

focus was not so much on detailed operating methods as on familiarization with MicroStation, so that the participants could gain an understanding of the characteristics of the data.

MicroStation is a CAD software application that differs in several points from the usual Windows software, such as in the user interface and method of use. Therefore, it was decided to use practical compilation work rather than theoretical explanation to give an understanding of basic operating procedures, the features of the software and data structure.

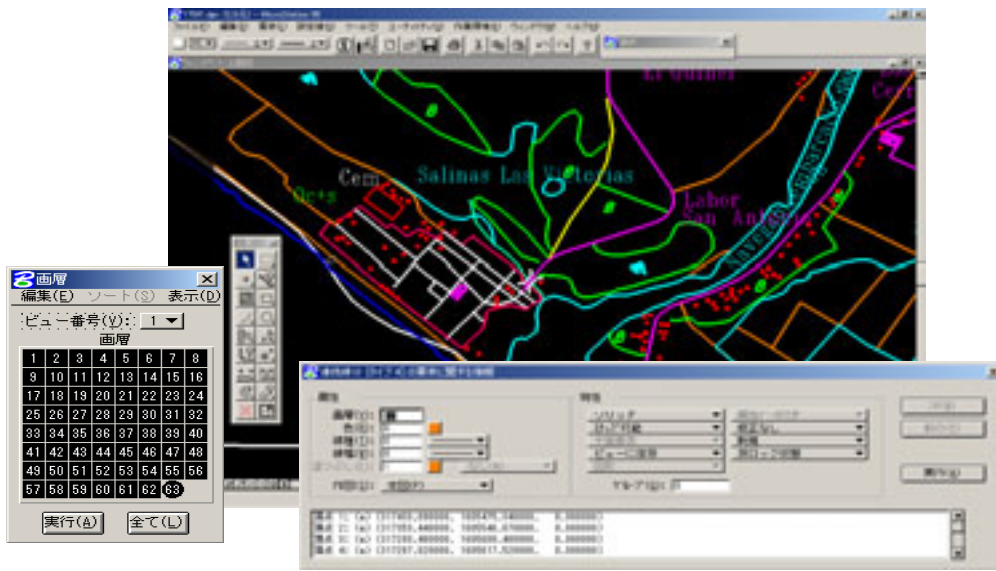


Figure 2.4-40 The MicroStation Interface

d) Use of GIS software

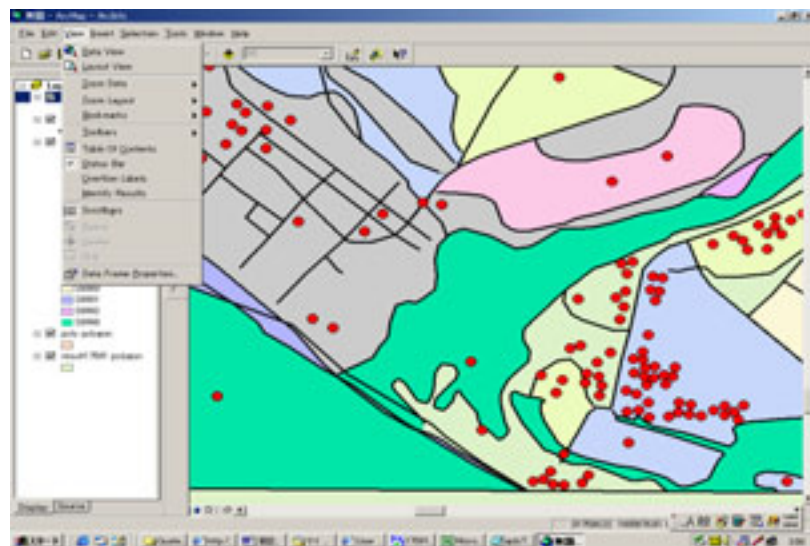


Figure 2.4-41 The ArcMap Interface

Following this, technology transfer was carried out using ArcMap, the latest version of ArcInfo. With regard to ArcInfo too, stress was placed on the participants' gaining experience in the features of the GIS software rather than on mastering detailed operating procedures. ArcMap is an improved version of the former ArcInfo (a command-based interface) to a GUI (graphical user interface), with a marked improvement in operability compared with the command-based interface.

The GUI allows the next task that is to be carried out to be displayed on the screen by clicking on a menu or icon, ensuring very easy, intuitive operation. Here, the aim was to learn intuitively by learning about GIS using an easy-to-use software application (ArcMap).

Following this, the participants studied the structure of the interface peculiar to GIS software and compilation methods, carrying out basic file manipulation and compilation using the sample data that had already been constructed. Having mastered this, they learned intuitively what was possible with GIS through practical exercises in features characteristic of GIS, such as logical selection, inter-figure selection (overlay) and the creation of thematic maps. In addition, understanding was enhanced through the construction of 3-dimensional models using the various tools, analysis of gradients, sunshine, etc., and the introduction of examples of practical application.

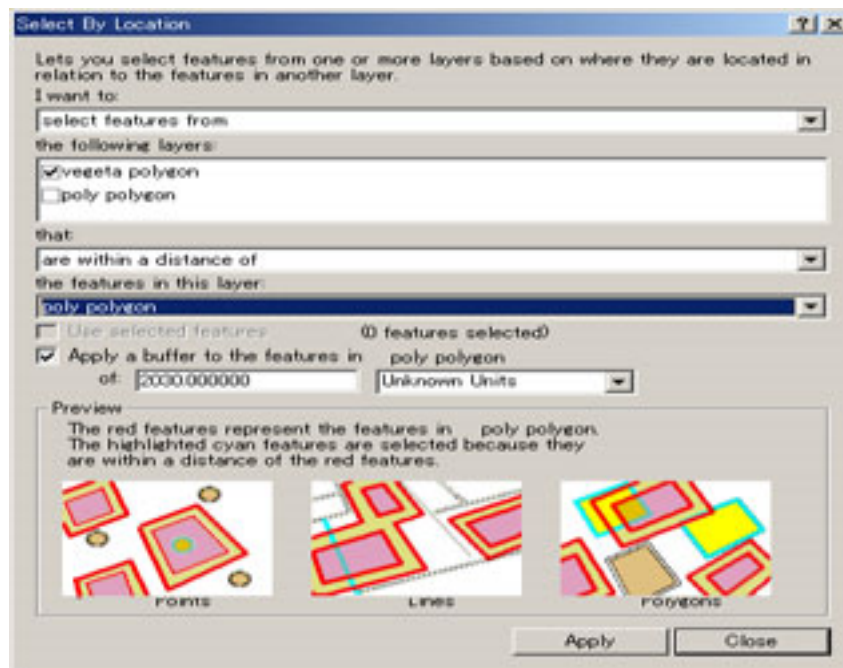


Figure 2.4-42 Example of specifications for inter-figure (overlay) selection tool

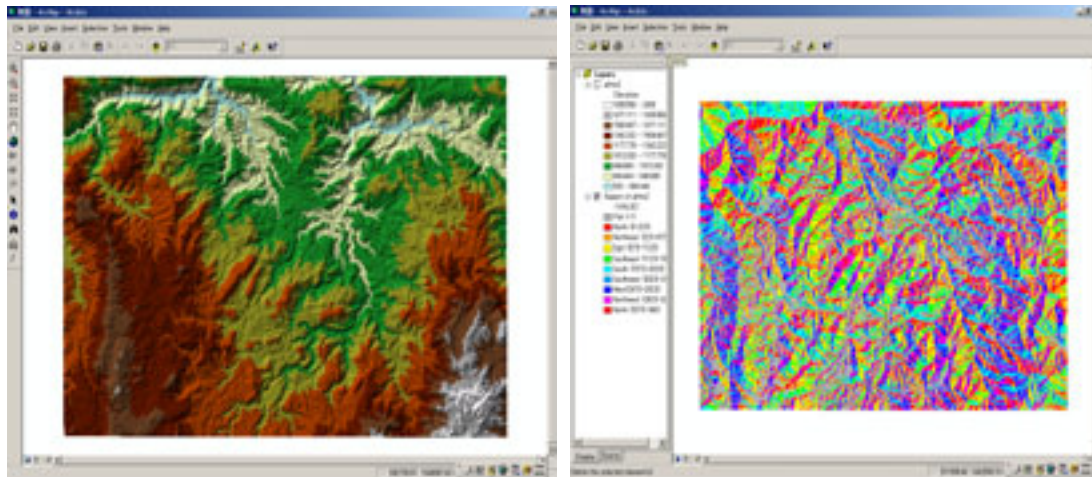


Figure 2.4-43 Examples of GIS application

#### 4) Problems

In the third field survey, technology transfer was concerned with relatively basic matters. The problem was that when the technology transfer targets all the participants, it is not possible to pass on everything, so that only a limited content was passed on. This was because it was surmised that the participants did not have much interest in the conceptual side of things. For engineers, who specialize in the conventional handicraft-type techniques and tasks, the most interesting thing seems to be jobs in which they can actually use their hands. Based on this observation, it was decided that starting from the fourth field survey, the method was changed to one promoting intuitive understanding through as much practical work as possible.

### (2) Technology transfer on structuralization/GIS application

#### 1) Outline

Based on the experiences of the technology transfer carried out in the third field survey, in the fourth field study, skills for practical operation and data compilation were transferred. The final goal of this lecture was to master the technology to convert the MicroStation Design File into the ArcInfo Coverage format.

The process of converting the MicroStation Design File into the ArcInfo Coverage format was a very important part of this Project. For complete understanding of this process, the participants had to be well versed not only in the characteristics of both the Design File and Coverage and the differences between the two, but also in the conversion process.

#### 2) Features of the Software Used

The ArcInfo Workstation was used in this process. This software uses not the normal

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GUI (Graphical User Interface) used widely on Windows, but the CUI (Character User Interface: operated by typing commands on prompt), used with WindowsNT or higher.

The CUI uses a language unique to the system, and communicates with the computer through characters (commands). For this reason it is highly likely that beginners will find it relatively difficult to operate. However, the CUI has several advantages; for example, a complicated processing procedure can be described, or a series of processes can be arranged in order. Therefore, for engineers who normally use the CUI it has better operability than the GUI, while it is foreseen that for less experienced engineers it will be a relatively high hurdle.

Nevertheless, as was mentioned earlier the lecture also targeted engineers who were not familiar with computer operation, so in the first half of the fourth field survey the main purpose was to first of all familiarize the engineers with computer operation, while in the second half explanations were given and training undertaken regarding background knowledge, data structure and programming. Compared to the third field study, the content of this lecture was of a higher degree of difficulty. Because of the large number of participants, technology transfer was carried out in 3 cycles, each cycle lasting 8 days. For those engineers of a higher technical level, a separate time was set aside in which technology transfer in programming was carried out. A summary is given below.

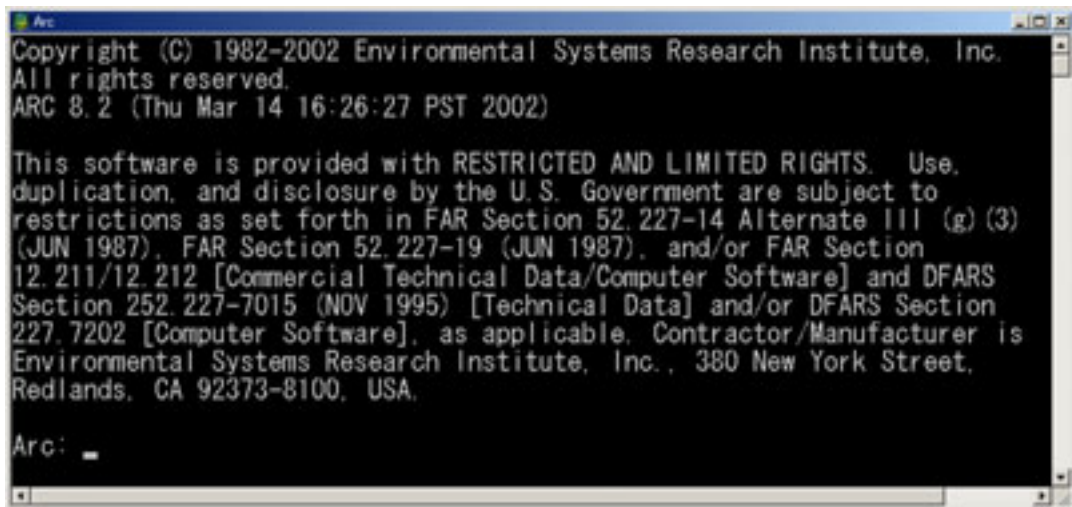


Figure 2.4-44 Character User Interface (CUI) on the ArcInfo Workstation

### 3) Content of study, and timetable

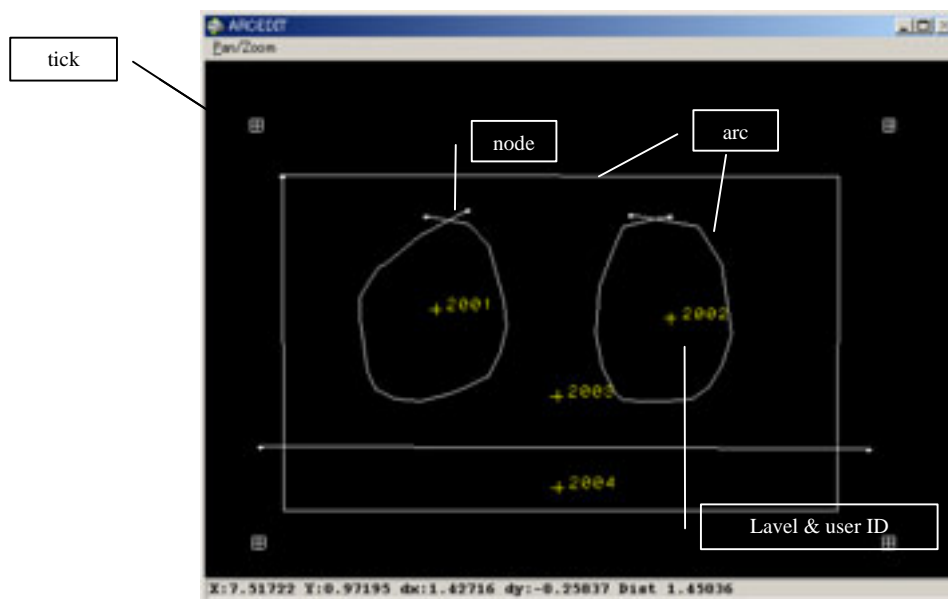
Fourth field study: Conversion / structuralization – Conversion to GIS database

- GIS database (ArcInfo Coverage) architecture
- How to configure GIS database (ArcInfo Coverage)
- Structural differences from national base map database (MicroStation Design File)
- Conversion to coverage, structuralization

**a) The database architecture and its configuration**

The first 4 days of the lecture were used to carry out technology transfer regarding the GIS database architecture and how to configure it. An attempt was made to have the participants gain an intuitive understanding of the features and architecture of Coverage by actually configuring the ArcInfo data (Coverage format) from the ground up. The greatest problem in learning something unknown is the psychological awareness of one's weakness in the subject. If the focus is only on detailed operation, the meaning of the technology transfer will be lost. To avoid this problem, priority in the first half of the lecture was placed on gaining familiarity with the software and its operation, through the repeated configuration of simple data.

First, a lecture was given on the proper insertion of the essential elements that form Coverage, and then time was allotted for the participants to gain an understanding of each element in the course of this. First, the ticks that form the basis of the Coverage architecture were put in place, after which the other elements (points, lines, polygons and IDs) were configured. In addition to the subsequent work of data compilation, technology transfer was carried out on the significance and role of the topological structure, which is indispensable for GIS.



**Figure 2.4-45** Sample of test data configured on the lecture



FID	Shape	FNODE#	TNODE#	LPOLY#	RPOLY#	LENGTH	TESTCOV#	TESTCOV-ID
1	Polyline	3	5	2	2	0.262805	1	5
2	Polyline	6	2	2	2	0.227468	2	3
3	Polyline	4	6	2	2	0.204730	3	3
4	Polyline	5	7	2	3	0.139217	4	5
5	Polyline	6	6	2	4	5.354312	5	3
6	Polyline	7	5	2	3	5.275660	6	5
7	Polyline	9	1	1	2	2.805133	7	1
8	Polyline	8	9	1	1	0.241360	8	4
9	Polyline	1	10	1	2	8.561731	9	1
10	Polyline	9	10	2	5	5.715655	10	4

Figure 2.4-46 Attribute information after configuration of the structure (topology)

### b) Structural differences from national base map database (MicroStation Design File)

Prior to the subsequent conversion work, the architecture of the MicroStation Design File was reviewed. An explanation was given regarding the features of the Design File and the differences between that and the GIS data. In addition, a detailed explanation was also given as to what information was maintained in the conversion process and what information was lost. After these points had been touched on, an explanation was given on the method of acquiring the necessary information from the specifications of the national base maps.

\* A person interprets planimetric features from points (symbols), line shapes and annotations

\* The computer interprets planimetric features using information from an external database

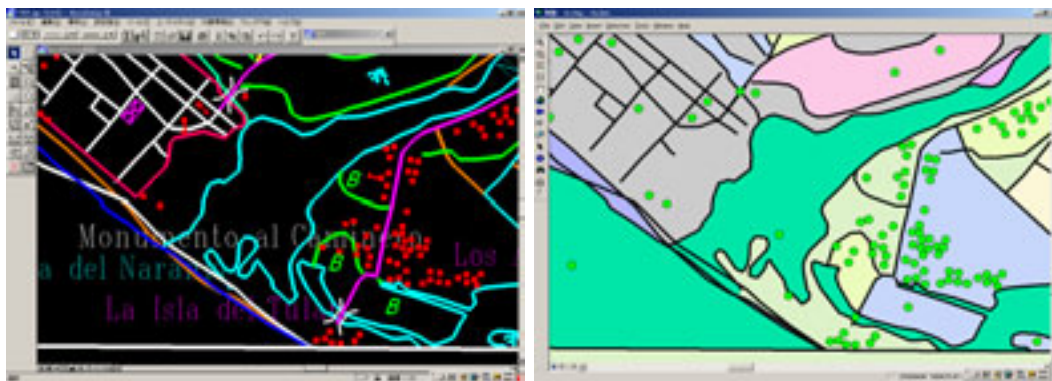
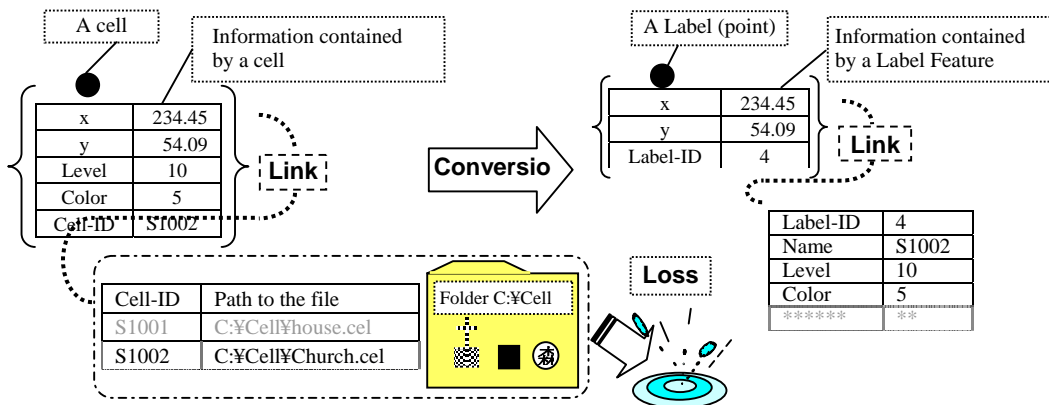


Figure 2.4-47 Differences between national base map(MicroStation)data and GIS (ArcInfo) data

**c) Conversion to Coverage, structuralization**

In the actual processing (for the Project), the files (74) that were divided into map sheets must be processed at high speed, so that it is necessary to create a program to carry out batch processing. For this purpose, technology transfer was conducted on the ArcInfo programming language, AML. As time was limited, only the minimum necessary for batch processing was covered; as in the first half, the participants mastered the meaning of commands through repeated operations.

On the final day of the lecture, the participants created a batch program for conversion that combined the techniques that they had mastered so far. However, in order to actually reduce the incidence of programming error, the batch program was a simple one, with as many steps as possible removed.



**Figure 2.4-48 Example of the transmission and loss of information in conversion work**

```
&args cov
&if [exists %cov% -cover] &then kill %cov% all

igdsarc %cov%.dgn %cov% 3d
6 6 * * * *

          * * * * 中略 * * * * *

54 22 54 22 * * *
63 63 0 * * *
~
y
y

&if [exists %cov%.tmp -file] &then &sys del %cov%.tmp
build %cov% point

&if [exists %cov%.pat -info] &then
joinitem %cov%.pat %cov%.acode %cov%.pat %cov%-id %cov%-id linear
build %cov% line

&if [exists %cov%.acode -info] &then
joinitem %cov%.aat %cov%.acode %cov%.aat %cov%-id %cov%-id linear
&if [exists %cov%.xcode -info] &then killinfo %cov%.xcode

/* &if [exists %cov%.acode -info] &then killinfo %cov%.acode

&if [exists %cov% -ANNOTATIONS.dgn] &then
dropfeatures %cov% anno.dgn geometry

&if [exists result%cov% -cover] &then kill result%cov% all
clean %cov% result%cov% 10 10 poly
```

**Figure 2.4-49 Conversion Program**

#### **4) Problems**

Throughout the technology transfer programs so far, a real problem has been the limited time period, together with the participants' level of proficiency in and enthusiasm for computers.

In actual terms, understanding of the technology transfer differed considerably depending upon the level of proficiency.

#### **(3) Transfer of technology in structuralization/GIS application (data correction) – conversion into printing data**

##### **1) General**

The technology transfer in the fifth field survey was made for items complementary to those found in the fourth field survey and the processes till their conversion into printing data based on the technology transfer of the fourth field survey. The level of technology transferred in the fourth field survey was high and it was difficult for some of the trainees to fully understand all matters. It was thus unavoidable to review the training items in the technology transfer in the fifth field survey. As a result, the technology transfer in the fifth field survey covered a wide range of items from data structuralization to data conversion into printing data.

The training courses including the review training were prepared for all the trainees, among whom engineers with relatively high skill level were selected for the transfer of the technology in the data correction and conversion into printing data that were the original purpose of the technology transfer. The purpose was to cover any problems with data structuralization, acquiring the correction methods to solve those problems and converting the corrected data into printing data.

##### **2) Schedule of technology transfer**

###### **a) Basic course – Review of data structuralization**

The lectures were scheduled for 4 weeks in a cycle of 5 days per week. The first 3 days concerned mainly the review of the technology transfer items in the fourth field survey (understanding of ArcInfo data structure and acquisition of the structuralizing method). For the last two days, the work of converting MicroStation data into ArcInfo data was undertaken. In this course, the technology transfer was achieved so that trainees be able to recognize the difference of the GIS data from the CAD data explained in the former technology transfer training through the practical work of data conversion.



## b) Advanced course – Data correction and conversion into printing data

For the last three days (full days) in the fifth field survey, the transfer of technology in data correction and conversion into printing data was carried out to 5 engineers with high qualifications.

### b-1 Conversion by data type (MicroStation DGN → ArcInfo Coverage)

First, the transfer of technology in the methods of converting each data type of planimetric feature (annotation, cell, graphic (point, line or polygon)) and of grasping the error occurrence conditions of each data type were conducted.

ArcInfo contains the function for converting a DGN file into Coverage, and it is necessary to change the variables in the function according to the data type in the file being converted. Especially, data types with large difference are annotations and other graphics. Annotation texts can be converted into an annotation layer of GIS data as attributes linked with point data by adding the following variables to the conversion function.

```
IGDSARC "Source File" "Result File" 3D # # # # # 100
3 3 * * * 17 Item TextBoth SaveZ
~
~
end
```

Added variables

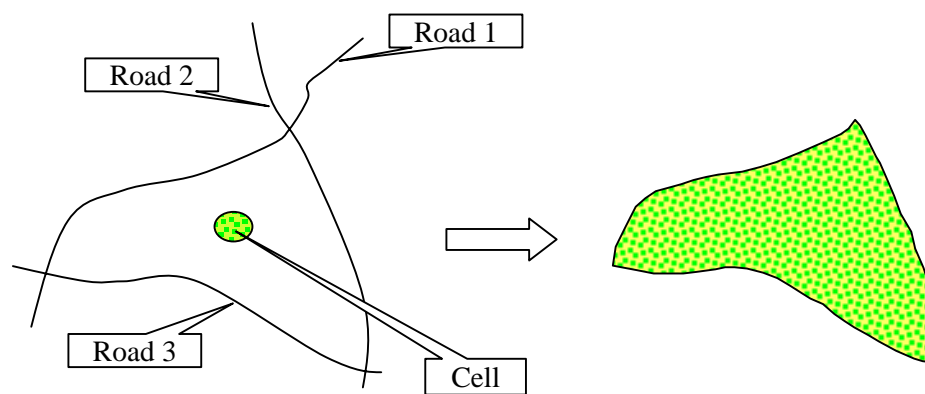
The main difficulty in this project was how to structuralize the area as GIS data in order to represent a specific planimetric feature. On a topographic map, an area representing an unspecific feature can be represented by line segments. This item had been explained in the former technology transfer, but the trainees were unable to realize the CAD data structures and understand the importance of this technology. Therefore, the practical work of converting the data prepared in this project and configuring and correcting polygons increased the understanding of the trainees.

When creating a polygon from the existing data, ArcInfo checks on the existence of a closed figure and creates a polygon with its boundary formed from the outer circumference of the closed figure. In this manner, it is important to define how to form the information on a given polygon. It is possible to create a polygon with a phase structure even if it is a single closed figure, but the information to specify an individual polygon is missing.

In the basic course, the ArcInfo functions were examined so that a polygon (to which the phase structure was added) could be created in existence of its closed figure and that the closed figure could include representative points called labels to represent the property (such as ID) of the polygon, creating thus the polygon with its unique property. It was also studied that the attribute data (such as level, color and cell number) of a cell digitized

as representative points and maintained on the design file were inherited even after conversion within Coverage as an external attribute table, when a cell was converted into GIS data (by Arc/Info Coverage). The trainees could understand that if representative points existed in a closed figure, ArcInfo could configure the polygon using the information maintained by the representative points as its ID.

The trainees could learn how to reconfigure a polygon with the information of a planimetric feature so that when representing an area such as forest or field on a topographic map by means of the properties described above, the cell corresponding to the planimetric features were converted to GIS data by placing the cell in the closed figure forming such area and the area was reconfigured through the actual data.



**Figure 2.4-50** Reconfiguration of GIS polygon from an area on topographic map

### **b-2 Data correction: Creating of node – Trimming**

The technology transfer was also be conducted on typical problems caused in conversion of CAD (MicroStation DGN) data into GIS data as well as the method of correcting those problems.

As described above, it is difficult to create the data structures required for GIS data such as creation of intersections (nodes) and data adjoining under CAD software. Therefore, it is necessary to correct manually the data converted into GIS data.

In conversion from CAD to GIS data, main problems with data structures were encountered: 1) there is no intersection point in the data structure if two lines are intersected in a two-dimensional space; 2) there is no contact point if lines contact on each other; 3) data overshoots; and 4) data undershoots. The method for correcting these problems is not difficult because the problems can be solved combining the basic operations.

However, the method to select a data error constitutes another problem. In this project, 200 to 300 or more data errors were encountered per file (map sheet). It was an inefficient method to search for and correct these errors one by one on each map display on

a screen without prior processing.

ArcInfo has the functions of detecting and displaying lost nodes and node errors, which can be used to process lost nodes, overshoots and undershoots. In 1/50,000-scale topographic maps, the line elements within a certain range may have data errors with high probability. The efficiency of error processing can be enhanced surprisingly in batch processing of these errors selected depending upon the conditions. Thus, the technology in the logical selection of these errors and their processing into batches if possible was also transferred.

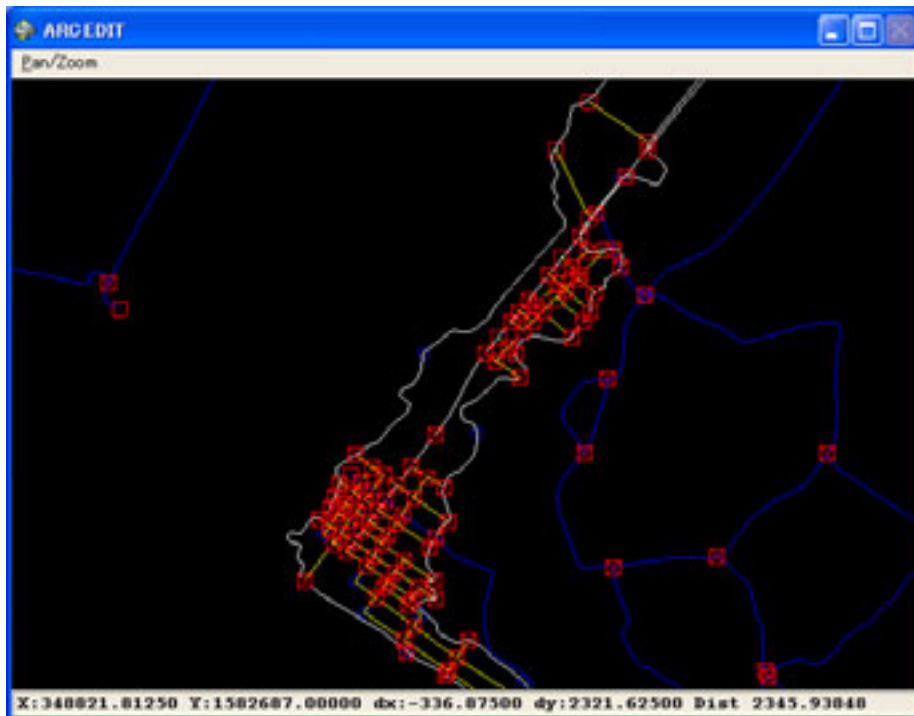


Figure 2.4-51 Error display on ArcInfo

### b-3 Data correction: Data adjoining – Creation of network data

For the planimetric features such as transport modes including roads that are configured as a network, it is necessary to add a network structure called route as data. However, the data converted from CAD data caused no problem, but the continuity of each line has not been secured. To solve this problem, it is necessary to detect the points of discontinuity and adjoin the line end points at each coordinate point. As described in b-2, the line elements with continuity are displayed as node errors. Thus, the technology that gives continuity to all the line elements displayed as node errors in a manual work was transferred to the trainees. The technology in securing the line continuity and selecting necessary data is a combination of basic operation skills as described in b-2.

The technology in selecting necessary elements after the line continuity is secured and in adding the attribute information unique to route data was also transferred.

### **3) Problems**

The problems occurring through this project related to the technical level of engineers and their level unmatched with the required technical level.

As described previously, the mobility of workers is high in Guatemala and it is also undeniable that a certain technology acquired by specific staff members in IGN had not been spread in IGN and run out of it often. Therefore, the Study Team was informed of the intention of the Cartography Division, as counterpart of technology transfer, to have the technology be transferred to all staff members.

The technology transfer in this project was undertaken according to their intention, but the actual progress of technology transfer depended upon the technical levels of the staff. As a result, it was impossible to transfer all the technologies corresponding to the actual works in this project.

### 2.4.5 Digital printing

Technology transfer on the process of producing the master plates for printing from the digital data was started in the fourth work in Guatemala.

Twelve engineers from the IGN Cartography Division participated in this technology transfer program. Up until now the production of master plates for printing at IGN was all done using analogue technology, and the technology for the production of master printing plates from digital data was transferred to the engineers for the first time under the present project..

In training, the engineers learned how to process printed map data converted from the spatial basic information database and to prepare the topographic map data with the same map representations as in the printed maps. Many of the participants showed a strong interest in the fact that digital processing alone made possible the same map representations as conventional methods, and they worked hard to acquire the new digital technology.

#### (1) Transfer of technology for map symbolization and digital compilation (part2)

##### 1) Outline

The technology transfer in map symbolization/digital compilation to create the printed map data for the national base maps was carried out as described below. IGN, who had used only analog technology for printing, has no experience in this work, despite the high demand for technology transfer. To meet this demand, the technology transfer was done by preparing the practical manual and by using the hardware and software of the study equipment.



Photo 2.4-13 A technology transfer

In the technology transfer in the fourth field survey, the basic operation of AdobeIllustrator, which is the graphic software used for map symbolization and digital compilation, and an exercise to create the printed map data of the 1:50,000-scale national base maps were taken up. For the basic operation of the software, the basic software application method was explained and an exercise was done so those IGN counterparts could master the technology.

In the exercise of creating the printed map data, the data converted from the spatial basic information database was processed to create the national base mapping data, which was the same map representation as the printed map. It was the part of the national base maps except



for the marginal information outside the neat lines.

The technology transfer was carried out three times within seven days. For the first period of three days, the lecture and practice exercise of the basic operation of AdobeIllustrator were conducted, and for the second period of four days, the exercise of processing the printed map data was conducted using a sample data. This technology transfer program was provided to 13 counterparts in the Cartography Division.



Figure 2.4-52 Data processing using Adobe Illustrator

## 2) Details of technology transfer

### 1st day

The lecture and exercise on AdobeIllustrator, which is the graphic software for map compilation that JICA provided, was carried out. In this lecture, the technology the counterparts could learn in seven days was introduced by presenting sample maps that would be used for the exercise in the latter part of the schedule.

Since AdobeIllustrator was software that IGN would be using for the first time, it was explained from the fundamental level. This level is about the general operating procedures and functions including window architecture, toolbox, and various types of palette and menus. The terminology used in AdobeIllustrator was also explained in connection with other software.

In the lecture, the counterparts practiced the operating procedures by actual operation of the software to deepen their understanding and master the technology. They did not need to grasp all the functions of AdobeIllustrator from the beginning, but the main target of this lecture was set to layer classification and paint assignment as well as the minimum necessary functions

screened for map compilation. In the exercise, much time was allotted to master the use of the pen tool and the selective tools to better understand “path” as one of the features of AdobeIllustrator.

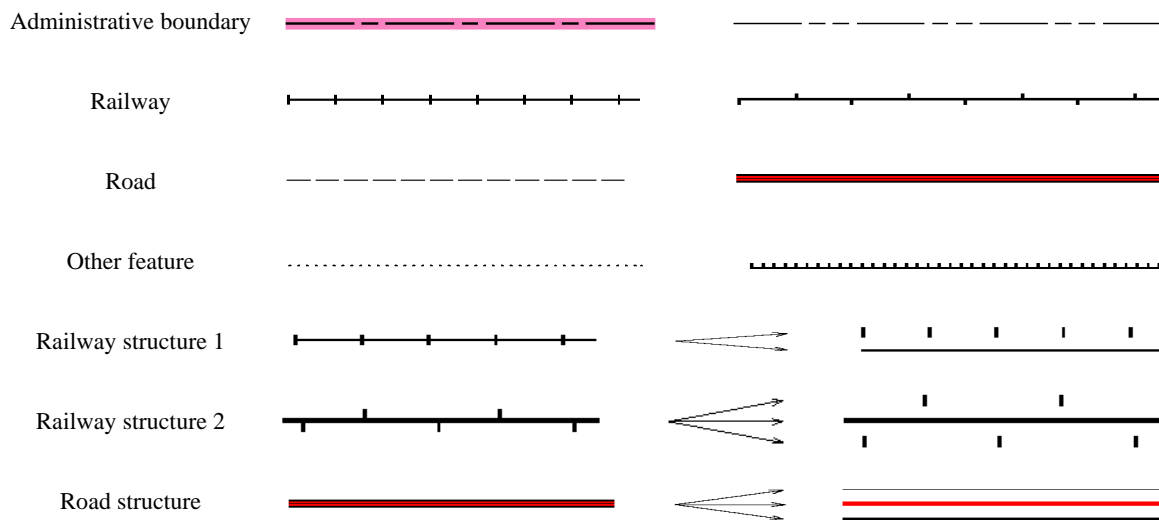
**2nd day**

For the first half-day period, the symbolizing techniques to represent the mapping features such as administrative boundaries, railways and roads were explained and practiced. The exercises on color setup using the color palette and the point, broken line and chained line setups using line type palettes were repeatedly done.

For railway representation, the methods of representing tics as broken lines and creating a parallel line to an original line to represent alternate left and right tics were explained. The method of representing a road as double lines was explained by drawing a thin line overlaid on a bold line. On the double-line road, it was explained that the overlay of a thin inner line on the bold outer line had a great significance and the operation of overlaying a copy line on an original line was repeatedly practiced.

For the second half-day period, the lecture and exercise on the methods of creating the specific colors (blue, brown and green) and using them in a printed map, and the methods of connecting two paths and integrating multiple paths were conducted.

For the specific colors, the difference between process colors with CMYK and the method of handling AdobeIllustrator were explained. For the path connection method, it was pointed out that if a path was cut off, a broken line was represented as a discrete line. It was also explained that the use of integrated multiple paths was necessary to represent a hollowed polygon (like a donut shape).



**Figure 2.4-53** Line symbols necessary for map representation

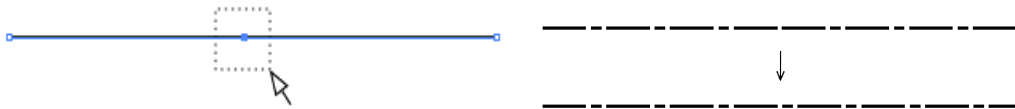


Figure 2.4-54 Processing of discrete lines

### 3rd day

During the first half of the day, the functions of locking and unlocking, and grouping and ungrouping were explained. Then, the creation of patterns was practiced. The locking and grouping functions are convenient to select objects, and the exercises of using the locking function to select overlapped objects and using the grouping function to handle multiple objects as one object were made. It was also explained that patterns were used to repeatedly draw the symbols used in a printed map such as vegetation. The method of creating some simple patterns was also practiced.

During the second half of the day, the layer operation and menu selection were practiced. As both functions were important repeated operations for the map compilation as explained on the 4th day, it was intended for the counterparts to master these operations without fail.

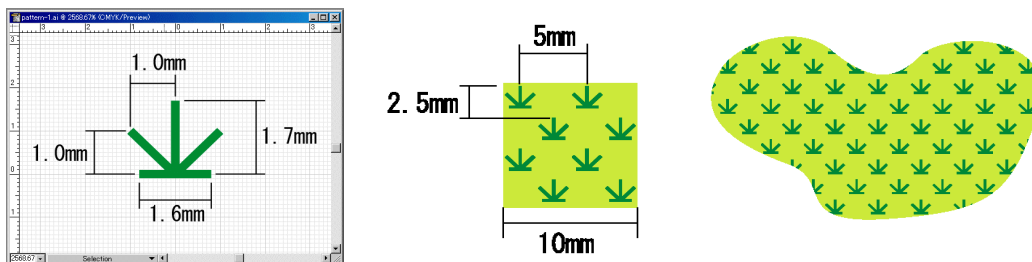


Figure 2.4-55 Creation of patterns

### 4th day

The exercise of creating mapping data for printed maps using the sample data in the map 2158-1 was done.

The sample data consisted of eight files converted from ArcInfo and MicroStation. The technology transfer in this study was targeted at acquisition of the data processing techniques using AdobeIllustrator, so that the explanation about the process of converting data from the spatial basic information database was limited to the minimum extent necessary.

The line data in the sample data consisted of 23 layers per file, and layer classification and paint assignment required repetition of similar operations. Therefore, a series of operations was lectured before each counterpart made the exercise. By doing so, it was considered that each of the counterparts could acquire the technique by processing the data individually.

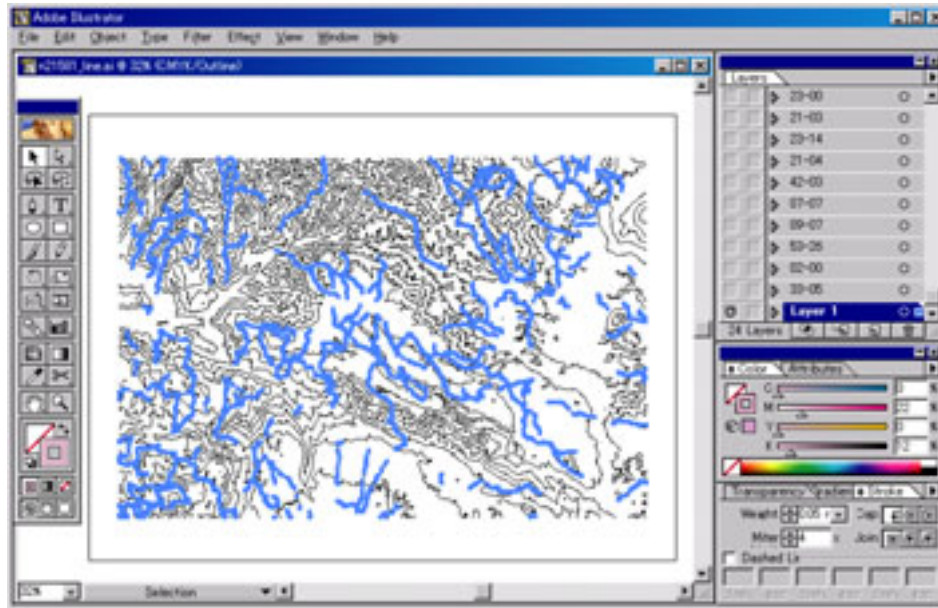


Figure 2.4-56 Example of processed terrain data

### 5th day

Following the processing of line data, the processing of polygon data was practiced. The polygon data consisted of two files, which were divided into seven and five layers, respectively. The processing operation of polygon data was similar to that of line data, but the detailed explanation of it was repeated before each counterpart did an exercise on the operation.

Then, the symbol data and text data converted from MicroStation were processed. First, it was explained that the data converted from MicroStation was represented in the RGB color mode, and the process to convert the data into the CMYK mode was made. The symbol data and text data consisted of a total of five files. No layer classification was made, but the color assignment and overprint setup were carried out. It was explained that AdobeIllustrator reproduced color and made no different stacking order among layers because the files were categorized by color without overlaying annotations with symbols. On the frame symbol for a road number, the work of replacing it with a closed figure was carried out using AdobeIllustrator because the frame symbols, except a circle in the sample data, were not closed figures.

### 6th day

The eight files, for which layer classification and paint assignment were completed, were integrated into one file and the stacking order of layers was adjusted in the exercise program.

In the explanation about file integration, the necessity of using paste on the upper layer and aligning the neat lines as common objects contained in each file was emphasized. On the

adjustment of layer order, it was explained that the casing of a dual-line road (an intersection of roads with a road width) should not be cut off by another road drawn later and that the intermission of lines in the case of overlapped contour lines, roads and rivers could be processed easily.

Next, the work, using a legend file, was explained. It was because the work should be standardized to ensure that the same layer architecture and the same paint assignment are set in accordance with the same specifications whoever would work on the mapping data for multiple printed maps. As one of the methods for this purpose, the method of preparing a legend file in advance was explained in stacking order to save labor and time in entry of layer names, paint assignment and layer order adjustment.

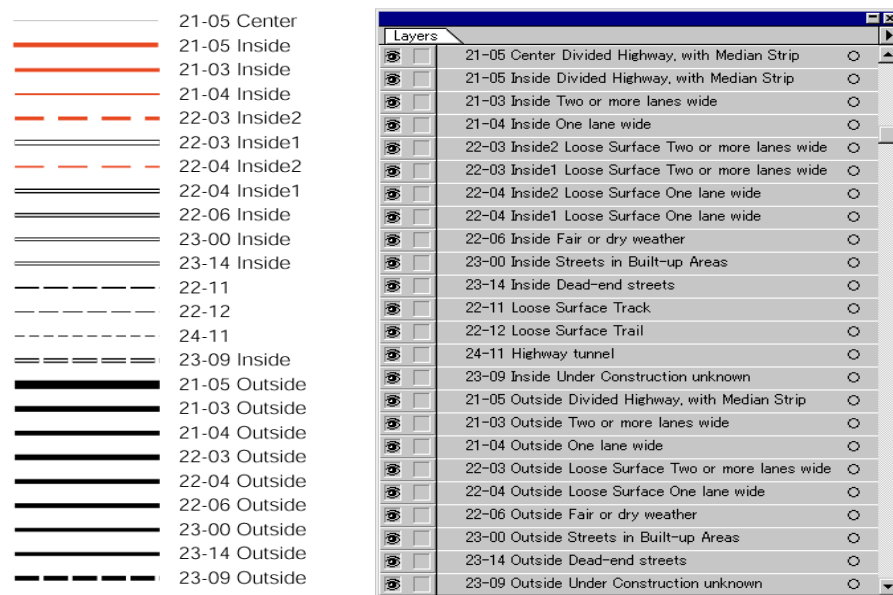


Figure 2.4-57 Example of layer architecture

7th day

The exercise of creating the register marks and color patches as necessary for printed matters was done. The method of outputting register marks at each positive film plate for printing after setting the overprint was explained and the significance of overprint was emphasized.

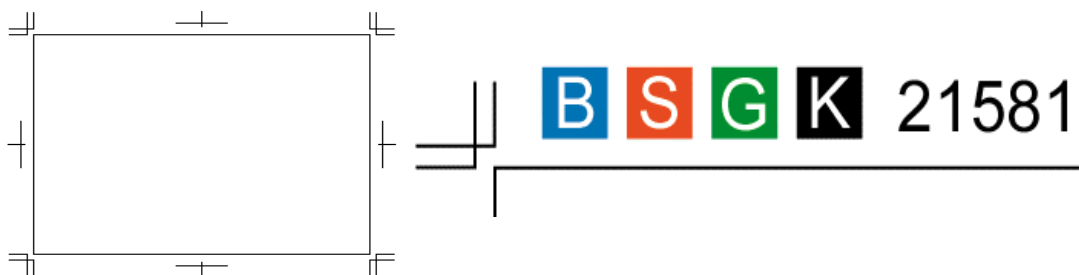


Figure 2.4-58 Examples of register marks and color patches



The 7th day was reserved in case the schedule up to the 6th day should be delayed and the work on the 7th day was planned in advance to have a lesser volume. If the technology transfer is completed as scheduled, the remaining time could be used for discussions with the counterparts. Thus, the 7th day was provided for question-and-answer regarding the exercises for the counterparts to review the technology acquired in the 6-day schedule.

### **3) Counterparts' understanding in technology transfer**

In the technology transfer program in this study, it is expected that all of 13 counterparts have understood and acquired the technology, though in different levels, because 11 members of them could operate the software in the environment of one PC set per member.

Not only the engineers who had been engaged in digitization using PC, but also those who had been in charge of analog drafting using Scribe, were interested in the process of creating printing plates from digital data. The study team was impressed with their positive attitude to cope with the exercises. The participation of many staff members of Cartography Division served to establish the technology of digital mapping and map symbolization/digital compilation using AdobeIllustrator as the common knowledge to IGN.

The counterparts that participated in the technology transfer program have different PC operation skills and mastering speeds, but all of them were able to master the basic operations of AdobeIllustrator through the lecture provided in this study. To establish the technology in IGN, however, it is necessary for them to be familiar with AdobeIllustrator by operating it repeatedly in the practical works.



Photo 2.4-14 Transfer of technology for map symbolization

In creating the mapping data for printed maps, the individual counterparts were different in their abilities in the work processes as described above, but it was expected that all of them could understand these processes because they accomplished all the exercises. In particular, they fully understood the layer classification and paint assignment through repeated exercises. For the process of creating patterns, the regular patterns that were easy to create were explained, and the method of creating complicated, irregular patterns will be explained and exercised in the next technology transfer program.

## **(2) Transfer of technology in map symbolization/digital compilation (Part 2)**

### **1) Outline**

For the technology transfer in the fourth field survey, the basic operation of AdobeIllustrator, a graphic software used in map symbolization/digital compilation, and the creation of printed map data for the 1/50,000-scale national base maps were undertaken. In the technology transfer in the fifth field survey, stress was placed on acquisition of the basic operation of software together with the review of the work flow in the last lecture including the explanation of digital printing flow and environment. For a better understanding of the software, the graphic design skill was also explained.

Trainees: 13 members of Cartography Division (divided into two groups of 7 members and 6 members)

Schedule: 10 days (3 hours/day) per group for all work processes

1st to 5th day – Lecture and practical training on basic operation of AdobeIllustrator

6th to 8th day – Practical training of printing data processing using sample data

9th day – Practical training of marginal information processing

10th day – Rechecking of important items

Distributed materials:

- Illustrator Basic Operation Manual and 1/50,000-scale National Base Map Compilation Manual
- Spanish-English Table of Illustrator Menu Commands
- Illustrator Tool Item Guide
- Marginal Information Creation Guide
- Summary of Important Items

### **2) Details of Technology Transfer**

#### **1st to 5th day – Lecture and practical training on basic operation of AdobeIllustrator**

The lecture and practical training were held basically in accordance with the manual prepared for the last lecture (the 1st – 3rd day in the last Progress Report).

Additional and supplemental items

#### **1. Lecture on outline of digital printing**

The lecture was made on the processes of DTP (desktop publishing), the reasons for

creating printed maps on AdobeIllustrator, software (including others than AdobeIllustrator) necessary for DTP and data flow, and film output and printing and the explanation was given on the screens of a projector.

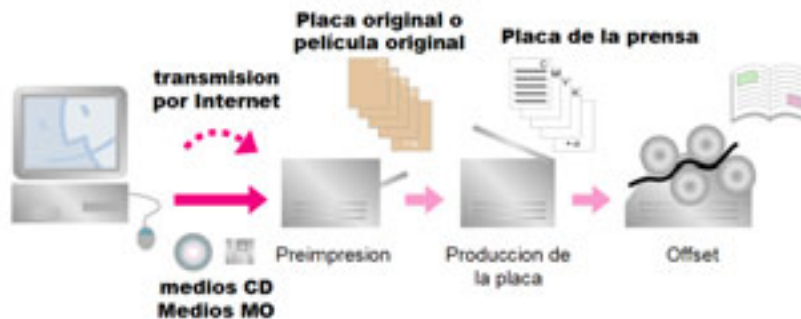


Figure 2.4-59 Digital printing process



Figure 2.4-60 Main software used in DTP and data flow

2. Explanation of menu commands

The Spanish-English Table of Illustrator Menu Commands was prepared and a sufficient explanation was provided for the menu commands frequently used, but explained briefly in the last lecture.

3. Recommendation for use of short-cut keys

The use of short-cut keys necessary to work efficiency was repeated in the practical training and familiar to the trainees. (Selection tool changeover, scroll, screen expanded/reduced display, copy and paste, view and non-view, lock and unlock, etc.)

4. Provision of pattern (shading pattern) samples

The sample file including patterns and original pattern maps before pattern registration was provided as a guide to pattern creation.

## 5. Preparation of practice practical trainings

In the last lecture, only the map compilation work was performed on Illustrator, but the practical training of drawing maps was not done properly. Therefore, the practical trainings of drawing maps using digital inputs were given to the trainees in order to deepen their understanding.

## 6th – 8th day – Practical training of printing data processing using sample data

The lecture and practical training were made basically in accordance with the manual provided in the last lecture (the 4th – 6th day in the last Progress Report).



Figure 2.4-61 Flow of printed map creation using GIS database

## Additional and supplemental items

### 1. Path patterns

The method of drawing path patterns was explained including narrow-gauge single-line railroads and cliffs as more expanded items than in the last lecture.

As a pattern drawing guide, a sample file containing patterns and original pattern maps before pattern registration was provided.

### 2. Map trimming (clipping mask)

The trimming method that is often used not only in the national base maps but also in other maps; in particular, the lecture and practical training on trimming in layer operation were provided.

### 3. Detailed check after map compilation work

A presentation has been made to explain why the data correction and fine adjustment after the map compilation work were mandatory.

Examples:

- Correction of line data converted from ArcInfo

100 or more line segments shows a line with line cuts. The displayed broken line segments of pedestrian sidewalks, rivers, administrative boundaries should be linked up.

- Nodes interesting bold and thin lines

The nodes intersecting bold and thin lines may result in errors in integrity. In this case, the data should be corrected to create a new “correction layer” for data maintenance.

#### 4. Map tracing

In the future development, partial (secular change) corrections in the national base maps will be required using the raster data as sketch data. Therefore, an explanation and practical training have been undertaken for the map tracing work when importing the raster data of existing maps into Illustrator.

### 9th day – Practical training of marginal information processing

The practical training for marginal information processing performed in the last lecture was undertaken in this project. This process begins with a rough arrangement of the “basic file” for marginal information on the map domain followed by rewriting of annotations of titles, latitude/longitude and other data and layer arrangement and ends with pasting of the data such as index maps from MicroStation.

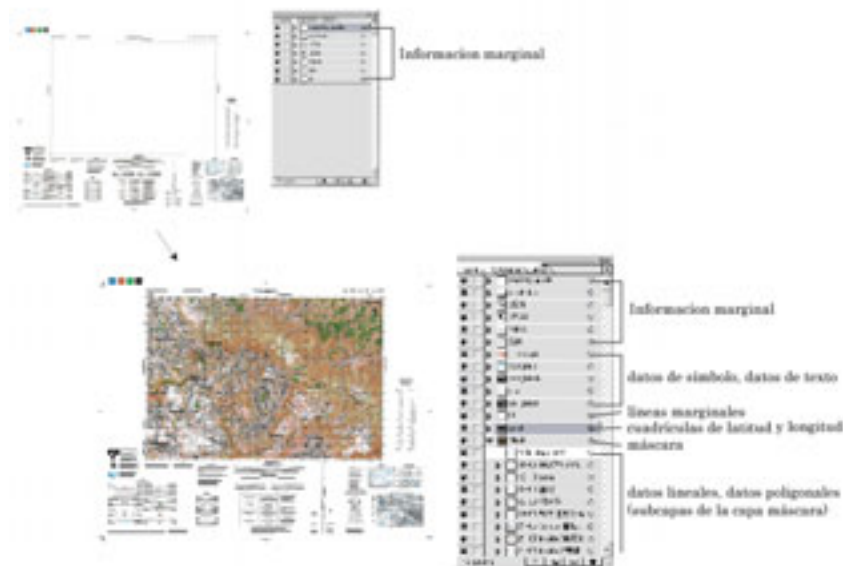


Figure 2.4-62 Marginal information arrangement work



As this process is also deserved as the final finishing process of making printed maps, the work was done keeping in mind to prepare the complete files capable of outputting the films. The final check was made whether black solids were overprinted and whether all objects were colored in 4-color separation (specified for the national base maps). The basic character typing methods (left-, right- and center-justify, character typing along a path, etc.) were also explained.

The marks created on AdobePhotoshop that were in image arrangement in the marginal information domain were explained.

### **10th day – Rechecking of important items**

On the final day of the technology transfer, a lecture concerning important items (such as overprint, layer operation and clipping mask) was performed again. The supplementary explanation and Q&A on the necessary conditions of film output data were also made.

### **3) Counterparts' Understanding on Technology Transfer**

This second technology transfer was undertaken in an environment in which each participant could operate one personal computer. Thus, it was expected that the counterparts could understand the transferred technology better than in the last lecture.

Not only the engineers who were engaged in digitization with their computers, but also others in charge of analog cartographic work including scribing were interested in the process of making up the negative films for printing. Their positive attitude to cope with the practical trainings was indeed very impressive. As the outline and environment of digital printing by DTP was explained, it appeared that the importance of the map symbolization/digital compilation using AdobeIllustrator was well recognized by the trainees.

Their skills in PC operation on AdobeIllustrator and their speeds in acquisition are different individually, but it is sure that almost all the trainees could master the basic operation of the software through the lectures performed. However, it is the nearest way of fixing the technology among the counterparts that they will practice the technology in their actual works and repeat trial and error processes to solve various problems. Such efforts will depend upon their own attitude.

In order to solve any unclear points or problems only by using the existing manual (English version attached to the software), the Spanish-English Table of Menu Commands was distributed to them. It is expected that the table will be useful for their work.

## 2.4.6 Hazard Map

### (1) Hazard map

INSIVUMEH created hazard maps in the past. The volcanic hazard maps, in particular, include those created by INSIVUMEH on its own and those created in cooperation with donor organizations. However, it was the first time for the organization to create hazard maps through simulation on a full-fledged basis.

The JICA study team carried out the transfer of technologies for creating disaster maps, geomorphological maps, and other disaster cause maps to be used as the foundation for hazard maps to be created. Furthermore, collaborative work was undertaken to produce basic data and establish the estimation parameters for simulation. Also, a discussion was held on methods of hazard evaluation and verification of results. Finally, the team carried out the transfer of technologies for managing the collected and organized data and hazard maps using GIS. Table 2.4-8 shows the description of technology transfer concerning hazard maps.

**Table 2.4-8 Technology transfer (concerning hazard maps)**

Technology transfer item	Period	Transfer method
Flow of creating hazard maps	February 2001	Techniques and results using specific examples have been explained.
Photograph interpretation technique for geomorphological maps	June 2001	We determined the items to be identified through photograph interpretation for each disaster and performed the photograph interpretation while showing examples of interpretation.
Disaster history survey method	From May to July 2001, June 2002	A survey on floods on rivers due to Hurricane Mitch has been made and we showed how to produce disaster maps.
Creation of basic data to be used to create hazard maps	From May to July 2001, June 2002	We collected and organized in collaboration geomorphological, geological, seismological, volcanic, and hydrologic data.
Establishment of simulation parameters	June 2002	The algorithm of simulation has been explained and the necessary data and parameters were examined in collaboration.
Verification of hazard maps	June 2003	We introduced preliminary hazard maps and evaluated and verified the results.
Preparation for and holding of hazard map seminars	June and October 2003	JICA study team prepared for presentations on hazard maps while INSIVUMEH prepared for those on disaster environment in Guatemala, and seminars was held.
Utilization of hazard maps for disaster prevention	June and October 2003	We discussed on the method to understand and utilize the hazard maps. In particular, we helped the concerned local government staff to understand the importance of education.

## 2.4.7 GIS and Hazard Map Seminar

### ◆ OBJECTIVES OF THE SEMINAR

#### \* GIS

To make known the practical use and application of GIS of 1:50,000 and 1:10,000, for the purpose of promoting the efficient use of the data for the benefit of economic and social development of Guatemala especially in the rehabilitation of the immediate areas of the Peace Zone.

#### \* Hazard Map

To make the population conscious about the methods of disaster prevention and to promote among institutions of the same theme the elaboration of the strategy for the utilization of GIS and the hazard maps in the Central America with the participation of CEPREDENAC and its members.

### ◆ EXPECTED RESULTS

The institutions will know the existence, use and application of GIS and hazard maps for the utilization thereafter.

### (1) Plenary meeting

**19 June, Convention Center, Rooms “Esmeralda” and “Oro”, Plenary Meeting for the Opening**

- 09:00 Registration and Opening
- 10:00 Speech by Japanese Ambassador, Mr. Kagehumi Ueno
- 10:15 Speech by the Minister of Communications, Infrastructure and Housing, Licenciada Flora de Ramos
- 10:30 Speech by Vice Secretary for the Global and Sector Policies, President’s Office for Plan and Programme, Lic. Jorge Mario Calvillo Loaiza
- 10:45 Introduction about the Project by Mr. Hideki Yokoyama, representing JICA, Tokyo
- 11:00 Coffee break
- 11:15 Speech by Director General of Instituto Geografico Nacional-ING- Ing. Manuel Hernandez Valenzuela
- 11:30 Speech by Director General of Instituto de Sismologia, Vulcanologia, Meteorologia e Hidrologia –INSIVUMEH- Ing. Eddy Sanchez
- 11:45 **“Practice of the disaster prevention and GIS in Japan”** by Ing. Kazuo Furukata, Chief, JICA Study Team

- 12:30 Lunch
- 14:00 Presentation on the result of Project, by Dr. Valerio Gutierrez, JICA Study Team
- 14:20 **“Proposal for the disaster prevention planning”** by Ing. Satoru Tsukamoto, JICA Study Team
- 15:00 **“Utilization of GIS for the fighting against Shagas Disease”** by Mr. Ken Hashimoto, JICA/OPS
- 15:20 **“The Mission of NIMA in Central America, the Guatemalan Model”** by Mr. Glenn T. Ramsey, Regional Officer, Agencia Nacional de Imagenes y Cartografia - NIMA-
- 15:40 **“Utilization of GIS in the poverty maps”** by Ing. Ricardo Miyares, Secretria de Planificacion y Programacion de la Presidencia - SEGEPLAN-
- 16:00 Coffee break
- 16:20 **“Outline of disaster prevention with hazard maps in the Republic of Guatemala”** by Ing. Alejandro Maldonado, Secretary General of CONRED
- 16:40 **“Strategy of Disaster Prevention in the Caribbean”** by Dr. Jacob Opadeyi, Asesor Tecnico Regional of CDERA
- 17:00 **“Strategy of Disaster Prevention in the Central America”** by Mr. Tsuneki Hori, JICA expert for CEPREDENAC and Geog. Douglas Salgado, JICA expert (recruited from Third Country) for CEPREDENAC
- 17:20 Closure of the 1<sup>st</sup> day seminar, by Mr. Masami Shukunobe, representing JICA in Guatemala

## **(2) GIS meeting**

<b>20 June, Room “Petenitza”, Cartography and GIS</b>
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- 08:30 Registration and Opening
- 09:00 Speech by Ing. Manuel Hernandez, Director General of IGN
- 09:15 **“Digital photogrametry for GIS”** by Mr. Jorge Mansilla, Chief of the Photogrametry Division, IGN
- 09:45 **“Establishment of database and application of GIS”** by Ing. Marcos Sutuc, Chief of the Cartography Division, IGN
- 10:15 **“Introduction to the National Strategy of GIS”** by Ing. Jorge Roldan, UVG
- 10:45 Coffee break
- 11:00 **“Utilization of orthophoto for generating disaster data base”** by Ing. Mynor Garcika y Ms. Julia Galindo, UTJ-PROTIERRA Escuintla
- 11:30 **“Methods and products of System for digital restitution”** by Ing. Noboru Fukushima, JICA Study Team
- 12:15 **“Procedures for development of GIS database from cartographics”** by Ing.
-

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- Daisaku Kiyota, JICA Study Team
- 13:00 Lunch
- 14:15 Cartographic Publication. **“Procedures for producing printed maps from GIS data base”** by Ing. Yoshimitsu Fukumoto, JICA Study Team
- 15:00 Application of GIS. **“Improvement of social conditions and poverty in the high lands of the north-western region”** by Ing. Chiyo Kigasawa, JICA Study Team
- 15:45 Coffee break
- 16:00 Application of GIS. **“Development of Infrastructure and Conservation of Environment in the Peace Zone”** by Ing. Daisaku Kiyota, JICA Study Team
- 16:45 Questions and Answers
- 17:15 Closure of the seminar by Ing. Furukata, Chief of JICA Study Team

In the seminar held for 2 days during the fifth field survey, the presentation for the concept and method of developing GIS data from the topographic map data and the applicability of the products in this project to the environmental field has made.

On the first day of the seminar, the topographic maps as maps, the role of GIS and the differences and common points of the data structures in the different methods of modeling the real world were defined and the efficient GIS data development method was presented. On the second day, the possibility of using the provided data in the environmental field was explained.

### [Presentation 1]

#### Method of developing GIS database from topographic maps

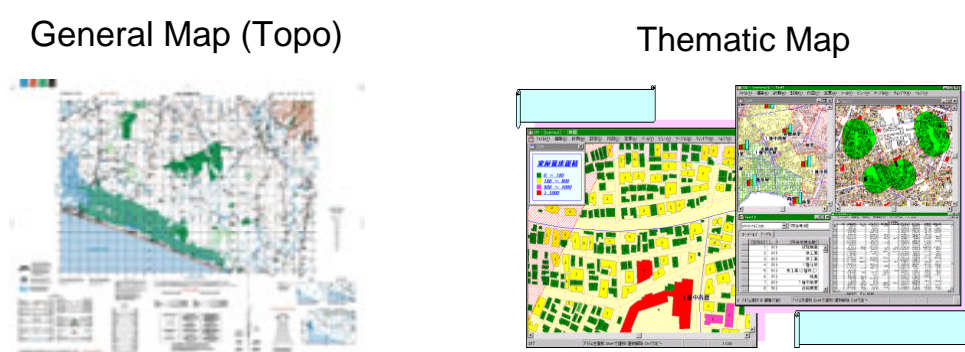


Figure 2.4-63 Topographic map and thematic map

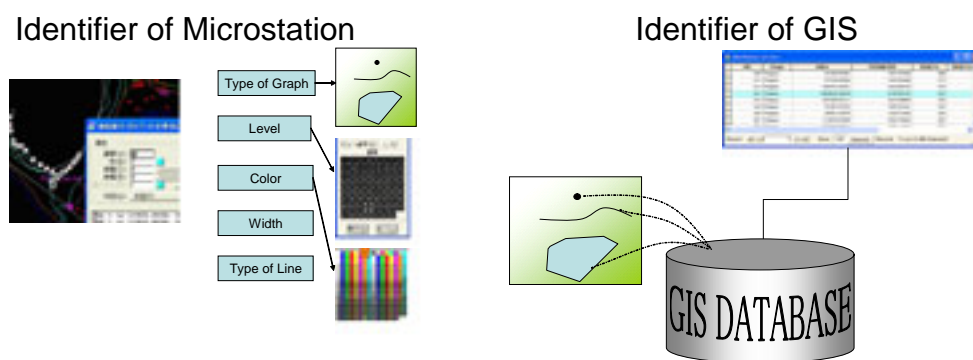
A map simplifies the positional relationships of planimetric features to represent a real world. On a map, planimetric features are simplified, symbolized and represented on a paper as two-dimensional information. However, the type of medium limits the quantity of represented information. Therefore, a map has been developed as a topographic map to

accurately represent planimetric features as many as possible and a thematic map to represent specific highlighted planimetric features.

On the other hand, the progress of computer technology allowed the real world including planimetric features to be modeled and represented by a computer. This progress promoted the data creation, maintenance and updating processes with high efficiency as well as digitization of topographic maps. The computerization eliminated the limitation to represent information in a fully theoretical manner. In addition, it became possible to represent the relative relationships (phase relations) between planimetric features and various types of thematic maps on a computer, contributing to a remarkable development of GIS.

Topographic maps are similar to GIS in providing mapping functions. Topographic maps fulfill the map functions on the condition that the represented information is interpreted properly, while GIS fulfils the map functions on a computer deciding and representing the planimetric features and their relative relationships. Therefore, the realistic world represented on the computer is different in computer model.

On topographic maps, planimetric features are symbolized in the forms that can be understood easily, while the information on planimetric features is maintained in an external database linked with their figures. The topographic map data constitute an aggregate of information on shapes, colors, sizes of line elements, and points configuring the shapes. On the other hand, the GIS data consist of the information on shapes, the phase information to represent the relationships between the shapes and the descriptive information on planimetric features stored in the external database linked with those shapes.



**Figure 2.4-64 Planimetric feature specifying method for topographic map and GIS data**

In this project, it is important to interpret the information on planimetric features when the creation of a topographic map is transmitted to configure their phase structures.

To this end, the planimetric features listed as acquired items are designed to be unique by combining line types, colors and levels so that the types of features can be identified from their graphic properties even after they are converted into data. The combined information is used as a key to convert a topographic map into GIS data and the phase structures are added to the

information and the data is corrected to develop the GIS data.

## [Presentation 2]

### GIS Adaptability to Environmental Management

GIS is a general name of an information system and technology to create, process, manage, analyze, represent and jointly use spatial information. Various types of information are integrated using the positional information as key and functions as platform to understand the scientific and social events.

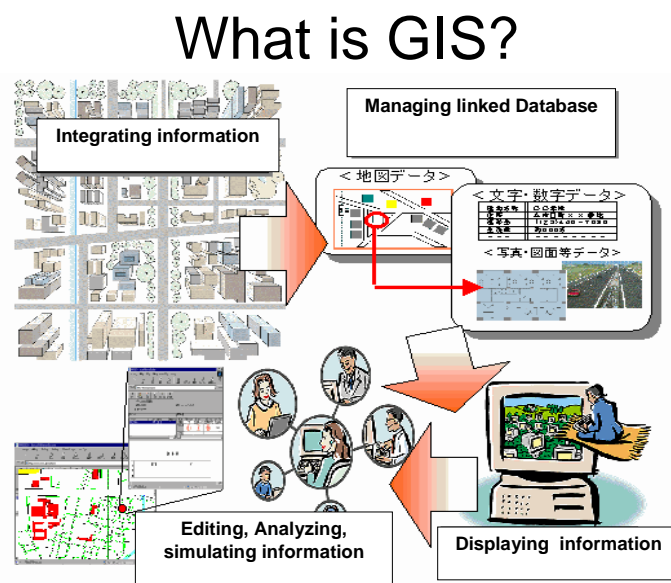


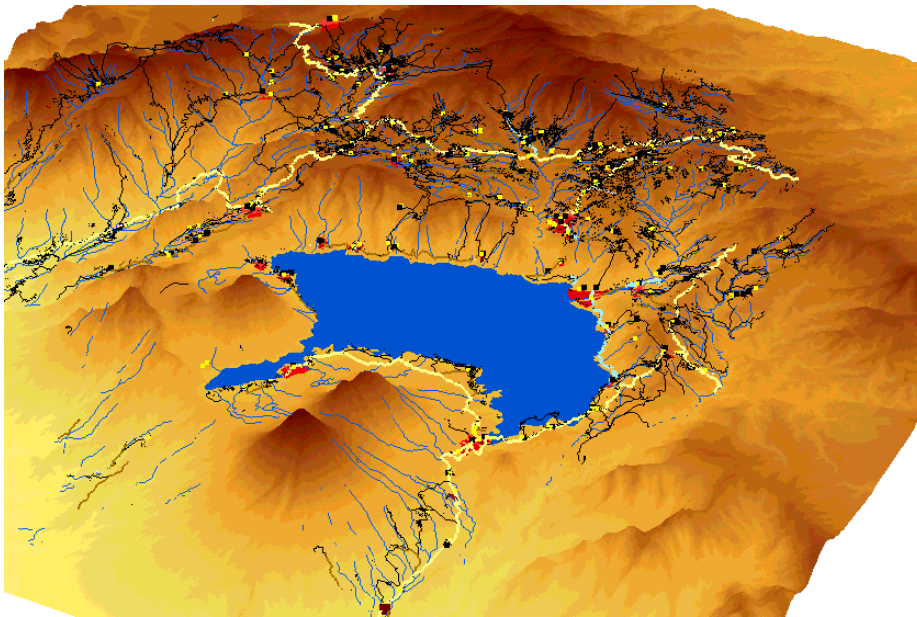
Figure 2.4-65 Roles of GIS?

GIS that can function as a platform of various types of information is very effective and useful for information management, maintenance and updating of information accuracy, information dissemination and support of decision-making.

In this presentation, we explained what GIS is and what functions GIS has and the effective use for environmental management of the GIS database developed in this project was considered. As an example, the case of calculating the potential risk of water pollution in Lake Atitlan in the Solola Province was introduced.

For a better understanding of the geographic features in the Solola Province, the roads, rivers, topographic features and buildings were processed into three-dimensional data so as to allow the trainees to intuitively interpret how the planimetric features such as houses, roads and rivers are distributed in the mountainous Solola Province. The advantage of GIS in simplified representation of planimetric features and the 3D topographic information were very effective for understanding the geographic features of this area. It was easy to understand that a number of houses are distributed along the river basins in the mountainous areas.



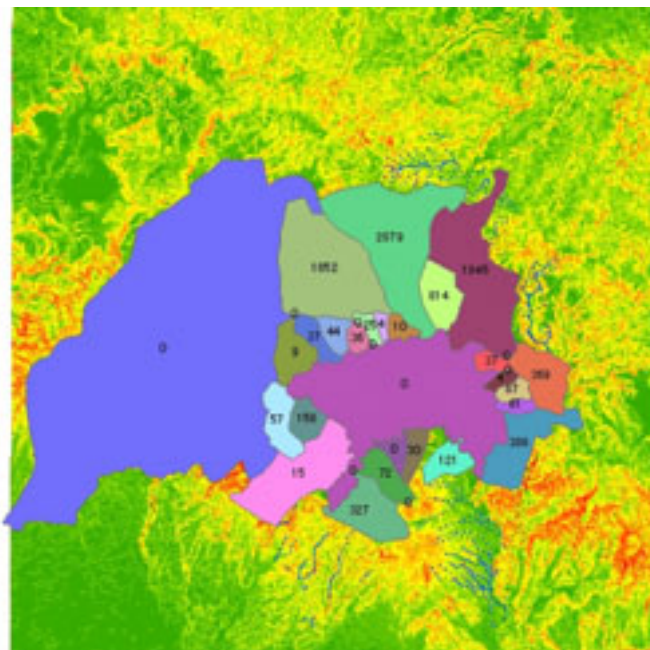


**Figure 2.4-66 3D View of Department of Solola**

In the Solola Province where the infrastructure including living wastewater treatment is less developed, excessive living wastewater degrades the environmental value in the water area to which wastewater is discharged. Lake Atitlan is one of the most famous resorts in Guatemala, and the deterioration of the water quality in the lake may cause a serious economic loss to the tourist industry.

In these circumstances, the watershed in the east of Lake Atitlan was calculated from the topographic data provided in the Study. The number and density of houses distributed in each watershed were computed to obtain the potential water pollution risk of Lake Atitlan.

The example of the quantitative calculation of the risk to degrade the potential environmental value that allows the priority budget allocation to facilities management and support of decision-making in administrative agencies was introduced.



**Figure 2.4-67 The Number of buildings in each watershed**

**(3) Hazard Map meeting**

The hazard meeting was held as follows:

**Table 2.4-9 Program of Hazard Map meeting**

09:00-09:15	Director of INSIVUMEH
09:15-10:00	INSIVUMEH Mission, Disaster in Guatemala, Application of SIG (E.Molina)
10:00-10:15	Hazard Mapping Project (S.Tsukamoto)
10:15-10:45	Disaster Investigation (V.Gutierrez)
10:45-11:00	Coffee break
11:00-11:40	MAGA : Agriculture (J.Duro)
11:40-12:00	Geomorphological Investigation and Disaster (H.Ishikawa)
12:00-12:50	Seismic Hazard (T.Matsumoto)
12:50-14:00	Lunch time
14:00-14:50	Volcanic Hazard (H.Takeuchi)
14:50-15:20	Landslide Hazard (V.Gutierrez)
15:20-15:50	Flood Hazard (H.Ishikawa)
15:50-16:05	Coffee break
16:05-16:45	Hazard maps and Disaster Countermeasures (S.Tsukamoto)
16:45-17:15	Questions and Answers
17:15-	Closing (S.Tsukamoto and E.Sanchez)

In the question-and-answer session, the following questions were asked and answered as shown below. Overall, many of the participants seemed to be satisfied with the explanation of the content of the hazard maps.

**1) About the project**

- When you selected the study area, why wasn't the Motagua river basin included?
  - Because the Motagua river basin was included in the USGS study area. Our study area was decided upon through discussions between INSIVUMEH and the JICA preliminary study team.
- Counterpart organizations and the number of people involved in the technology transfer
  - The hazard mapping was carried out in cooperation with many engineers in different fields, depending on the phase of the study. The collaborative work was done with about fifteen engineers, consisting mainly of chiefs in the various fields.

**2) On disaster history**

- What are the two earthquakes described as having struck between 2001 and 2003?
  - They are the earthquakes that struck on the subduction zone on the Pacific coast.

### 3) **About geomorphological maps**

- In Japan, how are geomorphological maps used in hazard maps? Can hazards be read from the geomorphological maps?
  - Geomorphological maps are useful in forecasting floods and volcanic disasters. They can also be used to forecast earthquake disasters, because the surface geology can be inferred from landforms.

### 4) **About forecasts**

- Have you considered the relationship between landslides and earthquakes or rain? How about the vegetation cover?
  - No, in this Study none of the external forces, including earthquakes, rain, or vegetation, was considered,.
- Did you conduct soil tests on each of the layers in the model columnar sections?
  - No, no soil tests were conducted, but the test values obtained in soil tests on similar soil in Japan were taken into consideration.
- Did you discuss the earthquake parameters with INSIVUMEH?
  - Yes, the earthquake parameters, being of paramount importance, were thoroughly discussed with INSIVUMEH.
- Did you create geological cross sections for liquefaction analysis?
  - Yes, we did.
- Are you going to provide INSIVUMEH with the simulation software used on the Samala river?
  - Yes, we are.

### 5) **About disaster prevention measures**

- What kind of measures should be taken to make hazard maps available to residents for their understanding?
  - The hazard maps that have been created in the Study are technical maps. Thus, it is necessary to provide education for disaster prevention, e.g., provide other maps that are easier to understand, or have INSIVUMEH engineers explain the hazard maps, to municipalities (municipalidades) and residents.
- Now that the priority accorded disaster prevention is falling, what kind of measures should be taken to maintain it?
  - Just after Hurricane Mitch and the Guatemalan Earthquake, disaster prevention awareness was high, and people gave it a high priority. To prevent awareness falling long after a disaster, it is necessary to prepare learning tools including hazard maps,

plan disaster prevention drills, etc.

- Are there any inexpensive and effective countermeasures against river flooding and earthquakes?
  - Yes, evacuation is one countermeasure that is both inexpensive and effective in reducing human damage. If the observational stance of INSIVUMEH is fortified, prompt communications will become possible.
- Is a revision of the law based on hazard maps included in the Project?
  - No, the revision of laws in itself is a major task. The administrative bodies must take time to examine it.
- What can be done to protect people living in the disaster hazard areas from damage?
  - That is a major task. One effective means is the use of hazard maps, which the Project has provided.

## 6) Regional problems

- In the Maria Linda river basin, stilt houses constitute one countermeasure against floods.
- Around Puerto Quetzal, there are facilities for dangerous items, and the risk from these is problematic.
  - Damage from dangerous-goods facilities includes danger to the place where the facilities are located, the strength of the structure, the toxicity and volatility of dangerous items, etc. This is the domain of risk assessment.
- Puerto Barrios is prone to earthquake disasters. What kind of countermeasures are effective?
  - The reinforcement of buildings and measures to combat liquefaction are important countermeasures against earthquakes.

### 2.4.8 Evaluation of Technology Transfer Training by Participants

We requested the IGN staff participating in the technology transfer training to fill out a questionnaire to evaluate the training as a maiden attempt. We not only requested for an evaluation of the contents of training that they had just received but also asked, since the end of the Project was approaching, such questions as whether they were confident about using the technologies they have learned in the past sessions.

#### (1) Questions in Evaluation Questionnaire

The participants were asked to answer all the questions on a 1-to-5 scale (where 1=Not Satisfied, 2=Not Very Satisfied, 3=OK, 4=Satisfied, and 5=Very Satisfied) and check-mark an appropriate symbol on the questionnaire. We also provided columns in which they could write specific comments if any. Table 2.4-10 shows the list of questions.

Questions 1 to 3 were general questions on a technology transfer training course: Whether the course duration was long enough, whether each of the technical topics was discussed deeply enough, and whether the course covered a sufficient number of technical topics. Questions 4 to 8 concerned evaluation on the lecturers in charge. These questions asked how much the participants were satisfied with the speed of the course, demonstrations that lecturers gave in class, handout materials, hands-on exercises in class, and interpretation.

**Table 2.4-10 List of questions**

Q1: Length of the course
Q2: Depth of the each technical topic
Q3: Variety of technical topics
Q4: Speed of the course
Q5: Lecturer demonstration
Q6: Handout materials
Q7: Exercises during the course
Q8: Translation

#### (2) Respondents in the Evaluation Questionnaire

We conducted questionnaires to the participants in the following technology transfer courses and collected their answers.

Participants in the digital photogrammetry course	8
Participants in the GIS operation course	11
Participants in the digital printing course	11

#### (3) Results of Evaluation Questionnaire

We collected and summed up the answers for questionnaires from a total of 30 participants of all the courses. Figure 2.4-68 shows the results. The horizontal axis shows the question