2-7 Flood Hazard Map

The Study Team produced two kinds of hazard maps.

Type G

Type G is large - A1- size color map (2-8). This type is designed to represent main results of the Study and for municipal activities.

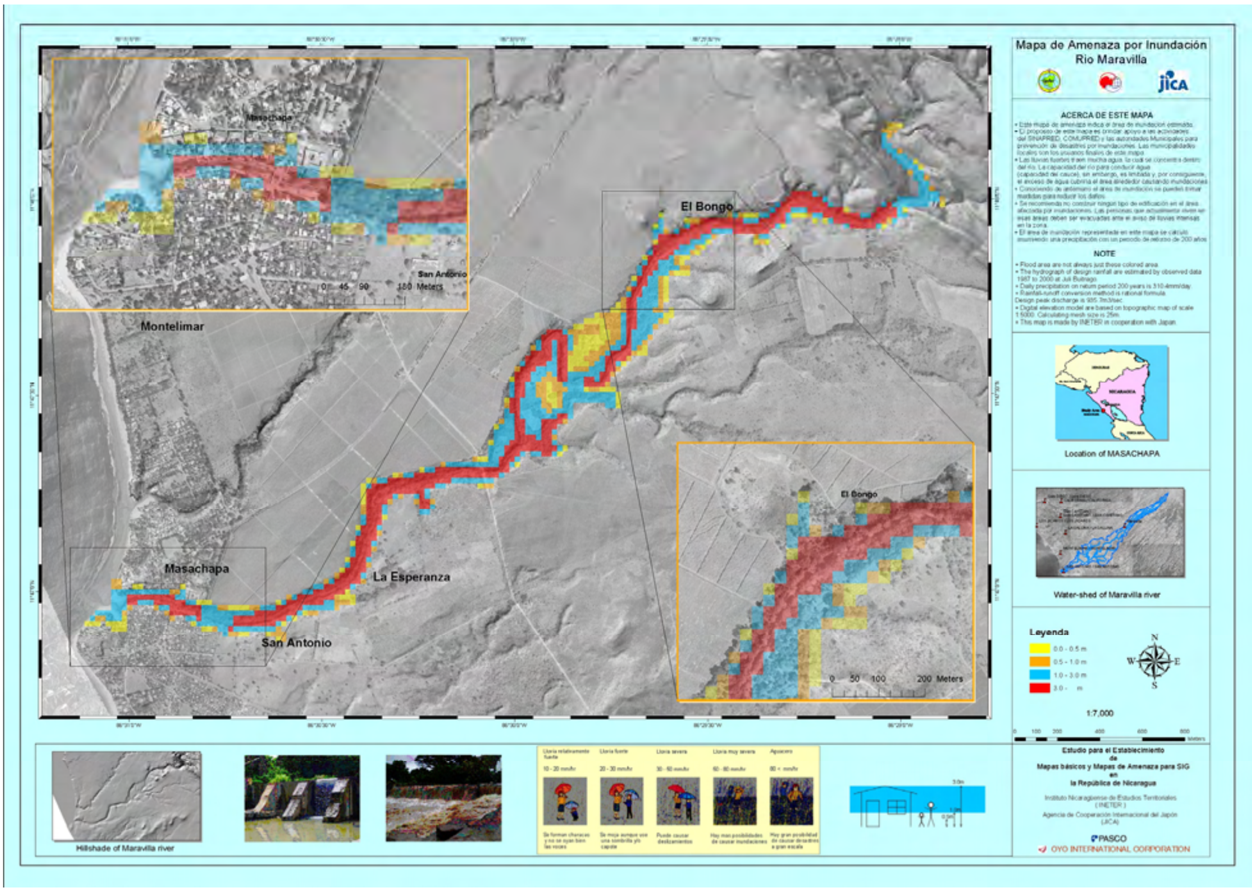


Figure 2-8 Large Size (Type G) Hazard Map for City

This figure shows estimated flood area and related information. The flood area shows the results of calculation for the case of 200 year-return period.

Type P

Type P is a small -letter- size black and white map (Figure 2-9). This type is designed to make photocopies and to distribute to inhabitants of the city.

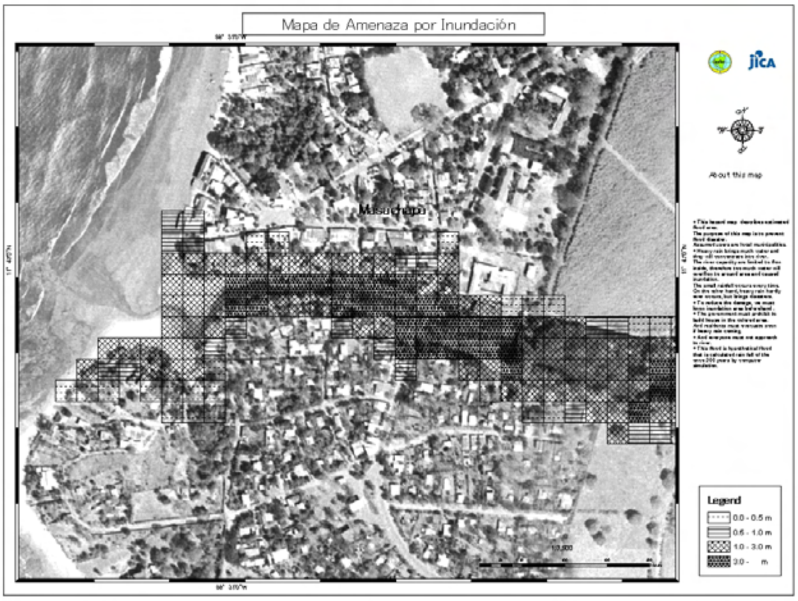


Figure 2-9 Small Size (Type P) Hazard Map for Inhabitants

2-8 Tsunami Hazard Map

Topography models are developed for the simulation of the Tsunami hazard map, by compilation of existing map. An additional survey was conducted near Masachapa. The 1992 Nicaragua Scenario Tsunami is used for the simulation, and for the same dimension of source area in front of San Juan del Sur, to simulate the worst case. The details of parameters are based on existing studies, but adjusted to give a best fit with the observed data of the maximum inundation. The hazard maps in major towns along the Pacific coast for Corinto, Puerto Sandino, Masachapa, and San Juan del Sur are developed. The outputs of simulations include time history of water level change at some points along the coasts, animation of water level change in the simulated areas, and distribution of maximum inundation in the coast area.

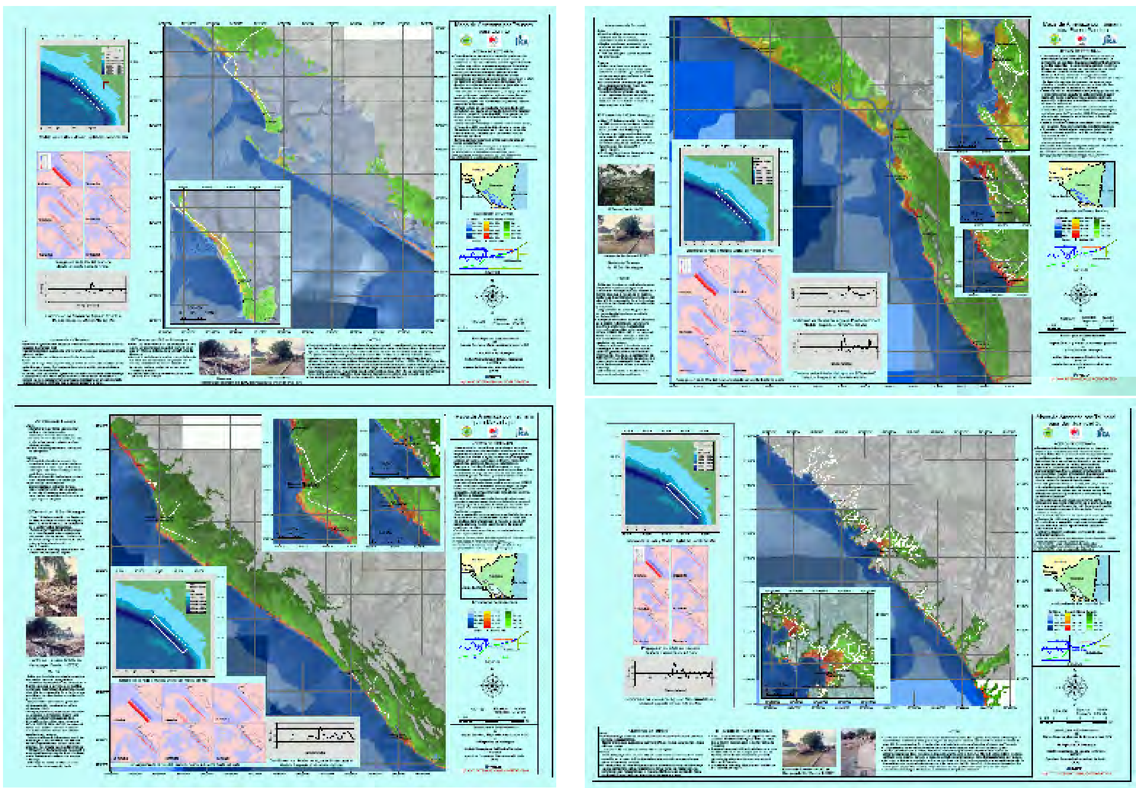


Figure 2-10 Examples of Tsunami Hazard Maps

3 TECHNOLOGY TRANSFER

3-1 Introduction

3-1-1 Targets

The targets of technology transfer are map producers and users. The topographic mapping team has targeted the efforts of technology transfer to the staff in INETER as the team members worked closely with them. The hazard mapping team targeted the staff in INETER and also users of hazard maps for technology transfer. The users of the hazard maps are generally the staffs in the governments and academics. The programs targeted for the staff in INETER are explained in the programs section. Seminars targeted for both producers and users are explained in the seminars' section.

The topographic mapping has seven parts: 1) control point survey; 2) field identification; 3) digital photgrammetry; 4) GIS; 5) EARDAS Imagine; 6) map symbolization; and 7) field completion. The hazard mapping has four parts: 1) earthquake; 2) volcano; 3) flood; and 4) Tsunami. Five persons were invited to Japan and attended technology transfer sessions.

3-1-2 Method

On-the-job training is the fundamental method for technology transfer. Trainees learned directly from the experts as working closely. Generally, lectures or fundamental explanations were given before OJT sessions. Manuals and other documents to support the OJT sessions were prepared. When it is involved in computer skills, the team members provided hands-on-sessions in Nicaragua and also in Japan.

Seminars are targeted for the counterparts, policy makers, academics and users of topographic maps and hazard maps. Asking the counterparts to take part in presentations and preparation improved their communication skills for themselves. They were good opportunities to get feed back from the trainees. Presentations in the seminars helped users to learn about topographic and hazard mapping, also.

3-1-3 Installation of Equipment for OJT

Necessary equipments of OJT were installed in the beginning of August, 2004. Actual allocation of equipment was discussed with INETER, and finally, the systems were set up at the Geodesy and Cartography Department and Geophysics Department. The system is composed of seven sub systems: 1) upgraded digital photogrammetry system; 2) new digital photogrammetry system; 3) digital map editing system; 4) GIS application system; 5) GIS simulation system; 6) Database establishment system; and 7) map symbolization system. The system configuration is shown in Figure 3-1.

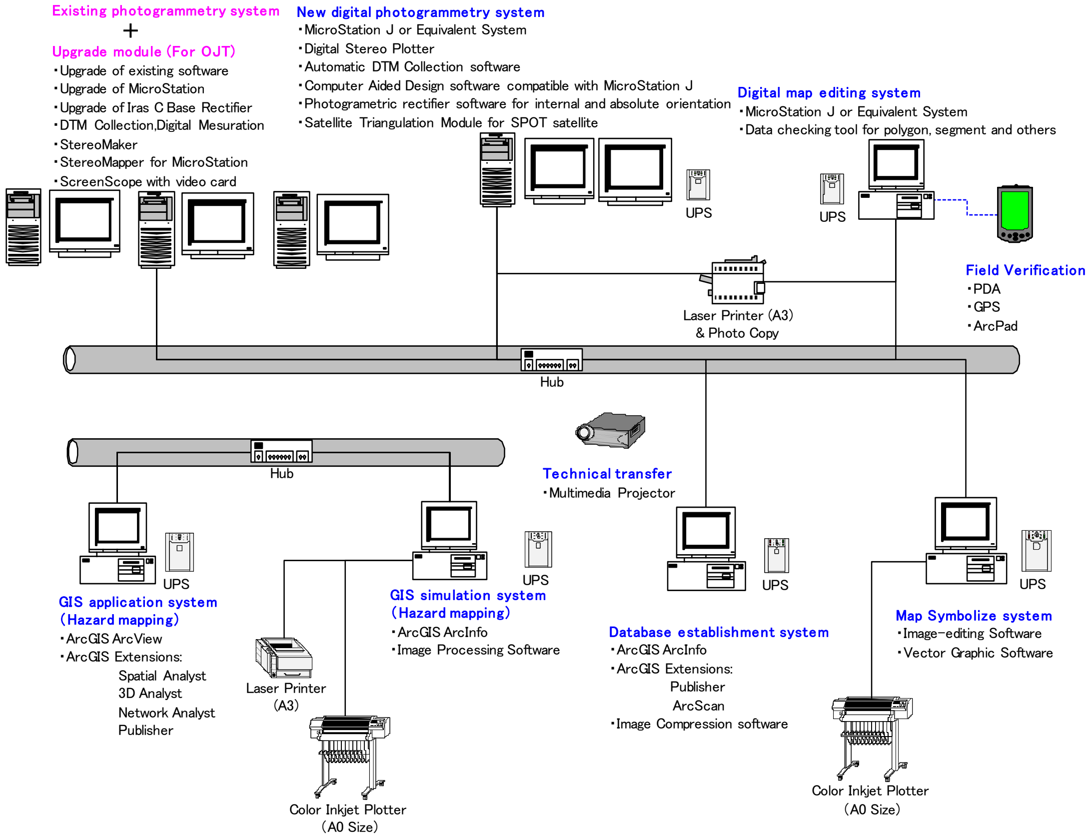


Figure 3-1　System Diagram

3-2 Programs for INETER

The programs for the staff in INTETER are organized into two parts: digital topographic mapping and hazard mapping.　A total of sixteen (16) sessions was carried out through out of the Study. The course names, instructors, and periods of the sessions were summarized in Table 3-1.

Table 3-1 Training Sessions for Digital Topographic Mapping

Session Name	Instructor	From	To	Location
Photo Control Point Survey	Kiyofumu Tamari	2004/1/13	2004/3/20	Managua
Field Identification 1	Daikichi Nakajima	2004/1/13	2004/3/20	Managua
Field Identification 2	Kiyofumu Tamari	2004/7/5	2004/8/27	Managua
Digital Photogrammetry 1	Takeo Mutoh	2004/7/5	2004/8/27	Managua
GIS Technology 1	Awadh Kishor Sah	2004/7/5	2004/8/27	Managua
Digital Photogrammetry 2	Takeo Mutoh/Minori Onaka	2005/1/13	2005/3/21	Managua
GIS Technology 2	Awadh Kishor Sah Hidetoshi Kakiuchi	2005/1/28	2005/3/8	Managua
ERDAS Imagine 1	Awadh Kishor Sah	2005/1/28	2005/3/8	Managua
Map Symbolization 1	Kozo Yamaya	2005/2/10	2005/3/21	Managua
Digital Photogrammetry 3	Minori Onaka	2005/5/20	2005/6/26	Managua
GIS Technology 3	Awadh Kishor Sah	2005/5/20	2005/6/26	Managua
ERDAS Imagine 2	Awadh Kishor Sah	2005/5/20	2005/6/23	Managua
Digital Photogrammetry 4	Minori Onaka	2005/10/1	2005/11/7	Managua
GIS Technology 4	Awadh Kishor Sah/Choi Jaeyoung	2005/10/1	2005/12/13	Managua
Field Completion	Kiyofumu Tamari	2005/11/3	2005/12/13	Managua
Map Symbolization 2	Kozo Yamaya	2005/10/17	2005/11/27	Managua

For hazard mapping, nine sessions (9) were conducted.

Table 3-2 Training Sessions for Hazard Mapping

Session Name	Instructor	From	To	Location
Earthquake Hazard 1	Osamu Nishii	2005/5/5	2005/6/12	Managua
Volcanic Hazard 1	Yoshitaka Yamazaki	2005/5/5	2005/6/12	Managua
Flood Hazard 1	Toshiaki Udono	2005/5/12	2005/6/18	Managua
Tsunami Hazard 1	Toshihiro Asahina	2005/5/12	2005/6/18	Managua
Bathymetric survey	Ikuo Katayama	2005/2/8	2005/3/7	Masachapa
Earthquake Hazard 2	Osamu Nishii	2005/11/3	2005/12/13	Managua
Volcanic Hazard 2	Yoshitaka Yamazaki	2005/10/1	2005/11/7	Managua
Flood Hazard 2	Toshiaki Udono	2005/10/1	2005/11/7	Managua
Tsunami Hazard 2	Toshihiro Asahina	2005/10/1	2005/11/7	Managua

3-2-1 Topographic Mapping

(1) Control Point Survey

1) Contents and Schedule

The objectives of technology transfer were to assess technology level of the counterpart and to support weak parts in the process of control point survey. Technology on GPS observation; and baseline and the net-adjustment calculation were relatively well maintained. Mr. Tamari instructed four trainees in Cartography Department from January 2004 to March 2004. The items for technology transfer were: 1) selection of control points and planning; 2) installation of land marking; 3) GPS observation; 4) baseline and net-adjustment calculation; and 5) description of stations.

2) Participants

The four trainees had previous experiences in GPS survey through the national boundary projects and cadastral projects. They have experiences in using Trimble Geomatics Office and have conducted GPS baseline and net adjustment calculation.

Table 3-3　　List of Participants (Control Point Survey)

Name	Affiliation
Claudio Gutiérrez Huete	Geodesy Section
Pedro Miguel Vargas Carvajal	Geodesy Section
Gonzalo Medina Pérez	Geodesy Section
Isidro Jarquín Vélez	Geodesy Section
Ramón Avilés	Geodesy Section
Josué Donado Figueroa	Geodesy Section

3) Results

Land marking and description of stations were new; the instructor demonstrated the process of making the land marking.　The calculation of the magnetic constant using Geomag32 was not difficult for them; however, since the tool was not type of software used daily, keeping the technology might became a challenge.　A manual was prepared for the purpose.　The WGS84 ellipsoid and coordinate conversion software, Geocalc, which simplified the current work, was accepted the four trainees and other staffs in INETER.　The instructor introduced the eccentric survey by a solar method.　With the method, installation of GPS to the point was instructed.

Land marking was less frequent work; the experience through the Study shall be kept within the organization from the trainees.　As described, the manuals were prepared for new technologies. Other conventional technologies which were recovered shall be documented.　The trainees seemed less concerned about vertical data, depending on heights from the geoid model derived from GPS surveys.　The instructor mentioned significance of height data for monitoring purposes during the OJT sessions.

(2)　Field Identification

1) Structure and Schedule

The objectives in this technology transfer items are to learn skills in: aerial photograph interpretation; verification on photographs; use of GPS in field identification; application of ortho-photographs in field identification; usage of MicroStation with digital ortho-photographs; prints of ortho-photographs using ArcView.　The new technology of using ortho-photographs and GPS were introduced.　Four trainees were selected to take part in the field identification from July 2004 to August 2004.　Mr. Nakajima instructed in the beginning of July 2004 and Mr. Tamari guided the work mainly in August.

2) Trainees

The four trainees knew the usefulness of GPS as knowledge, but in practice, this was the first time to use the device.　The method of using ortho-photographs and GPS was of their interest.

Table 3-4　　List of Participants (Field Identification)

Name	Affiliation
Isidro Jarquín Vélez	Cartography Section
Fernando Osorio	Cartography Section
Néstor Rodríguez	Cartography Section
Oliver Valladares	Cartography Section

3) Results

Existing documents were used as much as possible to reduce the number of items to be identified in the field. The ortho photographs at a scale of 1/10,000 were available in the northern part of the study area. The instructor has decided to use the ortho-photographs at the same scale for the field work, since the larger scale had been considered easier for beginners to interpret. It turned out that more data and information on aerial photographs to some extent overwhelmed the trainees to reduce the scale into 1/50,000. For the southern areas, the scale of the ortho-photographs was changed to 1/25,000. During the field identification in the southern part of the study area, the interpretation keys were prepared. The keys helped consistency of field identification among the trainees.

The annotation data were acquired from the existing topographic maps, considering the future usage as annotation database. The new technology of using GPS for field identification was introduced. Including the preparation of the interpretation keys, the trainees learned use of handy-GPS for field identification, and preparation of annotation database. In the office work, field data collected were arranged to new maps in accordance with annotation and code. Both office work and field work were completed with satisfactory levels of quality.

(3) Digital Photogrammetry

1) Structure and Schedule

"Digital Photogrammetry" consists of four major technology transfer components: aerial triangulation, digital plotting; DTM and contour line generation; and digital compilation. During the course of the Study, four technology transfer sessions were conducted. Four members from the photogrammetry section participated in the technology transfer sessions. Mr. Mutoh led the first and half of the OJT-2 and Mr. Onaka instructed later half of the OJT-2, OJT-3 and OJT-4. The goal of the technology transfer was to complete the two map sheets "NAGAROTE" and "EL TRANSITO".

During the OJT-1, because of the delay of installation of OJT system, hands-on-sessions were not conducted. Rather the sessions were focused more on general overview of the digital photogrammetry. One existing ImageStation was available. The instructor used the existing ImageStation and gave operational support to the trainees. OJT-2 focused on aerial triangulation and plotting of planimetric features. In OJT-3 data editing and DTM generation were mainly covered. OJT-4 was mainly targeted to DTM editing and contour line editing.

2) Trainees

Among five trainees, one of them had analogue plotting experiences; another one's experience was only limited in some knowledge on digital photogrammetry.

Computer experiences were also limited. Other two trainees had no experience in digital photogrammetry with some personal computer experiences. Five persons from the Photogrammetry Section participated in the training session. They were: Josué Donado Figueroa; Mayra Silva Diaz; Fátima Martínez Duarte; Uberne Rueda Padilla; and Ivone Sáenz Morales.

3) Results

Transfer of the restitution technique was carried out by manually drawing the Nagarote and El Transito sheets INETER is responsible for, starting with the planimetric entities during OJT-2. It became clear, during OJT-2, that it was too time consuming for our counterparts to draw the contours manually because of their lack of experience. Besides, accuracy was a problem. Considering this, the Study Team decided to dismiss the manual contour drawing method and changed, at the beginning of OJT-3, to the DTM contour acquisition method. During OJT-3, introduced know-how on data editing was successfully transferred with the completion of OJT-4. Data cleaning and polygon creation were the key elements for vector data editing.

(4) Introduction to GIS and Operations of ArcGIS

1) Contents and Schedule

The objectives of "Introduction to GIS and Operations of ArcGIS" were to acquire knowledge and skills on: 1) Concept of Geospatial database; 2) Functions and Capabilities of GIS; and 3) ArcGIS Software Operations. The course was designed for the staff of the Department of Geodesy & Cartography, and Geophysics in INETER. Nineteen (19) trainees participated in this training course. This course consisted of four OJT sessions in Nicaragua.

2) Trainees

Since many trainees participated during OJT-1 to OJT-3, they were divided into three groups with further into two sub-groups (two persons in each). During OJT-4, the trainees were divided into two groups with further into two sub-groups.

Table 3-5 List of Participants (Introduction to GIS)

Name	Affiliation
Ramón Avilés Aburto	Department of Geodesy & Cartography
Mayra Silva Diaz	Department of Geodesy & Cartography
Dina Flores Huembes	Department of Geodesy & Cartography
Alberto Orozco Navarro	Department of Geodesy & Cartography
Francisco Pérez Pérez	Department of Geodesy & Cartography
Ramón Alonso Torrez Rodríguez	Department of Geodesy & Cartography
Nestor Rodríguez	Department of Geodesy & Cartography
Oliver Valladares Saballos	Department of Geodesy & Cartography
Fernando Osorio Salazar	Department of Geodesy & Cartography
Isidro Jarquín Vélez	Department of Geodesy & Cartography
Aaron Godoy Zamora	Department of Geodesy & Cartography
Ena Gámez Balmaceda	Department of Geophysics
Virginia Tenorio Bellanger	Department of Geophysics
Antonio Alvarez Castillo	Department of Geophysics
Edna Gómez	Department of Geophysics

Marisol Echaverry López	Department of Geophysics
Tupac Obando Rivera	Department of Geophysics
Armando Saballos	Department of Geophysics
Emilio Talavera	Department of Geophysics

3) Results

The trainees understood well about not only the concept of GIS but also how to operate ArcGIS software for creation of GIS Database as well as using the created database for various application purposes. A few trainees, having reached to a higher level in the ArcGIS operations, could become key persons in this field. Hereafter, it would be very important for the counterpart agencies to establish a system for maintenance and updating of GIS database.

(5) Introduction to ERDAS Imagine and its Operations

1) Contents and Schedule

The objectives of “Introduction to ERDAS Imagine and its Operations” course were to acquire knowledge and skills on: 1) Concept of Raster Data; and 2) ERDAS Imagine Software Operations. The course was designed for the staff in INETER; however, two personnel from the Moviterra (UNAN, León), an affiliated agency of INETER had also joined the course.

2) Trainees

A total of twelve (12) trainees participated in this course.

Table 3-6 List of Participants (ERDAS IMAGINE)

Name	Affiliation
Josué Donado Figueroa	Department of Geodesy & Cartography
Uberne Rueda Padilla	Department of Geodesy & Cartography
Francisco Pérez	Department of Geodesy & Cartography
Noel Ramírez	Department of Geodesy & Cartography
Ramon Alonso Torrez	Department of Geodesy & Cartography
Isidro Jarquín Vélez	Department of Geodesy & Cartography
Marisol Echaverry	Department of Geophysics
Ena Gámez	Department of Geophysics
Armando Saballos	Department of Geophysics
Virginia Tenorio	Department of Geophysics
Eddy García	Moviterra *
Ena Reyes	Moviterra *

*Note: Moviterra is an institution which is collecting the real-time-volcanic-activity data around León City, and was taken as the candidate institution of training in response to the request of INETER.

3) Results

The trainees understood well about not only the concept of Raster data and operations of ERDAS Imagine Software. A few trainees, having reached to a higher level in the ERDAS Imagine operations, could become key persons in this field. Hereafter, it is very important for the counterpart agencies to establish a system for maintenance and updating of GIS database.

(6) Map Symbolization

1) Contents and Schedule

Map symbolization of technology transfer aims to attain certain level of understandings symbolization from plotted vector data to cartographic symbols and on creation of complete printing map files.

The software used was Adobe Illustrator version 10 or 11. The training was conducted from October 24to November 25 , 2005. The major items of training were: (a) Document setup and preference setup; (b) Preparation of spot colors and modification of swatches pallet; (c) Preparation of map symbols and pattern; (d) Data import or conversion for map editing with Adobe Illustrator; (e) Map Symbolization for each features as line, point, polygon and text; (f) Marginal design, grid and grid numbers completion; and (g) Methodology of checking for completed printing maps.

2) Trainees

Four trainees from the cartography section took part in the map symbolization OJT. They were: Isidro Alberto Jarquín Vélez; Dina Del Carmen Flores Huembes; Aaron Anastasio Goday Zamora; and Fernabdo José Osorio Salazar.

3) Results

It was the trainees' general impression that the results from Illustrator were more graphically appealing that those of MicroStation. Also the trainees understood that using functions like brush, cutting or offset lines, time-consuming process of symbolizing such as tics could be converted efficiently. The trainees experienced all the process of editing and symbolizing within a limited schedule.

(7) Field Completion

1) Structure and Schedule

The purpose of field completion is to investigate unidentifiable features during the field identification performed previously. Unreasonable parts, inconsistencies, questionable features compared to existing source materials are examined and confirmed. All field completion work was completed using draft maps. Handy GPS receivers which were introduced for technology transfer were also used during the work. The field completion survey was performed by the following five INETER counterparts. The field completion was carried out from October 31 to November 26, 2005. Arrangement of the field work results was carried out from November 28 to December 9, 2005. In INETER, the results were examined. The unknown places were reexamined in the phase of examination and organization of the results.

2) Participants

Five members from the Geodesy and Cartography took part in the training sessions. They were: Isidro Jarquín Vélez; Oliver Valladares Ramón Avilés Aburto; Alberto Orozco; Javier Hernández; and Fernando Osorio.

3) Results

In the field, there was no problem to verify about the point data using Handy GPS because of experience of the previous field identification. As for point data such as school, hospital, church, and others, it was necessary to make some omission or generalization since, it was impossible to express all point data on a topographic map. Although it was shown quite many point data in the draft maps, the Study Team instructed to omit some of the data to the field team. After finishing the field work, they were instructed to arrange the field data with the indication key code using the printed draft maps. The Study Team completed the arrangement of the work. OJT for the field completion including the annotation toponymy was successfully implemented.

3-2-2 Hazard Mapping

(1) Earthquake

1) Contents and schedule

Technology transfer was conducted on following items: 1) Improvement of earthquake catalogue; 2) Selection of suitable attenuation formula for explaining historical earthquake damage; 3) Evaluation of proximity of Managua against existing type of past earthquakes; 4) Establishment of scenario earthquake and determination of most probable earthquakes; 5) Ground modeling for site amplification; 6) Generation of grid system; 7) Calculation of distance from scenario earthquake to the grid; and 8) Expression of simulation result on map. Technology transfer for Item 1, 2, 3, and most part of Item 4 were completed in the period of March 2004 to January 2005. Other items from 5 to 8 were completed in the period of May 2005 to November 2005.

2) Participants

In November 2005, 3 days short course on seismic motion calculation was conducted. The participants from the Department of Geophysics to the course were as in Table 3-7.

Table 3-7 List of Participants (Earthquake)

Name	Affiliation
Wilfried Strauch	Department of Geophysics
Carlos Guzmán	Department of Geophysics
Guillermo Chávez	Department of Geophysics
Manuel Traña	Department of Geophysics

3) Results

Mr. Carlos Gusman is the engineer in charge to establish the seismic microzoning map in INETER. He properly understood the procedure of calculation of surface earthquake motion. Then, he developed a new man-machine interface for easy operation of the calculation process. This program covers 1) grid system generation, 2) calculation of the shortest distance from fault line to the center of each grid, 3) calculation of attenuation and obtain baserock motion of each grid, 4) calculation of surface amplification and obtain PGA at the center of each grid and 5) generate GIS database file to present on GIS base map.

(2) Volcanic Hazard

1) Structure and Schedule

The program included eight full days of training to cover two types of activities:

desk-work activities and on-the-field activities. The textbook “Volcanic Topography under Aerial Photographs in Japan” published by the Volcanological Society of Japan was utilized for the training. The indoor-work covered: Interpretation of Aerial Photography; Practice of Aerial Photography Interpretation; Practice using maps and 3D photographs of Telica-El Hoyo area and of the Leon-Telica area; and Determination of volcanic features using aerial photographs around Leon-Telica area. The field work was conducted on the Practice at Volcanoes Telica and El Hoyo sites.

2) Participants

Eight members of the Department of Geophysics participated in the training:

Table 3-8 List of Participants (Volcano)

Name	Affiliation
Martha Navarro	Department of Geophysics
Antonio Alvarez	Department of Geophysics
Guillermo Chávez	Department of Geophysics
Mayra Guerrero	Department of Geophysics
Marisol Echaverry López	Department of Geophysics
Rosario Avilés Alemán	Department of Geophysics
Armando Saballos	Department of Geophysics

3) Results

The training included discussions on the methodology for and the philosophy behind the simulation and hazard mapping processes, which was done for the first time at INETER. Significant progress was made in the understanding of hazard mapping processes by the counterpart. The participants had the opportunity of performing on-the-field verification of the aerial photography interpretation performed at the office. Assisted by the provision of some basic guidance, the participants carried out two days of enthusiastic learning although the allocated time was too short to go beyond the basic principles.

(3) Flood Hazard

1) Contents and schedule

The goal of OJT for flood hazard is for the trainees to carry out two dimensional flood simulations. Preparation of data, displaying of the results, creation of hazard maps, and uses of hazard maps were covered in the OJT program. The first sessions were conducted from June 2 to June 8, 2005 and the second part of the sessions were conducted from October 7 to November 4, 2005. The topics covered were: 1) Introduction and explanation of training plan; 2) Training on the preparation of the digital elevation model; 3) Preparation of input data files for the sample calculation exercise; 4) Explanation of the simulation software and installation on trainee’s computers; 5) Transfer of simulation results to Arc View format for map representation; 6) Preparation of Hazard Maps (discussions on contents and presentation); 7) Discussions on uses and applications of Hazard Maps; 8) Training of hydrological statistical analysis; and 9) Discussion and Evaluation.

2) Participants

Seven members took part in the training sessions.

Table 3-9 List of Participants (Flood)

Name	Affiliation
Luis Palacios Ruíz	Department of Hydrology
Isaías Montoya	Department of Hydrology
Luz Marina Rodríguez	Department of Hydrology
Erwin Rueda	Department of Hydrology
Carlos Collado	Department of Hydrology
Jamil Robleto	Department of Hydrology
Ena Gámez Balmaceda	Department of Geophysics

3) Results

The OJT sessions were completed with the following results:

a. Educational material was prepared by the participants including operation manuals, sample data and other documents that they can keep for future reference
b. The training was conducted in several continuous days, which helped to keep the interest and learning flow of participants
c. The same members participated in the whole training program, which helped all the participants to complete all the training activities
d. The participants were always cooperative and eager to learn.

(4) Tsunami Hazard

1) Contents and Schedule

Technical training was conducted for staff of the INETER Divisions of Geophysics and Hydrological Resources with the objective of helping them understand the model preparation and the methodology adopted for hazard map development. The program of the course is shown below.

Table 3-10 Topics and Items of OJT (Tsunami)

Day	Topic	Date
1	Modeling	October 20, 2005
2	Calculation	October 21, 2005
3	Calibration	October 25, 2005
4	Plotting	October 27, 2005
5	Implementation	November 1, 2005
6	Evaluation	November 3, 2005

2) Trainees

Two members from the Department of Geophysics and four members from the Department of Hydrology participated as listed in Table 3-11.

Table 3-11 List of Participants (Tsunami)

Name	Affiliation
Wilfrield Strauch	Department of Geophysics
Luis Palacios Ruíz	Department of Hydrology
Manuel Traña	Department of Geophysics
Luz Marina Rodríguez	Department of Hydrology
Carlos Armando Collado	Department of Hydrology
Carlos Ramos	Department of Hydrology

3) Results

Members in geophysical department are very busy with routine monitoring works and other projects in INETER, though they have good knowledge of Tsunami, good experience of programming and GIS operation. On the other hand, staffs in hydrological departments had limited knowledge on Tsunami and programming, though they have experience in GIS. They are expected to explain the methodology as well as limitations when they are asked from users outside INETER, and run and modify other cases.

(5) Additional Bathymetry Survey at Masachapa Coast

1) Contents and Schedule

For Tsunami Hazard Analysis, the field survey for rigorous sounding of the sea bottom profile was performed for one month from February 8 through March 7, 2005 in response to the request of the INETER as written in the minutes of September 10th, 2004.

The basic survey planning started in early February in 2004. Technical items were included such as: 1) How to decide the covering area of the bathymetry survey necessary for connecting the available NGDA data which lacks the resolution near coastal zone; 2) How to determine the interval, orientation, maximum length of sounding lines; 3) Choice of portable computer used on board and on land, and connected to the available sounding apparatus in INETER; and 4) How to put staff on duty from the view point of safe operation during the survey and selection of communication system between the launch and on land base.

2) Participants

List of participants are tabulated in Table 3-12.

Table 3-12 List of Participants (Bathymetry Survey)

Name	Affiliation
Luis Palacios Ruíz	Department of Hydro Resources
Sergio Antonio Cordonero Gonzáles	Department of Hydrography
Francisco Javier González	Department of Hydrography
José Tomas Valle Paz	Department of Hydrography
Juan José Martínez Aguirre	Department of Hydrography

3) Results

Lessons learned and countermeasures taken were as follows: 1) To hire the well designed launch with a captain who has good experience from a Marine Construction Company EPN; 2) Trial and show up how to build-up an ideal PC system to be used on board; 3) The settlement of extension length of sounding survey lines by judging the limit of echo reflection from sea bottom; and 4) Settlement of the temporal tide scale at Montelimar pier and continuous measurement of tide level and the data were used to correct the sounding data.

Because of the survey of this time was the first achievement of bathymetry survey under cooperation of INETER and EPN with the financial support of JICA, the both institution concluded an agreement of cooperation in the technical area in the future.

3-2-3 Training in Japan

A total of eight INETER staff was invited to Japan, in two groups, to receive training. The training courses were designed to provide the trainees a general review of what they had learned about topographic map and hazard map elaboration in the OJT sessions in Nicaragua. Below are the names of the participants and the period of their stay in Japan.

Table 3-13 Training in Japan

Session Name	Trainee	From	To	Location
Hazard Mapping 1	José Manuel Traña Pérez	2005/1/10	2005/2/08	Tokyo
Hazard Mapping 1	Guillermo Chávez	2005/1/10	2005/2/08	Tokyo
Digital Photogrammetry 1	Fernando Osorio	2004/11/22	2004/12/22	Tokyo
Digital Photogrammetry 1	Josué Donado	2004/11/22	2004/12/22	Tokyo
Hazard Mapping 2	Carlos Guzmán	2005/9/1	2005/9/30	Tokyo
Hazard Mapping 2	Jamil Robleto	2005/9/1	2005/9/30	Tokyo
Digital Photogrammetry 2	Mayra Silva Díaz	2005/9/1	2005/9/30	Tokyo
Digital Photogrammetry 2	Isidro Jarquín Vélez	2005/9/1	2005/9/30	Tokyo

3-3 Seminars

The Study Team and the Counterpart held four major seminars: International Seminar; INETER-National University of Engineering-JICA Study Team Seminars; Seminar at Managua City; and Workshop on Preparation of Hazard Maps and Application for Risk Reduction in León, Nicaragua.

(1) Final Seminar

The members of the central government, local governments, universitities, and the JICA project were invited, and the technology-transfer seminar for introducing the contents and the results of the study was held on August 17, 2006. The counterpart presented the presentation materials prepared incooperation with the Study Team as utilizing the presentation software MS PowerPoint. During the presentation, the results and outputs of the Study was explained along with their usages and users. A poster session was held to display specific outputs, and a demonstration was conducted using the computer system. The final seminar was successfully concluded with the number of partipants exceeding 100.

(2) International Seminar

The international seminar was held on June 9, 2005 that comprehensively covered the contents and progress of the Study. National, local, and international organizations were invited. The seminar aimed at not only presenting the results of the study but also at promoting sustainable production of hazard maps and effective uses of both digital and hard copy maps. A questionnaire survey was conducted to collect the participants opinions and recommendations on a) the preliminary project results presented at the seminar, and b) possible applications of those products for disaster reduction.

(3) INETER-National University of Engineering-JICA Study Team Seminars

On February 10, 2005, two seminars were held at the National University of Engineering

(UNI), organized by INETER, UNI and the JICA Study Team. The first seminar was on the impact of the Indonesia Tsunami of December 2004 and its consequences on the Central American region and was presided by the Mayor of Managua City and by Mr. Cristóbal Sequeira, Executive Secretary of SINAPRED. Dr. Carlos Villacís, the members of the Study Team were invited to present a report on the main findings and recommendations of the Kobe's World Conference on Disaster Reduction and their implications for Nicaragua. The event was well covered by several representatives of the mass media. In the evening, another seminar was held at the National University of Engineering (UNI) that was supposed to last from 5PM until 8PM.

(4) Seminar at Managua City

In collaboration with the Municipality of Managua and the National University of Engineering, a seminar was held at Managua's City Hall to present a progress report of the JICA-INETER project, learn about the City's program for disaster reduction, and propose activities for a closer relation and collaboration between INETER, Managua City and the National University of Engineering. The seminar was held at the City Hall's auditorium on February 17 from 10 AM to 12 noon. The seminar participants included representatives of the Mayors of Managua, Tipitapa, Ticuantepe, Ciudad Sandino and El Crucero as well as the Director of SINAPRED, the JICA representative and representatives of other institutions such as, the Ministry of Environment and Natural Resources, Civil Defense, Ministry of Health, etc.

(5) Workshop on Preparation of Hazard Maps and Application for Risk Reduction in León, Nicaragua.

The workshop was held on August 23, 2004 at House of Protocol UNAN - León. The organizations participated were: León City, INETER and the Study Team. The workshop had three specific objectives: To present the JICA-INETER Study, its expected products and their possible applications to the authorities and the community of León City; To present the current local capacity and the advance achieved in disaster vulnerability reduction in the City of León; and To discuss and produce recommendations to ensure that the Study results respond to the necessities of the City of León and increase the local disaster reduction capacity. The approximately 110 workshop participants were divided into four working groups to produce recommendations on specific aspects that would increase the Study's benefits for disaster risk reduction in León Municipality.

4 DISCUSSIONS

During the course of the Study, discussion sessions were held. This section summarizes the results of discussions. For details, please refer to the minutes of meetings.

4-1 Steering Committee

A steering committee was decided to be formed during the first discussion session. The members selected were from INETER, SINAPRED, and representatives from the Ministry of Foreign Affairs. Representatives from Managua City, ENACAL and the Ministry of Environment were also invited to the third Steering Committee meeting. In the meeting, the Study Team reported progress, results and specifications to the committee members. The committee was closed with the fifth meeting on the final report.

4-2 Technology Transfer

During the first discussion sessions, the OJT items and the work areas for OJT were agreed. The Study Team proposed the equipment necessary for OJT (M/M January 20, 2004).

All the equipments were installed based on the specifications which were agreed on January 2004. INETER agreed to check the quantity and working condition for all the systems together with the Study Team. Especially for ESRI products, INETER agreed to communicate with the delivery dealer. (M/M September 9/2004)

4-3 Additional Work Items

The INETER requested: 1) Bathymetric survey in the Masachapa coastal waters for Tsunami hazard simulation; 2) Profiling of the Maravilla River for Flood hazard simulation; 3) Preparation of topographic maps (Approx.200 km^2) at a scale of 1/5,000 in Managua city for the study on Improvement of Water Supply System in Managua; and 4) Basic facility information map for natural disaster prevention for GIS application (M/M September 9th 2004).

JICA and the Study Team had discussed the matter and recognized the significance of the work items. The four work items were decided to be conducted during the second year of the Study.

Regarding the expansion of topographic mapping at a scale of 1/5,000 for the southern part of Mountainous area, which was recommended by INETER in the Minutes of Meeting on 23rd, February 2005, the Study Team informed that the mapping of the southern part of Mountainous area was carried out in Japan to improve the accuracy of contour lines of 1/50,000 of the first year. (M/M June 24th 2004).

4-4 Specifications and Others

(1) Specifications

On the specifications following items were discussed: 1) map symbols (M/M July 24, 2005); 2) marginal information (M/M September 10, 2004); 3) Specification of GIS database (M/M February 23, 2005); 4) digital plotting data extraction rule (M/M February 23, 2005); and 5) copyrights of maps (M/M July 24, 2005).

(2) Web Site

Both sides agreed to upload the JICA project information to the website of INETER. Uploading data was prepared by INETER based on the Inception Report. (M/M January, 2004)

(3) Delivery of intermediate Results

The Study Team delivered the following intermediate results to INETER for the On the Job Training (OJT):

1) Two (2) sets of color contact print photograph data covering the volcano study (M/M 9/9/2004)
2) One (1) set of digital ortho-photograph (black and white) at scale of 1/25,000 covering the new photographing area; (M/M 9/9/2004)
3) One (1) set of scanned photograph data covering the new photographing area (M/M 9/9/2004)
4) One (1) set of color ortho-photographs at a scale of 1/10,000 for the Volcanic Hazard area (M/M 6/24/2005)
5) One (1) set of ortho-photographs (black and white) for map sheets, 2752-II (Corinto), 2753-III (León), 2853-II (La Paz Centro), 2953-III (Isla Momoto), 2952-I (Tiptapa), 2855-II (Achuapa) (M/M 7/24/2005)
6) One (1) set of digital photographs (black and white) at scale of 1/40,000 which were scanned using existing positive films. (M/M 7/24/2005)
7) Two (2) sets of GIS database of infrastructure for Disaster Mitigation in DVD; (M/M 11/24/2005)
8) One (1) set of digital photographs (Color) at scale of 1/20,000 for Volcano area (M/M 11/24/2005)
9) One (1) set of digital mapping data at scale of 1/5,000(M/M 11/24/2005)

5 PROCESSES OF TOPOGRAPHIC MAPPING FOR 1/50,000

The target area of new topographic mapping is approx. 20,000 km^2. (60 map sheets) for the Pacific Ocean region. The northern part equivalent to about 45% of the study area is covered with the existing aerial photographs taken in 2000 at the scale of 1/40,000. The new topographic mapping was conducted using the new photographs and existing one. Project started from the collection of the existing Data in Nicaragua. Work possesses are shown in Figure 5-1.

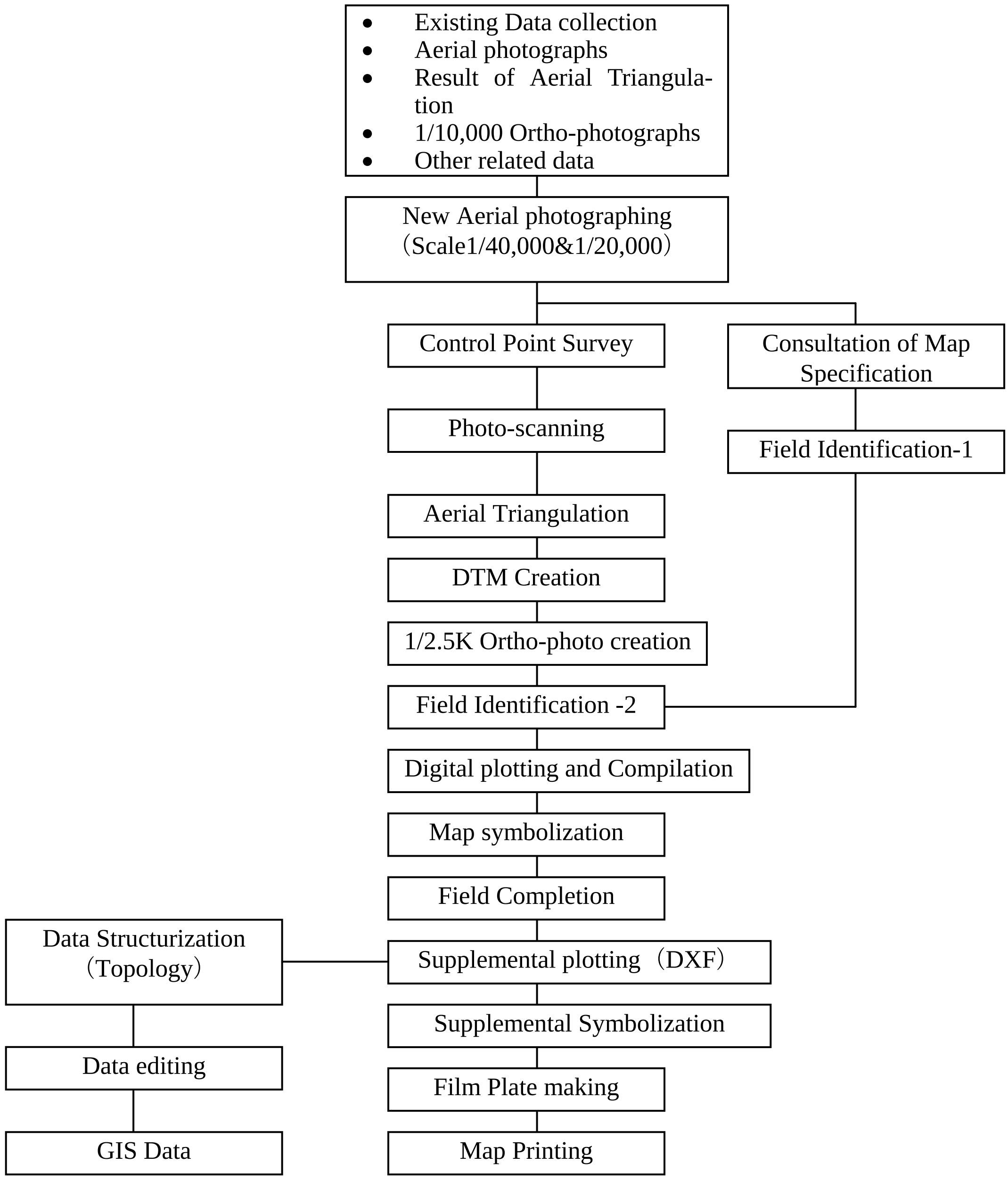


Figure 5-1 Topographic Mapping Work Flow

5-1 Data Collection

Existing information and materials were collected from INETER and other organizations. The various pieces of information and materials were used for the study to prepare new mapping data. The collected materials are as follows:

Table 5-1 Collected Existing Dataset

ITEM	Quantity	Format
1/50,000 scale printed maps	60 sheets	Paper, TIFF
1/10,000 scale ortho-photographs	317 output sheets	Paper
Two-times enlarged aerial photographs	94 photos	Paper
Aerial Triangulation results	1 set	Pat B Format
Existing positive films (1/40,000)	920 pieces	Film
Existing contact prints (1/40,000)	920 prints	Paper
National Borderline data	1 set	DXF
Administrative boundaries data	1 set	DXF
Annotation data for 1/50,000	1 set	DGN
Protected area	1 set	DGN
Annotation catalog for 1/50,000	1 set	DGN and Illus-trator
Coordinates table for existing control points	1 set	Excel

5-2 Approach to GIS Database

The existing GIS database in Photogrammetry Section of INETER was created from black and white Aerial Photographs taken in 1996 and 2000. The digital database has been created in six layers: 1) Administration layer; 2) Elevation Layer; 3) Hydrology Layer; 4) Infrastructure Layer; 5) Transportation Layer; 6) Vegetation Layer. The team and INETER discussed map symbol and coding system for GIS database to be prepared in this Study, especially concerning the layer code. It was fully considered that GIS database to be delivered would not be isolated from the existing database of INETER rather both will be compatible to each other.

5-3 Aerial Photography（1/40,000 and 1/20,000）

The Aerial Photographs consist approximately 12,000 km^2 Black &White aerial photography on the scale 1/40,000 and approximately 1350 km^2 color aerial photography on 1/20,000 scale for Volcanic Hazard mapping.

The first aerial photography flight was carried out on February 5, 2004 and entire project area was completed on February 25, 2004. The demobilization took place on February 26, 2004 after the coverage of the aerial photography was checked.

A total of 288 colors and 814 black and white, aerial photographs was taken during the aerial photography mission by sub-contractor, FINNMAP. A flight index map was prepared in the AutoCad-format and delivered in CD-ROM. The overview index map is shown Figure 5-2.

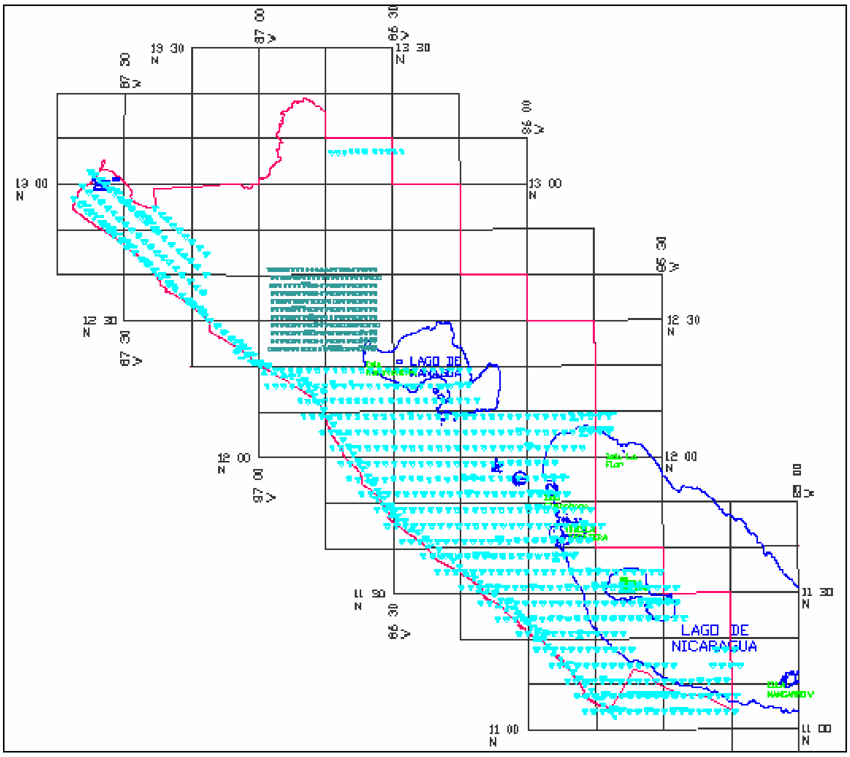


Figure 5-2　　Photo Index

5-4 Control Point Survey and Pricking

The counterpart agency solicited training in what refers to the installation of land markings and acquisition and the calculation of eccentric elements. Because of this requirement, land markings were installed in the 35 control points to follow original plan. Six (6) additional control points survey were carried out because aerial triangulation was not yet done in some area in the existing photographed area.　Therefore, 41 ground-control-pointsurveys were implemented in the study area.

Photo 5-1　　Land Marking Training

Photo 5-2　　GPS Observation

(1)　The results of Land marking and pricking points

Of the 41 points, 10 points were not visible on the photographs. As for that, there might have been a cause in the defect of the setting of the land marking. However, it was judged that 31 points was enough number of control points for the Bundle adjustment of aerial triangulation.

(2) GPS Observation

41 control points were observed by GPS with dual frequency. 14 sessions of GPS observation were carried out. According to the map specifications, Control Point Survey, the precision of the observation of each session is stipulated less than 2 cm ±Base line Length x 10 ppm as a loop closure.

(3) Description Sheet

The coordinates of land markings and pricking points were recorded in a description sheet so that the results of the calculations would serve as photo control points for the aerial triangulation.

(4) Pricking of the GPS leveling Points

To secure the precision of the elevation (Mean Sea Level) for succeeding aerial triangulation process, a pricking work of the GPS/leveling points was implemented.

(5) Methodology of a calculation of orthometric height

The existing GPS/leveling points, which VERTICAL DATUM PROJECT established in 2000, have only ellipsoidal height. Therefore, the geoid height of GPS/leveling points in the study area was required so that it could be converted to a orthometoric height from the ellipsoidal height. After creating a local geoid model and contour line, the orthometoric height of each point were calculated by an interpolation method.

5-5 Aerial Photograph Scanning

The aerial negative film used was black and white at a scale of 1/40,000 and Color at a scale of 1/20,000. Images were scanned using Vexcel UltraScan5000 Photogrammetric scanner with 20 microns. 288 colors and 814 black and white aerial photographs covering the study area were stored in HDD as a backup data. The scanned data will deliver in 2006.

5-6 Aerial Triangulation

The Study Team collected existing photographs and the results of aerial triangulation for the plotting process. The Study Team found the some area had no results of aerial triangulation in the existing photographed area. Therefore, additional aerial triangulation was carried out in existing photographed area.Block 1, Block 2 and Block 3 are original plan of aerial triangulation area in new photographed area. Block 4 and Block 5 are additional area. After all, aerial triangulation divided 6 Blocks.

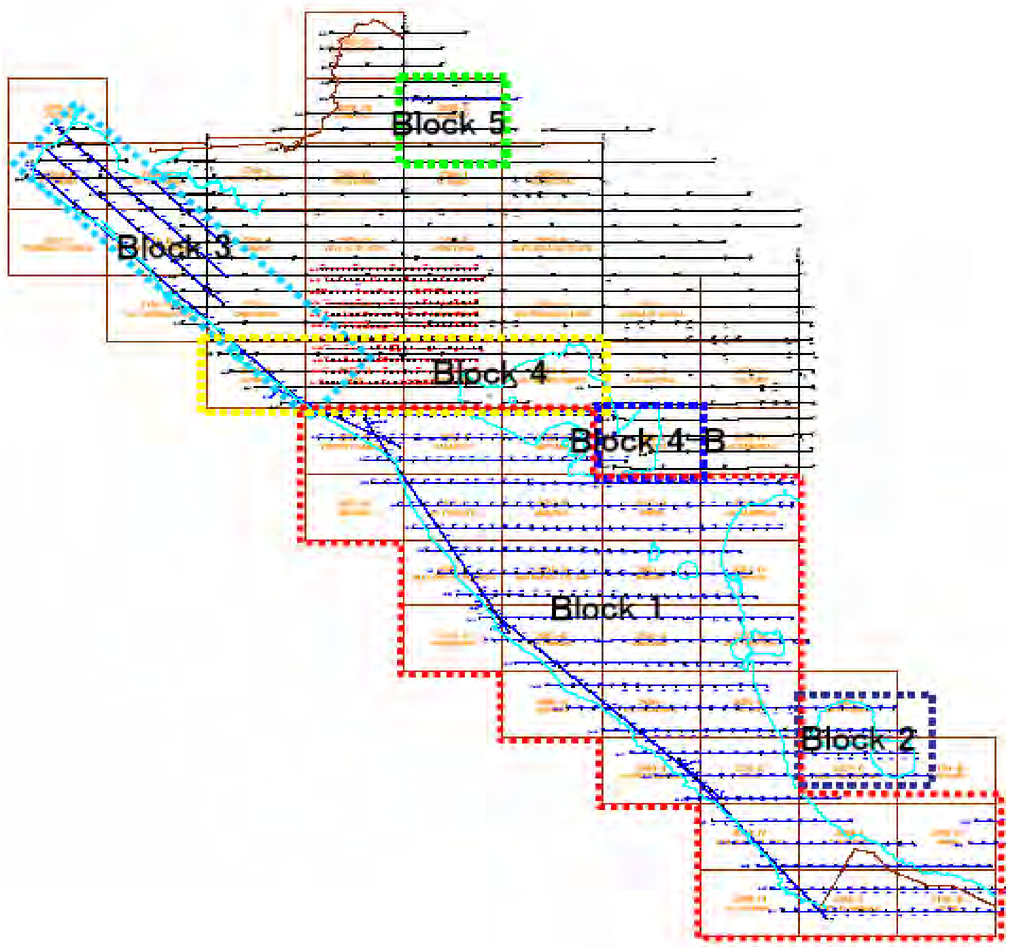


Figure 5-3 Aerial Triangulation Blocks

Residuals at Control Points used are summarized in Table 5-2.

Table 5-2 Residuals at Control Points Used for Bundle adjustment

BLOCK_1	RMS control points Standard deviation	MAX. Residuals
Sub block-1		
X	0.422 m	0.770 m
Y	0.277 m	0.495 m
Z	0.627 m	0.928 m
Sub block-2		
X	0.212 m	0.265 m
Y	0.212 m	0.296 m
Z	0.287 m	0.347 m
Sub block-3		
X	0.202 m	0.360 m
Y	0.229 m	0.366 m
Z	0.319 m	0.383 m

BLOCK_2		
X	0.316 m	0.515 m
Y	0.468 m	0.804 m
Z	0.510 m	0.941 m
BLOCK_3		
X	0.331 m	0.566 m
Y	0.175 m	0.281 m
Z	0.599 m	0.826 m
BLOCK_4		
X	0.636 m	1.156 m
Y	0.474 m	0.877 m
Z	0.549 m	0.553 m
BLOCK_4B		
X	0.226 m	0.498 m
Y	0.343 m	0.715 m
Z	0.393 m	0.958 m
BLOCK_5		
X	0.672 m	0.987 m
Y	0.536 m	0.942 m
Z	0.731 m	0.984 m

According to Specification, which agreed between the Study team and INETER, the standard deviation of at control points residuals shall be less than 0.2 ‰ of flight height. Maximum shall be less than 0.4 ‰of flight height. Therefore, the result of aerial triangulation was fully satisfied with the specification.

5-7 Preparation of Ortho-photographs for Field identification

Ortho-photographs at a scale of 1/10,000 were available in existing photographed area. The study team decided to create new ortho-photographs at a scale of 1/25,000 for the field verification in new photographed area. For the creation of ortho-photographs, DTM was generated using the aerial triangulation with 50 m grid spacing The DTM generation process was done fully automatically. Rectifying was performed using Inpho's OrthoMaster software in a fully automatic way. OrthoVista software uses advanced image processing techniques to automatically adjust and combine ortho-photographs of any source to one single seamless mosaic.

In order to cut the data according to the final map sheet division the data was first converted to Grid-format using ArcInfo. After cutting the ortho-photographs were saved by map sheets in Tiff-format.

5-8 Field Identification

The field identification was divided in two areas with existing photo area and new photographed area. The existing photo area was carried out from January to March, 2004 by the 4 field team. The new photographed area was carried out from July to August 2004.

(1) Field work

Methodology of the field identification consisted of two methods. One was a conventional method using two times enlargement of aerial photography and existing maps. Another way was to use existing and new ortho-photographs together with handy GPS. Ortho-photographs at a scale of 1/10,000 were used for the existing photographed area and ortho-photographs at a scale of 1/25,000 were prepared for the new photographed area.

Photo 5-3 Field identification

Figure 5-4 Ortho-photographs

(2) Arrangement of the field results

For the succeeding plotting work, the field results was checked and arranged in office. It was necessary to edit the location data of several objects which were collected by Handy GPS in the field. The editing process was done to compare the point coordinate and background image (ortho-photographs) using by MicroStation software in office.

5-9 Digital Plotting

(1) Plotting for Planimetric Features

Plotting work for planimetric feature such as road, river, lake, building, vegetation and other ground objects were acquired referring to the field verification results by three dimensional model of the air photograph. A sample of the planimetric feature data is shown in Figure 5-5.

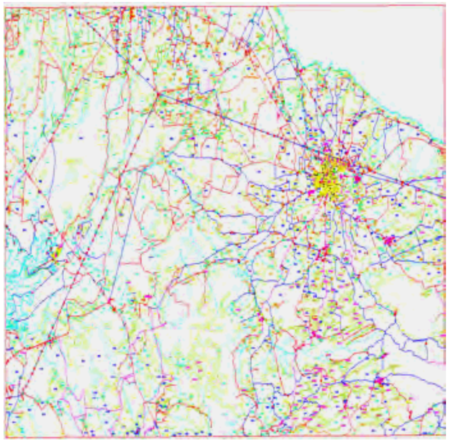


Photo 5-4 Digital Plotting Work　　　　Figure 5-5 Planimetric Feature

(2) Contour Delineation

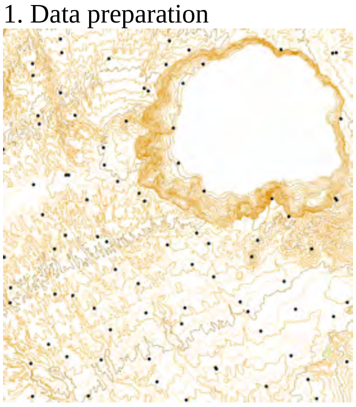
Originally, the methodology of contour delineation was planed to use an automatic Digital Terrain Model (DTM) module in digital plotting systems. However, it was found big discrepancy of automatic DTM and actual ground height in some forest area. In the case of big discrepancy, more than 5m, the accuracy of maps was expected to become to low accuracy than specifications. Therefore, Manual contour delineation method was used with three-dimensional view.

(3) DEM Generation

In this study, TOPOGRID command which is one of function in ArcInfo was used for generating DEM data with the use of contour and spot height data. Its grid space is 20 meters by requesting from INETER.

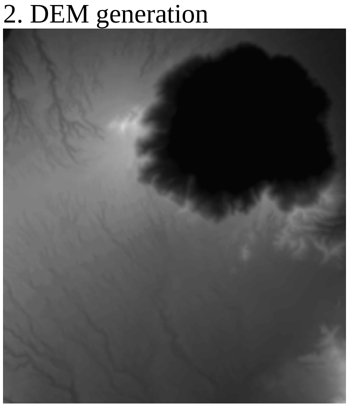
After generating DEM in ArcInfo, the data has been edited in ERDAS IMAGINE for providing constant value to the flat area such as surface of lake and sea .

1. Data preparation



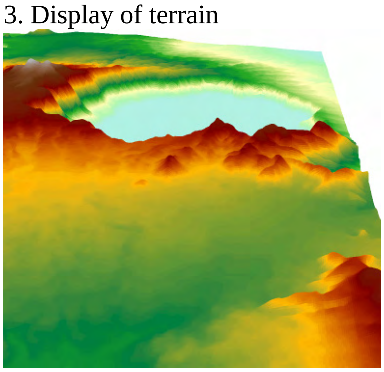
Contour & Spot height data

2. DEM generation



DEM(ArcInfo grid format)

3. Display of terrain



The bird's-eye view of DEM

Figure 5-6 Work Flow of DEM Generation

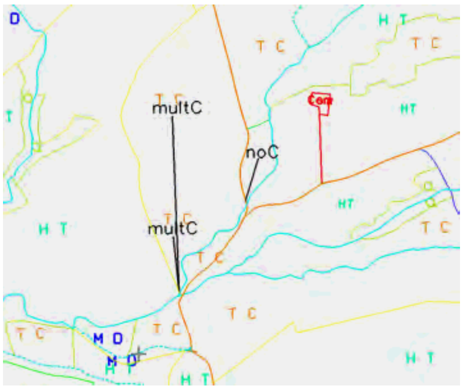
(4) Vector Data Editing

Plotting data were edited using CAD system, such as "MicroStation" and "AutoCad".

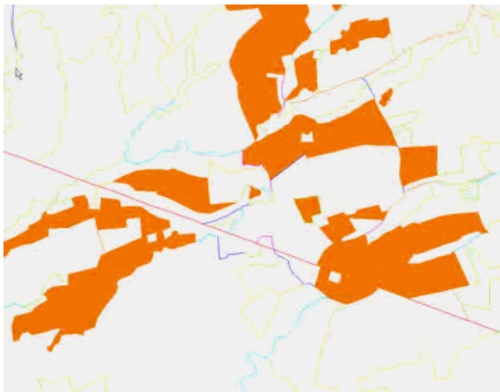
That is data cleaning and polygon data creation from plotting data. Data cleaning was executed using Mocrostation GEPGRAPHICS by the following seven steps.

STEP-1	Data conversion
STEP-2	Duplicate Linework
STEP-3	Find Linework Fragments
STEP-4	Thin Linear Element
STEP-5	Segment Linear Element
STEP-6	Data Gaps
STEP-7	Dangles

After cleaning the data, Topology structure was checked by using the Validate Topology Tool. Several kinds of warning code were shown in the case of un-completed polygon. Referring the following warning codes, data was edited by manual and automatic method.



Topology checking with warning code



Created shapes of one Layer

Figure 5-7 Topology Checking and Created Shapes

5-10 Map Symbolization

The topographic map data were symbolized in accordance with the map symbol application rules for five (5) colored print maps. Adobe Illustrator was used for the map symbolization as editing software.

The various compiled DXF layer data that had been acquired at the stage of vector editing process were converted to Adobe Illustrator files. In addition, the other data such as political boundaries, village names, and annotations were also converted to separate Illustrator files. All of these layer files were then combined within Adobe Illustrator to create a single file for each specific map sheet. Symbol coloring, line types and pattern fills were all created, configured and applied using Adobe Illustrator. Sample map of symbolization is shown in Figure 5-9.

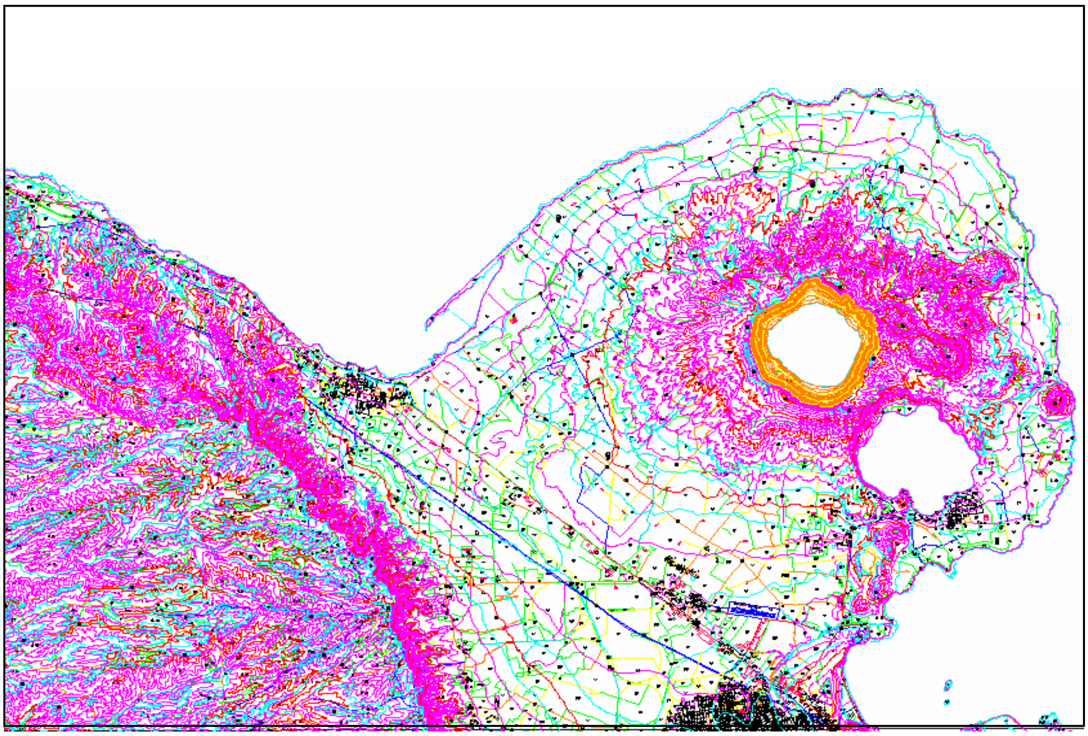


Figure 5-8 Plotted Data (DXF) of Map Sheet Name "MATEARE"

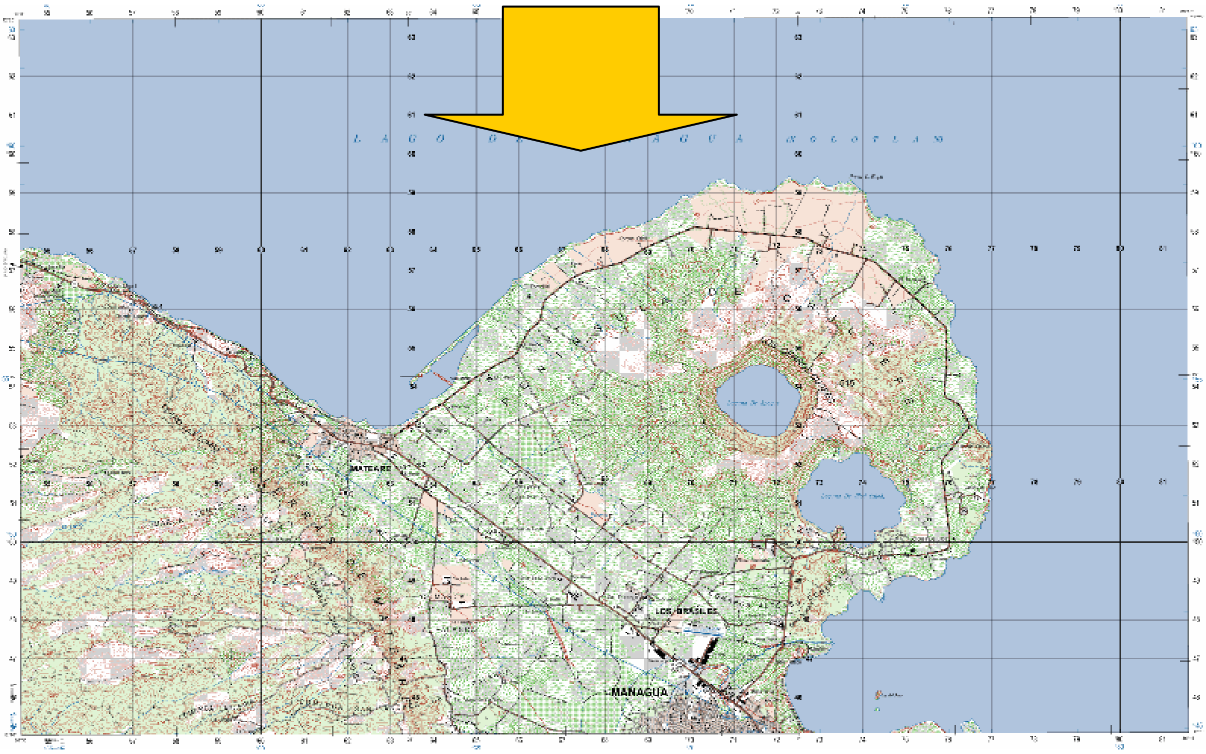


Figure 5-9 Symbolization Sample Map Sheet Name "MATEARE"

5-11 Field Completion

After digital plotting, vector editing and map symbolization, the field completion was carried out. This is the process to make final data to be presented in topographic map by checking and correcting in the field using the symbolized draft maps. The Study Team brought three sets of 60 symbolized draft map sheets from Japan to Nicaragua in the beginning of October. Using these sheets, the Team members and INETER counterparts in closer cooperation performed the field completion process from October to December 2005. Field completion was carried out for following items.

1) The objects such as school, hospital, factory, church, bridge, cemetery and other items.
2) The road classification
3) Annotations without their correspondent symbol
4) The objects to be annotated with abbreviations such as hospitals and schools without their correspondent symbol
5) Vegetations along surveying routes were checked. After finishing the field work, all the information verified was arranged using the duplicate copy of draft maps for Supplementary digital plotting.

5-12 Supplementary Digital Plotting and Map symbolization

(1) Supplementary plotting work

After field completion, Supplementary digital plotting was performed using the results of field completion material in Japan. This is the process for correcting, adding and deleting topographic map features. The works were performed referencing to the results of field completion for preparing of the final DXF data for map symbolization and creating the GIS database.

(2) Supplementary Digital Map Symbolization

After field completion and supplementary digital plotting, supplementary digital map symbolization was performed in Japan. This is the process for correcting, adding and deleting topographic map features, map symbols, and all sorts of annotation such as toponymy and abbreviations on the draft symbolized maps. The works were performed using the final DXF data obtained through the above mentioned supplementary digital plotting and the results of field completion indicated. INETER and Study Team discussed about other necessary supplementary item such as map feature and Marginal information for final map symbolization. Map symbols and road classification were change according to the results of field completion. Route marker was added to refer to the existing maps. Concerning the annotation of toponymy, annotation of destination and new annotation were added and location and font size of toponymy was changed according to the result of indication from the field completion.

5-13 GIS Data Creation

The plotted DXF data were converted to ArcInfo coverage format by ArcInfo software and the GIS data were created in accordance with the rule of "GIS Layer Specification for Nicaragua Project v6.0 March 7, 2005" The adopted map projection was UTM, the adopted datum was WGS84, and the map unit was meter. Main processes of GIS data creation are explained in Figure 5-10.

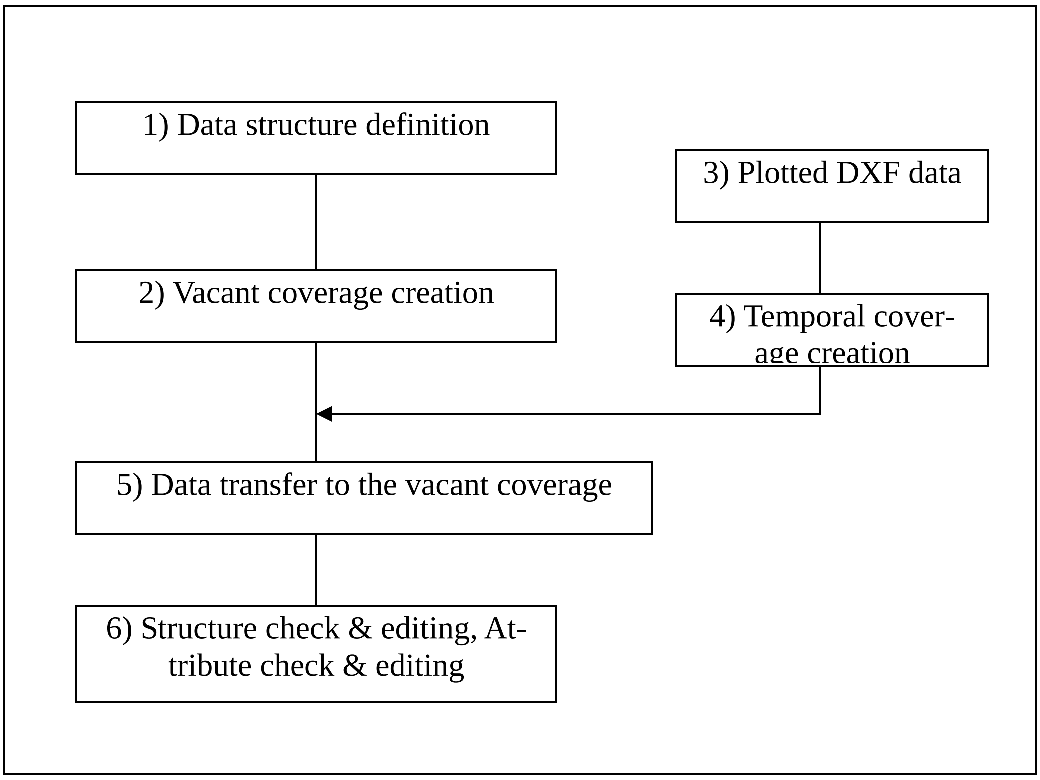


Figure 5-10 Process of GIS Data Creation

5-14 Film Output for Map Printing Plate

The final map data of Adobe Illustrator were converted to EPS (Encapsulated Post Script) file for the film plate making. Through Raster Image processor (RIP), Color separated negative film was prepared at the resolution of 3000 dpi by Image setter which is a high resolution laser printing devise. The map data consist of Cyan, Magenta, Yellow and Black (CMYK) and the Sepia were plotted onto negative film for each color.

For checking the negative film, each separated film was examined elaborately. In the case of any mistake, the film was re-plotted. Onto the negative film, the cross-shaped register marks were placed at the centers of out side of the neat lines so that exact multiple overlay printing would be possible.

5-15 Printing

The study team brought the negative films necessary for map printing so as to carry out the printing job in Nicaragua. The Study Team contracted a local printing company and produced the topographic maps, volcanic hazard maps and Earthquake Hazard Map by offset printing method. Flood Hazard Maps and Tsunami Hazard Maps were plotted by Color Ink jet plotter.

(1) Printing detail

Topographic maps and Hazard maps were printed to follow the agreement which was discussed with INETER on the Minutes of Meeting in November, 2005. Printing detail such as method, size, scale, scale and quantity were showed in Table 5-3.

Table 5-3 Printing detail

	Method	Type	Size	Scale	Quantity
Topographic Maps	Offset printing	60 map sheets	A1	1/50,000	500 for each map sheet
Earthquake Hazard Map	Offset printing	5 scenarios	B3	1/125,000	500 for each scenario. Total 2,500
Volcano Hazard Map	Offset printing	Lava flow	A0	1/100,000	200
		Pyroclastic flow, lahar and bomb	A0		200
		Tephra fall	A0	1/200,000	200
Flood Hazard Map	Ink jet plotter	Inundated area	A1	1/7,000	50
	Ink jet printer		Letter	1/3,500	50
Tsunami Hazard Map	Ink jet plotter	Corinto	A1	1/50,000	125
		Puerto Sandino			55
		Masachapa			45
		San Juan del Sur			75