

2.6 Present Condition of Sanitation Sector

2.6.1 Profile of Sanitation Sector

2.6.1.1 Institutional Framework of Sanitation Sector

The organizations that are concerned with water supply and sanitation sector are Liberia Water and Sanitation Corporation (LWSC).

In order to supply safe water and sanitation service to overall Liberia, LWSC was established in 1973 in accordance with the act of the government. LWSC manages water supply and sanitation service works especially for the center of Greater Monrovia and main towns of each county. LWSC has the following vision and mission.

(Vision)

- Supply safe water and serve good hygiene at affordable cost to all nationals

(Mission)

- Reduce water borne and the related disease burden in Liberia
- Provide sustainable, effective and efficient services
- Has accountable and responsible for beneficiaries who receive water supply and sanitation service
- Has responsible for cost recovery on water supply and sanitation sector

Organization and Staff of LWSC are shown in Figure 2.5.1 in the section for Water Supply Sector.

2.6.1.2 Existing Policies and Strategy

The National Poverty Reduction Strategy Programme (PRSP) was finalized in April 2008. This contains not only an overall vision of Liberia government and national main strategy but also implementation plans from 2008 to 2011 (four years), which focuses on the sustainable national growth and national development. In addition, the National PRSP is a process to the long term development plan of the Socio-Economic Transformation Strategy- SETS.

In terms of sanitation sector, the access ratio to appropriate sanitation was 27% in 1990 and reduced to 7% in 2003. After civil war, the access ratio achieved 15% in 2004 as the rehabilitation project has been carried out. From the aspect of circumstances, the National PRSP focuses on the access ratio of 40% in 2011.

The following show main countermeasures to achieve goals on sanitation sector:

- Full-scale rehabilitation of Monrovia sewerage system;
- Rehabilitation of 3,000 public toilets (school, hospital, clinic) in Liberia;
- Establishment of 50,000 private toilets in local communities;
- Establishment of 10,000 public toilets (school, health center, public facilities) in Liberia;
- Establishment of processing center of toilet construction material and its production; and
- Scale expansion of national hygiene promotion activities.

In order to sustain safe drinking water supply and hygiene environment for the satisfied life of communities, LWSC has goals and action plans for the 3rd short term from 2008 to 2010 based on National PRSP and Millennium Development Goal as follows:

(Goals)

- Reduction of Unaccounted for Water (or Non Revenue Water)

- Capacity improvement of LWSC staff
- Service improvement for users
- A secure water supply service
- Rationalization of salary system
- Increase of LWSC annual revenue
- Increase of the rate of water tariff collection
- A secure operating profit
- Improvement of water supply service in suburb of urban area and squatter area
- Enhancement of purification process control and water quality monitoring
- Capacity recovery of drainage system
- Improvement of water supply and sewerage service in Monrovia city and main urban area
- Improvement of water supply service coverage

(Action Plans)

The followings are action plans to achieve the above targets.

- Urgent rehabilitation of rising main and distribution pipelines as well as purification plant
- Replacement of distribution network
- Evaluation of groundwater potential
- Rehabilitation of sewage relaying pump station
- Procurement of vacuum trucks
- Capacity building

2.6.1.3 Financial Structure and Budgeting of LWSC

Financial Structure and Budgeting of LWSC are referred to section 2.5.1.3 in the Water Supply Sector.

2.6.1.4 Existing Project in Sanitation Sector

The largest project is Monrovia Water and Sanitation Rehabilitation Programme which focuses on Greater Monrovia. Currently, international donors such as the World Bank, EC and AfDB have been assisting the Programme. The following project is on going for the sanitation sector.

- Rehabilitation of Sewerage System and Improvement of On-site Sanitation Facilities

Sewage treatment plant with sludge lagoon constructed in 1979 is located in the wetland which is a southern part of Greater Monrovia. Not only wastewater of households which connect to sewerage system, but also night soil drawn by vacuum trucks from other households that cannot use sewer system, has been discharged into the sewage treatment plant. However, the sewage treatment plant has been suspended for long periods and sewage and night soil have flowed down into the stabilization pond without any treatment. The channel for discharging night soil is small hand trench which is dug in cultivation land. The content of rehabilitation work, in order to facilitate a disposal of night soil discharged from vacuum trucks, is restoration for the inlet of the stabilization pond of 26,000m².

In addition, the rehabilitation programs are composed of constructions of 11 public toilets, rehabilitation of 30 existing public toilets, procurements of maintenance equipments such as vacuum trucks and jet cleaning vehicles.

Table 2.6-1 shows a program demarcation of rehabilitation works which are being assisted by the donors.

Table 2.6-1 Program Demarcation of Rehabilitation Work by Donors on Water Supply and Sanitation Sector

Donors	Water Supply Sector	Sanitation sector (including On-site Sanitation)	Remarks (Other Area than Greater Monrovia)	
WB	<ul style="list-style-type: none"> Rehabilitation for White Plain Purification Plant, Booster Pump Station, Rising Main and Distribution Pipelines and Service Reservoirs 	<ul style="list-style-type: none"> Rehabilitation for 20-30 Public Toilets and Procurement of one Jet Cleaning Equipments 		
	USD5.1mln (2008-2010)	USD2.3mln (2008-2010)		
	<ul style="list-style-type: none"> Capacity Development and Program Management 	USD1.8mln (2008-2010)		
	<ul style="list-style-type: none"> Study on Sector Reform (Formulation of Policy, Strategy and Investment Program, Establishment of legislation) 	USD0.3mln (2008-2010)		
EC	<ul style="list-style-type: none"> Rehabilitation for Intake Pump, White Plain Purification Plant, Booster Pump Station, Rising Main and Distribution Pipelines and Service Reservoirs 	—		
	USD5.9mln (2008-2010)			
	<ul style="list-style-type: none"> Program Management 	USD1.0mln (2008-2010)		
	<ul style="list-style-type: none"> Study on Sector Reform (Formulation of Policy, Strategy and Investment Program, Establishment of legislation) 	USD0.7mln (2008-2010)		
DFID / AfDB	<ul style="list-style-type: none"> Rehabilitation for Booster Pump Station and Distribution Pipeline, and Procurement of Generators 	<ul style="list-style-type: none"> Restoration on Stabilization Pond, Construction of 11 Public Toilets and Procurement of One Vacuum Truck 	<ul style="list-style-type: none"> Assistance on Water Supply and Sanitation sector through NGO 	
	USD16.7mln (2008-2010)	USD0.6mln (2008-2010)		USD6.9mln (2007-2010)
	<ul style="list-style-type: none"> Capacity Development and Program Management 	USD2.3mln (2008-2010)		
USAID (Including US Army)	—	—		
UNICEF	—	—	<ul style="list-style-type: none"> Health Guidance, Hygiene Protection Guidance, Assistance on water treatment of individual households USD2mln/Year	
Population Service International (NGO)	—	—	<ul style="list-style-type: none"> Grant Delivery of low concentration Chlorine (Liquid Type) to 3 Zones (Grand Bassa, Grand Gedeh, Bomi) 	

Source: Donors such as World Bank, EC, DIFID, AfDB, etc

2.6.2 Present Conditions of Sanitation Sector

2.6.2.1 Present Conditions of Sanitation in Greater Monrovia

Sanitation system in Greater Monrovia is mainly categorized to two types which are off-site sewerage system in Bushrod Islands and Central Monrovia areas and on-site sanitation system in other area.

Present conditions of sanitation in Greater Monrovia based on population density, type of sanitation and level of sanitary conditions are classified as shown in Figure 2.6-1.

(1) Population Density

The classification of population density is as follows;

- High : 250 pop./ha¹ or more
- Medium : 100 pop./ha or more, less than 250 pop²./ha
- Low : Less than 100pop./ha

(2) Type of Sanitation

The type of sanitation is as follows and present conditions of sanitation are shown in Figure 2.6-2.

- Type-1 : Pour- flush toilet + sewer
- Type-2 : Pour-flush toilet + septic tank
- Type-3 : Open defecation, overhunging, vaults

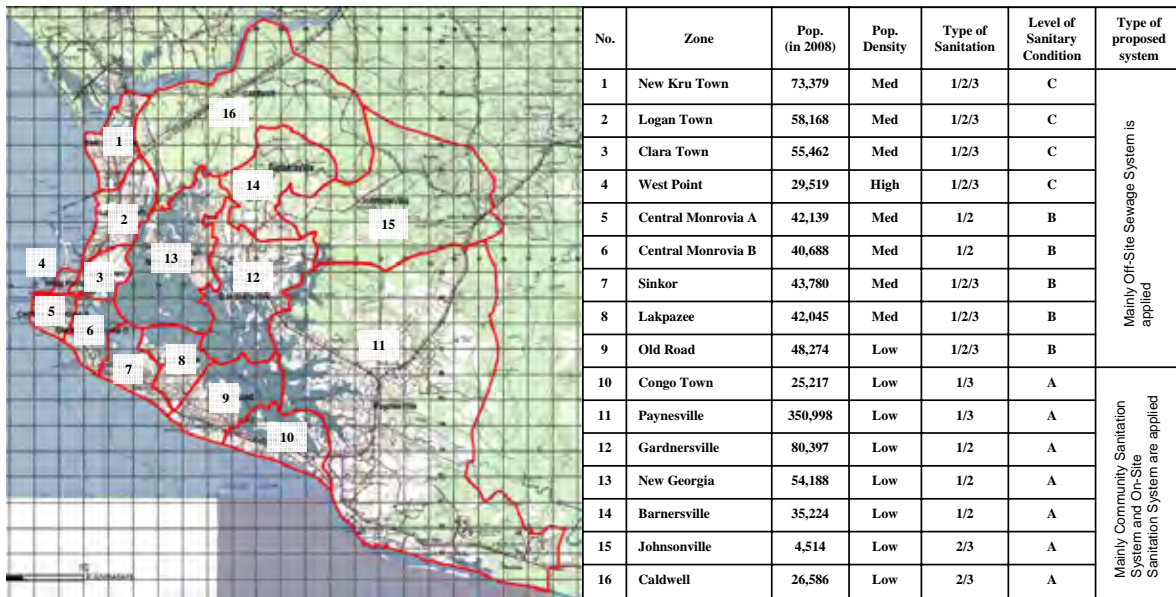
(3) Level of Sanitary Conditions

Level of sanitary conditions is categorized into the following three levels and present level of sanitation conditions is shown in Figure 2.6-3.

- Level-A : Poor
Pollution of the area and the groundwater is generated because there is no sanitation.
- Level-B : Very Poor
Excrement is not accumulated. However, excrement is running through broken open channels and overflowed to road when it rains heavily. Therefore, sanitary condition and landscape is deteriorated severely and odor is generated.
- Level-C : Extremely Poor
A lot of excrement is accumulated around the inhabitant area due to lack of toilet and the clogged sewer pipes. Therefore, sanitary condition and landscape is deteriorated severely and odor is generated.

¹ ha = hectare (10,000m²)

² pop = population



[Level of Sanitary Conditions]

Level-A (Poor): Environmental pollution such as soil, groundwater, etc. will be generated because there is no sanitation.

Level-B (Very Poor): Excrement is not accumulated. However, it is running through broken open channels and overflowed to road.

Level-C (Extremely Poor): Much excrement is accumulated around the inhabitant area due to lack of toilet.

Figure 2.6-1 Present Conditions of Sanitation in Greater Monrovia



Figure 2.6-2 Present Conditions of Sanitation –Type of Sanitation



Figure 2.6-3 Present Conditions of Sanitation –Level of Sanitation Condition

(4) Outlines of Off-site Sewerage System

The existing off-site sewerage system covers the areas for Bushrod Islands, Central Monrovia to Sinkor area as shown in Figure 2.6-1.

The existing sewerage facilities were constructed in 1950s and late 1960s. The existing off-site sewerage system is the separate sewerage system by which sewage and storm water are treated separately.

Sewer pipes were mainly laid in Bushrod Islands (New Kru Town, Logan Town, Clara Town), Central Monrovia, Sinkor and Old Road.

Sewage of each area was transmitted through the New Kru Town (Duala) pump station, the Bushrod Island (Sayon Town)pump station, Mesurado River pump station and BTC pump station, and finally treated in the Fiamo sewage treatment plant (Design Capacity: 6MGD/day) located in Sinkor.

Treatment process of the Fiamo sewage treatment plant is shown in Figure 2.6-4.

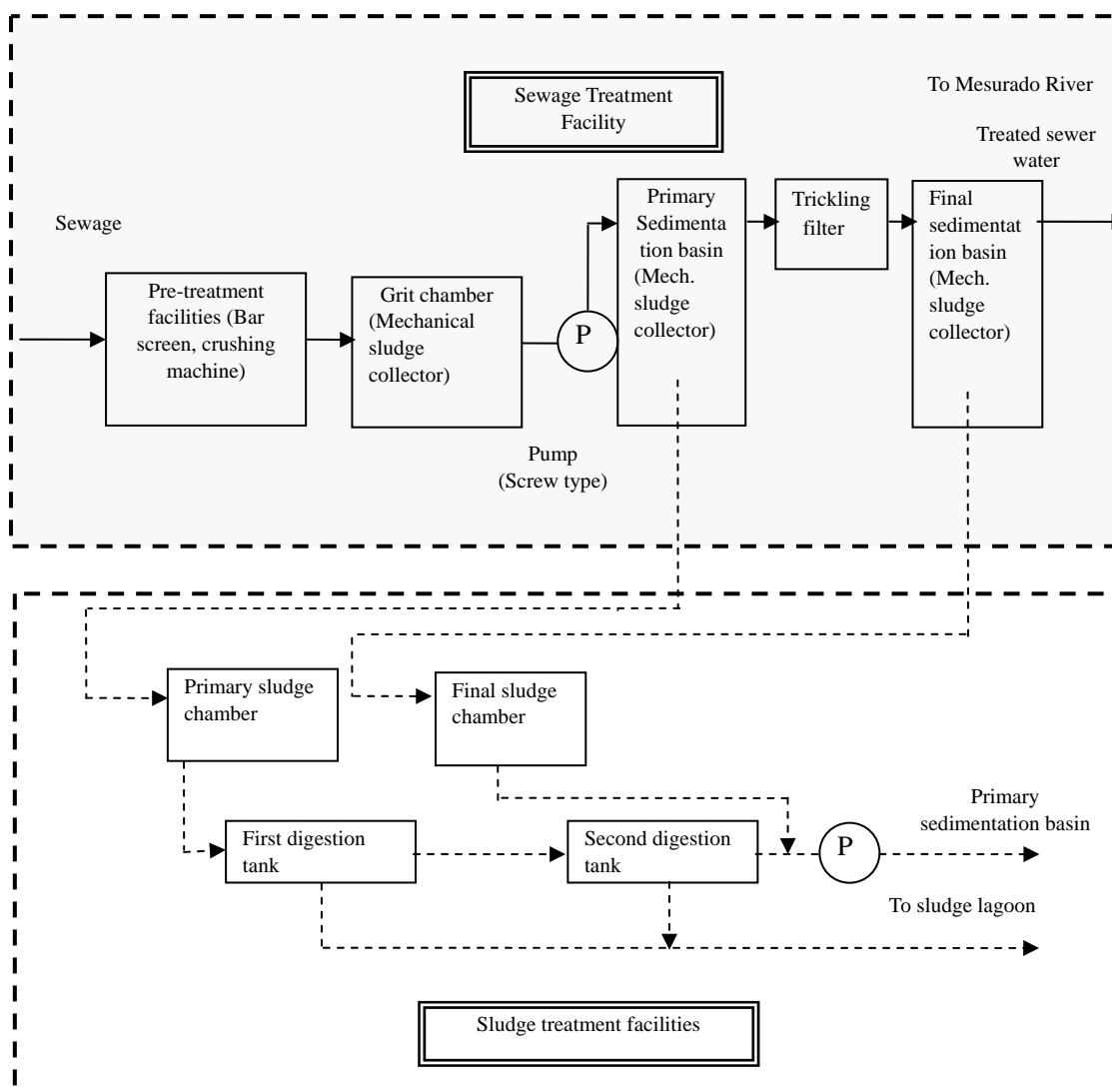


Figure 2.6-4 Outline of Fama Sewage Treatment Plant

(5) Current Situation of Sewerage System

LWSC is the responsible organization for the sewage treatment. On the other hand, the on-site sanitation facilities such as septic tanks are managed by Monrovia City Council. Table 2.6-2 shows sewerage and sanitation services in Greater Monrovia.

Table 2.6-2 Current Status of Sewerage and Sanitation Services in Greater Monrovia

Items	Data
Area of the center of Monrovia	42km ²
Area covered by on-site sanitation facilities	27.6 km ²
Area covered by off-site sewerage system	14.4km ²
Rate of service coverage of the on-site sanitation facilities	49%
-Pit-latrines	20%
- Septic tank	29%
Non-coverage	49%
Off-site sanitation system	2%
Numbers of house connections	2,900 connections
Number of house connections which are billed	800 connections

Source: Emergency Rehabilitation Program Report, GKW Consultant report 2006

Most of the parts in the off-site sewerage system constructed in 1960s have been seriously damaged

and are not operative at present. Sewer pipes in Bushrod Islands are clogged with sludge and debris. The area where sewer pipes are in operation is only Sinkor located around the Fiamo sewage treatment plant. Sewage being flown into the pump stations is slightly discharged into Mesurado River (see Figure 2.6-5). This is because the pumps in four relay pump stations as mentioned above were stolen and the pump stations are inoperative. In addition, the Fiamo sewage treatment plant has been out of use because all the mechanical equipments of the plant were stolen during civil conflict. A little sewage being flown into the plant is directly discharged into Mesurado River through a lagoon which is a part of the treatment plant. Currently, sludge is fully filled in the pit of pre-treatment facilities and the digestion tanks.

The length and diameter of sewer pipelines and conditions of the existing main sewer network facilities are shown in Table-2.6-3 and 2.6-4.

Present conditions of pump stations are shown in Figure 2.6-6, 2.6-7 and 2.6-8.

The maintenance equipments for sewerage system owned by LWSC are only three vacuum trucks and one jet cleaning machine.

From the aspects of circumstances of sewage disposal, most people dispose human waste at the field and riverbed surrounding their houses due to the lack of public toilets.



Figure 2.6-5 Sewage is Discharged into Mesurado River from Pump Station



Figure 2.6-6 Bushrod Island P.S



Figure 2.6-7 Underground Pit in BTC P.S



Figure 2.6-8 Slipway P.S to Lift Up Sewage to the Manhole

Table 2.6-3 Length of Diameters of Sewer Pipelines in Greater Monrovia

Catchment area and town area	Diameter	8"-12"	14"-20"	24"-42"	>42"	Total
	(m), pressure pipes in brackets ()					
New Kru Town PS to New Kru Town		1,726	717	-	-	2,443
Bushrod Islands PS to Logan Town and Clara Town		5,916 (3,697)	1,455	4,310	-	11,680 (3,697)
Mesurado River PS to Central Monrovia (Central Monrovia A and B)		4,313	137 (773)	658	-	5,108 (773)
West Point	no sewer pipes					
BTC PS to Central Monrovia (Central Monrovia A and B)		17,992 (1,829)	161	3,191	698	22,042 (1,829)
Fiama T.P (Gravity pipes) to Sinkor and Old Road		14,136	970	4,283	3,600	22,989
Total		44,082 (3,697)	3,440 (2,602)	12,442	4,298	64,262 (6,299)
Congo Town, Paynesville and Other	No sewer pipes					

Source: Feasibility Study Report, GKW Consultant

Table 2.6-4 Conditions of Existing Main Sewerage Facilities

Sewerage Facility		Condition
Main Sewage Relay Pumping Stations	New Kru Town P.S	This Pumping Station is designed to pump sewage from New Kru Town area into the first manhole of the northern branch of the Bushrod main sewer. ➤ Nothing remains above ground (completely damaged including Pump House building)
	Bushrod Islands P.S	This Pumping Station is supposed to discharge all the sewage of Bushrod Island area through a 3,600m long 12" cast iron force main into the sewerage system of central town. The last section of the force main, which was laid under the sidewalk of the Mesurado River Bridge, was reduced to 10" diameter, but it is missing now due to falling down of the bridge. ➤ Pump House Building and underground concrete structures are remained. ➤ All mechanical and electrical equipment such as pumps of the pump station were stolen or disrepair.
	Mesurado River P.S	This Pumping Station was loaded with the sewage pumped from the Bushrod Island area and the sewage generated in the northern part of Monrovia central town. ➤ Pump House Building and underground concrete structures are remained. ➤ All mechanical and electrical equipment such as pumps of the pump station were stolen or disrepair.
	BTC P.S	All sewage generated in the southern part of Monrovia proper as well as the sewage received from the Mesurado River Pumping Station was collected in this Pumping Station. ➤ Pump House Building and underground concrete structures are remained. ➤ All mechanical and electrical equipment such as pumps of the pump station were stolen or disrepair.
Lifting Pump Station (to pump up sewage to Manhole)	Clara Town L.S (1)	Sewage in a part of Clara Town area was collected in this Lifting Station and pumped up to the manhole. ➤ Pump House Building and underground concrete structures are remained, but deteriorated. ➤ All mechanical and electrical equipment were stolen or disrepair.

Sewerage Facility		Condition
	Clara Town L.S (2)	Sewage in other part of Clara Town area was collected in this Lifting Station and pumped up to the manhole. ➤ Pump House Building and underground concrete structures are remained, but deteriorated. ➤ All mechanical and electrical equipment were stolen or disrepair.
	Slipway L.S (1)	Sewage in a part of a Slipway area was collected in this Lifting Station and pumped up to the manhole. ➤ Pump House Building and underground concrete structures are remained, but deteriorated. ➤ All mechanical and electrical equipment were stolen or disrepair.
	Slipway L.S (2)	Sewage in other part of Slipway area was collected in this Lifting Station and pumped up to the manhole. ➤ Pump House Building and underground concrete structures are remained, but deteriorated. ➤ All mechanical and electrical equipment were stolen or disrepair.
	Matadi L.S	Sewage in Matadi area was collected in this Lifting Station and pumped up to the manhole. ➤ Pump House Building and underground concrete structures are remained, but deteriorated. ➤ All mechanical and electrical equipment were stolen or disrepair.
Main sewer pipelines	Pipelines have been implemented in 1950 and in the late 1960s as first scheme: Monrovia proper area in the northern part of Central Monrovia (See Figure 2.6-9)	➤ This old system is in poor structural conditions, despite an immediate measures program in 1982 that tackled some problems. Pipes are broken and silted up and especially during the rainy season they are surcharged and sewage flows out of manholes and broken sections. Main pipeline between Bushrod Island and Central Monrovia has been damaged due to falling down of Mesurado Bridge.
	Pipelines constructed in expansion phase between 1968 and 1970 as the main system: Bushrod Islands, the southern part of Central Monrovia, Sinkor area	Generally all laid between 1968 and 1970 are in good condition. However, problems in some sections are identified, which are: ➤ Pipe requires inspection for possible repair at the line from Curley Street to Center Street to Lynch Street in downtown Monrovia, ➤ Broken pipe in 3 rd Street in Sinkor, ➤ Pipe requires replacement in Russel Avenue from 3 rd Street to 5 th Street in Sinkor
Sewage Treatment Plant	Fiama T.P	The plant consists of intake, screen and grit chamber, low lift pumping and primary settling basins; trickling filters and secondary settling tank; two sludge digesters and sludge lagoons. ➤ By 1990, the system had fallen into disrepair. It stopped operating when electricity supply failed and water production was drastically reduced. ➤ Currently, little quantity of sewage arrives at the plant, which is diverted at the intake towards the sludge lagoons and discharges into a densely vegetated branch of Mesurado River. According to Feasibility Study Report of World Bank: ➤ Rehabilitation of the plant would require major investment. ➤ O&M cost would make the plant operation a costly undertaking. ➤ Rehabilitation and operation of the plant is not considered as a feasible technical and financial approach under the present economic conditions in Liberia.

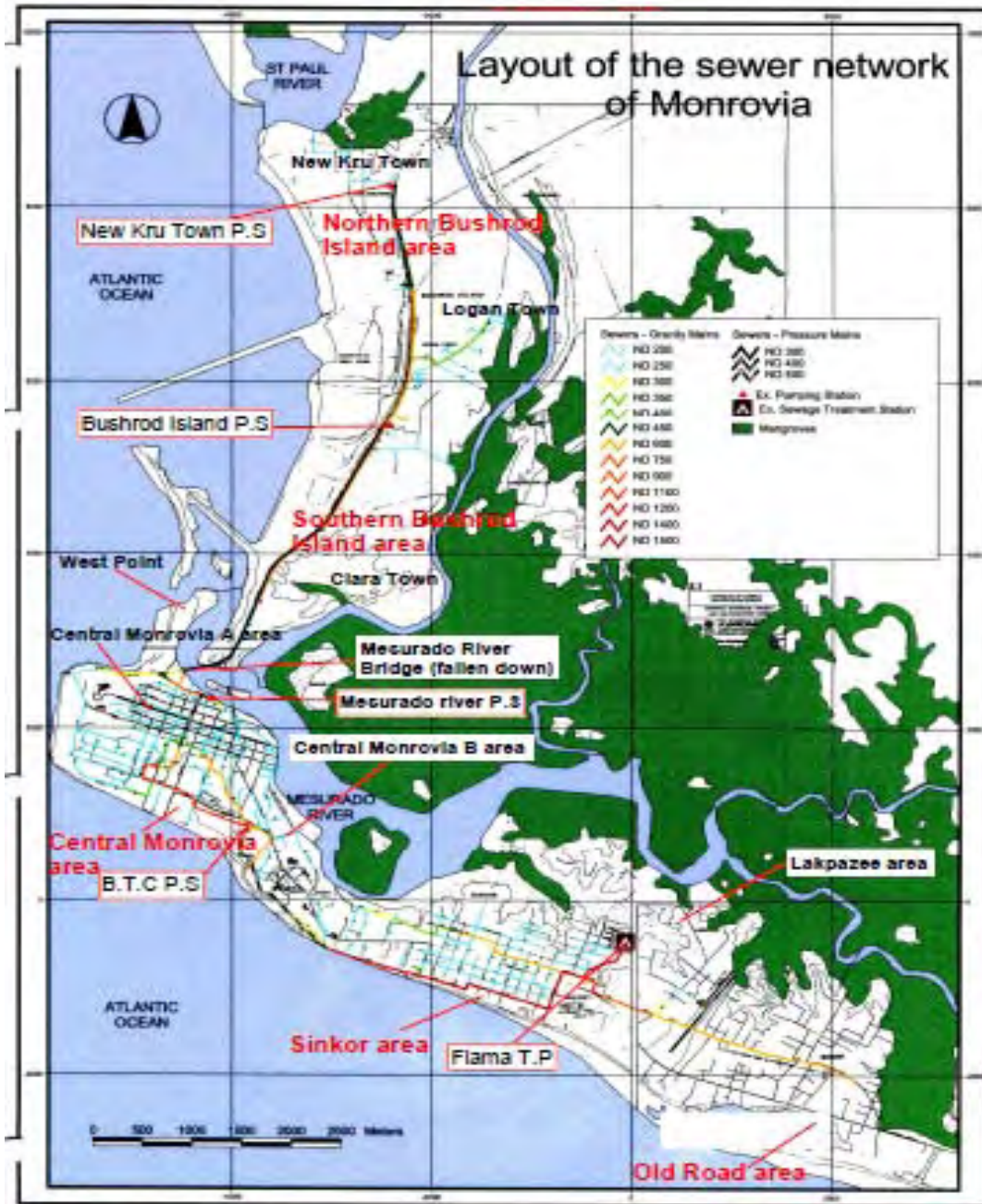


Figure 2.6-9 Layout of Existing Sewerage System at Bushrod Islands and Central Monrovia

(6) Current Situation of On-site Sanitation Facilities

Current severe problems are observed in congested low-standard housing areas in Bushrod Islands and Central Monrovia to Sinkor. These areas have in large parts no access to the sewer network and their means of services is limited to pit latrines or no facilities. During the rainy season the latrines are mostly flooded and cannot be used. Especially, problems occur occasionally during the heavy rainy season when low-lying tanks flood and sewage discharges to the surface.

The majority of residents in high density areas does not have access to facilities at all and are forced to waste by open defecation in the field and riverbed surrounding their houses due to the lack of public toilets.

Most of the low-density areas are served by septic tanks. This system is an adequate solution for the wastewater disposal in areas with low population density and was found to operate effectively.

2.6.3 Main Issues on Sanitation Services

According to the field survey by the study team, problems and issues on sanitation sector are summarized in Table 2.6-5.

Table 2.6-5 Current Issues and Countermeasures in Sanitation Sector

Issues	Countermeasures
In terms of sanitation sector, the access ratio to appropriate sanitation was 27% in 1990. However, it decreased to 7% in 2003. Although the access ratio achieved 15% in 2004 owing to rehabilitation after civil war, no adequate treatment is done. From the aspect of circumstances, the National PRSP focuses on the access ratio of 40% in 2011.	➤ Development of sanitation facilities such as Sewerage System, Community Sanitation System and On-Site facilities (i.e. public toilets, etc)
Sewer pipes are clogged with sludge and debris.	➤ Procurement of sewerage maintenance equipment including vacuum trucks and jet cleaning machines
There is no adequate disposal area of sludge generated from Public Toilet, etc.	➤ Immediate rehabilitation of lagoon system in Fiama Sewage Treatment Plant site
Mechanical and electrical equipment of sewerage facilities such as pumps in Sewage Pump Stations are stolen or damaged.	➤ Rehabilitation of Sewage Pump Stations including installation of mechanical and electrical equipment
Sewage Treatment Plant is disrepair and inoperative.	➤ Reconstruction of Fiama Sewage Treatment Plant

Source: Emergency Rehabilitation Program Report, WB

2.7 Present Condition of Storm Water Drainage Sector

2.7.1 Profile of Storm Water Drainage Sector

2.7.1.1 Institutional Framework of Storm Water Drainage Sector

All storm water drainage facilities in Monrovia are under the management responsibility of the Ministry of Public Works. Cleaning of drainage facilities is sometime implemented by Monrovia City Corporation and cleaning of sewerage drainage pipes is done by Liberia Water and Sewerage Corporation (LWSC).

(1) Ministry of Public Works (MPW)

Ministry of Public Works is responsible for the design, construction and maintenance of roads and highways, bridges, storm water drainage, public buildings and other civil works throughout the country. In addition, it takes responsibility for the administration of urban and town planning, as well as provision of architectural and engineering services for all ministries and agencies of government. In principle, it is responsible for the installation of the entire infrastructure. MPW comprises two Departments i.e. Administration and Technical Services (see Figure 2.7-1). The Department of Technical Services supervises and coordinates the functions of its five bureaus, namely; Operation, Technical Services, Construction, Planning and Programming and Rural Roads Coordination and Implementation.

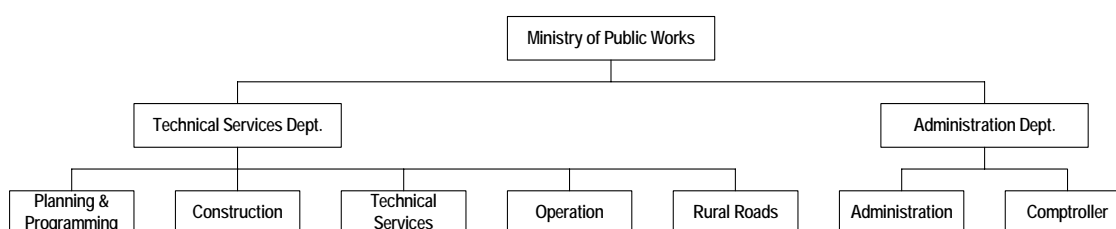


Figure 2.7-1 Organizations of Ministry of Public Works (MPW)

The activity of operation and maintenance of the storm water drainage belongs to the Operation Bureau, under Department of Technical Services.

(a) Department of Technical Services

The department is responsible for the execution of all technical programs of the Ministry. The job description of the Department is identified as follows:

- a. Provide professional and technical services required to support the programs of the Ministry and other Agencies of Government in the area of construction;
- b. Provide architectural and engineering services including site surveys, testing, design, contract management and project control for the Government;
- c. Undertakes execution of transport sector surveys, analysis of investment priorities and overall planning of the transport network of the country;
- d. Develop standards for design and construction; maintenance and operation of Government's real property; and
- e. Execute construction of highways, secondary, rural and feeder roads.

(b) Bureau of Operations

The Bureau of Operation is the largest of the several Bureaus of the Ministry in terms of number of employees, equipment fleet and resource allocation and consumption. This bureau commands over sixty percent (60 %) of the entire workforce and equipment fleet of the Ministry. This Bureau is charged with the statutory mandate, under the Ministry to rehabilitate all Public Highways, Bridges and City Streets. The Bureau of Operations under the Department of Technical Services includes the Highway Maintenance Division, Mobile Equipment Division and Administration Division. These three (3) Divisions carry out separate functions, which correspond to the overall function of the Bureau.

The Mobile Equipment Division is the Mechanical arm of the Bureau of Operations within the Ministry. This Division is responsible for the repair and maintenance of all vehicles and equipment assigned to the Ministry of Public Works by Central Government, for its operations. The Division also serves as a custodian of the Ministry's vehicles and equipment and all tools. It is headed by a Chief of Mobile and has a workforce that includes Mechanics, Drivers, Welders, Operators, Auto Electricians, etc.

(c) Special Implementation Unit (SIU)

The SIU is an autonomous unit created under the MPW. The mandate of the SIU is to manage the implementation of the Urban Works Project on behalf of the Ministry. This will include focus on the management and implementation of donor supported projects.

(2) Monrovia City Corporation (MCC)

The Public Health Law of 1975 granted the MCC the responsibility of ensuring clean and sanitary environmental conditions in Monrovia. The MCC is responsible for environmental management including sanitation primarily in the form of beautification, street cleaning including some of drainage channel, and solid waste collection and disposal. The demarcation for drainage cleaning duty is not yet clear with MPW.

(3) Liberia Water and Sewerage Corporation (LWSC)

The LWSC was established by the National Legislature Act of Liberia 1973 with responsibility to:

- Manage, operate and implement water supply and sewerage services;
- Establish and maintain facilities throughout Liberia;
- Apply the principle of fair and reasonable charges;
- Trade and manufacture materials; and

- Obtain rights and legal titles.

The planning, development, operation and maintenance of domestic and public sanitation facilities are shared between MCC, LWSC and the MHSW.

2.7.1.2 Existing Policies and Strategy

Regulations of river management and drainage design are not yet provided for in the law in Liberia.

2.7.1.3 Finance Structure and Budgeting

The MPW are still depending on the Donor of World Bank, African Development Bank (AfDB), German Agro Action (GAA), USAID and EC for many Projects.

The project budget donated from International Organization is disbursed to Special Implementation Unit (SIU) through the Trust Fund. UNDP or UNMIL often will the implement the project with MPW. In the budget year of 2008/2009, World Bank supports more than 10 projects such as Vai Town Bridge Project, Monrovia Streets Rehabilitation Project, and Caldwell Bridge Project, etc.

For the year of 2008/2009, The Government of Liberia allocates USD 22.1 mln to MPW. The overhead cost is approximately USD 4.4 mln , 19 % in total fund of MPW as below.

Table 2.7-1 MPW Overhead Expenditure and Rate

Specific Item	Fund (mln USD)	Rate (%)
Personal Service	1.4	6
Fuel, Parts & Maintenance	1.5	7
Other Operating Cost	0.9	4
MPW Capital Assets/Equipment	0.6	2
Total	4.4	19

USD 17.7 mln of the remaining is disbursed to the Capital, Roads and Construction Works.

The amount of USD 404,000 is disbursed to the drainage cleaning and culverts installation as Special Project Monrovia and it is equivalent to 2 % of the whole budget.

2.7.1.4 Existing Projects in Storm Water Drainage Sector

During the years of conflict, Liberia's infrastructure was nearly completely destroyed and the majority of services ceased being rendered. Following the conflict, the World Bank undertook technical assessments and feasibility studies in five infrastructure sectors with financing from the Trust Fund for Liberia (TFLIB).

In the result, Emergency Rehabilitation Program Report issued in 2006, identifying critical emergency works. A second infrastructure project – the Liberia Infrastructure Rehabilitation Project (LIRP) composed of three (3) sub-components has been implemented. In particular, Sub-Component B includes the rehabilitation works of storm drainage sector in urban area, mainly in Monrovia.

(1) Sub-Component B: Urban Infrastructure Rehabilitation (USD 7.02 mln)

This component will engage in simple rehabilitation works in urban areas, mainly in Monrovia. The types of works which are envisaged include:

- Rehabilitation of public toilets;
- Repair of selected and limited main and secondary gravity lines in the urban sewer network;
- Cleaning and repair of surface drains and underground pipes of the urban storm drainage system;
- Large scale collection of accumulated solid waste and associated activities;

- Small, visible urban works, such as repair of market places and painting of public buildings.

The above activities will be implemented by UNDP and, whenever possible, will be packaged into relatively small contracts (averaging USD 100,000) to enable the local contracting industry to participate in and execute most works. Simple tasks which do not require detailed engineering prior to their execution (e.g., garbage collections and drainage cleaning) will be undertaken immediately utilizing unskilled labor through Community Based Organizations and local private entrepreneurs. In this component, the drainage rehabilitation work (c) is summarized as follows:

(2) Drainage Rehabilitation (USD 1.90 mln)

The drainage cleaning and repair component of the urban infrastructure rehabilitation consist of:

- Clearing of open drains including removal of sludge, silt, organic material and debris from open channels and underground crossing points;
- Repair of underground crossing points;
- Construction of reinforced concrete walls up to 2 meters height; and
- Demarcation and plastering of concrete blocks

The information on the detail of the rehabilitation work has not been obtained from MPW during the site study as of December 2008. Some rehabilitation work of Central Monrovia and Bushrod Island has already been done as recognized in the field. The document on detail layout also is not obtained.

The information on rehabilitation of Sinkor open drainage is summarized below;

- Cleaning of the open drainage channels of total length 6,073 meters in Sinkor as well as the correspondent outlets and installation of RC Culvert at Lakpazee- Market Road Opened Channel.
- The survey of the cleaned drains with longitudinal sections and layout indicating crossings, bridges, other services, depths and widths of the drain.

(3) Urban Infrastructure Construction and Rehabilitation of Monrovia Sewerage Network Pumping Stations (USD 11.0 mln)

This Project will be funded by the International Development Association (IDA) under the Urban Rehabilitation and Sanitation Project (URSP), under preparation, or under the Liberia Reconstruction Trust Fund (LRTF). While the preparation of bidding documents for some of these works is on-going, others will have to be designed by the design and supervision engineer. Under this Project, Small scale urban works as on January 2009 will be prepared for the storm water drainage sector:

- Design reports, drawings, and bidding documents and assistance to the SIU with the procurement of contractors;
- Cleaning and repair of surface drains and underground pipes of the urban storm water drainage system; and
- Community surface area improvement through interlocking blocks as well as other visible urban works, which may include painting of public buildings, installation of playgrounds and others.

(4) Special Project Monrovia (USD 0.404 mln)

This Project is funded by the Government of Monrovia for the drainage cleaning and box culverts installation in Capital Monrovia and implemented by MPW in the budget year of 2008/2009 at following sites;

- Airfield Road (Culverts installation)
- Pipeline Community (Culverts installation)
- Silver Beach (Culverts installation)

- Soul Clinic Community (Excavation/Culverts installation)
- Famous Island (Culverts installation)
- Swedish Relief Clinic (Drainage cleaning)
- Congo Town Backroad (Culverts installation)
- Chocolate City (Culverts installation)
- Freeport Doe Community (Drainage cleaning)
- Central Monrovia (Drainage cleaning/rehabilitation) ; Randall, Benson, Carey, Gurley, Broad, Mechlin, 20th street

2.7.2 Present Conditions of Drainage System and Facilities

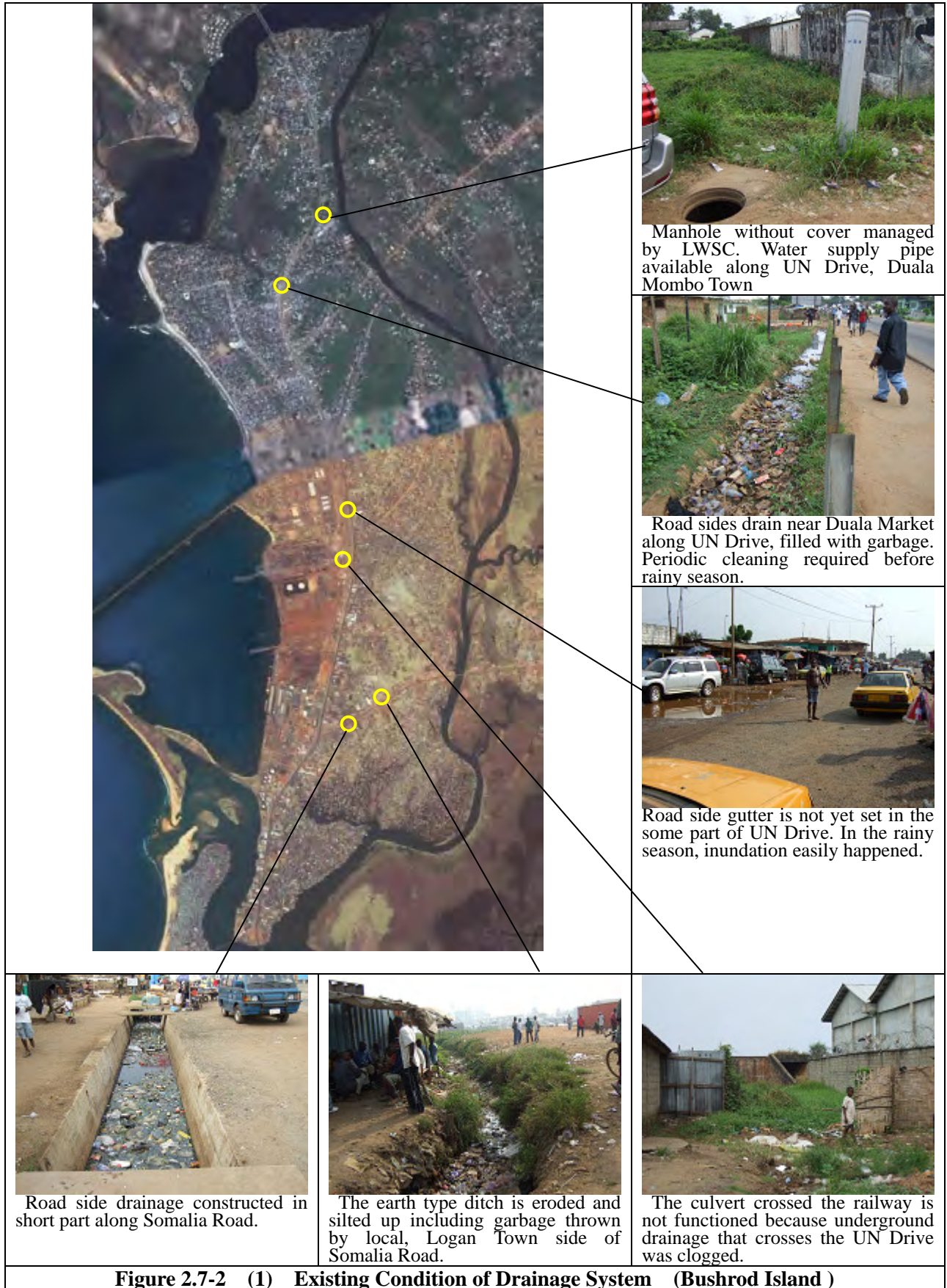
2.7.2.1 Major Drainage System

In the Study area, there is the populated area with the drainage system in the north and south-east of Monrovia, shown in the Figure 7.2-2. (e.g. Bushrod Island, Central Monrovia and Sinkor).

For Bushrod Island, the five channel drain in the eastern direction into the Stockton Creek and one in the northern St. Paul River. In the rainy season, the flooding is often in low land area and the UN Drive. (Figure 2.7-2 (1))

The undulating topography of central areas of Monrovia allows the construction of relatively small and short drains, resulting in short distances from any point in town to the next receiving water. The surface water system in central Monrovia was constructed in the period 1955 to 1957, with later additions to accommodate the growth of the town. Immigrants moved into the empty spaces in town, building their houses without considering the natural drainage pattern. All along the Mesurado River and its southern branches, one can find houses even in the very low-lying areas which have always been subjected to flood. Houses have been built so close to each other that they do not leave sufficient space for storm water to run off. There are a number of drainages that have been blocked, due to solid waste deposits at the outlet of the drainage channels. (Figure 2.7-2 (2))

Sinkor and Lakpazee in the south-eastern of Monrovia form the natural drainage systems. The number of households has been increasing in recent years. (Figure 2.7-2 (3))





Inlet of road surface water on Benson St. Garbage easy to enter. No grating



Many garbage are thrown around broken underground pipe for drainage.



Road side gutter in West Point Road. It is covered by mud and garbage.



Soniwein drainage crosses Randell Street



Drainage in Soniwein community crosses Lynch Street



Main channel of Soniwein with concrete lining covers concrete roof in downstream



4 set pipe culverts of Coleman Avenue at 18th Street. Flow capacity is less by siltation.



Eutrophied Swamp of Low-lying Area with Water Lilly habited in Fiamah



Open channel of concrete lining crosses Russell Avenue in Jallah Community



Additional channel on underground pipe culvert arranged by community, Coleman Ave.



Inundated place, due to insufficient flow capacity of drainage near 18th Street



Cross drainage along Tubman Boulevard near Hospital

Figure 2.7-2 (3) Existing Condition of Drainage System (Sinkor and Lakpazee Zone)

2.7.2.2 Drainage Structure Type

The drainage facilities are composed of reinforced concrete pipes ranging from 14” to 60” diameter, corrugated metal pipes ranging from 18” to 72” diameter, box culverts, the catch basins, manholes, and the open concrete and earth stream channels.

In Central Monrovia, an underground rectangular channel of about 450 m length of downstream stretch of Soniwein leads to the Atlantic Ocean. The open channels are generally unlined, and smaller trenches with stone lining can also be found in some places of Sinkor and Lakpazee.

In Central Monrovia and parts of Sinkor and Bushrod Island, most of the roadside drains are constructed as closed culverts, taking the storm water through gutters. In the lower density areas, the drains are mostly open, following the natural creeks.

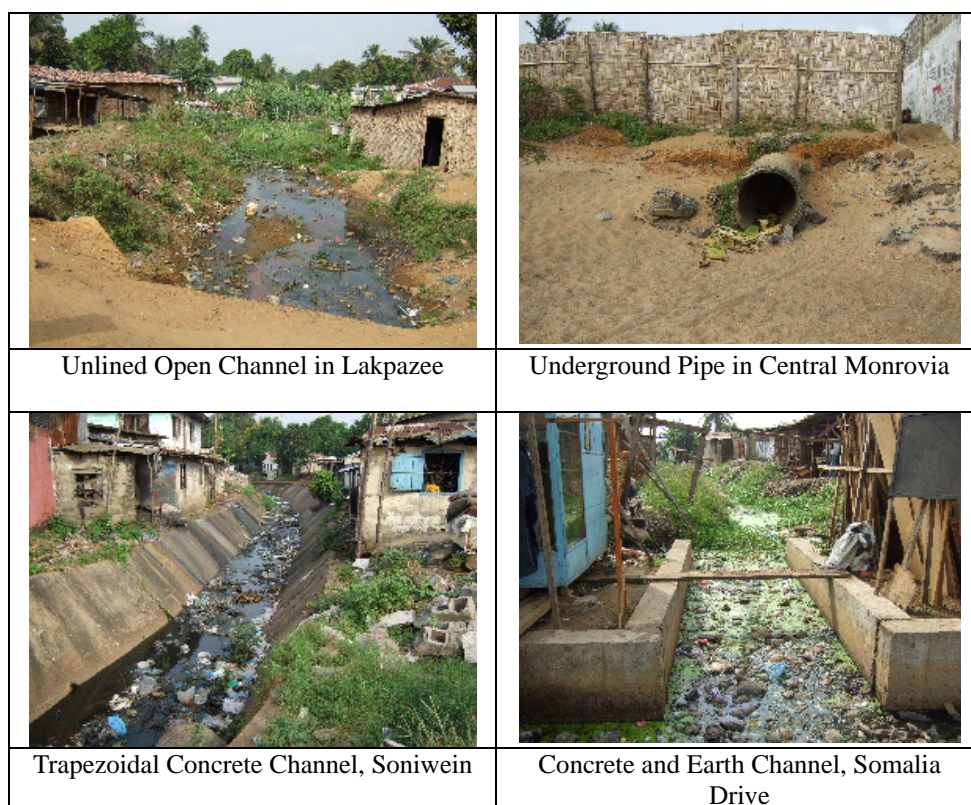


Figure 2.7-3 Drainage Structures in Monrovia

Structure types are summarized in the following quantities:

- 27 km underground pipes and box culverts
- 22 km major earth channels
- 1.7 km large trapezoidal concrete channels
- 0.5 km large concrete underground channels
- 920 manholes (almost each one combined with an adjacent rain water intake)

The design of the system provided for drainage of surface waters from the streets through inlets. These inlets are rectangular (of about 1.60 x 0.35 m size) and generally located on opposite sides of the streets along the curb stones. Adjacent to each inlet, a manhole exists in the walkway. An underground pipe connects the two manholes, passing under the intakes. On one side, under the walkway, a longitudinal pipe finally leads the water away. Only the drainage of the Capitol Bypass (which has been built later by a German Company) is arranged differently: the storm water inlets are rectangular 0.60 X 0.45 m and the longitudinal drainage pipe runs under the centre of the street.

Manhole covers are generally rectangular and made from reinforced concrete.

2.7.2.3 Operation and Maintenance

Despite the large number of staff employed in MPW workforce (more than 1,000 employees), less than 15 staff members are dealing with the surface water drainage of Monrovia. They are equipped only with a limited number of hand tools like shovels and can achieve very little in the piped sections.

The main problem is that almost of the cast iron or steel gutters of the inlet on the streets have been stolen, and also the concrete manhole covers are sometimes damaged or missing. Subsequently, solid and waste materials have been dumped into the openings, sometimes up to the top. The uncontrolled disposal of garbage in the city has turned the surface water drainage system into a major depository for garbage and other debris far beyond its capacity. As a result, flooding has become routine in a number of streets.

In addition, other problem includes:

- Inadequate drainage construction and connection to the sewers;
- Illegal connections of sewer pipes to the drains; and
- No fund for maintenance work of repair and recovery.

MCC, responsible for solid waste management in Monrovia deals with sometime drainage cleanings using the finance of international donors. The cleaning works have been done for some channels or drainage based on proposal. Meanwhile, LWSC has been promoting the sewerage system using advanced machine of the high pressure cleaning cars. The surface drainage channels are sometimes cleaned by the local communities. Vacuum trucks with pressure pumps, jetting equipments and some tools will be required for maintenance purpose and repair works.



Figure 2.7-4 Present Condition of Drainage Structure and Equipment for O&M

2.7.3 Constraints and Key Issues

Through the site study and interview from the Government staff, the constraints and key issues on the

storm drainage sector are divided into the urgent issue and general issue.

2.7.3.1 Urgent Issue

To minimize frequent inundation area in the core area of Monrovia, the following urgent issues should be resolved as soon as possible.

- Some of the concrete manhole covers, and majority of the original cast iron inlet gutters are missing. Inlets and manholes are frequently filled with garbage up to the top.
- Many manholes and inlets are structurally damaged
- The drainage system requires, not only cleaning, but also civil repair works and/or reconstruction.
- At some major street junctions in downtown Monrovia, the concrete manhole covers are missing and cause a danger to vehicles and pedestrians, especially during rainy season, when the manholes are filled with water and are virtually undistinguishable.
- The repair works cannot be undertaken by the current small maintenance crew because of lack of equipments, tools, material, and non-personnel assigned to the work.
- In the streets of Carey and Benson, the flooding during storms is also caused by the overflowing sewers, thereby contaminating the storm water.
- Documents of drawing and layout of all existing drainage system are missing.
- Inventory of drainage structures (channel, pipes, culverts, and manholes) is unfilled in MPW and its necessity is unrecognized to MPW.

2.7.3.2 General Issue

As described in 2.7.3.1, the urgent issues coverage the cleaning, repair, replace of the drainage structures. To the contrary, the institutional issues as the general issue are picked up as follows;

- To set up the unit for operation and maintenance
- To allocate operation and maintenance funds
- To establish disclosure of official information on drainage cleaning project or programme
- To establish the design criteria/standard of the storm water drainage
- To discuss the possibility of operation and maintenance mandate transfer to other organization (MCC or semi-public enterprise)
- To prepare the penalty provision for dumping of solid waste into the drainage.

CHAPTER 3 STRATEGY FOR FORMULATION OF COMPREHENSIVE MASTER PLAN ON URBAN RESTORATION AND IMPROVEMENT

3.1 Approach to Urban Restoration and Improvement

3.1.1 Significance of Urban Structure of Greater Monrovia

Formulation of urban structure at this moment has the following significant meaning.

- Integration of Urban Development and Restoration & Improvement -

In Greater Monrovia, the following situation is unfortunately observed.

- 1) Restoration and improvement of urban infrastructure and facilities supported by donor countries and organizations are in progress with insufficient mutual adjustment or coordination.
- 2) It is uncertain whether such restoration and improvement activities are heading to the same future vision of Greater Monrovia due to lack of urban development master plan for Greater Monrovia.

Though this Study is to formulate restoration & improvement plan of urban infrastructure and facilities, it shall be made consistent with urban development master plan with longer horizon.

Table 3.1-1 Comparison of Restoration & Improvement Plan and Urban Master Plan

Type	Objectives	Planning Period	Sector	Prerequisite
Restoration & Improvement Plan (the JICA Study)	Restoration and improvement plan of urban infrastructure and facilities	Short to medium term (10 years)	Urban infrastructure including Road/transport, water supply and sewerage/drainage	Rapidity and flexibility
Urban Development Master Plan	Master plan to realize future vision of the city envisaged after the integration and rational coordination of urban functions	Medium to long term (15 - 20 years) (Midterm revision is expected.)	Land use plan, transport plan, urban supply and disposal plan including electricity, water supply, sewerage and drainage, garbage disposal system plan, major public facility plan including schools, hospitals, fire station and police offices, etc.	Economic rationality

As compared above, the JICA Study is to formulate restoration and improvement plan for urban infrastructure including road and transportation, water supply and sanitation, storm water drainage that were damaged or destroyed during the civil war for 10 years. On the other hand ordinary urban development master plan is to show the future plan comprising all relevant sub-plans after the integration and rational coordination of urban functions for medium- or long- term (15 - 20 years).

Accordingly the identified projects in the JICA's restoration and improvement plan shall be in the same direction toward future vision of urban development master plan to be formulated. In this context it is very important to discuss the urban structure vision of Greater Monrovia and reach to consensus among involved parties.

3.1.2 Approach to Urban Restoration and Improvement

Target time frame adopted in this Study to identify issues and problems and formulate restoration/improvement projects is as shown below.

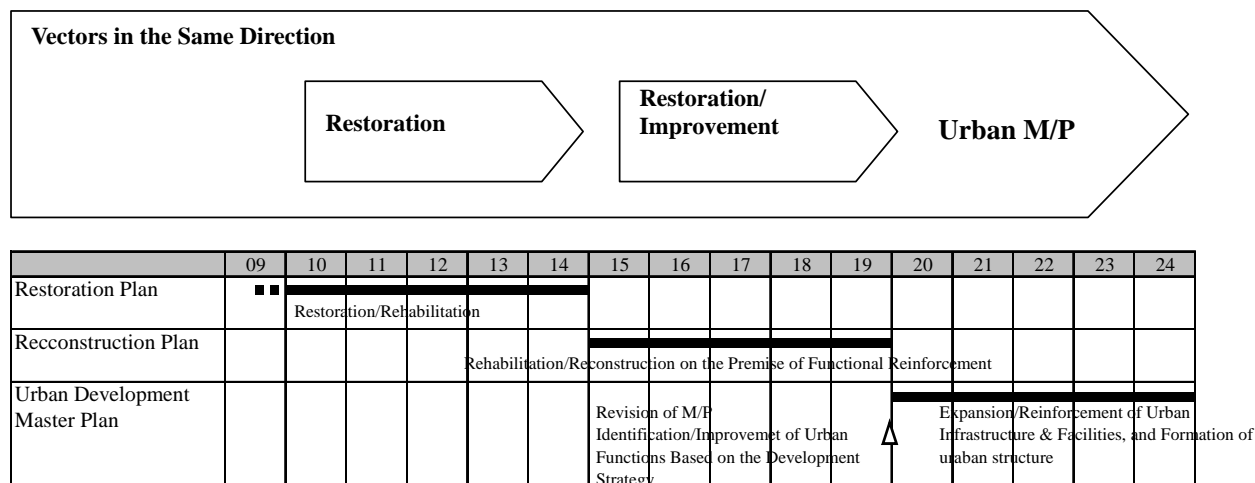


Figure 3.1-1 Approach in the Time Frame

3.2 Future Vision of Greater Monrovia

3.2.1 Roles of Greater Monrovia for Liberia

3.2.1.1 Liberia’s Growth Potential

Liberia has a rich natural resource base, including fertile lands for agriculture and tree crops, extensive forestry resources, iron ore, gold, diamonds, and the ocean and coastal areas.

Natural resource-based industries have the potential to create significant numbers of jobs, provide substantial budget revenues, and initiate rapid growth.

3.2.1.2 Roles of Greater Monrovia

The following functional roles of Greater Monrovia are envisaged in the context of restoration/improvement and economic development of Liberia based on the Poverty Reduction Strategy (PRS).

- A. Base of service industries for primary and secondary industries
- B. Base of downstream product industries
- C. Base for international trade and export
- D. Base for economic diversification
- E. Hub of information network

Most of functions listed above shall be further reinforced or developed from now on.

Liberia's Growth Potential
<p><Base/Background> Rich natural resource base, including fertile lands for agriculture and tree crops, extensive forestry resources, iron ore, old, diamonds, and the ocean and coastal areas</p> <p><Potential Industries></p> <p>(1) The Primary industries and</p> <ul style="list-style-type: none"> • Rice and cassava (traditional crops) • Rubber, palm oil, coffee, cocoa, and others (cash crops) • Timber <p>(2) The Mining industries</p> <ul style="list-style-type: none"> • Iron Ore • Gold and diamonds <p>(3) Complementary Service Industries for the Primary and Mining Industries</p> <ul style="list-style-type: none"> • Construction industry • Hotels, restaurants, retail trade, electricity, and other service industries <p>(4) Downstream product industries (Economic Diversification)</p> <ul style="list-style-type: none"> • Agro-processing • Horticulture • Furniture and other downstream wood products industry • Downstream rubber products industry <p>(5) Service industries (Economic Diversification)</p>

Roles of Greater Monrovia for Economic Development	Required Urban Functions
A. Base of service industries for primary and secondary industries	<ul style="list-style-type: none"> • Hotels, restaurants, retail trade, electricity, and other service industries
B. Base of downstream product industries	<ul style="list-style-type: none"> • Agro-processing industry • Furniture and other downstream wood products industry • (steel industry) • Downstream rubber products industry • Fisheries-processing industry
C. Base for international trade and export	<ul style="list-style-type: none"> • International port (Freeport) • International airport (RIA) • International land transport corridors • Distribution industry • SEZs, EPZs
D. Base for economic diversification	<ul style="list-style-type: none"> • Education and training function • Financial business • Tourism industry • (Horticulture) • (Suburban intensive farming)
E. Hub of information network	<ul style="list-style-type: none"> • IT industry

Figure 3.2-1 Roles of Greater Monrovia

3.3 Future Urban Structure and Allocation of Function

3.3.1 Principles of Development and Conservation

The following principles were adopted for the spatial development and conservation in consideration of urban structure of Greater Monrovia.

3.3.1.1 Conservation of Precious Natural Resources

Mesurado Wetlands (Ramsar site(24/082/06), 6,760ha, 06° 18'N 010° 45'W, located in the capital city Monrovia and Montserrado County)

The conversion of land use and construction of urban infrastructure at Mesurado Wetlands by reclamation is not assumed in the planning period of JICA Study.

3.3.1.2 High Density Development

Intensive development is pursued to avoid the negative impacts caused by low density development which requires large governmental expenditure for construction of urban infrastructure and public services.

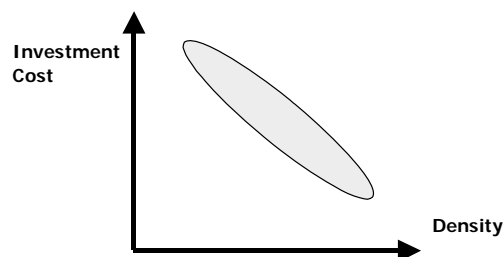


Figure 3.3-1 High Density Development

3.3.1.3 Distinction between Conservation/Reservation Areas and Urban Functional Areas

The Greater Monrovia is distinctly classified into conservation/reservation areas and urban functional areas to avoid urban sprawl and development in a haphazard way. The conservation/reservation areas shall be the reserved area for urban development in distant future, lands for horticulture and suburban intensive farming, and conservation areas as precious natural resources.

3.3.1.4 Functional Expansion and Intensification

As the relocation of urban function is usually against the land potential, functional expansion and intensification are respected.

3.3.1.5 Utilization of Urban Development Potentials

Current development potential endowed with Greater Monrovia, that is, international transport infrastructure, accumulation of population and industry, etc. shall be effectively utilized in development.

Table 3.3-1 Utilization of Urban Development Potentials

Type	Potential	Utilization Direction
Population		
Residential Population	Some 29% of Liberia population resides in the GM (2008). High pop. density in old towns of New Kru Town, Logan Town, Clara Town, Central Monrovia, Sinkor, Old Road.	Labor intensive industry development within the commuting range
Transport		
Freeport	Almost only export/import port in Liberia with water depth 11m. Handling volume in 2004: 1 mln. ton (incl. 26,000TEU) Competing with Dakar, Banjul, Bissau, Conakry, Freetown, Abidjan and Accra	Development and fostering export industries dependent to the marine transport near the port
RIA	Located at 50km south of Monrovia and 11km far from seashore Asphalted (3,353m x 46m) Int'l pax. in 2005: 38,900 (1,191flights)	Formation of secondary and tertiary industrial corridor between Monrovia and RIA
International land transport corridors	Construction of International corridors such as Monrovia-Ganta/Guinea border, Monrovia-Buchanan-Robertsport	Development of downstream products industries along the corridors in GM
Industry		
Business ind.	Concentration of Business functions at Central Monrovia.	CBD reinforcement
Commerce	Large market burgeoning at the transport nodal points.	Development of commercial cores utilizing potential
Secondary industry	Free Zone Area near the port (presently used as an UN Military base)	Establishment of EPZ and/or SEZ

3.3.2 Urban Structure Patterns

Present urban structure of Greater Monrovia is characterized by the followings.

- a. Urban area formation by accumulation of industries dependent on the marine transport centered by Freeport
- b. CBD formation in Central Monrovia where grid pattern road network is provided.
- c. Urban functions forming ring city along some 25 km-ring road comprising of Somalia Drive and Tubman Boulevard
- d. New urbanization along the regional corridor

Two urban alternative structures based on the present urban structure of Greater Monrovia were assumed and examined (see table below.)

Table 3.3-2 Urban Structure Patterns

Item	Urban Structure Pattern	
	a) Multi-core urban corridor structure (similar to present pattern)	b) Multi-core urban sector (fan-shape) structure
Urban area development	<ul style="list-style-type: none"> • Linear-type urban infrastructure and facilities (ex. transport network, water supply sewerage system) can be effectively supplied. • The pattern is in line with present urbanization and present development potential can be utilized.(easy to expand) 	<ul style="list-style-type: none"> • Cost-effectiveness becomes lower in the areas far from the center. • The cost for securing the development potential expands leading to the difficulty in the urban area expansion.
Transport network	<ul style="list-style-type: none"> • Public transport is well managed because of the high traffic demand density and similar traffic demand direction • Urban traffic tends to concentrate to the trunk roads and emerge traffic congestion. <p>Note: In Greater Monrovia it has a reality that traffic congestion accruing to the corridor pattern or concentric pattern can be overcome and the lowering of efficiency of urban functions can be avoided by utilizing large ring road. (Important)</p>	<ul style="list-style-type: none"> • Public transport management is not easy because of the low transport demand density. • Urban traffic is dispersed and not to concentrate to the specific transport nodes, however large amount in transport infrastructure improvement is required.
Environmental protection	<ul style="list-style-type: none"> • It is easy to secure green areas inside and adjacent to the urban area advantageous from the disaster prevention viewpoint. 	<ul style="list-style-type: none"> • It is difficult to secure green areas inside urban area due to the continuous urban expansion disadvantageous from the disaster prevention viewpoint.

In conclusion, the JICA Study Team recommends multi-core urban corridor structure (similar to present pattern) based on the circular allocation of urban functions as urban structure vision of Greater Monrovia.

In a long horizon, new location of industries or industrial parks, alleviation of traffic load at specific roads and intersections, diversion of through traffic at city center shall be discussed considering new urban structure elements such as bypass road. As for the development direction, development axis toward north beyond St. Paul River shall be considered because of the closeness to city center and Freeport.

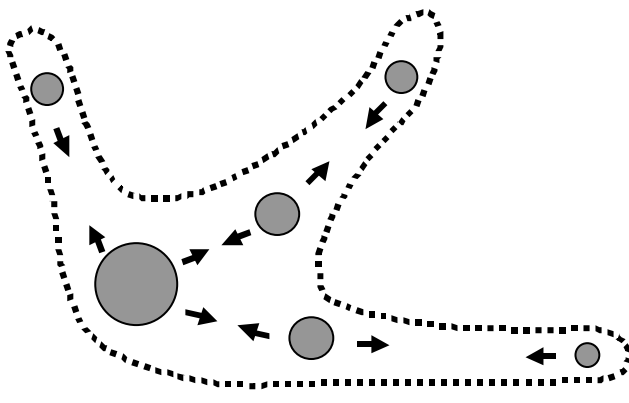


Figure 3.3-3 Multi-core Urban Corridor Structure

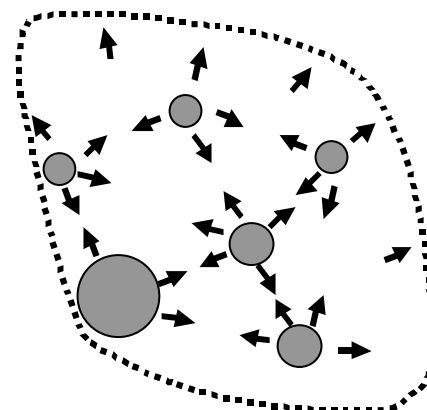


Figure 3.3-2 Multi-core Urban Sector (fan-shape) Structure

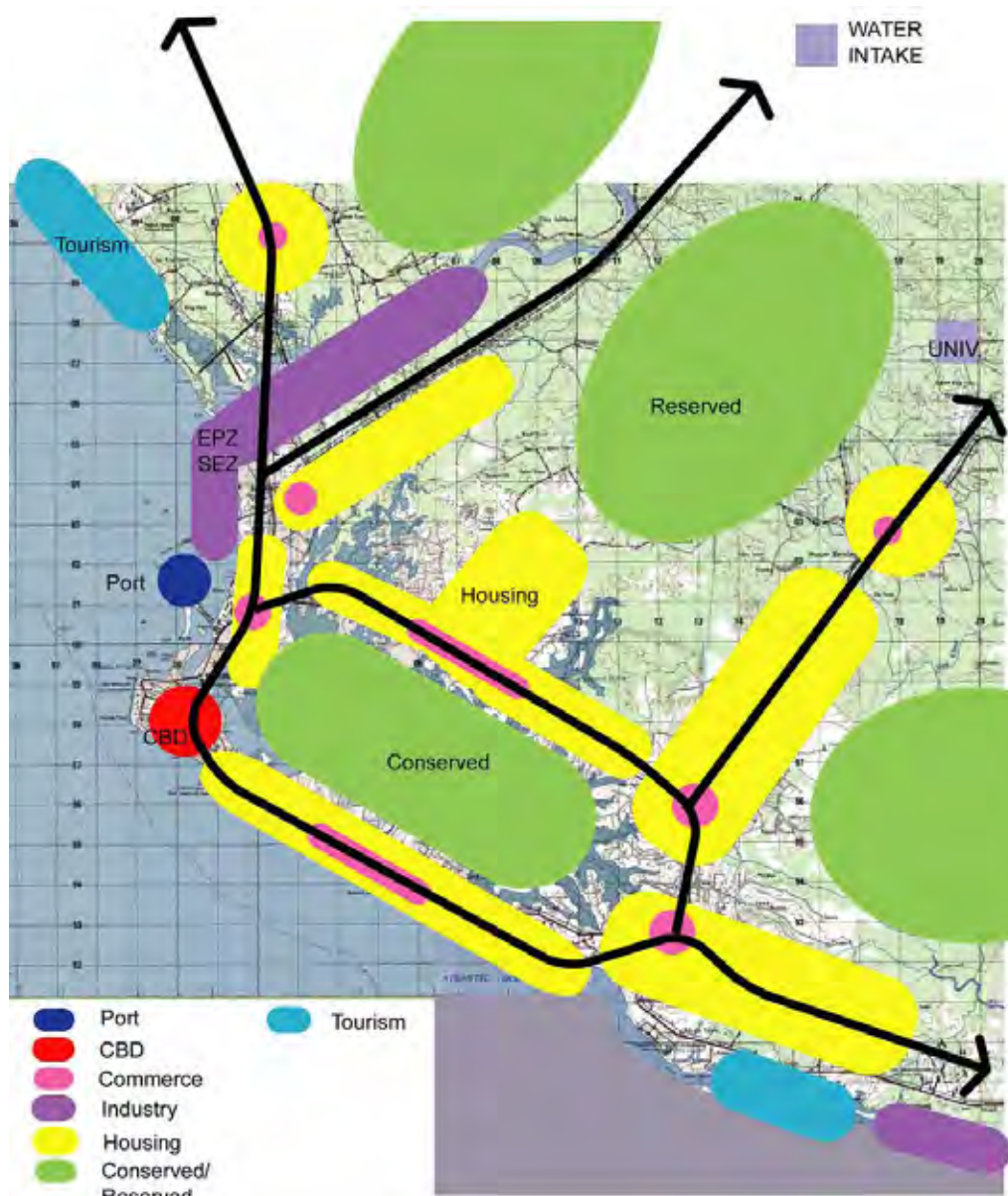


Figure 3.3-4 Urban Structure Vision of Greater Monrovia (2019)



Figure 3.3-5 Urban Structure Vision of Greater Monrovia (beyond 2019)

3.4 Socio-economic Framework

3.4.1 Population

3.4.1.1 Total Population

As described in Chapter 2, the population of Liberia increased at a 2.1% annual rate from 1984 to 2008, but if no civil war occurred, it was supposed that the higher rate of increase was shown. In this study, as shown in Table 3.4-1, the population of Liberia is predicted to exceed the previous rate of increase.

Table 3.4-1 Liberia Population Projection

Year	Population	Growth Rate	Remark
1962	1,016,443		
1974	1,503,368	3.3%	Census Data of 1962-1974
1984	2,101,628	3.4%	Census Data of 1974-1984
2008	3,489,072	2.1%	Census Data of 1984-2008
2010	3,665,706	2.5%	Estimate of this Study
2015	4,127,218	2.4%	Estimate of this Study
2020	4,624,189	2.3%	Estimate of this Study

On the other hand, the population of the Montserrado County containing Greater Monrovia increased at a high annualized rate of 3.6% from 1984 to 2008, and its high increase is supposed to come about not only by the simple natural increase but returnees, domestic refugees, movement from rural areas to urban areas, etc. Rapid population growth causes the land scarcity of the Monrovia central area, and residents are in the tendency independently transferred to circumference areas where there is still vacant land, such as Sinkor, Bushrod Island, New Georgia, and Gardnersville. Therefore, the population concentration to Greater Monrovia is assumed to become weaker, but continue for the time being. In this study, as shown in Figure 3.4-1 and Table 3.4-2, the following two cases were considered: a) the increased rate of Greater Monrovia becomes higher (Max Case), b) the population concentration to Greater Monrovia continues, but the increased rate of population becomes slow (Minimum Case).

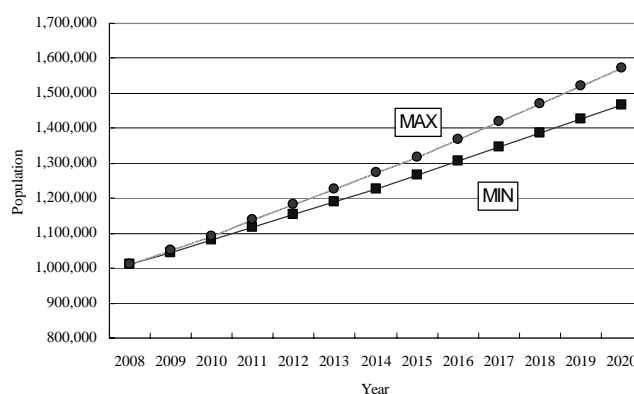


Figure 3.4-1 Urbanization Patterns

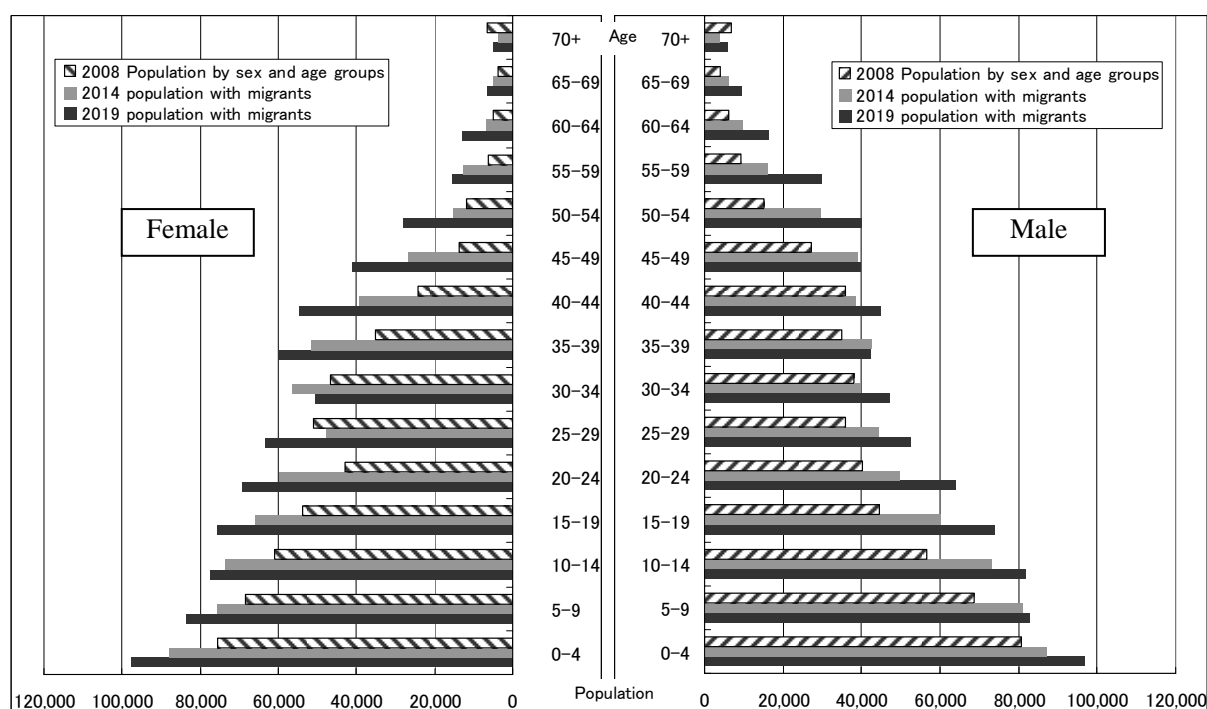
Table 3.4-2 Population Projection

Year	Population in Greater Monrovia				Remark
	Max	Growth Rate	Min	Growth Rate	
1974	240,210		240,210		
1984	448,337	6.4%	448,337	6.4%	Census Data of 1974-1984
2008	1,010,575	3.4%	1,010,575	3.4%	Census Data of 1984-2008
2010	1,093,037	4.0%	1,080,462	3.4%	Estimate of this Study
2015	1,317,108	3.8%	1,264,759	3.2%	Estimate of this Study
2020	1,571,882	3.65%	1,466,202	3.0%	Estimate of this Study

3.4.1.2 Population Forecast according to Age Group

The population distribution according to the age groups and gender is estimated using the PT survey results.

The estimate of population distribution over the age group in target year 2014 and 2019 using Cohort Analysis of Population Distribution is show in Figure3.4-2.



Source: PT Survey, Liberia Demographic and Health Survey 2007, Human Development Report Liberia 2006.

Note: Data on age-wise population distribution is based on PT Survey under this Study. Data on fertility rate according to each age group from 15-49 of urban Liberia is from Liberia Demographic and Health Survey 2007. Data on death rate is from Human Development Report Liberia 2006 and Liberia Demographic and Health Survey 2007. The population distribution by age and gender for migrants is assumed to be the same as the population distribution of each predicted year excluding migrants.

Figure 3.4-2 Population Distribution According to Age and Gender

Based on the Cohort Analysis, the population increase between 2008 and 2014, and between 2014 and 2019 can be broken down to population increase due to natural growth and population increase due to migration, as shown in Table 3.4-3. In each time period, roughly half of the population increase is due to natural growth.

Table 3.4-3 Components of Population Increase of Monrovia

Year	Total Population of Monrovia	Population Increase	Population Increase due to Natural Growth (% of increase due to natural growth out of population increase)	Population Increase due to Migration (% of increase due to migration out of population increase)
2008	1,010,575			
2014	1,250,000	239,425	123,823 (52%)	115,602 (48%)
2019	1,470,000	220,000	106,907 (49%)	113,093 (51%)

Note: Estimate of total population is as estimated in 10.4.1 of this report. Estimate of population increase due to natural growth is from cohort analysis. The population increase due to migration is obtained from the subtraction of population increase due to natural growth from the population increase.

3.4.1.3 Population by Community

Cities grow in the shape of corridor, the shape of cluster, and to all the directions by geographical feature restrictions, historical circumstances, and transportation facility distribution etc. The present growth pattern of Greater Monrovia is defined as liner type.

Figure 3.4-3 shows the results of population forecast simulation under linear type of current urbanization pattern and cluster type of another expected pattern. For these simulations, population growth potential U_i was defined for each community i as follows:

$$U_i = \frac{T_i \times S_i - P_i}{D_i}$$

Where,

U_i : Population growth potential at community i

T_i : Design population density at community i

S_i : Area of community i (ha)

P_i : Population of community i (persons)

D_i : Distance from Core Center (km)

The increasing population in Greater Monrovia is distributed according to the proportion of population growth potential of each community out of the total population growth potential of Greater Monrovia.

This simulation assumes that:

- The larger the capacity to accommodate further population, the higher the population growth potential.
- The closer to city center (central Monrovia) and Paynesville, the higher the population growth potential.
- For communities whose current population density exceeds 743 persons/ha, the population growth potential falls into minus territory.

As shown in the forecast, the areas such as New Georgia and Gardnerville with good access to city center indicate high population growth. Areas such as Paynesville with much available land also show some degree of population growth. However, the population density of the majority of areas in Johnsonville and Paynesville is below 50 persons/ha

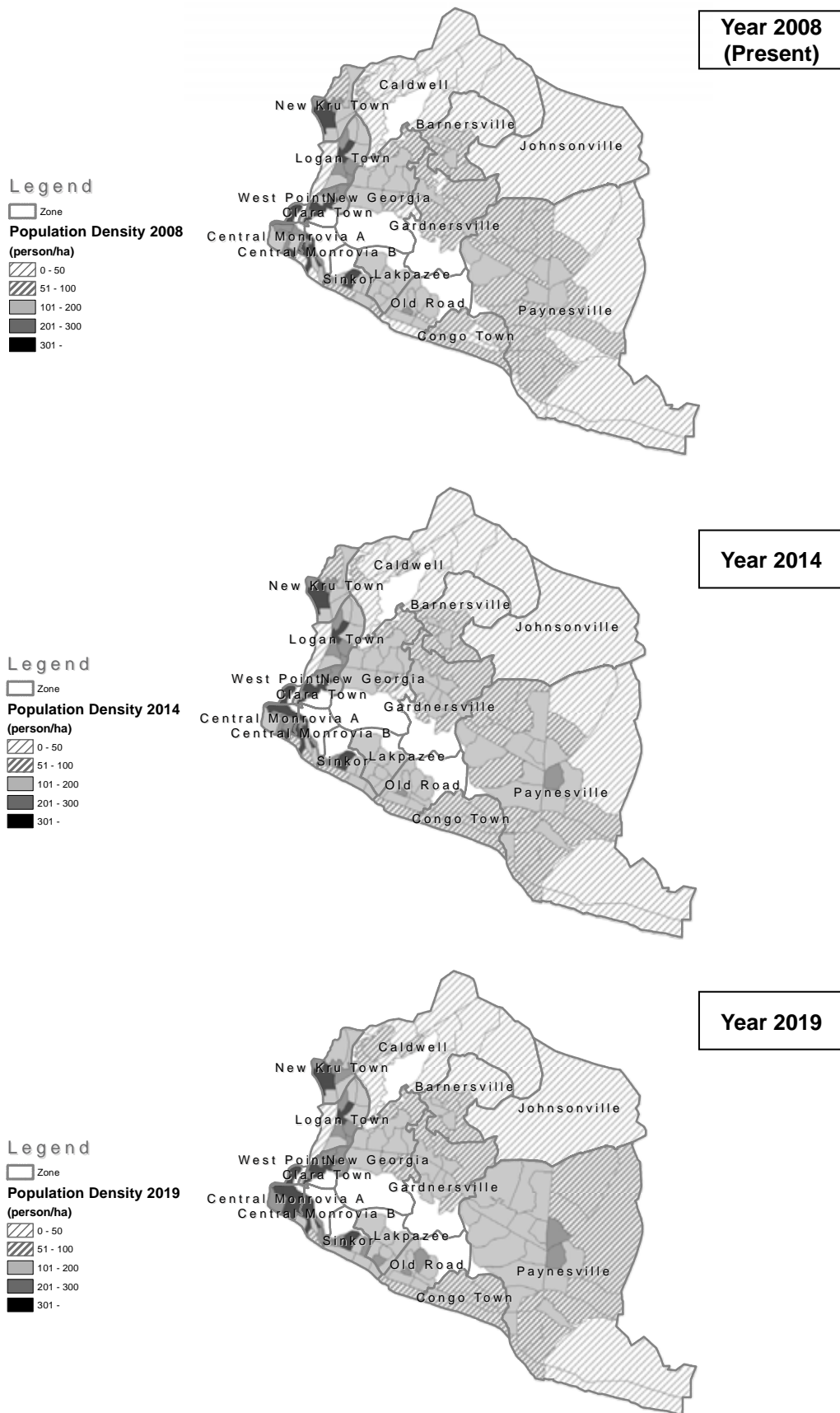


Figure 3.4-3 Future Population by Community (Cluster Type)

3.4.2 GDP

Liberia is one of the poorest countries in the African countries, and according to the estimation of the World Bank, GNI per Capita of Liberia is 150 dollars as of 2007. Although this value shows the lowest subsequently to Burundi and the Democratic Republic of the Congo among African countries (refer to Table 3.4-4), the latest Liberian economy is in a rapid recovery tendency.

Table 3.4-4 Some Lower African Countries in GNI

Country	GNI per Capita 2007 (USD)
Burundi	110
Congo, Dem. Rep.	140
Liberia	150
Guinea-Bissau	200
Ethiopia	220
Malawi	250
Sierra Leone	260
Niger	280
Rwanda	320
Mozambique	320

Sources: World Development Indicators database, World Bank, revised 17 October 2008

The regression analysis was conducted from the values of GDP per Capita from 2003 to 2008, and a future value was estimated as shown in Figure 3.4-4, it will change to USD 252.8 in 2014, USD 312.4 in 2019, and the annual average increase rate became 4.3%.

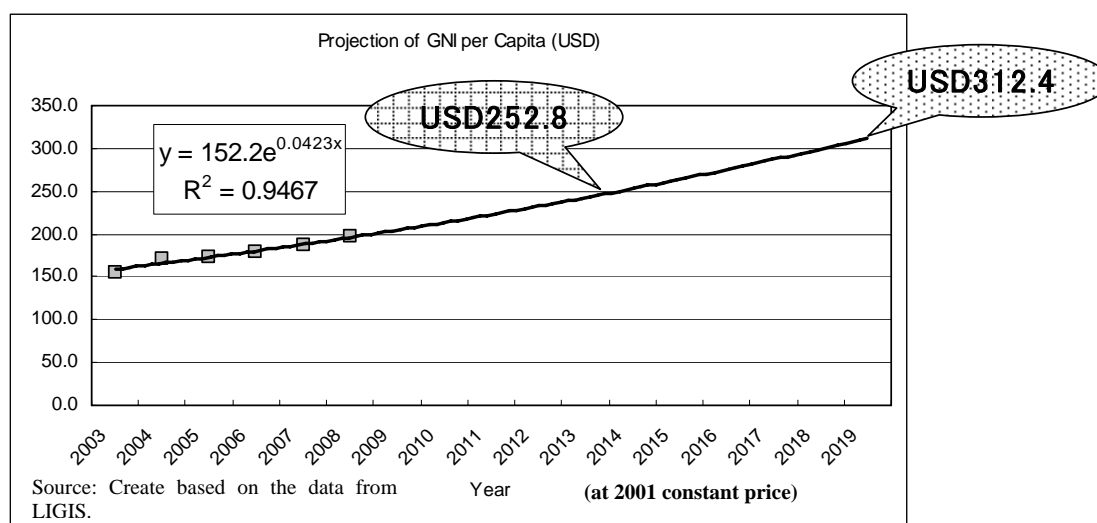


Figure 3.4-4 Result of Regression Analysis of GDP per Capita

On the other hand, considering that GDP per Capita of Liberia was over USD800 in maximum before the civil war, it is expected to recover at least about USD 550 which is the value in 1987 just before a civil war by the target year of 2019. The annual average increase rate in this case becomes 11.4%.

According the Poverty Reduction Strategy which is a comprehensive development plan after the civil war, the increase rate of GDP by 2011 is assumed to be the high increase rate exceeding 10%. Also in this study, the high increase rate exceeding a previous trend (4.3%) was adopted, and it was assumed that GNI per Capita was recovered about 10% of an annual rate until 2019.

3.4.3 Employment

(1) Number of Employment by Industry

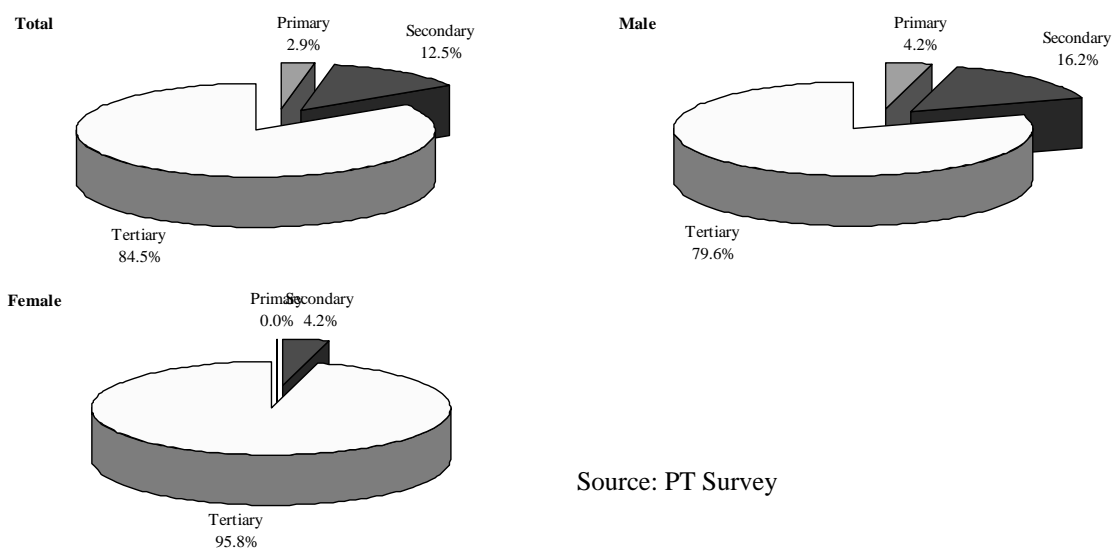
Since the work to analyze the total number of workers according to the census is not completed, the number of employment by industry shall be estimated using the PT survey results.

According to the results of the PT survey, the present population over 13 years old in Greater Monrovia was 639,540. Among those, the number of employment turns into 248,315 persons, and the employment rate has become 38.8%. Breakdown of 61.2% who have no jobs are shown in Table 3.4-5, being housewives 5.9%, being the students 23.9%, consequently the perfect unemployment rate is 17.2%.

Table 3.4-5 Reasons of Not Employed

Items	Ratio
Jobless	17.2%
Housewives	5.9%
Students	23.9%
Others	14.2
Total	61.2%

The number of primary sector occupies 2.9%, while the secondary sector occupies 12.5% and the tertiary sector occupies 84.5%. That is, the employment is predominantly made up of the tertiary sector. Especially in the case of women, 95.8% of the whole are occupied by the tertiary sector.



Source: PT Survey

Figure 3.4-5 Composition of Employment by Industry

(2) Employment by Industry across Zones

According to the PT survey conducted in this Study, the employment of residence by industry and employment of work place across the zones of Greater Monrovia is as shown in Figure 3.4-6 and Figure 3.4-7.

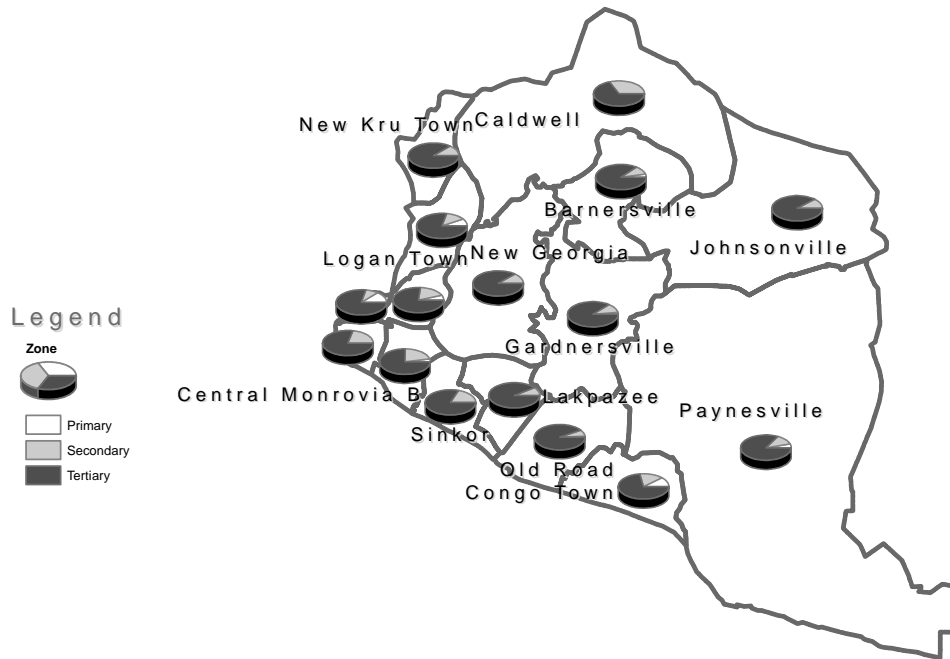


Figure 3.4-6 Zone-wise Employment at Worker’s Place of Residence by Industry

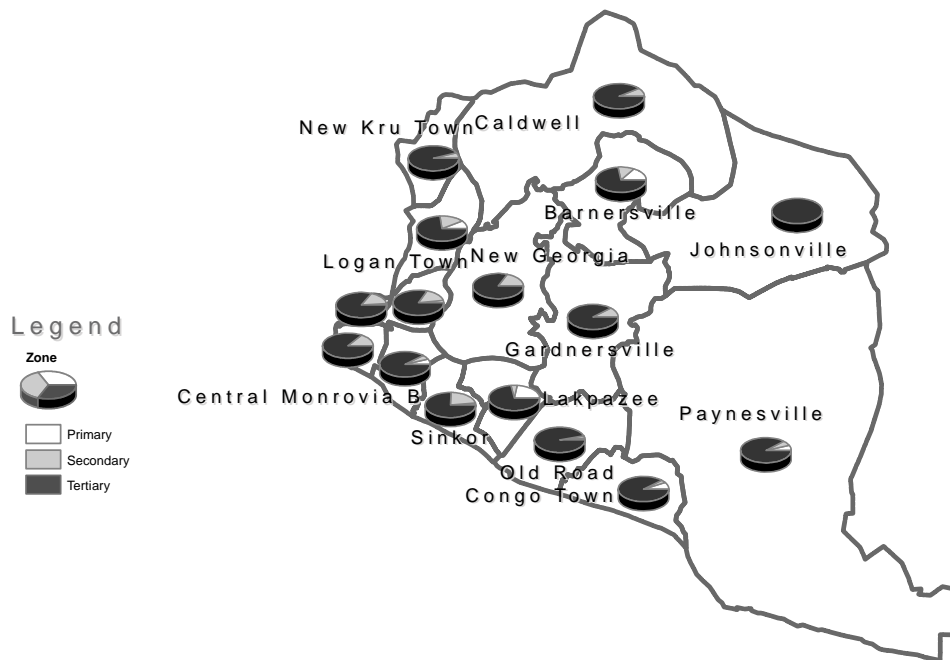


Figure 3.4-7 Zone-wise Employment at Worker’s Working Place by Industry

As seen from the two above figures, zones with high ratio of primary industry employment of work place is Paynesville, Central Monrovia A, and Lakpazee. However, these workers seem to be residing in other zones, as ratio of primary industry for employment of residence is minimal for these zones. Ratio of secondary industry employment is high in Sinkor, Gandnersville, and Clara Town. These are also zones where industrial activities were sited through the land use field survey conducted in this Study.

(3) Estimate of Number of Future Employment by Industry

Number of future employment by industry was estimated assuming that the number of workers in the primary sector will decrease from the current 2.93% in 2008 to 2.00% in 2014 and to 1.00% in 2019.

The remaining number of workers is divided among secondary and tertiary industry according to the present ratio between the two industries. The number of future employment by industry was estimated by assuming also that the percentage of jobless population decreases from the current 17.2% to 8.0% by 2019.

According to these assumptions, total working population is estimated to increase from the current 248,315 in 2008 to 342,197 by 2014 and 436,891 by 2019 (See Table 3.4-7).

Table 3.4-6 Estimate of Future Number of Employment by Industry

	2008		2014 (Estimate)		2019 (Estimate)	
Workers in Primary Sector (Share out of Total No. of Workers)	7,280	2.93%	6,844	2.00%	4,369	1.00%
Workers in Secondary Sector (Share out of Total No. of Workers)	31,154	12.55%	43,345	12.67%	55,904	12.80%
Workers in Tertiary Sector (Share out of Total No. of Workers)	209,881	84.52%	292,008	85.33%	376,619	86.20%
Total No. of Workers	248,315	100.0%	342,197	100.0%	436,891	100.0%
Share of Working Population out of Population of Age 13 and Above	38.8%		41.2%		43.1%	
Monrovia Population of age 13 and above	639,540		830,347		1,013,233	
Total Monrovia Population	1,010,575		1,250,000		1,470,000	

Source: 2008 Census and PT Survey

Note: The table assumes decrease in jobless population from the current 17.2% to 8.0%. The remaining population (worker, student, wife and others) was distributed according to the current ratio from PT survey in this Study.

Table 3.4-7 below shows a rough estimate of the number of employment at working place by industry in 2014 and 2019. These estimates assume that the current distribution of employment at working place across zones stays the same in the future. These estimates, however, shall be adjusted based on the land-use plan to be finalized soon.

Table 3.4-7 Estimate of Future Number of Employment at Working Place by Industry

	2008		2014 (Estimate)		2019 (Estimate)	
Total Working in Greater Monrovia	240,196	100%	331,260	100%	423,273	100%
Primary	6,484	2.7%	6,096	1.8%	3,891	0.9%
Secondary	28,902	12.0%	40,211	12.1%	51,863	12.3%
Tertiary	204,810	85.3%	284,953	86.0%	367,519	86.8%
Total Working in Outer Zones	8,119	100.0%	10,937	100.0%	13,618	100.0%
Primary	796	9.8%	748	6.8%	478	3.5%
Secondary	2,252	27.7%	3,133	28.6%	4,041	29.7%
Tertiary	5,071	62.5%	7,055	64.5%	9,100	66.8%
Total Working Population and Share out of Population of age 13 and above	248,315	38.8%	342,197	41.2%	436,891	43.1%
Monrovia Population of age 13 and above	639,540		830,347		1,013,233	
Total Monrovia Population	1,010,575		1,250,000		1,470,000	

Note: The table assumes distribution of employment at working place across zones is the same as the current distribution..

3.4.4 Car Ownership

A car ownership rate is known to be correlative with GDP as shown in Figure 3.4-8. It is assumed that the private car ownership of Greater Monrovia in the present condition is about 5.2 vehicles per 100 household. Taking into consideration that an average household size of the Montserrado County is 4.7 in the Census, the private car ownership rate per 1,000 persons will become 11.1 vehicles. If GDP per Capita of Liberia estimated by (1) is applied to Figure 3.4-8, it will be expected that the future private car ownership rate of Monrovia will become in 20-30 vehicles/1,000 persons in 2014, and will become in 25-50 vehicles/1,000 persons in 2019.

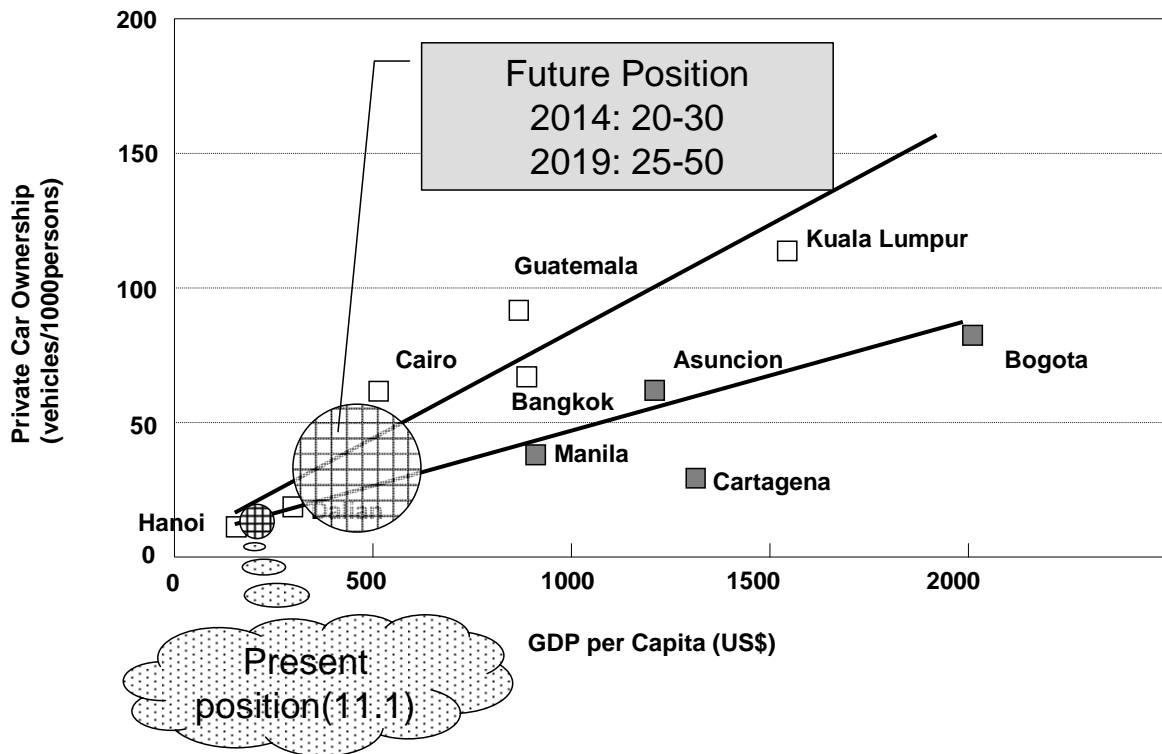


Figure 3.4-8 Car Ownership and GDP per Capita

3.5 Future Land Use Plan

3.5.1 Designation of Urbanization Promotion Area and Urbanization Control Area

3.5.1.1 Definition and Principles for Designation

Under the budgetary constraints, the area where intensive investment for infrastructure (Urbanization Promotion Area) will be designated by assuming urbanized area up to 2019 for effective land use and urban development.

In this context, investment of infrastructure improvement including roads and other lifelines are taking into account of, the areas where already built-up or semi-built up is observed and its neighboring lands fall into this category.

Urbanization Promotion Area (UPA): The area where urbanization is admitted or promoted.

- 1) The area where population density is 60 persons/ha or more
- 2) The area where population density is 40 persons/ha or more commonly recognized as urbanized area and less than 60 persons/ha recognized as built-up area (including population decreasing area)
- 3) The area where population density is less than 40 persons/ha, however planned urbanization is promising (for multi-core urban structure formulation)

Urbanization Control Area (UCA): The area where urbanization is restricted.

- 1) The detached or small areas where population density is between 40 persons/ha or more and less than 60 persons/ha
- 2) The area where population density is less than 40 persons/ha and one of following conditions is met; however planned urbanization is promising (for multi-core urban structure formulation)
 - Area where urbanization is restricted due to topographical condition (wetland, steep land, etc)
 - Excellent agricultural land

- Environmentally conservation land (ex. Ramsar site)

Table 3.5-1 Principles for UPA and UCA Designation Based on the Present Population Density

Population density	Urbanization Promotion Area (UPA)	Urbanization Control Area (UCA)
60 persons/ha or more	In principle designated as UPA	
40 persons/ha or more	The area where population density is 40 persons/ha or more commonly recognized as urbanized area and less than 60 persons/ha recognized as built-up area (including population decreasing area)	The detached or small areas where population density is between 40 persons/ha or more and less than 60 persons/ha
Less than 40 persons/ha	1) The residential area where future population density is expected to be more than 40 persons/ha, and planned urbanization is promising (planned development including urban infrastructure such as roads and parks) 2) Commercial/business and industrial areas already urbanized (excluding area with no buildings) 3) Commercial/business and industrial areas and planned urbanization is promising (planned development including urban infrastructure such as roads and parks) 4) The area where planned urban development is already secured (adjacent to urbanized area). 5) The area where planned urban development on a large scale is secured (detached from urbanized area) 6) The area where reclamation project is implemented	① The area where urbanization is not appropriate in consideration of urbanization trend, prospect of road network, sewer and drainage improvement ② The area in danger of flooding, high tide, tsunami and other natural calamity area ③ The area where excellent farms are located or to be conserved as an agricultural land in a long time horizon ④ The area where land is conserved to maintain excellent natural scenery and urban environment, to protect water resources, and prevent earth and soil spillage

3.5.1.2 Applied Method to Designate Urbanization Promotion Area and Urbanization Control Area

The Urbanization Promotion Area and Urbanization Control Area were delineated in principle based on road, river, waterway, railroad and other topographical features apparently showing the territory of the land.

Provided that open conduits require with 3‰ gradient for sewerage and drainage, approximately 300m length is required for 1m decent in vertical direction. Consequently provision of gravity type sewerage and drainage systems for low land less than 1m above sea level with less than 3‰ slope is difficult. Therefore, the area less than 1m above sea level with less than 3‰ slope was excluded from the Urbanization Promotion Area) to regenerate wetland even though the area is presently used as residential area (most of the areas was considered as informal settlement).

Since 1m contour line is not shown in the topographical map prepared by another JICA Study Team, JICA Study Team delineated the Urbanization Promotion Area and Urbanization Control Area and areas to return to wetland by field survey and by examining the aerial photographs and IKONOS data.

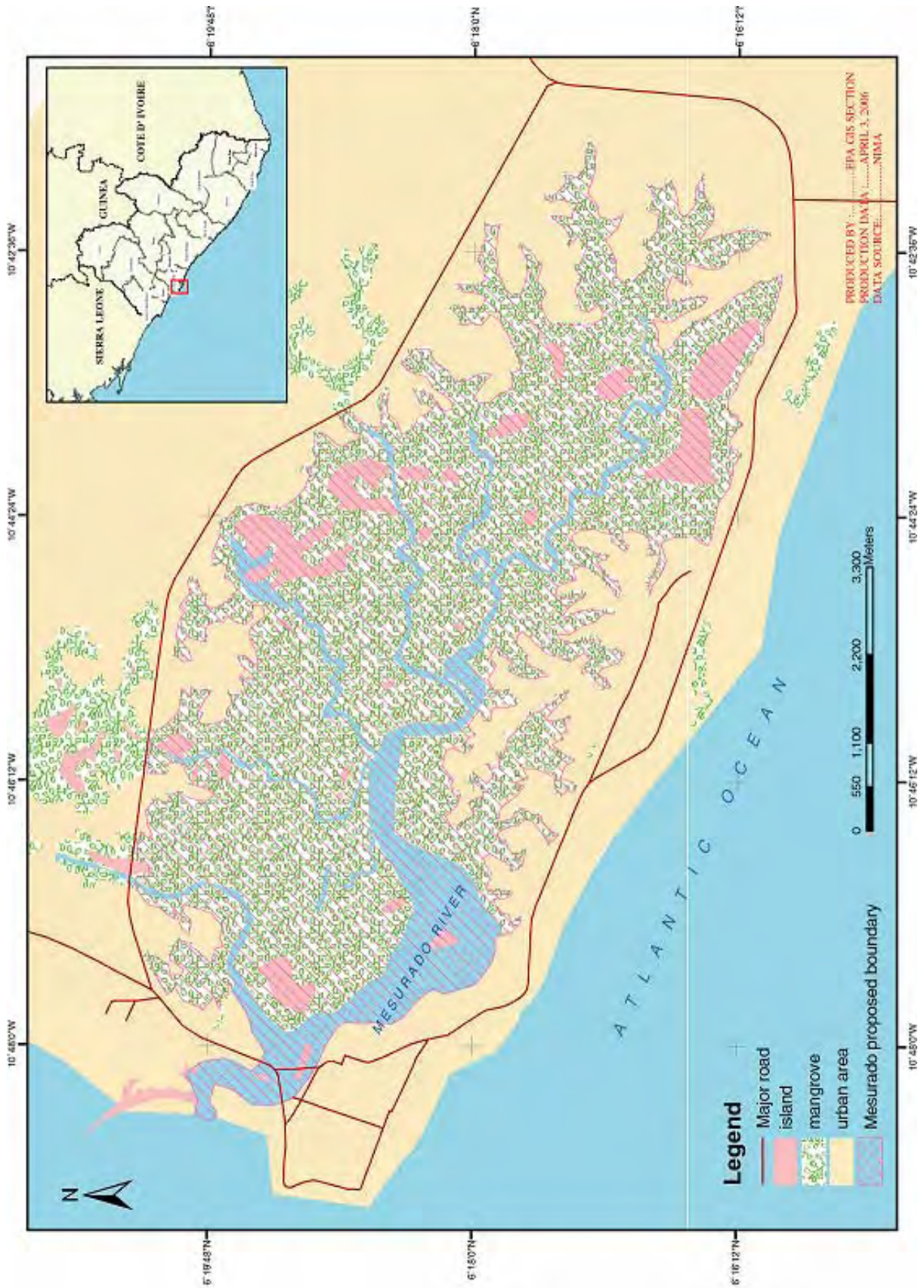


Figure 3.5-1 Mesurado Wetlands (Ramsar site (24/082/06), 6,760ha, 06°18'N 010°45'W, Located in the Capital City Monrovia and Montserrado County)

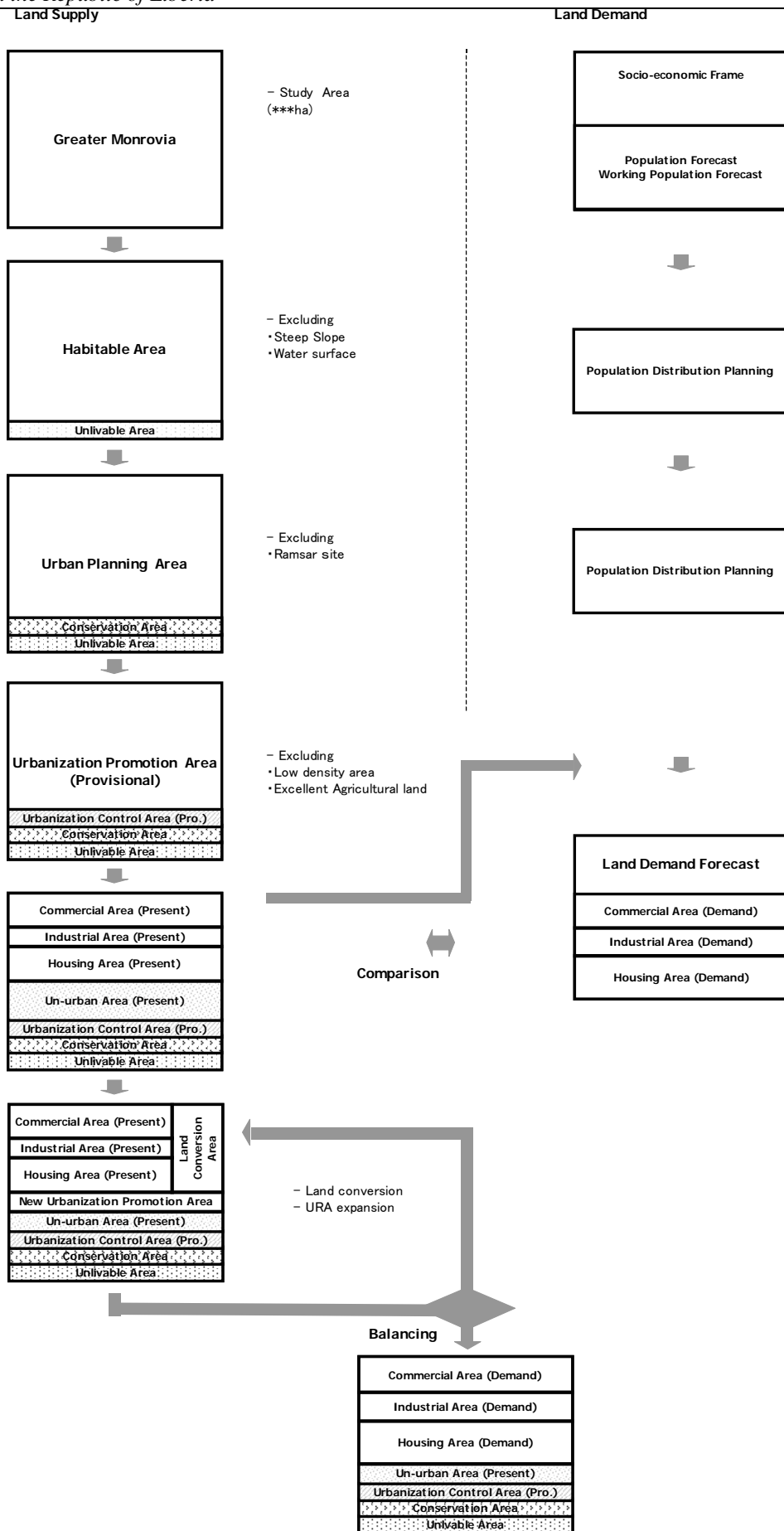


Figure 3.5-2 Land Use Zoning Procedure

3.5.2 Population Distribution by Potential Model

3.5.2.1 Development Pattern

Applying potential model in line with the multi-core urban structure, forecast population of Greater Monrovia was distributed.

3.5.2.2 Population Distribution Planning

(1) Working Population Distribution

Working population was distributed based on the land potential and industrial development in future.

- 1) Future primary working population was proportionally distributed to zones based on the present zonal primary working population
- 2) Future secondary working population was proportionally distributed to zones based on the future industrial area by zone
- 3) Future tertiary working population was distributed to zones based on the potential model with parameters of present tertiary working population and tertiary population growth rate by zone

(2) Population Distribution

Population was distributed based on the land potential.

3.5.3 Forecast of Land Use Demand and Urbanization Promotion Area in 2019

3.5.3.1 Forecast of Land Use Demand in 2019

Following method was adopted for land use demand forecast.

(1) Net demand for Residential Area

(a) Residential Area Demand in 2019 (Net) (AR(2019))

Total residential area in zone i by housing type j in 2019 (Net): AR_{ij}(2019)

Total residential area in zone i by housing type j in 2008 (Net): AR_{ij}(2008)

Population in zone i by housing type j in 2019: Pop_{ij}(2019)

Population in zone i by housing type j in 2008: Pop_{ij}(2008)

Population density in zone i by housing type j in 2019 (Net): PD_{ij}(2019)

$$AR(2019) = \sum \sum (Pop_{ij}(2019) / PD_{ij}(2019))$$

(b) Residential Area Demand in 2019 (Net) (AR(2019))

Total residential area in zone i by housing type j in 2008 (Net): AR_{ij}(2008)

Total area converted from housing type i to other land use j in zone i until 2019 (Net) : AR_{icij}(2019)

Total area converted from other land use j to housing type i in zone i until 2019 (Net) : AR_{icji}(2019)

$$AR(2019) = \sum \sum (AR_{ij}(2008) - AR_{icij}(2019) + AR_{icji}(2019))$$

(2) Net Demand for Commercial Area

(a) Total Commercial Area Demand in 2019 (Net) (AC(2019))

Total commercial area in zone i in 2019 (Net): AC_i(2019)

Total commercial area in zone i in 2008 (Net): AC_i(2008)

Tertiary working population at work place in zone i in 2019 (Net): $PW3i(2019)$

Tertiary working population at work place in zone i in 2008 (Net): $PW3i(2008)$

$AC(2019) = \sum ACi(2008) \times (PW3i(2019) / PW3i(2008))$

(b) Total Commercial Area Demand in 2019 (Net) (AC(2019))

Total commercial area in zone i in 2008 (Net): $ACi(2008)$

Total area converted from commercial area to other land use j in zone i until 2019 (Net): $ACicci(2019)$

Total area converted from other land use j to commercial area in zone i until 2019 (Net): $ACicjc(2019)$

$AC(2019) = \sum (ACi(2008) - ACicci(2019) + ACicjc(2019))$

3.5.3.2 Net Demand for Industrial Area

(1) Total Industrial Area Demand in 2019 (Net) (AI(2019))

Total industrial area in zone i in 2019 (Net): $AIi(2019)$

Total industrial area in zone i in 2008 (Net): $AIi(2008)$

Secondary working population at work place in zone i in 2019 (Net): $PW2i(2019)$

Secondary working population at work place in zone i in 2008 (Net): $PW2i(2008)$

$AI(2019) = \sum AIi(2008) \times (PW2i(2019) / PW2i(2008))$

(2) Total Industrial Area Demand in 2019 (Net)(AI(2019))

Total industrial area in zone i in 2008 (Net): $AIi(2008)$

Total area converted from industrial area to other land use j in zone i until 2019 (Net): $AIicij(2019)$

Total area converted from other land use j to industrial area in zone i until 2019 (Net): $AIicji(2019)$

$AI(2019) = \sum (AIi(2008) - AIicij(2019) + AIicji(2019))$

Table 3.5-2 Present Land Use and Future Land Use Demand in Greater Monrovia Area

2008 Present Land Use

Zone	Residential				Ind	Com	Total (Net)	Total (Net)/Hab. Area	Habitable Area	Ulivable Area	Total Area	
	Ext. Low Den.	Ext. High Den.	On-going (Low)	Total Res								
	(ha)	(ha)	(ha)	(ha)								
100	New Kru Town	213	46	1	260	14	26	301	72	416	97	513
200	Logan Town	171	33	0	204	21	29	254	52	489	135	624
300	Clara Town	54	8	90	152	3	24	179	79	225	17	242
400	West Point	26	0	0	26	2	5	33	63	53	0	53
500	Central Monrovia A	80	22	0	102	1	14	117	49	237	8	245
600	Central Monrovia B	63	5	0	68	0	12	80	40	199	13	212
700	Sinkor	120	55	0	175	10	15	200	67	298	21	319
800	Lakpazee	140	56	0	196	10	23	230	72	319	120	439
900	Old Road	216	60	0	276	0	28	304	68	450	102	552
1000	Congo Town	276	52	28	355	0	31	386	78	494	287	780
1100	Paynesville	1705	439	4111	6255	5	25	6284	86	7340	1751	9091
1200	Gardnersville	438	69	229	736	27	25	789	80	988	228	1216
1300	New Geogia	314	62	131	508	1	23	532	82	648	400	1048
1400	Barnersville	19	36	637	691	0	15	707	81	874	333	1207
1500	Johnsonville	37	0	160	197	0	10	208	10	2093	1097	3190
1600	Caldwell	6	2	725	733	0	7	740	55	1351	1644	2995
Total		3,878	945	6,112	10,935	94	312	11,344	69	16,473	6,253	22,726

2019 Estimated Land Use Demand

Zone	Residential					Ind	Com	Total (Net)	Habitable Area	Ulivable Area	Total Area	
	Low Density	Medium Density	High Density	On-going	Total Res							
	(ha)	(ha)	(ha)	(ha)	(ha)							
100	New Kru Town		141	119		260	14	26	301	416	97	513
200	Logan Town		75	107		182	50	23	254	489	135	624
300	Clara Town		54	73		127	3	48	179	225	17	242
400	West Point			26		26	1	9	33	53	0	53
500	Central Monrovia A			96		96	1	20	117	237	8	245
600	Central Monrovia B			61		61	0	22	80	199	13	212
700	Sinkor		74	83		157	11	32	200	298	21	319
800	Lakpazee	43	94	55		192	2	36	230	319	120	439
900	Old Road	104	96	60		261	1	43	304	450	102	552
1000	Congo Town	277	74			351	0	35	386	494	287	780
1100	Paynesville	2537	1513	450		4500	12	49	4,561	7340	1751	9091
1200	Gardnersville	294	292			586	48	31	665	988	228	1216
1300	New Geogia	207	200			407	1	27	435	648	400	1048
1400	Barnersville	434	132			566	2	19	587	874	333	1207
1500	Johnsonville	158				158	0	39	197	2093	1097	3190
1600	Caldwell	594				594	50	9	653	1351	1644	2995
Total		4,648	2,745	1,130		8,524	196	468	9,181	16,473	6,253	22,726

3.5.3.3 Forecast of Urbanization Promotion Area in 2019

(1) Urbanization Promotion Area in 2019 (UPA(2019))

Total commercial area demand in 2019 (Gross) = Total commercial area demand in 2019 (Net) (AC(2019)) / Composition rate of commercial area (Net)

Total industrial area demand in 2019 (Gross) = Total industrial area demand in 2019 (Net) (AC(2019)) / Composition rate of industrial area (Net)

Total residential area demand in 2019 (Gross) = Total residential area demand in 2019 (Net) (AC(2019)) / Composition rate of residential area (Net)

Urbanization Promotion Area in 2019 (UPA(2019)) = Total commercial area demand in 2019 (Gross) + Total industrial area demand in 2019 (Gross) + Total residential area demand in 2019 (Gross)

(2) Urbanization Promotion Area in 2019 (UPA(2019))

Urbanization Promotion Area in 2008: UPA(2008)

Land conversion from UPA to UCA up to 2019: UPAc(2019)

Land conversion from UCA to UPA up to 2019: UCAc(2019)

$$UPA(2019) = UPA(2008) - UPAc(2019) + UCAc(2019)$$

3.5.3.4 Density Standard

Applied density standards are shown below.

As for density of residential areas, the following gross and net density standards were applied referring to the densities of existing residential areas.

- 1) High density residential areas (mainly comprising of condominium houses): 150-250persons/ha (Gross) /300-500persons /ha (Net)
- 2) Medium density residential area: 130-150persons /ha (Gross) /200-300persons /ha (Net)
- 3) Low density residential area: 100-130persons /ha (Gross)/150-200persons/ha (Net)

Table 3.5-3 Population Density Standards by Housing Type

House Type	Plot size (sq.m)	House size (sq.m)	Maximum Plot Ratio	No. of Plots/Houses per ha (plots/houses/ha)	Ave. Household Size (persons/H.H.)	Gross Pop. Density (persons/ha)
Detached house type (1-2stories)	625	(25 x25)		10.4	6	62
	400	(20 x 20)		16.3	6	98
	300	(20 x 15)		21.7	6	130
Terrace house type (1-2sories)			100	25.5	6	153
			100	40.8	6	245
			100	36	6	216
Condominium house type (3-4stories)			100	51	6	306

Table 3.5-4 Standard Composition of Residential Area by Housing Type

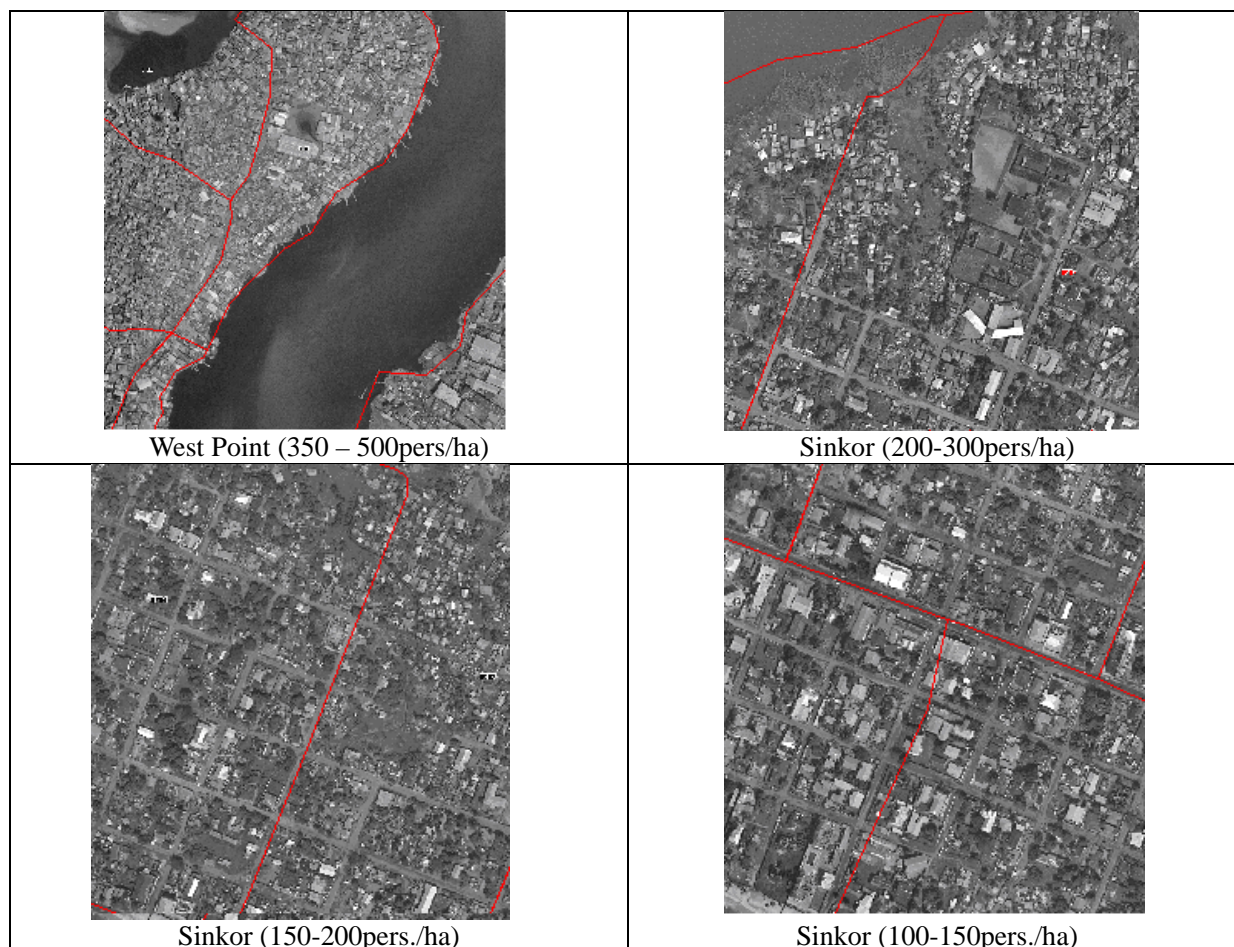
House Type	Housing	Other building	Green area	Transport	Total (%)
Detached house type (1-2stories)	60-75	4-7	4-10	17-22	100
Terrace house type (1-2sories)	15-55	10-11	13-16	23-25	100
Condominium house type (3-4stories)	40-50	12-15	15-19	24-27	100

Table 3.5-5 Gross Working Population Density of Industrial/Commercial Areas

	Pop. Density (Gross)	Pop. Density (Net)
Industrial	120-190 pers./ha	150-250 pers./ha
Commercial	430-980 pers./ha	650-1,500 pers./ha

Table 3.5-6 Standard Composition of Commercial/Industrial Areas

Land Use Type	Concerned	Other building	Green area	Transport	Total (%)
Industrial	70-80	4-7	4-10	10-15	100
Commercial	60-65	4-7	4-10	24-27	100



3.5.4 Land Use Zoning

3.5.4.1 Land Use Conversion Direction

- 1) The land use conversion was based on the assumption that the land use conversion pattern is determined by the solvency of the urban function (land use conversion pattern by solvency).
- 2) Following land use conversions were also taken into account.
 - Land use conversion at idle land where industrial activity was suspended to public land use
 - Restoration of wetland at the informal settlement in the swampy area
- 3) Public land shall be secured as illegally occupied public lands, and idle lands in the urban area. Legal frame for the expansion of public lands and control on building activities are prerequisites.

Table 3.5-7 Land Use Conversion Pattern in the Urbanized Area (land use conversion pattern by solvency)

From \ To	CBD	Commercial	Light industry	Heavy industry	High density residential	Low density residential	Public use
CBD	○						
Commercial	○	○					
Light industry	○	○	○		○	○	
Heavy industry				○	○	○	
High density residential		○	○		○		
Low density residential		○			○	○	
Public use							

3.5.4.2 Land Use Zoning Principles

- 1) Land use zoning was designed to purify the land use for effectiveness of urban functions and enhancement of urban environment.
- 2) Designation of mixed land use area was not excluded in the zoning system in consideration of rational land use conversion entailing to the evolution of Greater Monrovia Area.
- 3) Land use zoning in this Study complies with the distribution of urban functions based on the solvency of urban functions and characteristics of the land.
- 4) Present land use and urbanization were reflected in the zoning system.
- 5) Land use conversion was designed also taking account of economic solvency of urban functions.
- 6) Zoning system respected zoning system stipulated in Zoning Act that came into effect in 1958. (Zoning map based on the Zoning Act was prepared but lost during the civil conflict.)
- 7) Regardless of Ramsar site designation Peace Island and Pagos Island shall locate within UPA.
- 8) Industrial exclusive zone was proposed in this Study for strategic land use to restrict private activities.

Table 3.5-8 Zonings in This Study

Zoning in this Study	Zoning in Zoning Act
a) Low density housing area	R1 District: Low density housing area R2 District: Low density housing area
b) Medium density housing area	R3 District: Medium density housing area
c) High density housing area	R4 District: High density housing area
d) High density commercial and business	B1 District: High density commerce, general business, and the retail sale of commodities area
e) Commercial	B2 District: Low density commerce, general business, and the retail sale of commodities
f) Mixed use	B3 District: Commerce and light manufacturing processing area
g) Light industrial	M1 District: Light industry area
h) Exclusive industrial	-

It should be noted that zoning system shown above is essential condition but not sufficient condition for realization of land use plan. Other legislation controlling development and construction would be necessary, for instance detailed land use zoning for conservation of historic area or excellent agricultural land. Also scheme for the urban development and redevelopment method would be necessary for the improvement of infrastructure and realization of future land use plan together with zoning system. For instance the seemingly arbitrary road network development in the periphery shall be rearranged by new project implementation scheme.

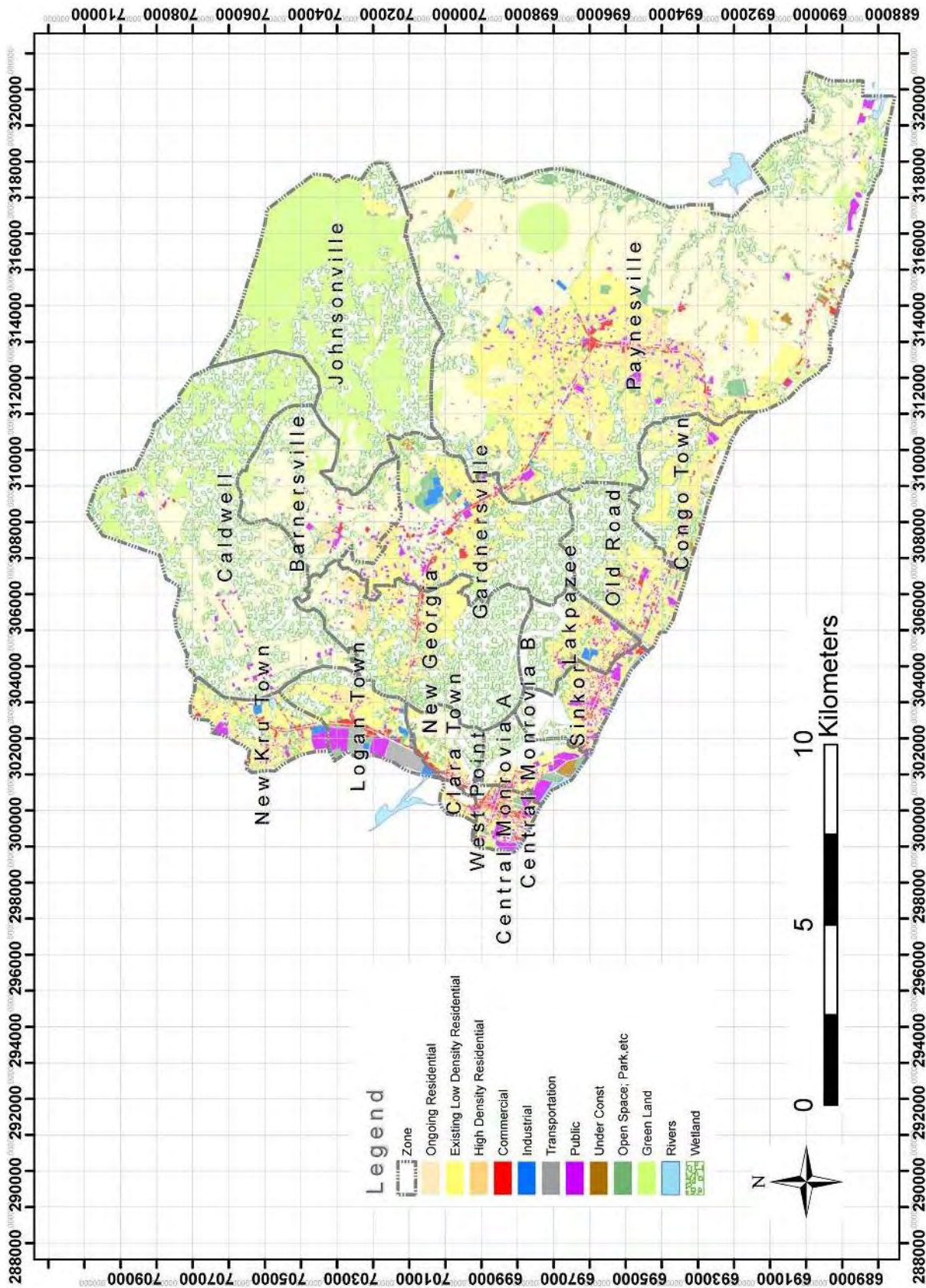


Figure 3.5-3 Present Land Use (2009)

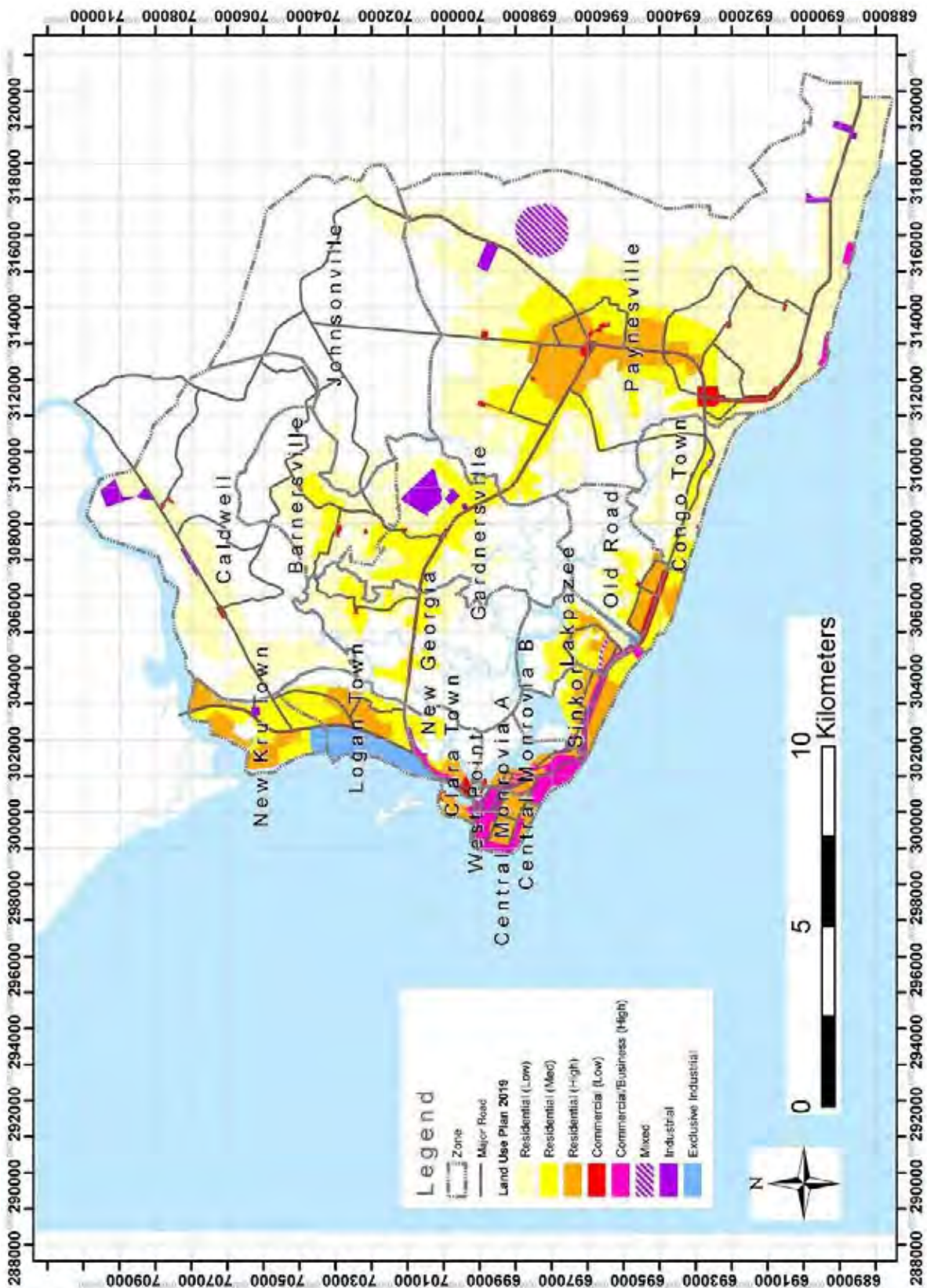


Figure 3.5-4 Proposed Land Use Zoning (2019)