MINISTRY OF PUBLIC WORKS
THE REPUBLIC OF LIBERIA

No.

THE MASTER PLAN STUDY ON URBAN FACILITIES RESTORATION AND IMPROVEMENT IN MONROVIA IN THE REPUBLIC OF LIBERIA

FINAL REPORT EXECUTIVE SUMMARY

November 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.
KATAHIRA & ENGINEERS INTERNATIONAL

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Exchange Rates:
LRD 1.00=USD 0.014
USD 1.00 = JPY 93.13
(As of September 2009)

PREFACE

In response to a request from the Government of the Republic of Liberia, the Government of Japan decided to conduct a Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Masatsugu Komiya of Yachiyo Engineering Co, Ltd. between November 2008 and October 2009.

The team held discussions with the officials concerned of the Government of the Republic of Liberia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Liberia for their close cooperation extended to the study.

November 2009

Toshiyuki KUROYANAGI,
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

November 2009

Mr. Toshiyuki KUROYANAGI,
Director General
Economic Infrastructure Department
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you the final report of the Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia in the Republic of Liberia. The report contains a Master Plan for urban facilities restoration and improvement for Greater Monrovia targeting the year of 2019, encompassing future vision of Greater Monrovia with associated land use plan as well as plans for road and transportation sector, water supply sector, sanitation sector, and storm water drainage sector, taking into account the advices and suggestions of your Agency. Also included are comments made by Ministry of Public Works and other relevant organizations.

As a result of the 14-year civil conflict in the Republic of Liberia and the incoming population to Greater Monrovia, urban facilities of Greater Monrovia require urgent restoration and improvement through coordinated effort by relevant organizations in various sectors. We proposed profiles of short and medium term projects for road and transportation sector, water supply sector, sanitation sector, and storm water drainage sector, based on future vision, urban structure, land use, and allocation function of Greater Monrovia. Also included in the Master Plan are recommended institutional measures, project implementation plans, and operation and maintenance plans for each sector. It is expected that the institutional strengthening and appropriate operation and maintenance will enhance the effective and efficient restoration and improvement of urban facilities in Greater Monrovia.

In view of the urgent restoration and improvement of urban facilities in Greater Monrovia, we recommended that Government of the Republic of Liberia implements urgently the plans and projects for the concerned sectors proposed in the report.

We wish to take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to the Ministry of Public Works and other relevant organizations for close cooperation and assistance extended to us during our investigation and study.

Very truly yours,

Masatsugu Komiya
Team Leader
The Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia in the Republic of Liberia

Location Map of Greater Monrovia and Republic of Liberia

SUMMARY

Background of the Study

The 14 years of civil strife in Liberia caused major damage to much of the country's infrastructure centered around the capital Monrovia, including trunk roads across the nation, urban roads in Monrovia, power generation and distribution facilities, water supply facilities and so on. Moreover, even the facilities that were not greatly damaged became deteriorated due to lack of maintenance. Accordingly, the country faces an urgent need to restore and reconstruct basic infrastructure facilities. It will be necessary to compile short-term and medium-term restoration and improvement plans and invest comprehensive, efficient and planned resources based on a future vision and strategy.

In this context the Government of Liberia submitted a request for the Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia in the Republic of Liberia to the Government of Japan in November 2007. In response to this, the Government of Japan implemented the preliminary study in June 2008, during which the necessity of the Master Plan for Recovery and Reconstruction of Urban Facilities in Monrovia was confirmed, the S/W was signed for the implementation of the Study.

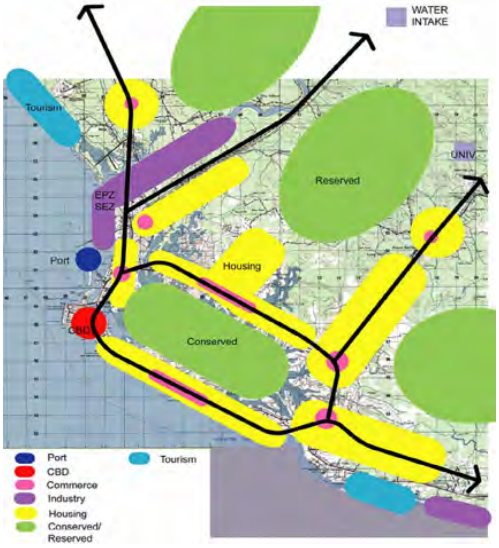
Objectives of the Study

1) Formulate Master Plan for Restoration and Improvement of urban facilities in Greater Monrovia, and Implementation Plan on construction of public road, water supply, sewerage and sanitation and storm water drainage facilities.
2) Transfer technology for formulating Development Plans to the counterpart agencies through conducting the Study.

Socio-economic Framework

		2008	2019
Population	Current Population (2009)	1,010,575	
	Natural Growth (2008-2019)		230,730
	Social Growth (2008-2019)		228,695
	Future Population (2019)		1,470,000
Sectoral Working Population	Primary	7,280	4,369
	Secondary	31,154	55,904
	Tertiary	209,881	376,619
Unemployment Rate (%)		17	8
Annual Rate per Capital of GDP Growth Rate (%) (2009-2019)			10
Car Ownership (vehicles/1,000 persons)		11	25-50

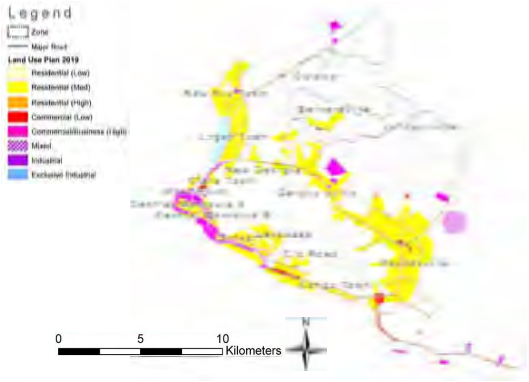
Future Urban Structure (Multi-core urban corridor pattern)



Land Use

		2008		2019	
		(ha)	(%)	(ha)	(%)
Residents	On-going	7,790	55%	-	-
	Low density	4,958	35%	5,958	47%
	Medium density	-	-	3,966	32%
	High density	945	7%	1,679	13%
Commercial		471	3%	702	6%
Industry		119	1%	245	2%
Total		14,283	100%	12,550	100%

Note: Land use for 2019 is only for UPM.



Strategy of Master Plan Formulation

(1). Restoration & Improvement Plan based on the Required Development
(2). Formulation of Packaged Projects based on the Restoration & Improvement Needs
(3). Infrastructural Development Project at Community Level
(4). Resident Protection in an Urbanization Controlled Area (UCA)
(5). Management of Time Schedule for Improvement Relevant Projects (Storm Water Drainage & Road, Water Supply & Sewerage)

Development Goal

Sector	Status	Goal
Urban Development	Expansion of a city area	Efficient infrastructure improvement in a densely populated area (population density in an urbanization zone 227per/ha)
Road / Traffic	Insufficient quality and quantity of road network system (primary : 12%, secondary : 4%, district road : 9%)	Rate (100%) of road development (primary, secondary, district road)
Water Supply	There are lots of dwellers who rely on water venders and water service coverage ratio is low (37%)	Water service ratio (100%) by utilizing river and groundwater for the target year of 2019
Sewage and Sanitation	The access ratio of a sewer and sanitary facilities is as low as 35%with the exception of public toiles (Based on MDG)	Access ratio (68%) to sanitation with the exception of public toiltes (Based on MDG of 2019)
Storm Water Drainage	Inundation and overflow of waste water occur at the time of flood. There are the damaged manholes and channels and some of them are missing.	Restoration of storm water drainage in Central Monrovia (open channels, the buried pipes and manholes)

Master Plan for Restoration and Improvement of Urban Facilities in Greater Monrovia

(Unit：mln USD)

Sector/Projects			Contents	Cost	Year	
					2009-2014	2015-2019
Estimated Cost for Road and Transport						
	TR-0	Emergency Infrastructure Project (MPW, LRTF, on-going)	The on-going Project being implemented by the Ministry of Public Works and World Bank utilizing the Liberia Reconstruction Trust Fund by multilateral cooperation	18.60	18.60	0.00
	TR-1	Johnson Street Bridge Improvement Project (Undecided)	• Bridge length: 450 m, bridge width: 12.2m (Gabriel Tucker Bridge) • Approach Road: 400 m • Road widening from 2-lane road to 4-lane road	24.00	24.00	0.00
	TR-2	Somalia Drive Reconstruction Project (Undecided)	• Road length: 13 km • Road width: 23-27.5m • Improvement of stockton and Double bridges • Improvement of major intersections • Road widening from 2-lane road to 4-lane road	21.10	21.10	0.00
	TR-3	Reconstruction of Bridges on Missing Link (Undecided)	• 11 bridges on Missing link, total length: 305m • Bridge width: 5.5-7.0m • Improvement of approach road	10.64	10.64	0.00
	TR-4	Road Rehabilitation Project (Undecided)	• Urban primary road: 60km • Urban secondary road: 105km • Thertiary road: 200km	48.28	14.48	33.79
	TR-5	Intersection Improvement Project (Undecided)	• 28 intersections • Improvement of geometry design • Installation of tyraffic signal • ELWA junction is on-going by assistance of World Bank	5.30	1.33	3.98
	TR-6	Bus Terminal & Bus Stop Facilities Construction Project (Undecided)	• Five (5) transit terminal new construction • 140 bus stop renovation and installation	6.80	1.70	5.10
	TR-7	Traffic Safe Management Project (Undecided)	• Technical transfer program • Pilot project for traffic control and safety	2.00	0.20	1.80
	TR-8	Vai Town Bridge Reconstruction (WB, Grant, on-going)	• Bridgh length240m • Reconstruction of collapsed Vai Town Bridge • Improvement of approach road and Vai Town intersection	15.00	15.00	0.00
	TR-9	Rehabilitation of Monrovia City Streets Project (WB, Grant, on-going)	• Rehabilitation of 23 streets in Monrovia CBD • On-going by assistance of World Bank	17.60	17.60	0.00
	TR-10	Caldwell Bridge Construction Project (WB, Grant, on-going)	• Bridgh Length: 110m, Number of Lanes: 4 Lanes • On-going by assistance of World Bank	7.00	7.00	0.00
	Estimated Cost for Projects Proposed in this M/P			**118.12**	**73.45**	**44.67**
	Total Estimated Cost for Road and Transport			**176.32**	**131.65**	**44.67**
Estimated Cost for Water Supply						
	WS-1	Monrovia Water and Sanitation Rehabilitation Program (Ongoing)	• Rehabilitation of the White Plains treatment plant (intake pump, treatment plant, booster pump station, rising&distribution pipelines and service resrvoirs), (Production capacity：16MGD, Beneficiaries：750,000)	38.50	38.50	0.00
	WS-2	Monrovia Expansion and Rehabilitation of Three County Capitals (Ongoing)	• Development of satellite water supply system in north part of Paynesville zone (Beneficiaries：About 70,000)	19.24	19.24	0.00
	WS-3	Project for Emergency Development of Water Supply System at Paynesville in Greater Monrovia (PEDW)	• Development of satellite water supply system in south part of Paynesville zone (Beneficiaries：About 60,000)	16.60	16.60	0.00
	WS-4	Expansion Project of White Plains Water Supply System (EPWS) (Undecided)	• Expansion of the White Plains water supply system (treatment plant, rising&distribution pipelines and service reservoirs), (Max. total production capacity: 32MGD, Beneficiaries：1.1mln)	128.63	34.18	94.45
		Expansion of Treatment Plant Phase I	• Expansion of the White Plains treatment plant (Max. total production capacity: 24MGD)	15.93	10.60	5.33
		Expansion of Treatment Plant Phase II	• Expansion of the White Plains treatment plant (Max. total production capacity: 32MGD)	23.34	0.00	23.34
		Expansion of Rising Main Line	• Expansion of rising pipelines (Capacity: 26MGD)	33.96	13.58	20.38
		Expansion of Distribution Main Line	• Expansion of distribution main pipelines (distribution maine to be expanded of 215km out of total network pipelines of about 415km)	40.44	0.00	40.44
		Service Reservoir Installation	• Expansion of 13 service reservoirs (Capacity: 800-8,500m3)	14.96	10.00	4.96
	WS-5	Project for Expansion of Water Supply System at Paynesville in Greater Monrovia (PEWS) Phase II (Undecided)	• Development of satellite water supply system in Paynesville zone (Beneficiaries：About 100,000)	22.87	13.51	9.36
	WS-6	Technical Cooperation Project of Groundwater Management	• Technical transfer of Groundwater monitoring and water quality controll management	0.32	0.32	0.00
	WS-7	Technical Cooperation Pproject of Non-Revenue Water (Undecided)	• Technical transfer of non-revenue reduction measures	1.50	1.50	0.00
	Estimated Cost for Projects Proposed in this M/P			**169.92**	**66.11**	**103.81**
	Total Estimated Cost for Water Supply			**227.66**	**123.85**	**103.81**
Estimated Cost for Sewer						
	SN-1	Monrovia Water and Sanitation Rehabilitation Program (WSRP)(Ongoing)	Immediate Rehabilitation of the Sewage Treatment Plant (Restoration on Stabilization Pond, Construction of 11 public Toilets and Procurement of one Vacuum Track)	15.00	15.00	0.00
	SN-2	Urban Infrastructure Construction and Rehabilitation of Monrovia Sewerage Network Pumping Stations (WB, ongoing)	De-sludge and cleaning the blocked sewer pipelines in Central Monrovia to Sinkor area and rehabilitation of pumping stations (4 Nos.) and lifting stations (5 Nos.) in off-site Sewage pipelines for Central Monrovia	4.80	4.80	0.00
	SN-3	Community Sanitary System and Public Toilet Installation & Vacuum Truck Procurement Plan for 2014 (Undecided)	Installation and procurement: ・66 community sanitation systems and 225 public toilets ・8 vacuum trucks	18.11	18.11	0.00
	SN-4	Project for Reconstruction of Sewerage Treatment & Sludge Treatment Plant (Undecided)	・Reconstruction of the sewage treatment plant of 6MG/day (22,700m3/day) ・Construction of sludge treatment plant of 230 m3/day	74.20	0.00	74.20
	SN-5	Community Sanitary System and Public Toilet Installation & Vacuum Truck Procurement Plan for 2019 (Undecided)	Installation and procurement: ・93 community sanitation systems and 86 public toilets ・7 vacuum trucks	23.38	0.00	23.38
	Estimated Cost for Projects Proposed in this M/P			**115.69**	**18.11**	**97.58**
	Total Estimated Cost for Sewer			**135.49**	**37.91**	**97.58**

The projects higlited in grey color were proposed by JICA study team.

(Unit：mln USD)

Sector/Projects			Contents	Cost	Year	
					2009-2014	2015-2019
Estimated Cost for Storm Water Drainage						
	SW-1	Improvement of Drainage System in Monrovia Core Area (Undecided)	In Bushrod Island, Central Monrovia, Sinkor zones 1. Restoration of storm water drainage system (Drainage pipes：about 27km, grating：970places, manholes：1,700places)	12.26	12.26	0.00
		Drainage System Imrpvoement (Central Monrovia)	・Development and restoration of drainage pipes: about 19km, Grating: 669places, Manholes: 1,173places ・Restoration of open channel: about 1.5km	1.62	1.62	0.00
		Drainage System Improvement (Sinkor)	・Development and restoration of drainage pipes: about 5km, Grating: 185places, Manholes: 323places ・Restoration of open channel: about 9.3km	3.97	3.97	0.00
		Drainage System Imrpvoement (Bushrod Island)	・Development and restoration of drainage pipes: about 3km, Grating: 116places, Manholes: 204places ・Restoration of open channel: about 6.7km	3.07	3.07	0.00
		(Admin, ES, Contingency, etc.)	・Administarative, engineering & supervision, contingency, etc.	3.60	3.60	0.00
	SW-2	Equipment Supply for Drainage Pipes Cleaning (Undecided)	Procurement of mainatenance equipments for storm water drainage	1.33	1.33	0.00
		Procurement of Equipment	・Water jet cleaner, vacuum cleaner (lift type), water tank, sludge hauling dump truck, truck for equipment transport of 4tons	0.93	0.93	0.00
		(Admin, ES, Contingency, etc.)	・Administarative, engineering & supervision, contingency, etc.	0.40	0.40	0.00
	SW-3	Technical Cooperation Programme (Undecided)	Capacity building on operation and maintenance system	0.28	0.28	0.00
	Estimated Cost for Projects Proposed in this M/P			**13.86**	**13.86**	**0.00**
	Total Estimated Cost for Storm Water Drainage			**27.45**	**27.45**	**0.00**
Estimated Cost for Community Infrastructure Improvement						
	CM-1	Community Infrastructure Improvement Project (Undecided)	Community Infrastructure Improvement Project	27.79	**11.08**	**16.71**
		Road Rehabilitation	Road Restoration	16.09	4.83	11.26
		Water Supply	Development of Satellite Sysytem Water Supply	4.69	2.77	1.92
		Community Sanitary System and Public Toilet Installation & Vacuum Truck Procurement	Improvement of communal sanitation system, public toilet installation and vacuum truck procurement	7.01	3.49	3.52
	Estimate Estimated Cost for All Projects Proposed in this M/P			**445.38**	**182.62**	**262.76**
	Total Est Total Estimated Cost for All Sectors			**594.71**	**331.95**	**262.76**

The projects higlited in grey color were proposed by JICA study team.

Pilot Project of Public Tap Construction (Satellite Water Supply System)

1) Scope of Project

The public taps for 1,000 persons of an MTA community was planned and built. (Max. daily water supply : 41m^3/day)

2) Project Contents

・ Well（Depth : 73m）drilling
・ Submersible pump installation (90liter/min. x 55m x 2.2kW)
・ Generator installation (12.5kVA)
・ Elevated tank installation (Capacity : 7.5m^3)
・ Distribution pipe laying (PVC&GS, pipe length : about 900m)
・Kiosk installation (5 places)

3) Construction

JICA Study Team contracted with Bezaleel & Turnkey (Local Construction Contractor). Construction started in March, 2009 on a sub-contract basis by the JICA Study Team and was completed in October, 2009.

Recommendation

1) Authorize the Master Plan formulated in this study for incorporation in national/regional development plan
2) Timely implement feasibility studies
3) Examine the private funding, new tax regulation, cost sharing by beneficiaries and community activities in order to secure the investment resources
4) Involve local labor-based construction for increasing employment opportunity
5) Adequately maintain the facilities for sustainability
6) Promote local construction industries for improving local contractors
7) Adjust the plan in response to the situation change
8) Conduct social and environmental assessments smoothly
9) Authorize land use zoning map
10) Designate the detail boundary of Ramsar Site convention
11) Enhance capacity of relevant organization
12) Approve preferential treatment in taxation for the construction equipments & materials to be provided from abroad
13) Examine the tax regulation of preferential treatment for the equipments & materials to be provided from abroad
14) Formulate communal development plan
15) Cooperate with central or local government for implementing communal development plan
16) Promote communal participation for the project led by central or local government

The Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia in the Republic of Liberia

Final Report Executive Summary

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ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	Asphalt Concrete
AfDB	African Development Bank
AIDP	Agriculture and Infrastructure Development Project
BOD	Biochemical Oxygen Demand
BPR	Bureau of Public Roads
BRP	Bureau of Regional Planning
BSC	Bachelor of Science
BST	Bituminous Surface Treatment
CC	Cement Concrete
CBD	Central Business District
CBR	Community-Based Recovery
CDA	County Development Agenda
CL	Cordon Line
COD	Chemical Oxygen Demand
CWIQ	Core Welfare Indicators Questionnaire
DCC	District Development Committee
DFID	UK Department for International Development
EA	Enumeration Area
EC	European Commission
EIA	Environmental Impact Assessment
EIP	Emergency Infrastructure Project
EIPSC	Emergency Infrastructure Project Supplementary Component
EIS	Environmental Impact Statement
EMP	Environment Management Plan
EPA	Environmental Protection Agency
EPWS	Expansion Project of White Plains Water Supply System
ERTC	Expansion and Rehabilitation of Three County Capitals
EU	European Unions
FAO	Food and Agriculture Organization
FDA	Forestry Development Authority
GAA	German Agro Action
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
GM	Greater Monrovia
GNI	Gross National Income
GoL	Government of Liberia
GoJ	Government of Japan
GTZ	Deutsche Gesellschaft fur Technical Zusammenarbeit GmbH
HCPI	Harmonized Consumer Price Index
HIS	Household Interview Survey
IDA	International Development Association
IEE	Initial Environment Examine
IT/R	Interim Report
JICA	Japan International Cooperation Agency
LDAA	Liberia Domestic Airports Agency
LDHS	Liberia Demographic and Health Survey
LHS	Liberian Hydrological Services
LCIP	Liberia Community Infrastructure Program
LIRP	Liberia Infrastructure Rehabilitation Project
LISGIS	Liberia Institute for Statistics and GeoInformation Services
LNP	Liberia National Police
LPRC	Liberia Petroleum Refining Company
LRTF	Liberia Reconstruction Trust Fund
LWSC	Liberia Water and Sewer Corporation

MCC	Monrovia City Corporation
MFA	Ministry of Foreign Affairs
MIA	Ministry of Internal Affairs
MoF	Ministry of Finance
MLME	Ministry of Lands, Mines and Energy
MoT	Ministry of Transport
M/P	Master Plan
MPEA	Ministry of Planning and Economic Affairs
MPW	Ministry of Public Works
MSC	Master of Science
MTA	Monrovia Transit Authority
NECOLIB	National Environmental Commission of Liberia
NHA	National Housing Authority
NGO	Non Govermental Organization
NPA	National Port Authority
NTA	National Transit Authority
NTPS	National Transportation Policy and Strategy
O & M	Operation and Maintenance
OD	Origin-destination
OJT	On the Job Training
PAPs	Project Affected Persons
PFMU	Project Financial Management Unit
PEDWW	Project for Emergency Development of Water Supply System at Paynesville in Greater Monrovia
PEMU	Project Financial Management Unit
PPP	Public-Private Partnership
PRS	Poverty Reduction Strategy
PS	Pump Station
RIA	Roberts International Airport
RIAA	Roberts International Airport Agency
RMTC	Road Maintenance Training Center
ROW	Right of Way
PCU	Passenger Car Unit
PSU	Primary Sampling Unit
PT	Person Trip
SC	Steering Committee
SCL	Screen Line
SEZ	Special Economic Zone
SIU	Special Implementation Unit
SOE	State-Owned Enterprise
SPM	Suspended Particulate Matter
S/W	Scope of Work
TC	Traffic Count
TFLIB = LRTF	Trust Fund for Liberia
TP	Total Point
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Found
UNHCR	United Nations High Commissioner for Refugees
UNMIL	United Nations Mission in Liberia
UPA	Urbanization Promotion Area
URSP	Urban Rehabilitation and Sanitation Project
USAID	U.S. Agency for International Development
UTM	Universal Transverse Mercator Projection
VAT	Value Added Tax
VCR	Volume to Capacity Ratio
VES	Vertical Electric Sounding
WB	World Bank

WG	Working Group
WHO	World Health Organization
WMO	World Meteorological Organization
WSRP	Water and Sanitation Rehabilitation Program
WTP	Water Treatment Plant

UNIT

℃	Degree Celsius
bln	billion
ft	Feet
Gal	Gallon
Hrs	Hour
ha	Hectare
kg/cm^2	Kilogram per square meter
km	Kilometer
km/h	Kilometer per Hour
L/min	Liter per minute
L/sec	Liter per second
LRD	Liberian dollar
m	Meter
mb	Millibar
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligram per liter
mln	million
min	Minute
mm	Millimeter
m^2	Square meter
m^3	Cubic meter
m^3/d	Cubic meter per day
m^3/sec	Cubic meter per second
mS/m	Milli-Siemens/meter
PCU	Passenger Car Unit
per/ha	Persons hectare
No(s).	Number(s)
NTU	Nephelometric Turbidity Units
Sq.m.	Square meter
Ohm-m	Ohm-meter
%	Percent
USD	U.S. (United States) Dollar

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The 14 years of civil strife in Liberia caused major damage to much of the country's infrastructure centered around the capital Monrovia, including trunk roads across the nation, urban roads in Monrovia, power generation and distribution facilities, water supply facilities and so on. Moreover, even the facilities that were not greatly damaged became deteriorated due to lack of maintenance. Accordingly, the country faces an urgent need to restore and reconstruct basic infrastructure facilities. It will be necessary to compile short-term and medium-term restoration and improvement plans and invest comprehensive, efficient and planned resources based on a future vision and strategy.

In this context the Government of Liberia submitted a request for the Master Plan Study on Urban Facilities Restoration and Improvement in Monrovia in the Republic of Liberia to the Government of Japan in November 2007. In response to this, the Government of Japan implemented the preliminary study in June 2008, during which the necessity of the Master Plan for Recovery and Reconstruction of Urban Facilities in Monrovia was confirmed, the S/W was signed for the implementation of the Study.

1.2 Objectives of the Study

1) To compile a master plan for recovery and reconstruction of urban facilities in Greater Monrovia, and to compile a project implementation plan targeting roads, public water supply, sewerage and sanitation and storm water drainage facilities.
2) Through implementation of the Study, to implement the transfer of technology for compilation of development plans among the counterpart agencies

1.3 Study Area

The Study area is Greater Monrovia comprising the city of Monrovia, its neighbors, Paynesville and Johnsonville.

1.4 Scope of Works

Urban Facilities Restoration and Improvement Master Plan is comprised of following sectors.

- Road Sector (restoration plan targeted at 2014 and a reconstruction plan targeted at 2019)
- Water Supply Sector (restoration plan targeted at 2014 and a reconstruction plan targeted at 2019)
- Sanitation Sector (restoration plan targeted at 2014 and 2019)
- Storm Water Drainage Sector (restoration plan targeted at 2014)

(1) Phase I

[1-1] Collection, Organization and Review of Relevant Documents and Information
[1-2] Review on Approach, Contents and Methodology of Study Implementation and Preparation of Inception Report
[1-3] Establishment of Study Organization and Discussion on Inception Report
[1-4] Collection and Review of Information
[1-5] Comprehension of Issue
[1-6] Formulation of Future Vision and Approach to Urban Restoration and Improvement (Target Year 2014 and 2019)
[1-7] Setting of Socio- Economic Frame
[1-8] Formulation of Land Use Plan
[1-9] Implementation of Survey on Actual Circumstances
[1-10] Analysis on Actual Traffic Conditions
[1-11] Implementation of an Exploratory Well as a Producing Well (Construction Supervision)
[1-12] Preparation of and Discussion on Interim Report

[1-13] Briefing, Discussion and Holding Seminar on Interim Report

(2) Phase II

[2-1] Formulation of Restoration and Improvement Plan for Road Sector
[2-2] Formulation of Restoration and Improvement Plan for Water Supply Sector
[2-3] Formulation of Restoration Plan for Sewage Sector
[2-4] Formulation of Restoration Plan for Storm Water Drainage Sector
[2-5] Economic and Financial Analysis
[2-6] Formulation of Comprehensive Master Plan Urban Facility on Restoration and Improvement
[2-7] Implement of Survey on Socio-Economic Impact Assessment (IEE Level)
[2-8] Formulation of Operation and Maintenance Management Plan
[2-9] Conclusions and Recommendations
[2-10] Preparation, Discussion, and Holding Seminar on Draft Final Report
[2-11] Preparation and Submission of Final Report

(3) Phase III (Supplement Survey)

[3-1] Groundwater Development Survey for the Project for Emergency Development of Water Supply System at Paynesville
[3-2] Monitoring of Operation and Maintenance of Common Water Tap
[3-3] Environmental Survey for Road Project

1.5 Study Organization

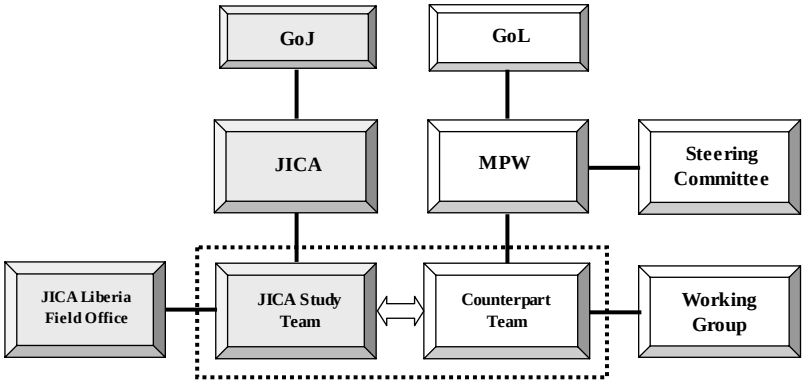

Figure 1.1 Study Organizations

[Steering Committee]

Chair:	Ministry of Public Works (MPW)
Vice Chair:	Ministry of Planning and Economic Affaires (MPEA)
Members:	Ministry of Foreign Affaires (MFA)
	Ministry of Transport (MoT)
	Ministry of Land, Mines and Energy (MLME)
	Monrovia City Corporation (MCC)
	Liberia Water and Sewer Corporation (LWSC)

[Working Group]

Ministry of Public Works (MPW)
Ministry of Planning and Economic Affaires (MPEA)
Ministry of Foreign Affaires (MFA)
Ministry of Transport (MoT)
Ministry of Land, Mines and Energy (MLME)
Monrovia City Corporation (MCC)
Liberia Water and Sewer Corporation (LWSC)

[JICA Study Team]

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1.6 Study Schedule

The Study commenced in November 2008 and is to be completed in November 2009. Additional study will be completed in February 2010

1.7 Main Meetings and Mini Workshops

1) Steering Committee Meeting

No.1	1st SC meeting	(11 Dec. 2008)
No.2	2nd SC meeting	(26 Mar. 2009)
No.3	3rd SC meeting	(28 Apr. 2009)
No.4	4th SC meeting	(28 Sep. 2009)

2) WG Meeting

No.1	1st WG meeting	(17 Dec. 2008)
No.2	2nd WG meeting	(30 Dec. 2008)
No.3	3rd WG meeting	(21 Jan. 2009)
No.4	4th WG meeting	(13 Feb. 2009)
No.5	5th WG meeting	(10 Mar. 2009)
No.6	6th WG meeting	(16 Apr. 2009)
No.7	7th WG meeting	(4 Jun. 2009)
No.8	8th WG meeting	(14 and 15 Jul. 2009)
No.9	9th WG meeting	(31 Aug. 2009)

3) Mini Workshop

No.1	1st Mini Workshop	(29 Jan. 2009)
No.2	2nd Mini Workshop	(3 Mar. 2009)
No.3	3rd Mini Workshop	(30 Mar. 2009)
No.4	4th Mini Workshop	(13 May 2009)
No.5	5th Mini Workshop	(29 Jun. 2009)
No.6	6th Mini Workshop	(10 Jul. 2009)
No.7	7th Mini Workshop	(10 Aug. 2009)

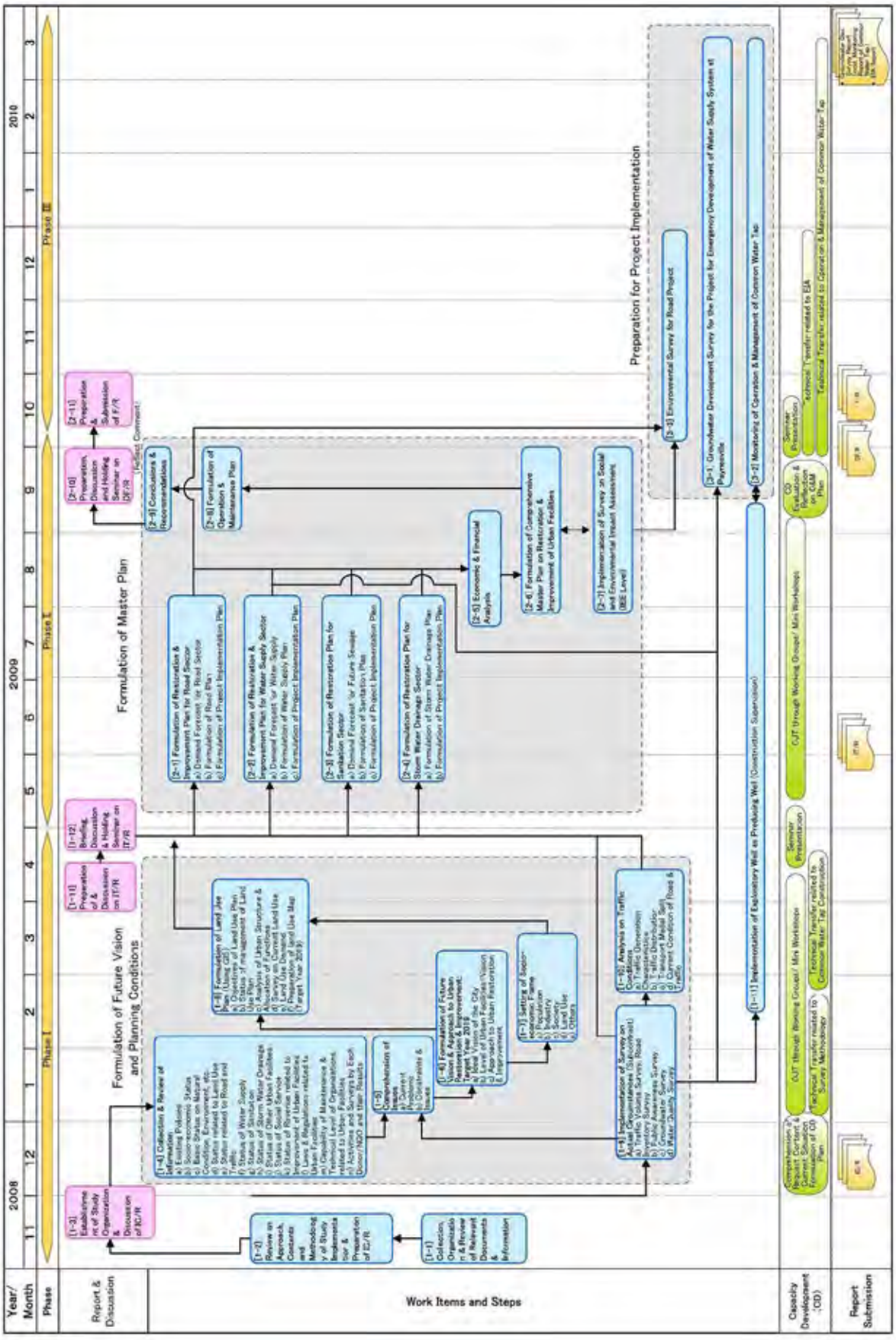


Figure 1.2 Study Flowchart

CHAPTER 2 PRESENT CONDITION AND ISSUES OF THE STUDY AREA

2.1 Natural Condition

(1) Temperature and Rainfall

Situated south of the Tropic of Cancer extremely close to the Equator, Liberia has very high temperatures throughout the year. Seasons are divided into the rainy season from May to November and dry season from December to April, and annual rainfall reaches 4,000 mm.

(2) Topographical and Geological Conditions

Surrounding the Mesurado lagoon, flat land is spread and distributed over the west side and northwest side, and low hills with gentle undulation are distributed along the seashore and the eastward watershed.

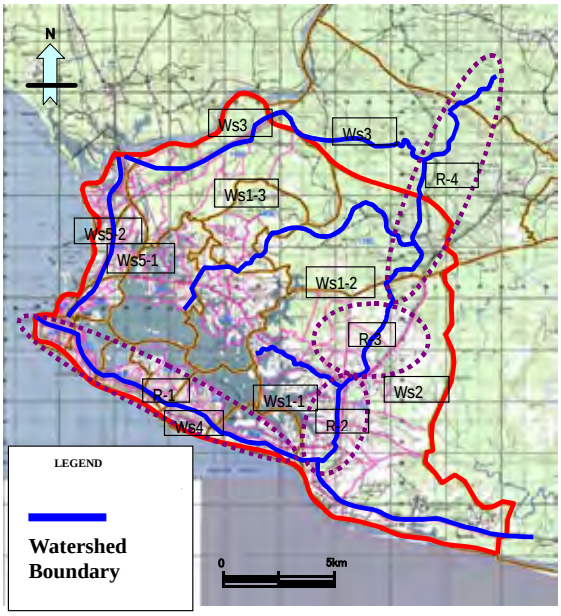


Figure 2.1 Watershed Boundary

2.2 Socio-economic Condition

2.2.1 Population

The population of Greater Monrovia in 2008 was 1,010,575 with average population density of 44.3 persons/ha. During 1984 to 2008 population concentration to the Monrovia progressed especially in outlying parts of the existing urban area.

Table 2.1 Population of Liberia in 2008

Population Liberia	Population Monrovia	Share of Monrovia	Area Monrovia	Pop. Density (per/ha)
3,489,072	1,010,575	29%	22,823	44.3

Source: National Population and Housing Census

2.2.2 Economy

The GDP in 2007 was estimated to be USD 473.9 mln; however, this was only 40% of the GDP before fighting broke out in 1987 ascribing to the negative impact of civil war.

The Liberian economy has displayed steady growth in recent years with GDP increasing by 5.3% in 2005, 7.8% in 2006 and 9.5% in 2007. Growth in production has been especially conspicuous for products like rice, cassava, construction and commerce, etc., and such agricultural and service sectors may be said to hold the key to economic recovery.

Table 2.2 Liberia Sectoral Origin of GDP at 1992 Constant Prices

(unit: mln USD)

Year	Agriculture	Forestry, Hunting gathering & Fishing	Mining & Panning	Manufac turing	Tertiary	Total	GDP Growth Rates (%)	Population	GDP per capita
2005	184.8	71.3	0.7	51.7	93.3	401.8	5.3		
2006	192.3	74.1	0.7	55.5	110.5	433.2	7.8		
2007	210.4	81.1	0.8	60.7	120.9	473.9	9.5	3,489,072	135

Source: Central Bank of Liberia, Annual Report 2007, National Population and Housing Census: Preliminary Results

Table 2.3 Employment Status Prices (According to LDHS)

(%)

Gender	Employed in the 12 months preceding the LDHS survey		Not employed in the 12 months preceding the survey	Missing/ Don't know	Total
	Currently employed	Not currently employed			
Women	44.5	5.0	50.4	0.0	100.0
Men	66.7	2.9	30.4	0.1	100.0

Source: LDHS 2007

Table 2.4 Employment Structure

(%)

Gender	Professional/ Technical/ Managerial	Clerical	Sales & Services	Skilled Manual	Unskilled Manual	Domestic Service	Agriculture	Missing	Total
Women	6.7	0.1	85.6	1.5	0.3	1.7	1.0	3.2	100.0
Men	15.6	2.4	50.9	17.8	3.5	0.4	2.0	7.4	100.0

Source: LDHS 2007

2.3 Present Condition of Land Use

2.3.1 Present Situations on Land Management in Greater Monrovia

(1) Administrations Related to Land Use Management in Liberia

Administrations related to and responsible for land management are summarized below.

Table 2.5 Administrations Related to Land Use Management in Liberia

Component	Administration related to the Component	Law
(1) Urban Master Plan	Bureau of Regional Planning (BRP), Ministry of Planning and Economic Affairs (MPEA) - BRP is responsible for preparing comprehensive regional development plan (TOR of BRP) - BRP also has authority to prepare city-wide master plan	No Regional / City Planning Law
(2) Regulation Plan (Zoning Plan)	MPEA is responsible for system of Zoning Plan and planning with MPW and MCC. MPW is the implementation authority	Zoning Act for the City of Monrovia (1957-1958)
(3) Every-day Work System	MPW (Division of Zoning, Land-use and Planning) is responsible for the implementation and Every-day Work. The role of MCC is not clear. MLME is responsible for managing land transfer process and cadastral mapping.	

(2) Present Administrative Frame and Activities on Land Use Management

In Greater Monrovia there was a long absence of legal/administrative control and management as formal procedure. The long-term absence of formal management made the institutional capacity of related authorities very weak and resulted in lack of experiences and data.

(3) Issues and Problems on Administrative Frame

Table 2.6 Issues and Problems on Administrative Frame

Component	Issues and Problems	Alternatives to Solve the Problems
(A) Urban Master Plan	- No Urban Master Plan for the region and city to guide activities rationally	
	- No regulation to control activities of land development/building constructions, in particular at urban expanding lines at Caldwell and Johnsonville, and at swamp area around Lagna.	- To establish the City Planning Act
	- No Local Authority responsible for Greater Monrovia as the key for land use management	- New Act will promote the City Government to cope with the whole Greater Monrovia.
	- Weak institutional capacity of planning area in MPEA, MPW and MCC due to the long-absence of planning execution	- Comprehensive capacity development is urgently required to solve current issues step-by-step.
(B)	- No Zoning Plan	- Formulating new Zoning Act that could

Component	Issues and Problems	Alternatives to Solve the Problems
Regulation Plan (Zoning Plan)	- Zoning Act is not updated	cope with not only transition issues found at built-up area of current Monrovia City, but also urban sprawling areas found outside Monrovia City. - Preparing new Zoning Plan - Comprehensive capacity development for, MPW and MCC (and future Monrovia City)
(C) Every-day Work System	- Weak capacity and lack of necessary administrative organizations	- Comprehensive capacity development and institutional reform

2.3.2 Present Land Use Condition

Land Use Field Survey was conducted to identify present land use early in 2009 in this Study.

Table 2.7 General View of Land Use in Greater Monrovia

Present Conditions	Planning Issues
Urban Expansion - Settlement and industrial areas have expanded into inland swampy areas in Caldwell, Barnesville, Johnsonville and Paynesville.	- To decide a borderline of Urban Area to be urbanized in next 10 years to reserve the inlands as future urban / un-urban resources in Greater Monrovia.
Transition of Land Use - Central Business District (CBD), informal settlements, and large-scale on-going settlements/housing estates at Paynesville	- Urban Master Plan for Greater Monrovia is not yet prepared and there are serious difficulties to draw the future vision due to the weak institutional capacity, lack of staffs, data, and equipment in the current transitional era. - Local (Action) Plans are also urgently needed.

After the study on present land use and problems, the Study Team summarized land use issues as below.

Figure 2.2 Industrial Land Use of Map

(1) Planning Issues of Present Land Use

Table 2.8 Planning Issues by Present Land Use

Land for Business and Commerce	Land for Industrial Activities
Central Monrovia - To utilize its potential for economic diversification and strategic land use transformation **Sinkor-Old Road Corridor / Zone** - To utilize present residential land use and accumulation of special businesses **Port Area and Bushrod** - To utilize road and port potential (for business/trading center) - To utilize present accumulation of population and housing and development trend - (MPEA has concepts to renew Bushrod Island as a new business/trading center.) **Redlight at Paynesville** - To utilize closeness to RIA and large scale private land ownership **"Redlight – Old Road Corridor"** **"Port Area - Red Light Corridor" (Somalia Drive)** - To identify land transform scheme for the road-side and the corridor - To utilize Port-area impact and identify the role of this corridor **Redlight to North and Paynesville to International Airport** - To utilize nation-wide highways and regional development outside Greater Monrovia.	**Port Area** - To identify future use of Free Zone currently occupied by UNMIL - To identify future use of idle land within Free Zone **Redlight Area** - To identify further accumulation of industries in this area **Industrial Park in Gardnersville** - To identify future land use of current industrial park where almost no industrial activity is observed **Central Monrovia and Sinkor-Lakpazee-Old Road** - To identify the direction at future land use where presently used as mixed used land [toward exclusive land use or mixed (transitional land use) land use]
Lands for Housing	Un-Urban Land Us
Squatter settlements - To provide large number of affordable houses for low income settlers - To establish urban area boundary to prevent urban sprawling	- To utilize those areas as a buffer zone for Ramsar Wetland - To utilize those areas for provision of conservation areas in Greater Monrovia - To balance sprawling and development in those areas

2.4 Present Condition of Road and Transportation

2.4.1 Institutional Framework of Road Sector

Present responsibilities of organizations and agencies in road and transportation sector are summarized. The MPW is responsible for the provision and maintenance of primary and secondary roads, urban road maintenance and provision, and for the execution of civil works funded internationally.

2.4.2 Policies and Regulations

(1) National Transportation Policy and Strategy (NTPS)

The new Transport Policy and Strategy was officially approved in November 2008 by GoL with technical and financial support from the WB. The Vision of the NTPS is to develop an efficient, safe, affordable and sustainable transport system in Liberia by 2011.

(2) Poverty Reduction Strategy (PRS)

The goals of the priority interventions for Roads and Bridge sector within PRS are:

- To ensure that all roads are pliable year round, to refurbish select public buildings, and to build the capacity necessary for a sustained road maintenance program;
- To improve the Liberian transport sector through policy, systems and infrastructure

development that creates access to reliable, affordable and efficient services.

Table 2.9 Institutional Framework of Road Sector

Organization		Major Activities
1.	Ministry of Public Works (MPW)	· Planning, designing and constructing public infrastructures · Constructing and also supervising construction contracts · Building and maintaining roads, bridges and public buildings · Ensuring that acceptable engineering and architectural standards are adhered to · Registering and issuing certificates to construction companies/contractors operating in the country · Administering urban planning and zoning
2	Ministry of Transport (MoT)	· Administration and implementation of national transport law · Execution of respective transport policies for land, sea, rail and air transport services
3	National Transit Authority (NTA) (to be established)	· Development of private sector participation in the transport services · Development and operation of modes of transport in urban and rural centers · Encouragement of the non-motorized transport and mass passenger transport use as alternatives to growing vehicle traffic
4	Monrovia Transit Authority (MTA)	· Development of private sector participation in the transport services (publicly owned company)
5	Liberia National Police	· Traffic operation and control · Accident investigation

2.4.3 Funding Resources

(1) Liberia Reconstruction Trust Fund (LRTF)

LRTF is a new multi-donor pooled fund administrated by the World Bank for priorities defined in the PRS. The Special Implementation Unit (SIU) in MPW and the Public Financial Management Unit (PFMU) in the MoF execute the projects supported by LRTF.

(2) Road Sector Expenditure/Budget

Table 2.10 Expenditure and Budget of MPW

(unit: USD)

Items		FY 2007/2008	FY 2008/2009
Personnel		1,179,651	4,210,000
Goods/Services		2,473,690	
Road Construction / Rehabilitation	Monrovia area (includes Public Buildings)	6,240,603	6,218,000
	Nationwide (15 counties)		11,755,000
MPW Budget Total		9,944,179	22,100,000

Source: Ministry of Public Works

Funding Requirement in short term road sector plan by NTPS in the next three years including primary roads and some secondary/farm-to-market roads; the total cost is estimated at around USD 181mln. Additionally, some USD2.6mln. is required over the next three years for capacity building.

2.4.4 Existing Projects in Road Sector

(1) World Bank Road Sector Projects in Monrovia

The World Bank (WB) has been contributing to many road investment projects through a grant scheme or LRTF scheme.

Table 2.11 World Bank Road Sector Projects in Monrovia

Title		Period	Total Proj. Cost	Outline
1	Emergency Infrastructure Project (EIP)	2006-2010	USD 30mln	To repair some primary roads and major bridges, improve potable water supply to Monrovia and strengthening capacity
2	Emergency Infrastructure Project Supplementary Component (EIPSC)	2006-	USD 16.5mln	Basic rehabilitation of selected rural roads sections, in Monrovia including selected urban works
3	Liberia Infrastructure Rehabilitation Project (LIRP)	2006-2010	USD 8.5mln	To restore priority infrastructure in the Port of Monrovia and Roberts International Airport (RIA)
4	Monrovia Street Rehabilitation Project	2009-2011	USD 17mln	To rehabilitate roads in Monrovia, mostly in the Central Business District (CBD)
5	New Vai Town Bridge Project	2009-2010	USD 16mln	Construction of new bridge for fallen Vai Town Bridge
6	Caldwell Bridge Project	-	5mln	To replace Caldwell Bridge with new four lane bridge
7	Monrovia - Ganta/Guinea Border Corridor Project	2009-	Approx. USD 100mln (Trust Fund)	Road rehabilitation
8	Monrovia Ring Road Project			Road rehabilitation (including road to New Kru Town along Free Port and road to Cotton Tree)
9	Urban Works and Public Awareness and Training Campaign Program			Urban works, public awareness and training are being incorporated into each of the construction activities.

Source: WB

Figure 2.3 Road Congestion at Broad St. Source: JICA Study Team

Figure 2.4 Main Road Sector Projects by the WB Grant Scheme

(2) Other Donor Projects Related to Monrovia

Table 2.12 Other Donor Projects Related to Monrovia

Title		Funding Source	Outline
1	Labor-Based Public Works Project	AfDB	Rehabilitation of the Fish Town-Harper Road stretch
2	Capacity Building Project for the Transport Sector of Liberia	GTZ	To build up a functioning local capability to analyze + plan + solve transport policy problems on their own within the next 3 to 5 years

2.4.5 Review of Present Road and Transport Sector Condition

The transport sector in Liberia prior to the civil war included road and railway networks, civil aviation

and several ports. Today, the railway network is almost non-existent, civil aviation is limited to Monrovia with only UN flights operating upcountry. The Port of Monrovia is the only fully operational port in the country.

(1) Existing Road Network System

The road networks in Monrovia interconnect production with consumption and market centers.

Most roads can hardly cope with rapid increase in traffic volumes due to their bad state and insufficient road capacities.

Other road related problems particularly in Monrovia are; inadequate parking spaces, lack of maintenance and room for future expansion, lack of modern terminal (bus/truck terminals), inadequate facilities for non-motorized traffic and pedestrian lanes and lack of road furniture.

Road capacity has been reduced by road side parking, street vending and pedestrians.

Gravel and earth roads may become impassable during rainy seasons due to the deep puddles and/or muddy surface that are caused by their roughness and poor drainage system.

Most of the roads are undivided 2 lane composition. Basically lane width in paved road is 3.5 meter per lane. Therefore, undivided 4 lane road has 14.0 meter or more in width and 2 lane road is normally 7.0 meter in width. Among the investigated roads, Tubuman Boulevard, Bushed Island Road, Capital Bypass and Broad Street are multi lane composition. Only Broad Street has median strip.

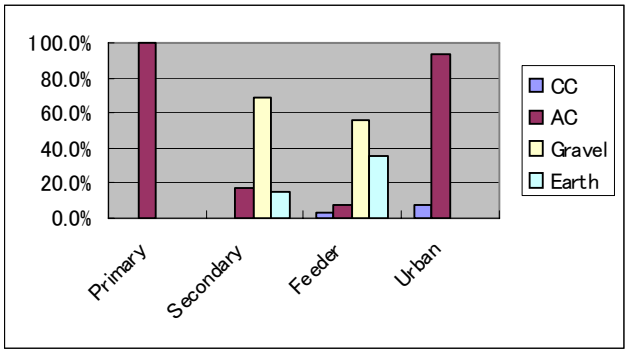


Figure 2.5 Surface Type Composition by Road Class

Figure 2.6 Surface Type of the Road

(2) Traffic Volume and Travel Speed Survey

Four (4) traffic surveys, namely a) Screen Line Survey, b) Cordon Line Survey, c) Traffic Count Survey, d) Person Trip Survey were conducted in early 2009 in the Study.

Daily traffic volume of over 40,000 veh/day were observed at stations on Tubman Boulevard and Somalia Drive constituting the ring road. The largest traffic volume was observed at the station at Free port at 59,000 veh./day.

The traffic volume inflow to and outflow from the Study Area was some 31,000veh./12hours in total.

The highest traffic volume of about 12,600veh./12hours was recorded on the North-West corridor.

Vehicle occupancy rate of sedan/wagon was 4.4 persons/veh. on average.

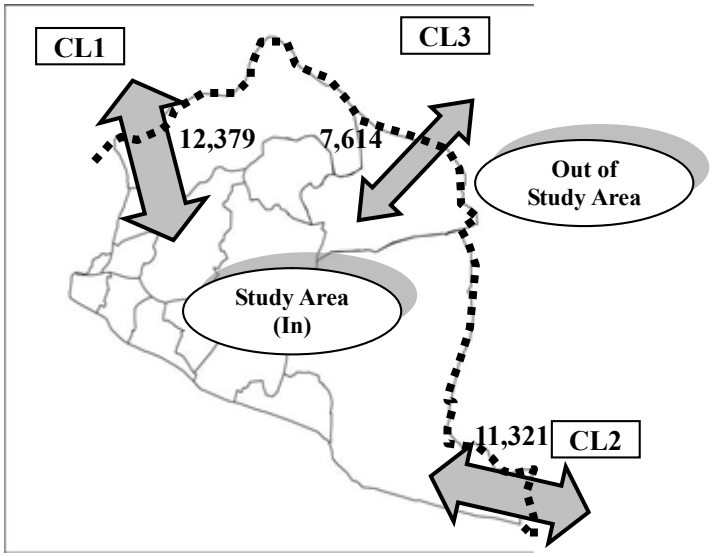


Figure 2.7 Traffic Volume to/from Study Area

Table 2.13 Occupancy Rates

Vehicle Type	Sedan/ Wagon	Taxi	Mini bus	Large Bus
No. of Passengers incl. driver	4.4	5.1	13.5	21.6

Source: JICA Study Team

More than 2,500 household interview survey to all the members aged 13 years old and above were conducted. The number of persons surveyed was 6,783 accounting for some 1.0% of 640,000, estimated population of over aged 13 years in the Study Area.

Table 2.14 Vehicle Ownership

(Unit: Households)

Household with car ownership		Household without car ownership		Total	
306	(11.5%)	2,355	(88.5%)	2,661	(100.0%)

Table 2.15 Characteristics of Person Trip

- Trip purpose

To home	To work	To school	Business	Others
45.8%%	15.1%	10.7%%	8.7%	19.7%

- Mode of travel

Passenger car	Taxi	Bus	Truck	Motorcycle	Walking	Others
7.6%	53.0%	8.3%	2.2%	4.1%	24.8%	0.1%

The total number of person trips per day is 1,348,582 trips and the average number of trips per person was 2.11PT/day.

(3) Existing Public Transport System

The provision of transport services (taxi, mini bus and two wheels motor bike) in Monrovia is generally dominated by the private sector.

The quality of public transport is very poor with permit holders using imported secondhand vehicles.

There is no traffic safety enforcement.

(4) Existing Traffic Management and Control System

The traffic signals were installed at main intersections, but almost all the signals were damaged and are now out of work. Most of other facilities such as traffic signs, pedestrian crossing, bus stop facilities have disappeared. To overcome the present situation of traffic control and safety, the LNP is to launch a new plan, named "Road Safety for All", which will ensure the placement of road traffic signs and regulatory signals on all streets, intersections, junctions respectively.

(5) Existing Road Maintenance System

The maintenance of all roads except tracks in the communities is the responsibility of the Ministry of

Public Works. Within the Ministry, Operation Department is conducting maintenance works. Highway Maintenance Division, Mobile Equipment Division and Administration Division are under the Department. Some portion of the maintenance works are carried out by private contractors which are selected through competitive bidding.

2.4.6 Issues on Road and Transportation Sector

According to the findings from the field surveys and review of existing studies, the problems and issues on road and transportation sectors are summarized below.

Table 2.16 Issues and Future Direction on Road and Transport Sectors

Sub-sector	Issues
Road Network	✓ The main road network consists of few primary and secondary road with bad surface condition even though the road rehabilitation has been stated. ✓ Feeder roads directly connect to primary and secondary roads, and most of these are dead-end tracks. This causes all the movements to concentrate on the main roads. ✓ Some communities have feeder roads with bad status. In rainy seasons, such communities are being isolated.
Road Condition	✓ The road condition will be improved through ongoing rehabilitation works in central Monrovia and some major road sections. ✓ Most feeder roads in Monrovia are unpaved, and made of lateristic materials. During the rainy season, segments of these roads become partially or completely impassable causing not only substantially higher transport costs of passengers but also total isolation of adjacent communities.
Road Maintenance	✓ During the war both agencies concerned with road and transportation sectors lost their capacity to manage, provide and maintain these mandates. ✓ The two agencies lost most of their data and documentation and materials. They have not been able to undertake regular road condition assessments.
Road Congestion	✓ The road network was never expanded to allow normal traffic growth while a large number of internally displaced persons and other refugees in Greater Monrovia added to the congested conditions. ✓ The road capacity in the major urbanized area, such as CBD as well as Red Light, Waterside, Duala and other places, has been reduced by road side parking and public bus stops, street vending and pedestrians who are compelled to walk on the carriageways as most of the walkways are full of parked vehicles and petty businesses.
Public Transport Service	✓ At present, public transport share of the market in Monrovia is negligible. Most of the people without private car still rely on taxi services, although MTA stated the scheduled bus service. ✓ The quality of public transport is very poor with permit holders using imported secondhand vehicles and they lack or has poor condition of bus stops/transit terminal facilities. ✓ There is no traffic safety enforcement. Monrovia already experiences traffic congestion every day. This could be alleviated with the introduction of larger vehicles for public transport.
Traffic Safety	✓ Greater Monrovia has faced the problem of high rate of road traffic accidents, which result in significant economic damage. ✓ The number of death and injured persons are adding year after year according to increase of number of accident cases. ✓ The un-safe situation in the urbanized area has also been caused by lack of public education and awareness, and poor traffic management.
Traffic Control Management Facility	✓ As many roads and bridges were seriously damaged during the war, traffic control and safety facilities were either damaged or destroyed. ✓ Traffic signals were installed in main intersections, but all the signals were damaged and are now out of work. Most of the other facilities such as traffic signs, pedestrian crossing, and bus stop facilities, have disappeared during the war.

2.5 Present Condition of Water Supply Sector

2.5.1 Institution, Policy and Strategy

(1) Institution

LWSC manages water supply works especially for the center of Greater Monrovia and main towns of each county. In 2009, 140 staff belong to LWSC.

(2) Policy and Strategy

The National Poverty Reduction Strategy Programme shows overall vision and main strategy in water supply and sanitation sector. Countermeasures to achieve goals in water supply and sanitation sectors are as follows:

- Improvement of Water Access Rate from 25% to 50% by 2011
- Construction of satellite water supply system with water source of groundwater (Monrovia)
- Sustainability on 90% of water supply facilities

(3) Existing Project

The largest project is Monrovia Water and Sanitation Rehabilitation Programme which focuses on Greater Monrovia. Currently, international donors such as the World Bank and EC have been assisting the Programme. The essence of the project is summarized into the following five points.

- Rehabilitation of Water Supply Facility
- Rehabilitation of Sewerage System and Improvement of On-site Sanitation Facilities
- Capacity Building for LWSC
- Assistance on Program Management
- Assistance on Sector Reform

Figure 2.8 Rehabilitation Works and Current Progress

Table 2.17 Program Demarcation of Rehabilitation Work by Donors on Water Supply and Sanitation Sectors

Donors	Water Supply Sector	Sewerage (including On-site Sanitation) Sector	Remarks (Other Area than Greater Monrovia)
WB	• Rehabilitation for White Plain Purification Plant, Booster Pump Station, Rising Main and Distribution Pipelines and Service Reservoirs	• Rehabilitation for 20-30 Public Toilets and Procurement of one Jet Cleaning Equipments	
	USD5.1 mln.（2008-2010）	USD0.7 mln.（2008-2010）	
	• Capacity Development and Program Management		
	USD1.8 mln.（2008-2010）		
	• Study on Sector Reform (Formulation of Policy, Strategy and Investment Program, Establishment of legislation		
	USD0.3 mln.（2008-2010）		
EC	• Rehabilitation for Intake Pump, White Plain Purification Plant, Booster Pump Station, Rising Main and Distribution Pipelines and Service Reservoirs	—	
	USD5.9 mln.（2008-2010）		
	• Program Management		
	USD1.0 mln.（2008-2010）		
	• Study on Sector Reform (Formulation of Policy, Strategy and Investment Program, Establishment of legislation		
	USD0.7 mln.（2008-2010）		
DFID / AfDB	• Rehabilitation for Booster Pump Station and Distribution Pipeline, and Procurement of Generators	• Restoration on Stabilization Pond, Construction of 11 Public Toilets and Procurement of One Vacuum Track	• Assistance on Water and Sewerage Sector through NGO
	USD2.4 mln.（2008-2010）	USD0.6 mln.（2008-2010）	USD6.9 mln.（2007-2010）
	• Capacity Development and Program Management		
	USD2.3 mln.（2008-2010）		
USAID （Including US Army）	—	—	
UNICEF	—	—	• Health Guidance, Hygiene Protection Guidance, Assistance on water treatment of individual households
			USD2 mln.／Year
Population Service International (NGO)	—	—	• Grant Delivery of low concentration Chlorine (Liquid Type) to 3 Zones (Grand Bassa, Grand Gedeh, Bomi)

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

2.5.2 Present Condition of Water Supply Services

The water service coverage ratio between 2004 and 2007 is calculated using service population which was provided by LWSC. Moreover, since water service coverage ratio in 2008 was not available, it was assumed based on historical revenue water in 2008 and the estimated future service coverage ratio. The water service coverage ratio is at least 50% at Bushrod Islands and Central Monrovia.

Table 2.18 Change of Water Service Coverage Ratio in Greater Monrovia

Items	2004	2005	2006	2007	2008
Administrative Population (Million)	0.90	0.93	0.95	0.98	1.00
Service Population (Million)	0.10	0.10	0.35	0.35	0.37
Service Coverage Ratio	11.1%	10.8%	36.8%	35.7%	37.0%

Source: Population Census in 2008, Water Demand and Market Study in Monrovia, Liberia, and LWSC

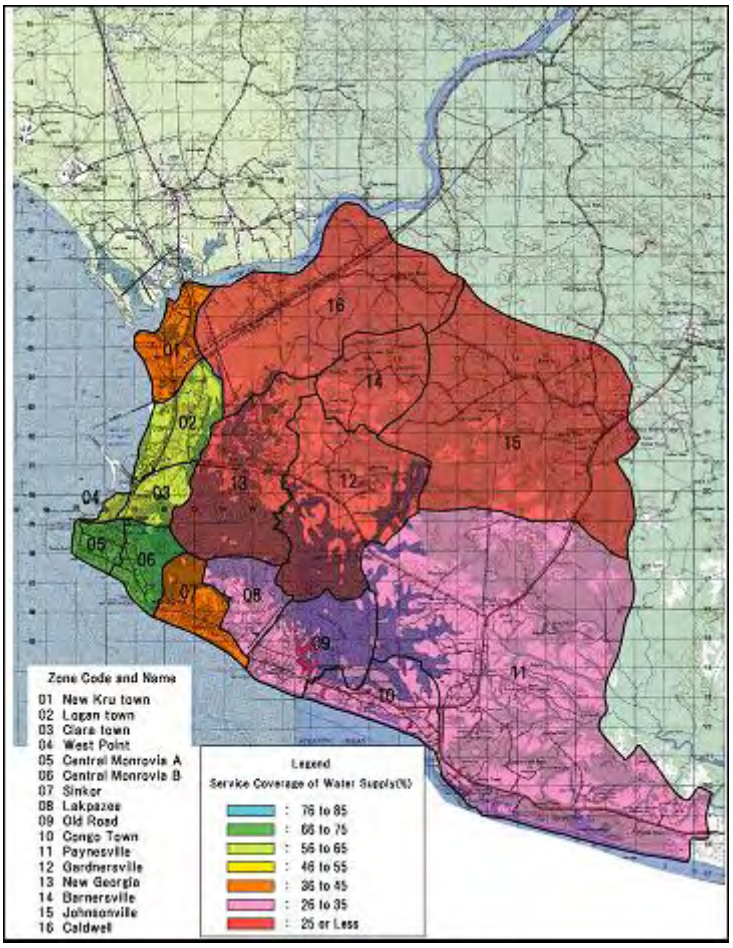


Figure 2.9 Outlines of Water Service Coverage Rate in Greater Monrovia in 2008

2.5.3 Present Condition of Water Supply Facilities

Raw water pumped up from the Saint Paul River (Minimized flow: 1,140MGD) is treated in the White Plain purification Plant (Plant Capacity: 16MGD), which is located nearby the intake point. Purified water of about 4.3MGD (2008) is supplied to Greater Monrovia passing through the rising main pipelines systematized into two and two booster pump stations. Two existing service reservoirs (Ducor Reservoir: 0.6MG, Mamba Reservoir: 1.0MG) were constructed for supplying water to the high elevated area in 1952 and 1960 respectively. Purified water has not reached those service reservoirs due to the lack of capacity of the White Plain purification Plant and rising pump, and fault of booster pumps. Therefore, the two service reservoirs have not been in service.

2.5.4 Current Status of Water Supply Management

(1) Water Supply and Sewerage Services

Production water has significantly increased since 2007. However, at least 80% of the production water is wasted due to various causes such as leakage, etc.

(2) Operation & Maintenance (O&M)

The Operation Department of the LWSC is in charge of maintenance as well as the technical services and supports for financial management of the satellite water supply system. Rehabilitation program has been carried out without any leakage survey, and therefore, effects of rehabilitation may be not be evaluated in the future.

(3) Water Tariff System

Current water tariff system of LWSC is divided into four categories, mainly by types of water supply and water uses. The water tariff on water trucks is 10 times higher than that on residential house connection and kiosk. The number of registers is about 3,988 in 2008. Water sales, which were the main income source, were about USD 1mln in 2007.

2.5.5 Results of Hydrogeological Investigation

(1) River Discharge

The monthly mean discharge of St. Paul River shows maximum 1,045m^3/sec in September at Mount Coffee, minimum 92m^3/sec in February at Mount Coffee. The mean annual discharge is 531m^3/sec at Mount Coffee.

(2) Possibility of Aquifer of Formation and Structure

The possibility of aquifer assumed from the feature of formation is shown below:

- Paynesville formation (Sandstone portion)
- Edina formation (Sandstone portion)
- Quaternary (Sand portion)

The hydrogeological condition based on the geographical sounding is summarized below.

- There is possibility of rather widely spread sandstone aquifer in the survey area. The sandstone aquifer is not monotonous and in stable condition, but rather in complicated condition.
- The sandstone aquifer doesn't have clear aquiclude at upper portion, but rather imperfect confined aquifer.
- The sandstone aquifer increases thickness toward east, south east and south direction.
- The depth of hard portion of base rock in the survey area is 42 to 200m according to VES results.

2.5.6 Result of Water Quality Analysis

Water quality survey regarding river, groundwater, public water tap and sewage in Monrovia city and the surrounding areas was conducted in this Study.

- Regarding existing intake, the concentration of nitrogen such as ammonium and nitrate is very low compared with WHO guideline value. E.Coli. concentration is also low and the concentration is equivalent to a group on Japanese environmental standards.
- Regarding lead, the concentration in shallow well (Sister Agnes Clinic, Well depth: 15m) is more than WHO guideline value and the concentration on the other shallow well is relatively high.

2.5.7 Results of Public Awareness Survey

The Study Team conducted Public Awareness Survey in January 2009 in Greater Monrovia (128 Urban Communities and 33 Rural Communities). Findings are followings.

Table 2.19 Abstracted Survey Results of Public Awareness Survey

Item		Results
a)	Sources of Household Water Supply	Push-Push' (namely, carts) is the most major tool of water supply. The next major tool is public taps (Kiosk).
b)	Water Supply Hours	Water supply hours vary largely by zones. Water is available for at least 6 hours daily to about 46 % of households, which rely on pipe borne water.
c)	Water Consumption	About 60% of households consumed between 15 and 30 gallons of water a day per household, while 27% consumed between 35 and 50 gallons a day. Only around 10% consumed less than 10 gallons a day.
d)	Types of Toilets	Over half (58%) of the households covered by the survey have used flush toilets.

The ability to pay for water expenses is estimated at USD4 to 16 monthly per household. Even if the dwellers have the will to access to safe water and sanitation facilities, it is envisaged that their abilities and willingness to pay are very limited for receiving water.

2.5.8 Results of Exploratory Well Drilling

The exploratory well drilling work, namely the drilling work of 4 wells (Well No.J-1, J-2, J-3 and J-4) was carried out to obtain the aquifer structure and aquifer properties including hydraulic parameter in detail at each well site.

The observation of water level of existing shallow wells surrounding exploratory or new production well is necessary to control sustainable groundwater development.

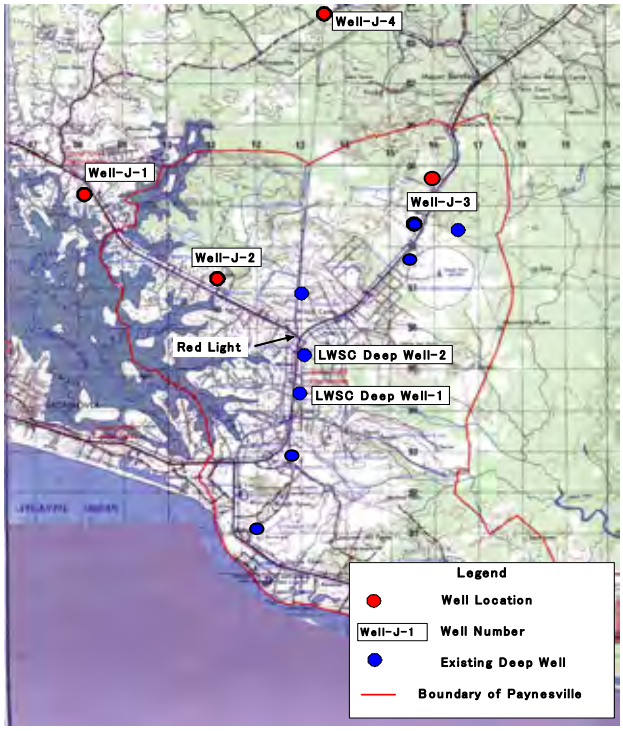


Figure 2.10 Location of Exploratory Well

2.5.9 Main Issues on Water Supply Services

From the aspects above, in order to improve water supply works, the problems and main issues can be summarized as in the following table.

Table 2.20 Problems and Future Issues on Water Services

Problems	Issues
Much deteriorated water supply facilities	• Large scale replacement of rising main, distribution pipelines and service reservoirs
Around 63% of dwellers in Greater Monrovia takes water from unsafe water source such as shallow or dug wells	• Improvement of the coverage of water service by LWSC
High water production cost	• Improvement of water supply system to be optimized (i.e. Not to use rising main for supplying water to dweller directly)
Low revenue water	• Improvement of water tariff system (i.e. to reduce frat rate in tariff collection) • Reduction of leakage • Enhancement of individual water meter installation
Water supply for low income households	• Development of water supply facilities with low Operation & Maintenance cost
Lack of water quality parameter to be analyzed to the WHO standards	• Establishment of appropriate water laboratory

2.6 Present Condition of Sanitation Sector

2.6.1 Policy and Strategy

The National Poverty Reduction Strategy (PRS) shows overall vision and main strategy in sanitation sector. Countermeasures to achieve goals for sanitation sector in the PRS are as follows.

- Full-scale Rehabilitation of Monrovia Sewerage System
- Rehabilitation of 3,000 public toilets (school, hospital, clinic) in Liberia.
- Establishment of 10,000 public toilets (school, health center, public facilities) in Liberia

2.6.2 Existing Project

The existing project for the sanitation sector is referred to in previous section, and Monrovia Water and Sanitation Rehabilitation Programme is mentioned in it. The donors such as the World Bank, EC have assisted the Liberian government to establish new public toilets and to rehabilitate the public toilets.

2.6.3 Present Condition of Sewerage System and Sanitation Facilities

(1) Outlines of Sewerage System and Sanitation Facilities

The existing sewerage was constructed in 1950s and late 1960s. The existing sewerage system is the separated system which is divided into sewer and drain.

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

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

(2) Current Status of Sewerage System and Sanitation Facilities

LWSC is the responsible organization for treating sewer water. On the other hand, the on-site sanitation facilities such as septic tanks are managed by Monrovia City Council. Most people resort to defecation in the open due to the lack of public toilets and much excrete is accumulated surrounding their houses.

Table 2.21 Current Status of Sewerage and Sanitation Services in Monrovia

Urbanized Area	Area covered by the on-site sanitation facilities	Area covered by sewerage	Rate of service coverage of the on-site sanitation facilities		Population Rate without Flush Toilet	Population Rate Covered by Sewerage	Numbers of house connections to Sewerage System
			Pit-latrine	Septic tank			
42km^2	27.6 km^2	14.4km^2	20%	29%	49%	2%	2,900 household

The area where sewer pipes are functional is only Sinkor located around the Fiama sewerage treatment plant.

Most parts of sewerage system constructed in 1960s has been seriously damaged and not been functional.

Sewer pipes in Bushrod Islands are blocked with sludge.

Sewer water into the pump stations is slightly discharged into Mesurado River

Fiama treatment plant operation has been suspended due to the equipment missing during civil conflict.

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

Figure 2.11 Sewer Water from Pump Station into Mesurado River

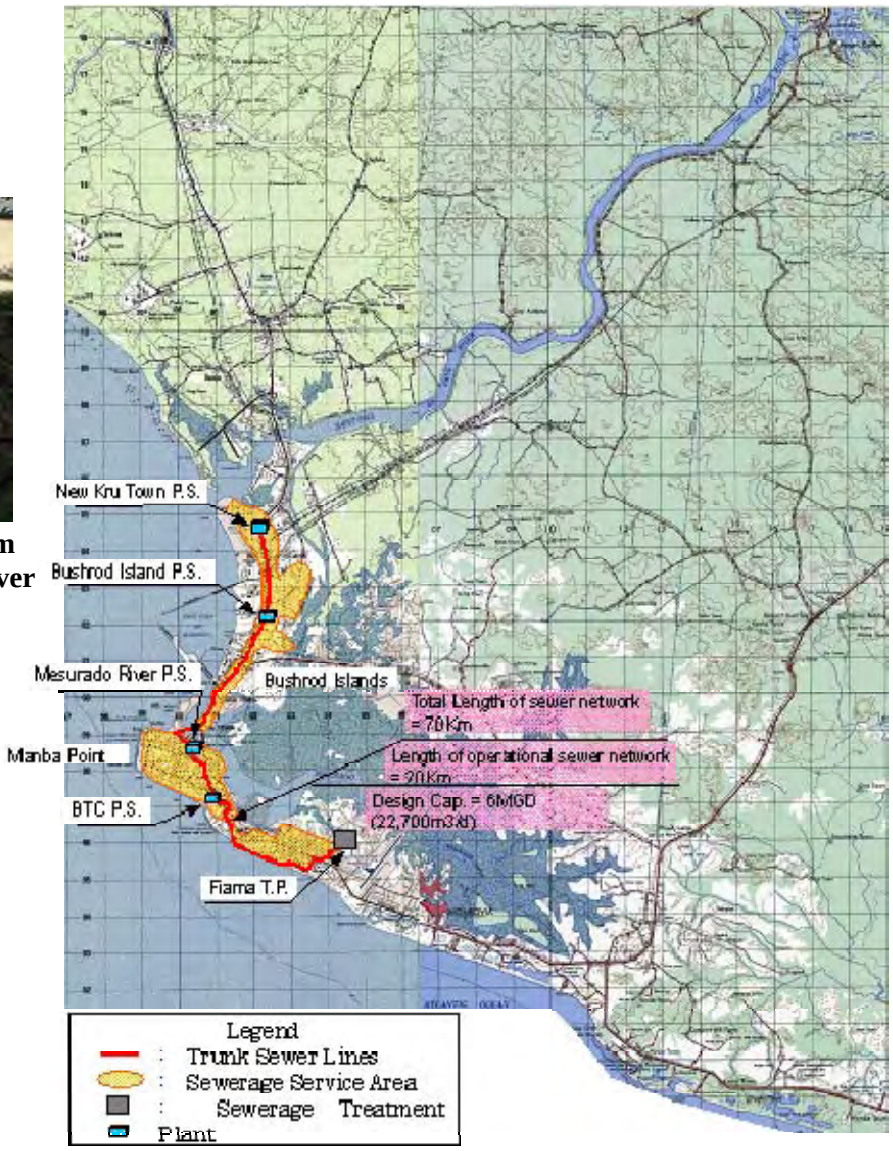


Figure 2.12 Outlines of the Overall Existing Sewerage System in Monrovia

(3) Main Issues on Sewerage and Sanitation Services

Problems and issues on sanitation sectors are summarized below.

Table 2.22 Problems and Issues on Sewerage and Sanitation Services

Problems	Issues
Around 50% of people has neither access to sewerage nor on-site sanitation facilities even in Central Monrovia	• Development of sanitation facilities such as Sewerage System, Community Sanitation System and On-Site facilities (i.e. public toilets, etc.)
Sewer pipes clogged with sludge and debris	• Procurement of sewerage maintenance equipment including vacuum vehicle 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 relay pumping stations are stolen or disrepair.	• Rehabilitation of relay pumping stations including installation of mechanical and electrical equipment
Sewage Treatment Plant is disrepair and inoperative.	• Reconstruction of Fiama Sewage Treatment Plant

2.7 Present Condition of Storm Water Drainage Sector

2.7.1 Existing Policies and Regulations

River management or the regulations of drainage design are not yet provided for in the law in Liberia. All storm water drainage facilities in Monrovia are under the management responsibility of the MPW. The cleanings of some drainage are sometime implemented by Monrovia City Corporation and cleanings of sewerage drainage pipes belong to LWSC.

Table 2.23 Organizations and Activities in Storm Water Drainage

Organization		Activity in Storm Water Drainage
MPW		
	Department of Technical Service	Supervising and coordinating the functions of its five bureaus (Operation, Technical Services, Construction, Planning and Programming and Rural Roads Coordination and Implementation)
	Bureau of Operation	Operation and maintenance of the storm water drainage
	SIU	Management and improvement of donor support projects
MCC		- Environmental management including sanitation primarily (Public Health Law, 1975)
LWSC		- Manage, operate and implement water and sewerage services (the National Legislature Act of Liberia 1973)

Table 2.24 Existing Projects

Project Title		Contents	Org.	Source
Emergency Rehabilitation Program Report			WB	TFLIB
Liberia Infrastructure Rehabilitation Project (LIRP)				USD 7.02 mln
	Sub-Component B: Urban Infrastructure Rehabilitation	Drainage Rehabilitation (Central Monrovia, Bushrod Island and Sinkor)	UNDP	USD 1.9mln
Urban Rehabilitation and Sanitation Project (URSP)				
	Urban Infrastructure Construction and Rehabilitation of Monrovia Sewerage Network Pumping Stations	Cleaning and repair of surface drains and underground pipes, etc.		USD 11.0 mln (IDA or LRTF)

2.7.2 Present Conditions of Drainage System and Facilities

(1) Major Drainage System

Drainage system is provided in the north and south-east of Monrovia. 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.

Logan Town side of Somalia Road.

Broken underground pipe, Central Monrovia

Inlet of road surface water, Benson St.

Figure2.13 Existing Condition of Drainage System

(2) Drainage Structure Type

Structure type in quantities: approximately 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, about 920 manholes (almost each one combined with an adjacent rain water intake).

(3) Operation and Maintenance

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.

Table 2.25 Current Issues and Countermeasures in Storm Water Drainage Sector

Problems	Issues
Missing of documents of all existing drainage system Unfilled inventory of drainage structures (channel, pipes, culverts, and manholes) in MPW	Layout drawing of existing drainage system indicating future plan Inventory of existing drainage system
Flooding during storm in the Carey and Benson Sts due to overflowing sewers.	Civil repair works and/or reconstruction Cleaning and repair of drainage pipes and underground channels Establishment of new secondary concrete drainage channels in densely populated areas Procurement of vacuum truck with pressure pump and jetting equipment and tools for maintenance
Many damaged manholes and inlets Missing of some concrete manhole covers, and majority of the original cast iron inlet	Replacement of broken or missing concrete manhole covers Furnishing of locally made inlet gutters from reinforcing bars
Frequent filling with garbage up to the top of Inlets and manholes	Procurement of vacuum truck with pressure pump and jetting equipment and tools for maintenance Cleaning and repair of surface channels, manholes and all inlets by manual labor works Cleaning and repair of drainage pipes and underground channels Establishment of new secondary concrete drainage channels in densely populated areas
Insufficient maintenance crew and personnel, because of missing equipments, tools and material, for repair work	Development of organization for operation and maintenance Capacity Development of MPW staffs for planning and designing of drainage Procurement of vacuum truck with pressure pump and jetting equipment and tools for maintenance
No funds available to cover the running cost for the project.	Fund raising and community power enhancement
No information on drainage cleaning project or programme available	Layout drawing of existing drainage system indicating future plan

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

3.1 Approach to Urban Restoration and Improvement

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

- Integration of Urban Development and Restoration & Reconstruction -

In Greater Monrovia following situation are 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) Secondly it is uncertain whether these 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 & reconstruction plan of urban infrastructure and facilities, it shall be made consistent with urban development master plan with longer horizon.

3.2 Future Vision of Greater Monrovia

3.2.1 Roles of Greater Monrovia for Liberia

(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.

(2) Roles of Greater Monrovia

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

a) A base of service industries for primary and secondary industries
b) A base of downstream product industries
c) A base for international trade and export
d) A base for economic diversification
e) A hub of information network

3.3 Future Urban Structure and Allocation of Function

3.3.1 Principles of Development and Conservation

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

a) Conservation of precious natural resources
b) High density development
c) Distinction between conservation/reservation areas and urban functional areas
d) Functional expansion and intensification
e) Utilization of urban development potentials

3.3.2 Urban Structure Patterns

Two urban structure alternatives, namely, a) Multi-core urban corridor structure (similar to present pattern) and b) Multi-core urban sector (fan-shape) structure were assumed and examined based on the present urban structure of Greater Monrovia.

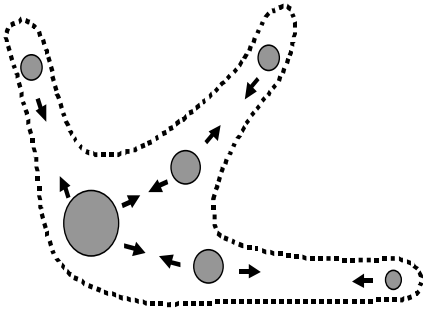


Figure 3.2 Multi-core Urban Corridor Structure

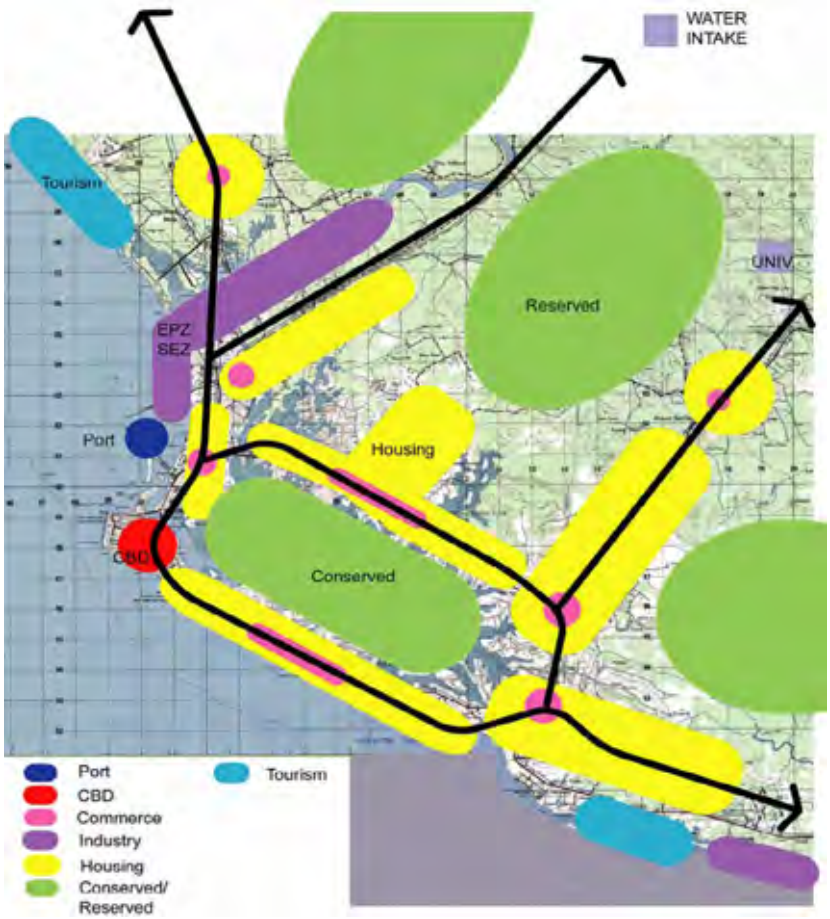


Figure 3.1 Urban Structure Vision of Greater Monrovia (2019)

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

3.4 Socio-economic Framework

3.4.1 Population

(1) Total Population

Although the population concentration to Greater Monrovia is assumed to become weaker, two cases (rapid urbanization and moderate urbanization) were set for population forecast.

Table 3.1 Population Projection of Liberia

	2008		2014 (Estimate)		2019 (Estimate)	
Primary	7,280	2.93%	6,844	2.00%	4,369	1.00%
Secondary	31,154	12.55%	43,345	12.67%	55,904	12.80%
Tertiary	209,881	84.52%	292,008	85.33%	376,619	86.20%
Total Working Population	248,315	100.0%	342,197	100.0%	436,891	100.0%
Share of Working Population	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.

(2) GDP

It was assumed that GNI per capita will increase by about 10% of an annual rate until 2019.

(3) Car Ownership

Based on the forecast of GDP per Capita, the future private car ownership rates of Monrovia were estimated at 20-30 vehicles/1,000 persons in 2014, and will become in 25-50 vehicles/1,000 persons in 2019.

3.5 Future Land Use Plan

3.5.1 Designation of Urbanization Promotion Area and Urbanization Control Area

Under the budgetary constraints, Greater Monrovia area was divided into the following two areas.

- Urbanization Promotion Area (UPA): The area where urbanization is admitted or promoted, designated by assuming urbanized area up to 2019 for effective land use and urban development.
- Urbanization Control Area (UCA): The area where population density is too low to effectively invest infrastructure and urbanization is assumed to be restricted.

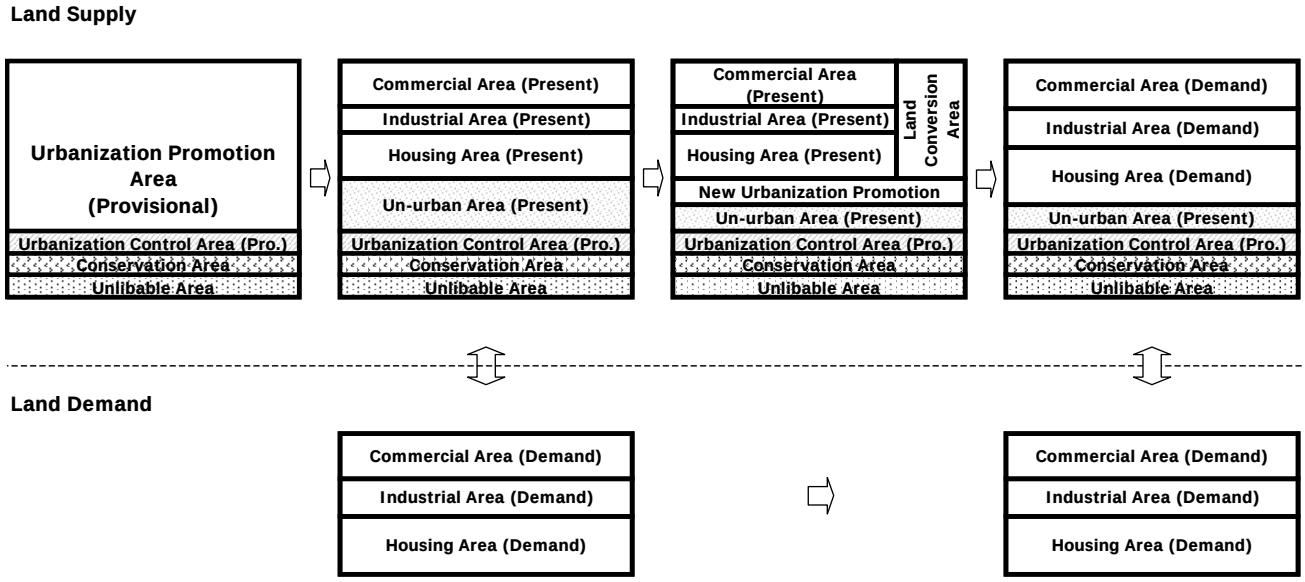


Figure 3.3 Land Use Zoning Procedure

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.

3.5.2 Population Distribution by Potential Model

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

3.5.3 Forecast of Urbanization Promotion Area in 2019

Density standards applied for the forecast of UPA were shown below.

Table 3.2 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. A	Habitable Area	UnLivable Area	Total Area
		Ext. Low Den.	Ext. High Den.	Ongoing (Low)	Total Res							
		(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(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	1,705	439	4,111	6,255	5	25	6,284	86%	7,340	1,751	9,091
1200	Gardnersville	438	69	229	736	27	25	789	80%	988	228	1,216
1300	New Geogia	314	62	131	508	1	23	532	82%	648	400	1,048
1400	Barnersville	19	36	637	691	0	15	707	81%	874	333	1,207
1500	Johnsonville	37	0	160	197	0	10	208	10%	2,093	1,097	3,190
1600	Caldwell	6	2	725	733	0	7	740	55%	1,351	1,644	2,995
Total		3,878	945	6,112	10,935	95	313	11,344	69%	16,473	6,253	22,726

2019 Estimated Land Use Demand

Zone		Residential					Ind	Com	Total (Net)	Habitable Area	UnLivable Area	Total Area
		Low Density	Medium Density	High Density	Ongoing	Total						
		(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(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	2,537	1,513	450		4,500	12	49	4,561	7,340	1,751	9,091
1200	Gardnersville	294	292			586	48	31	665	988	228	1,216
1300	New Geogia	207	200			407	1	27	435	648	400	1,048
1400	Barnersville	434	132			566	2	19	587	874	333	1,207
1500	Johnsonville	158				158	0	39	197	2,093	1,097	3,190
1600	Caldwell	594				594	50	9	653	1,351	1,644	2,995
Total		4,647	2,747	1,130		8,524	196	467	9,181	16,473	6,253	22,726

3.5.4 Land Use Zoning

Proposed land use zoning map of Greater Monrovia in this Study is shown below.

Figure 3.4 Proposed Land Use Zoning（2019）

CHAPTER 4 URBAN FACILITIES RESTORATION AND IMPROVEMENT PLAN (ROAD AND TRANSPORTATION SECTOR)

4.1 Policy and Strategy for Road and Transport Plan

4.1.1 Strategy for Road and Transport Plan in Greater Monrovia

The goals and objectives of urban transportation planning are summarized below.

Table 4.1 Logical Frame of Urban Transportation Planning for Greater Monrovia

Term	Goal	Objective
Short term Plan Phase 1 (2008 - 2011)	To reduce poverty To recover economic activities	Three year Road Development Plan with LITF by GOL and International organizations (WB, AfDB and so on))
Short Term Plan Phase2 (2012 - 2014)	To reduce poverty To facilitate economic activities	To link a urban road network by paved and categorized road system To reconstruct the missing ling and damaged bridge and keep continuous traffic through the year
	To implement fundamental public transportation service	To implement the bus stop facilities and enhance scheduled public bus service
	To mitigate traffic congestion and accident	To intense the capacity of primary road To install and study traffic control and management system (traffic education, traffic signal, traffic sign and traffic regulation)
Medium Term Plan (2015 - 2019)	To support economic activity growth To rise living standards and address transportation poor To facilitate additional need of citizen and make efficient transportation system	To enhance the function of road network (capacity, surface, linkage) To implement comprehensive public transport system and transit terminal To implement traffic control and management system

4.1.2 Road Hierarchy and Classification System

The main characteristics of each functional class are summarized below.

Table 4.2 Definition of Road Classification for Greater Monrovia

Class	Function
Urban Primary Road	✓ Link to national primary road outside of Monrovia ✓ From core metropolitan spines ✓ Accommodate longer trips ✓ Connect major trip generators ✓ Network Bus service provided
Urban Secondary Road	✓ Link between township ✓ Accommodate travel demands between townships or major communities. ✓ Link to urban primary roads ✓ Network Bus service provided
Urban Tertiary Road （Feeder road, Neighborhood Road）	✓ Link Between Community ✓ Provide circulation within as well as between townships and communities

Table 4.3 Proposed Design Standards by Road Class

Classification	Design Speed (km/h)	Lane Wide (m)	Typical No. of Lanes	Shoulder (m)	Sidewalk (m)
Urban Primary Road	60 - 80	3.00 – 3.50	4 - 6	1.0 – 3.0	2.0 – 4.0
Urban Secondary Road	40 - 60	3.00 – 3.25	2 --4	1.0 – 2.0	1.0 – 3.0
Urban Tertiary Road	30 - 40	2.50 – 3.00	1 - 2	0.5 – 1.0	0.0 – 2.0

Based on the proposed design standards, the typical cross section by road class is illustrated as follows.

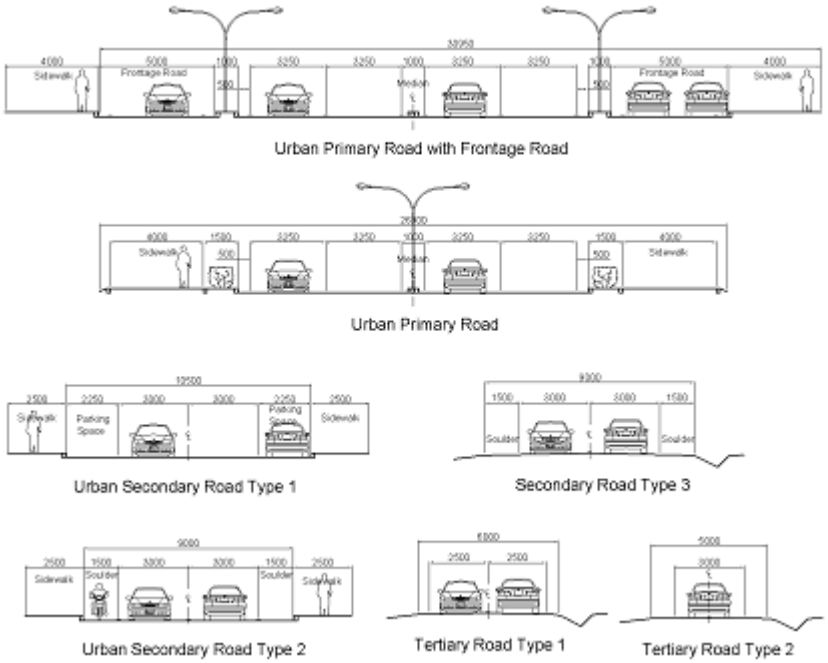


Figure 4.1 Typical Cross Section by Road Class

4.2 Traffic Demand Forecast

4.2.1 Methodology

The transport model framework uses a conventional 4 steps approach which has been well-tried and found to be effective in many cities around the world. During all steps of travel model calibrations and demand forecast, JICASTRADA system and EXCEL spread sheet are employed.

4.2.2 Future Modal Split

Based on the methodology mentioned above, future vehicle trip by vehicle category are projected as shown below.

Table 4.4 Future Vehicle Trips by Vehicle Category

Year	Pax. Car	Taxi	Mini Bus	Large Bus	Truck	Bike	Total
2008	36,457	157,192	8,609	726	10,536	34,763	248,282
2014	53,662	199,584	10,931	921	15,509	44,138	324,746
2019	75,945	240,349	13,165	1,099	21,950	53,151	405,659

Note; Pax Car = Passenger Car (Sedan or Pick up)

4.2.3 Traffic Assignment Results of Present Road Network

As a result, the average travel speed is decreased from 16.6 km/h in 2008 to 12.3 km/h in 2019, and VCR in 2019 reached 1.42, which means that the level of service on the road network will face a severe situation from the economic and environmental points of view.

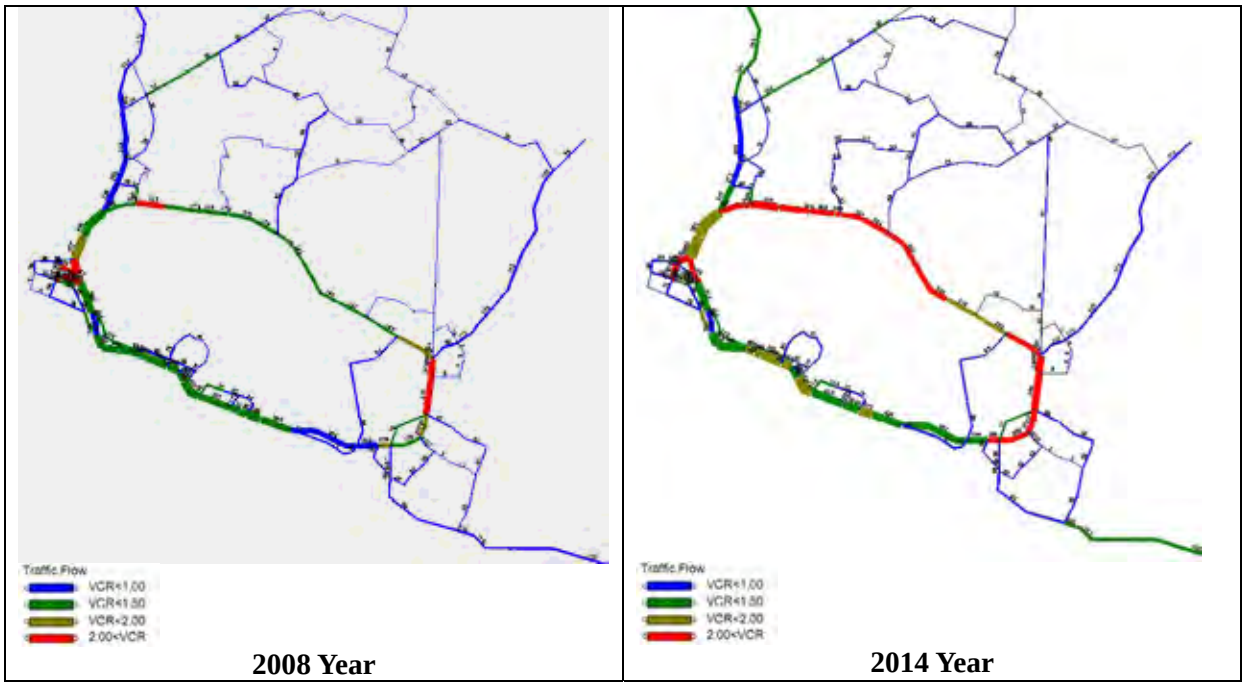


Figure 4.2 Traffic Assignment Result

4.3 Road Network Plan

4.3.1 Future Road Network Development Plan

Based on the road network development policies and the concept to integrate the land use plan and the transport system, the future basic road network system was developed.

Table 4.5 Summary of Road Network Plan

Road Class	Distance (km)
Urban Primary Road	60.4 km
Urban Secondary Road	105.0 km
Urban Tertiary Road	200.3 km
Total	365.8 km

Figure 4.3 Road Network Plan by Class

4.3.2 Component of Road Network Development Plan

Major projects for the Road Network Development Plan are summarized below.

(1) Johnson Street Improvement Project

a) Objectives of the Project

- To mitigate the traffic congestion
- To provide favorable and acceptable road service at crossroad of Mesurado marshland

b) Scope of the Project

- Construction of New Bridge parallel to the existing bridge: 450 m and Approach Road: 400 m

(2) Somalia Drive Improvement Project

a) Objectives of the Project

- To mitigate the traffic congestion
- To provide favorable and acceptable road service at ring road around Mesurado marshland

b) Scope of the Project

- Expanding carriage way to be 4 lanes for 13 km stretch
- Additional Bridge on Stockton Bridge
- Rehabilitation of existing Double Bridge
- Improvement of major intersections

(3) Bridge on Missing Link Improvement Project

a) Objectives of the Project

- To enhance accessibility to communities all year round

b) Scope of the Project

- Construction of: 11 bridges on Missing Links
- Construction of Approach road of bridge

4.3.3 Impact of Road Network Development Plan on Traffic Performance

The basic traffic indicators expressing traffic system performance of the road network development plan are assessed as shown below.

Table 4.6 Traffic Performance Indicators for Base Case and Master Plan Case

	Without Case (Base Case)			MP Case		(MP) - (Without)	
	2008	2014	2019	2014	2019	2014	2019
Trips	231,404	309,327	395,893	309,327	395,893	0	0
Vehicle*hour	116,771	196,062	312,151	118,213	174,277	-77,849	-137,874
Vehicle*km Total	2,416,421	3,308,815	4,399,289	3,328,223	4,410,534	19,408	11,245
Average Trip Length (km)	10.44	10.70	11.11	10.76	11.14	0.06	0.03
Average Travel Time (min)	30.3	38.0	47.3	22.9	26.4	-15.1	-20.9
Average Speed (km/h)	20.7	16.9	14.1	28.2	25.3	11.3	11.2

The emission unit by travel speed is set based on the standard unit as of 2007 in Japan, as shown below.

Table 4.7 Forecasting Results of Air Pollution in MP and Base Cases

	Without Case (Base Case)			MP Case		(MP) - (Without)	
	2008	2014	2019	2014	2019	2014	2019
CO2 (kg/ day)	502.1	757.2	1,092.7	607.5	845.5	-149.8	-247.2
NOx (kg/ day)	897.2	1,381.8	2,014.3	1,060.5	1,501.3	-321.2	-513.0
SPM (kg/ day)	83.8	127.3	183.6	100.1	140.1	-27.2	-43.5

4.4 Public Transportation Plan

4.4.1 Present Condition, Problems and Issues of Public Transport

So-called para transit including shared taxis, minibuses and motorcycle taxis are major transport means in passenger transport in Greater Monrovia

Such para transit locates at the equilibrium point of individuality and massiveness/regularity from the viewpoint of transport service, and also locates at the intermediate point between personal transport means and mass transport means from viewpoint of transport cost.

4.4.2 Public Transportation Policy for this Study

Following public transport policies for Greater Monrovia Area are proposed.

(1) Direction of Public Transport Modal Shift

- Esteem of para transit
- Promotion of shift to mass transit in the high transport demand density areas
- Improvement of interrelation between mass transit (bus) and para transit

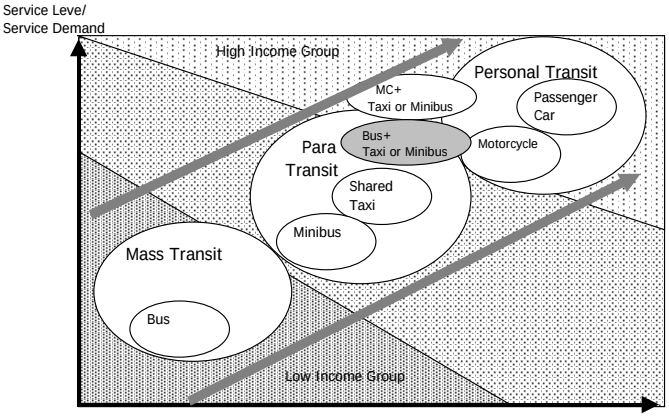
(2) Direction of Governmental Subsidization

- Improvement of public transport service efficiency through competition in the market
- Governmental subsidization for civil minimum

(3) Direction of Facility Rehabilitation and Reconstruction

- Intensification of interrelated network by terminal
- Promotion of shifting to circular route pattern
- Conformation of public transport service area to Urbanization Promotion Area

Urbanization Promotion Area was proposed in the former section on future urban structure. Public transport service area shall be provided within UPA based on the future urban structure.



Source: JICA Study Team

Figure 4.4 Relationship Between Income Level and Public Transport Mode

4.4.3 Component of Public Transport Project

(1) Public Transport Terminal Project

To arrange public transport terminals to streamline public transport network and improve road traffic fluidity.

(2) Para Transit Bay Construction Project

To construct para transit bays in the reaches of the trunk roads where traffic congestion often occurs.

(3) Bus Transport Technical Cooperation Project

To provide bus operator with technical cooperation to secure public transport service for basic human needs and to aim at environmental protection and safety improvement at the same time.

4.5 Traffic Management System Plan

4.5.1 Traffic Management Measures

(1) Measures of Traffic Engineering

a) Improvement of intersection and road section

Segregation of slow-speed vehicles from high-speed vehicles, pavement markings, exclusive left-turn lane, raised medians, sidewalk and crosswalk, prohibition of parking in and near intersections

b) Installation and Improvement of traffic signal

It is not necessary to introduce a high level signal system within the next five (5) years, but the existing local controllers of signals should be replaced by an up-to-date type of local controllers with required functions. Such new controllers should be used at all new intersections which are planned to be signalized.

(2) Promotion of Traffic Education

One of the reasons for the drastic increase in traffic accidents is the undisciplined behavior of drivers and pedestrians. Thus, promotion of traffic safety and traffic education is essential.

(3) Strengthening of Traffic Enforcement

At present, drivers observance and attitude to towards traffic regulations are extremely poor. Strengthening of traffic enforcement is necessary. Improvement in this area is important not only for the safety of the citizens but also for attracting foreign tourists.

4.5.2 Parking Facility

Based on the survey conducted in this Study, total number of parked vehicles is 3,457 vehicles at 30 km roadside length. As of parking by vehicle type, the major vehicle type is passenger car with 68%, follows by pickup trucks with 8%. The parking density on average is about 11.6 vehicles per 100m.

Table 4.8 Trend of Vehicle Trip Attraction

(unit; vehicle trip/day)

	Year 2008	Year 2014	Year 2019
Greater Monrovia (Growth Rate)	248,267	324,738	405,659
Monrovia CBD (Growth Rate)	45,381	54,947	63,570

Therefore, several measures, such as on-street parking prohibition, off-road parking and parking regulation should be introduced in order to reduce the frequent diversion of pedestrians onto the carriageway and the corresponding congestion of the affected road sections.

4.6 Project Implementation for Road and Transport Sector

Table 4.9 Preliminary Cost Estimation for Road and Transport Sector Project

Project Code	Project Name	Project Description	Cost (1,000USD)
TR-0	Emergency Infrastructure Project	✓ On-going Project by MPW and WB with LITF (multi donor fund)	18,600
TR-1	Johnson Street Bridge Construction	✓ Length 450 m, Width 12.2 m ✓ Approach Road 400 m	24,000
TR-2	Somalia Drive Improvement	✓ Road Length 13 km ✓ Road Wide 23 m – 27.5 m ✓ Improvement of Stockton and Double Bridges ✓ Improvement of major intersections	21,100
TR-3	Bridges on Missing Link Construction	✓ 11 bridges on Missing link, total length of bridge 305 m ✓ Width 5.5 m / 7.0 m ✓ Improvement of approach road	10,640
TR-4	Road Network Rehabilitation	✓ Urban Primary Road 60 km ✓ Urban Secondary Road 105 km ✓ Urban Tertiary Road 200 km	64,370
TR-5	Intersection Improvement	✓ 28 intersections ✓ Improvement of geometry design ✓ Installation of traffic signal ✓ ELWA Junction is on-going by WB	5,300
TR-6	Bus Stop and Terminal Improvement	✓ 5 Transit Terminals new construction ✓ 140 Bus Stops renovation / installation	6,800
TR-7	Traffic Management and Control Program	✓ Technical Transfer Program ✓ Pilot Project for Traffic control and safety	2,000
TR-8	Vai Town Bridge Construction	✓ Bridge length 240 m ✓ Improvement of approach road and Vai Town intersection ✓ On-going project by WB	15,000
TR-9	Monrovia CBD Rehabilitation	✓ Rehabilitation of 23 street in Monrovia CBD ✓ On-going project by WB	17,600
TR-10	Caldwell Bridge Construction	✓ Bridge length 110 m ✓ On-going project by WB	7,000
Road and Transport Sector Total			192,410

CHAPTER 5 URBAN FACILITITıES RESTORATION AND IMPROVEMENT PLAN (WATER SUPPLY SECTOR)

5.1 Strategy for Water Supply Plan

First goal, which is given in Poverty Reduction Strategy (PRS), is to raise water service coverage ratio to 50% by 2011 in overall Liberia.

Second goal is based on the sector development plan for 2019 on which LWSC puts its own policy. It is to raise water service coverage ratio to 100% in Greater Monrovia.

5.2 Basic Frame for Planning

The criteria for estimating water demand in each water use are as shown below.

Table 5.1 Criteria of Water Demand Projection

Water Use			Type of Supplying	Criteria
Administrative Population			For 2014	1,250,000 beneficiaries
			For 2019	1,470,000 beneficiaries
Service Coverage Ratio	House connection		For 2014	15% (Average of all the zones)
	Kiosk, Gantry, etc.			56% (Average of all the zones)
	House connection		For 2019	22% (Average of all the zones)
	Kiosk, Gantry, etc.			78% (Average of all the zones)
Domestic Water	[1]	House Connection		16Gal/capita/day (About 60liter/capita/day)
		Kiosk, Gantry, etc.		6Gal/capita/day (About 20liter/capita/day)
Institutional & Commercial Water	[2]=[1]x30%			30% of domestic water consumption
Industrial Water	[3]			0.132gal/ha/sec. (About 0.5liter/ha/sec.)
Physical Losses	[4]=([1]+[2]+[3])x30%		For 2014	30% of daily water consumption
	[5]= ([1]+[2]+[3])x25%		For 2019	25% of daily water consumption
Daily Maximum Water Demand	[6]= ([1]+[2]+[3]+[4])x120%		For 2014	120% of daily average water demand
	[7]= ([1]+[2]+[3]+[5])x120%		For 2019	

Source: JICA Study Team and World Bank Study Report (Republic of Liberia)

5.3 Water Supply Development Plan

5.3.1 Groundwater Development Plan

(1) Target Aquifer

The depth of the shallow aquifer is presumed to be within several meters and 20m. The present amount of water use is 16% of the amount of recharge. Therefore, there is still enough volume for groundwater development.

The depth of the deep aquifer is presumed to be within 20m and 50m. The deeper portion more than 50m deep is presumed to be inappropriate to develop as good aquifer because of the shale faces and hard rock condition.

(A) Distribution of Strata of Shallow Aquifer **(B) Distribution of Strata of Deep Aquifer**

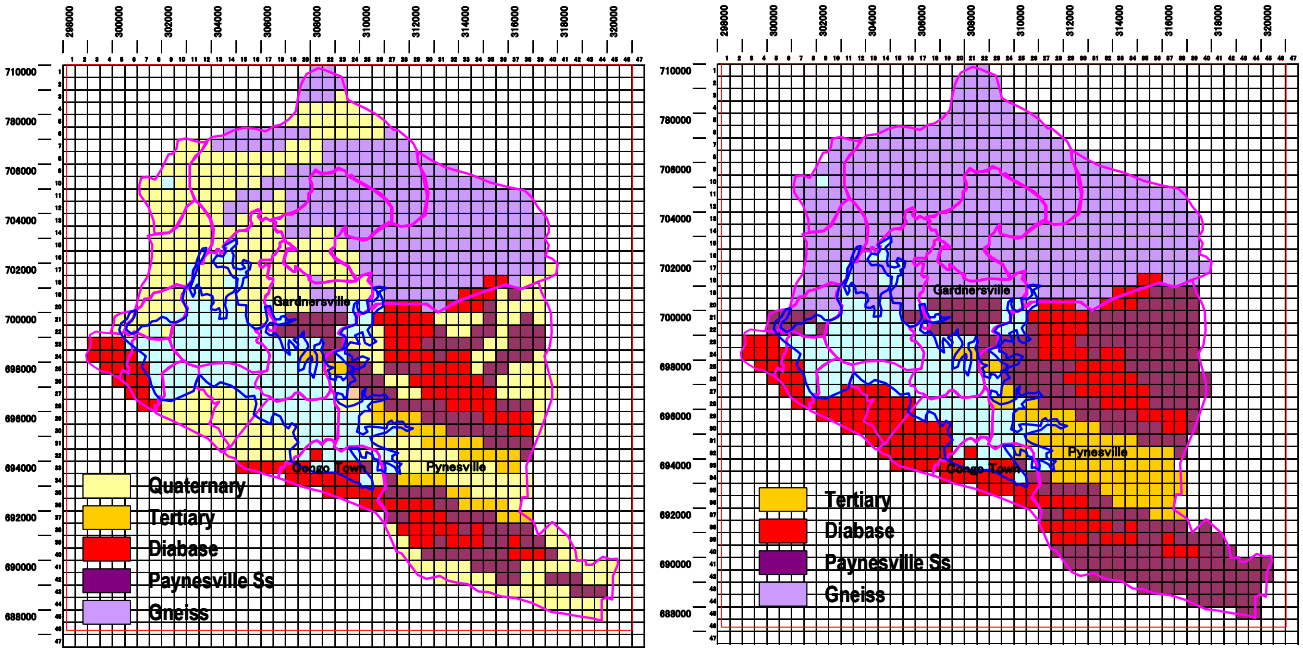


Figure 5.1 Geological Distribution of Shallow and Deep Aquifer

(2) Groundwater Development Potential

The southeast side of the study area and Du river area including areas to the east of the study area have possibility of high groundwater development potential.

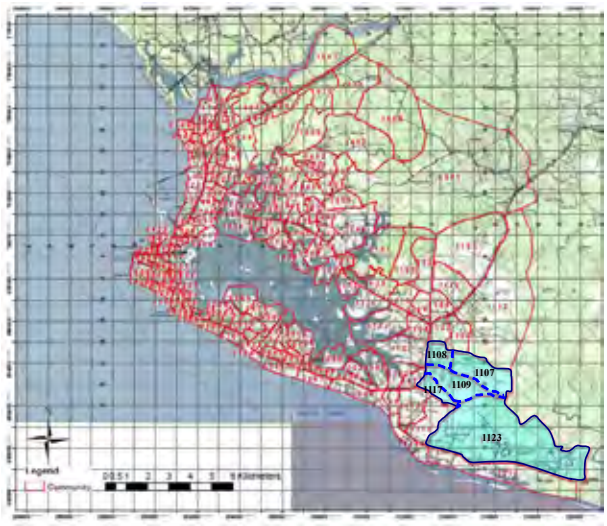


Figure 5.2 Target Groundwater Development Area

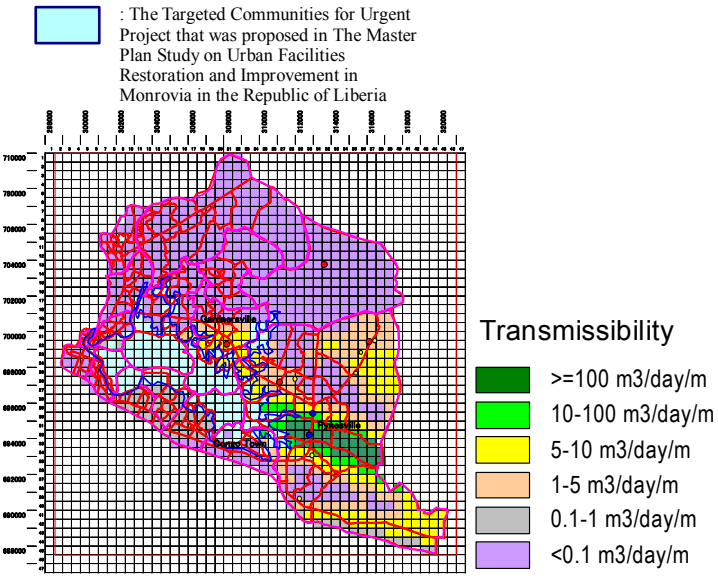


Figure 5.3 Groundwater Development Potential by Transmisivity

(3) Groundwater Development Area and Required Amount

Five communities which show the groundwater development area according to the short term plan of the water supply development plan above are the target area.

Table 5.2 Required Water Supply Amount of Each Community to Recharge

ID.	Community	Area	Water Supply Amount	Mean Annual Rainfall	Amount of Rainfall	Recharge	Supply Amount/ Recharge
		km^2	m^3/yr	mm	m^3/yr	m^3/yr	%
1107	Duport Road North-East	3.324	414,458	3,500	11,634,000	1,163,400	36
1108	Duport Road North	1.241	207,229	4,300	5,336,300	533,630	39
1109	Duport Road South	2.65	317,751	4,000	10,600,000	1,060,000	30
1117	Paynesville Joe Bar	1.018	221,044	4,500	4,581,000	458,100	48
1123	Rehab - Borbor Town	15.977	442,088	4,085	65,266,045	6,526,605	7

(4) Groundwater Development Project

The required well number to the required yield of each community is shown below.

Based on the groundwater development potential, required number of wells has been set up in consideration of distribution of Rank A, B, and C.

In addition, at the present stage, investigation for the development area is not carried out. Since the Rank A condition is uncertain, the estimation is carried out dividing into following 2 cases.

1) Case I: In case that water yield of $50m^3/day/m$ (Rank A) can be secured.

2) Case II: In case that water yield of $50m^3/day/m$ (Rank A) cannot be secured but 10-$50m^3/day/m$ (Rank B).

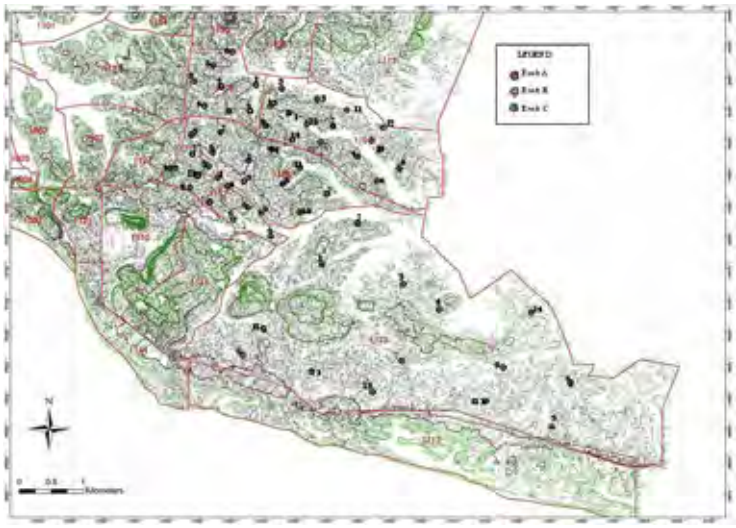


Figure 5.4 Arrangement of Production Wells for Groundwater Development Project

In addition, each case was examined as 70% of the strike rate for Rank A, 80% of the strike rate for Rank B, and 90% of a strike rate for Rank C.

A well arrangement plan is shown to the right.

Table 5.3 Required Number of Well of Each Community

ID	Community	Supply amounts of water (m^3/day)	Necessary Well Number					
			Case I			Case II		
			Rank A	Rank B	Rank C	Rank A	Rank B	Rank C
			359.4	99.1	44.5	359.4	99.1	44.5
1107	Duport Road North-East	1,135.5	5	0		0	15	
1108	Duport Road North	567.8	3	0		0	8	
1109	Duport Road South	870.6	3	2		0	11	
1117	Paynesville Joe Bar	605.6		1	12		1	12
1123	Rehab - Borbor Town	1,211.2		8	6		8	6
Total		4,390.6	40			61		

A: >= $50m^3/day/m$ B: 10-50 $m^3/day/m$ C: 5-10 $m^3/day/m$

5.3.2 Water Supply Development Plan

(1) Water Demand Projection

Future water demand in Greater Monrovia was estimated to be 18.8mln. Gal/day (about 71,000m^3/day) in 2014 and 30.3mln. Gal/day (about 114,000m^3/day) in 2019.

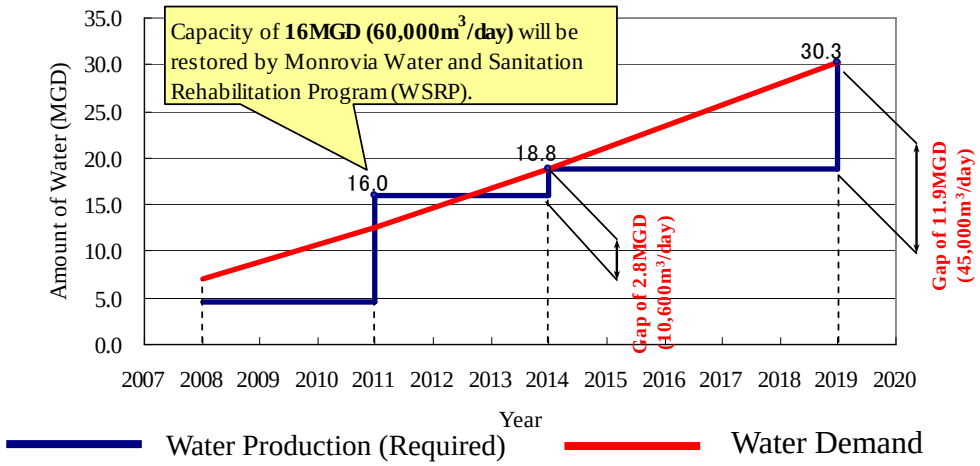
Table 5.4 Service Population and Water Demand in Greater Monrovia

Items		2008	2014	2019
Administrative Population		1,009,912	1,250,000	1,470,000
Service Population		372,436	888,800	1,470,000
Service Coverage Ratio	%	37	71	100
Water Demand	Gal/day	4,300,000	18,883,947	30,250,000
	m^3/day	16,276	71,476	114,496

Source: JICA Study Team

(2) Water Balance

The capacity of the existing White Plains water supply system is to be restored to 16MGD in 2011 through the Water and Sanitation Rehabilitation Program (WSRP). Hence, water production will exceed the water demand up to the year 2013. However, water production will be short by about 3MGD (about 10,000m^3/day) in Greater Monrovia in 2014, unless water supply system is developed after 2011.



Source: JICA Study Team

Figure 5.5 Trend of Water Production and Water Demand

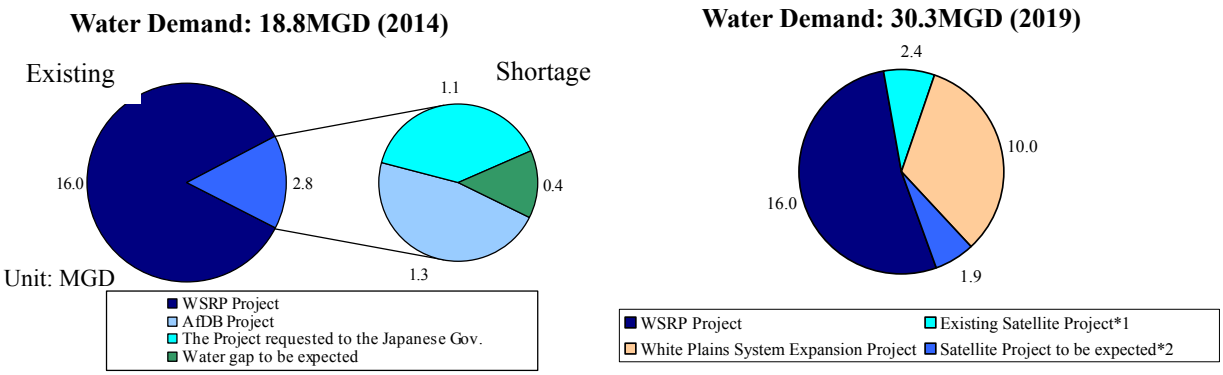
(3) Short Term Plan of Water Supply Development

Greater Monrovia will face water shortage of about 3MGD (about 10,000m^3/day) in 2014. Out of 3MGD, water of about 2.5MGD (Population: about 0.13millions) will be short in Paynesville zone, having the largest population in Greater Monrovia.

As an immediate action, project implementation of the satellite water supply system is expected to eliminate water shortage, realize stable water supply with safe quality water and contribute to raise water coverage ratio.

Total water demand in 2014 is 18.8MGD (about 70,000m^3/day), while water production of 16MGD (about 60,000m^3/day) is secured by WSRP. It is expected that the rest of 2.8MGD (about 10,000m^3/day) shall be covered by the satellite water supply system.

The target areas of PEDW are composed of five (5) communities of Duport Road North-East, Duport Road North, Duport Road South, Paynesville Joe Bar and Rehab - Borbor Town. Their service population is about 60,000, accounting for about 70% of the administrative population. Total water demand for the beneficiaries is about 1.1MGD (about 4,400m^3/day).



Source: JICA Study Team

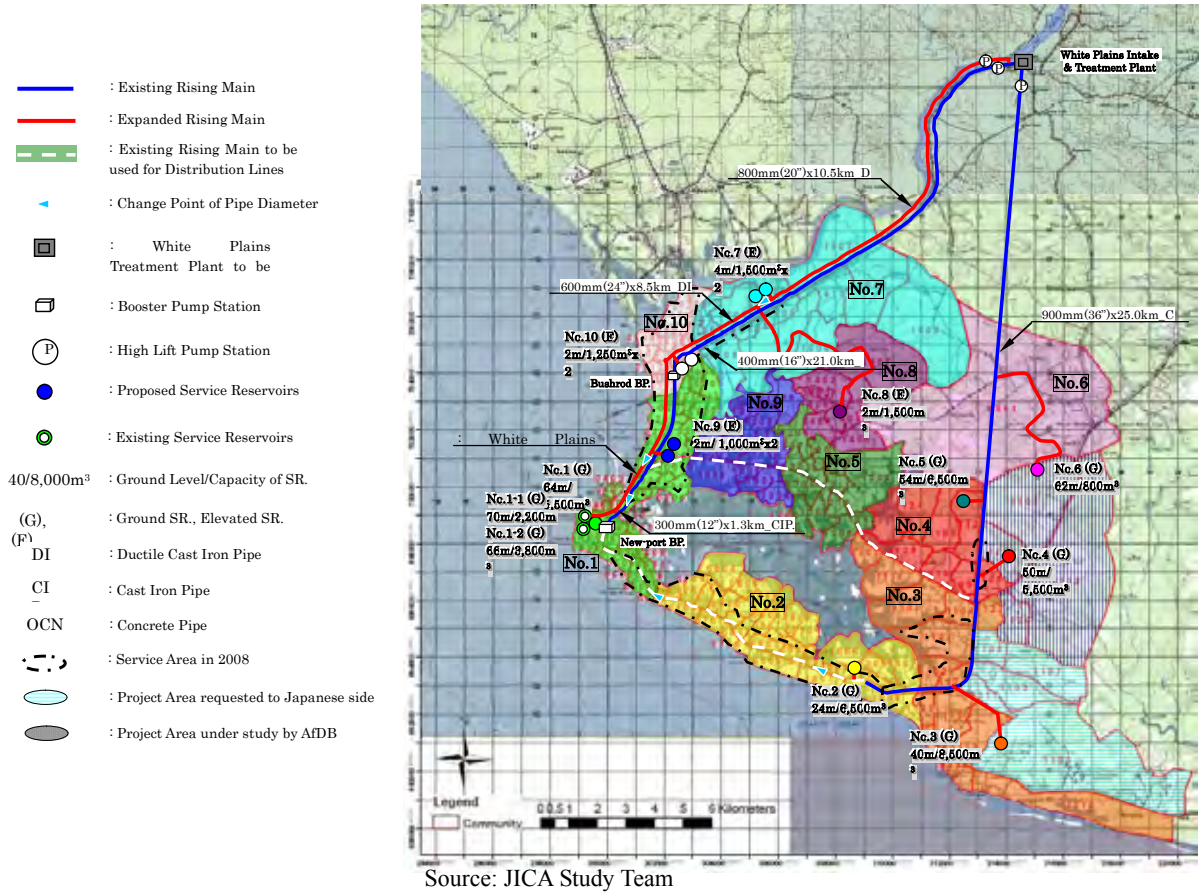
1 shows two projects: one is the project for the year 2014 requested to the Japanese side and the other is the project to be carried out by AfDB for the target year of 2014

2 shows the project which is mentioned hereinafter as the Project for Emergency Development of Water Supply System at Paynesville in Greater Monrovia (Phase II)

Figure 5.6 Water Production by Projects for 2014 and 2019

(4) Middle Term Plan of Water Supply Development

Unless the White Plains water supply system is expanded after 2014, water production will be about 12MGD (about 45,000m^3/day) short in Greater Monrovia in 2019. In the areas of some parts of Paynesville zone, dwellers will be supplied from the additional satellite water supply system as Phase II project since 2014 as well as before that. Water production in the additional satellite water supply system shall be expected to be about 1.9MGD (about 7,000m^3/day) by 2019, while water production of about 10MGD (38,000m^3/day) shall be covered by the White Plains water supply system to be expanded.



Source: JICA Study Team

Figure 5.7 Service Area and Conceptual Water Supply System in 2019

(a) Expansion Project of White Plains Water Supply System (EPWS)

In order to supply safe and stable water of 26MGD to dwellers of 1.1millions in Greater Monrovia, the existing White Plains water supply system is required to be expanded and improved drastically for the future. Table below shows future vision by facility in 2014 and 2019.

Table 5.5 Future Vision of the White Plains Water Supply System

Water Supply Facility	Current Situation in 2009	Restoration Plan for 2014	Improvement Plan for 2019
Water Sources	4.5 MGD (Saint Paul River) and in addition to small 0.1 MGD	24MGD (Max. capacity)	32MGD (Max. capacity)
Treatment Plant	4.3MGD	16MGD by 2011	32MGD (Max. capacity)
High Lift Pumps	7MGD	16MGD	26MGD
Rising Pipelines	4.5MGD	16MGD	26MGD
Service Reservoirs	1.6MG (not used)	1.6MG	15MG
Distribution Pipelines	200kms.	About 75% of the distribution pipelines to be rehabilitated by 2011 through the WSRP	Distribution pipelines shall be expanded to increase water supplying points .

Source: JICA Study Team

(b) Project for Expansion of Water Supply System at Paynesville in Greater Monrovia (PEWS) Phase II

In order to raise water service coverage ratio to 100% in Paynesville zone for the target year of 2019, PEDW shall be followed by Project for Expansion of Water Supply System at Paynesville in Greater Monrovia (Phase II) so that water of 1.9MGD (about 7,000m^3/day) can be produced and supplied for dwellers of 0.1millions.

(c) Technical Cooperation Project of Groundwater Management (TCPGM)

In order to supply safe and stable water to citizen using water source of deep groundwater, groundwater management system is to be established.

(d) Technical Cooperation Project of Non-Revenue Water Reduction (TCPNR)

In order to eliminate non-revenue water, capacity buildings shall be carried out.

Table 5.6 List of Water Supply Project

Project	Cost (mln USD)
Short Term (2014)	
Monrovia Water and Sanitation Rehabilitation Program (WSRP)	38.50
Monrovia Expansion and Rehabilitation of Three County Capitals (ERTC)	19.24
Project for Emergency Development of Water Supply System at Paynesville in Greater Monrovia (PEDW)	16.60
Medium Term (2019)	
Expansion Project of White Plains Water Supply System (EPWS)	128.62
Project for Expansion of Water Supply System at Paynesville in Greater Monrovia (PEWS) _Phase II	27.56
Technical Cooperation	
Technical Cooperation Project of Groundwater Management (TCPGM)	0.32
Technical Cooperation Project of Non-Revenue Water Reduction (TCPNR)	1.50

Source: JICA Study Team

5.4 Public Tap and Hand Pump Installation in Pilot Project

In order to improve O&M capacity of community on water supply management, satellite water supply system utilizing groundwater and hand pump were installed in three (3) sites in this study as a pilot project. O&M monitoring concerned with the communities and its water committees shall be conducted in the supplemental survey, which will begin in cooperation with JICA Study Team from the end of September 2009.

CHAPTER 6 URBAN FACILITIES RESTORATION PLAN (SANITATION SECTOR)

6.1 Strategy for Sanitation Plan

First goal, which was given in Poverty Reduction Strategy (PRS) is to raise sanitary service coverage ratio to 40% by 2011 in overall Liberia.

Second goal is based on the sector development plan for 2019 on which LWSC puts its own policy. It is to raise sanitary service coverage ratio to about 80% in Greater Monrovia.

6.2 Sanitation Development Plan

6.2.1 Overall Rehabilitation Plan

According to the result of the detailed survey conducted in several areas in Greater Monrovia, the following three types of sanitation system will be categorized and proposed as the appropriate system in Greater Monrovia.

- Off-site Sewerage System in the areas where sewerage facilities were installed before war.
- Community Sanitation System in the areas where private toilets are provided in community.
- On-site Sanitation System in the area where it is difficult to own private toilets.

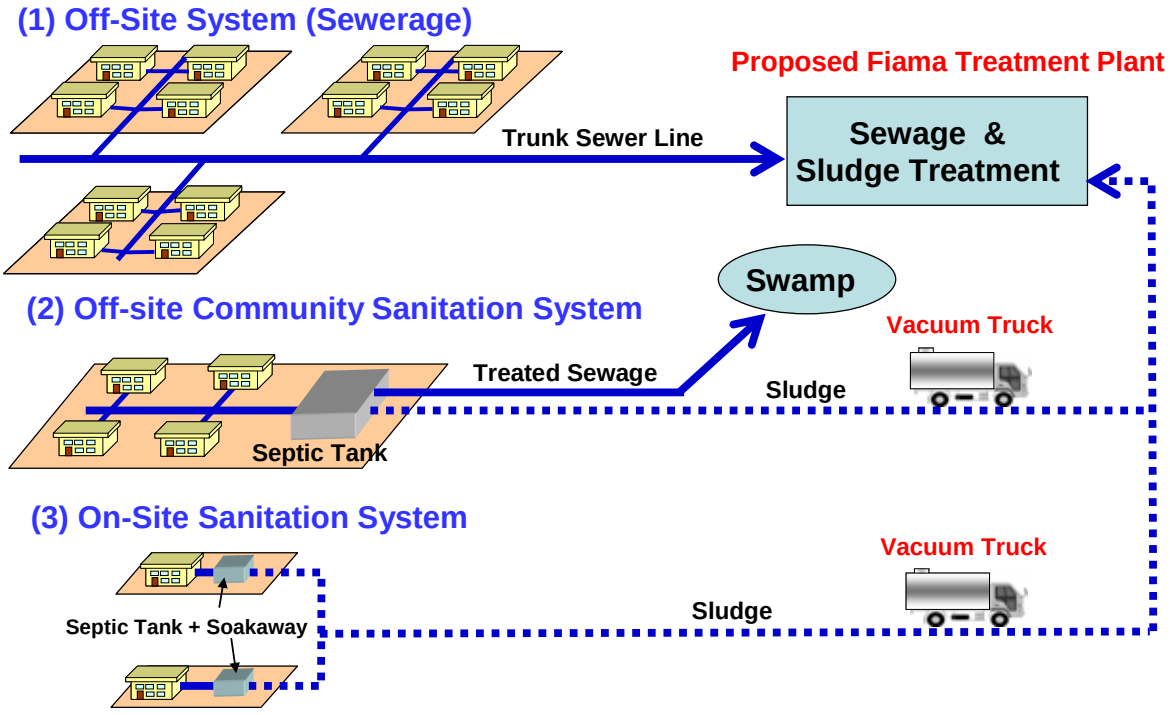


Figure 6.1 Type of Proposed Sanitation System in Greater Monrovia

According to the quantitative analysis of water usage, population density and current sanitation conditions in Greater Monrovia, the restoration plan as shown below are on going and proposed:

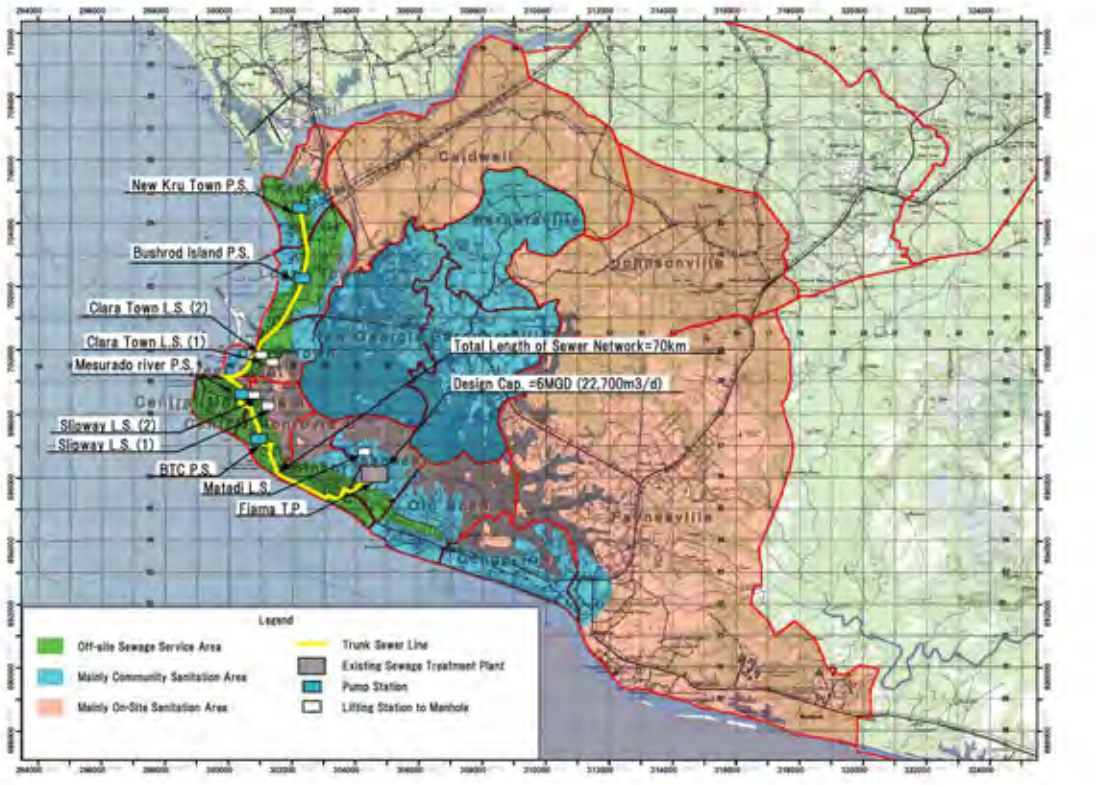


Figure 6.2 Areas to be Covered by Proposed Sanitation Systems in Greater Monrovia

Table 6.1 Restoration Plan for Sanitation Sector

Projects	Types of Projects	Progress Status (Source of Funds)	Target Year
1. Monrovia Water and Sanitation Rehabilitation Program	Immediate Rehabilitation of the Sewage Treatment Plant (Restoration on Stabilization Pond, Construction of 11 public Toilets and Procurement of one Vacuum Track)	On-going (AfDB)	2011
2. Urban Infrastructure Construction and Rehabilitation of Monrovia Sewage network Pumping Stations	De-sludge and Cleaning the blocked sewer pipelines in Central Monrovia to Sinkor area Rehabilitation of Pumping Stations (4 Nos.) and Lifting Stations (5 Nos.) in off-site Sewage pipelines for Central Monrovia	On-going (WB)	2011
3. Community Sanitation System and Public Toilet Installation & Vacuum Truck Procurement Plan	Installation and procurement: 1) 66 community sanitation systems and 225 public toilets 2) 8 vacuum trucks	Proposed in JICA M/P study	2014 (approx.50% of population with sanitation in Greater Monrovia)
4. The Project for Reconstruction of Sewage Treatment & Sludge Treatment Plant	1) Reconstruction of the sewage treatment plant of 6MG/day (22,700m^3/day) 2) Construction of sludge treatment plant of 230 m^3/day	Proposed in JICA M/P study	2019 (approx.80% of population with sanitation in Greater Monrovia)
5. Community Sanitation System and Public Toilet Installation & Vacuum Truck Procurement Plan	Installation and procurement: 1) 93 community sanitation systems and 86 public toilets 2) 7 vacuum trucks	Proposed in JICA M/P study	

6.2.2 Restoration Plan on Sanitation Sector

The following restoration and improvement shall be necessary in order to solve the current issues:

(1) Restoration Plan for the Target Year of 2014

- Community Sanitation System and Public Toilet Installation & Vacuum Truck Procurement Plan for the target year of 2014

(2) Restoration Plan for the Target Year of 2019

- Community Sanitation System and Public Toilet Installation & Vacuum Truck Procurement Plan for the target year of 2019
- Plan for Reconstruction of Sewage Treatment & Sludge Treatment Plant

6.3 Recommendation on Institutional Measures

In order to achieve goals of sanitation service, which is focused on the target year of 2019, since it is expected that projects for restoring and improving sanitation system be increased, exclusive division shall be required to be established in LWSC. The division shall be able to not only coordinate the projects appropriately, but also to make sanitation strategy plans, to which assisted by international organization will be needed.

On the other hand, development including improvement of sanitation services has not been conducted for long time during civil conflict. At the same time, water supply facility inventory, design manual, sewage and sanitation law have not been developed. In order to manage, implement sanitation project systematically, conduct O&M efficiently and standardize sanitation system, they should be developed urgently by LWSC, MLME and MPW.

6.4 Access Population and Ratio to Sanitary Facilities

The access population and ratio to the sanitary facilities will be developed as shown Figure 6.5-1 with the following two cases:

Case-1: Access population and ratio to all the sanitary facilities in Greater Monrovia

Case-2: Access population and ratio to the sanitary facilities in Greater Monrovia excluding public toilets.

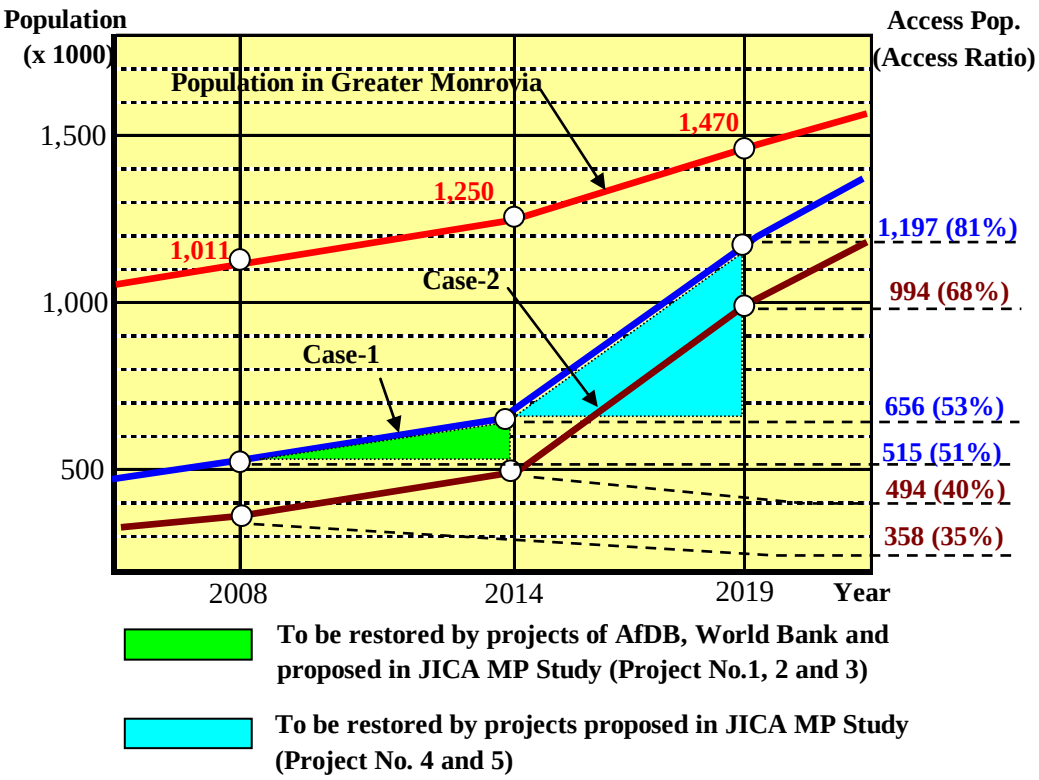


Figure 6.3 Trend of Access Population and Ratio to Sanitation Facilities for Greater Monrovia