3 DISCUSSIONS BETWEEN THE BIH SIDE AND THE STUDY TEAM

The Team visited BiH in March 2003 to start the first phase of the Study. The first meeting of the Coordinating Committee was held in Sarajevo on March 12, where the Team gave a briefing to the meeting on the four - year study project and presented the Inception Report to explain the details. More meetings were held on March 13, 18, 19, 21, 24 and 27 to discuss the basic matters and finalize the minutes of meetings. (Minutes of Meetings 2)

On the other hand, detailed discussions about topographic map features to be included in the new topographic maps for the Principal 21 Cities started on March 25. After the BiH side determined the items of topographic map feature, several technical meetings were held for discussing detailed matters, such as definitions of each feature, specifications for data acquisition and specifications for map symbols, and these matters were finalized before aerial photo - interpretation and field identification began. At the same time, layer specifications for the GIS data were discussed.

At the start of the second phase in September 2003, a Coordinating Committee meeting was held to discuss additional matters. Both sides signed the minutes of meetings on these matters, i.e. specifications of map symbols and marginal information, layer specifications for the GIS data, and specifications of the equipment for technology transfer sessions. (Minutes of Meetings 3) The layer specifications for the GIS data are compiled in the specifications' section is in this volume.

In the end of the second phase in February 2004, a Coordinating Committee meeting was held, where the Team presented the Interim Report to explain details of the works carried out during the first and the second phases and discussed implementation for the next phases. Main subjects were such as installation of the equipment for technology transfer sessions in BiH, presentation of national boundaries on the new maps, provision of the position data of public facilities from the BiH side, and selection of new map sheets to be offset - printed as final products. After the meeting, both sides had a technical meeting on the specifications of map symbols and letters for the new maps. (Minutes of Meetings 4)

During the technology transfer sessions in the third phase, May 2004, the Team had some discussions with the BiH side about implementation of the succeeding works.

In the process of field completion from September to October 2004, the Team found several problems especially on specifications of topographic map features and geographic names. So both sides discussed to find solutions and agreed upon. (Minutes of Meetings 5)

In the end of the third phase in January 2005, a Coordinating Committee meeting was held, where the Team presented the Progress Report to explain the details of the works carried out during the third phase and discussed implementation for the final phase of the Study. Main subject was preparation of the Seminar in BiH in the last stage of this project. (Minutes of Meetings 6)

In the end of the forth (final) phase in September 2005, a meeting of the Coordinating Committee was held, where the Team presented the Draft Final Report explaining the achievement of the Study and presenting recommendations to the Government of BiH on the future data updating and servicing. (Minutes of Meeting 7)

Principal matters discussed at the above meetings are described below.

(1) Ellipsoid and Projection

In accordance with suggestion of the JICA preparatory study team, the Team presented a proposal to the BiH side that the digital topographic mapping for the Principal 21 Cities would be based on WGS - 84 and UTM. The BiH side conditionally agreed on the proposal but requested that the paper map sheets to be printed would be based on Bessel and Gauss - Kruger because of the regulation of BiH. After a discussion, the Team accepted it on the condition that additional gridlines and coordinate values of UTM would be printed in a different color for user's convenience. (Minutes of Meetings 2)

(2) Mapping Areas

The Team presented a plan that the mapping areas of the Principal 21 Cities would be those given in the scope of work agreement in 2002. The BiH side, however, requested the Team to make small changes of mapping areas by shifting from viewpoint of giving priority to more important areas. The Team accepted the request on the condition that the map sheets to be printed would be based on the exiting sheet line system. As a result, some paper map sheets will be partly blank. The mapping areas accepted are given in Figure 1 - 1. (Minutes of Meetings 2)

A new JICA project the "Study on Sustainable Development through Eco - Tourism in Bosnia and Herzegovina" was agreed between the government of Japan and the government of Bosnia and Herzegovina, and the scope of work was signed in August 2003. The eco - tourism areas are the catchments of the Pliva River and the Velez Mountain range area. The study requires new topographic maps based on the aerial photos taken in 2003. Therefore, it was agreed on between the BiH side and the Team that an additional topographic mapping at a scale of 1:25,000 should be done. The work started in September 2003. The Federal Administration for Geodetic and Real Property Affairs in the Federation Bosnia and Herzegovina; and the Administration for Geodetic and Real Property Affairs, the Republic of Srpska have cooperated in the control point survey,

aerial photo interpretation, field identification and field completion. The work, equivalent to ten map sheets, for the eco - tourism study ended at the end of March 2004. (Minutes of Meetings 2)

(3) Control Point Survey

The Team presented a proposal that GPS observation would be performed in order to set new points as the ground control points instead of using existing points. The Team explained that this method is effective enough for the mapping and more efficient and more economical than conventional ones and it can keep the surveyors from mine risk. The BiH side, however, requested the Team to set up aerial signals at existing points as ground control points. After discussion, the Team accepted the strong request on the condition that, where no suitable existing point is available, a new point should be established by GPS observation.

The Team also presented a plan that leveling would be performed for vertical control where necessary. But, the BiH side suggested that, since a lot of existing points with elevation data are available in the mapping areas, new leveling is not necessarily needed and promised to provide the Team with these data. The Team accepted the suggestion. (Minutes of Meetings 2)

(4) Topographic Map Features

So many items of topographic map features are included in the existing 1:25,000 topographic maps made under the regime of the former Socialist Federal Republic of Yugoslavia. Many of these items do not meet the current condition of BiH. Based on the existing items, both sides discussed reorganizing the content items for the new topographic maps from a standpoint of meeting the current needs. As a result, the total number of items has been reduced from 356 to 286. (Minutes of Meetings 3)

(5) Specifications of the OJT Equipment

Recently GIS technology has been introduced to the Ministries concerned and some other institutions in BiH. The BiH side mentions that the Ministry of Civil Affairs, Federal Admini - stration for Geodetic and Real Property Affairs, Federation of BiH, Republic Administration for Geodetic and Real Property Affairs, Republic of Srpska, and Public Records Department of the Government of Brcko District have full of responsibility to other Ministries concerned as topographic and related data supplier. The BiH side also mentions that Arc/Info has been the prevailing GIS software over these data users. Taking account of the reasons, the BiH side has an opinion that this software is the most preferable for the Study and the future undertakings, and requested the Team to transfer the technology of digital mapping through OJT using this software. In response to the request, the Team proposed a design of the system for digital photogrammetry, digital plotting and editing, digital map symbolization and GIS. The BiH side accepted it. (Minutes of Meetings 3)

(6) National Boundaries

In the early stage of the project, it was the Team's understanding that national boundaries would not be presented on the new maps. But at the meeting, the BiH side proposed that the boundaries should be presented and the Team accepted it. The BiH side agreed to provide the Team with the boundary data. It was also confirmed that, if the BiH National Boundary Commission makes a specific instruction, the mapping mission should follow it. (The data were delivered to the Team in March 2004, which are image data of boundaries manually drawn on the existing 1:25,000 scale topographic maps.) (Minutes of Meetings 4)

(7) Mapping Area across the National Boundaries

For the map sheets in which BiH shares the boundary with neighboring countries, it is necessary to define how far to present neighboring territories. It is foreseen that a map sheet whose presentation is restricted to the boundary would be inconvenient for map users. So it was confirmed by both sides that, in case of a section of boundary that is defined by a river course, map presentation should cover the water surface as far as the opposite shoreline. In case of a section that is not defined by rivers, the presentation should cover as far as about two centimeters beyond the boundary on the map. (Minutes of Meetings 4)

(8) Map Sheets to be Printed

A total of fifty - eight (58) sheets for the Principal 21 Cities had been mapped through the processes of photo interpretation, field identification and digital plotting. According to the original plan, forty - seven (47) map sheets are to be printed in the last phase of this project and delivered to BiH accompanied with the plate films. The rest (11 sheets) are to be delivered to BiH only in the form of data. So the BiH side selected the map sheets to be printed and gave the sheet number list to the Team. (Minutes of Meetings 4) After the selection, additional ten map sheets for the Eco - tourism Study areas were specified to be printed.

(9) Map Sheet Names and Geographic Names

It was foreseen that some sheet names should be renamed for the new maps due to change of geographic names, etc. So the BiH side promised to provide these names to the Team by September 2004. (Minutes of Meetings 4 and Minutes of Meetings 6)

(10) Position Data of Public Facilities

Public facilities such as power lines, gas pipelines, water pipelines and radio wave towers were foreseen to have changed since the last topographic mapping of the former Yugoslavia. For presenting up - to - date information on the new maps, the BiH side agreed to provide the Team with new authorized position data of those by September 2004. (Minutes of Meetings 4)

(11) Specifications of Map Symbols and Letters

Specifications of map symbols and letters for the new maps were agreed as shown in the Interim Report. But, various unforeseen problems are much likely to happen during digital plotting, symbolization and field completion processes. So it was also agreed that if some improvement is needed during the succeeding processes, both sides should discuss amendment. (Several modifications, additions and cancellations were made during those processes. Those are described later in Chapter 4. (Minutes of Meetings 4)

(12) Marginal Information

According to the agreement between both sides, the Team prepared a sample sheet showing the layout of marginal information of the new maps and presented the BiH side at the meeting. This layout was adopted with small amendments. The note regarding the Mapping Project was translated into local language. (Minutes of Meetings 4)

(13) GIS Data of Additional Mapping Areas

During the creation of GIS data based on the existing topographic maps, additional mapping of ten sheets started for Eco - tourism study areas. So it was confirmed that the data for these areas should be replaced with the new data resulting from the additional mapping. (Minutes of Meetings 5)

(14) Image of the New Map

The Team prepared sample copies of symbolized map sheets in Japan and showed them to collect comments from the BiH side in May 2004. The Team also brought an offset - printed sheet (Raska Gora) from Japan and showed it to the BiH side so as to check the image of final printed maps. This one was prepared to be similar to the existing 1:25,000 topographic maps. JP Geodetski Zavod tested printing the same sheet using the films brought by the Team. (Minutes of Meetings 6)

(15) Official Check

The Team explained the technical approach adopted for lettering geographic names on the new maps. Both sides confirmed that the BiH side should make an official check for the national boundaries and all the lettered geographic names on the draft symbolized map sheets during field completion.

(16) Partly Blank Sheets

Both sides reconfirmed that, among the forty - seven (47) sheets to be printed, nine (9) sheets would be partly blank due to lack of data.

(17) Delivery of the Results for Eco - tourism Study Areas

Both sides confirmed that the results of 1:25,000 topographic mapping for eco - tourism study areas should be delivered to the Ministry of Civil Affairs.

(18) Seminar

It was confirmed that a one - day seminar should be held in Sarajevo in September 2005 aiming to publicize the new digital topographic maps to the public. It was also confirmed that the Ministry of Civil Affairs, BiH and the Team should jointly organize the seminar. (Minutes of Meetings 6)

(19) Recommendations

Accepting the Draft Final Report at the meeting of the Coordinating Committee on September 27, 2005, the BiH side mentioned an intention to prepare its official report based on the recommendations given by the Team and to present it to the Ministry of Civil Affairs, the Council of Minister of BiH and others concerned in the BiH authorities. The Team supported the intention. (Minutes of Meetings 7)

(20) Others

During field completion process, the Team requested the BiH side to provide names of the new map sheets and names of the adjoining map sheets. The BiH side satisfied the request in December 2004.

The BiH side requested the Team to provide the BiH counterparts with supplementary instructions on digital plotting. The Team extended its stay for two weeks and gave instructions both in Sarajevo and Bijeljina.

4 PROCESSES

The topographic data production, which is the new mapping and GIS data creation, was conducted through the following processes.

4-1 Control Point Survey and Signalization of Control Points

For the new mapping, the Principal 21 Cities were divided into 14 blocks for control point survey and aerial triangulation first. Then, another two blocks were added for the Eco-tourism Study.

4-1-1 Initial Plan and Actual Works

The Team's initial plan to prepare ground control points (GCPs) was to perform GPS observation and pricking at newly selected points and also to perform leveling where necessary vertical data lacked. Signalization of control points was planned only at the points where it would be difficult to prick due to monotonous land cover.

But the BiH side mentioned in the discussions that, since there are a number of existing control points available, no more new points have to be established and they requested the Team to signalize control points at the existing control points.

The Team recommended the initial plan under apprehension that many of the existing control points must be missing or the description of points must have become obsolete due to a long lapse of time and big land use changes. The Team mentioned that even if the points exist, it must be difficult and time-wasting to access them because of unfavorable conditions such as steep slopes, forests, possible land mines and inaccessibility by vehicles. After discussion, both sides came to an agreement that signals would be set at the existing points, but when easily identifiable control points do not exist within the planned areas, new control points should be established by GPS survey and pricking at the sites that would be easily recognizable on the photos.

The BiH side suggested that the Team should use the uniformly distributed existing control points instead of conducting the leveling work because these points have three dimensional coordinate values that satisfy the precision requirement for the height correction. The Team acknowledged the suggestion and received the list of the coordinates (about 5,000 points).

After aerial photography, several points were found to be in need of pricking because the signals were unrecognized on the photos. Pricking works were performed by the Team during field identification survey from September to October 2003.

4-1-2 Details of the work

(1) Selection of Control Points

Based on a tentative plan prepared in Japan, existing control points marked on the existing 1:25,000 scale topographic maps were examined in order to select the GCPs suitable for the new mapping. The points were confirmed in the field.

(2) Signalization of Control Points

Signalization of existing control points was done for preparing GCPs for each block in locations suited for aerial triangulation. In order to avoid unfavorable locations such as forests, minefields, and mountainous areas, the forth order control points near roads or in arable lands were selected. Where the existing control points were missing or inaccessible, signals were set up at new points not far from the planned locations. (Photo 4-1)

Photo 4 - 1 Control Point Survey Planning

Signals with three 1m × 3m wings in a radial pattern were set at the existing control points where stone markers were confirmed during the fieldwork. At a location where the stone marker was not confirmed and no other points were available in proximity, a new stone marker was set up at a new control point and a signal was established. (Photo 2-5, 2-7, 4-2, 4-3)

Photo 4-2 Aerial Signal 1

Photo 4-3 Aerial Signal 2

(3) GPS Observation

A total of ten sessions of GPS observation were conducted in the Federation side for all the control points, and three sessions were conducted in the Republic side including three new control points in Block 8 and Block 12.

The maximum of five the dual frequency receivers, Trimble 4000SSE, of the counterpart agencies were used for the static method of observation. The general observation time was set to two hours.

All the sessions of the GPS base line analysis and the closure precision observation resulted in precision of less than several centimeters (± 2ppm or less). Based on the results of the base line analysis, the coordinate values of the BiH National Coordinate System were calculated by the network adjustment processing by block.

4-2 Aerial Photography

The aerial photography at a scale of 1:40,000 was performed for the whole territory of BiH, about 51,000 km2, from July to August 2003 by a sub-contractor, FM-International Oy FINNMAP. Flight courses totaled 48 and 2,702 photos were taken. The flight index map was prepared in the Auto-Cad-format and delivered in the diskette.

The aerial photography mission was based at the Sarajevo International Airport. The survey aircraft, Rockwell Turbo Commander 690, N91384 was mobilized to Sarajevo on June 28, 2003. After the test flight on July 2, 2003, the aerial photography started on July 3, 2003. Flights were performed when the weather conditions allows the photography. The entire area was completed on August 9, 2003. Totally 23 aerial photography flights were performed to complete the aerial photography. The demobilization took place on August 12, 2003 after the quality of the aerial photography was guaranteed.

Table 4 - 1 Output of the Aerial Photography

Item	Quantity
Original film negatives	1 set
Rush prints	1 set
Contact prints	2 sets
Flight Index	1 set
List of photo center coordinates	1 set
Flight records	1 set
Final Report	1 set

Table 4 - 2 Specifications of Aerial Photography

Scale of Photography	1:40,000
Type	Panchromatic
Photography Courses:	48 courses, about 2,500 photographs, flight length of about 8,800 ㎞ , area coverage about 51,000 k ㎡
Camera:	Leica RC-20 or better (f= 152 mm, 23 ㎝ × 23 ㎝)
Flight altitude above the ground:	6,700 m ± 5%
Overlap	Forward 60 ± 5%
	Side 30 ± 10%
Crab:	Less than 10°
Tip and Tilt:	Less than 5°
Tolerable cloud cover:	less than 3% of successive 5 frames of photographs (excluding parts necessary for plotting orientation)
Condition	The coordinates of the principal points are measured using DGPS.

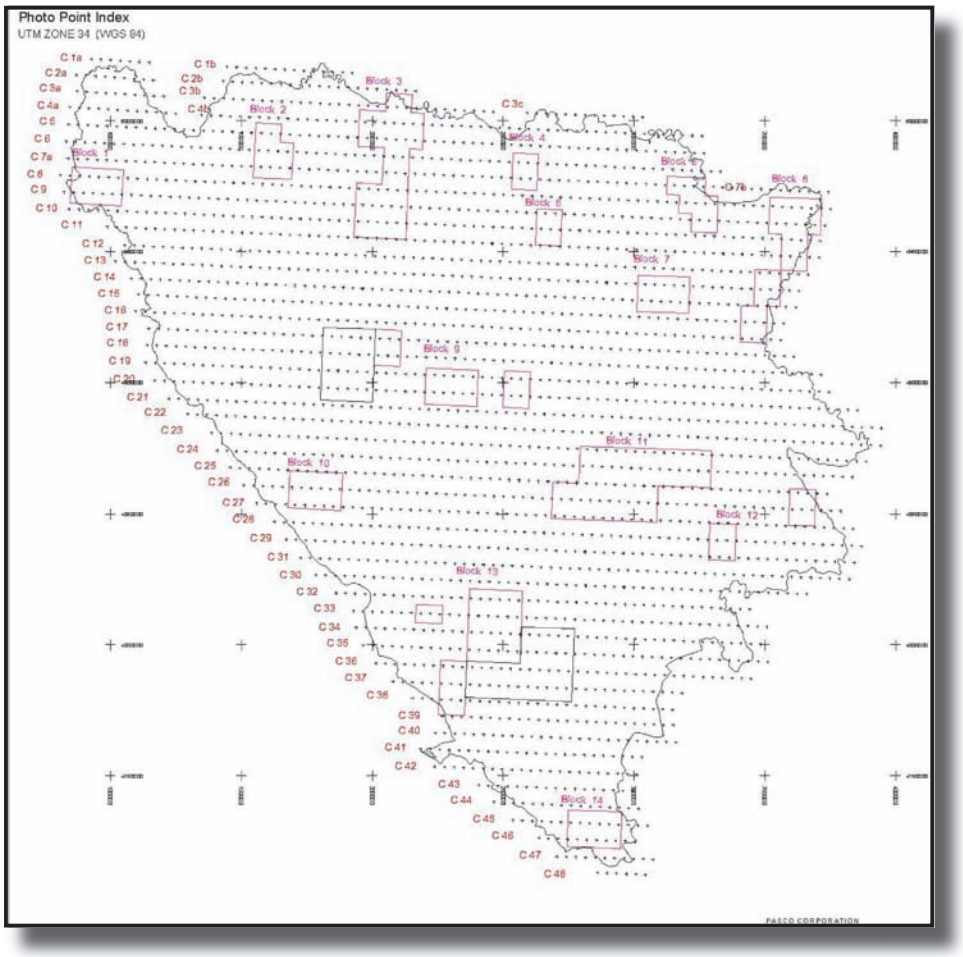


Figure 4 - 1 Flight Index Map

(1) Flight Permits

The necessary permits to commence were applied to the concerned authorities of Bosnia and Herzegovina, Croatia and Serbia Montenegro. Because the area is a portion of the Balkan airspace, and still under NATO control, it was also necessary to coordinate with Stabilization Forces (SFOR) and fulfill the required regulations to carry out the aerial photography. The following permits were applied before commencement of the aerial photography.

Table 4 - 3 Permits for Aerial Photography

Issuing Authority	Issued Date	Note
NATO/SFOR	May 16, 2003	General Permission
Republic Serbia and Montenegro	May 27, 2003	The permit for border crossing of the border between Bosnia and Herzegovina – Republic Serbia and Montenegro
Federal Ministry of Defense of the Federation Bosnia and Herzegovina	May 30, 2003	Permit from Military
Ministry of Defense of Srpska Republic	June 10, 2003	Permit from Military
Republic of Croatia	June 18, 2003	The permit for border crossing of the border between Bosnia and Herzegovina - Croatia
	June 30, 2003	Final corrected permit
Directorate Department of Civil Aviation, BiH	June 26, 2003	Landing Permit
	July 1, 2003	Authorization to carry out the aerial photography flights

(2) Aerial photographing

Aerial photography was carried out according to the Technical Specification. All the flight lines were planned using WWMP-software. The aerial photography area was divided into the four (4) blocks according to the ground elevation.

KODAK AERO LX 2408 and Agfa Aviphot Pan 80 black and white aerial photography film were used for the project.

Table 4 - 4 Summary of Aerial Photography

Project Manager		Mr. Timo Järvinen		
Assit. Project Manager and ADGPS Computations		Mr. Jussi-Pekka Saari		
Pilot		Ms. Ciara McGurk		
Navigator		Mr. Ian McDougall		
Aircraft Model		Rockwell Turbo Commander 690 A, N91384		
Camera	Camera Type	Leica RC 20		
	Lens Type	15/4 UAGA-F		
	No.	13158		
	Calibration date	02.10.2000		
GPS Navigation System		CCNS 4		
Differential GPS Registration		BASE STATION	Ashtech Z-12 Dual frequency receiver	10 Mb memory
		AIRCRAFT B Rockwell Turbo Commander 690 N91384	Ashtech Z-12 Dual frequency receiver	10 Mb memory Photo option
Data recording interval		1 second		

The coordinates of base station were observed from the existing first order geodetic station No.833 at Kosevo Stadium in Sarajevo. All the data was processed daily after the aerial photography by Ashtech (PNAV) Precision Navigation -software using forward and backward processing method.

The eccentricity components between camera perspective and aircraft phase centers were as in the following table:

Table 4 - 5 Eccentricity Components

	X (m)	Y(m)	Z(m)
Rockwell Turbo Commander 690 N91384	+0.300	-0.205	+1.255

(3) Photographic Processing

Processing of the aerial photographs was carried out in FM-Kartta Oy' s photography laboratory in Helsinki, Finland. KODAK black and white film processor was used for film developing. Contact prints were printed with SPEC automatic dodging printer. The film annotation was carried out according to the Technical Specifications and the instruction by the Study Team. The letter included the following data: (1) JICA MAPPING PROJECT; (2) Scale of photography 1:40000; (3) Flight course number; (4) Serial number of camera & lens; (5) Flight altitude; and (6) Photo number.

4-3 Photo Interpretation and Field Identification

The Team members for this work were dispatched to BiH twice in 2003. The first work was conducted from June 21, 2003 to August 19th, 2003; the second was from September 17th, 2003 to November 30, 2003. A total of eleven persons from the counterpart agencies participated in this work. Their names are listed in Table 2 - 4.

During the first work, because of delay in start of aerial photography, sixty aerial signals had to be inspected. Damaged or missing signals were repaired by the counterparts. The aerial signals inspected are as follows:

Table 4 - 6 Aerial Signal Inspection

Block	Points
Block1	0101, 0102, 0103, 0104
Block2	0201, 0202, 0203, 0204
Block3	0301, 0302, 0304, 0305, 0306, 0307
Block4	0401, 0402, 0403, 0404
Block5	0501, 0502, 0503, 0504
Block6	0601, 0602, 0603, 0604
Block7	0701, 0702, 0703, 0704
Block8	0801, 0802, 0803, 0804, 0805, 0806, 0807
Block9	0901, 0902, 0903, 0904, 0905, 0906, 0907
Block10	1001, 1002
Block11	1101, 1102, 1103, 1104, 1105, 1106, 1107
Block13	1301, 1302, 1303, 1304, 1305, 1306, 1307

Photo 4 - 4 Damaged Aerial Signal

Photo 4 - 5 Repaired Aerial Signal

For the field identification, parties were formed for the both entities. As a rule, a party was composed of one inspector for the existing topographic maps, one recording staff onto the double-enlarged photographs and one driver. The work period by block is shown as in the following table.

Table 4 - 7 Field Identification Work Periods by Block

Block	Territory	Counterpart	Quantity (map sheet)	Work Period
Block1	FBH	FBH	2	October 20 – October 26
Block2	RS	RS	2	August, 19 – August 22
Block3	RS	RS	7	September 8 – October 4
Block4	RS	RS	1	September 29 – October 2
Block5	RS	RS	1	October 7 – October 10
Block6	Brcko	RS	2	September 1 – September 10
Block7	FBH	FBH	2	October 27 – November 9
Block8	RS	RS	5	August 25 – September 5
Block9	FBH/RS	FBH	9	October 27 – November 24
Block10	FBH	FBH	2	October 27 – November 2
Block11	FBH/RS	FBH	9	October 6 – October 24
Block12	FBH/RS	RS	2	November 3 – November 9
Block13	FBH/RS	FBH/RS	16	November 10 – November 27
Block14	RS	RS	2	August 10 – August 14

The quantity of work was originally equivalent to forty-seven map sheets in area, but because of additional requirement for the Eco-tourism Study, another ten map sheets were added.

Originally, geo-referenced photo images was planned to be used along with the handy GPS receivers for the field identification. However, since geo-referenced-photo image preparation was possible to delay because of the delay in start of aerial photography, the Team decided to prepare double-enlarged photographs for the work. The GPS receivers were also planned to be used for data acquisition of topographic map features; however, the datum information was found to be unavailable. Therefore, the pricking method was applied to.

Table 4 - 8 Double-Enlarged Photographs for Field Identification

Block No.	Roll No.	Flight Run	Photo Number	
			from	to
1	BOSNIA 03	7	7_0569	7_0575
	07	8	81798	81792
	07	9	9_1800	9_1807
	07	10	101907	101901
2	03	4	40798	40794
	03	5	50703	50707
	03	6	60549	60546
	03	6	60699	60696
	07	7	70587	70593
	07	8	81779	81774
3	04	2	20824	20821
	04	3	30858	30865
	03	4	40787	40779
	03	5	50714	50721
	03	6	60688	60684
	03	7	70604	70608
	07	8	81769	81762
	07	9	91836	91830
	07	10	101878	101872
	09	11	112261	112255
4	03	5	50731	50733
	03	6	60675	60671
	03	7	70618	70621
	10	8	82537	82541
5	10	8	82541	82543
	07	9	91849	91852
	07	10	101859	101855
	10	11	112564	112568
6	03	6	60658	60654
	03	7	70638	70633
	10	8	82554	82558
	10	8	82688	82691
	10	9	92676	92668
	10	10	102643	102647
7	10	13	132748	132741
	10	14	142713	142719
	11	15	152789	152796
8	03	7	70645	70650
	10	8	82695	82701
	10	9	92664	92658
	10	10	102651	102657
	10	11	112588	112593
	10	12	122601	122595
	10	13	132736	132732
	10	14	142724	142729
	11	15	152800	152804
	11	16	162811	162807
9	09	19	19_2467	19_2461
	09	20	20_2383	20_2391
	09	21	21_2322	21_2318
15	07	15	151709	151706
	06	16	161604	161598
	06	17	171554	171558
	11	17	172871	172866

Block No.	Roll No.	Flight Run	Photo Number	
			from	to
	06	17	171561	171564
	02	18	180462	180456
	06	18	181628	181633
	10	19	192482	192479
	09	19	19_2459	19_2456
	09	20	20_2393	20_2396
	09	21	21_2330	21_2324
10	05	25	251230	251222
	05	26	261166	261173
	01	27	270231	270225
11	07	23	231683	231672
	11	23	23_2976	23_2980
	07	24	241663	241671
	12	24	24_3013	24_3022
	06	25	251402	251419
	05	26	261193	261204
	06	26	261453	261450
		26	1451	
	06	27	271381	271394
12	06	25	251427	251430
	06	26	261438	261434
	01	27	270192	270205
	01	28	280186	280180
	01	29	290153	290157
13	04	30	301066	301063
	04	32	321044	321035
	08	33	331985	331972
	02	34	340449	340440
	08	34	341993	341997
	02	35	350431	350438
	02	36	360415	360410
	01	37	370259	370254
	02	38	380276	380280
	02	39	390389	390392
16	04	32	321035	321031
	08	33	331972	331966
	08	34	341997	342004
	02	35	350438	350439
	08	35	352050	352057
	02	36	360410	360405
	08	36	362047	362038
	01	37	370254	370249
	08	37	372098	372109
	02	38	380280	380283
	08	38	382095	382082
	08	39	392127	392125
14	02	44	440317	440310
	02	45	450330	450337
	02	46	460348	460341

The results of the aerial photograph interpretation and field identification are all recorded onto double-enlarged photographs. Figure 4-2 exemplifies the results. Symbols used on the double-enlarged photographs are specifically guided by the Team in accordance with the specifications.

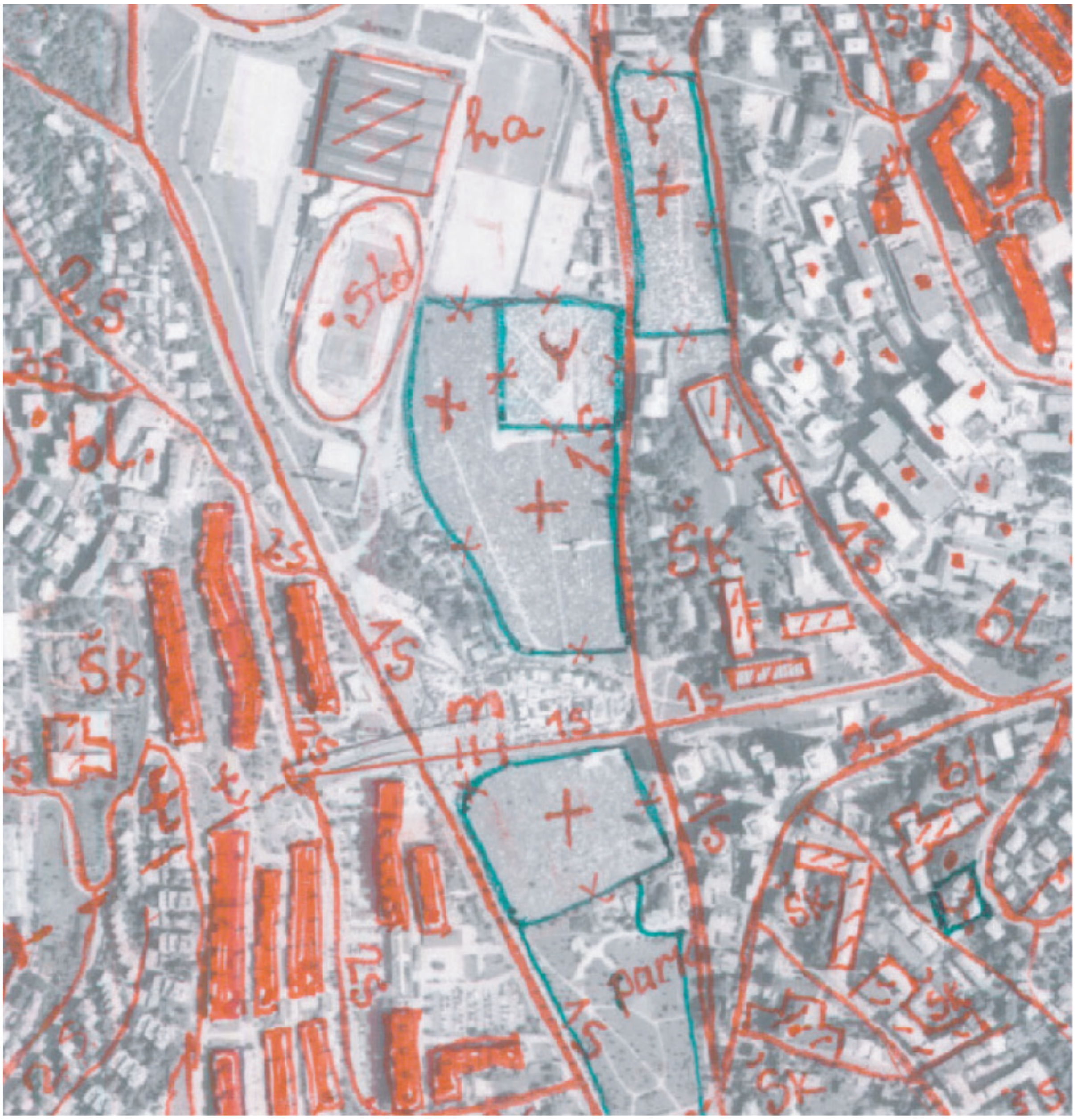


Figure 4 - 2 Notes on a Double-Enlarged Photograph

Inspection and repair of the aerial signals, the interpretation of aerial photography and field identification for Principal 21 Cities and the additional areas were completed as planned with the cooperation of the counterparts from the both entities. At the same time, the counterparts experienced those works. The detail of OJT is covered in the 2-5 Technology Transfer in this report.

4-4 Scanning of Aerial Photos

Totally 2,702 aerial photos covering the country were scanned to acquire digital image data to be used for aerial triangulation, digital plotting and technology transfer sessions during the study. The used scanner was Zeiss SCAI scanner for performing high precision scanning. (c.f. Figure 3-18) Scanning resolution is 20 micrometers. A file name of each scanned data was put as AA_BBBB, that is, AA is a course number and BBBB is a photo number. A file saving work was done with care not to put wrong file names and sample extraction checks were done a few times. The scanned data were recorded in HDDs with 500GB of storing capacity and are capable of direct LAN and USB connection. Also they are stored in AIT2 tapes that have random access functions. Both HDDs and tapes are the final products to be delivered to the BiH Government.

Photo 4 - 6 Photo Scanner 1

Photo 4 - 7 Photo Scanner 2

4-5 Aerial Triangulation

The digital aerial triangulation was conducted for respective blocks described in 3-2 using 615 models of the new aerial photographs in the Principal 21 Cities (47 map sheets in area) and the JICA Eco-Tourism study areas (10 map sheets in area). See Figure 4-1. Used triangulation modules were HATS, MATCH-AT and Pat-B.

The process of aerial triangulation is as fallows:

1) Design and planning of aerial triangulation
2) Preparation of data from GPS and leveling
3) Importing scanned aerial photographs
4) Interior orientation of the scanned images
5) Observation of ground control points
6) Automatic measurement of tie points, and manual inspection and correction
7) Observation of level points
8) Block adjustment computation by Bundle Method

Residuals of Control Points are shown in the following Tables.

(1) Block 1

Table 4 - 9 Residual Errors (Block 1)

Number of photos	28		
Number of strips	4		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
101	0.209	-0.014	0.276
102	-0.246	-0.074	-0.041
103	-0.438	0.168	-0.076
104	0.475	-0.080	-

(2) Block 2

Table 4 - 10 Residual Errors (Block 2)

Number of photos	30		
Number of strips	5		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
201	-0.070	0.087	0.044
202	0.101	-0.061	0.116
203	0.066	-0.081	-0.180
204	-0.097	0.055	-0.307

(3) Block 3

Table 4 -11 Residual Errors (Block 3)

Number of photos	78		
Number of strips	11		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
50301	-0.129	0.149	-0.784
50302	-0.017	-0.039	-0.163
50303	0.439	-0.487	-0.487
50304	-0.403	0.003	0.458
50305	0.486	0.312	0.459
50306	-0.062	-0.277	-0.023
50307	-0.314	0.339	-0.327

(4) Block 4, 5

Table 4 -12 Residual Errors (Block 4, 5)

Number of photos	36		
Number of strips	7		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
50401	-0.013	-1.136	0.570
50402	0.859	-0.677	0.157
50403	-0.234	0.219	0.628
50404	-0.804	1.381	-0.463
50501	0.476	0.089	0.286
50502	0.010	0.542	0.553
50503	-0.716	-0.183	0.926
50504	0.421	-0.234	0.640

(5) Block 6

Table 4 - 13 Residual Errors (Block 6)

Number of photos	37		
Number of strips	5		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
50601	0.472	-1.095	-0.249
50602	-0.207	0.077	-0.057
50603	-1.125	0.762	-0.222
50604	0.860	0.256	0.064

(4) Block 7

Table 4 - 14 Residual Errors (Block 7)

Number of photos	23		
Number of strips	3		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
50701	-0.142	0.006	-0.370
50702	-0.324	-0.530	0.147
50703	-0.231	0.107	-0.305
50704	0.697	0.416	-0.221

(7) Block 8

Table 4 - 15 Residual Errors (Block 8)

Number of photos	61		
Number of strips	10		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
30801	-0.033	0.102	-0.492
30802	-0.075	0.082	-0.563
30803	-0.298	0.189	0.226
30804	0.284	-0.363	-0.151
30805	0.158	-0.088	-0.150
30806	0.120	0.344	0.683
30807	-0.156	-0.267	-0.490

(8) Block 9

Table 4 - 16 Residual Errors (Block 9)

Number of photos	111		
Number of strips	13		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
901	-0.116	-0.106	0.056
902	0.513	0.768	0.118
903	-0.104	0.331	0.085
904	-0.098	0.177	0.037
905	-0.067	-0.465	0.246
906	0.236	-0.298	0.173
907	-0.142	-0.126	-0.171
1501	-0.252	-0.416	-0.092
1502	0.31	-0.233	-0.03
1504	0.113	0.047	-0.103
1505	0.168	-0.59	0.039
1506	-0.586	0.669	0.154
15377	0.024	0.243	-0.192

(9) Block 10

Table 4 - 17 Residual Errors (Block 10)

Number of photos	29		
Number of strips	3		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
1001	-0.212	0.172	0.085
1002	-0.037	-0.085	0.054
1003	0.294	-0.052	-0.098
1004	-0.045	-0.035	0.060

(10) Block 11

Table 4 - 18 Residual Errors (Block 11)

Number of photos	93		
Number of strips	5		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
1101	0.033	-0.004	0.006
1102	0.034	0.027	-0.016
1103	-0.069	0.002	0.001
1104	0.045	0.022	-0.004
1105	-0.039	-0.028	0.009
1106	0.057	-0.079	0.063
1107	-0.005	-0.020	-0.014
900208			-0.001

(11) Block 12-1

Table 4 - 19 Residual Errors (Block 12-1)

Number of photos	16		
Number of strips	3		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
1201	0.100	-0.617	0.193
1203	-0.031	-0.739	1.614
1206	-0.152	1.415	-1.011
1207	-0.128	0.104	-
8886	0.211	-0.163	0.124

(12) Block 12-2

Table 4 - 20 Residual Errors (Block 12-2)

Number of photos	17		
Number of strips	3		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
1202	-1.180	0.814	0.726
1205	0.639	0.193	-
1209	0.356	-1.242	0.209
1211	0.186	0.236	0.577

(13) Block 13

Table 4 - 21 Residual Errors (Block 13)

Number of photos	176		
Number of strips	9		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
51301	0.268	-0.903	0.386
51302	0.231	-0.993	0.311
51303	-0.063	-0.773	0.718
51304	-0.742	0.057	-0.087
51305	-0.743	-0.097	-0.200
51306	0.018	0.329	-0.824
51307	0.842	1.514	-1.674
51310	-1.083	-0.592	0.598
51601	0.016	0.595	1.204
51602	0.997	0.962	-0.297
51603	1.039	-1.094	0.218
51604	-0.137	-0.186	-1.564
51605	-1.564	1.386	-1.149
51606	-0.046	-0.204	-0.770

(14) Block 14

Table 4 - 22 Residual Errors (Block 14)

Number of photos	24		
Number of strips	3		
Residual errors of control points in [meter]			
Control Point ID	rx	ry	rz
1401	-0.014	-0.004	0,013
1402	-0.001	0.003	-0.010
1403	0.000	-0.001	-0.001
1404	0.003	-0.005	0.005
401	0.015	0.017	0.008
402	-0.007	0.003	0.004
403	0.004	-0.013	-0.002

Inspection of Aerial Triangulation Results

The values of the standard deviation for the residual errors (rx, ry and rz) of the coordinates of the control points need to be 0.02% of the heights above ground or lower, and the maximum value of the residual errors shall not exceed 0.04% of the heights above ground. The height above ground is about 6,000 meters; 0.02% of 6,000 meters is 1.2 meters. Therefore, all the values satisfy the standard.

After the adjustment calculation, the triangulation results were imported to the digital plotter and the following inspection was conducted on the stereoscopic models. There was no problem with the inspection result.

1. No existence of y-parallax.
2. Good connection between adjacent models and adjacent courses
3. Correctness of the check points coordinates

4-6 Digital Plotting

A total number of map symbols from the existing topographic maps were 356. The total number is reduced to 286 after the study team reorganized the map symbols to be plotted without losing the amount of information.

The total area of mapping for the Principal 21 Cities is 6,400 km2 or 47 in terms of full sheets. But the actual count of map sheets covering the mapping areas has increased to 58, since several of the mapping areas were partially shifted in response to the request of the BiH side in March 2003.

In addition, ten (10) more map sheets were mapped for the JICA Eco-tourism Study areas. Consequently, the total count of the sheets is 68.

The digital plotting systems used were as follows:

1) DiAp (based on MicroStation software)
2) Summit Evolution (based on AutoCAD or MicroStation software)
3) Socet Set (based on MicroStation software)

The main processes of digital plotting were as follows:

1) Importing of the aerial triangulation results
2) Importing of the stereo-pair images
3) Plotting viewing three-dimensional images
4) Extracted data check
5) Data storing in CAD format

The digital plotting work was done according to the following instructions:

1. To acquire the data based on the "Specifications for Digital Topographic Data Acquisition" agreed between the BiH side and the Team. The specifications are compiled in the specificaitons section of this volume.
2. The plotting area is the following;

1) Where the national boundary is defined by a wide river, plotting should be done as far as the opposite shoreline.
2) Where the national boundary is not defined by a wide river, plotting should be done as far as about 2cm beyond the national boundary at the scale of 1:25,000.

3. To put the neat lines of the existing maps.
4. Each polygon feature should have a point with the code number inside.
5. When there are blank areas inside of a polygon (layer number: XXXX), input XXXXin into the layer number attribute of the blank polygons.
6. To acquire the data of roads, railways, rivers, canals, waterways, various pipelines, power lines, or contour lines as the continuous line.
7. To acquire the line type bridge/tunnel data copying the road/railway data, if the road/railway passes on the bridge. The same way should be used between overlapped line features.
8. The destroyed houses, whose walls remain, should be acquired as buildings.
9. If small individual buildings (3522) exist densely, make groups of two or three buildings and acquire only one center point of each group as one small individual building.
10. Destroyed large factories or closed large factories should be acquired as large individual buildings (3718).
11. Each mosque is sure to have the steeple. Confirm it.
12. To check and correct the contour lines three-dimensionally if you make them automatically using DTM, etc.
13. To put 7 or 8 spot heights including control points and elevation values of contour lines in a area of 10 cm x 10 cm on the 1:25,000 scale map.
14. To see the existing maps in case the photo-interpretation is difficult.

Character of the final data is the following;

1. The data format is DXF ASCII format version 12.
2. The used data types were only Point, Line, Polyline or Single line text.

GIS data were also created by ArcGIS software using these plotted data. The particulars are given later in this section.

4-7 Digital Map Symbolization

After digital plotting, digital map symbolization was carried out. This is the cartographic process to symbolize the vector data into map image on the screen.

In the third phase of this project, map symbolization was performed in Japan with the vector data of the 58 map sheets for the Principal 21 Cities that were prepared through digital plotting during the second and third phases. The ten (10) sheets for the Eco-tourism Study areas have been already completed in the second phase.

Some of the mapping areas of this project share borders with neighboring countries, namely Croatia, Serbia, and Monte Negro. Among the 68 map sheets, 13 sheets have such borders. In the Minutes of Meetings of March 2004, it was confirmed that national boundaries should be presented on the map sheets. Therefore, the BiH side provided the Team with image data of national boundaries drawn on the existing topographic maps in March. The Team digitized these boundaries and plotted them on the draft map sheets in the process of digital map symbolization in Japan.

The BiH side gave the definition of the boundaries in the local language to the Team, reading, " The boundary of BiH is as of 1991." It was lettered as marginal information only for the competent draft map sheets.

When analogue maps were digitized, some of the symbols were technically difficult to express in a digital format. The technical difficulties were resolved and the result of the map symbol specifications is included in the specifications' section of this volume.

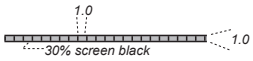
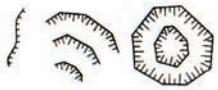
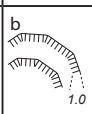
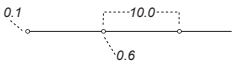
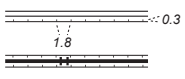
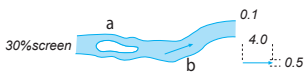
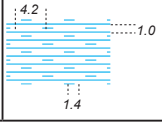
No	Feature name	Analogue Map Symbol	Digital Map Symbols	Note
41	Belt conveyer			The slash lines in the center of the analogue symbol cannot be expressed as "pattern" in symbolizing software.
54	Cliff formed by digging			The two types of line segments are placed perpendiculer to the drection of a cliff. At curved locations, expression becomes difficult. Uniform length is used for the digital symbol.
79	Ropeway, lift			The small circles placed on each side of a line, in the analogue symbol is replaced with circles on a line.
90	Retaining wall on the upper side of road and railway			The T-shape of the analogue symbol is hard to express along a curve. The T-shape is replaced with a line and a tic for the digital map symbol.
112	River of 15m or mre in width an ddirection of river flow			A flow direction arrow, which was drawn as curve in the analogue symbol was replaced by straint line for more efficient operation of symbolization.
141	Hardly passable swamp			The dash-lines were placed at randam in the analogue symbol. A regular broken line is used for the digital map symbol.

Table 4 - 23 Analogue Map Symbols and Digital Map Symbols (excerpts)

4-8 Field Completion

After digital plotting and digital map symbolization, field completion is carried out. This is the process for completing final data to be presented in draft maps by checking and correcting the symbolized draft maps on the spot and by referring to some latest authorized source materials on facilities, administrative boundaries, geographical names, etc.

In this project, first of all, the Team brought five sets of sixty-eight (68) symbolized draft map sheets from Japan to BiH in the beginning of September. Using these sheets, the Team members and BiH counterparts in closer cooperation performed the field completion process from September to October 2004.

Field completion in this project covers four kinds of works, namely, (1) field check, (2) reference of existing source materials, (3) national boundary check, and (4) lettering check.

The Team prepared a manual for field completion in the local language. It covers (1) work planning and general preparation, (2) preparatory marking of objects to be checked on the map, (3) selection of surveying routes, (4) items to take notice of in surveying, (5) final compilation of the results, and (6) reference of collected source materials. (Minutes of Meetings 3)

The objective of field check is to check the features and letters on the spot, which remained questionable or omitted in the processes of field identification, digital plotting and symbolization. The following notices are essential to take.

1. Whether the objects acquired in the field identification process of the last phase have been put on the exact positions in the map or not, for example, school, hospital, factory, religious building, bridge and cemetery,
2. Whether the objects, which should have been acquired in the field identification process, are omitted or not, for example, road and its type, railroad and its type.
3. Omitted letterings
4. The objects to be lettered with abbreviations such as hotel, motel, gas station, wide pedestrian bridge
5. Identification of vegetations along surveying routes
6. Spelling of lettering
7. Marginal information

The following notices are essential for compiling final materials from the results of the field completion.

1. To be careful in manual transcription of the results to the final material (maps)
2. To mark with clear block letters
3. Abbreviation letters to be used in material compilation are A (add), D (delete), and CG (change or correct).

The following objects are checked or acquired from the source materials provided by the BiH side.

1. Existing control points
2. National boundaries
3. Main power lines
4. Gas pipeline between Belgrade and Sarajevo
5. Electrified or non-electrified sections of railroad

After a short field training near Sarajevo and Bijeljina, field check started in the middle of September. As scheduled, all map sheets were thoroughly checked and corrected and a set of final materials (maps) were compiled by the end of October. The Team members finally checked these materials and took them to Japan. The results of the field completion were indicated on the draft-symbolized maps as Figure 4-3.

During the field completion, several technical problems were discussed between both sides and agreed upon. These matters are described later in the next sections of the supplementary digital plotting and supplementary digital map symbolization.

4-9 Supplementary Digital Plotting

After field completion, supplementary digital plotting was performed in Japan. This is the process for correcting, adding and deleting topographic map features with digital plotter according to the results of field completion. According to the results shown on the final materials (maps) prepared through the process of field check and also to the source materials collected from the authorities concerned to public facilities, operators stereoscopically reidentified the objects that were omitted or mistakenly entered to the enlarged photo prints in the process of field identification in 2003 or mistakenly acquired in the process of digital plotting. And then, they corrected or added or deleted those topographic map features. The final data format is DXF ASCII format version 12.

During the field completion, several agreements about additional layers to acquire were made between both sides as follows.

(1) Wide bridge (more than 17.5 m in width) with piers Line code: 2500

(2) Wide bridge (more than 17.5 m in width) without piers Line code: 2505

(3) Industrial reservoir (more than 35 m in length or diameter) Polygon code: 5542

(4) Pond (less than 35 m in length or diameter) Point code: 5345

This layer is acquired from the existing topographic map.

The following agreements about layer acquisition were made as well.

(1) In case of swamps covered by trees, these overlapping layers shall be acquired independently. (But, only swamp shall be entered to the GIS data.)

(2) All tunnels of abandoned railroads shall be acquired as they are on the existing map.

(3) Power lines shall be acquired referring to the source materials collected from JP Elektroprivrede. For acquiring the feature, it is desirable to stereoscopically identify pylons.

(4) Gas pipelines shall be acquired referring to the source materials collected from BH Gasa.

(5) Water pipelines shall be acquired as they are on the existing map.

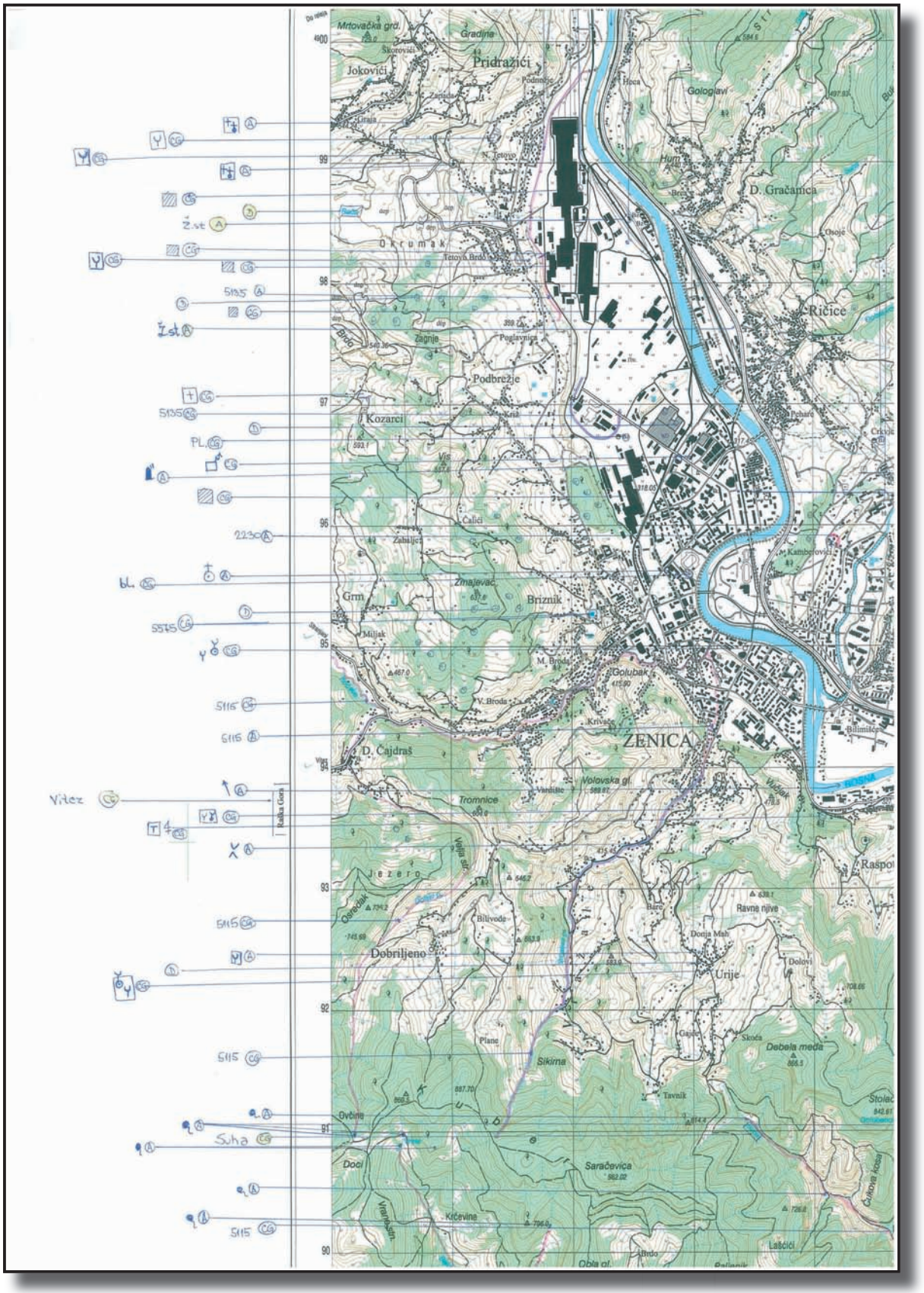


Figure 4 - 3 Results of the Field Completion Marked on Draft Map