4 DATA PREPARATION FOR IIMS

4.1 Preparation of Spatial Data Infrastructure

Geographic features to be applied in the IIMS were selected and their data specifications were examined. The GIS data comprises both basic topographic map data (called the spatial data infrastructure) and additional data for urban management. The spatial data infrastructure was produced based on a 1:5,000 map and all geographic features on the 1:5,000 topographic map were basically accepted in the spatial data infrastructure. Geographic features comprising spatial data infrastructure were defined as:

1. Built-Up Area. a) Settlement Area b) Industry Area
2. Administration
3. Electric Power Line
4. Road and Railroad
5. Vegetation
6. Water Surface
7. Topography
8. Control Points
9. Public Facilities
10. Orthophoto
11. Annotation

The process to prepare the spatial data infrastructure was examined. The study area was covered by many existing maps and materials. The most suitable process to shorten the preparation term was adopted. As the Cap-Vert District was covered with 1:5,000 scale topographic maps produced in 1981, initial basic data was digitized from existing maps and updated by aerial photos taken in 1997. There are a total of 70 sheets of aerial photos. The existing topographic maps were also reprinted.

The data for the rest of the area was acquired by digital mapping. The croquis maps produced by DTGC in cooperation with IGN France were prepared by digital photogrammetry. Plotting was carried out based on the stereo model oriented using existing same scale maps. Geographic features were acquired digitally from these models. The

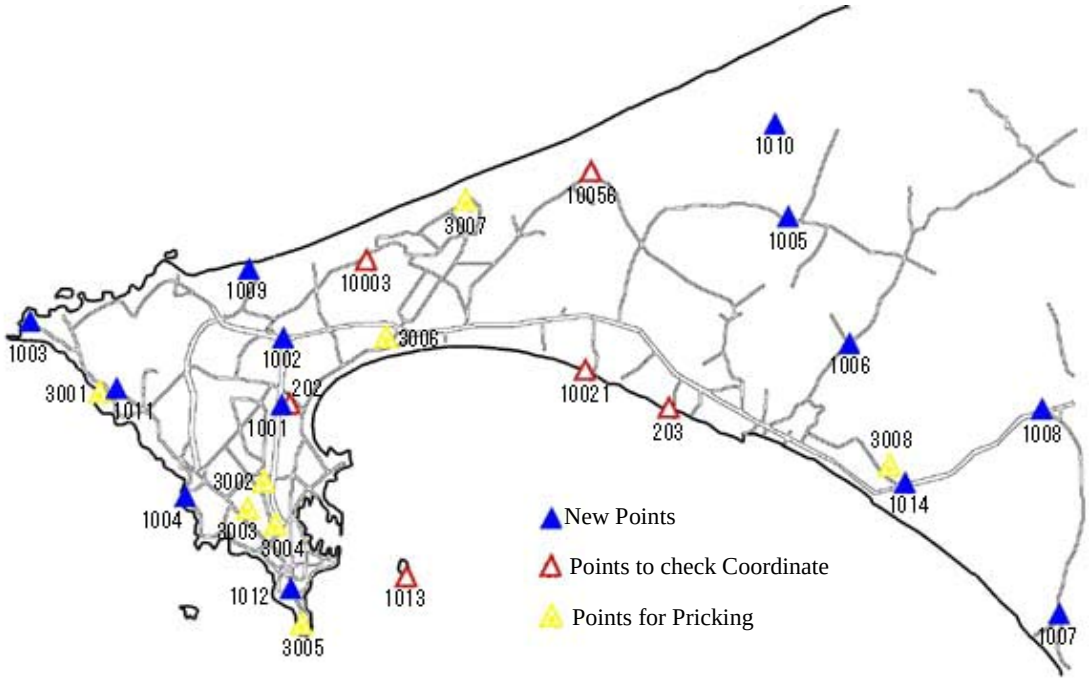
coordinate system adopted was the Expand Lambert System in France and not the Clarke 1880 ellipsoid in Senegal when the data was acquired. Also, the y-coordinate values were moved 1000km to south. Although this data cannot be easily converted to other geographic coordinates, the figures of geographic feature are applicable.

A ground control survey was carried out to implement the aerial triangulation. The ground control survey consists of the control survey to orient the horizontal position of a control point and the leveling to orient its elevation. As errors were found during verification of existing control points, all the control points necessary for aerial triangulation were re-measured by the GPS survey. The re-measured control points were pricked on the aerial photos. For the control points that could not be pricked on the aerial photos, the features that could be interpreted on the photos clearly were pricked, and their positions were obtained by the eccentric survey using the plane table survey. The existing control points whose coordinates could not be fixed were pricked and surveyed for verification in the aerial triangulation.

17 control points for which GPS survey was made are shown in Figure 4.1.

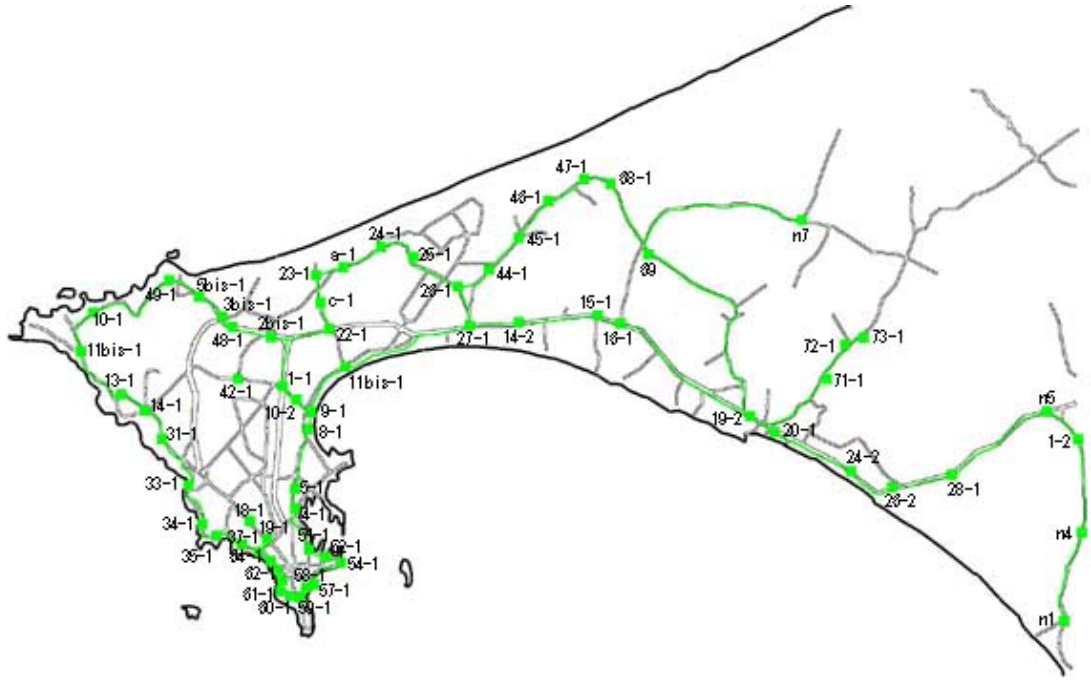
Routes where 5th order leveling was made are shown in Figure 4.2. The points at which their elevation values were measured were pricked on the contact prints of the aerial photos and the elevation values were entered in the prints, which were prepared as the materials for aerial triangulation.

Figure 4.1 Control Points



Source: JICA Study Team

Figure 4.2 Leveling Routes for the 5th Order Leveling Implemented



Source: JICA Study Team

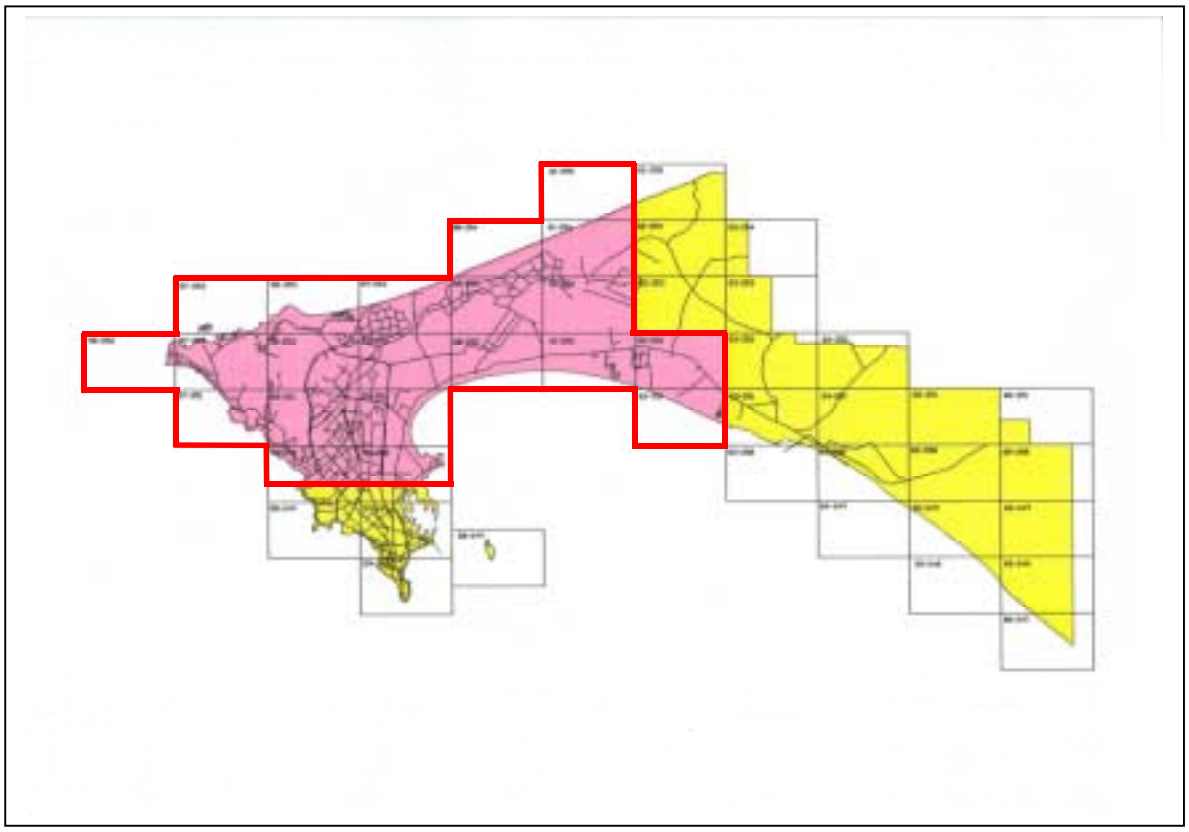
A field survey was carried out covering the entire area of the Subject Area for the purpose of checking the map data and preparing statistical data. The facilities database was updated with information confirmed during the field survey.

Digital Mapping Preparation

(1) Digitizing Existing Maps

In order to prepare the spatial data infrastructure, geographic features from 21 sheets of the existing 1:5,000 topographic maps covering an area of about 80 square km were digitized by conversion to raster data and recording on CD-ROM.

Figure 4.3 Mapping Area



Digitized area from existing maps

Digital mapping area

Source: JICA Study Team

(2) Aerial Triangulation

In order to determine orientation parameters of all aerial photos taken in 1997, aerial triangulation was carried out over the entire area, and the orientation parameters of each aerial photo and the coordinates of pass-point and tie-point were determined.

(3) Digital Mapping of Study Area

The geographic features of areas missing from the existing maps were acquired by digital mapping, covering 120 square km.

(4) Data Correction

The digitized and mapping data were unified, then compiled according to the specification of the spatial data infrastructure.

(5) Field Correction

During mapping of the spatial data infrastructure, some features could not be plotted because of uncertain features and unclear images. In order to prepare the accurate spatial data infrastructure the field correction was carried out in cooperation with Senegalese engineers. The conducted field correction for each geographic feature included the following: administrative boundary, existing land use, public facilities, road network, and natural environment.

4.2 Preparation of Additional GIS Data

A GIS data layer has been defined for each classification shown in Table 4.1 as "Data for IIMS". This table contains the spatial data infrastructure and the other GIS data. The contents of each layer is also explained.

Table 4.1 Spatial Data Infrastructure and Structure of Data

	Code	Layer of Geographic Feature	Class of Geographic Feature	Sub-Class of Geographic Feature	Data Structure
1	100	Built up area			
2	101		Settlement	Rural Settlement	Polygon
3	102			Settlement Regular	Polygon
4	103			Settlement Irregular	Polygon
5	104			Planned Settlement (middle)	Polygon
6	105			Planned Settlement (high)	Polygon
7	106			Commerce & Residence	Polygon
8	107		Industry	Plant	Polygon
9	108			Warehouse	Polygon
10	200	Administration			
11	201		Administrative	Ward	Polygon
12	202		boundary	Ward	Polygon
13	203			Village	Polygon
14	204			Department	Polygon
15	205		Qartier	Qartier	Point
16	210		Administrative		
17	211		boundary1981	Zone	Polygon
18	300	Basic infrastructure			
19	301		Electricity	High voltage line	Line
20	302			Middle voltage line	Line
21	303			Low voltage line	Line
22	303			Equipment	Polygon
23	304		Water supply	Water pipe	Line

	Code	Layer of Geographic Feature	Class of Geographic Feature	Sub-Class of Geographic Feature	Data Structure
24	305			Equipment	Polygon
25	306			Community tap	Point
26	307		Sewerage	Main Sewer pipe	Line
27	308			Sub-Sewer pipe	Line
28	309			Sewer pipe	Line
29	310			Equipment	Polygon
30	311		Drainage	Drain	Line
31	312			Drain pipe	Line
32	400	Road/Rail way			
33	401		Road	National Road	Line
34	402			Region Road	Line
35	403			Department Road	Line
36	404			Road in city	Line
37	405			Farm road	Line
38	406		Railway	Railway	Line
39	407			Railway Station	Line
40	408		Bus	Bus-Route	Line
41	409			Bus Terminal	Polygon
42	410		Garbage	Garbage Collection Route	Line
43	411			Garbage container	Point
44	500	Vegetation			
45	501		Vegetation	Forestry	Polygon
46	502			Swamp area	Polygon
47	503			Grassland	Polygon
48	504			Farmland	Polygon
49	600	Water surface			
50	601		Water surface	Sea	Polygon
51	602			Lake	Polygon
52	603			River	Polygon
53	604			River	Line
54	700	Topography			
55	701		Topography	DTM (10m)	Grid
56	800	Control Points			
57	801		Control Points	Triangulation Point	Point
58	802			Bench Mark	Point
59	900	Public Facilities			
60	901		Public	Public agency	Polygon
61	902		Facilities	International Organization	Polygon

	Code	Layer of Geographic Feature	Class of Geographic Feature	Sub-Class of Geographic Feature	Data Structure
62	903			Embassy	Polygon
63	904			Education	Polygon
64	905			Health Facility	Polygon
65	906			Security	Polygon
66	907			Sports	Polygon
67	908			Culture	Polygon
68	909			Tourism	Polygon
69	910			Information	Polygon
70	911			Religion	Polygon
71	912			Market	Polygon
72	1000	Orthphoto			
73	1001		Orthophoto	Orthphoto	Image
74	1200	Land Use	Land Use	Present land use map 1999	Polygon
75	1300			Urban Activity	Polygon
					Point
76	1400			Type of settlement	Polygon
77	1500			Spatial Structure	Polygon
78	1600			Past project and feature project	Polygon
					Line
79	1700			Potential of Site	Polygon
					Line
80	1800			Urban Equipment	Polygon
					Line
					Point
81	1900			Present land use map 1987	Polygon
					Line
					Point
82	2000			Land development framework	Polygon
				for 2021	Line
83	2100			Spatial development history	Polygon
84	2200			Occupation du SOL	Polygon
					Line
85	2300		Zoning	Flight control area	Polygon
86	2400			Zoning map for building control	Polygon
87	2500	Natural	Topography	DTM (100m)	Grid
88	2501			Slope map	Grid
89	2502			Relief map	Grid
90	2503			Depression	Grid
91	2600			Land form map	Polygon

	Code	Layer of Geographic Feature	Class of Geographic Feature	Sub-Class of Geographic Feature	Data Structure
					Line
					Point
92	2700		Soil	Agriculture potential map	Polygon
93	2800			Soil map	Polygon
					Point
94	2900			Soil degradation map	Polygon
95	3000		Hydrology	Water resource map	Polygon
96	3100		Natural Disaster	Inundation	Polygon
97	3200		Conservation	Protection area map	Polygon
98	3300	Land price	Land price	Land price map	Polygon
99	3400	Tourism	Tourist site	Tourist information map	Point
100	3500	Statistic Data	Population data		
101	3501			- Population data in 1996	
102	3502			- Population data in 1996	
103	3600		PDU of Dakar 2001 in 1982(DUA-MUH)		
104	3601			- Population data (Distribution of population in 1980, household survey in August 1980)	
105	3602			-Employment (population by employment, number of employees)	
106	3603			- Level of comfort utilities	
107	3604			- Construction methods	
108	3605			- Density of housing per ha and per habitat	
109	3606			- Enrolment ration in schools	
110	3607			- Public and private primary schools	
111	3608			- Public and private secondary schools	
112	3609			- Primary health centers and clinics	
113	3610			- Security, fir station, courthouse	
114	3611			- Movie theater, sports facilities	
115	3612			- Tourism facilities	
116	3613			- Information facilities	
117	3700		Land price in the official gazette in December 1989		

Source: JICA Study Team