4.3.3 Tourism Development Concept

(1) Definition

Tourism industry is a city whose tourism objects are developed so as to make the city attractive and creating economic value and becomes an integrated part of economic, social and cultural activities of the society.

Tourism objects themes

Natural tourism (Eco Tourism, Water Tourism), Educational and Spiritual Tourism, Historical Tourism, Tsunami Tourism), Village Tourism, and Shopping Tourism.

(2) Existing Tourism in BAC

The history of BAC stretches back almost a thousand years, enriched by various cultures, particularly eastern cultures. BAC has a potential to be developed as a living laboratory for Tsunami Disaster.

Existing problems:

- Destruction of tourism objects caused by disaster as well as absence of/lack of proper maintenance.
- Neglect or ignorance of tourism objects has caused encroachments of some tourism sites.
- Lack of information or unattractive site, reducing the number of returning visitors.
- Poor access to tourism sites.
- Lack of/inadequate infrastructures in the city to support tourism activities.

Tourism potentials:

- Old city tourism (Historical Tourism).
- A city with strong Moslem culture community (Spiritual Tourism).
- Natural tropical island (Eco Tourism and Education Tourism).
- The 21st Biggest Tsunami Victim City (tsunami tourism and education tourism).
- In close proximity and easy access to other tourism potentials such as in Sabang City and ABR (Malahayati and Lhok Nga).

Potential Tourism Spots

Table 4.4.3 lists some potential tourism spots in BAC that can be developed into tourism objects. The location is illustrated in Figure 4.4.3.

Table 4.3.3 Potential Tourism Spots in BAC

No	Potential Objects	Location	Description
1	Ulee-Lheue Mosque	Ulee Lheue	The only remaining building
2	PLTD power generating ship	Punge Blang Cut	Drifted to residential area
3	Mass Grave	Ulee Lheue	Burial of 15,000 tsunami victims
4	Fishing Boat Monument	Lampulo	Stranded on the roof
5	The big tree	Ulee Lheue	The only remaining tree
6	Stone Sculpture	Ulee Lheue	Tallest building around coastal area
7	Coastal Area	around Ulee Lheue	To be developed as tsunami living museum

No	Potential Objects	Location	Description
		bridge	
8	Coastal Area	around Ulee Lheue bridge	To be developed as water recreation
9	Coastal Area	Along coastal line	Waterfront green park
10	Dutch cemetery	Center of BAC	Develop as historical burial park
11	Sultan Iskandar Muda cemetery	Center of BAC	
12	Princess Pool	Center of BAC	Develop as historical park
13	Aceh Royal Palace (Pendopo)	Center of BAC	Develop as heritage park
14	Baiturahman Great Mosque	Center of BAC	
15	Islamic Sultanate Heritage	Gp. Pande	
15	Royal Burial heritage	Gp. Pande	
16	Syiah Kuala cemetery	Deah raya	Can be develop as Historical Burial park
17	Old Peunayong city	Peunayong	Chinatown/heritage area
18	Blang Padang	Center of BAC	Green city park
19	Taman Sari	Center of BAC	
20	Syah Kuala University Park	Syiah Kuala	
21	BRIMOB park	Jelingke	
22	Cultural Exhibition	Lampriet	
23	Safiatudin Park	Lampriet	
24	Fishpond and river	Along coastal	Fishing/Water recreation
25	Market	Ulee Kareng	Can be develop as shopping/culinary tourism
26	Fish auction center	Lampulo	
27	Rex Park	Peunayong	

Source : Additional Study Team, 2006

(3) Recommendation for BAC Urban Tourism

BAC needs to be developed within a Tourism Industry that integrate every existing tourism objects over BAC and surrounding areas (Sabang City and ABR), with strict reference to prevailing Islamic Law (Qanun).

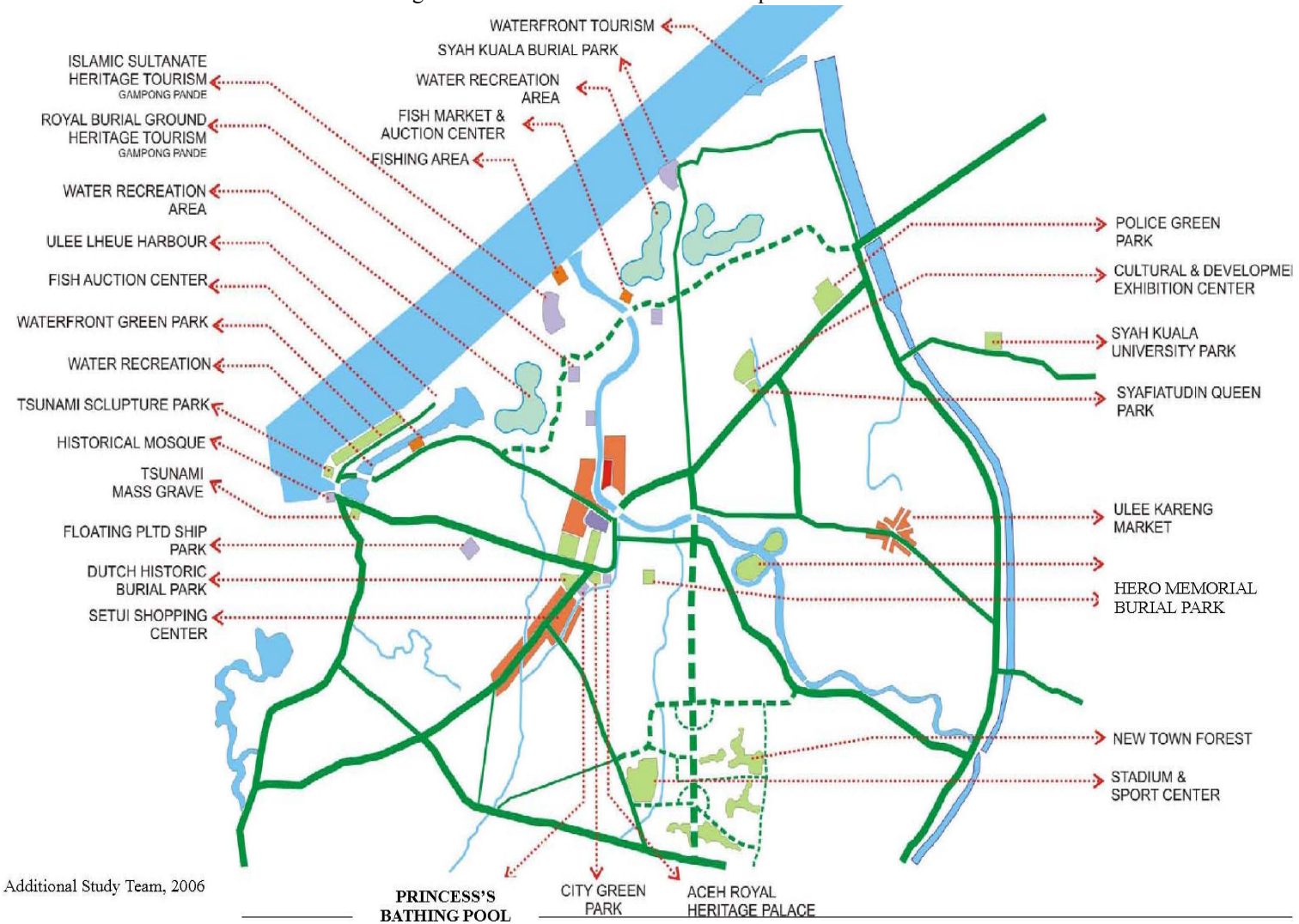
(4) BAC Urban Tourism Concept

8 Providing easy access to tourism sites (through existing or new roads) in integration with the city system.

9 Furnishing tourism sites to give unique characteristics that set them apart from others.

10 Creating BAC to be more accommodative for tourists, and to prepare tourism supportive infrastructures to increase tourists' length of stay.

Figure 4.3.4 Location of Potential Spots Tourism Area



Additional Study Team, 2006

Source : Additional Study Team, 2006

(5) BAC Urban Tourism Development Plan

a. To develop Tourism Package (such as: Tsunami Tourism, Historical Tourism, Spiritual Tourism (Islam), Education Tourism, Shopping Tourism), and Tourism Tracks that links several tourism sites.

b. To develop Ulee Lheue area into an integrated tourism spot offering various tourism themes (historical tourism, coastal tourism, water tourism, tsunami tourism, city forest/park tourism, sport tourism).

c. To create Peunayong, Pasar Aceh, Lampulo, Neusu-Setui and Ulee Kareng area as shopping tourism areas, and develop Banda Aceh Old City/China Town (Peunayong).

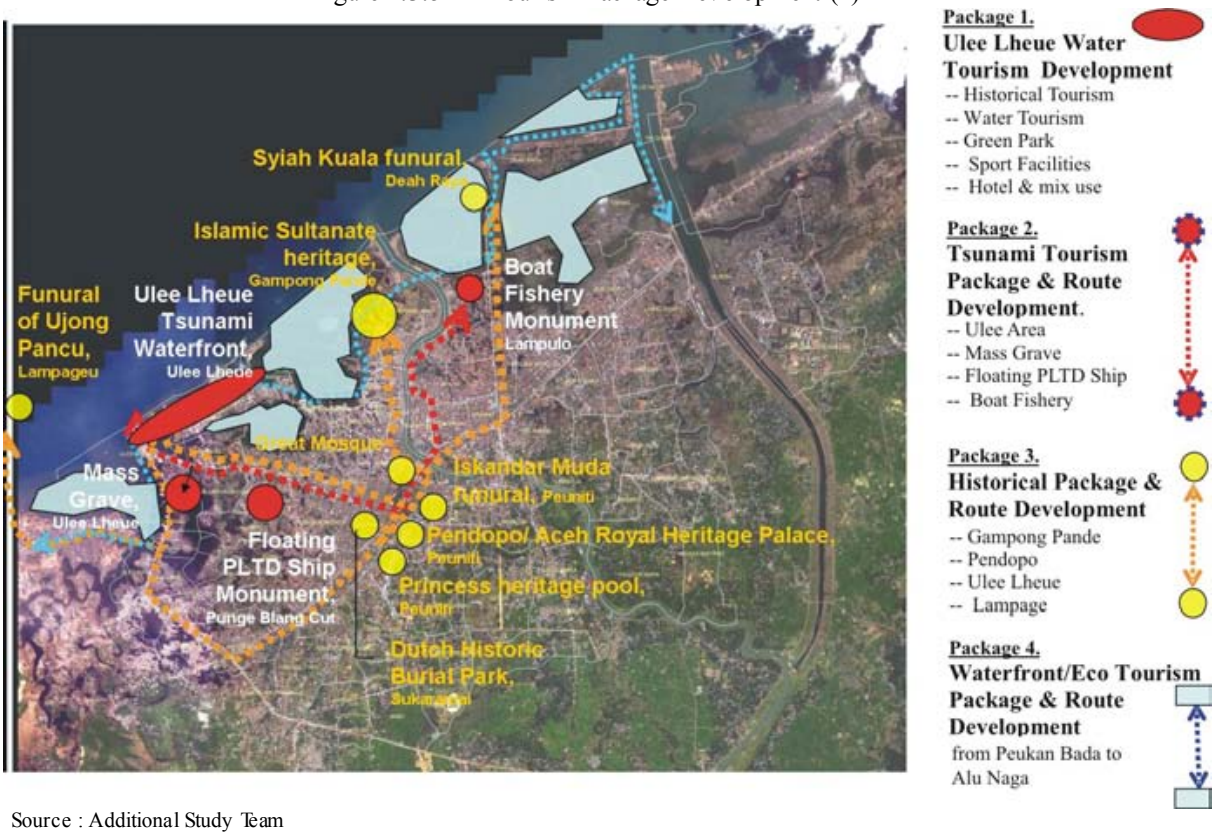
d. To develop coastal area as natural tourism site (water tourism), and shopping tourism/restaurant (sea food, cottage, etc)

e. To develop all open space in the city as an attractive public space for local community and tourist (domestic and foreign tourists).

f. To prepare the city street furniture (signs/symbol), information board, tourism information center started from the BAC entrance and all the way to the tourism object site.

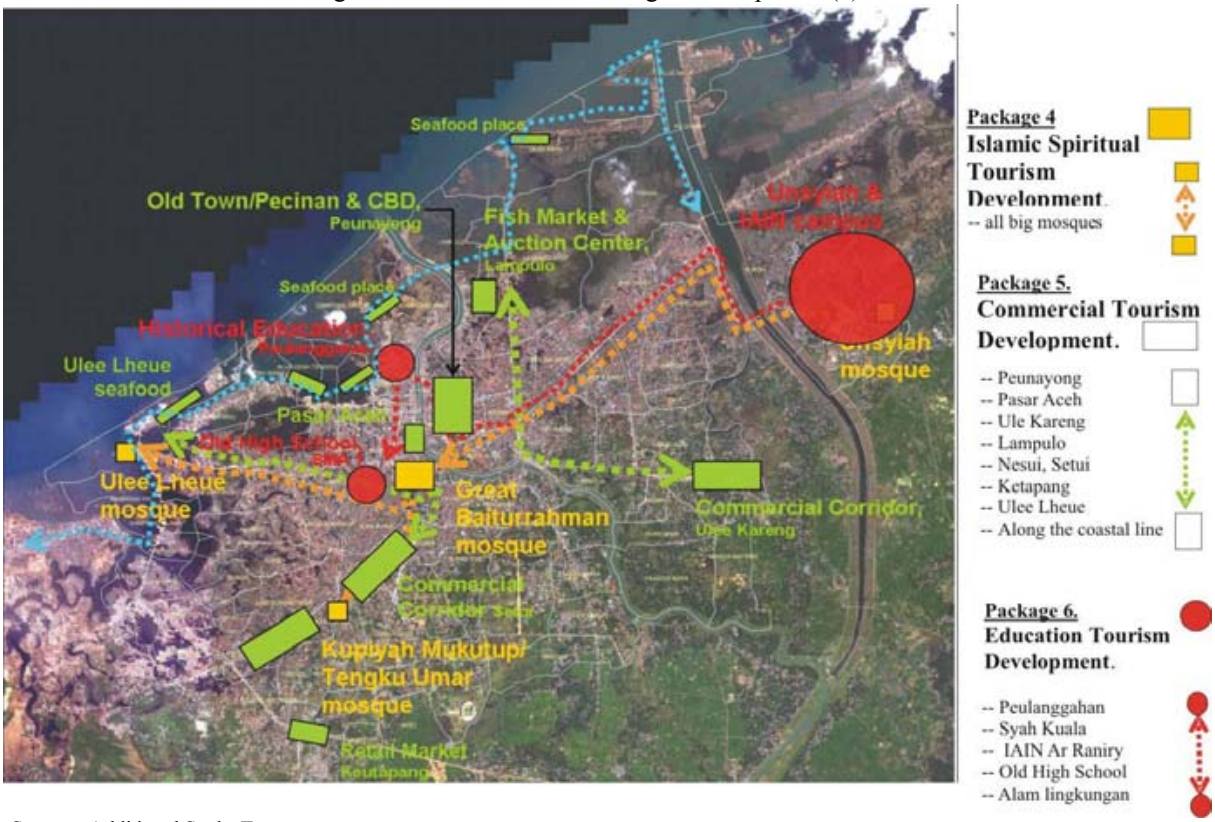
g. To provide supporting facilities in BAC (hotel, airport, transportation means and system).

Figure 4.3.5 Tourism Package Development (1)



Source : Additional Study Team

Figure 4.3.6 Tourism Package Development (2)



Source : Additional Study Team

4.3.4 Industrial Development Concept

(1) Definition

Industrial Development Concept is a concept that put industrial activities as the city main base, by processing every available natural and human resources. Factors that support these industrial activities are human labor (quantity and quality), accessibility, raw materials, technology, social condition, economy, culture and environment.

(2) Existing Conditions

There has been no rooted industrial activity within present administrative area of BAC. Instead BAC has a long history as a port city (transit city) and its people are famous for their trading skills.

Large industry and heavy polluted industry is not recommended in BAC, because:

- BAC is not designated as an industrial city. This is reflected from the former Master Plan which excludes industrial zone inside BAC perimeter.
- There no raw material/natural resources for heavy industry in BAC.
- BAC is proposed to be developed with Green City approach, so any allocation of environmentally unfriendly activity should be avoided.

(3) Recommendation for BAC Industrial Development

BAC is not recommended to be developed as a heavy industrial city especially polluting industry. Industrial development in BAC is directed toward the maximization of abundant labor force and natural resources, while still environmentally friendly.

Industrial activity is proposed to be developed in areas away from urban and residential areas. Ideally it should be located in close proximity to Malahayati Port to facilitate cargo traffic by ship. It is also proposed to promote industrial use around Lhoknga, a district where a large cement manufacturing plant (PT Semen Andalas Indonesia or commonly known as PT SAI) used to operate.

The development of industrial zone is proposed to be linked to metropolitan development plan and land use.

Industrial development is also proposed to include provision of housing or accommodation for labors.

4.3.5 Non-Polluted Mass Transport Concept

According to the metropolitan city development concept, BAC serves both internal and external movements. Internal movement is generated by daily activities of local people both inside and outside of BAC. External movement is generated by migrants who work, visit or temporarily stay in BAC. Both movements will contribute to the growth of traffic in BAC.

The constraint faced in this study is the unavailability of data on trips generated per day for BAC. Data from other cities in Indonesia shows that trips generated per day ranges from 30% - 50% of the city's total population (JMTSS, 1990). Based on this, with a total population of 263,668 in 2005, BAC will expectedly generate approximately 120,000 trips per day. Trips coming from adjacent areas potentially reach about 90,000 trips per day. Total trips generated will be roughly 200,000 trips per day.

Assuming that each person traveling uses a private car, because of the absence of public transport service, approximately 200,000 car trip per day will crowd BAC streets, resulting in acute congestion along urban road network. Countless emission will pollute the air and brought health risks to urbanites.

The non-polluted mass transport pertains to the idea of creating an urban transportation which complies to the demand of providing a safe and efficient transportation operation. The mass transportation itself refers to the concept of transporting people in large quantity simultaneously to achieve efficiency. The non-polluted transportation concept will conform to the issues of environmental conservation.

In the future, the implementation of mass and non-polluted transportation will:

- Provide BAC with a system for transportation that can encourage the urban movement point to point in an effective and efficient level
- Provide affordable public transportation
- Alleviate traffic congestion across BAC
- Reduce transportation related air pollution

b. BAC LRT System

1) Proposed LRT Routes

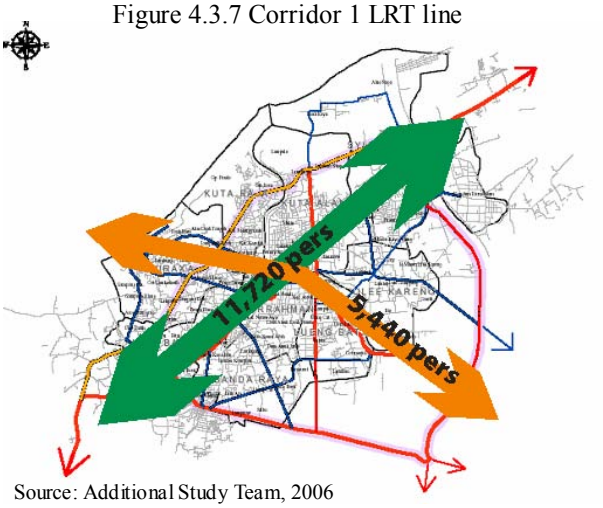
According to the road network pattern, it is recommended that LRT routes be proposed as follows:

Corridor 1

Corridor 1 will be delineated along main arterial of BAC. It connects southwestern parts of BAC to northeastern parts of BAC, reducing road traffic.

With a total route length reaching approximately 8 km, the corridor is proposed to be equipped with at least 16 shelters, in 500 m interval. Each shelter will be placed in the junctions of trunk routes and feeder routes.

Figure 4.3.7 Corridor 1 LRT line



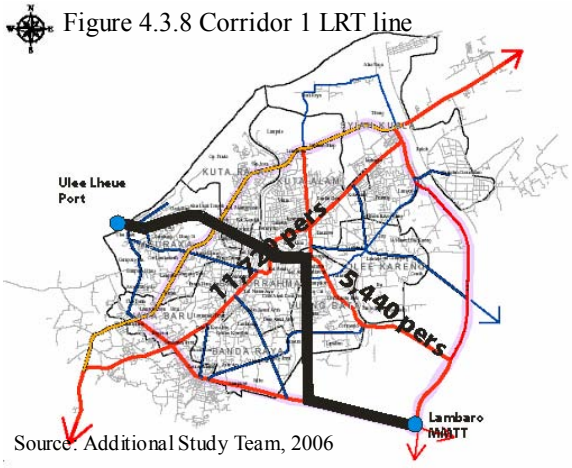
Source: Additional Study Team, 2006

Corridor 2

Corridor 2 connects the vital transportation node of Ulee Lheue Port to southeastern parts of BAC. It serves passengers traveling to either Ulee Lheue Port or areas along corridor 2.

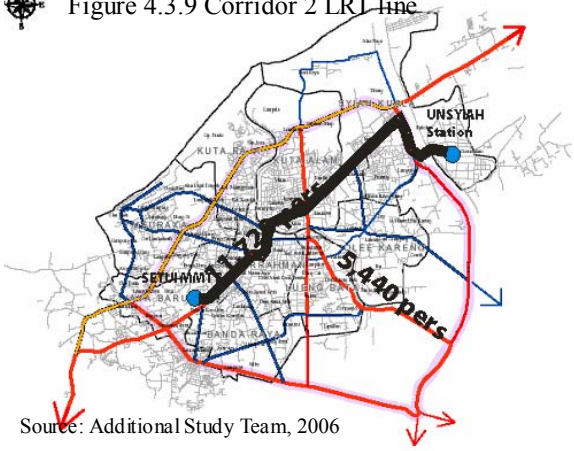
In future implementation, with its approximately 9.0 km total length, corridor 2 will be equipped with at least 18 shelters, in 500 m intervals. Each shelter will collect prospective passengers coming from its vicinity or from the feeder service with end route at any junction between corridor 2 and the feeder services.

Figure 4.3.8 Corridor 1 LRT line



Source: Additional Study Team, 2006

Figure 4.3.9 Corridor 2 LRT line



Source: Additional Study Team, 2006

2) Proposed LRT Types

Implementing the LRT will depend on passenger demand rate and the load capacity of the LRT itself. There are two types of the LRT based on its capacity, especially its line capacity, i.e. LRT Type 1 and LRT Type 2. Their main difference is its designated right of way. LRT Type 1 will use a right of way that remains open by road traffic intervention, while the LRT Type 2 will use that of one without road traffic intervention.

Because of the presence the intervention by road traffic, LRT 1 will logically have less line capacity than the LRT 2, since the line capacity is dependent on the flow rate of the LRT a day. Shortly, the intervention by road traffic will prolong LRT travel time, and increasing the headway needed by first vehicle and consecutive vehicles

Although LRT 1 has lower line capacity, its construction cost is presumed cheaper, since the track is shareable with road traffic, so new structure provision can be avoided.

The LRT 1 will be quite applicable for BAC because it is more flexible in providing space to urban development in the future.

3) Proposed Power Supply

LRT is commonly powered by electricity ranging from 700 to 1500 KV. The power demand could be supplied by a new power plant or existing ones if it is presumed sufficient enough in capacity as it shares with community uses.

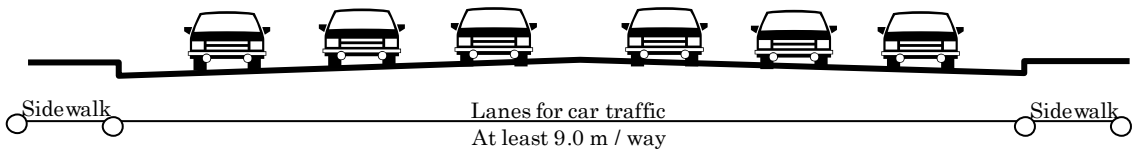
4) Track and Road Sharing

As previously has been exposed, the LRT 1 is dedicated to use track that can utilize some space of the existing road. To alleviate traffic congestion resulting in the narrowing of the road space for non train traffic, it is recommended to apply traffic demand management following the supply management that will be implemented. Out of such a problem, the space sharing between LRT track and road will remain applicable under some assumptions previously presented.

Space sharing will only apply for roads with at least 3 lanes and or 9.0 meters in width. At which a bridge presents, the LRT track must not share width with road alignment. The track preferably uses an independence bridge. It will be unavailable if the bridge width exceeds 9.0 meters.

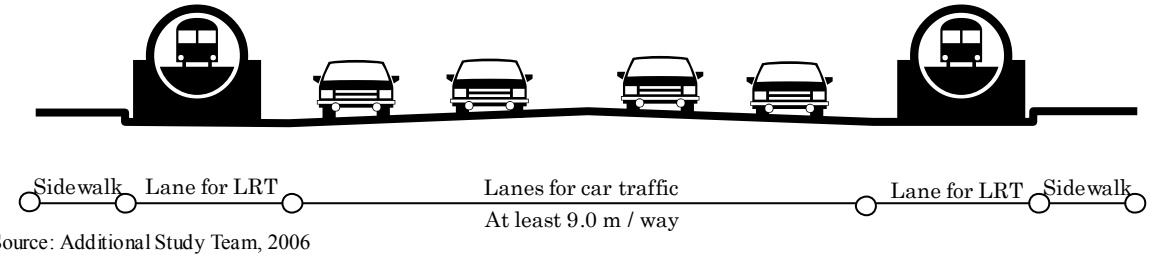
Afterward, the proposed strategy will be as depicted in Figure 4.3.10 and 4.3.11.

Figure 4.3.10 Road lanes utilization before LRT introduction



Source: Additional Study Team, 2006

Figure 4.3.11 Road and track sharing after introducing the LRT



Source: Additional Study Team, 2006

4) Headway Adjustment

Because of the normal headway will cause low load factor for MRT, it is necessary to set headway in appropriate value so the proposed MRT operation will be effective as well as efficient.

Table 4.3.4 shows the results of headway adjustment to meet the operational planning in 2015 in accordance with the prospective passenger demand. The result indicates that the lower headway seems to be economically feasible and producing some benefits. Passengers will benefit from the more choices any hour they want to access the MRT and from the minimum waiting time in station or transfer point they will spend. Operators will benefit from the total passenger they transmit a day proportional to the cost a day they have to pay for the investment value.

Table 4.3.4 Adjusted headway following the passenger demand in 2015

Description	Vehicle Capacity (pass)	Adjusted Headway (minutes)		
		Line 1	Line 2	Line 3
Light Rail Transit I	450	37,3	143,2	94,5
Light Rail Transit II	900	74,6	286,4	189,1

Source: Additional Study Team, 2006

4.3.6 Disaster Preparedness

a. Hazard Potential

Some of hazard potentials in BAC come from two main types of disaster: earthquake and tsunami. The main source of earthquake is from the dynamic activity of seabed at the Indonesia Sea. According to the previous data in Indonesia, the earthquake activity had been periodically occurred, which the largest value was repeated within 25-100 years period.

Earthquake disaster commonly caused damage in a horizontal direction. It means that the power to destroy streams horizontally from the center of generation then spread out to any direction the power can sustain. Therefore, the effect caused by the earthquake commonly in a form of lateral damages such as earth cracks, structures collapses, land subsidence, etc. The damage treats people in a way of excessive impacts such as collapsed parts of building can fall onto people, making died or injures.

Tsunami was the post disaster to the earthquake, as it generates after the earthquake shock. The last tsunami occurred in Aceh was preliminary begun with the 6.8 earthquake in Richter scale which epi-center is located at the Indonesia sea.

Tsunami commonly causes large damages to the area close to the shoreline in direction both lateral and vertical. The recorded tsunami occurred in the world, the last tsunami in Aceh was the third largest in the world. It caused more than 70,000 casualties with a half of those died and the remains suffered from injures. It also caused large devastated area along the shoreline, resulting in thousand people to be dislocated and became refugees.

b. Preparedness against disaster

1) Structure selection techniques against earthquake

The earthquake shock caused the structures damage in many existing infrastructures such as roads, building, bridges, etc. The structures commonly experience damage in various levels depending on their capabilities in responding the earthquake periodically shocks. Therefore, in responding the earthquake caused damage, all structures within the disaster potential region must equip themselves with tools that can absorb the earthquake power so they could sustain when the earthquake occurs.

Some of techniques vastly used in structures designs against earthquake shock are as follows:

- Structures with rigid frames

  Structures with rigid frames proved stronger in fighting against earthquake. The rigid frame

structures made of piles and beams that connecting and composing each other in forms of strong ties. The ties must stronger than the suspected disaster energy proportional to time.

- Structures with dilatation

  Earthquake shocks buildings in lateral direction, so to reduce the impacts the building must apply the dilatation. As a guideline, every building with 50 m in length can apply 1 m or more space dilatation. The purpose of the application of dilatation is to give space for building vibration in horizontal direction. As the building can vibrate in enough distance, it can sustain from the earthquake impact.

- Structures with spring concept

  As previously mentioned, earthquake will affect the building from the horizontal direction. Therefore, the damages caused by it will flow from the sub structures up to the upper structures. Therefore, the application of the spring concept in the sub structures could minimize the shocks energy generated by earthquake. The spring works in way of allowing the structures to respond the energy sent by the earthquake by moving itself in a reverse direction periodically and stopping when the energy action halted.

- Structures with slight mass

  Structures made of wood have proven more responsible to the earthquake shock than that of other materials. Thus, in areas with high liquefaction are preferable to apply wood structures than concrete ones. Wood structures, as its mass is slight and its upper structure is not monolite with sub structures, have higher flexibility in responding the lateral energy generated by the earthquake than concrete. Even, wood structures, with accurate design, can sustain in earthquake with 6.0 in Richter scale.

2) Facilities against Tsunami

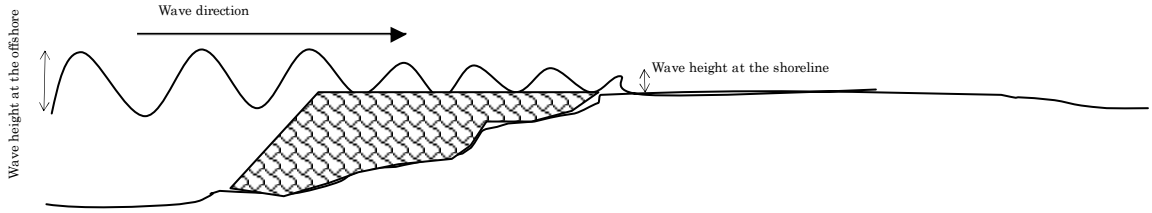
In purpose of fighting tsunami and reducing its impacts to people or infrastructures in the area close to the shoreline, some types of building must be prepared in the surrounding shoreline. Many buildings play in various roles depending on the type of building and its usage purpose.

- Breakwater

There are two types of breakwaters that can be used to fight against tsunami and or to reduce the tsunami impacts, namely, a normal breakwater and detached breakwater. A normal breakwater is a breakwater (or breakwaters) that its form is long perpendicular to the shoreline toward the sea. The detached breakwater is a breakwater that its form is long parallel to the shoreline, forming like as fences or water dike.

A detached breakwater is more effective in reducing the tsunami wave height-and-speed as it fights tsunami at the lateral position, while, a normal breakwater fights against tsunami in a way of breaking the tsunami wave in longitudinal direction.

Figure 4.3.12 Detached Breakwater



Source: Additional Study Team, 2006

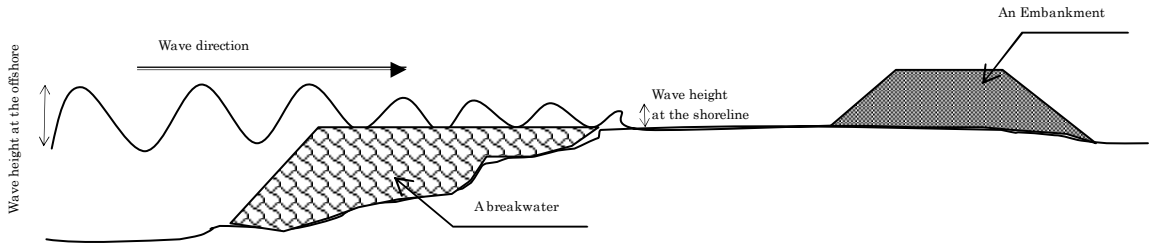
- Embankment

An embankment plays a role of preventing water after passing the breakwater so it is going to infiltrate the area in the inner side of the embankment. However, the embankment can also be prepared as the second line of breakwater as its form is possible to break the water passing it.

The existence of the embankment is important enough as the breakwater can never prevent water a whole. The presence of the embankment, thus, can help stopping the running water toward the shore areas.

The form of embankment itself is like that of the detached breakwater. The main difference is in embankment physic is not cut off space as that of presence in the breakwater. Those are situated in the shoreline parallel to the line direction of the shore. Because of each function, the breakwater location is prior to the position of the embankment.

Figure 4.3.13 Embankment



Source: JICA Study Team, 2006

The real embankment can be a coastal road or an independent water dike. The form of a coastal road is valuable because of it acts two function in the same time.

- Plantation on Coast

Plant is a natural material that can effectively be used as the barrier against tsunami danger. If presented on coast, plant can reduce the speed of tsunami wave and prevents land clearing from the tsunami activities. The area can also benefit from the greening process by which the air surrounding the area can keep fresh and less pollutant.

- Tidal Gate

A tidal gate will block tsunami wave when it flows through a water tunnel or a river, so it cannot pass the river or pass but with slow speed and low wave. The presence of tidal gate can be very helpful especially for preventing the area on the surrounding of the riverbank.
In future, all rivers have to be equipped with the tidal gate. All tidal gates should be preferable equipped with automatic control for closing and opening gate without manual intervention. Automatic control can ensure high reliability and work performance during operational.

c. Public Awareness Program

People must be aware of disaster time by time, so they have to be educated and informed with continuous and complete things related with disaster. The governments both national and local are to establish a sustainable program that can help people having awareness about disaster anywhere and anytime under the recommendations below:

- The government or a special authoritative institution should establish any memorial things to which people can keep in mind about disaster and its impacts. Some of them can be a monument, memorial parks, and so on.
- It is the duty of the government to educate people about disaster by means of both formal and informal educative institution. One of examples is entering the disaster awareness program into the school curricula of the elementary education till to university.

- It has to utilize any means of media to propagate disaster-related things and how to fight, prepare, and escape from danger when disaster comes. Such media can be TV, radio, brochure, and so on.
- It has to prepare an integral system and ready-to-use tools that are able to provide people with information about disaster when it comes. Such tools can be GIS, Internet, integrated system of preliminary warning, and so on.

It has also been the duty of the government to provide people with a stuff of information of the minimum requirements that must be fulfilled when constructing any building such as houses, stores, etc.

4.4 PROPOSED BANDA ACEH URBAN SYSTEM

Urban system refers to the functions and roles of cities (urban hierarchy). Phases to determine BAC urban system is as follows: 1) BAC spatial development model, 2) urban functions and roles.

4.4.1 Spatial Development Model for BAC

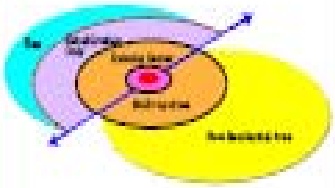
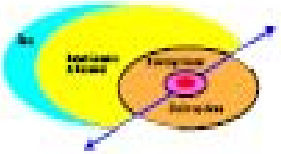
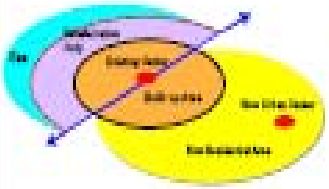
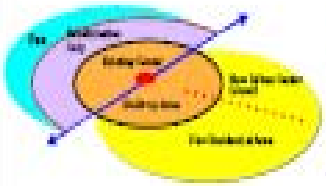
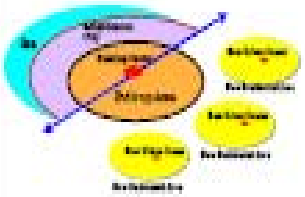
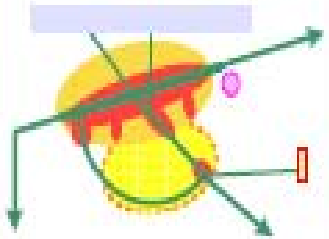
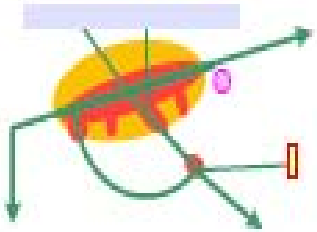
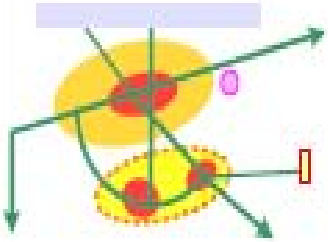
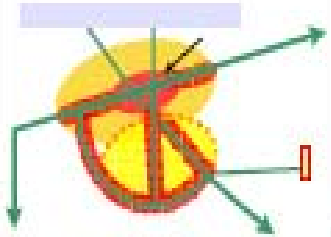
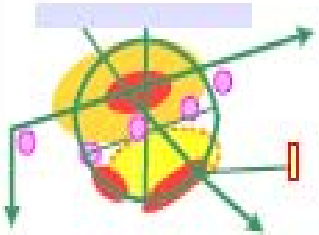
There are various types of model in city development, characterized by number of population, geographic condition, land use, modes of transportation, natural environment, administrative services, economic development activities, prevailing culture and tradition, etc. In addition preparedness against disaster is one of the important aspects to be considered, especially in BAC. In case of BAC, it is deemed that there would be five (5) conceivable models to be adaptable. These models are as described in Table 4.4.1 and schematically shown in Figure 4.4.1 and Table 4.4.1

Table 4.4.1 Outlines of Five Conceivable City Models

Models	Characteristics
Model A: Center Growth with Dual Residential Areas	• Residential area tends to expand to southern area since coastal area was devastated. • Administration and commercial activities remain mostly at the present location.
Model B: Center Growth with Coastal Area Development	• Coastal area will be re-developed to state of pre-disaster condition, while developing the southern area. • Administration and commercial activities remain mostly at the present location.
Model C: Dual Center with Dual Residential Area	• New urban center will be located to de-centralize administrative and commercial activities from the present urban center. • Residential area will extend between two (2) centers.
Model D: Linear Growth with Dual Residential Area	• Commercial and business center will grow along arterial road in future. • Residential area will be developed in the south.
Model E: Linked Multi Center with Multi Residential Area	• Sub-centers will be developed in form of cluster. The existing urban center and sub-centers will be linked by artery road. • Administrative centers will be relocated to disperse risk of disaster. Commercial activities would subsequently grow around new administrative centers.

Source: JICA Study Team, 2005

Figure 4.4.1 Alternatives of City Development Model BAC

	A	B	C	D	E
MODEL	CENTER GROWTH WITH DUAL RESIDENTIAL AREA	CENTER GROWTH WITH COASTAL AREA DEVELOPMENT	DUAL CENTER WITH DUAL RESIDENTIAL AREA	LINEAR GROWTH WITH DUAL RESIDENTIAL AREA	LINKED MULTI-CENTER WITH MULTI RESIDENTIAL AREA
DEVELOPMENT PATTERN					
SCHEMATIC CONCEPT					

Source: JICA Study Team, 2005

4.4.2 Urban Functions of BAC

Urban hierarchy system is set up because of two major aspects, that is city services availability (city size) and cities services easiness (city oriented) these are shown by accessibility level to the existing cities. From the city conditions analysis (pre and post earthquake and tsunami) and BAC growth tendencies along with planning review that have been done previously. Generally BAC Urban function are similar to previous planning (RTRW 2005-2010 and JICA Study Team on URRP for BAC), but there is several different locations that have significant influences to its surroundings. BAC urban function consists of:

1. City Center : City center are located in Kuta Alam, Kuta Raja and Baiturahman District administrative area. Functions: *Regional scale services trade*, *Regional scale government,* Supporting functions: Commercial, Services/Banking, Public and Social Facilities, Small Industries, Religious and Cultural Center.

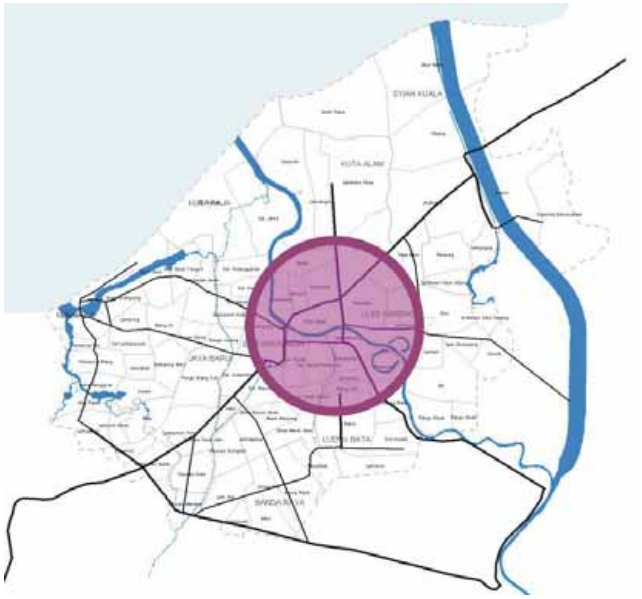
2. Sub City Center located in: a) Ulee Lheue, Meuraxa District, Functions: Passengers and Goods/commodities Port, Historical tourism and Beach Tourism (Tsunami Waterfront Area), Supporting function: Services Trade b) Lung Bata District, around Lampenuerut, Functions: Sport Center, Terminal area, Trade and Services (New Town), Government (New Town), Ware, c) Ulee Kareng, Ulee Kareng District, Functions: Services and Trade, Social Services/Facilities (Education and Health).

3. Development Unit : a) Around campus area, Syah Kuala District, Functions: Education Center, Services and Trade. b) Around Jl. T.Nyak Arif – Jl. Laksamana Malahayati intersection, Syah Kuala District, Functions: Services and Trade, Social Services. c) Around Lampulo, Gampong Jawa, Gampong Pande, Functions: Services and Trade, Cultural (History) d) Around Simpang Ketapang, Bandar Raya and Jaya Baru District, Functions: Services and Trade, Ware.

4. Neighborhood unit : a) Around Simpang Lueng Bata, Lueng Bata District b) Around Lamjabat, Surien, Bitai villages, Meuraxa District c) Around Syah Kuala Cemetery Area, Syah Kuala District d) Around Aloe Naga Village, Syah Kuala District

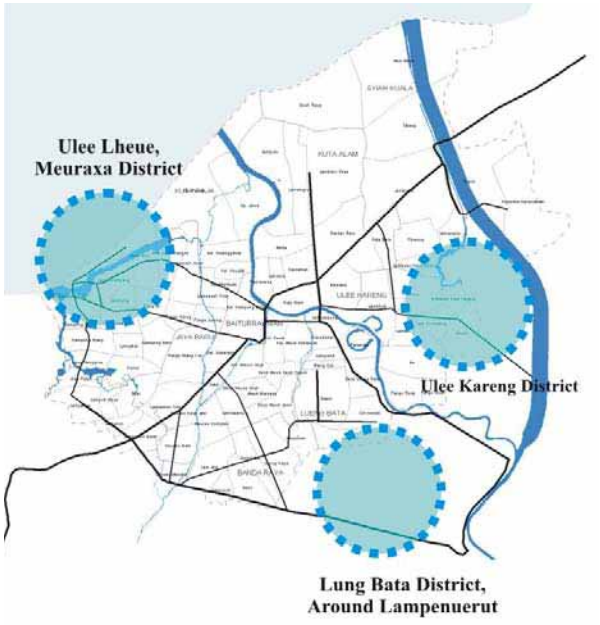
The abovementioned urban functions are illustrated in Figure 4.4.2, Figure 4.4.3, Figure 4.4.4 and Figure 4.4.5.

Figure 4.4.2 City Center of BAC



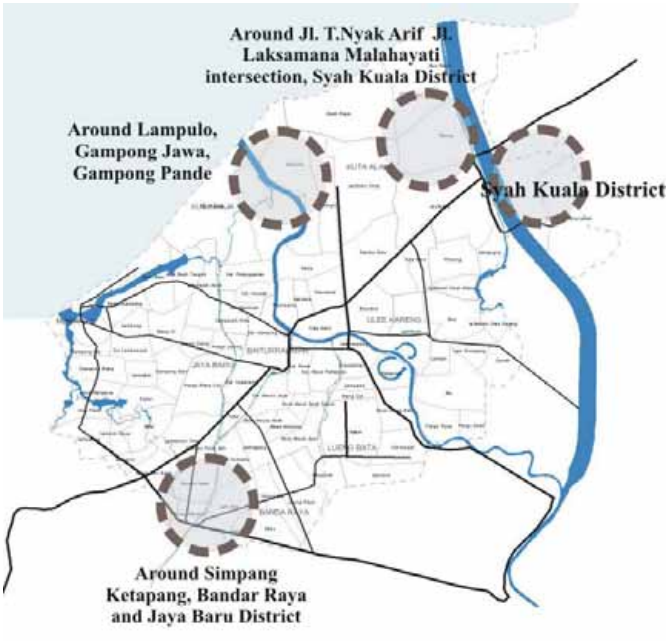
Source: Additional Study Team, 2006

Figure 4.4.3 Sub City Center of BAC



Source: Additional Study Team, 2006

Figure 4.4.4 Development Unit of BAC



Source: Additional Study Team, 2006

Figure 4.4.5 Neighborhood Unit of BAC

Source: Additional Study Team, 2006

4.4.3 Urban Hierarchy of BAC

Basically there is a hierarchy of regional center as described above. The hierarchy of an urban center can be determined based on several factors[1] as follows: 1) number of population in the urban center; 2) number of public facilities available; and 3) types of public facilities available. The more populous and the more number and types of facilities in an urban center, the higher is its hierarchy. More complex services may be acquired from centers of higher hierarchy.

BAC urban hierarchy is influenced by spatial development model, pre-determined urban functions, and the following policies:

- National and Provincial Spatial Policy: The national policy states that NAD Province belongs to Development Region A (WP-A) together with North Sumatera, West Sumatera and Riau Provinces. In Development Region A, BAC is designated as Order II city, functioning as a "Counter Magnet" for Medan City (Order I city). Within NAD Province, BAC is classified as a Hierarchy I city. The roles of BAC are as government center and office, social activity center, transportation center, religious center.

- RTRW for BAC: The city is divided into 4 urban units and 5 sub urban units.

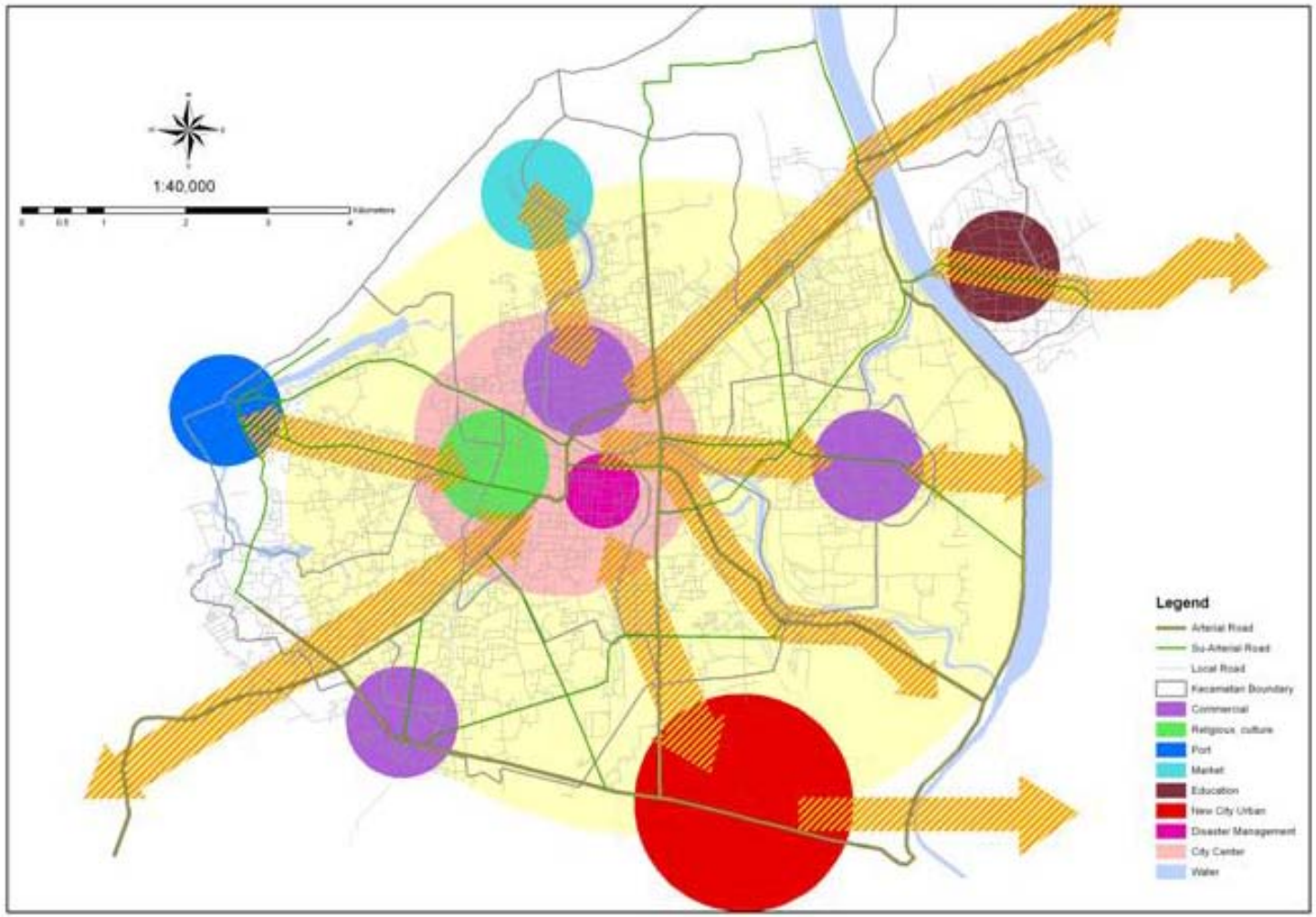
The abovementioned considerations help forms the proposed urban hierarchy of BAC, which consists of:

- Urban units: City Center urban planning unit (Hierarchy-1), Ulee Lheue urban unit (Hierarchy-2), Ulee Kareng urban planning unit (Hierarchy-2) and Lueng Bata urban planning unit (Hierarchy-2).
- Sub urban units (Hierarchy-3): Sub urban units A, B, and C in City Center; Sub urban planning unit Lueng Bata, Sub urban planning unit Ulee Lheue, Sub urban planning unit Ulee Kareng A and B.
- Sub-sub urban units (Hierarchy-4): Sub-sub urban planning unit Alu Naga, Sub-sub urban planning unit Deah Raya, Sub-sub urban planning unit Surien, Sub-sub urban planning unit Lueng Bata.

4.4.4 Urban System of BAC 2015

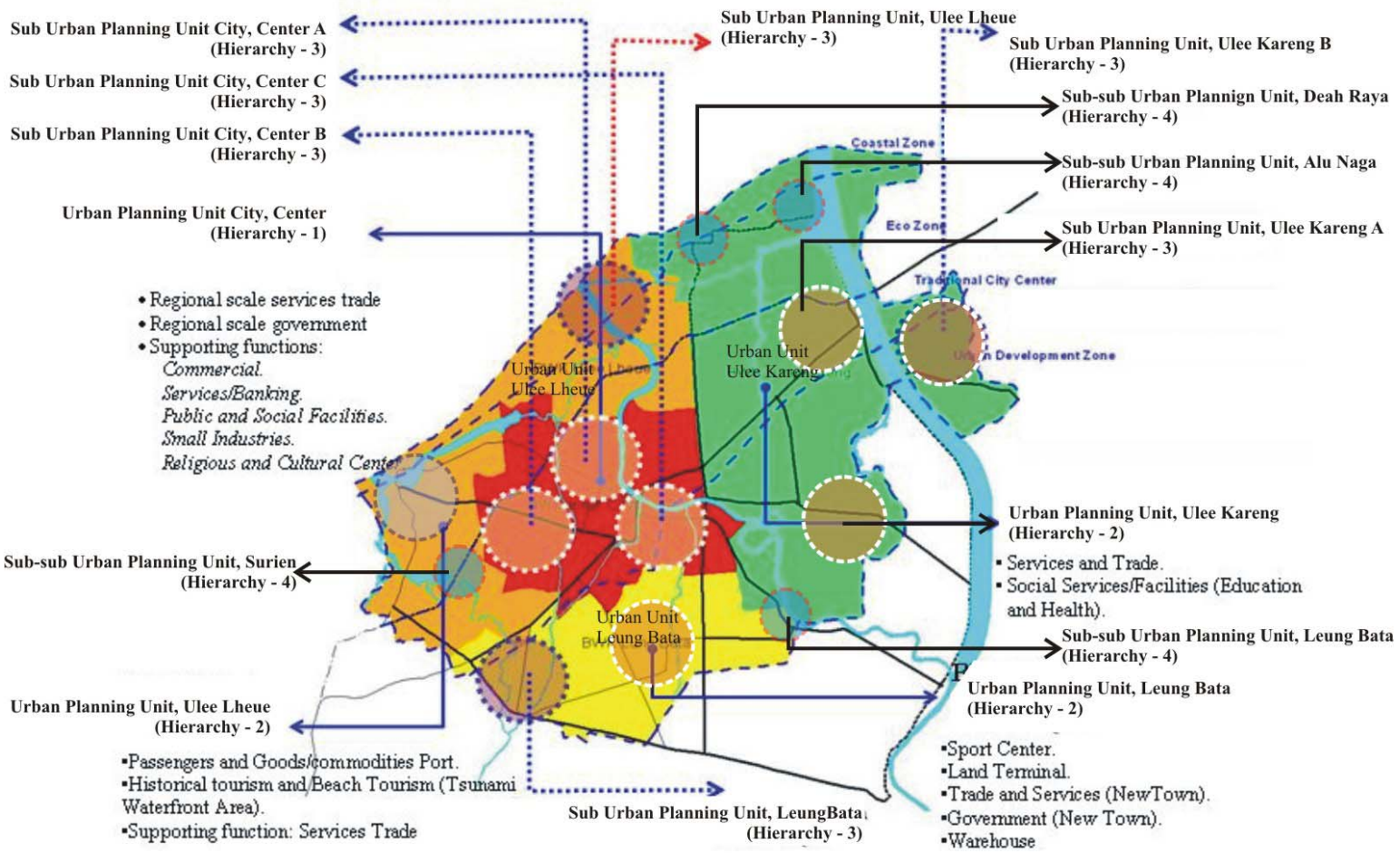
JICA Study Team has proposed an Urban System of BAC for planning horizon 2009, by integrating RTRW, Blue Print and consideration of disaster mitigation factors. In this urban system, each activity center is designated for certain urban function (commercial, religious, cultural, port, market, education, new city urban, city center). All will be linked to urban movement system (Figure 4.4.6). In accordance to the projected population for 2015, it is deemed necessary to include new smaller scale functions, in a more evenly distributed manner, in formerly non-serviceable areas. Each function is linked, to form a proposed urban system for 2015 (Figure 4.4.8).

Figure 4.4.6 Urban System of BAC, 2009



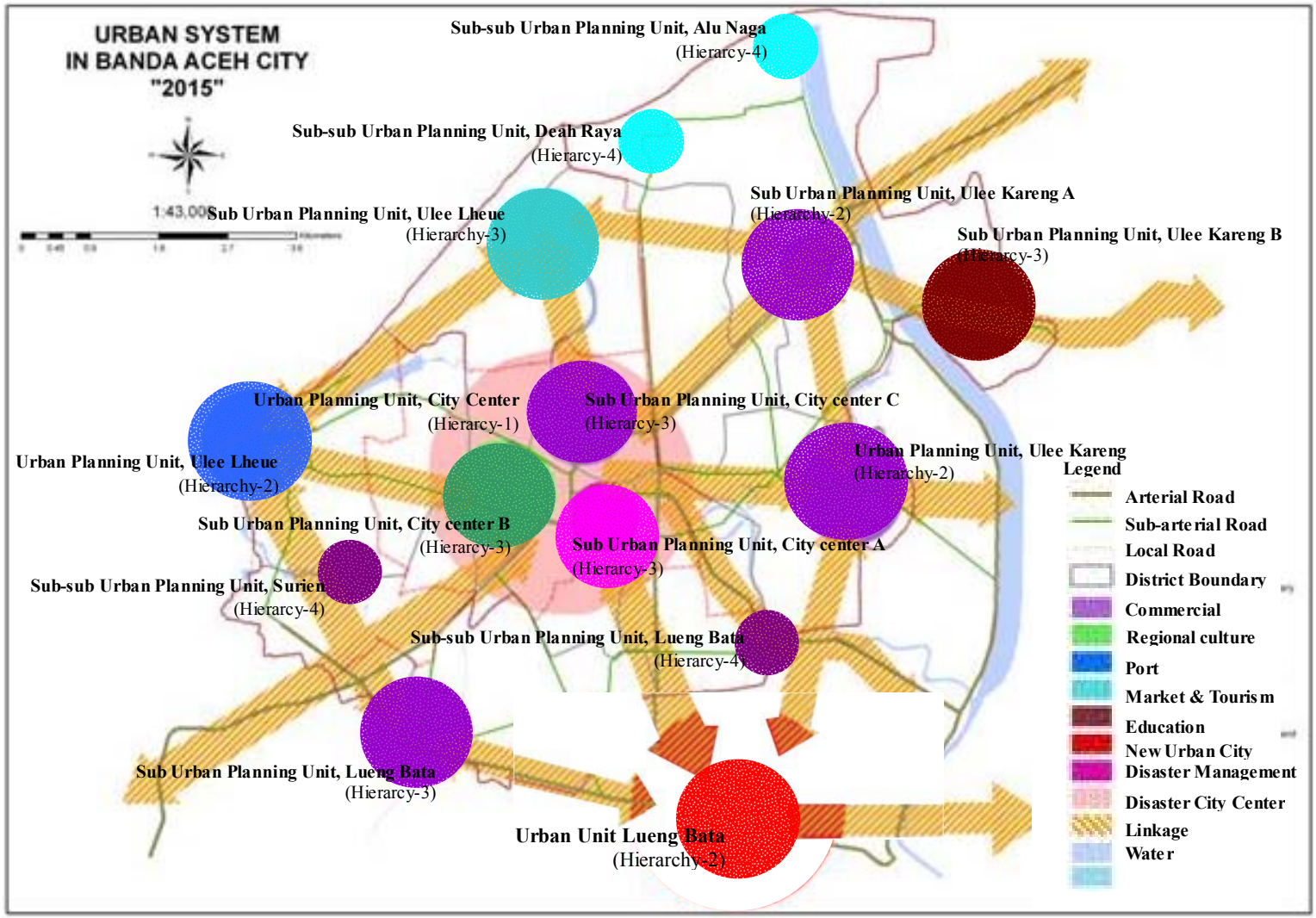
Source: JICA Study Team, 2005

Figure 4.4.7 Urban Function and Urban Hierarchy of BAC, 2015



Source: Additional Study Team, 2006

Figure 4.4.8 Urban System of BAC, 2015



Source:Additional Study Team, 2006

4.5 PROPOSED SPATIAL STRUCTURE AND URBAN PATTERN

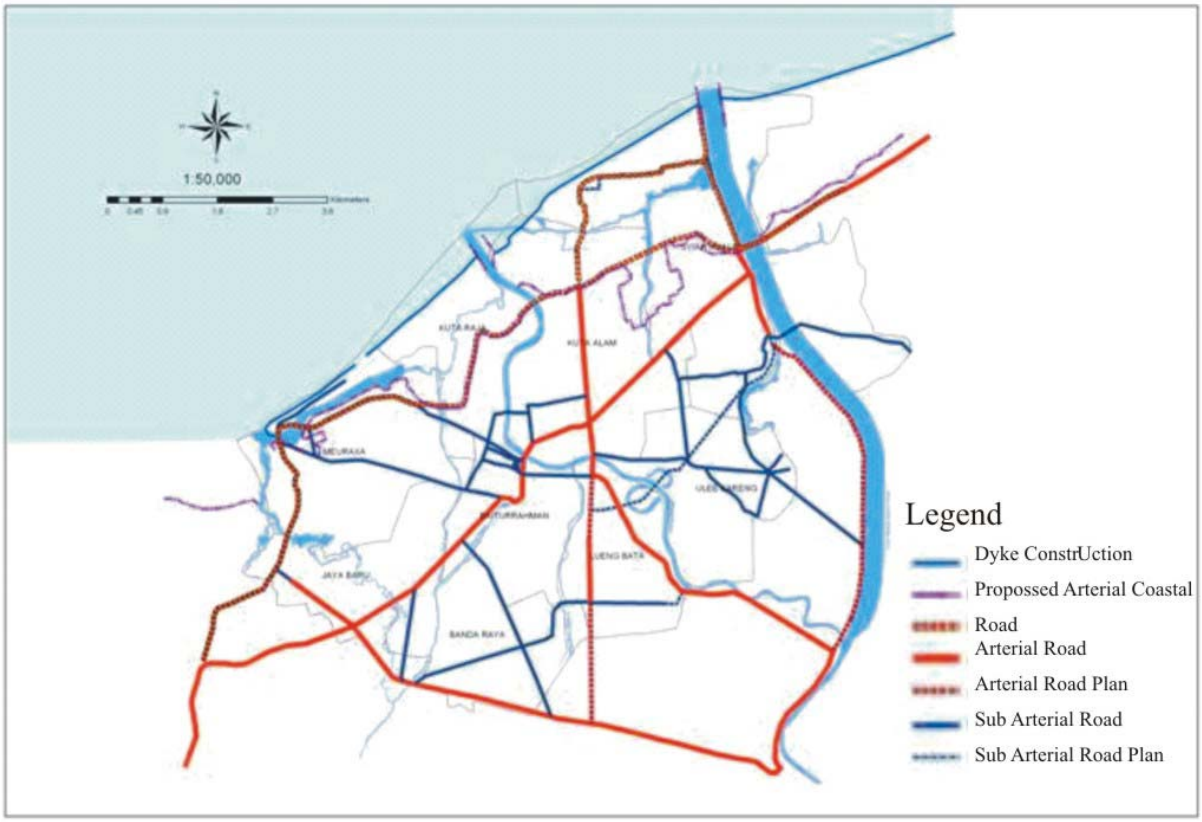
4.5.1 Proposed Urban Skeleton (Road and River)

The proposed urban skeleton of BAC is similar as proposed by URRP Study. There are only a few proposed changes as follows: 1) coastal road is proposed to function as north ring road as well as a tourism route to coastal tourism area; 2) new construction of Baru Street to connect Simpang Surabaya to Sukarno Hatta Street; 3) rehabilitation of of Syah Kuala Street as access road to the beach (including to Syah Kuala Cemetery).

As stated in URRP Study, the following urban skeleton is also proposed: Jl. Sukarno Hatta, Jl. Tgk. Abd. Rahman Meunasah Meucab, Jl. Lhok Nga, Jl.Cut Nyak Dien, Jl. Tengku Umar, Jl.Sultan Alaidin Johan Syah, Jl.Sultan Malikul Saleh, Jl. Iskandar Muda, Jl.Sultan Alaidin, Jl. Tengku Cik Ditiro, Jl. Tengku Imum Lueng Bata, Jl.Rama Setia, Jl.Habib Abdurahman, Jl. Diponegoro, Jl.KH Ahmad Dahlan, Jl. Tentara Pelajar, Jl. Panglima Polim, Jl. Muhamad Daud Beureuh, Jl. Tengku Nyak Arief, Jl. Laksamana Malahayati, Jl. Syah Kuala, Jl. Tengku Hasan Dek, Jl. TH.GLP Payong, Jl. Tgk. Nyak Makam, Jl. Tengku Iskandar, Krueng Aceh River, Krueng Aceh Floodway.

Syahkuala, Ulee Kareng, Kutaraja, Kuta Alam, Baiturahman and Lueng Bata

Figure 4.5.1 Urban Skeleton of BAC, 2015



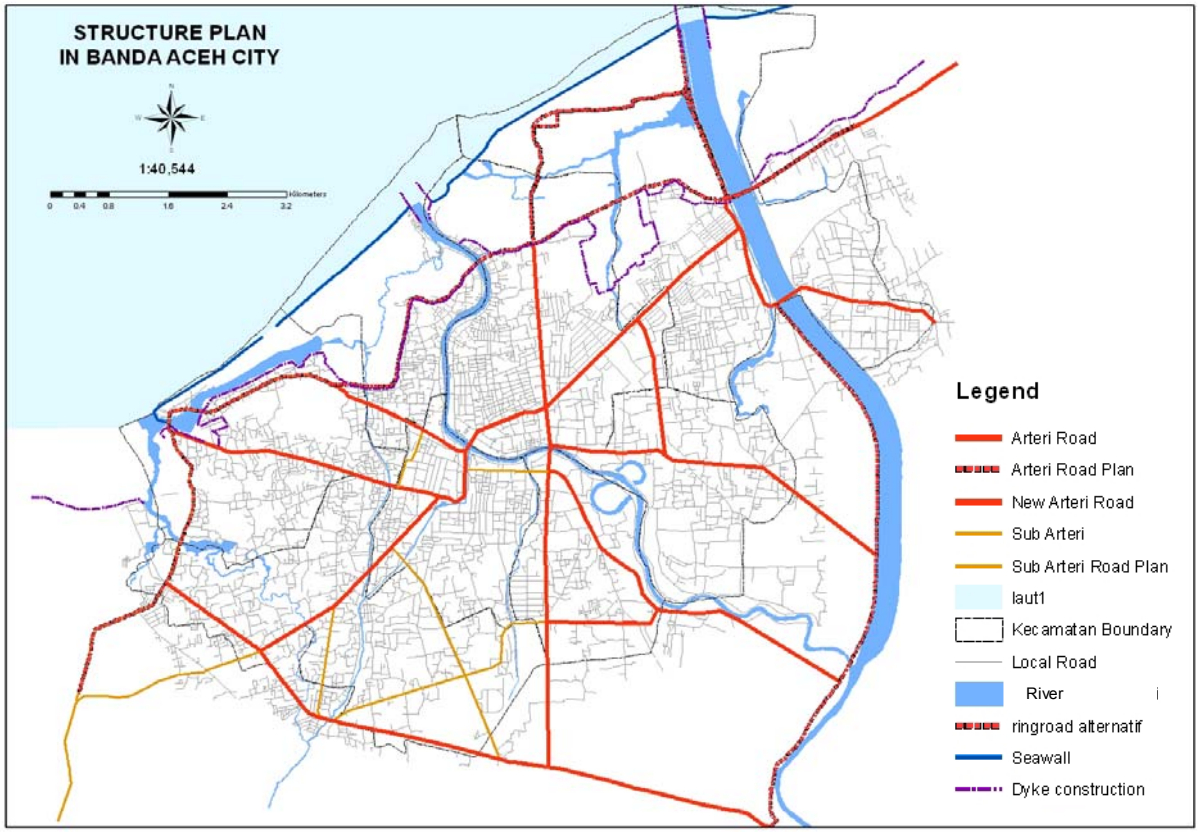
Source: Additional Study Team, 2006

4.5.2 Proposed Urban Pattern 2015

Older parts of BAC that were planned in its early history generally reflect a geometrical pattern (gridiron, linear, and such). On the other hand, areas that were formed as a result of unplanned growth (some residential and commercial areas) are non-geometrical/amorph in pattern.

The urban pattern of each reconstruction model area is as follows: 1) Peunayong is already a built up area in a gridiron pattern; 2) Lueng Bata New Town model area is proposed to be designed with centric/radial pattern; 3) Ulee Lheue model area is proposed to be designed with formal grid and radial pattern.

Figure 4.5.2 Urban Pattern of BAC, 2015



Source: Additional Study Team, 2006

4.5.3 Specific Spatial Structure Plan

After proposing the urban pattern for BAC, a spatial structure plan will be designed as a more detailed guideline for development.

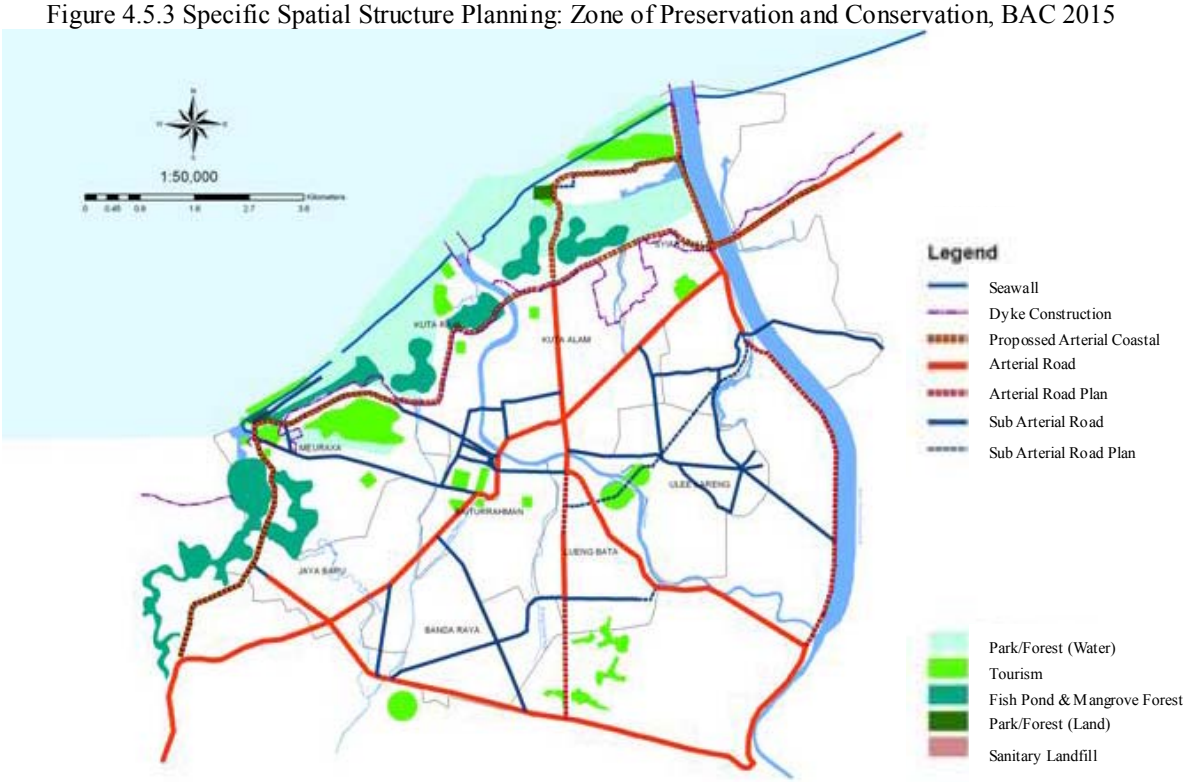
(1) Zone of Preservation and Conservation

- ***Green Area (Green Open Space)***, locations: Meuraxa, Kutaraja, Kuta Alam, Baiturrahman, Syahkuala, Ulee Kareng, Lueng Bata and Banda Raya districts. Green Area includes public open spaces such as parks, riverbanks, street corridors, sport centers, pockets of green spaces in residential areas.
- ***Mangrove Forest***, locations: Kutaraja, Kuta Alam and Jaya Baru districts. This zone is meant as an effort to preserve existing mangrove forests. Mangrove forests are also proposed to be planted in coastal areas devastated by the tsunami. Example is ex-fishpond

area proposed to be allocated for green belt.

- ***River,*** locations: Syahkuala, Ulee Kareng, Kutaraja, Kuta Alam, Baiturrahman and Lueng Bata. River preservation is important to maintain its function as primary and secondary drainage channels.
- ***Coastal area,*** location: Kutaraja, Syahkuala, Kuta Alam and Meuraxa. This area is important for local economic development (fishponds) as well as conservation of beach and vegetation, and historical area (urban heritage).

Figure 4.5.3 Specific Spatial Structure Planning: Zone of Preservation and Conservation, BAC 2015



Source: Additional Study Team, 2006

(2) Zone of Development

- ***Commercial,*** locations: in city center area along BAC main roads and in planned commercial area in Lueng Bata. Commercial area in city center should be appropriate to according to pre-determined hierarchy.
- ***Government office,*** location: existing area in city center along BAC main roads, and planned area for administrative uses in Lueng Bata. Care should be taken to adjust the allocation to proper hierarchy.
- ***Sport Center Area,*** location: Banda Raya. This zone is utilized for recreation uses, sport and tourism area.
- ***Port***, location: Ulee Lheue Ferry Terminal in Meuraxa district, serving passenger and cargo traffic.
- ***Bus Station***, location: Banda Raya. Allocated space for bus station in Lueng Bata. Integrated to multi-modal terminal in Lambaro regional center.

- ***Education,*** location: Syah Kuala Education Center.
- ***Tourism Area,*** location: in coastal area and city center. Particular focus on Ulee Lheue area with specific functions as port and tourism area (Tsunami Waterfront).
- ***Sanitary landfill,*** location: Gampong Jawa. Remaining useful life of this existing landfill is only for two more years. Alternative landfill sites outside BAC have been identified.

Figure 4.5.4 Specific Spatial Structure Planning: Zone of Development, BAC 2015

Source: Additional Study Team, 2006

4.5.4 Primary Land Use Plan 2015

BAC land use plan is prepared as a reference for an effective rehabilitation and reconstruction efforts, to minimize the damage of disaster and to promote orderly urban development. The land use is planned by taking into account the following plans: Land Use Plan of BAC (2001-2010) promulgated in 2001 (pre-tsunami), Spatial Plan of BAC in the Blue Print (2005, post tsunami) and URRP for BAC by JICA Study Team. The primary land use plan of BAC is listed in Table 4.5.1.

Table 4.5.1 Primary Land Use Plan of BAC

No	Land Use	Detail Land Use	Location
1	Residential	City Center Residential	Kuta Raja District: Peulanggahan, Keudah. Meuraxa District: Lampaseh Kuta, Punge Jurong. Baiturahman District: Sukaramai, Neusu Jaya, Kampong Baro, Peuniti, Ateuk Pahlawan, Merduati. Kuta Alam District: Kuta Alam, Peunayong, Laksana, Kampung Mulia.

No	Land Use	Detail Land Use	Location
		Rural Residential	1.Coast line Meuraxa District: Ulee Lheue, Deah Glumpang, Deah Baro, Aloe Deah Tengoh, Lampaseh Aceh Kuta Raja District: Gampong Pande, Gampong Jawa. Kuta Alam District: Lam Pulo, Lam Dingin, Lambaro Skep. Syah Kuala District: Dayah Raya, Alue Naga 2.Land Syah Kuala District: Tibang , Jelingke, Rukoh, Lam Gugop, Darussalam, Ie Masen Kaye Adang. Ulee Kareng District: Ie Masen, Ceurih, Ilie Pango Deah, Pango Daya. Lueng Bata District: Cot Masjid, Lamdom. Banda Raya District: Peuyeurat, Lhong Raya, Lhong Cut, Mibo, Lampuot, Lam Ara. Jaya Baru District: Geuceu Menara, Lamteumen Barat, Emperum, Lamjene.
		Transition Area Residential	All housings among City Center Housings and Rural Housings.
2	Commercial/Services and Trade	Linear Commercial	Along Jl. Teuku Umar dan Jl. Cut Nya Dhien Along Jl. Tengku Iskandar Along Jl. Sukarno Hatta Along Jl. Syah Kuala Along jalan baru dari Simpang Surabaya Along Jl. Tgk. Nyak Makam Along Jl. Tgk.Imum Lueng Bata
		Areal Zone Surrounding Centers	Ulee Kareng New Town Setui Peunayong
3	Government	Old Government Office	Jl. Muh. Daud Beureuh Jl. Tengku Nyak Arief
		New Government Office	New Town Lueng Bata
4	Industries	Limited to small, non polluted industries	Spread in several city area
5	Cultural and Educations	Cultural (Islam)	Mesjid Raya and surrounding area
		Educations	Syah Kuala and Lueng Bata
6	Park and City open Space	Tsunami Waterfront: Tsunami Living Museum, Recreation and sports, Mass Grave, City Forest, education facilities	Ulee Lheue, Lampulo, Syah Kuala
		Escape Area	Open space in northern side of Jl. Cut Nya Dien, Jl.Tengku Umar, Jl.Muh Daud Beureh, Jl.Tengku Nyak Arif

No	Land Use	Detail Land Use	Location
7	Coastal Area	Harbor, Port	Ulee Lheue, Lampulo
		Fish Market	Lampulo
		Landfill and Septage Treatment Plan	Gampong Jawa
		Fishing settlements	Along the coastline

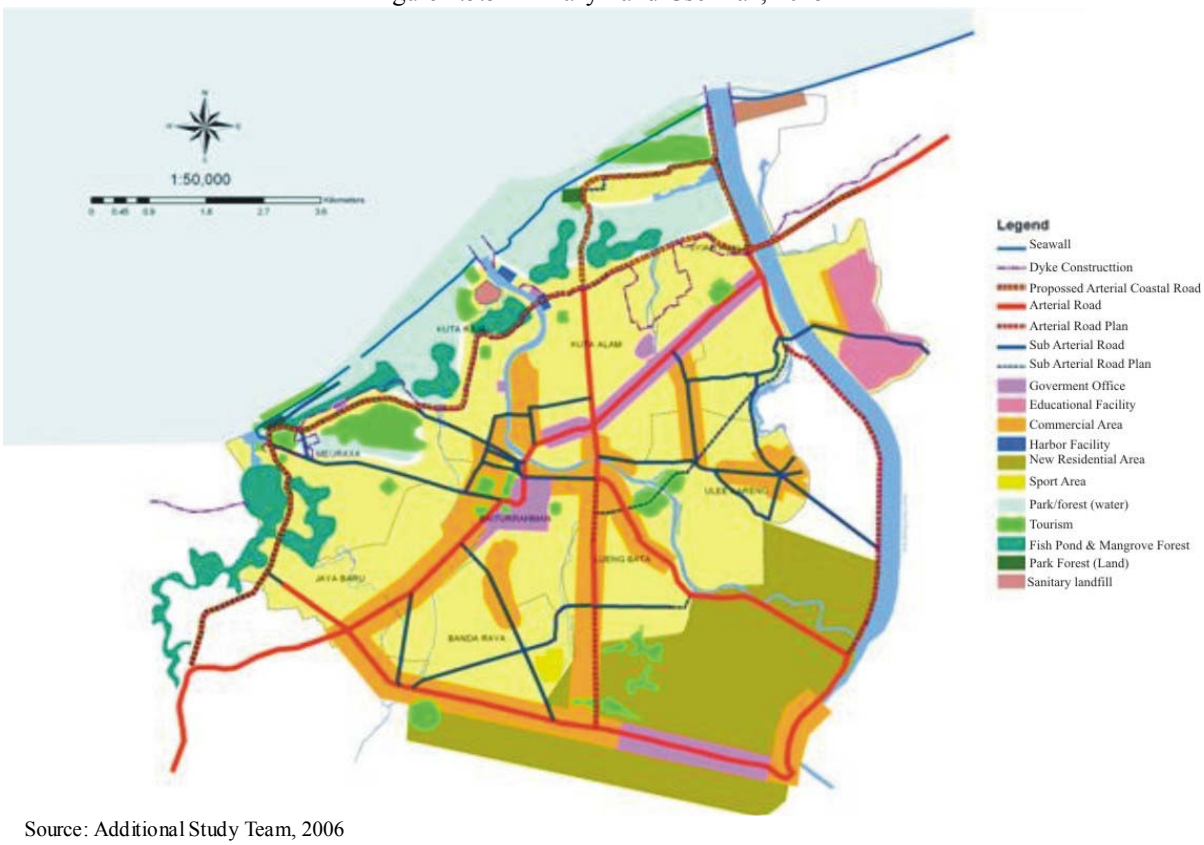
Source: Additional Study Team, 2006

Table 4.5.2 Land Allocation according to Primary Land Use Plan for 2015

Land Use	Ha	%
Park Forest (Land)	805.77	
Fishpond Mangrove	383.56	
Sub Total Non Build up area	**1,189.32**	**18%**
Commercial	1,130.14	
Education	166.16	
Sport Center	24.9	
Tourism	0	
Residential Area	327.30	
Government Office	3,474.65	
Sanitary Landfill	299.20	
Port	10.92	
	20.72	
Sub Total Built up area	**5,453.97**	**82%**

Source: Additional Study Team, 2006

Figure 4.5.5 Primary Land Use Plan, 2015



Source: Additional Study Team, 2006

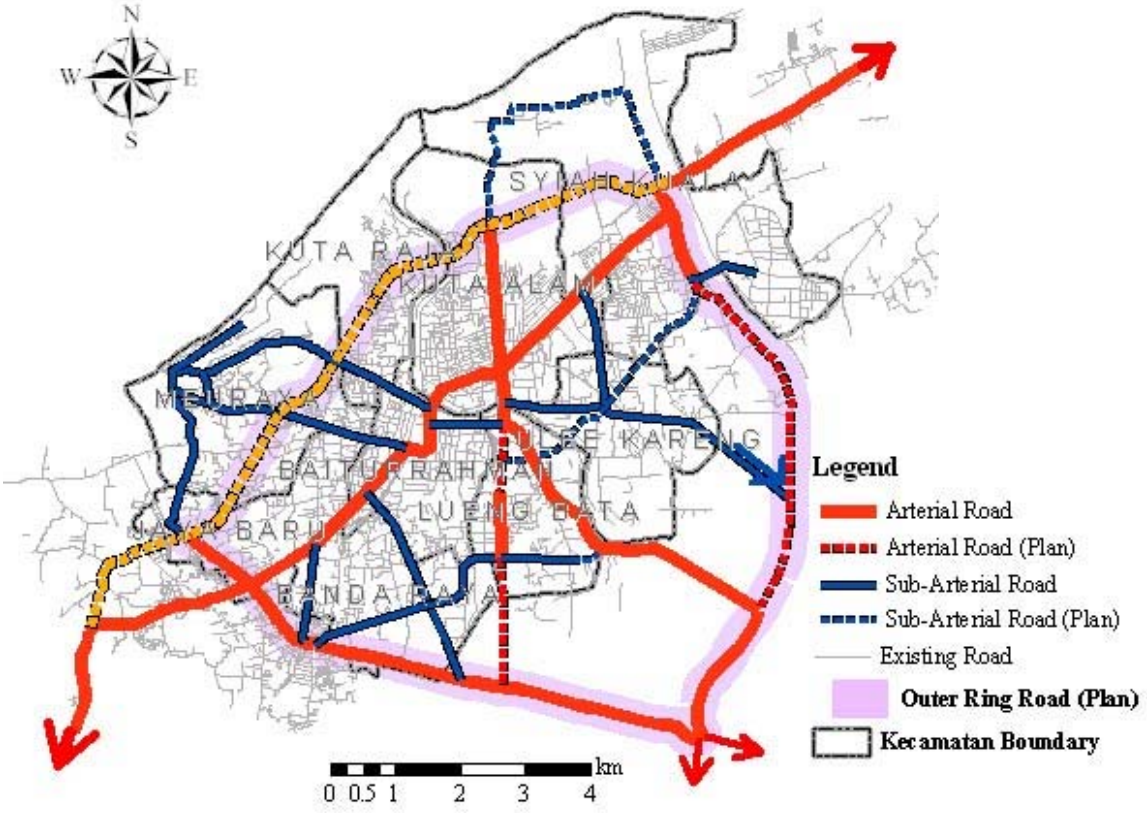
4.6 INFRASTRUCTURE DEVELOPMENT PLAN

4.6.1 Roads

(1) URRP Road Hierarchy Proposal

The URRP Study states that based on their function roads can be classified into four categories i) main arterial road, ii) arterial road, iii) sub-arterial, iv) access road. The main arterials consist of links that connect Banda Aceh and its surrounding areas, urban planning unit to urban unit, and nodes of transportation to other nodes. Sub-arterials links some areas, excluding the previous defined. A complete guide to the structure of roads hierarchy is as shown in Figure 4.6.1.

Figure 4.6.1 Road Hierarchy Plan Based on URRP (2009)



Source: JICA Study Team, 2005

(2) Proposal For Up to 2015

In completion of the URRP study, another road hierarchy plan is proposed and presented in Figure 4.6.2. The new proposal is not largely different with the URRP result. The only differences are the coastal road alignment which is slightly adjusted to follow the embankment trace in ongoing construction progress; and the road hierarchy classes which have been adjusted to Indonesian classification system.

(a) Primary system

Primary system consists of primary arterial and primary collector networks. Links in the primary arterials connects Banda Aceh to the surrounding areas. They provide movements from Banda Aceh to the other province or regency and facilitate through movement with bypass concept (green lines in Figure 4.6.2).

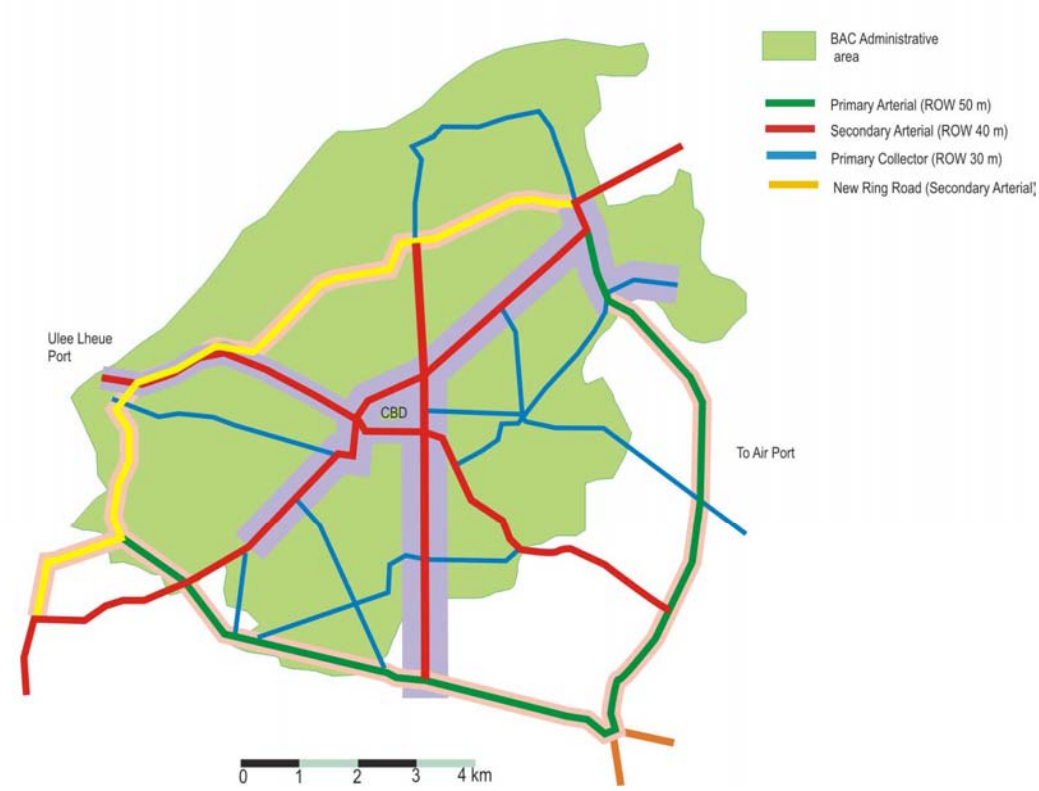
The primary collectors link urban units in Banda Aceh urban system. The primary collectors also provide wide range access to people from the small unit of village (aqua lines in Figure 4.6.2).

(b) Secondary system

Secondary system consists of two categories of roads: secondary arterials and secondary collectors. Secondary arterials link sub urban units, facilitating medium speed and medium journey types of travel. Secondary system support primary system by collecting traffic from the primary collectors or from secondary collectors. (red in Figure 4.6.2).

Secondary collectors link sub-sub urban units. They collect trip or traffic from smaller unit of village and trip from streets.

Figure 4.6.2. A New Road Hierarchy Plan Proposal (2015)



Source: Additional Study Team, 2006

Table 4.6.1 Roads Hierarchy and Characteristics

Class of road	Types of Road	Dimensions	Design speed	Width (ROW)
Class 1	Primary Arterials	6 L 2 W/D	>70 km/hr	50 m
	Secondary Arterials	6 L 2 W/D	>60 km/hr	40 m
Class 2	Primary Collectors	4 L 2 W/D	>50-60 km/hr	30 m
	Secondary Collectors	4 L 2 W/UD	<50 km/hr	20 m
Class 3	Primary Locals	2 L 2 W/UD	<30 km/hr	12 m

Source: Additional Study Team, 2006

Notes: L = lane, W = Way, D = Divided or Median, UD = Undivided

(4) Preliminary Cost Estimate

It is proposed to implement the following rehabilitation and reconstruction works for road and road traffic facilities:

Table 4.6.2 Proposed Rehabilitation and Reconstruction Works for Roads and Road Traffic Facilities

No.	Works	Work Items	Features of Works
R1: Road			
R1-1	Rehabilitation of arterial road	JL. Lhoknga (including Lamjame bridge)	Road: 2.6km; Bridge: 33m
		JL. TGK. ABD Rahman Meunasah Mencab	Road: 1.6km
		JL. Iskandar Muda (including Punge I, Laguna I bridge)	Road: 3.6km; Bridge: 80m
		JL. Habib Abdurrahman (including Titi Tungkat, Laguna II bridge)	Road: 3.7km; Bridge: 56m
		JL. Syiah Kuala (including Syiah Kuala I/II bridge)	Road: 3.9km; Bridge: 43m
R1-2	Rehabilitation of sub-arterial and other roads	Roads in the city	Road: 165.1 km
R1-3	Construction of coastal road (Ring road, north part)	Road construction with bridges, road facilities and drain facilities (box culvert etc.)	Road: 14.4km, (20-25m wide, 1.5m elevation, 5-15m slope both sides), Bridge: 150m
R1-4	Extension of Jl. Syiah Kuala	Road construction	Road: 4 km
R1-5	Improvement of escape roads	Road improvement	Road: 6 km
R1-6	Completion of the ring road and construction of new arterial roads (including 3rd east-west road)	Road and bridge construction	Road: , Bridge
R2: Traffic Safety Facilities			
R2-1	Reconstruction of traffic management systems	Signals Traffic signs Road marking	9 signals 225 traffic signs 6km road marking
R2-2	Improvement of signals	Signals	28 signals
R3: Road Traffic Facilities			
R3-1	Reconstruction of bus (labi-labi) terminal	Construction of bus terminal (building, traffic management, utilities)	Area: 34,000 m^2
R3-2	Construction of vehicle inspection center, bus terminal and truck terminal		Area: 50,000 m^2
R4: Ferry Terminal			
R4-1	Reconstruction of ferry port	To be implemented by Australian Government	-

Source: JICA Study Team, 2005

The preliminary cost estimate is made under the conditions and assumptions set forth below:

(1) Physical contingency and price escalation are assumed to be 10 % each of the direct construction cost.

(2) Engineering service is assumed to be 10 % of the direct construction cost for detailed study & design and construction supervision.

(3) The direct construction cost is assumed not to include the amount of VAT but import duties.
(4) Land acquisition and compensation costs are not included in the project cost due to difficulty of estimation at this time
(5) Tentative Implementation Plan
(a) Priority for Implementation

The target years of rehabilitation and reconstruction works are set at 2006 and 2009 respectively. However there are a huge amount of works on roads, road traffic facilities and other such as ferry terminal. The works will therefore be implemented in a stage-wise way.

Table 4.6.3 Development Scenario

Priority	Stage	Proposed Works
Scnario-1 (Realistic)		
1	Rehabilitation	Rehabilitation of arterial roads and bridges
		Rehabilitation of damaged sub-arterial and other roads
2	Reconstruction	Reconstruction of road safety facilities
		Reconstruction of bus (labi-labi) terminal
3	Long term	Construction of coastal road and extension of Jl. Syiah Kuala (north-south road)
		Completion of the ring road and construction of new arterial roads
		Construction of transportation facilities
Scenario-2 (Effectiveness of Transport)		
1	Rehabilitation	Rehabilitation of arterial roads and bridges
		Rehabilitation of damaged sub-arterial and other roads
2	Reconstruction	Reconstruction of traffic management systems and transportation facilities
		Reconstruction of bus (labi-labi) terminal
		Construction of coastal road and extension of Jl. Syiah Kuala (north-south road)
3	Long term	Completion of the ring road and construction of new arterial roads

Source: JICA Study team, 2005

(b) Tentative Implementation Plan

The tentative implementation plans according to the above development scenario-1 is shown in Table 4.6.4.

Table 4.6.4 Implementation Plan of Road and Transport (Development Scenario-1)

Projects/Programs		Implementation Schedule										
		Rehabilitation Stage		Reconstruction Stage			Development Stage					
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Road	(1) Rehabilitation of Arterial Roads and Bridges	■	■									
	(2) Rehabilitation of Sub-arterial and other roads	■	■									
	(3) Construction of coastal roads						■	■	■			
	(4) Extension of Jl. Syiah Kuala										■	■
	(5) Improvement of existing roads for Escape Roads			■								
	(6) Construction of New arterial roads									■	■	■
Traffic safety	(7) Reconstruction of			■								

facility	traffic management system											
	(8) Improvement of signals											
Road traffic facility	(9) Reconstruction of bus terminal											
	(10) Construction of terminals and inspection											
Ferry terminal	(11) Construction of Ulee Lheue ferry terminal											

Source: JICA Study team, 2005

(6) Annual Fund Requirement

The annual fund requirement is estimated on the basis of the project cost estimate and implementation schedule as shown below:

Table 4.6.5 Annual Fund Requirement

Projects	Rehabilitation		Reconstruction			Development						Total
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
(1) Rehabilitation of Arterial Roads and Bridges	37.99	37.99										75.98
(2) Rehabilitation of Sub arterials and other roads	271.61	271.61										543.22
(3) Construction of (4) Coastal Road						120.9	120.9	120.9				362.8
(5) Extension of Jl. Syiah Kuala										21.935	21.935	43.87
(6) Improvement of Existing road for escape road			19.74									19.74
(7) Construction of New Arterial Roads									66.74	66.74	66.74	200.22
(8) Reconstruction of Traffic management system				4.15								4.15
(9) Improvement of signals						9.21						9.21
(10) reconstruction of Bus Terminal			31.7	31.7								63.4
(11) Constructions of Terminals and Inspection Center										46.605	46.605	93.21
(12) Construction of Ferry Terminal			22.53	22.53	22.53							67.59

Source: URRP Study team

4.6.2 Drainage and Flood Control

(1) Rehabilitation and Reconstruction Planning for Urban Drainage System Based on URRP Study for BAC

a. Mission, Strategies and Goals

As noted in existing drainage, substantial portion of existing drainage facilities were damaged completely. In addition, dykes and floodwalls along main rivers/floodway were broken out and/or washed away at many locations and in length. It is very serious matter how quickly such

damaged/washed out/destroyed facilities could be restored in order to save people and properties against coming rainy season and high tide. In addition urban drainage system will be required to be reorganized in conformity with a new road network and urban development plan.

Table 4.6.6 Mission, Strategy and Goals for Urgent Rehabilitation and Reconstruction Plan for Urban Drainage

Mission	To ensure safety of human lives and properties To contribute to enhancement of economic development activities without any interruption even during high tide and rainy season To complete systematic urban drainage network over the entire city area
Strategies	To minimize habitual inundation areas with reinforcement of drainage facilities To layout drainage network in conjunction with urban road development plan To remove sediment, debris and garbage deposits in conduits To reinforce O & M capability of DPU
Goals	To reinstall systematic drainage in devastated area by 2009 To reinstall and reinforce drainage pump stations by 2009 To rehabilitate broken and destroyed dyke and floodwall urgently

Source : JICA Study Team, 2005

b. Rehabilitation and Reconstruction Planning for Urban Drainage System

One of the most urgent issues is to implement urgent rehabilitation works on drainage system and dykes and floodwalls of major rivers in the city, since the city would be attacked by high tide and storm water in the later part of 2005. Although the preliminary planning of rehabilitation and reconstruction of drainage system is attempted in this report, it is important to conduct more detailed study before actual implementation of the works in framework of long-term drainage system improvement.

(1) Planning Criteria

a) General criteria

Target year	:	Rehabilitation; 2006, Reconstruction; 2009
Target area	:	BAC with administrative area of 61 km2
Population in 2009	:	254,000 as projected under this study
Population distribution	:	As per studied as a part of urban development plan of this study
Urban development	:	As per spatial and urban development plans of this study

b) Criteria for drainage system design

Design storm rainfall	:	165 mm with a return period of 5 years
Run off calculation	:	Rat Rational formula
Run off coefficient	:	Variable, characterized by drainage area
Drainage conduit	:	Rectangular shape

(2) Approach to Planning

The rehabilitation and reconstruction plan basically follows drainage pattern and system before the disaster. However, it is necessary to slightly modify in conformity to the proposed city development plan.

Also in order to cope with the immediate problems such as marching of high tide and rainy season, it is absolutely necessary to execute countermeasures as soon as possible. The rehabilitation and reconstruction works are therefore proposed to be carried out in the priority order mentioned below.

Priority 1 : Urgent recovery of drainage pump stations Nos.1,8,4,6 and primary drains for a length of 766 m (Drain IDs 1.3, 11.1)

Priority 2 : Normalization of primary drains of approximately 4,620 m (Drain IDs 2.1, 4.1-2, 6.2, 7.1, 9.1-3, 9.5-6, 11.2, 12.1-3)

Priority 3 : Rehabilitation of pumping stations Nos. 2, 3.5 and 7 and rehabilitation of primary drains for a length of 1,896 m (Drain IDs 1.1-2, 13.5-6)

Priority 4 : Rehabilitation of primary drains for a length of 3,691 m (Drain IDs 4.1.1,4.3-4,6.1,6.34,8.1)

Priority 5 : Reconstruction of primary drain for a length of 622 m (Drain IDs 17.1-4, 19) and new drains for a length of 8,108 m (Drain IDs 1.1, 1.5, 3.5-3.7, 12.5, 14.13, 15.14, 16.1-2, 17.1-4, 19)

As reported in the preceding section of this report, there are a number of habitual inundation areas and some parts of the city area are lower than high water level of the Aceh River. It is considered to be rational that drainage system is designed with a combination of drainage channels, retardation areas and pumping stations to efficiently and safely drain storm water from the land area of the city.

(3) Drainage Zones

Drainage zones remain the almost same as those before disaster. The entire drainage area is divided into three (3) zones. However the new sub-drainage areas are created, characterized by the city development plan under the current study. Those new sub-drainage areas are S14-2, S15-2, S16-2 and S17-2.

(4) Run-off

The run-off from each sub-drainage area is computed on a basis of the Rational formula and design storm rainfall as given in Table 4.6.7

Table 4.6.7 Run-off Calculation from Each Drainage Area

Zone	Sub	Primary	Pump	Run-Off			
	Drainage	Drain	Station	Drainage Area	Furthest Distance	Coefficient Discharge	Run-off
				(ha)	(m)	-	(m^3/s)
Zone I	1	1.1	P.3	58.00	150	0.5170	1.254
Zone I	1	1.2	P.2	53.00	200	0.5175	0.268
Zone I	1	1.3	P.1	65.50	200	0.5585	1.205
Zone I	1	1.4		29.50	150	0.5755	0.481
Zone I	2	2.1		130.00	400	0.5095	1.571
Zone I	3	3.1		41.00	1,300	0.5085	0.576
Zone I	3	3.2		75.50	600	0.5335	2.613
Zone I	3	3.3.		223.00	650	0.5190	6.484
Zone I	3	3.4		58.00	280	0.5410	1.406
Zone I	3	3.5	P.8		0.00		
Zone I	4	4.1		47.00	325	0.5075	1.832
Zone I	4	4.1.1		35.00	275	0.4930	
Zone I	4	4.2		39.50	250	0.4745	1.291
Zone I	4	4.3		29.00	250	0.4850	0.787
Zone I	4	4.4		44.00	275	0.4890	1.410
Zone I	5	5.1		77.50	200	0.4335	2.110
Zone I	5	5.2		30.00	275	0.5059	1.000

Zone	Sub	Primary	Pump	Run-Off			
Zone I	5	5.3		56.00	400	0.4990	0.500
Zone I	5	5.4		50.50	350	0.5150	0.240
Zone I	5	5.5		110.00	150	0.5365	2.130
Zone I	6	6.1		40.50	200	0.5100	4.680
Zone I	6	6.2		125.50	550	0.5070	1.621
Zone I	6	6.3		57.00	370	0.4895	0.940
Zone I	6	6.4		75.00	350	0.4850	1.490
Zone II	7	7.1		65.00	275	0.4475	0.945
Zone II	8	8.1		90.00	200	0.4700	1.340
Zone II	9	9.1		127.00	2	0.4610	1.223
Zone II	9	9.2		45.00	500	0.4745	1.128
Zone II	9	9.3		60.00	200	0.4685	0.854
Zone II	9	9.4		53.00	200	0.4700	0.920
Zone II	9	9.5		19.00	250	0.4700	0.552
Zone II	9	9.6		50.00	420	0.4640	1.015
Zone II	10	10.1		41.00	2	0.5035	1.138
Zone II	11	11.0		54.00	300	0.5155	0.840
Zone II	11	11.1	P.4	34.00	300	0.5100	1.480
Zone II	11	11.2		335.00	700	0.4850	6.116
Zone II	11	11.3		19.00	220	0.4025	0.551
Zone III	12	12.0		58.00	450	0.5120	2.351
Zone III	12	12.1		150.00	50	0.5125	0.593
Zone III	12	12.2		24.00	100	0.5060	1.578
Zone III	12	12.3		38.50	175	0.4930	1.880
Zone III	12	12.4		33.00	250	0.5035	1.581
Zone III	13	13.1	P.6	45.00	100	0.5540	2.628
Zone III	13	13.2		16.00	100	0.5660	1.118
Zone III	13	13.3		26.50	400	0.3835	0.129
Zone III	13	13.4		28.50	350	0.5165	0.684
Zone III	13	13.5	P.5	43.00	500	0.5215	0.539
Zone III	13	13.6	P.7	50.00	150	0.5245	2.552
Zone III	14	14.1		45.50	300	0.5105	3.200
Zone III	15	15.1		45.00	100	0.4934	1.780
Zone III	15	15.2		27.00	150	0.5070	0.841
Zone III	15	15.3		85.00	425	0.4975	1.880
Zone III	16	16.1		180.00	200	0.3810	3.251
Zone III	17	17.1		41.50	200	0.4250	0.710
Zone III	17	17.2		20.50	100	0.5170	1.058
Total	-	-		3,499.00	-	-	82.34

Source: JICA Study Team, 2005

(5) Preliminary Design

Primary Drains and Pumping Stations

The discharge capacity of existing primary drains and pumping stations was firstly assessed whether they are capable of draining the discharge of their drainage area. Table 4.6.8 summarizes the comparison of the computed discharge and drainage capacities of pumps and drains.

Table 4.6.8 Capacities of Existing Drainage Facilities vs Run-off

Sub-drainage areas	Name	Drain to:	Run-off (m^3/s)	Discharge Capacity of Drain (m^3/s)	Pumping Capacity (m^3/s)
1.3	P.1	Aceh R.	1.205	1.082	0.245
1.2	P.2	Aceh R.	0.268	0.470	0.200
1.1	P.3	Aceh R.	1.254	0.357	0.270
11.1	P.4	Daroy R.	1.480	1.099	0.745
13.5	P.5	Doy R.	0.539	0.51	0.824
13.1	P.6	Doy R.	2.628	0.512	0.225
13.6	P.7	Doy R.	2.552	4.022	0.200
3	P.8	Titi Panjang	11.080	0.686	0.225

Source: JICA Study Team

Of the existing 8 pumping stations, 7 stations have less capacity than the required drainage quantity. Also it is assessed that existing drains are not capable of conveying storm run-off so that excess water should be absorbed in retardation basins. Table 4.6.9 summarizes drainage facilities proposed for rehabilitation and reconstruction plan.

Table 4.6.9 Summary of Rehabilitation and Reconstruction Plan for Urban Drainage

Term	Rehabilitation Stage	Zone	Sub Drainage	Primary Channel	Pump No.	Run-Off		Pumping Facilities	Primary Channel				Water Gates			Retarding Ponds	
						Drainage Area	Run-Off		Total Length	Damaged Length	Damaged Ratio	New Channels	Total Gates	Damaged Gates	Damaged Ratio	Dimension	Volume
						(ha)	(m3/s)	(m3/s)	(m)	(%)	(%)	(m)	-	-	(%)	(m)	(m3)
Urgent Recovery	1	Zone I	1	1.3	P.1	65.50	1.205	1.205	950	500	53	0	4	4	100	-	0
		Zone I	3	3.5	P.8	0.00	0.000	11.079	250	0	0	0	0	0		240X120X3.5	540,000
		Zone II	11	11.1	P.4	34.00	1.480	1.480	700	266	38	0	2	0	0	-	0
		Zone III	13	13.1	P.6	45.00	2.628	2.628	225	0	0	0	1	0	0	-	0
	2	Zone I	2	2.1	-	130.00	1.571	-	1,225	490	40	0	2	2	100	-	0
		Zone I	3	3.1-4	-	397.50	11.079	-	5,025	0	0	0	3	2	67	-	0
		Zone I	4	4.1-2	-	86.50	3.123	-	1,475	265	37	0	2	0	0	-	0
		Zone I	6	6.2	-	125.50	1.621	-	1,725	1,670	97	0	2	0	0	-	0
		Zone II	7	7.1	-	65.00	0.945	-	1,363	1,363	100	0	6	0	0	-	0
		Zone II	9	9.1-3,5-6	-	301.00	4.772	-	3,575	293	24	0	12	2	17	-	0
		Zone II	10	10.1	-	41.00	1.138	-	1,500	0	0	0	1	0	0	-	0
		Zone II	11	11.2	-	335.00	6.116	-	1,750	280	16	0	2	4	200	-	0
		Zone III	12	12.1-3	-	212.50	4.051	-	2,075	259	35	0	3	0	0	500X50X3	75,000
		Zone III	13	13.2-4	-	71.00	1.931	-	1,887	0	0	0	5	0	0	-	0
Rehabili -tation	3	Zone I	1	1.1-2	P.2,3	111.00	1.522	1.522	950	850	177	0	4	4	100	-	0
		Zone III	13	13.5-6	P.5,7	93.00	3.091	3.091	1,348	1,046	142	0	9	0	0	-	0
	4	Zone I	1	1.4	-	29.50	0.481	-	575	0	0	0	5	3	60	-	0
		Zone I	4	4.1,1.3-4	-	108.00	2.197	-	1,285	454	70	0	0	0		-	0
		Zone I	5	5.1-5	-	324.00	5.980	-	5,270	0	0	0	0	0		-	0
		Zone I	6	6.1,3-4	-	172.50	7.110	-	4,005	1,948	171	0	3	0	0	-	0
		Zone II	8	8.1	-	90.00	1.340	-	1,289	1,289	100	0	0	0		-	0
		Zone II	9	9.4	-	53.00	0.920	-	1,000	0	0	0	1	1	100	-	0
		Zone II	11	11.0,3	-	73.00	1.391	-	1,760	0	0	0	6	0	0	-	0
		Zone III	12	12.0,4	-	91.00	3.930	-	2,365	0	0	0	0	0		-	0
Recons -truction	5	Zone I	1	1.1,1.5	-	0.00	0.000	-	0	0	0	440	0	0		-	0
		Zone I	3	3.5-7	-	0.00	0.000	-	0	0	0	1,920	0	0		-	0
		Zone III	12	12.5	-	0.00	0.000	-	0	0	0	500	0	0		-	0
		Zone III	14	14.1-3	-	45.50	3.200	-	840	0	0	1,020	12	4	33	-	0
		Zone III	15	15.1-4	-	157.00	0.000	-	4,150	0	0	820	5	0	0	-	0
		Zone III	16	16.1-2	-	180.00	3.251	-	975	0	0	680	4	4	100	-	0
		Zone III	17	17.1-4,4.19	-	62.00	1.768	-	1,825	0	0	2,728	4	0	0	-	0
Total	-	-	-	-	-	3,499.00	77.843	21.005	51,362	11,595	23	8,108	98	30	31	-	615,000

Source : JICA Study Team

Retardation Areas

It is proposed to create the retardation ponds at two (2) locations: one is at Pump Station No.8 with a storage capacity of 540,000m3 and the other is in Sub-drainage 12 with a storage capacity of 75,000m^3.

(6) Preliminary Cost Estimate

The rehabilitation and reconstruction cost is roughly estimated as shown in Table 4.6.10, on the basis of experiences of the similar works.

Table 4.6.10 Preliminary Cost Estimate

Proposed Project/Program	Works	Amount (billion rupiahs)
A. Projects	(1) Urgent Recover (Priority 1 and 2)	130.28
	(2) Rehabilitation Works (Priority 3 and 4)	49.40
	(3) Reconstruction Works (Priority 4)	177.97
	(4) Rehabilitation and reconstruction of dykes and floodwall along major rivers	95.00
	Total	452.65

Source: JICA Study Team, 2005

The cost estimated is also based on the following conditions and assumptions:

a) Land acquisition and compensation cost is not included.

b) The direct construction cost is assumed to include the amount of VAT but not to include import duties.

c) The physical and price contingencies are assumed to be 10 % of the direct construction cost, respectively.

d) The engineering service for design and construction supervision is assumed also to be 10 % of the direct construction.

(7) Implementation Schedule

It is proposed the proposed plan will be implemented along with the following schedule:

Table 4.6.11 Tentative Implementation Schedule

Projects/Programs	Implementation Schedule				
	Rehabilitation Stage		Reconstruction Stage		
	2005	2006	2007	2008	2009
A. Projects					
(1) Urgent Recover (Priority 1 and 2)					
(2) Rehabilitation Works (Priority 3 and 4)					
(3) Reconstruction Works (Priority 5)					
(4) Rehabilitation and reconstruction of dykes and					

Source: JICA Study Team

(8) Annual Fund Requirement

In accordance with the preliminary project cost estimate and tentative implementation schedule presented above, annual fund requirement for Drainage System is set as follows.

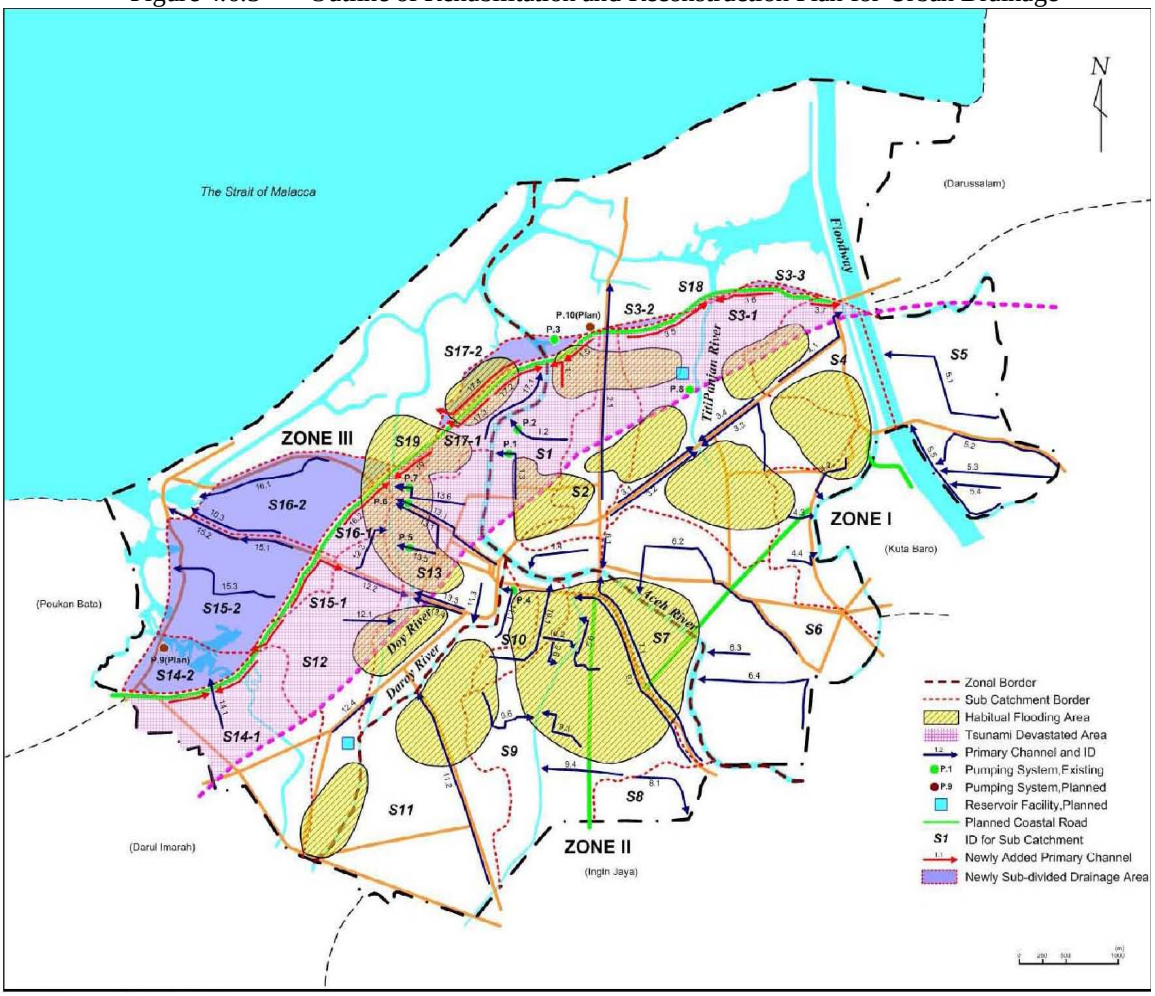
Table 4.6.12 Annual Fund Requirement for Drainage System

(Rp. billion)

Projects/Program	Rehabilitation		Reconstruction			Long-term	Total
Project	2005	2006	2007	2008	2009	2010/15	
Urgent Recovery (Priority 1 and 2)	32,569	65,138	32,569				130.28
Rehabilitation Works (Priority 3 and 4)		14,820	34,580				49.40
Reconstruction (Priority 5)			35,594	71,188	71,188		177.97
Rehabilitation and reconstruction of dykes and floodwall along major rivers/floodway	28,500	66,500					95.00
Total	61,069	146,458	102,743	71,188	71,188		452.65

Source: JICA Study Team, 2005

Figure 4.6.3 Outline of Rehabilitation and Reconstruction Plan for Urban Drainage



Source : JICA Study Team, 2005

(2) Drainage Plan of "River Management and Coastal Management Project"

a. Problem Solving Concept

To handle the flood and/or inundation problems in BAC, there must be integrated, effective, and efficient problem solving concept. The concepts are :

(1) Flood Canal in the south side of the BAC to divide the flood water volume, and to protect BAC from the flood overflow from the higher ground area, directed into Kr. Raba

(2) The city drainage system must be functioned as the collector drain and long storage, that they will be able to intercept and retain the water volume/flood in the water tide.

(3) To optimize/normalize the river according to the city river system and drainage plan.

(4) The building of retarding basin and retarding pond supported with water pump system.

(5) To secure the river bank area and to reduce the flood water volume (surface overflow) by managing the water overflow volume to be absorbed into the ground.

b. City Flood Control and Drainage Management

a. Flood Control Plan

Based on the flood/inundation problem solving concept, the flood management includes:

(1) Building the flood canal in the south side of the BAC (Floodway) to direct the flood water out of the inner city rivers that usually cause flood/inundation.

Table 4.6.13 Flood Canal Plan in the south part of BAC

No	River	Width (m)	Right & Left Riverbanks (m)	Length (km)	Q_5 (m^3/sec)	Q_{10} (m^3/sec)
1	Kr. Titi Paya – Kr. Kon Keumeh	20	5	3,895	117,5	148,64
2	Kr. Kon Keumeh – Kr. Lhueng Paga	20	5	3,270	123,4	175,44
3	Kr. Lhueng Paga – Kr. Daroy	33	5	2,444	187,82	269,05
4	Kr. Daroy – Tunnel width 50 m	50	5	1,116	278,31	411,74
5	Tiga Tunnel	10	-	800	-	-
6	Outlet Tunnel – Width 58 m	10 - 58	5	3,498	337,807	485,31

Source: Proyek Pengendalian Sungai dan Pengendalian Pantai, Provinsi NAD

(2) Inner city river normalization for the river that usually cause inundation.

River normalization includes:

Table 4.6.14 River Normalization Plan

No	River	Length (km)	Width (m)	Dyke Gradient	River Gradient	Discharge Capacity (m^3/sec)	Flood Volume for Each Recurring Interval
1	Kr. Daroy	3.05	20	0.5	0.00025	from 10 becomes 102	25 years
2	Kr. Neng	0.98 1.6 11	5 7 11	0.5	0.00055	from 2 becomes 47.33	5 years
3	Kr. Lhueng Paga (upstream)	3.62	10	0.5	0.001	from 12 becomes 111.43	25 years

Source: Proyek Pengendalian Sungai dan Pengendalian Pantai, Provinsi NAD

b. City Main Drainage Management Plan

The city drainage management plan includes:

(1) The drainage system of BAC divide in 7 Zone main drainage management. Zone boundary:
- Zone 1, bordered by Kr. Neng and Kr Doy
- Zone 2, bordered by Kr. Aceh and Kr. Doy
- Zone 3, bordered by Kr. Kr Aceh
- Zone 4, bordered by Kr. Daroy and Kr. Lhueng Paga
- Zone 5, bordered by Kr. Titi Panjang and Kr. Cut
- Zone 6, bordered by Kr. Lhueng Paga and Kr. Tanjung
- Zone 7, bordered by Kr. Aceh and Kr. Cut

(2) Building saline water dyke barrier in the coastal area to prevent the sea water tide to permeate to the upland (construction by BRR).

(3) Building the water gate, retarding pond, and water pump on the tunnel outlet to be use as the main drainage tunnel.

The water gate and water pump arrangement shown in the table below:

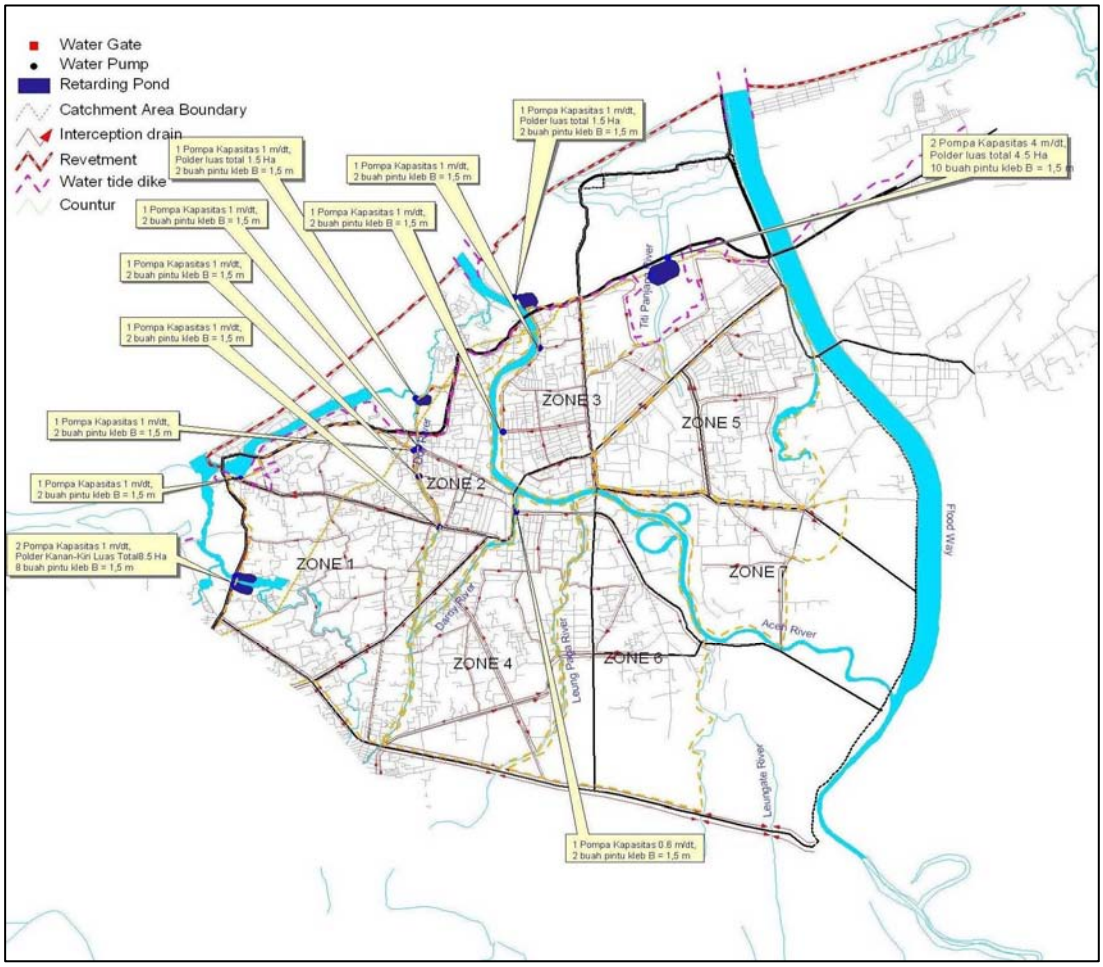
Table 4.6.15 The Water Gate, Retarding Pond and Water Pump Arrangement Plan

No	Location	Retarding Pond (Ha)	Watergate		Pump	
			Unit	Width (m)	Unit	Capacity (m^3/sec)
1	**Outlet Zone 1**					
	Ujung Kr. Neng	8.5	8	1.5	2	4
	Outfall in Ulee Lheu area	-	2	1.5	1	1
	Outlet in Kr. Doy	-	2	1.5	1	1
2	**Outlet Zone 2** (4 outlets, interconnected long storage)					
	Outlet 1	-	2	1.5	1	1
	Outlet 2	-	2	1.5	1	1
	Outlet 3	-	2	1.5	1	1
	Outlet 4 (Lampaseh area)	1.5	2	1.5	1	1
3	**Outlet Zone 3** (4 outlets, interconnected long storage)					
	Outlet 1	-	2	1.5	1	1
	Outlet 2	-	2	1.5	1	1
	Outlet 3 (Lampulo area)	1.5	2	1.5	1	1
4	**Outlet Zone 4**					
	Outlet (long storage)	-	2	1.5	1	0.6
5	**Outlet Zone 5**					
	Outlet Kr. Titi Panjang	4.5	10	1.5	2	4
6	**Outlet Zone 6**	-	-	-	-	-
7	**Outlet Zone 7**	-	-	-	-	-

Source: Proyek Pengendalian Sungai dan Pengendalian Pantai, Provinsi NAD

The management of BAC drainage, which is handled by Proyek Pengendalian Sungai dan Pengendalian Pantai (River and Coastal Management Project) is shown in Figure 4.6.4.

Figure 4.6.4 BAC Drainage Management Plan



Source: PT. Global, PT Wahana, 2006

c. Preliminary project cost estimate

The rehabilitation and reconstruction cost was estimated based on data and information made available from DPU. Preliminary project cost for the urgent rehabilitation and reconstruction works proposed in this study is estimated based on the following conditions and assumptions, however, these are subject to change due to finalization on the Indonesian authorities.

The project cost estimation is based on the advance programs arranged in URRP for BAC. The preliminary cost estimate of flood control and drainage improvement is shown in Table 4.6.16.

Table 4.6.16 Preliminary Cost Estimate of Flood Control

Components	Cost Items	Task	Amount (million rupiahs)
Planned Floodway in southern BAC	Direct construction cost	From Kr. Titi Paya to Kr. Kon Keumeh	12,854
		From Kr. Kon Keumeh to Kr. Lhueng Paga	10,791
		From Kr. Lhueng Paga to Kr. Daroy	12,831
		From Kr. Daroy to Tunnel, width 50 m	8,705
		Tunnel Three	1,440

Components	Cost Items	Task	Amount (million rupiahs)
		From Outlet Tunnel to Floodway, 58 m wide	18,889
	Physical contingency		6,551
	Price escalation		6,551
	Engineering services		6,551
		Subtotal	85,162
River Normalization		Kr. Daroy	6,710
		Kr. Neng	13,310
		Kr. Lhueng Paga (upstream)	3,982
	Physical contingency		2,400
	Price escalation		2,400
	Engineering services		2,400
		Subtotal	31,203
Total			116,365

Source: Additional Study Team, 2006

d. Tentative Implementation Plan

The implementation schedule of flood control plan is set up as shown in table 4.6.17.

Table 4.6.17 Tentative Implementation Schedule for Urban Drainage Sector

Description	2010	2011	2012	2013	2014	2015
Flood Canal Plan in the south part of BAC						
River Normalization						

Source: Additional Study Team, 2006

e. Annual fund requirement

The annual fund requirement is estimated based on the project cost estimate and implementation schedule as shown below:

Table 4.6.18 Annual Fund Requirement for flood control

Components	(unit: million rupiahs)					
	2010	2011	2012	2013	2014	2015
Construction of Floodway in southern part of BAC	16,710	14,028	16,680	11,316	1,872	24,556
River normalization	8,723	17,303	5,177			
Total	25,433	31,331	21,857	11,316	1,872	24,556

Source: Additional Study Team, 2006

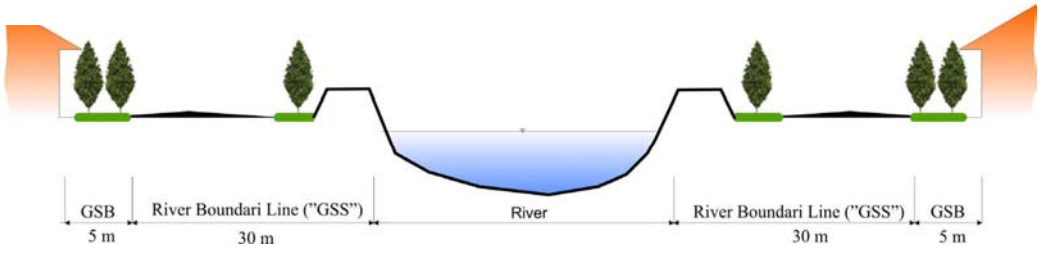
(3) Conservation

Besides the drainage network and system plan, it is also necessary to do the effort to reduce the water flood volume (surface overflow), the ground water conservation and river bank area protection. The management done in several ways:

a. River Boundary Line ("GSS") and Coastal Boundary Line

The designated river boundary line for Floodway and Aceh River (as Flood Management River) is 30 m to the right and left. The cross-section is illustrated in Figure 4.6.5.

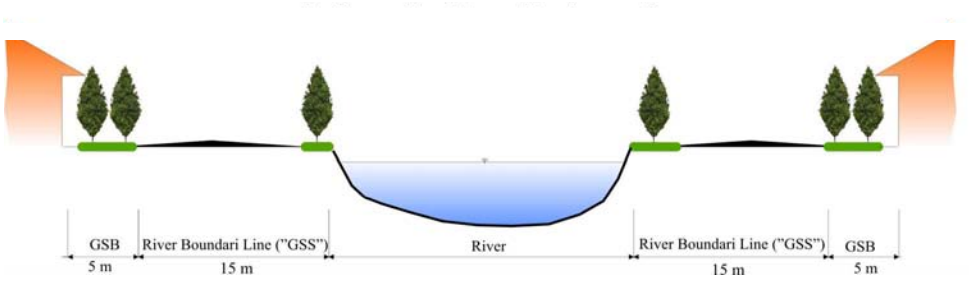
Figure 4.6.5 River Boundary Line of Floodway & Aceh River



Source: Additional Study Team, 2006

The designated river boundary line for Titi Panjang, Lueng Paga, Daroy, Doy and Neng Rivers (as city main drainage) is 15 m at minimum to the right and left, as illustrated in Figure 4.6.6.

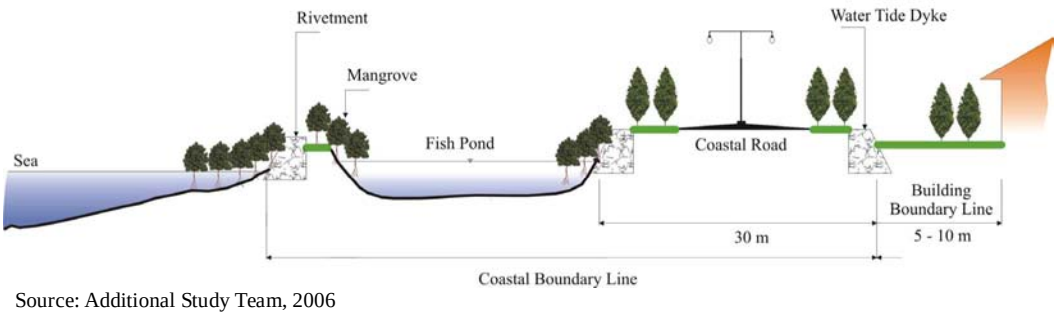
Figure 4.6.6 River Boundary Lines of Titi Panjang, Lueng Paga, Daroy, Doy & Neng Rivers



Source: Additional Study Team, 2006

Coastal Boundary Line (Fig. 4.6.7) is planned proportional to coast shape and conditions (from outer shoreline to tidal dyke or coastal road)

Figure 4.6.7 Coastal Boundary Line



Source: Additional Study Team, 2006

(1) Construction of recharging wells.

Its purpose is to reduce run-off volume as well as to conserve ground water.

(2) Urban forest

Run-off water needs to be absorbed by wider area to avoid concentration which may cause flooding. Thus run-off water must be absorbed as much as possible. This effort is done by promoting the planting of urban forest, in compliance to the land use plan formulated in this study.

(3) Construction of check dam to reduce downstream sedimentation.

(4) Conservation of river basin vegetation by preserving existing forest as water recharge area.

(5) Preserving swamp/fishpond for water interception and retention area.

4.6.3 Water Supply

1. BAC

Based on the design criteria, the predicted water demand is as follows.

Table 4.6.19 Forecast of Water Demand

Description		unit	2005	2006	2007	2008	2009	2015
Population		person	200,843	212,893	225,767	239,206	254,000	360,304
Served Population	Total	person	116,489	127,736	146,749	167,444	203,200	288,243
	House Connection	person	104,840	114,962	132,074	150,700	182,880	259,419
	Public Tap	person	11,649	12,774	14,675	16,744	20,320	28,824
Net Demand	House Connection	m^3/day	15,726	17,244	19,811	22,605	27,432	38,913
	Public Tap	m^3/day	466	511	587	670	813	1,153
	Non-Domestic	m^3/day	3,238	3,551	4,080	4,655	5,649	8,013
	Total	m^3/day	19,430	21,306	24,478	27,930	33,894	48,079
UFW	Rate	%	50	45	40	35	30	30
	Amount	m^3/day	9,175	9,588	9,791	9,775	10,168	14,424
Gross Demand		m^3/day	29,146	30,894	34,269	37,705	44,062	62,503
Supply Capacity	Lambaro	m^3/day	37,584	37,584	37,584	37,584	37,584	37,584
	Siron	m^3/day	1,728	1,728	1,728	1,728	1,728	1,728
	Total	m^3/day	39,312	39,312	39,312	39,312	39,312	39,312
	Balance	m^3/day	10,166	8,418	5,043	1,607	-4,750	-23,191

Source: Additional Study Team, 2006

Water demand in 2006 is 30,894 m3/day, while water supplied by Lambaro WTP is 37,584 m^3/day and Siron WTP 11,728 m^3/day. Therefore total available water is 39,312 m^3/day.

Starting from 2009, when water demand level is predicted at 44,062 m^3/day, there will be a water deficit of 4,750 m^3/day. This deficit will increase to 23,191 m^3/day in 2015. In order to overcome this gap, a realistic implementation program is proposed to involve:

- Water resources and water treatment:
  - Rehabilitation and reconstruction (including up-rating)
  - Exploration of new water sources.
- Rehabilitation and expansion of water distribution system
- Management and human resources aspects

The Development Plan of Water Supply System in BAC is as follows:

1) Rehabilitation and reconstruction of Lambaro and Siron WTP.

   The Swiss Government is financing the rehabilitation of main Lambaro WTP. GTZ and UNICEF are financing the works conducted at Siron WTP.

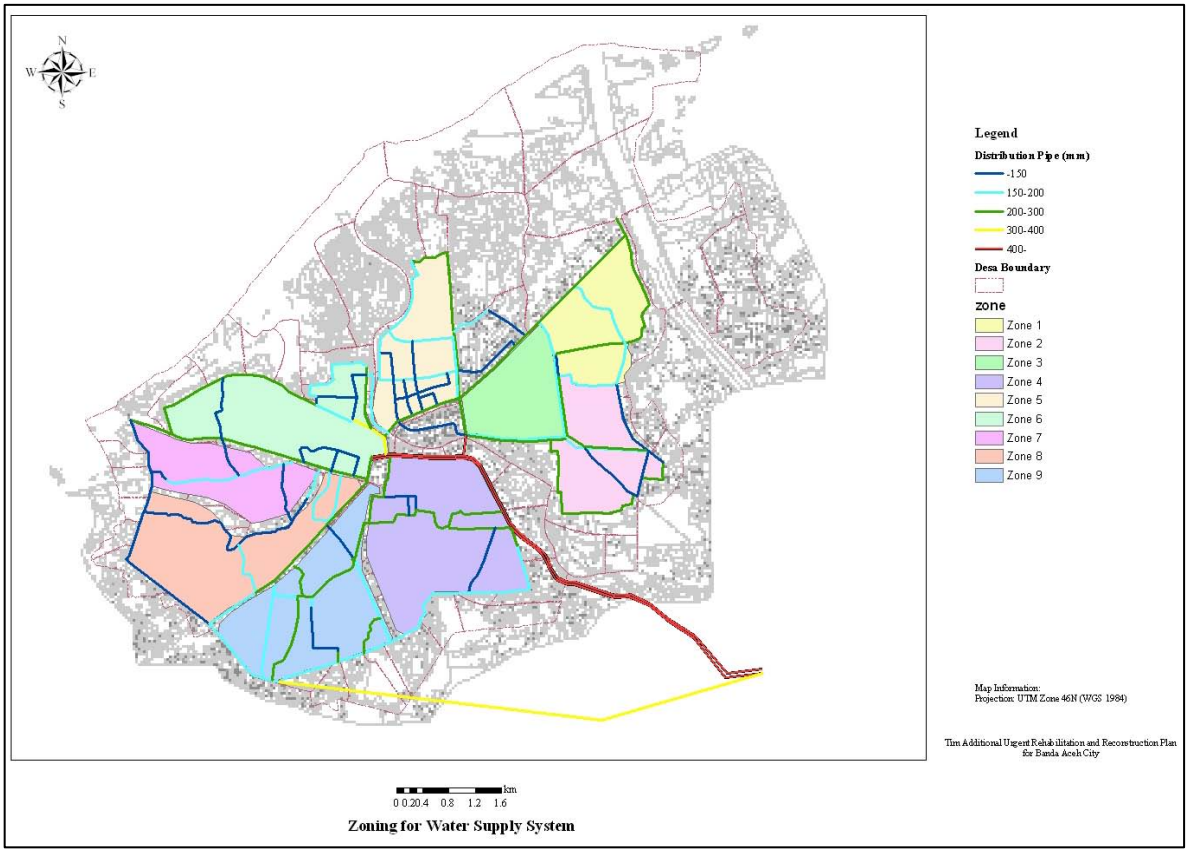
2) Rehabilitation and reconstruction of Piped Transmission and Distribution System and its supporting facilities, including city reservoir, both from Lambaro system as well as Siron system with support from JICS.

3) Water supply zoning system, to facilitate the operation and maintenance, including the handling of Unaccounted For Water, by forming a special task force.

   In detail, the proposed plan is to create a Zoning System to prepare the distribution network for future implementation of District Meter Area approach. The approach is beneficial for network operation and maintenance (and also for reducing Unaccounted For Water). Project description, program and construction work with preliminary project cost estimate and tentative implementation schedule shall be prepared. PDAM is proposed to establish a Special Team for Reduction of Unaccounted for Water (UFW).

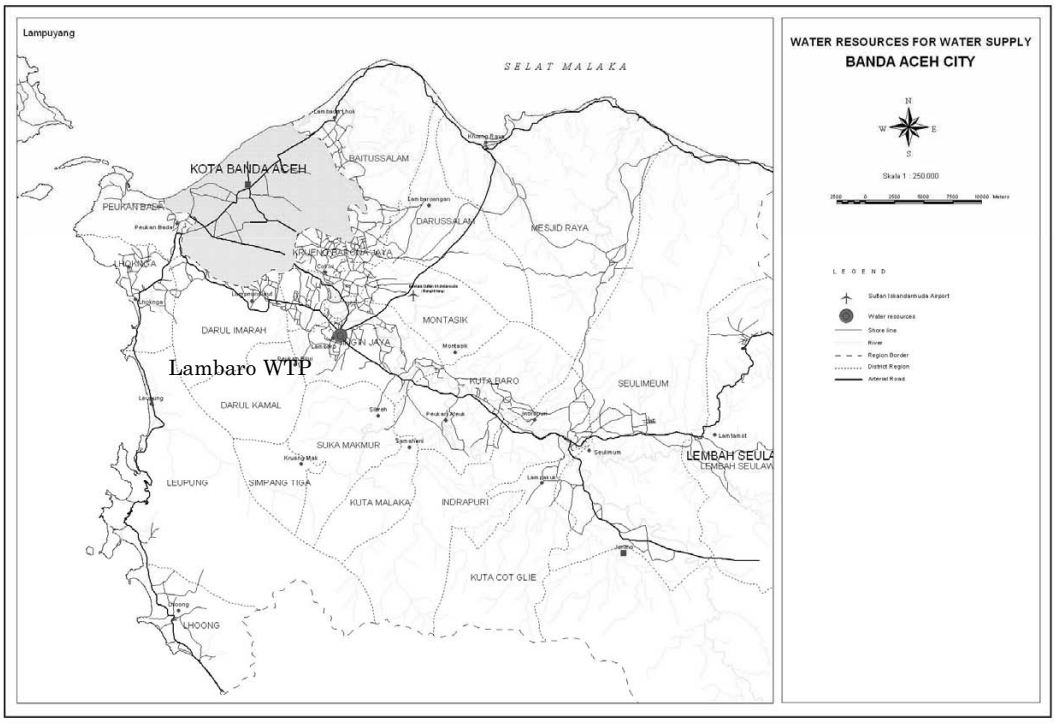
4) The Up-Rating of Lambaro WTP or construction of a new WTP is imperative in order to cover the increasing number of house connections..

Figure 4.6.8 Zoning of BAC Water Supply System



Source: JICA Study Team, 2005

Figure 4.6.9 Location of Lambaro WTP



Source: Additional Study Team, 2006

5) Water source protection. Water source for Lambaro Water Treatment (as the main provider of potable water for Banda Aceh population) comes from Aceh River. Therefore river protection will be prioritized. Initial protection is by delineating a clear and well-designed River Boundary Line. As an (positive) impact, water quality and quantity will be maintained.

6) Develop institutions. Future efforts should focus on the operations, management, efficiency and financial sustainability of PDAM.

Training for PDAM personnel has been initiated by UNICEF, USAID-ESP, IRD, Switzerland and SAB-SAS (Netherland).

1. Surrounding Area

The concept of water supply provision in surrounding area is as follows:

- For immediate term, expand the distribution system in order to deliver piped water to Temporary Living Center (TLC) and short and long term for new housing
- Rehabilitate water supply system
- Expand the distribution network of existing water system in order to serve new development areas

The outline plan for water supply system in surrounding area is as follows:

1) Glietaron system

Repair and expand transmission and distribution system

2) Jantho system

DED pipeline to Seulimeun and Indrapuri and construct new transmission pipeline

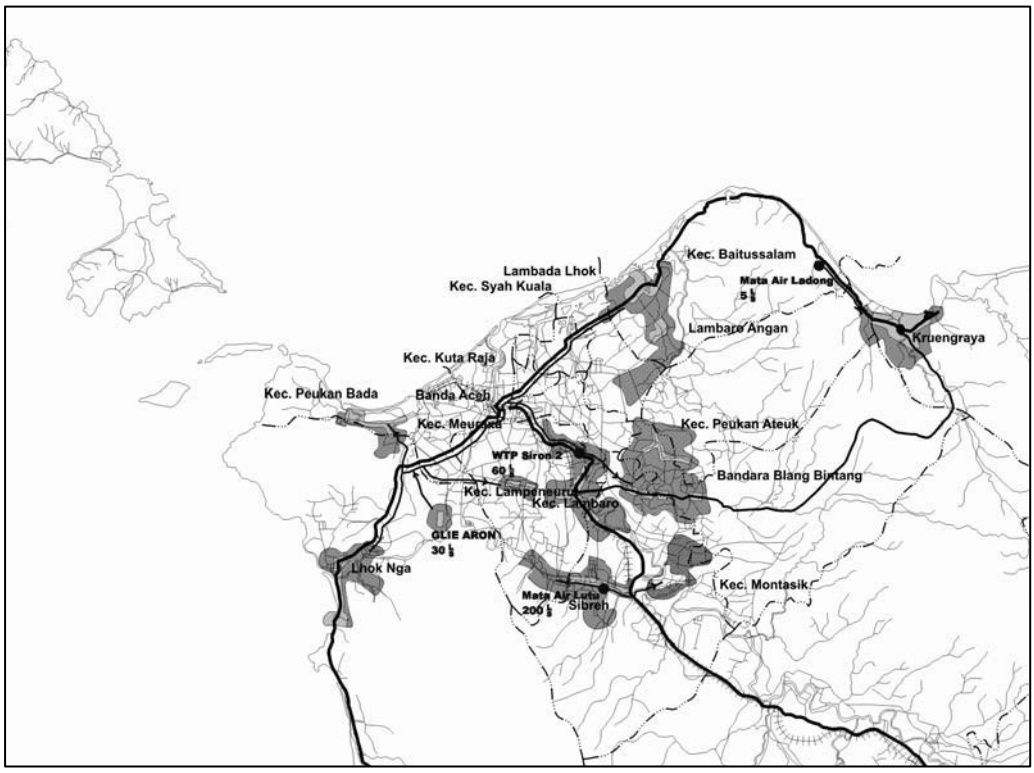
3) Siron 2 system

DED and construction of intake and expansion of transmission to serve TLC in Ingin Jaya, Baitussalam and Darussalam Districts.

4) Montasik system

5) Hydraulic study and DED for transmission pipeline

Figure 4.6.10 Water Supply for Surrounding Area



Source: Additional Study Team, 2006

4.6.4 Waste Water Treatment (Septage Treatment Plant)

1. BAC

Waste water treatment plant and sewerage is not deemed suitable for BAC.

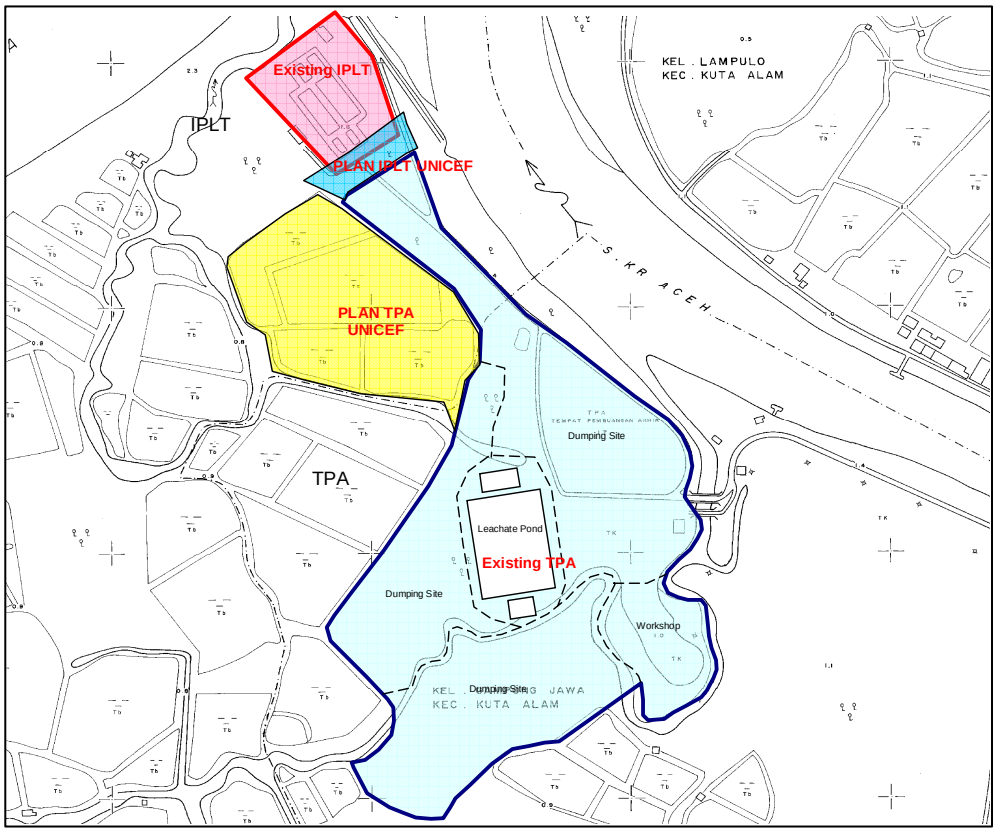
General planning criteria for STP are very suitable with BAC condition. But the existing capacity cannot cope with effluent generation.

The planned treatment is on-site sanitation, with once a year desludging schedule by a pumping truck to be transported and treated in Septage Treatment Plant. The capacity of existing STP is 56 m^3/day (rehabilitated with the help of JICA), while predicted waste volume in 2005 is 114 m^3/day. It can be concluded that the capacity of Septage Treatment Plant must be increased by 58 m^3/day, and additional transporting tanks must also be procured.

Stage 1

Construct a new STP with a capacity 60 m^3/day near the existing STP. This STP will be built by UNICEF on 2006 (Figure 4.6.11.). At present the STP is in the construction preparation stage.

Figure 4.6.11 STP and Sanitary Landfill, Existing and Planned



Source: Additional Study Team, 2006

Stage 2

The total capacity of existing and planned STP (UNICEF) is 116 m^3/day. In the year 2015 total septage generation will reach 204 m^3/day. Therefore BAC must build an STP with minimum capacity of 88 m^3/day. There are two site alternatives of the new STP. Firstly, it can be constructed as an exclusive site for Septage Treatment Plant (STP), or secondly, as a combined STP and sanitary landfill site.

2. Surrounding Area

Table 4.6.20 Septage Generation in Surrounding Area

Description	Unit	2005	2009	2015
Lhoong Population	person	8,027	8,749	9,537
Lhoknga Population	person	13,238	14,429	15,728
Indrapuri Population	person	17,160	18,704	20,388
Mesjid Raya Population	person	11,884	12,954	14,119
Darussalam Population	person	16,848	18,364	20,017
Baitussalam Population	person	10,736	11,702	12,755
Sukamakmur Population	person	12,504	13,629	14,856
Darul Imarah Population	person	59,300	64,637	70,454
Total Population	person	149,697	163,170	177,855
Assumed number of households	houses	29,939	32,634	35,571
Volume of septage	m^3/year	0.9	0.9	0.9
Septage generation from household	m^3	26,945	29,371	32,014
Septage from industry and other	m^3	4,042	4,406	4,802
Total septage per year	m^3/year	30,987	33,776	36,816
Total septage per day	m^3/day	85	93	101

Source: Additional Study Team, 2006

The concept of waste water management is as follows:

1) In urbanized surrounding area, septage will be collected by pumper truck to be treated at STP
2) One STP serves more than one satellite cities
3) STP can be combined with Landfill

The outline plan for sanitation is as follows:

1) Organize a community education campaign about the importance of sanitation, disposal and guideline for septic tank construction
2) Locate suitable sites for STP (special or combined with disposal)
3) Procure septic tank pumper trucks and equipments
4) Design, construct, and put into operation STP in surrounding area

4.6.5 Solid Waste Management

1. BAC

The predicted solid waste generation is as follows:

Table 4.6.21 Solid Waste Generation

Description	unit	2005	2006	2007	2008	2009	2010	2015
Population	person	200,843	212,893	225,767	239,206	254,000	307,695	360,304
Solid Waste Generation	liter/ person/day	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total Solid	liter/day	100,422	106,447	112,884	119,603	127,000	153,848	180,152

Source: Additional Study Team, 2006

The analysis of projected domestic solid waste generation by the year 2010 is 153,847 liters/day. It is assumed that the per capita rate of solid waste generation is 0.5 liter/person/day, while total solid waste generation in BAC will increase to 180,152 liters/day in 2015.

With the remaining useful life of Gampong Jawa Landfill of 2 years, a new alternative site needs to be found.

Solid Waste Management Development consists of:

1) Solid waste containment

   It is planned that each household be equipped with a capacity 40 liter bin.

2) Solid waste collection

   Garbage will be collected twice a week from collecting station (packed in containers). The solid waste collection is divided into 5 following areas:

   - T. Nyak Arief, Ulee Kareng, Kuta Alam, Kp Kramat, and Laksana
   - Pasar Aceh and vicinity
   - Jl. Teuku Cik Ditiro, Kp. Ateuk, Neusu, and vicinity
   - Jl. Teuku Umar, Ketapang, Lamteumon, and vicinity
   - Taman Kota

3) Landfill and solid waste processing

Stage1. Extending Landfill in Gampong Jawa

The landfill consists of sanitary landfill in Gampong Jawa. This facility can still accommodate solid waste disposal for the next two years.

The first alternative is to expand the existing landfill area by 3.2 Ha into neighboring area, with aid from UNICEF and BRR.

Stage 2. New sanitary landfill site

As an alternative, a new landfill location must be found within two years, not excluding locations outside Banda Aceh. These alternatives for landfill sites are in Koeta Teu, Kleumbang, Gapang, Talue Sueke.

If located in ABR, the sanitary landfill may serve both BAC and ABR as a regional sanitary landfill (Figure 4.6.22).

Table 4.6.22 Alternatives of Sanitary Landfill Sites

No.	Location	Geographic Coordinate	Surface Area (ha)	Distance to Main Waste Source (km)
1	Koeta Teu (Montasik District)	772258 / 608169	15	21.5
2	Kleumbang (Darussalam District)	772258 / 609614	15	22.2
3	Gapang (Baitussalam District)	767636 / 620611	25	21.6
4	Taleue Seuke (Baitussalam District)	767873 / 622393	25	17.8

Source: Progress by GTZ, August 2005