

**The Study on Formulation of Spatial Planning for
GERBANGKERTOSUSILA (GKS) Zone in
East Java Province, the Republic of Indonesia**

Final Report

**Volume 3: GIS Atlas
(Key Maps and Drawings for GKS Spatial Plan)**

February 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

Value Planning International, Inc.
Oriental Consultants Co., Ltd.
Yachiyo Engineering Co., Ltd.

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1 Introduction

1.1 Introduction of GKS-ISP GIS Atlas

Based on a number of maps and data collected through the Study on Formulation of Spatial Planning for GERBANGKERTOSUSILA(GKS) Zone in East Java Province (GKS-ISP), the JICA Study Team developed GIS data for integrated spatial analysis to support planning work.

The collected basic data were fully processed and analyzed to generate spatial information on natural attributes, environmental constraints socio-economic conditions and various existing problems in the GKS region with the GIS technique. Results of those data manipulations were displayed in forms of maps and tables.

This GIS Atlas compiles a number of selected outputs out of the results of the Study to show the current conditions, intermediate outcomes for planning process to identify planning issues and results of spatial analyses of land/ environmental resource evaluation to support formulation of a land use plan and a spatial plan in GKS.

This GIS Atlas has been prepared as an additional material to the main report of the GKS-ISP Final Report and is expected to contribute to those who are concerned with solution of urban/

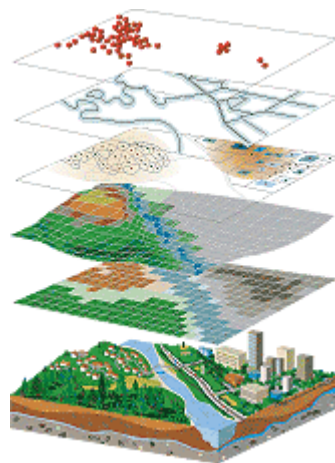


Figure 1.1
Image of GIS data
and real world

regional problems and urban/ regional planning in the GKS region.

1.2 Features of GIS

GIS has the following basic features: digitized geospatial data, data overlay, linkage of geospatial data to tabular data (attribute data), data share, and easy data update.

The basic features above allow users to develop GIS data, overlay a wide range of data layers, and label or symbolize data using the linked attribute data. Multiple users can work with the same dataset independent of each other to browse and analyze data, or to create maps of nearly any size or level of quality. In addition, updates posted to a centralized GIS database can be immediately available to all users.

The JICA Study Team utilizes this GIS technique as not only for mapping/ visualization tools, but also planning tools to identify existing conditions/ problems, and support formulation of an master plan.

1.3 Objectives of Using GIS in the GKS-ISP

The objectives of using GIS in GKS-ISP are to prepare baseline data for evaluation of present conditions and to support formulation of the master plan in the GKS zone. The following are how GIS has been used in the GKS-ISP;

For tabulation. There are various kinds of data collected through

GKS-ISP. Those collected and prepared data were analyzed spatially. In addition, some of those results were used for tabular information for further analysis. For example, railway station service coverage population was calculated with the GIS techniques, and the result was utilized for urban/ regional planning and transportation planning.

For map preparation. A strong point of the GIS technology is visualization of the result of data analysis. In the GKS-ISP, the GIS techniques were used for preparing maps to accelerate planning works and to support decision making among various stakeholders.

As supporting tool for master planning. From another aspect of utilization of GIS in GKS-ISP, GIS was utilized as supporting tools for formulation of spatial plan in each master planning phase. In the phase of “Problem finding”, GIS technology was utilized as tool of understanding existing condition in the Study area with collected and newly developed GIS data by the Study Team. In the phase of “master planning”, it is utilized as simulation/ evaluation tools for planning work. Thus, GIS technology was utilized in various purposes in this Study.

Section 4 in this Atlas explains the methodology of land and environmental resource analysis which was used as base data for formulating a land use plan and a spatial plan in this Study.

In addition, this GIS technology is expected to be utilized after this master plan study as monitoring tools of implementation of projects and the maintenance plan of infrastructure.

2 List of Maps

In this GIS Atlas, a total of 37 maps are selected out of many maps prepared by the JICA Study team. These maps are divided in to three groups.

A Existing Conditions Analysis (Baseline data)

- A01** Base map of GKS
- A02** Administrative Boundary of GKS (Kecamatan) 2008
- A03** Population Distribution by Kelurahan/ Desa, 2008
- A04** Population Density by Kelurahan/ Desa, 2008
- A05** Distribution of Housing/ Settlement 2008
- A06** Existing Land use 2008
- A07** Existing Road Network 2008
- A08** Existing Railway Transport Network 2008
- A09** Settlement Area ratio by Kelurahan/ Desa 2008
- A10** Traffic Analysis Zone

B Land/ Environment Resource Evaluation

- B01** Accessibility to City Centers 2008/ 2030
- B02** Accessibility to Road 2008/ 2030
- B03** One-hour Service Coverage from Kota Surabaya CBD 2008/ 2030
- B04** Accessibility to Railway Station
- B05** Agriculture area Distribution 2008
- B06** Forest Distribution 2008
- B07** Protected Forest and Production Forest area Prepared by East Java Province
- B08** Water Catchment area Prepared by East Java. Province
- B09** Conservation area Prepared by East Java. Province
- B10** Flood Potential Zone Prepared by East Java Province
- B11** Assessment of Land Elevation
- B12** Assessment of Slope Condition
- B13** Assessment of Land Stability
- B14** Assessment of Forest Ecosystem
- B15** Assessment of Mangrove Ecosystem
- B16** Land/ Environment Resource Evaluation (All Constraint factors)
- B17** Land/ Environment Resource Evaluation (All Development Promotion factors), 2009 and 2030
- B18** Land/ Environment Resource Evaluation (Result), 2009 and 2030

C GKS-ISP Plans

- C01** Population Growth 2008 - 2030
- C02** Environmental Sensitive Zone (ESZ)
- C03** GKS Land Use Plan 2030
- C04** GKS Road Network Plan 2030
- C05** GKS Railway Transport Network Plan 2030
- C06** GKS Transport Network Plan 2030
- C07** GKS Strategic Projects 2030
- C08** GKS Spatial Plan 2030

Note:

All of GKS-ISP GIS data are prepared in projected coordinate system of UTM Zone 49S, WGS84.

3 Contents of Maps

The Maps compiled hereafter in this Atlas are briefly explained in this Section. The map codes are identical to those attached to corresponding maps.

A Existing Conditions Analysis (Baseline data)

In this Study, all the base data were collected from BAKOSURTANAL (National Coordination Agency for Survey and Mapping), including the administrative boundary, roads, railways and land use. Based on BAKOSURTANAL data, the JICA Study team updated these data using available satellite imagery, results of field surveys and collected data from relevant governmental agencies in GKS.

In addition, various statistical data were collected and joined to the GIS base data as attribute, which data include population census data, socio-economic data and road inventory data to understand existing condition in GKS.

A01 Base map of GKS

Preparation of a base map is the first step of geographic data development. The base map of the study area is prepared based on a BAKOSURTANAL map at a scale of 1:25,000. The BAKOSURTANAL map data, however, are originally prepared using aerial photos taken in the beginning of 1990's and most of the map items are not updated so far, thereby the Study team updated major road, railway, administrative boundary and so forth using as much imagery, data and information as possible to

prepare base map data.

A02 Administrative Boundary of GKS (Kecamatan), 2008

Polygons delineating administrative boundaries are the basic units for socio-economic statistical data analysis as well as the minimum spatial unit for planning work. In total, seven Kabupaten/ Kota, 132 Kecamatan and 1951 Kelurahan/Desa boundaries are drawn in this map with names of Kabupaten/ Kota and Kecamatan.

A03 Population Distribution by Kelurahan/ Desa, 2008

Map A03 shows the population distribution by Kelurahan/ Desa in 2008, using PODES (Potential Desa) in 2008 published by BPS as baseline population data.

A04 Population Density by Kelurahan/ Desa, 2008

Map A04 shows a distribution pattern of population density. As depicted in the map, higher population density area is concentrated in Kota Surabaya and along existing toll roads and arterial roads, especially those between Kota Surabaya and Kabupaten Sidoarjo.

A05 Distribution of Housing/ Settlement, 2008

A06 Existing Land Use, 2008

Existing land use data (2008) is produced by the JICA Study Team based on land use data originally produced by BAKOSURTANAL. To update the BAKOSURTANAL land use data, available satellite imagery data are utilized as much as

possible together with a field survey to confirm the actual land use.

Map A05 is prepared based on the existing land use data by selecting a "housing/ settlement" category alone from the linked attribute table. This map explains an existing settlement distribution pattern in the GKS region. There is a strong relationship between the transportation network and settlement distribution.

Map A06 illustrates the existing land use in GKS.

A07 Existing Road Network, 2008

A08 Existing Railway Network, 2008

A07 and A08 depict the existing transport network by transport mode. Both of transport network data (2008) is produced by the Study Team from BAKOSURTANAL transport network data which prepared based on of 1990's aerial photo. To update BAKOSURTANAL data, available satellite imagery and field survey are utilized in addition to map/ information from each Kabupaten/ Kota in GKS.

A09 Settlement Area ratio by Kelurahan/ Desa, 2008

Area characteristics of Kelurahan/ Desa were analyzed based on the Kelurahan/ Desa boundary data by overlaying on several thematic maps of specific items.

Map A09 explains the existing settlement area ratio for each Kelurahan/ Desa, which is defined as the percentage of "housing/

settlement” area to the total area of the corresponding Kelurahan/ Desa area. This data is generated by overlaying the Kelurahan/ Desa boundary data and the “housing/ settlement” area data in the existing land use map. Each “housing/ settlement” area in terms of percentage was calculated in GIS and compiled in a table format.

A10 Traffic Analysis Zone

Traffic Analysis Zone (TAZ) is the unit for traffic data collection and a series of transport analysis. In order to grasp traffic flows and transport characteristics in GKS, all Indonesia land need to be included for the spatial framework. For this purpose, GKS is divided into 301 TAZs in total, out of which 313 TAZs are set in the whole Indonesia.

The TAZ was produced based on Kelurahan/ Desa boundaries as of 2008.

B Land/ Environment Resource Evaluation

B01 Accessibility to City Centers 2008/ 2030

B02 Accessibility to Road 2008/ 2030

B03 Accessibility to Railway Station

Maps B01 to B03 are prepared using “Euclidean distance functions” in ArcGIS Spatial Analyst tools to calculate Euclidean distance from urban centers/ roads/ railway stations. These maps shows accessibility to urban services/ activities, and dark red color means higher accessibility area to urban services; on the other hand dark green areas mean lower accessibility areas to the urban service/ activities.

These three accessibility analysis results are incorporated to Land/ Environment resource analysis.

B04 One-hour Service Coverage from Surabaya CBD 2008/ 2030

Map B04 shows the comparison of one-hour service coverage to/ from Surabaya CBD on road transport, in terms of time-distance (minutes) using the ArcGIS Network Analyst extension. A yellow color gradation area denotes the area of 30 minutes from/ to the Surabaya CBD and orange color gradation area, that of 60 minutes from/to the Surabaya CBD area. As shown in this map,

the service coverage to/ from the Surabaya CBD will expand considerably when all of road projects which are proposed by the Study team are completed.

B05 Agriculture Area Distribution 2008

B06 Forest Distribution 2008

Maps B05 and 06 show existing distribution of the agriculture area and forest area based on the existing land use data which is originally produced by BAKOSULTANAL. Both agricultural and forest areas are highly important factors from the viewpoint of environment and land condition. Both factors are fully considered when the land use plan and spatial plan are formulated in this Study.

B07 Protected Forest and Production Forest area Prepared by East Java Province

B08 Water Catchment area Prepared by East Java Province

B09 Conservation area Prepared by East Java. Province

B10 Flood Potential Zone Prepared by East Java Province

In this Study, various kinds of environmental factors are carefully considered to formulate a balanced land use plan. Maps B07 to B10 depict Protected areas and Conservation areas regulated by East Java Province. All of factors in these maps are included and considered in Land/ Environmental resource analysis.

B11 Assessment of Land Elevation

B12 Assessment of Slope Condition

Maps B11 and B12 are prepared using SRTM (Shuttle Radar Topography Mission) digital elevation data originally produced by NASA. To analyze land elevation and slope condition, these raster format data are re-sampled in cells at a size of 200m by 200m and integrated into map data of the land/ environment resource analysis.

B13 Environmental Sensitive Zone (ESZ) for Land Stability

B14 Environmental Sensitive Zone (ESZ) for Forest Ecosystem

B15 Environmental Sensitive Zone (ESZ) for Mangrove Ecosystem

Based on the analysis of existing environmental conditions, key

environment and ecosystem of the GKS zone are identified by the Study team in indicators such as “land stability,” “forest ecosystem” and “mangrove ecosystem.” All of the three key factors are considered in the land use plan and the spatial plan for a balanced development

B16 Land/ Environment Resource Evaluation (All Constraint factors)

The GIS technique reveals a distribution pattern of a land with high development constraints, as illustrated on Map B17, which shows accumulated negative scores in gradation. A higher negative scored land is colored in darker brown, while a lower negative score land, in darker green. This map clearly shows areas to be given a careful consideration against urban development or land conversion.

B17 Land/ Environment Resource Evaluation (All Development Promotion factors), 2009 and 2030

The GIS analysis also depicts distribution patterns of development potentials in both 2009 and 2030, as shown in Map B17. Land areas of higher accumulated positive score are colored in darker brown in a gradation. It is obvious that the land development potential will remarkably increase along with the proposed future transport network. A notable increase in development potential from 2009 to 2030 is found in the western suburban area of Surabaya, the northern coastal areas along Gresik and Lamongan, and the Suramadu Bridge Corridor in Bangkalan.

B18 Land/ Environment Resource Evaluation, 2009 and 2030

Superimposing the two categorized maps makes an overall evaluation result on land use potentials as shown in Map B18, which shall be basic conditions to be taken into account for land use planning and environmental policy making.

In addition, the distribution pattern of the higher score areas in 2009 which are colored in dark brown are very similar to the existing distribution pattern of the residential area (yellow area), commercial area (red area) and industrial area (dark blue). This means that the scoring system employed in this model can represents the existing urbanization pattern properly.

From this analytical result, it can be assessed that if the accumulated score of a land area is negative, the area must strictly be conserved or preserved, because this means the area's negative factors are stronger than its positive factors. In contrast, if the overall score of a land area is positive, the area could accept development activities.

It should be noted that the positive scored areas include agricultural land and this analysis results are utilized as base data for formulating the land use plan and the spatial plan in the GKS region.

C GKS-ISP Plans

C01 Population Growth, 2008 - 2030

Based on various data and information, the socio-economic framework of population and GRDP is projected by the Study team. This map shows population growth between 2008 to 2030, this is one of socio-economic framework prepared by the Study team.

C02 Environmental Sensitive Zone (ESZ)

The Environmental Sensitive Zone (SEZ) is a zone which needs special protection in terms of value and /or vulnerable landscape and ecosystem from the viewpoint of environmental conservation. An ESZ map is one of the common zoning maps and effective tools for environmental spatial management. An ESZ is delineated and designated with permitted land uses.

C03 GKS Land Use Plan 2030

In addition to the land/ environment resource analysis, environmentally sensitive area analysis and urbanization and land use demand analysis are conducted to prepare a land use plan. Map C03 shows a long-term land use plan for the GKS Zone targeting the year of 2030 which is proposed by the Study team. The proposed land use plan is formulated maintaining balance in environmental conservation and urban development.

C04 GKS Road Network Plan 2030

C05 GKS Railway Network Plan 2030

C06 GKS Transport Network Plan 2030

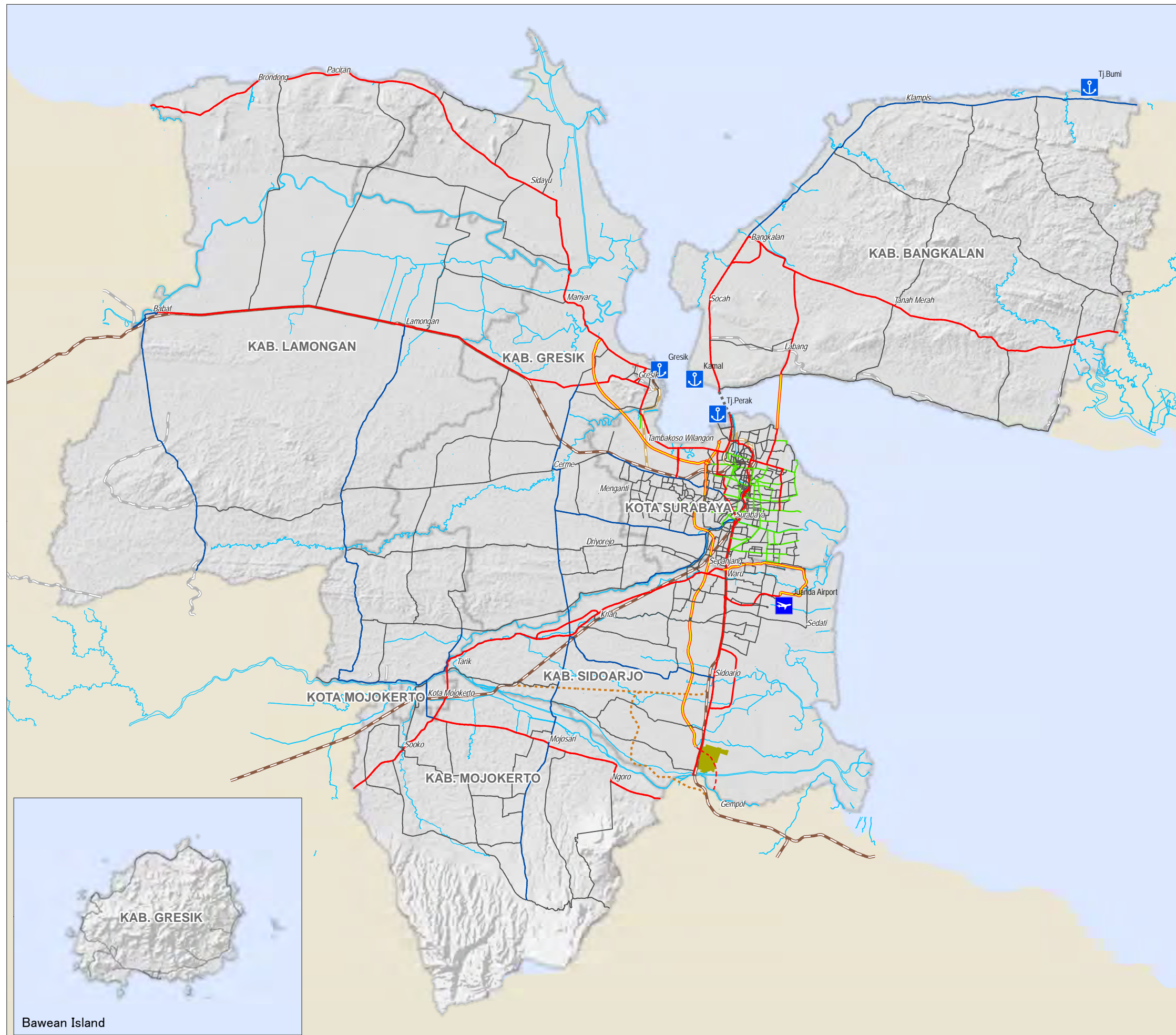
Through a series of discussion and transport surveys conducted by the Study team, various issues are identified. Maps C04 to C06 depict the transport network plan 2030 in GKS zone proposed by the JICA Study team.

C07 GKS Strategic Projects 2030

After reviewing and prioritizing the strategic projects proposed by the Kota/ Kabupaten's spatial plans, the priority projects are determined as Strategic Zones for the target year 2030. In addition, a number of strategic projects are proposed through this GKS spatial planning process in the transportation and infrastructure sectors. Those are also designated as Strategic Zones. Map C07 depicted those strategic projects.

C08 GKS Spatial Plan 2030

Based on all the analysis done in this Study and discussions with the relevant governmental agencies and stakeholders, a spatial plan 2030 of the GKS zone is proposed as shown in Map C08.



A01 Base Map of GKS

- Legend**
- Road Network (Existing)
 - Toll
 - Toll (Not operated)
 - Arterial
 - Collector
 - Secondary Arterial
 - Local
 - Ferry
 - Railway
 - Existing Railway (Passenger service)
 - Existing Railway (freight service)
 - Existing Railway (discontinued Line)
 - Existing Railway (under Construction)
 - Airport
 - Port
 - RIVER
 - Porong Mud Flow
 - Kab./Kota Boundary



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