)	Longitude (E)	Ellip.Height	X	Y	Z
01 Agstafa	41 6 43.1411271	45 25 7.7172832	365.646	3378182.0125	3427933.2218	4172115.3114
02 Aqgel	40 10 19.9396178	47 29 11.684822	3.706	3298046.9225	3597494.4559	4092689.3060
03 Dashburun	40 53 2.1326216	49 19 23.3441769	77.235	3147618.9188	3662436.8776	4152810.5860
04 Durovdaq	39 30 43.7450865	49 6 38.3817297	-0.413	3225496.5243	3725015.3161	4036415.3239
05 Ebishtepe	39 42 48.6344187	48 7 33.6601718	15.723	3279525.9456	3658431.9820	4053648.6320
06 Erkech	40 29 18.1168593	46 29 48.381442	1277.643	3344725.5087	3524207.7398	4120279.7529
07 Gourtepe	40 4 27.5014655	48 58 15.170817	131.586	3208416.8212	3687075.2333	4084459.6229
08 Kechaldag	40 32 54.6316944	49 47 41.5692402	119.443	3133064.1957	3706809.3282	4124605.4646
09 Maqmurtu	40 52 22.9623151	45 41 53.9340568	1187.239	3374011.2273	3457274.5378	4152622.9508
10 Prishib	39 6 47.4992147	48 36 50.7634338	12.606	3276217.5856	3717983.3941	4002153.8650
11 Qlican	40 34 31.3672453	48 57 19.9500817	1074.620	3186230.4281	3659599.8549	4127493.6604
12 Quruqobu	40 24 3.9598928	48 15 14.3618621	25.759	3238636.5279	3629094.2212	4112092.3111
13 Samedabad	40 34 12.8557492	47 4 8.6426561	58.198	3304702.2484	3552435.0493	4126398.3140
14 Serchelidag	41 1 48.7843943	47 7 42.7812173	762.285	3278664.5835	3531790.9286	4165529.3706
15 Shordere	38 50 20.7996067	48 4 50.2069254	1799.038	3324409.4238	3702593.6224	3979619.8291
16 Sixalibek	39 30 12.2516602	48 39 46.6939989	-14.924	3254904.4119	3700154.3327	4035656.9072
17 Soltanbud	39 44 8.7505495	47 44 34.9810105	60.601	3302866.8871	3635286.8703	4055577.6143
18 Tutapeshte	38 41 45.6577095	48 51 37.0992576	-6.000	3279337.1766	3753920.8363	3966101.6013
19 Ucar	40 29 7.1930905	47 40 10.2651696	15.849	3271396.6399	3591377.7548	4119204.2161
20 Ulacali	40 2 4.6176931	48 36 13.8395957	-14.950	3233771.5271	3668490.0736	4080991.7852
21 Uludash	40 58 49.7858752	47 43 47.6465378	618.628	3243780.8775	3568608.2742	4161267.5769
22 Xasidere	40 42 9.3503854	48 25 2.5173573	870.996	3214253.9154	3622512.0840	4138082.4109
23 Zulyatepe	40 58 44.4675052	46 11 15.8806946	319.138	3338563.8012	3479932.1211	4160947.3823

Table 6.2-6 *Discrepancy of Horizontal and Vertical Distance after Transformation*

	Station	From Catalog (Original)			Plane Grid Coordinates Transformation using 7 parameters					
		N	E	Ellip. Height	N	E	Ellip. Height	dN	dE	dH
Zone 8	1 Agstafa			365.644	4553174.64	8535177.61	365.65	0.06	0.15	0.00
	2 Aqgel			3.707	4451694.83	8711819.05	3.71	-0.23	-0.02	0.00
	6 Erkech			1277.637	4484912.52	8626904.40	1277.64	-0.17	0.05	-0.01
	9 Maqmurtu			1187.233	4526789.38	8558866.65	1187.24	0.05	0.13	-0.01
	13 Samedabad			58.199	4494985.82	8675216.04	58.20	-0.20	-0.07	0.00
	14 Serchelidag			762.284	4546192.81	8679012.93	762.29	-0.01	0.01	0.00
	17 Soltanbud			60.601	4403868.16	8735160.55	60.60	-0.46	0.06	0.00
	19 Ucar			15.851	4486924.13	8726355.16	15.85	-0.16	-0.01	0.00
	21 Uludash			618.626	4542078.64	8729764.65	618.63	0.00	0.00	0.00
	23 Zulyalepe			319.134	4539003.00	8599965.49	319.14	0.11	0.19	0.00
Zone 9	3 Dashburun			77.240	4529116.85	9358665.50	77.24	0.54	-0.02	0.00
	4 Durovdaq			-0.411	4377145.49	9337511.45	-0.41	-0.40	-0.08	0.00
	5 Ebishtepe			15.723	4401748.68	9253533.62	15.72	-0.23	-0.02	0.00
	7 Gourtepe			131.588	4439831.78	9326904.48	131.59	0.23	0.09	0.00
	8 Kechaldag			119.447	4491212.78	9397915.43	119.44	0.50	0.28	0.00
	10 Prishib			12.605	4333858.55	9293632.11	12.61	-0.13	-0.14	0.00
	11 Qilican			1074.618	4495508.21	9326881.35	1074.62	0.44	0.01	0.00
	12 Quruqobu			25.762	4477768.09	9266867.00	25.76	0.04	-0.04	0.00
	15 Shordere			1799.029	4304771.25	9246504.39	1799.04	0.55	-0.02	-0.01
	16 Sixalibek			-14.943	4377078.05	9298979.80	-14.92	-0.14	0.00	-0.02
	18 Tutapeshte			-6.001	4287007.48	9313842.79	-6.00	-0.11	-0.49	0.00
	20 Ulacali			-14.923	4436202.92	9295472.56	-14.95	-0.02	0.07	0.03
	22 Xasidere			870.996	4510835.45	9281721.01	871.00	-0.23	-0.08	0.00

Figure 6.4-6 Seven parameter coordinate transformation by Trimble GPSurvey V..2.2