KARACHI WATER & SEWERAGE BOARD(KW&SB)
THE ISLAMIC REPUBLIC OF PAKISTAN

No.

THE STUDY ON WATER SUPPLY AND SEWERAGE SYSTEM IN KARACHI IN THE ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT

Volume 2: Main Report

July 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

NIHON SUIDO CONSULTANTS CO., LTD.
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PREFACE

In response to the request made by the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct "The Study on Water Supply and Sewerage System in Karachi" and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to India a study team headed by Mr. Sadanobu SAWARA of Nihon Suido Consultants Co., Ltd. between February 2006 and July 2008. The study team was composed of members from Nihon Suido Consultants Co., Ltd. and Tokyo Engineering Consultants Co., Ltd. JICA also established an Advisory Committee, headed by Mr. Yoshiki OMURA, Senior Advisor, Development Research Institute of JICA, which, from time to time during the course of the study, provided valuable advice to the study team.

The team held discussions with the officials concerned of the Government of Pakistan and conducted field surveys in the study area. Upon returning to Japan, the team conducted further analyses and prepared the present report.

I hope that this report will contribute to the enhancement of the welfare of people in Karachi city and to the further strengthening of the friendly relationship between the two countries.

Finally, I wish to express my sincere appreciation to the relevant officials of the Government of Pakistan for their cooperation and the assistance extended to the study team.

July 2008

Ariyuki MATSUMOTO
Vice-President
Japan International Cooperation Agency

July 2008

Mr. Ariyuki MATSUMOTO
Vice President
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you this Final Report on the Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan. This report incorporates the views and suggestions of the authorities concerned of the Government of Japan and your Agency. It also includes the comments made on the Draft Final Report by the Karachi Water and Sewerage Board (KW&SB) and other authorities concerned of the Islamic Republic of Pakistan.

The Final Report comprises a total of three volumes as listed below.

Volume 1 : Executive Summary
Volume 2 : Main Report
Volume 3 : Appendixes

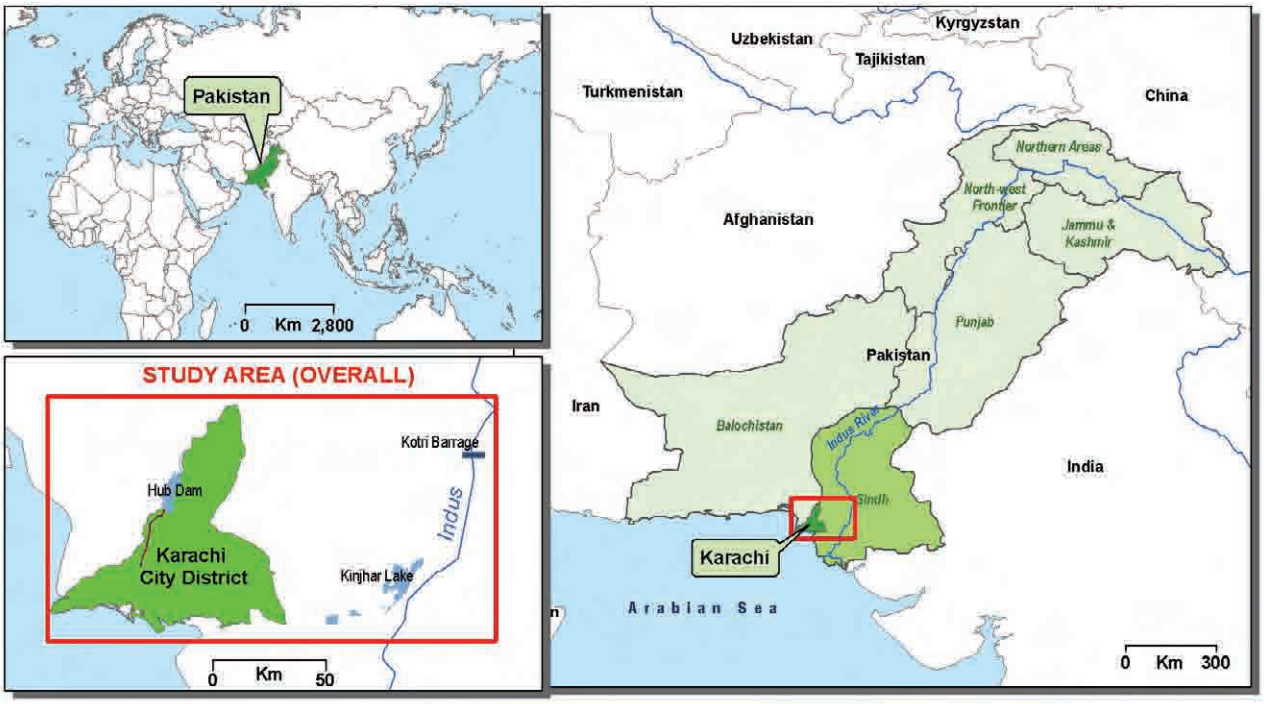
The report contains our findings, conclusions and recommendations with regard to the formulation of a master plan for the development of the water supply and sewerage system in Karachi up to the year 2025 and the identification of a Priority Project which is proposed to be implemented in the short- to medium-term future.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Health, Labour and Welfare of the Government of Japan for their valuable advice and suggestions. We would also like to express our deep appreciation to the relevant officers of the KW&SB and other authorities concerned of the Government of Pakistan for their cooperation and the assistance extended to us during our study.

Very truly yours,

Sadanobu SAWARA
Team Leader
Study on Water Supply and Sewerage System in Karachi
in the Islamic Republic of Pakistan

STUDY AREA LOCATION MAP



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
KARACHI WATER & SEWERAGE BOARD (KW&SB)

THE STUDY
ON
WATER SUPPLY AND SEWERAGE SYSTEM IN KARACHI
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT

Volume 2: Main Report

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Abbreviations

Abbreviation	Definition
AC	Asbestos Cement
ACR	Annual Confidential Report
AD	Anaerobic Digester Tank
ADB	Asian Development Bank
AEE	Assistant Executive Engineer
AERC	Applied Economic Research Centre
AP	Anaerobic Pond
APHA	American Public Health Association
B/C	Benefit-Cost Ratio
BOD	Biochemical Oxygen Demand
BOO	Build-Operate-Own
BOOT	Build-Operate-Own-Transfer
BOT	Build-Operate-Transfer
B/S	Balance Sheet
CAPEX	Capital Expenditure
CBO	Community-based Organization
CCB	Citizen Community Board
CDC	Commonwealth Development Corporation
CDGK	City District Government Karachi
CDWP	Central Development Working Party
CE	Chief Engineer
CETP	Common Effluent Treatment Plant
CIP	Cast Iron Pipe
CIS	Customer Information System
CMS	Complaints Management System
COD	Central Ordnance Depot
COD_{Cr}	Chemical Oxygen Demand (Cr)
CRC	Citizen Report Card
CRF	Capital Recovery Factor
CRO	Chief Revenue Officer
CSC	Consumers Service Centre
CWP	Cooling Water Pond
DA	Divisional Accountant
DDO	Drawing and Disbursement Officer
DGPS	Differential Global Positioning System
DHA	Defense Housing Authority
Dia	Diameter
DIP	Ductile Iron Pipe
DMA	District Metering Area
DNI	Distribution Network Improvement
DNM	Distribution Network Main
DO	Dissolved Oxygen
DPS	Distribution Pumping Station
DSR	Debt-Service Ratio
E&M	Electrical & Mechanical
ECIL	M/s. Engineering Consultants International
ECNEC	Executive Committee of the National Economic Council

EDO	Executive District Officer
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
Elect. Cond.	Electric Conductivity
EOI	Expression of Interest
EPA	Environmental Protection Agency
EPA-Sindh	Environmental Protection Agency, Sindh Government
FFA	Framework Financing Agreement
FFC	Federal Food Commission
FIRR	Financial Internal Rate of Return
FIS	Financial Information System
FP	Facultative Pond
F/P	Filtration Plant
FST	Final Settling Tank
GDP	Gross Domestic Product
GIP	Galvanized Iron Pipe
GIS	Geographic Information System
GKBWS	Greater Karachi Bulk Water Supply
GOB	Government of Balochistan
GOP	Government of Pakistan
GOS	Government of Sindh
GPS	Global Positioning System
H&S	Health & Safety
HRD	Human Resource Development
HRM	Human Resource Management
HSR	High Service Reservoir
IDA	International Development Agency
IEE	Initial Environmental Examination
IRS	Integrated Revenue System
IRSA	Indus River System Authority
IS	Information Systems
ISO	International Organization for Standardization
IT	Information Technology
IWRM	Integrated Water Resource Management
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
Katchi Abadis	Squatter Settlement
KB	Kalri Baghar
KDA	Karachi Development Authority
KDPPA	Karachi Division Physical Planning Agency
KESC	Karachi Electric Supply Corporation limited.
KG	Kinjhar – Gujjo
KMC	Karachi Metropolitan Corporation
KMCSDP	Karachi Mega City Sustainable Development Program
KPI	Key Performance Indicator
KPT	Karachi Port Trust
KMP	Karachi Master Plan - 2020
KSDP-2020	Karachi Strategic Development Plan 2020
KW&SB	Karachi Water & Sewerage Board
KWA	Karachi Water Authority
LIBOR	London Interbank Offered Rate

L.I.T.E	Landhi Industrial Trading Estate
LSR	Low Service Reservoir
LSU	Local Support Unit
M/P	Master Plan
MCA	Monopoly Control Authority
MD	Managing Director
MFF	Multitranche Financing Facility
MIS	Management Information System
MMP	Mott MacDonald Pakistan
MNF	Minimum Night Flow
MPGO	Master Plan Group of Offices
MPN	Most Probable Number
MS	Mild Steel
MSCL	Millennium Systems & Consultants (Pvt) Ltd
MSF	Multi-stage Flash
MWP	Ministry of Water & Power
NA	(Information) Not Available
Nadra / NADRA	National Database Registration Authority
NCS	National Conservation Strategy
NEK	North East Karachi
NEPRA	National Electric Power Regulatory Authority
NEQS	National Environmental Quality Standards (for Municipal and Liquid Industrial Effluent)
NGO	Non-Governmental Organisation
NLC	National Logistic Cell
NPV	Net present Value
NRW	Non Revenue Water
ODA	Official Development Assistance
O&M	Operation & Maintenance
OGRA	Oil and Gas Regulatory Authority
OPEX	Operational Expenditure
OPP-RTI	Orangi Pilot Project - Research and Training Institute
P & D	Planning & Development
P/L	Profit and Loss Statement
Pak-EPA	Pakistan Environmental Protection Agency
PC-1	Planning Commission-1
PCRWR	Pakistan Council for Research in Water Resource
PCSIR	Pakistan Council for Scientific and Industrial Research
PEMRA	Pakistan Electronic Media Regulatory Authority
PEPA 1997	Pakistan Environmental Protection Act 1997
PH	Power House
PI	Performance Indicator
PIU	Project Implementation Unit
PPP	Public-Private Partnership
PQA	Port Qasim Authority
PRCC	Pre-stressed Reinforced Cement Concrete
PS	Pumping Station
PS or P/ST	Pump Station
PSI	Pakistan Standard Institution
PSM	Pakistan Steel Mill
PSP	Private Sector Participation

PST	Primary Settling Tank
PTA	Pakistan Tanners Association
PTA	Pakistan Telecommunications Authority
PVC	Polyvinyl Chloride
RCC	Reinforced cement concrete
Res.	Reservoir
RFP	Request for Proposals
RTA	Regional Transport Authority
S.I.T.E	Sindh Industrial Trading Estate
SCADA	System Control and Data Acquisition
SCF	Standard Conversion Factor
SE	Superintendent Engineer
SEPA	Sindh Environmental Protection Agency
SITE	Sindh Industrial Trading Estate
SKAA	Sindh Katchi Abadis Authority
SLGO	Sindh Local Government Ordinance
SPM	Suspended Particulate Matter
SS	Suspended Solids
SSGC	Sui Southern Gas Company Limited
T/W	Treatment Works
TA	Technical Assistance
TCP	Technical Cooperation Project
TDM	Trunk Distribution Main
TDS	Total Dissolved Solids
TF	Trickling Filter
TKP	Tameer–e–Karachi Programme
TMA	Town Municipal Administration
ToR	Terms of Reference
TP	(Sewage) Treatment Plant
TPS	Transmission Pumping Station
TWL	Top Water Level
UASB	Upflow Anaerobic Sludge Blanket (Process)
UC	Union Council
UFW	Unaccounted for Water
UNDP	United Nations Development Programme
W&SS	Water & Sanitation Services
WAPDA	Water and Power Development Authority
WB	World Bank
WHO	World Health Organization
WLR & SS	Water Loss Reduction & System Strengthening
WS	Workshop
WSP-SA	Water and Sanitation Program – South Asia
WtP	Willingness to Pay

Units of Measurement

Abbreviation	Definition
%	percent
acft	acre feet
AF	acre feet
am	time between midnight and noon
℃	degree Celsius
cfu/ml	colony forming unit
cm	centimetre
cm^2	square centimetre
cusecs	cubic feet per second
dbt/d	dry basis ton per day
dl	decilitre
ft	feet
gpcd	gallon per capita per day
gpm	gallon per minute
gmcd	gram per capita per day
ha	hectare
hp	horsepower
in	inch
kg/d	kilogram per day
kg/m/h	kilogram per metre per hour
$kg/m^3/d$	kilogram per cubic metre per day
km	kilometre
km^2	square kilometre
KVA	kilovolt ampere
kW	kilowatt
kWh	kilowatt hour
l	litre
lpcd	litre per capita per day
m	metre
m/ha	metre per hectare
m/s	metre per second
m^2	square metre
m^3	cubic metre
m^3/d	cubic metre per day
m^3/h	cubic metre per hour
m^3/m	cubic metre per minute
$m^3/m^2/d$	cubic metre per square metre per day
m^3/s	cubic metre per second
m^3/y	cubic metre per year
MAF	million acre feet
MCM	million cubic metre
mg	million gallons
mg/l	milligram per litre
mgd	million gallons per day
ml	millilitre
mm	millimetre
Mm^3	million cubic metre

MMBTU	million British thermal unit
mph	miles per hour
MPN	most probable number
MW	megawatt
N/cm^2	newton per square centimetre
NTU	nephelometric turbidity unit
pm	time between 12 noon and 12 midnight
ppm	parts per million
Rs	Pakistan Rupee
TCU	true colour unit
US$	United States Dollar
wbt/d	wet basis ton per day
yd^2	square yard
μg/l	microgram per litre
μS/cm	micro-Siemens per centimetre

Unit Conversion

1 ft = 12 in = 0.304800 m
1 in = 0.025400 m = 0.083333 ft
1 m = 3.280840 ft = 39.370079 in

1 yd^2 = 0.000084 ha = 0.836127 m^2
1 ha = 10000 m^2 = 11959.900463 yd^2
1 m^2 = 1.195990 yd^2 = 0.000100 ha

1 AF = 0.271330 mg (imperial) = 1233.489000 m^3
1 mg (imperial) = 4546 m^3 = 4 AF
1 m^3 = 0.000811 AF = 0.000220mg (imperial)

1 cusecs = 0.5382 mgd (imperial) = 2447 m^3/d
1 mgd (imperial) = 4546 m^3/d = 1.858 cusec
1 m^3/d = 0.000409 cusec = 0.00022 mgd (imperial)

1 lpcd = 0.219969 gpcd (imperial)
1 gpcd (imperial) = 4.546090 lpcd

SUMMARY

S1 BACKGROUND OF THE STUDY

S1.1 FORMULATION OF JICA STUDY

Karachi is the capital of the province of Sindh and the largest city in Pakistan with a total present population of approximately 16 million. It is playing pivotal roles in the nation's economic and industrial activities. However, due mainly to the significantly large population growth rates (4 to 5% per annum), which the city has experienced over the last three decades, the augmentation of the water supply system including water source, bulk conveyance system and distribution network has consistently lagged behind the fast growing water demand of the city. The consequence is the rationing of supply currently experienced in most areas of the city, where water is supplied only once in every two to three days and for the duration of a few hours at a time. People are obliged to spend money on ground-level tanks, booster pumps, roof-top storage tanks and water filters and even then all water must be boiled prior to drinking. Many households are compelled to use secondary sources of water such as shallow wells or tanker supplies (costing in excess of US$ 1.50/m^3) just to meet their basic needs.

The existing sewerage system, of which service coverage is said to be 30% at present, has also a number of problems. They include low sewage flows received at existing sewage treatment plants resulting from the inadequate provisions of sewer trunk mains and the malfunctioning of pumping facilities, deterioration of water quality in rivers and canals, and clogging of waterways caused by damping of massive rubbish.

In Karachi, a master plan for the water supply system was prepared in 1985 and that for the wastewater management system in 1988. In the past, however, only a few projects were actually implemented based on the recommendations of these master plans mainly because of the financial constraints. After the elapse of almost two decades since preparation of these master plans, situations surrounding the city have changed so significantly that the development plans proposed by these master plans have largely become obsolete or greatly deviated from the actual needs of the city. This eventually lead to the formulation of a broad consensus in Pakistan that these master plans should be reviewed and revised for the future development of water supply and sewerage systems as well as for the optimization of the water services management.

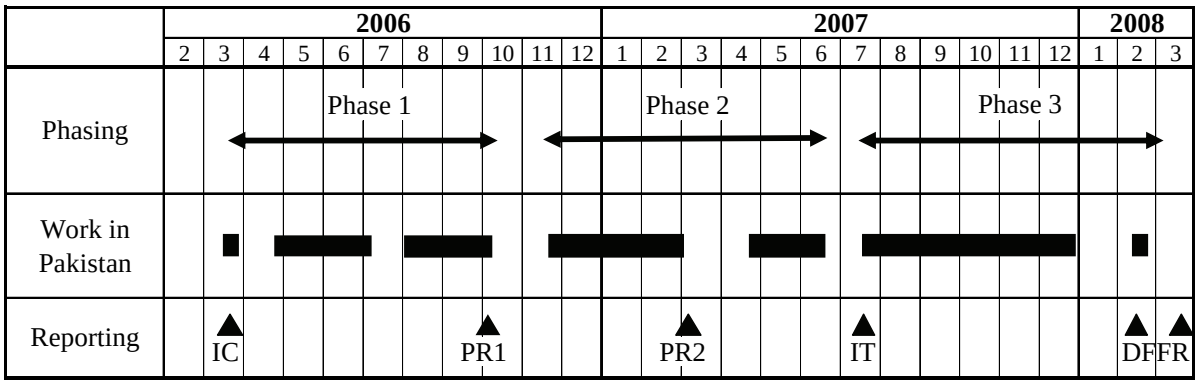
Against the background mentioned above, the Government of Pakistan officially requested the Government of Japan to conduct a master plan study to formulate a phased development plan of water supply and sewerage system for Karachi up to the year 2025.

In response to the request of the Government of Pakistan, the Government of Japan through the Japan International Cooperation Agency (hereinafter referred to as 'JICA') dispatched a preparatory study team to Pakistan in July 2005 and the "Scope of Work for the Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan (hereinafter referred to as the 'S/W')" was agreed upon on 13 July 2005 between JICA on one part and the City District Government Karachi (hereinafter referred to as "CDGK") and the Karachi Water and Sewerage Board (hereinafter referred to as 'KW&SB') on the other part.

S1.2 IMPLEMENTATION SCHEDULE OF JICA STUDY

It was originally agreed that the Study would be implemented in the following three phases over a total period of approximately two years as shown in **Figure S12.1.1**.

Phase 1: Basic Study (March 2006 to October 2006)
Phase 2: Master Plan (November 2006 to June 2007)
Phase 3: Feasibility Study (July 2007 through March 2008)



IC : Inception Report
PR1 : Progress Report No.1
PR2 : Progress Report No.2
IT : Interim Report
DF : Draft Final Report
FR : Final Report

Figure S12.1.1 Original Implementation Schedule of JICA Study

However, due to the additional work required during the Phase 3 for the finalization of the water supply and sewerage master plan, the Study period was extended for approximately 3 months until June 2008. The inclusion of this additional work and the extension of the Study period were agreed at the Steering Committee meeting held on August 8, 2007, which discussed the Interim Report of the Study. **Figure S12.1.2** shows the implementation schedule, according to which the JICA Study was actually carried out.

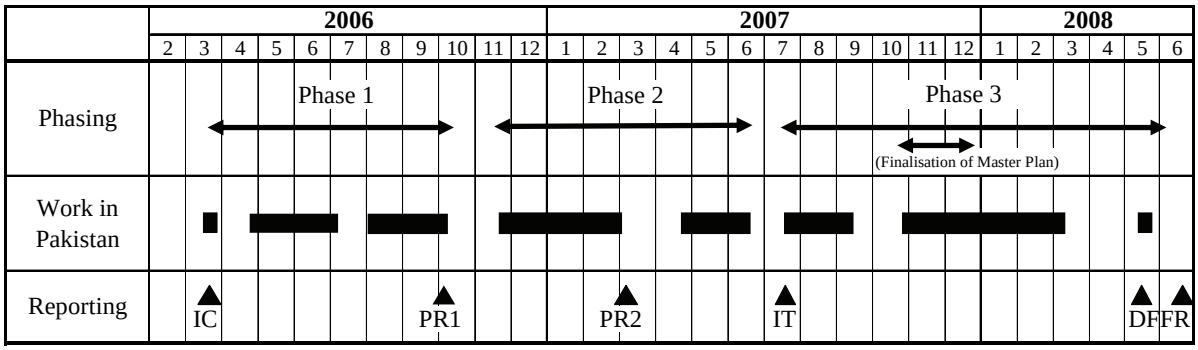


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Figure S12.1.2 Actual Implementation Schedule of JICA Study

S2 OBJECTIVES OF THE STUDY AND STUDY AREA

S2.1 OBJECTIVES OF THE STUDY

It was agreed in the S/W dated 13 July 2005 that the "Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan (hereinafter referred to as the 'Study')" would be conducted by a team of consultants appointed by JICA (hereinafter referred to as the 'JICA Study team') with the main objectives of (a) formulating a master plan for development of the water supply and sewerage systems in Karachi up to the target year of 2025, (b) conducting a feasibility study on the priority projects selected in the master plan, and (c) pursuing technical transfer to Pakistani counterpart personnel in the course of the Study. KW&SB, the organization currently responsible for the provision of water and sewerage services in Karachi, was the counterpart agency to the JICA Study team. KW&SB also acted as a coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

S2.2 STUDY AREA

The Study area covers the entire administrative area of the City District Government Karachi (CDGK) and other areas administered by various agencies such as the Government of Pakistan, Government of Sindh, 6 Cantonment Boards, Defence Housing Authority, Port Qasim Authority, Karachi Port Trust, Pakistan Railways, Sindh Industrial Trade Estate, Lyari Development Authority, Malir Development Authority and Cooperative Housing Societies. In addition, it also covers areas outside the CDGK's administrative boundaries where water sources and bulk water transmission facilities currently exist or have been planned for future development.

The CDGK's administrative area occupies an area of 2,787 km^2. It is administratively divided into 18 Towns which are further sub-divided into 178 Union Councils (UCs). **Table S22.1.1** provides the names and areas of the 18 Towns and the number of UCs included in each Town.

Table S22.1.1 18 Towns and 178 Union Councils

Sr No	Town	Area			No. of Union Councils[2)]
		Acres[1)]	km^2	%	
1	Keamari	106,217	429.84	15.4%	8
2	SITE	6,286	25.44	0.9%	9
3	Baldia	7,217	29.21	1.0%	8
4	Orangi	5,803	23.48	0.8%	13
5	Lyari	1,977	8.00	0.3%	11
6	Saddar	5,967	24.15	0.9%	11
7	Jamshed	5,790	23.43	0.8%	13
8	Gulshan-E-Iqbal	13,260	53.66	1.9%	13
9	Shahfaisal	2,901	11.74	0.4%	7
10	Landhi	9,670	39.13	1.4%	12
11	Korangi	10,247	41.47	1.5%	9
12	North Nazimabad	4,127	16.70	0.6%	10
13	North Karachi	5,058	20.47	0.7%	13
14	Gulberg	3,417	13.83	0.5%	8
15	Liaqatabad	2,685	10.87	0.4%	11
16	Malir	4,395	17.78	0.6%	7
17	Bin Qasim	137,961	558.31	20.0%	7
18	Gadap	355,798	1,439.86	51.7%	8
Total		688,776	2,787.37	100.0%	178

Source: 1) KSDP-2020, Page 43; 2) JICA Fact Finding & Recommendation Study on Water Supply and Sewerage System in Karachi - Final Report March 2005, Table 2.1, Page 2-2

S3 EXISTING WATER SUPPLY AND SEWERAGE SYSTEMS

S3.1 WATER SOURCES

S3.1.1 Existing Water Sources

(1) The Indus River

The Indus River, the main source of water for Karachi, is severely constrained by dry season water demand, but has abundant wet season discharges. Except during the summer flood season, very little water escapes to the sea. The quota for urban supplies in Karachi from the River Indus was first sanctioned on May 11, 1957, which allowed Karachi to take 450 cusecs (242 mgd or 1,100,000 m^3/d) from 16 October to 15 April (rabi) and 520 cusecs (280 mgd or 1,270,000 m^3/d) from 16 April to 15 October (kharif) from the tail of the system at Kotri, through storage in Kinjhar Lake. Later, a presidential decree in 1988 increased this quota to 1,200 cusecs (645 mgd or 2,940,000 m^3/d).

In March 1991, representatives of the four provinces held a series of meetings in Lahore and Karachi and agreed on the apportionment of the waters of the Indus River System as shown in **Table S31.1.1**.

Table S31.1.1 1991 Water Apportionment Accord

Province	Kharif		Rabi		Total	
	MAF	MCM	MAF	MCM	MAF	MCM
Punjab	37.07	45,725	18.87	23,276	55.94	69,001
Sindh*	33.94	41,865	14.82	18,280	48.76	60,145
N.W.F.P (a)	3.48	4,293	2.30	2,837	5.78	7,130
(b) Civil Canals**	1.80	2,220	1.20	1,480	3.00	3,700
Balochistan	2.85	3,515	1.02	1,258	3.87	4,773
Total	77.34	95,398	37.01	45,651	114.35	141,049
	1.80	2,220	1.20	1,480	3.00	3,700

* Including already sanctioned Urban and Industrial uses for Metropolitan Karachi
** Ungauged Civil Canals above the rim stations
MAF: Million Acre Feet. MCM: Million Cubic Metre

Source: Water Apportionment Accord, 1991

Water from the Indus River is distributed over the Sindh Province through three barrage systems, namely, Guddu, Sukkur and Kotri. **Table S31.1.2** presents the allocation of the provincial quota to each of these three barrage systems. Urban and industrial water for Karachi is taken from the Kotri Barrage and discharged through the Kalri Baghar Feeder Upper (KB Feeder Upper) to Kinjhar Lake. Kotri Barrage is the lowest barrage of the Indus River.

Table S31.1.2 Allocation of Provincial Quota in Sindh State

Month	Period	Barrage System (1,000 cusec)			
		Guddu	Sukkur	Kotri	Total
April	1	0.00	34.00	6.20	40.20
	2	0.20	34.30	6.80	41.30
	3	1.40	31.60	6.90	39.90
May	1	3.70	35.10	12.30	51.10
	2	6.50	39.50	15.70	61.70
	3	12.60	43.10	21.70	77.40
Jun	1	22.70	49.10	26.90	98.70
	2	31.10	56.00	32.60	119.70
	3	35.20	60.60	33.80	129.60
Jul	1	41.10	61.20	34.20	136.50
	2	36.20	57.10	29.80	123.10
	3	30.10	54.30	31.00	115.40
Aug	1	28.50	54.00	27.60	110.10
	2	27.80	54.40	28.40	110.60
	3	28.70	54.60	23.80	107.10
Sep	1	26.50	55.10	27.60	109.20
	2	26.80	57.50	25.10	109.40
	3	25.80	55.80	23.30	104.90
Oct	1	17.60	43.60	18.00	79.20
	2	10.20	37.80	14.50	62.50
	3	6.30	33.00	11.30	50.60
Nov	1	4.10	31.40	9.60	45.10
	2	3.50	31.40	7.50	42.40
	3	3.20	31.10	5.70	40.00
Dec	1	2.60	31.40	5.00	39.00
	2	1.99	31.80	4.70	38.49
	3	1.99	26.30	4.50	32.79
Jan	1	5.40	12.30	3.10	20.80
	2	10.40	5.40	8.60	24.40
	3	5.50	20.30	11.70	37.50
Feb	1	1.30	31.90	8.80	42.00
	2	1.70	31.10	4.90	37.70
	3	2.30	30.00	5.20	37.50
Mar	1	2.70	29.70	4.40	36.80
	2	3.40	29.40	4.20	37.00
	3	2.00	28.50	4.70	35.20

Source: Water Apportionment Accord, 1991, Annexure - II

Kinjhar Lake is a natural reservoir, the storage of which has been increased by constructing nearly 20 km of embankments having a maximum height of 9 m. The lake has a catchment area of 910 km^2. The lake has a surface area of about 30,000 acres (12,000 ha or 120 km^2) and a useable storage capacity of 390,000 acft (481,000,000 m^3). Water leaves the lake through the KG (Kinjhar - Gujjo) Canal which supplies settled water directly to the intake at Gujjo.

The Indus River System Authority (IRSA) is being responsible for the implementation of the 1991 Water Apportionment Accord while Kotri Barrage, KB Feeder and Kinjhar Lake are being maintained by the Irrigation Department of the Government of Sindh. The existing quota for the KW&SB from the Indus River is 1,200 cusec (645 mgd or 2,940,000 m^3/d) and it has already been exhausted by the completion of the K-III Project in May 2006.

The existing quota for the KW&SB from the Indus River (1,200 cusecs or 645 mgd or 2,940,000 m^3/d) has already been exhausted by the completion of the K-III Project in May 2006.

At present, the KW&SB is supplying approximately 580 mgd (2,640,000 m^3/d) of Indus water

to Karachi through various schemes shown in **Table S31.1.3**.

Table S31.1.3 Present Supply from the Indus River

Raw Water Bulk Supply	Pakistan Steel Mill (PSM)	26 mgd
	Port Qasim Authority (PQA)	7 mgd
Gharo		28 mgd
GKBWS		480 mgd
Army Pump House		40 mgd
Total		581 mgd

Source: KW&SB

At present, KW&SB is supplying approximately 580 mgd (2,640,000 m^3/d) of Indus water to Karachi through various schemes.

(2) Hub Dam

The Hub Dam is a multi-purpose dam (municipal, industrial and irrigation purposes) constructed on the Hub River approximately 50 km to the north-west of Karachi City. The construction of the dam started in September 1963 and completed after 18 years in September 1981. The catchment area of the dam extends across two provinces, namely Sindh and Balochistan, covering a total area of 3,410 sq miles (8,730 km^2). There has been an agreement between the two provinces that, at the Regulator located at the end of the Hub Main Canal, 63.3% of the total flow from the dam will be diverted to the Karachi Water Supply Canal (Sindh) while 36.7% to the Lasbela Canal (Balochistan).

Completed in 1981, the dam was first filled up with water in 1984. It was again filled up in 1989, 1992, 1994, 1995 and 2003. The last time the dam was filled up was August 2007. During the 8 years from 1995 to 2003, the dam was never filled up. As a result, the supply from the dam reduced to almost zero during the four years from July 1999 till June 2003. The dam has a design capacity of 717,000 acft (884, 000, 000 m^3) with the following operational properties.

Maximum Water Level : 339 ft (103.3 m) above the mean sea level
Lowest Water Level : 276 ft (84.1 m) above the mean sea level
Effective Water Depth : 63 ft (19.2 m)

In 1985, a yield analysis of the Hub River was conducted based on the 18 year discharge data collected at the Bund Murad Khan gauging station. The analysis indicated that at the 95% level of reliability the corresponding yield from the dam was 124,000,000 m^3 /yr (340,000 m^3/d or 75 mgd).

The yield analysis of the Hub River conducted in 1985 indicated that at the 95% level of reliability the corresponding yield from the dam was 75 mgd (340,000 m^3/d).

(3) Dumlottee Well Field

In the later half of the 19th century, water for Karachi was supplied from the Dumlottee Well Field, located on the banks of Malir River in the Dumlottee area about 30 km to the northeast of the city. A number of large diameter shallow wells constructed in the Malir river alluvium provided about 8 mgd (36,340 m^3/d) of water to Karachi through a gravity conduit. For many years since then, the well field remained as the main source of supply for Karachi.

The capacity of the system was increased to 20 mgd (90,800 m^3/d) in 1923 by adding some more wells, a 15 mgd gravity conduit and two 6 mgd reservoirs. However, the supply from this system has gradually decreased over time to 4 mgd by 1985, and to 1.5 mgd in 2002 and afterwards. At present, this system can produce merely 1.4 mgd (6,300 m^3/d) of water during only a few months after the rainy season. The system is almost dry for the rest of the year.

Excessive quarrying of sand from the river bed of Malir River combined with the extensive use of groundwater by farmers in the area is considered to be the main reason for the depletion of the well yield. The overall picture of the Dumlottee Well Field is that it is no longer a reliable source of supply for Karachi.

The overall picture of the Dumlottee Well Field is that it is no longer a reliable source of supply for Karachi.

S3.1.2 Future Development of Water Sources

It was agreed in the Minutes of Meeting on S/W of JICA Study signed on 13 July 2005 that the JICA Study would not include any new studies on the development of water sources in its scope of work, but it would examine existing relevant data and reports to explore the possibility of alternative resources including storage, desalination, reuse of wastewater and other options.

(1) Surface Water

The 1985 water supply master plan study conducted by Sir M. MacDonald and Partners (principal consultant) and Associated Consulting Engineers (local associated consultant) made a review of all potential water sources in the Karachi region, which included the Indus River and other surface water and groundwater sources, seawater desalination, and the indirect reuse of treated sewage effluents for the recharge of aquifers and substitution of existing non-potable uses. As a result, the study indicated that the Indus River and desalination are the only two sources that could technically meet a large water demand in Karachi. The study also indicated that the cost of desalination for the foreseeable future was prohibitive and that desalination should therefore be considered as a last resort. The study then concluded that the Indus River was the only viable water source for Karachi.

The 1985 water supply master plan study concluded that the Indus River was the only viable water source for Karachi.

In 2002, in response to the Central Development Working Party (CDWP), GOS established an ad-hoc committee comprising of representatives from the Planning and Development Department of GOS, Irrigation and Power Department of GOS, and Karachi Water & Sewerage Board (KW&SB). The committee prepared a report on long term water supply plan for Karachi up to the year 2025 and submitted the report to the CDWP on November 14, 2002. In summary, the report provided the following major findings and recommendations.

(Findings)

- Existing allocation of 1,200 cusecs from the Indus River would be fully utilized in 2005 with completion of the 100 mgd K-III project. The population of Karachi was ever growing and additional requirement up to year 2025 was estimated to be another 1,200 cusecs thus the total requirement would be 2,400 cusecs.
- The present scheme of assured water supply for Karachi should be treated as Phase-I to cater short-term Assured Water Supply for Karachi City up to year 2005. The Phase-II of this scheme would be required for long-term requirement of water supply to Karachi to cater requirements beyond 2005 and up to 2025.

(Recommendations)

- For growing water demand of Karachi the allocation for Karachi up to 2025 may be increased, by another 1,200 cusecs raising the total allocation to 2,400 cusecs, by the Government under a national cause without affecting supply of water quota of the Thatta District for agriculture purposes. Once additional allocation was allowed then a 2-stage study programme for expansion of system would have to be initiated.
- Stage-I: Study by the Irrigation and Power Department of GOS for increasing capacity in the system from the KB Feeder Upper up to the Kinjhar Lake without affecting the

stability of the Kotri Barrage.

- Stage-II: Feasibility study by KW&SB in consultation with the Irrigation and Power Department of GOS from the Kinjhar Lake to Karachi determining the most economically viable, technically feasible and secure route.

In November 2002, an ad-hoc committee constituted by the Government of Sindh prepared a report on long term water supply plan for Karachi up to the year 2025. The committee concluded in the report that Karachi would need additional quota of 1,200 cusecs (total 2,400 cusecs) from the Indus River to meet the city's future water requirement up to the year 2025.

Based on the recommendations of the above committee, the KW&SB initiated a feasibility study titled 'Feasibility Study for Future Alternative Route of Bulk Water Supply and Long Term Expansion of Karachi Water Supply System from Kinjhar Lake – K-IV Project of Karachi Water and Sewerage Board' in December 2005, and issued "Executive Summary" in May 2007 (see **S4.2** for details).

Past operation records of the Hub dam indicate that the dam is not an entirely dependable water source. Many now observe that the dam could serve as a standby reservoir for the best. There is no real prospect of expanding this surface water source in the future.

There is no real prospect of expanding the Hub water source in the future.

Meanwhile, no studies examining the exploitability of local surface water sources have been conducted to date. Potential local surface sources would include the Thadoo, Mole and Khadeji Nallahs, and the reactivation of the Haleji Lake. Although the exploitability of these sources as a reliable source of water supply for Karachi appears to be very low, it would be worth conducting studies to examine the potentiality of these sources if accurate flow records covering at least 25 years in the past are available.

(2) Groundwater

The 1985 water supply master plan study made a review of all potential water resources in the Karachi region including groundwater. This review concluded that other groundwater sources in the region were of relatively small magnitude with the total potential yield of all the groundwater sources within 100 km radius from Karachi being as insignificant as 4 mgd (18,000 m^3/d).

In 2004, KW&SB conducted a study to explore the possibility of developing groundwater sources in the region as a source of water supply for Karachi. The study was titled "Feasibility Study to Explore Groundwater Source in Karachi District" and explored the availability of groundwater from the basins of Malir, Gadap, Lyari and Hub to supplement the existing supplies. The scope of the study included a) reconnaissance survey, b) 160 probes of resistivity survey, c) drilling of 30 investigation boreholes, and d) construction of 5 tube wells and 10 piezometers.

After extensive surveys and analyses, this study concluded that since precipitation and groundwater recharge were little in Karachi, the sustainable yield of groundwater was already in balance with the existing pump discharge from about 1,000 existing wells and it was difficult to develop new wells. The conclusion of this study is quite similar to that of the 1985 water supply master plan.

Based on the foregoing, it is concluded in this JICA Study that the capacity of groundwater resources in Karachi is so small that it can barely meet the present level of withdrawal. Under

the circumstances, there is no realistic prospect of developing new groundwater resources which can be used to cater for the future water requirement of Karachi. It is rather recommended that more stringent controls should be put in place on the construction of new wells in order to maintain the current groundwater balance in the region.

It is concluded in this JICA Study that there is no realistic prospect of developing new groundwater resources which can be used to cater for the future water requirement of Karachi.

(3) Desalination

The 1985 water supply master plan study assessed the possibility of seawater desalination as a means of meeting future water supply requirements. As a result, the study concluded that:

- The cost of desalination for the foreseeable future was prohibitive and only if technological advances were made to considerably reduce the costs of energy then desalination could become an attractive option for Karachi.
- Given the very high capital and operating costs, desalination should be considered as a last resort.
- Since it was essential to use clean, unpolluted seawater the distiller would have to be located on the coast at some distance from the city centre.
- Development of desalination plants to serve fewer isolated consumers might be attractive, particularly where revenue from selling desalinated water could cover its costs; such consumers would include the Karachi Port Trust (KPT), Port Qasim Authority (PQA) and Pakistan Steel Mill (PSM).

The 1985 water supply master plan study concluded that the cost of desalination for the foreseeable future was prohibitive.

During the last two decades, there has been no remarkable technical breakthrough which could substantially reduce the capital and recurrent costs of seawater desalination. As such, the conclusion of the 1985 water supply master plan study is still effective at present. During the past five years, however, several agencies and authorities in the coastal region have tried to install seawater desalination plants to cope with water shortages in their areas of jurisdiction using the Private Sector Participation (PSP) modalities. However, due to the high price of desalinated water indicated by the private sector, contract negotiations on almost all of these schemes were either cancelled or suspended indefinitely. The only exception is the 3 mgd (13,500 m^3/d) MSF distillation plant currently under construction in the DHA Phase-VIII area under a BOT contract. The plant, upon its scheduled completion in April 2008, is expected to generate 94 MW of electricity with the use of natural gas while also producing 3 mgd of desalinated water at the same time. It has been agreed that the BOT contractor will operate the plant for a concession period of 20 years before handing it over to DHA, and that, during the concession period, the contractor will sell 80 MW of electricity to the Karachi Electricity Supply Corporation (KESC) and 3 mgd of desalinated water to the Clifton Cantonment Board (CCB) at the exit of the plant. The price of water was set to be Rs 95/1,000 gallons at the base year which would be subjected to an automatic annual increase of 5% every year onward.

Based on the foregoing, it is concluded in this JICA Study that seawater desalination will not be able to provide a viable solution for a mega city like Karachi in the foreseeable future unless there is a significant technical breakthrough substantially reducing the cost of desalinated water. Nonetheless, it would continue to remain as an option for a limited number of organizations and industries located in the coastal region which can afford to pay the high cost of desalinated water in order to alleviate water shortages persisting in their areas of jurisdiction.

During the last two decades, there has been no remarkable technical breakthrough which could substantially reduce the capital and recurrent costs of seawater desalination. As such, the conclusion of the 1985 water supply master plan study is still effective at present, and it will continue to remain effective in the foreseeable future.

(4) Reuse of Treated Effluents/Raw Sewage

Reuse of treated effluent is practiced in TP-3 and Pakistan Steel Mill sewage treatment plant. In TP-3, 4,500 m^3/d of effluent is pumped to nearby Pakistan Air Force (PAF) premise to water the plants there. While no tariff is charged for treated effluent, necessary costs are borne by PAF.

Pakistan Steel Mill treats the domestic sewage generated in its company housing and a part of industrial wastewaters and to sell the treated effluent to a nearby golf course and orchard where treated effluent is sprayed to trees and grasses.

Apart from treated effluent reuse, CDGK's Works and Services Department withdraws the raw sewage and sprays it to grasses and trees at road dividers. The necessary cost for watering is borne by the Department.

Other raw sewage applications are found in some areas. One is a golf club that has its own arrangement to take the sewage from a trunk sewer. The other is housing development area where generated sewage is partly used to water trees and grasses there.

There are several applications of raw sewage as well as treated effluent to trees and grasses. Raw sewage application on trees and grasses is not recommended from hygienic viewpoints, since it possibly is contaminated by pathogenic bacteria from its nature.

A study titled "Effluent Water Reuse for Karachi" is planned under Technical Assistance (TA) loan of Asian Development Bank. This TA loan amounts to US$ 10 million and is planned to be disbursed in four years from early 2007. The outcome of the Study is expected to include the cost comparison of treated effluent reuse with other sources and the establishment of reuse plan.

Treated effluent can be used for various purposes such as watering plants/grasses in parks and similar facilities, irrigation, agriculture, industrial use and groundwater recharge.

In any case, a large scale reuse of treated effluent requires careful investigation whether the reuse is viable or not from technical, hygienic, financial and economic viewpoints, especially if additional and/or advanced level treatment is needed. Trial application of treated effluent is recommended prior to its full application.

S3.2 WATER SUPPLY AND SEWERAGE SYSTEMS

S3.2.1 Water Supply System

The water supply system of KW&SB as of the end of year 2006 supplies bulk water of about 630 mgd to the citizen of Karachi City from the Indus River, Hub Dam and Dumlottee Wells as shown in **Figure S32.1.1** through the Grater Karachi Bulk Water Supply System (see **Figure S32.1.2**), Karachi Water Supply Canal and Dumlottee Conduit respectively.

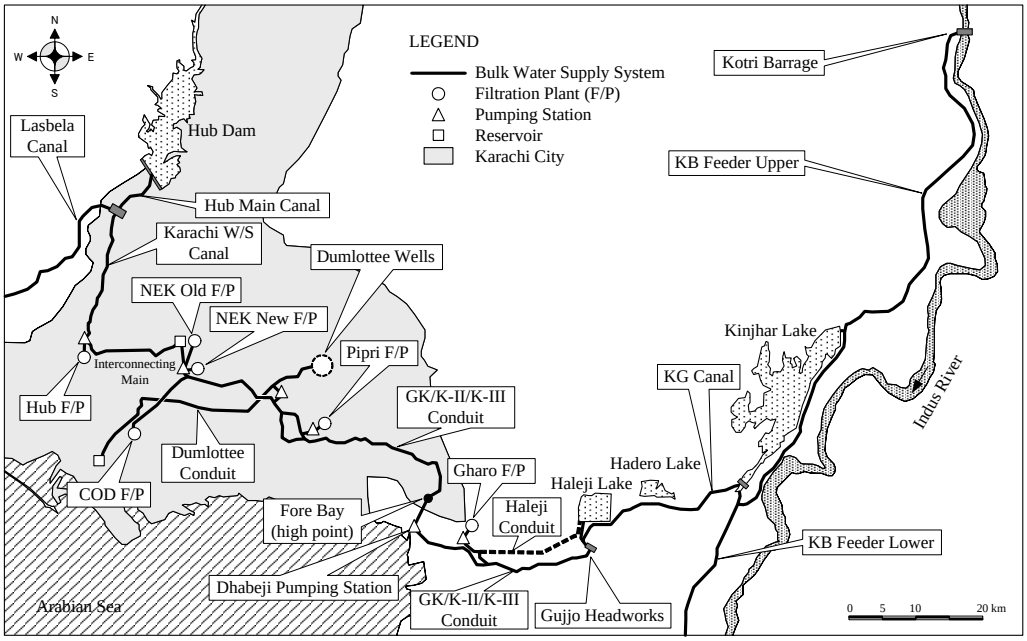

Figure S32.1.1 Existing Bulk Water Supply System

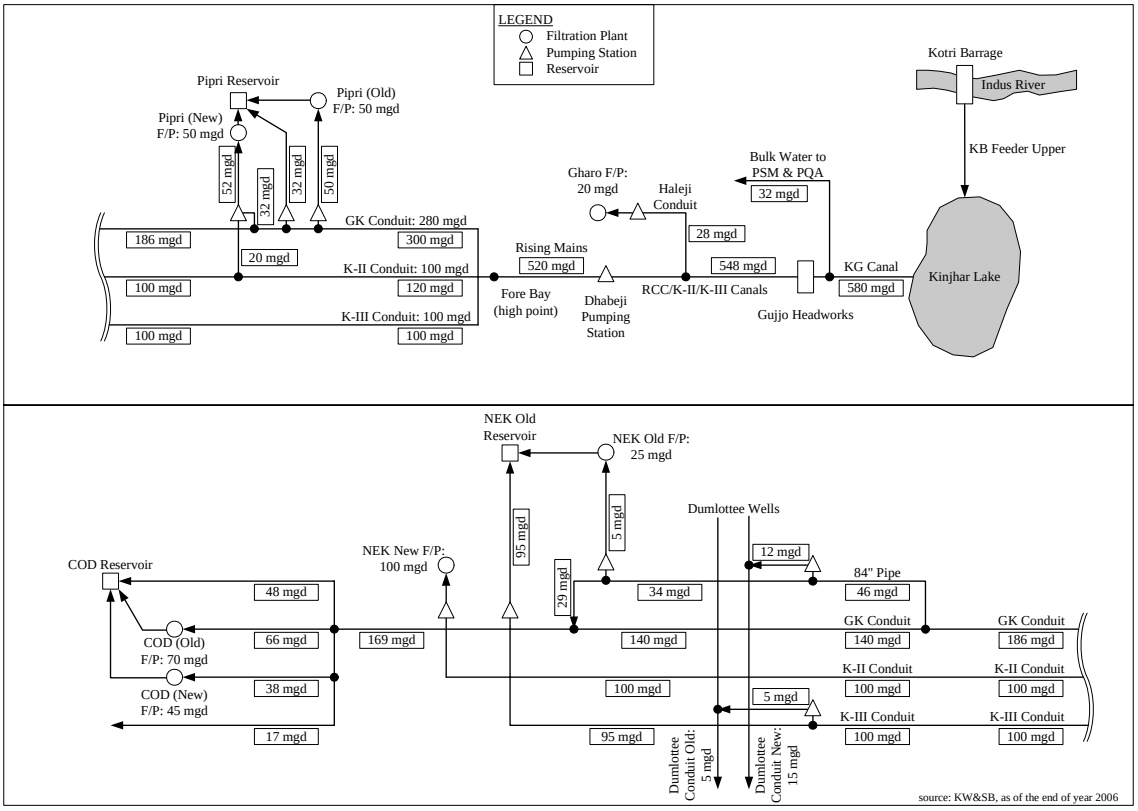

Figure S32.1.2 Existing Greater Karachi Bulk Water Supply System

Out of the total supplied water of 630 mgd, water of 209 mgd is supplied without filtration as shown in **Table S32.1.1**, which is about one third of the total amount.

Table S32.1.1 Present Water Supply Capacity

Supplied from		Rated Capacity	Actual Supply
Gharo Filtration Plant		20 mgd	30 mgd
Pipri Filtration Plant	with Filtration	100 mgd	102 mgd
	without Filtration	-	32 mgd
Dumlottee Conduit (without Filtration)	from Wells	20 mgd	0 mgd
	from GK/K-III Systems	-	17 mgd
NEK Old Filtration Plant		25 mgd	5 mgd
NEK New Filtration Plant		100 mgd	100 mgd
COD Filtration Plant	with Filtration	115 mgd	104 mgd
	without Filtration	-	48 mgd
Hub Filtration Plant		80 mgd	80 mgd
Supply without Filtration (from K-III System)		100 mgd	95 mgd
Supply without Filtration (from GK System)		-	17 mgd
Total		560 mgd	630 mgd

source: KW&SB

From filtration plants and reservoirs, water is supplied through water trunk mains and distribution pipelines. Major routes of the existing water trunk mains are shown in **Figure S32.1.3**.

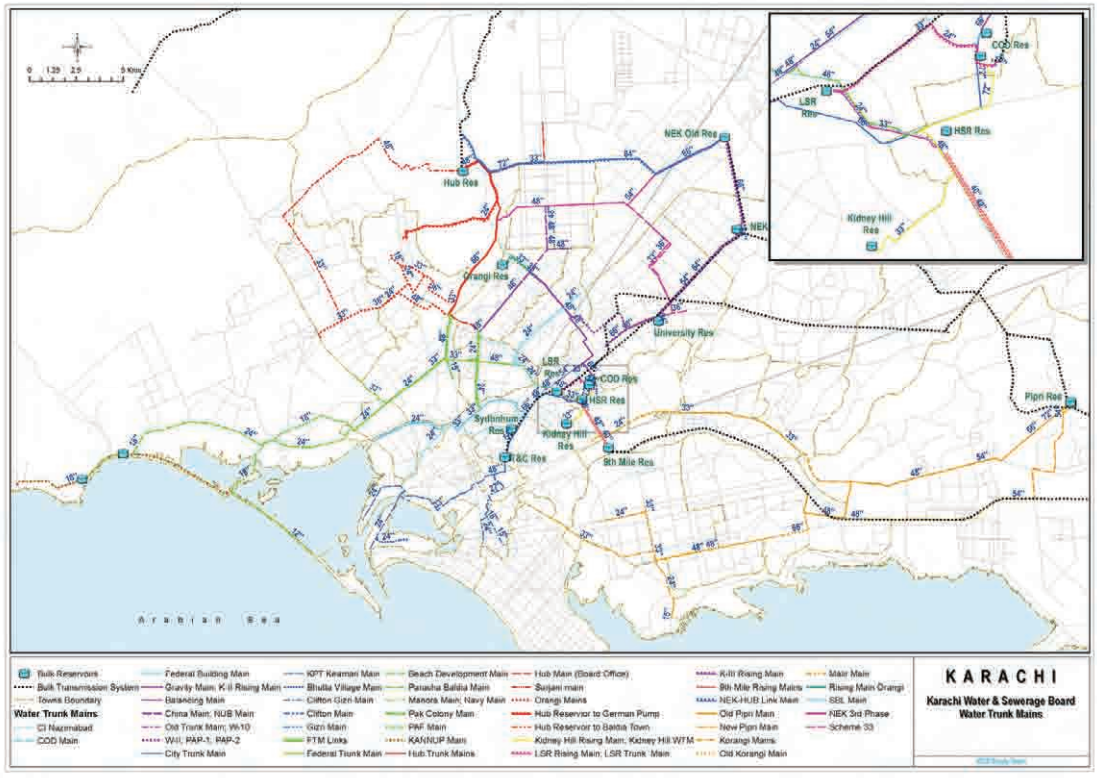

Figure S32.1.3 Existing Water Trunk Mains

The water trunk mains consist of approximately 400 km pipelines with diameters ranging from 12 in to 84 in as listed in **Table S32.1.2**. Main material of the water trunk mains is pre-stressed cement concrete (PRCC), which is about 80 % of the total length. A total length of the existing distribution pipelines is about 4,850km as of the year 2001 as listed in **Table S32.1.3**. About 70 % of the existing distribution pipelines are asbestos cements (AC) pipes. AC pipes has been used even in recent pipe installation work. The present City Nazim has, however, urged a plan of replacing aged distribution pipelines of small size, which are mainly AC pipes, with PE pipes in the "Tameer-e-Karachi Programme (TKP)" for improving the water supply conditions in Karachi.

Table S32.1.2 Water Trunk Mains

Diameter		Length
in	mm	(m)
12	300	5,720
15	375	4,266
18	450	36,106
24	600	72,268
32	800	27
33	825	77,235
36	900	15,311
40	1,000	2,644
42	1,050	2,631
48	1,200	88,113
54	1,350	39,667
64	1,600	6,112
66	1,650	30,960
72	1,800	13,693
84	2,100	10,409
Total		405,163

Source: KW&SB

Table S32.1.3 Distribution Pipelines

Diameter		Length
in	mm	(km)
3	75	1,636.2
4	100	1,531.9
5	125	60.0
6	150	609.0
8	200	199.0
9	225	34.6
10	250	130.6
12	300	317.0
15	375	107.1
16	400	20.1
18	450	96.8
21	525	1.0
24	600	58.1
27	675	5.2
30	750	2.5
33	825	25.2
36	900	6.3
48	1,200	8.9
54	1,350	3.0
60	1,500	2.0
Total		4,854.4

Source: KW&SB

Although water can be distributed by gravity in most part of the city because of the deference in land elevation between the existing distribution reservoirs and water supply areas, 139 distribution pumping stations are being operated and managed by KW&SB in total due to the lack of water pressure caused by insufficient diameters of water trunk mains resulted from inappropriate hydraulic calculation for the system. In addition, many of the water consumers install individual small suction pumps and suck water from distribution pipes forcibly. This is the one of the reasons of serious water supply situations in Karachi, which causes low water pressure, water shortage, and problems of water quality degradation such as contamination by sewer sucked into the pipes by the negative pressure resulting from using suction pumps. According to the results of water quality analysis acquired in this study, residual chlorine was found at the outlets of clear water reservoirs at the existing filtration plants. But there were no residual chlorine in the distribution pipelines.

Table S32.1.4 shows the number of service connections in the last 6 years. At present there are about 1.2 million connections in the water supply system in Karachi. However, the number of the connections in Cantonments and DHA area is not included in this table since these areas independently supply water to their consumers after receiving water from KW&SB's bulk water supply system.

Table S32.1.4 Number of Service Connections

Category	Number of Service Connection					
	2001 - 2002	2002 - 2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007
Domestic*	816,259	823,931	853,710	879,935	899,270	910,709
Non-Domestic	226,638	230,046	241,214	255,833	264,298	282,048
Bulk	4,113	4,152	4,268	4,440	5,040	5,149
Total	1,047,010	1,058,129	1,099,192	1,140,208	1,168,608	1,197,906
Aug. Ratio	-	101.1%	103.9%	103.7%	102.5%	102.5%
				Average of Aug. Rate		102.7%

* : excluding number of "Addition Stories"
Source: Revenue Data 2001 - 2007, KW&SB

There are no water meters on the individual service connections in Karachi. Consumers pay

water charges on the basis of plot size, hence they do not pay much attention to wastage of water. Awareness of effective usage and storage of water is significantly low in Karachi. The current average consumption rate per capita per day including the wastage and leakage inside the houses is, therefore, expected to be high.

Conditions of the existing service pipes are shown in **Photos S32.1.1** and **S32.1.2**. **Photo S32.1.3** shows a community pumping station which has been installed for sucking water from a nearby distribution main forcibly. **Photo S32.1.4** shows illegal connections in Katchi Abadis (Squatter Settlement) across a channel.

Photo S32.1.1
3/4" GIP Service Connection

Photo S32.1.2
4" PVC Plugging with Rubber Tube

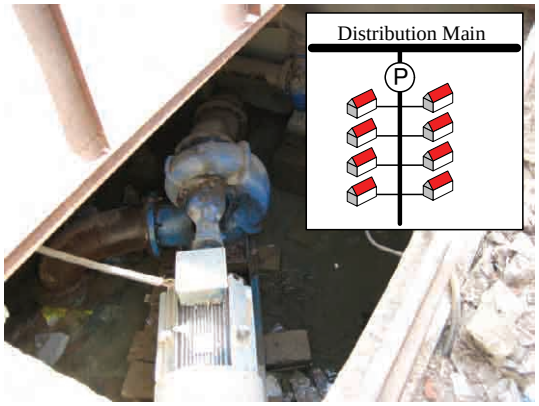

Photo S32.1.3
Suction Pump to Suck Water Forcibly

Photo S32.1.4
Piping for Illegal Connections across a Channel

In the areas outside the piped water supply areas of KW&SB, water is mainly supplied from 10 Bowser Filling Stations in the city area by water tankers. The total amount supplied by water tankers in Karachi in 2004 was estimated at 17 mgd, which was about 3 % of the total supply amount of 630 mgd. On the other hand, according to the KW&SB's report on Feasibility Study to explore Groundwater Source in Karachi District, 2004, average withdrawal of groundwater was estimated at about 30 mgd.

S3.2.2 Sewerage System

(1) Collection System

There are three sewer districts in Karachi City, namely TP-1, TP-2 and TP-3 districts. North Karachi and Orangi Towns both at the right bank side of Lyari River will be included in sewer district of TP-3 after construction of new sub main sewers connecting to Lyari Interceptor.

Korangi and Landhi Towns at the left bank side of Malir River have been isolated from sewer district of TP-2 due to the destruction of the pressure main connected to TP-2. KW&SB has planned to implement a new sewage treatment plant for these towns at the left bank side of Malir River. **Table S32.2.1** outlines sewer districts in Karachi City.

Table 32.2.1 Sewer Districts

Sewer District	Area (ha)	Treatment	Remarks
TP-1 District	5,400	Partly	
TP-2 District	11,800	Partly	
TP-3 District	5,600	Partly	
Total	22,800		
(Korangi District)	8,900	No	Will be connected to proposed new TP
(Orangi District)	2,900	No	Will be connected to TP-3
(North Karachi District)	2,700	No	Will be connected to TP-3

Figure S32.2.1 shows geographical relation among these three sewer districts and the locations of three sewage treatment plants.
Trunk Sewers include three to TP-1, two to TP-2 and one box culvert to TP-3. Total length of branch sewers is 3,290 km. There are four large scale and 16 smaller scale pumping stations conveying the generated sewage directly or indirectly to one of three sewage treatment plants.

(2) Sewage Treatment Plants
Table S32.2.2 summarizes three existing sewage treatment plants (TPs).

Table S32.2.2 Summary of Three TPs

	TP-1 (SITE)	TP-2 (Mahmoodabad)	TP-3 (Mauripur)
Drainage Area	F.B. Area, Liaquatabad, Nazimabad & North Nazimabad, Part of Orangi Town, Pak Colony etc.	Old city areas, Clifton Societies, Mahmoodabad, part of Azam Basti, Dada Bhai, Sadder, Malir	Old Lyari, Garden East and West, Gulshan-e-Iqbal, PIB colony, Soldier Bazar, Baldia, Nazimabad, North Karachi
Site Area	120 acres (48.6 ha)	120 acres (48.6 ha)	545 acres (221 ha)
Year of Construction	1960/1995 (rehabilitated)	1960/1996 (rehabilitated)	1998
Incoming Trunk Sewers	Upper Lyari Main: 66'' (2010mm) Upper Lyari 1: 54'' (1650 mm)	Malir Trunk Sewer: 56'' (1710 mm)	Lyari Interceptor (2 × 2500mm × 2000mm)
Treatment Process	Trickling filter process	Trickling filter process	Anaerobic + Facultative pond
Major Facilities	Influent pumps, PST, TF, FST Anaerobic digesters Sludge drying beds	Influent pumps, PST, TF, FST Anaerobic digesters, Sludge drying beds	Influent pumps, AP, FP Sludge drying beds
Planned Served Population	1,600,000	1,600,000	2,000,000
Present Served Population	NA	NA	NA
Capacity	51 mgd (232,000 m^3/d)	46 mgd (209,000 m^3/d)	54 mgd (245,000 m^3/d)
Present Flow Rate	25 mgd (114,000 m^3/d)	24 mgd (110,000 m^3/d)	30 – 35 mgd (136,000 – 159,000 m^3/d)
Design Influent Qualities	BOD 385 mg/l SS 555 mg/l	BOD 365 mg/l SS 530 mg/l	BOD 385 mg/l SS 450 – 500 mg/l
Present Influent Qualities	BOD 317 mg/l SS 319 mg/l	BOD 300 mg/l	BOD 370 mg/l SS 388 mg/l
Design Effluent Qualities	BOD 80 mg/l SS 200 mg/l	BOD 80 mg/l SS 200 mg/l	BOD 80 mg/l SS 200 mg/l
Present Effluent Qualities	BOD 80.8 mg/l SS 76.4 mg/l	BOD 100 mg/l	BOD 75 mg/l SS 69 mg/l

Source: KW&SB

As shown in the table, the actual flow to these three TPs is 79 to 84 mgd (360,000 to 380,000 m^3/d) which is around a half of their total capacity of 151 mgd (686,000 m^3/d). This is due to the absence of or damaged trunk sewers and malfunction of pumping stations.

Figure S32.2.1 Sewer Districts of Karachi City

(3) Design Criteria

There are no established design guidelines for sewerage planning in Pakistan. Instead, every consulting firm has its guidelines for several design parameters and uses them in preparing sewerage planning. These design parameters include water supply per capita per day, ratio of sewage generation to water consumption, peak flow factor, flow velocity formula, range of flow velocity and manhole interval.

S3.3 LAWS, POLICIES AND ADMINISTRATIVE FRAMEWORK

S3.3.1 Water Supply and Sewerage

(1) Legislative and Administrative Framework

According to the Constitution of Pakistan, water is a Provincial subject and the responsibility for water related issues rests with the Ministry of Water and Power (MWP). Within the Ministry, exists the 'Water Wing' (WAPDA) to discharge its water related responsibilities. For water related matters, the MWP coordinates efforts primarily between WAPDA, the Indus River System Authority (IRSA), the Federal Food Commission (FFC), as well as other Federal Ministries and Provincial Irrigation and Agriculture Departments amongst others.

The relevant legislation in force includes the WAPDA Act, 1958; the Environmental Protection Act (EPA), 1997 and the IRSA Act, 1992 amongst others; whilst at a more local level the Sindh Local Government Ordnance (SLGO), 2001 and the KW&SB Act, 1996 run in parallel. Whilst the SLGO, 2001 gives the City District Government of Karachi (CDGK) general powers for the provision of water and sanitation services, the KW&SB Act, 1996, provides a more detailed account of specific technical and administrative responsibilities and powers vested in KW&SB as an 'autonomous' body.

More recently the Government of Pakistan (GOP) have issued the 'National Environmental Policy, 2005'; the 'National Drinking Water Policy, 2006' and the draft 'National Sanitation Policy, 2006. In response to national policy, the GOS have issued the draft 'Sindh Water Supply Policy, 2006' and the draft 'Solid Waste & Sanitation Policy, 2006'.

Devolution of water and sanitation services (W&SS) from the Provincial Government of Sindh to the CDGK was enacted as a result of the SLGO, 2001. This was effected by setting up a 'Water & Sanitation Department' within the CDGK headed by an 'Executive District Officer' (EDO). 'EDO Water & Sanitation' is responsible to the CDGK and the people of Karachi via a system of Town Municipal Administration (TMA) and Union Councils (UC's). Due to the size of the city and considering the "essential services" nature of W&SS, it was decided to retain KW&SB as the 'executing agency' for W&SS. As such the KW&SB Act, 1996 was not revoked when the SLGO, 2001 came into force.

In accordance with SLGO, 2001; of which Sections 52 and 182 are particularly relevant, KW&SB are responsible for water and sanitation services for Karachi. KW&SB are also responsible for bulk supply of water to various agencies including 'Cantonments', such as the Defence Housing Authority (DHA), the Sindh Industrial Trading Estate (SITE), the Karachi Port Trust (KPT) and other major organisations/agencies. These organisations/agencies are responsible for onward distribution of water and collection/disposal of wastewater. There has been much discussion regarding KW&SB taking ownership of the water and sanitation infrastructure within these areas and for provision of services, however, due to poor asset condition, this is yet to be agreed.

Working alongside KW&SB is the 'Sindh Katchi Abadis Authority' (SKAA), various Non-Governmental Organisations (NGO's) and 'Citizen Community Boards' (CCB's) with the aim of improving W&SS and ensuring that all areas and communities throughout Karachi are

represented. The idea of CCB's or 'beneficiary groups' taking an active role in the O&M of local schemes has been slow 'getting off the ground'.

Responsibility for compliance with 'drinking water standards', safe disposal of sewage and for compliance with environmental legislation/standards is placed on KW&SB, however, the fragmented nature and responsibility for W&SS provision as described above does not 'sit well' with this. KW&SB currently follow and are subject to compliance with the World Health Organisation (WHO), 1971 International Drinking Water Standards and the EPA Standards, however, due to lack of effective independent monitoring or 'policing', KW&SB are effectively 'self regulating'.

Whilst KW&SB constitute an autonomous body, in carrying out its duties, KW&SB interact with a number of CDGK departments having either advisory, political, administrative or sanctioning powers over their financial and operational activities. In this event, KW&SB have little 'autonomous freedom' and therefore, essentially continue to operate as an executing agency with a number of financial and operational constraints placed on them coupled with a high level of political interference in day to day operations. The Government of Sindh through Legal Notification No. SOVIII/KW&SB/72/2002 re-constituted the Board of the KW&SB. KW&SB is governed by a board of directors of which the Managing Director (MD) of KW&SB is a member and the City Nazim is the Chairman. Other board members include representation from industry as well as government bodies. It is understood that whilst formal board meeting are conducted infrequently, the MD consults on a regular basis with the Chairman of the board and other related CDGK and GOS departments regarding approval/processing of major development projects, approval of budgets, funding, financing, loan repayment, tariff adjustments, water quality/effluent standards compliance etc.

(2) Sector Policy Framework

National policies relevant to the water supply and wastewater services in Karachi include the National Water Policy, the National Drinking Water Policy, and the National Sanitation Policy. The vision that forms the foundation of Pakistan's National Water Policy (Draft) is summarised as:

"By 2025, Pakistan should have adequate water available, through proper conservation and development. Water supplies should be of good quality, equitably distributed and meet the needs of all users through an efficient management, institutional and legal system that would ensure sustainable utilization of the water resources and support economic and social development with due consideration to the environment, quality of life, economic value of resources, ability to pay and participation of all stakeholders."

The overall goals of the National Drinking Water Policy are:

- To ensure safe drinking water to the entire population at an affordable cost in an equitable, efficient, and sustainable manner, and
- To ensure reduction in the incidence of mortality and morbidity caused by water borne diseases.

The overall objectives of the National Drinking Water Policy are outlines as follows:

- To provide a supportive policy and legal framework that facilitates access of all citizens to safe drinking water on a sustainable basis;
- To provide guidelines that will allow consistency and conformity between the drinking water policy and the overall water sector policy, environmental policy, health policy and drinking water quality standards that will facilitate the provision of safe water to all;
- To define an institutional framework within which the sector institutions can more

effectively address the challenges they face in the provision of drinking water in all areas of the country;

- To provide a financial framework within which the provision of water supply can be undertaken in a cost-effective, equitable and sustainable manner;
- To identify and facilitate the implementation of as set of key strategies that will help in enhancing access to safe drinking water supply; and
- To provide a framework within which local communities, women and vulnerable groups can be facilitated to enhance their access to safe drinking water.

Pakistan's National Sanitation Policy acknowledges that only about 42 percent of the total population has access to sanitation facilities, and aims to create a framework for "providing adequate sanitation coverage for improving quality of life of the people of Pakistan and to provide the physical environment necessary for healthy life.

At the Provincial level, the Sindh Water Supply, Solid Waste & Sanitation Policies have been drafted based on the national policy. However, these are currently under review (as of November 2007) by a Technical Review Committee constituted by Government of Sindh (GOS) and are thus yet to come into force.

S3.3.2 Environment

(1) Policy and Legal Framework

Laws finding relevance with the modern definition of 'environment' were first enacted in Pakistan in the late 1950's and in the first half of the 60's. Further, the Environment Ministry was established in 1975, as a follow up of Stockholm Declaration of 1972. The most effective period for environmental legislation in the country runs from 1983 to 1997. The first Environmental Protection Ordinance was promulgated in 1983. With this enactment, a series of legislation making process was initiated that culminated in the enactment of the Pakistan Environmental Protection Act, 1997. The National Environmental Quality Standards (NEQS) became effective in 1997. More recently the Ministry of Environment have issued the 'National Environmental Policy, 2005'

a) The National Conservation Strategy (NCS)

The Pakistan NCS is a broad based policy statement aimed at achieving environmentally sustainable economic and social development in Pakistan. The three overriding objectives of the NCS are a) Conservation of Natural Resources b) Sustainable Development and c) Improved Efficiency in the use and management of resources. The NCS specifies the broad guidelines for an integrated effort aimed at protecting the environment and the natural resources of the country.

b) Pakistan Environmental Protection Ordinance 1983

The 'Ordinance' for the first time established the Pakistan Environmental Protection Council and the Federal and Provincial EPA's. It also pioneered in the Pakistan, the requirement of preparing Environmental Impact Assessment (EIA) reports.

c) Pakistan Environmental Protection Act (PEPA) 1997

The Pakistan Environmental Protection Act 1997 (PEPA 1997) is the most important environmental legislative instrument in Pakistan. The Act aims "To provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution and promotion of sustainable development".

The apex body established under the PEPA 1997 is the Pakistan Environmental Protection Council that is headed by the Prime Minister of Pakistan. The functions of the Council include enforcement of the PEPA 1997, to establish national environmental policies, ensure their

implementation, approve National Environmental Quality Standards, give directions to conserve bio-diversity and renewable and non-renewable resources and consider the national environment report. The Environmental Protection Agencies (EPA's), both at the Federal and provincial levels exist under the Pakistan Environmental Protection Council.

d) National Environmental Action Plan (NEAP)

The NEAP was approved by the Pakistan Environmental Protection Council in February 2001. The development objective of the NEAP was to initiate actions and programmes for achieving a state of environment that safeguards public health, promotes sustainable livelihoods and enhances quality of life of the people of Pakistan. It focused on taking immediate measures to achieve a visible improvement in the rapidly deteriorating quality of air, water and land, through effective cooperation between the government agencies and civil society.

(2) Administrative Framework

The following details some of the important administrative arrangements that have been put in place under the provisions of the Pakistan Environmental Protection Act, 1997:

a) The Pakistan Environmental Protection Council

The apex body established under Section 3 of the Pakistan Environmental Protection Act, 1997 is the Pakistan Environmental Protection Council. It is chaired by the Prime Minister and comprises of all the four provincial Chief Ministers, federal and provincial ministers of environment and up-to thirty five (35) persons, with at least twenty (20) non officials, including representatives of the Chamber of Commerce and Industry, agriculture, medical and legal professions, trade unions, NGO's, scientists, technical experts and educationists. The functions and powers of the 'Council' include the following:

- Approval of the National Environmental Quality Standards (NEQS)
- Approval of comprehensive national environmental policies, within the framework of the NCS
- Provision of guidelines for the protection and conservation of species, habitats and bio-diversity in general and for the conservation of renewable and non-renewable resources; and
- Coordination of the integration of principles of sustainable development into national development plans and policies

b) Pakistan Environmental Protection Agency

The Pakistan Environmental Protection Agency exists under the Pakistan Environmental Protection Council. It is headed by a Director General (DG). The DG may establish such advisory committees as he may deem fit to assist him. Section 5 of the Pakistan Environmental Protection Act 1997, constitutes the Pakistan EPA (The Federal Agency), which is the regulatory institution entrusted with the functions of administering and enforcing the Act and its rules and regulations. These include:

- Preparation, revision, establishment and enforcement of the NEQS
- Establishment of systems for surveys, monitoring, inspection and audit
- Certification of environmental laboratories
- Rendering of advice and assistance in environmental matters
- Encouraging the formation and working of NGO's, community organizations and village organizations
- Taking all necessary measures for the protection, conservation, rehabilitation and improvement of the environment, prevention and control of pollution and promotion of sustainable development

c) Sindh Environmental Protection Agency (SEPA)

Section 8 of the Pakistan Environmental Protection Act, 1997 establishes the provincial EPA's of which one is the Sindh Environmental Protection Agency. The provincial EPA is to exercise powers delegated under Section 26. Many of the federal agency's functions and powers under the Pakistan Environmental Protection Act, 1997 have already been delegated to the Provincial EPA's. Section 8 gives statutory cover to the Provincial EPA's, which were hitherto functioning under administrative arrangements.

S3.4 KW&SB'S ORGANISATION AND FINANCIAL MANAGEMENT

S3.4.1 Organisation

Over the years, the provision of water and sanitation services has been undertaken by a variety of agencies. The 'Karachi Joint Water Board' was constituted in 1953, who were responsible for the first major expansion of Karachi's water supply system; taking bulk water from the Indus River.

From 1957, the Karachi Development Authority (KDA) took responsibility for bulk water supply and the Karachi Metropolitan Corporation (KMC) became responsible for water distribution and sewerage within the city. At that time a number of other agencies took responsibility for managing their own 'systems', including the 'Cantonment Board' and other major government organisations such as the Armed Forces, the Karachi Ports Trust (KPT) etc. This is still the case today.

As there was no single agency to plan and execute water and projects at that time, in 1983, the Sindh Government introduced the 'Sindh Local Government (amended) Ordinance, 1983' to bring responsibility within one agency, the KMC at that time, who became responsible for provision of services, the raising of funds and taxes and for the expansion of 'systems'.

The 'Karachi Water and Sewerage Board Act, 1996' was enacted, which served to separate KW&SB from KMC and placed them under the GOS as an autonomous body.

'Devolution Plan', the 'SLGO, 2001' was introduced which placed KW&SB under the CDGK. CDGK established the 'Water and Sanitation' Department' headed by an Executive District Officer (EDO). As the KW&SB Act, 1996 was not revoked, the Water and Sanitation Department – CDGK and KW&SB are one and the same entity; whereby the Managing Director of KW&SB is the EDO Water & Sanitation – CDGK.

To comply with the spirit of the SLGO, 2001, KW&SB have reorganised their operations geographically in-line with TMA's and UC's who have a 'say' in how services are provided within their jurisdictions.

KW&SB's prime responsibility is the development and regulation of water supply and collection and disposal of sewage in the city of Karachi. Based on the forgoing, KW&SB need to work in close cooperation with other city agencies to ensure efficient services, including those agencies that manage their own 'systems'.

A Board chaired by the City Nazim (CDGK), is responsible to the GOS for the functioning of KW&SB, whilst the MD-KW&SB takes responsibility for overall day-to-day operations.

The current high-level organisation structure showing the relationship of KW&SB with the CDGK is shown in **Figure S34.1.1**.

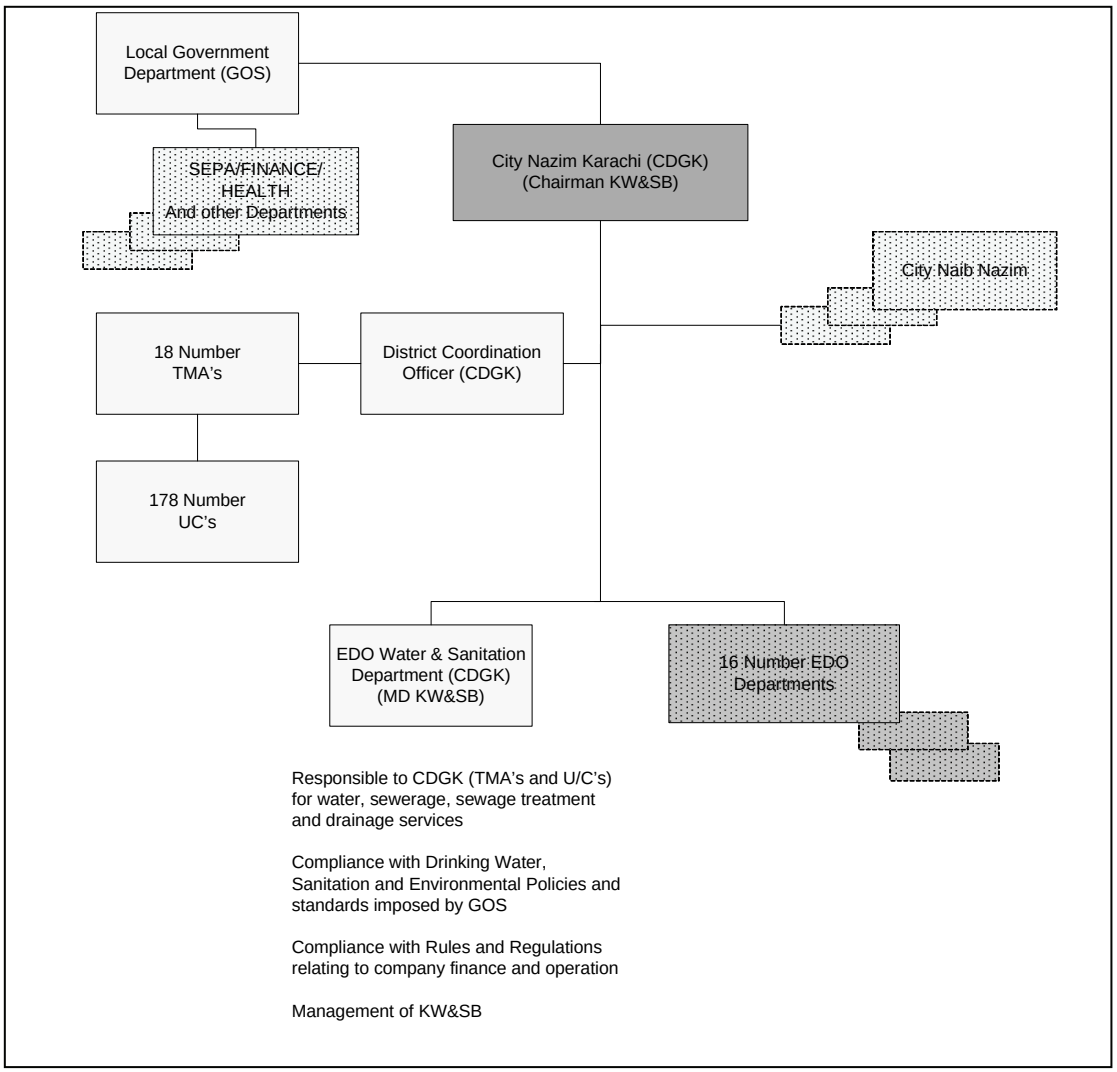

Figure S34.1.1 High Level Organisation Structure (As of February 2008)

KW&SB's main responsibilities (according to KW&SB Act, 1996 and SLGO, 2001) can be summarised as follows:

- Produce and supply potable water
- Sanction of water and sewerage connections and water supply to tankers
- Levy and collect fees for water and sewerage services
- Make regulations with approval from government
- O&M and construction of water and sewerage facilities
- Regulate water supply and inspect water and sewerage connections
- Prepare and submit to government for approval, tariffs and other charges

The number of employees budgeted (2006) is currently 9327 of which current staff in post is 8260. This is split 3230 staff at City level and 5030 staff distributed throughout the offices within the 18 Towns. An accurate up to date 'picture' of staff numbers is difficult to determine as staff records and payroll 'demands' are administered locally at Town offices by authorised 'Drawing & Disbursement Officers' (DDO's).

The latest (November 2007) high-level organisation structure with an indication of the main functional responsibilities is shown in **Figure S34.1.2**.

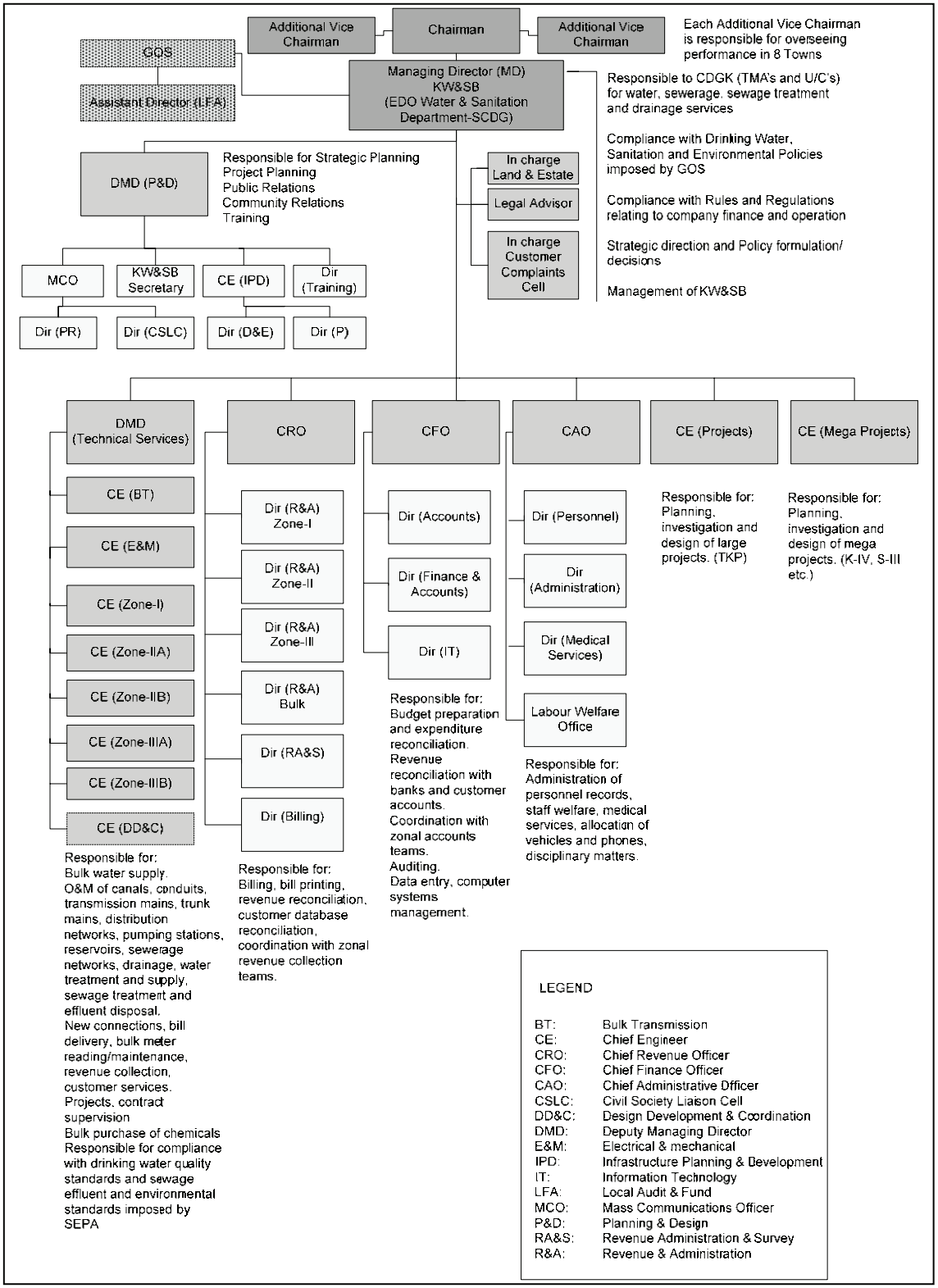

Figure S34.1.2 KW&SB High Level Organisation Structure with Key Responsibilities

Responsibility for operations and maintenance rests primarily with the 5 zonal CE's, the CE (BT), CE (E&M) and the CE (DD&C). They are responsible for the conveyance of bulk raw water from source as well as for conveyance systems (canals/conduits), reservoirs, trunk mains, transmission mains, distribution networks, pumping stations, drainage systems and sewerage

networks, as well as for the O&M of water and sewage treatment facilities. Staff associated with these activities, are dispersed at the various operational sites as well as at the 18 Town offices. Management and administrative staff associated with O&M are also placed at the '9th Mile' and 'HQ' offices.

Currently responsibility for large and mega projects rests with the CE (Projects) and CE (Mega Projects). This includes development of K-IV, major sewerage schemes (S-III), desalination and effluent reuse investigations. Invariably, consultants are used for outline design, bid documentation, detailed design and construction supervision. Smaller scale projects, refurbishments, overhauls, major breakdowns etc. are managed by the respective CE's.

S3.4.2 Financial Management

(1) Financial Conditions

The financial conditions of KW&SB were figured out through the recent five year financial statements between 2000/01 and 2004/05. KW&SB recorded consecutively deficit. Although for the beginning two years the revenue covered the direct expenses, it could not cover even the direct expenses for the rest three years.

The ordinary results including the both operating and non-operating results recorded the serious deficit. The annual deficit in 2004/05 was Rs.2.36 billion, although that was Rs.0.82 billion only in 2000/01. Thus, the accumulated deficit reached to Rs.10.44 billion at the end of the fiscal year 2004/05. This deficit corresponds to the total revenue for almost four years of the annual revenue in 2004/05. This trend of the ordinary deficit for the recent five years was illustrated in **Figure S34.2.1**.

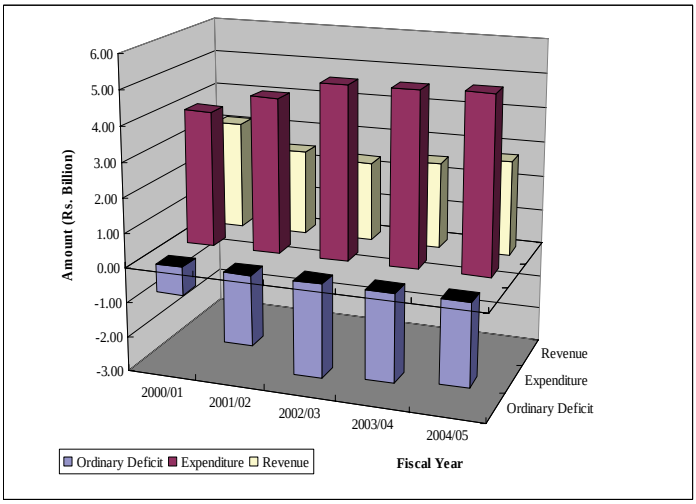

Figure S34.2.1 Management Performance of KW&SB for Recent Five Years

Of the total water revenue, that from the bulk water consumers accounted for 64% in 2004/05, in spite that the number of the bulk users' connections (4,440 connections) occupies only 0.32% of the total (1.40 million connections) in the same year. The revenue from the retail consumers was only 36% of the total, although the number of the retail consumers accounted for more than 99% of the total. On the other hand, the revenue of sewerage service from the bulk users accounted for 42%. Then, that of the retail users was 58%. Overall percentage shares of the total revenue were broken down as: 54% of water revenue from bulk consumers, 30% from retail consumers, 7% of sewerage service from bulk users, and 9% from retail users.

The operating expenditure in the fiscal year 2004/05 was Rs.3.90 billion. Among various expenditure items, the top five expenditure items were: (1) Rs.1.64 billion of electricity charges or 42% of the total expenditure, (2) Rs.874 million of compensation (salaries and benefits), 22%, (3) Rs.865 million of depreciation, 22%, (4) Rs.161 million of repair and maintenance, 4%, and (5) Rs.133 million of bad debts expenses, 3%. In addition, a large expenditure item in non-operating expenditure was recorded as Rs.1.18 billion of financial charges. The total expenditure was estimated at Rs.5.08 billion, so the financial charges accounted for 23% of the total.

In the B/S of the fiscal year 2004/05, the total assets of KW&SB were estimated at Rs.36.9 billion. The total assets were broken down to Rs.29.4 billion of fixed assets and Rs.7.5 billion of current assets. As a matter of course, liabilities and equity were Rs.36.9 billion. They consist of Rs.25.1 billion of long term liabilities, Rs.29.9 billion of current liabilities and Rs. 7.1 billion of stockholders' equity.

The debtors (consumers' balance) in the current assets are an account receivable from consumers. Their amount consecutively increased from Rs.4.8 billion in 2000/01 to Rs.6.0 billion in 2004/05. Its annual increase rate was 5.8% on average. Moreover, the total amount of Rs.3.2 billion was already written off as bad debts by the end of 2004/05. Accordingly, the debtors were aggregated to Rs.9.2 billion in 2004/05, if the bad debts had not been written off.

At the end of the fiscal year 2004/05, the foreign loans were recorded as shown in **Table S34.2.1**.

Table S34.2.1 Foreign Loans in B/S at End of 2004/05

(Unit: Rs. Billion)

Item	Long Term Liabilities	Current Liabilities	Total
Total of Foreign Loan Liabilities	24.8	3.5	28.3
Principal	14.5	0.6	15.1
Accrued Financial Charges	10.3	2.9	13.2

The outstanding of principal was Rs.14.5 billion in total. The accrued financial charges were an accumulation of financial charges which were the sum remaining after subtracting paid financial charges from the entire financial charges in the year. The accrued financial charges mounted up to Rs.10.3 million, accounting for 71% of the principal outstanding. Once adding the current foreign liabilities to them, the total foreign liabilities reached at Rs.28.3 billion. The accrued financial charges were Rs.13.2 billion, 87% of the total outstanding principal of Rs.15.1 billion. The total outstanding of Rs.28.3 billion was equivalent to more than 10 years' annual sales of 2004/05.

(2) Management Characteristics

Through financial diagnosis on the financial statements of KW&SB for the recent three years from 2002/03 to 2004/05, the management characteristics are brought into the open by means of management indices. Referring to these indices, the management conditions were discussed from the following viewpoints: profitability, safety and productivity.

"Turnover of capital" (net sales over total capital) was 0.07 for the three years. This rate of turnover was smaller than the Japanese index (an average of water supply systems in more than 300,000 residents) of 0.11. Among the total capital, the equity is recorded as Rs.3.77 billion, but it is completely withdrawn to cancel of the accumulated deficit for long time. In fact, the accumulated deficit was much more than the stockholders' equity. Thus, the actual rates are considered as negative because of the huge accumulated deficit. In consequence of this negative, grants in aid were appropriated for making up for this condition.

In 2004/05, an average unit price of water was estimated at Rs.21 per 1000 gallons. On the other hand, an average unit production cost of water was estimated at Rs.40 per 1000 gallons. The unit price was only 53% of the unit cost. Incidentally, the Japanese case shows that the percentage was 99%, i.e., Rs.350 per 1000 gallons of unit price to Rs.354 per 1000 gallons of unit production cost. This phenomenon gives KW&SB a warning of reconsideration on structure of revenue and expenditure.

"Turnover of account receivable" (net sales over account receivable) indicates speed of bill collection. The larger index means the better efficiency for capital utilisation. KW&SB recorded a quite worse index like 0.42 to 0.45. These figures were considerably low as compared with the Japanese index of 7.4. These indices mean that KW&SB spend more 16~18 times to collect bill than the Japanese water supply enterprises. The index 0.45 means that it takes 810 days or around 2.2 years to collect bills on average. In general, the turnover should be kept between 6.0 and 8.0, to manage the business in safe condition.

The ratio of interest to net expenses indicates static safety of financial procurement. The smaller index shows the better soundness of management. The ratio of KW&SB was calculated as between 23.2% and 23.5%, which were more serious than that of the Japanese index of 18.5%. Moreover, KW&SB could not pay a part of interests within due time and carried forward it to the next year, which was reckoned in "accrued financial charges" in the B/S. These accrued charges have increased year by year.

Main check points of productivity are (1) ratio of compensation to net sales and (2) ratio of compensation to net expenses. The former ratio of KW&SB was between 32.9% and 34.0%. This was higher than the Japanese index of 22.5%. The latter ratio was between 15.5% and 17.2%. This was lower than the Japanese one of 22.7%. These phenomena were caused by the huge difference between annual sales and expenditure of KW&SB. The number of employee per supplied water volume seems to be considerably larger than the Japanese average. It was 22 persons per mgd, which were more than three times of the Japanese index of 6.4 persons per mgd (14 persons per 10,000 m^3 per day).

(3) Financial Problems

The following financial problems were identified through the analysis of financial conditions and the diagnosis of financial statements. These problems should be considered in the master plan and also in the feasibility study.

1) Too small operating revenue: The huge deficit in every year mainly would come from too small operating revenue. For the latest few years in particular, the revenue covers only a half of the total expenditure.
2) Too large operating expenditure: The operating expenditure for last four years has consecutively increased year by year. For the recent three years in particular, the total expenditure including non-operating expenditure reached more than double of the total revenue. In spite of that, the total expenditure seems to be small for proper operation and maintenance on the water supply and sewerage systems.
3) Financially ailing structure: KW&SB confronts structural fiscal deficits. In order to solve this structural problem, it has to bring about a much more radical reform of the management system.
4) Excessive account receivable: KW&SB has huge account receivable at present. In 2004/05, its amount was Rs.6.0 billion, corresponding to 2.2 times of the annual sales in the same year. This heavy outstanding might blunt its management improvement strategy.
5) Undercapitalisation: Equity of KW&SB is Rs.3.8 billion only at present. It accounts for around 10% of the total capital (liability and equity) in 2004/05. Water supply and sewerage services are one of the processing industries, so huge capital investment is indispensable to manage the business soundly.

S3.4.3 Human Resource Development

There is no central coordinating role at policy level dealing with HRD. This has been devolved to the respective CE's and CO's to manage within their areas of responsibility.

Programmes for building staff capacity should be aimed at developing technical competencies, process competencies and managerial competencies to ensure efficient operation of all aspects of the business. Currently, apart from a variety of basic skills training courses, skills are developed by means of on-the-job training. Responsibility for training rests with the Director (Training) within the DMD (P&D) Department. However, resources are limited and most training is conducted on-the-job.

Currently KW&SB do not conduct conventional staff performance appraisals. 'Job descriptions' are not widely used and therefore, key tasks and priorities and how these are measured are not always clearly understood. A system for sharing corporate objectives has not been developed and therefore it is not clear how departmental or functional objectives are set and measured to ensure that these contribute to wider corporate goals. A system for sharing departmental objectives has not been developed and therefore it is not clear how individual's objectives contribute to wider departmental objectives.

KW&SB do not have a system in place for formally setting or communicating corporate, departmental or personal performance targets/key performance indicators and performance measures are not formally set or monitored. The current system of 'rewards and recognition' (terms and conditions) does not relate to performance and therefore good performance goes largely 'unrecognised' and poor performance goes largely 'un-checked'.

No or little feedback is given to individuals regarding their performance; consequently, training or future development needs are not formally discussed, agreed or documented.

Currently, KW&SB do not have a formal policy on career development or a career development and progression planning process, although criteria is well established for promotions and job transfers. Career development/progression is generally based on the following criteria:

- Length of service
- Age
- Experience
- Job history
- Past performance
- Seniority
- Educational background/qualifications

The above criteria is generally accepted by most despite the fact that such an approach does little to motivate those with potential for a more rapid career progression path. The current approach stifles initiative and motivation as good performance on its own does not lead to better terms and conditions or promotional prospects.

The ultimate aim of a career development programme is to enhance the future performance of the organisation itself through the development and advancement of its employees. It is recommended that individuals take responsibility for their own careers, by introduction of a training and development framework designed to allow all grades and disciplines equal opportunity for advancement.

Introducing a 'new' approach to career development and succession planning would require that KW&SB give careful consideration to a number of factors, including the following:

- The need for a shift in culture and management willingness to change the current approach to career development and criteria for promotions
- The need to introduce a company policy and philosophy on employee development and career progression that is well communicated and understood by all
- The need to introduce personal training and career development plans for all individuals aspiring to gain new skills and experience or enhance existing skills and knowledge
- The need to introduce a transparent system of performance evaluation that rewards good performance
- The need to introduce a performance management system that leads to career and promotional prospects based on ability and good performance, experience, knowledge, attitude, initiative etc, rather than on seniority or length of service alone
- The need to train and develop managers to help manage their own careers and the careers of their subordinates

S3.5 IDENTIFICATION OF MAJOR PROBLEMS

S3.5.1 Water Supply System

Most of the urgent problems identified by the JICA Study are related to the water distribution system. In contrast, there seem to be fewer and less urgent problems in the bulk water supply system. Although the present water treatment capacity is insufficient and therefore a large volume of raw water is still being supplied without treatment, the addition of new water treatment capacity is not considered a high priority at present given the poor conditions of the existing distribution network. The overall picture is that there are many more urgent problems in the water distribution system than in the bulk water supply system.

The overall picture is that there are many more urgent problems in the water distribution system than in the bulk water supply system.

These problems are closely related to each other and are often mutually reinforcing. They can broadly be categorized as follows:

- Poor conditions of the existing water distribution system
- Lack of KW&SB's autonomy in the day-to-day operation and management of the services
- KW&SB's weak financial capacity
- Absence of measured supplies and volumetric charging system (imposition of 'Water Tax')

Table S35.1.1 provides the symptoms and consequences of these problems.

Table S35.1.1 Major Problems Identified by JICA Study

Major Problems	Symptoms	Consequences
Poor conditions of water distribution system	▫ Intermittent water supply ▫ High level of leakage ▫ Low system pressure ▫ Contamination ▫ Inequitable distribution	▫ Customers' distrust in KW&SB and the services it provides ▫ Reluctance to pay for the services ▫ Insufficient revenues
Lack of autonomy	▫ High level of receivables ▫ Tanker supplies ▫ Illegal connections ▫ Low tariffs	▫ Insufficient revenues ▫ Low morale of KW&SB staff
Weak financial capacity	▫ Delay in capital replacement ▫ Delay in system expansion ▫ Poor current maintenance ▫ Poor working environments (offices & equipment) ▫ Reliance on Government funding (OPEX and CAPEX)	▫ Deteriorating services ▫ Deteriorating assets ▫ Low morale of KW&SB staff ▫ Political interference
Absence of measured supplies and volumetric charging system	▫ Absence of system input metering and retail supply metering ▫ No incentives for efficient use of water ▫ No boundary of responsibilities for maintenance of service connections between KW&SB and its customers ▫ No means to estimate leakage and non-revenue water ▫ Negates the issue of illegal connections (retail users)	▫ No control of water supply system ▫ Misuse and wastage of water ▫ 'Leakage', 'non-revenue water' and 'illegal connections' being indefinable

Major problems of Water Supply System:
- **Poor conditions of water distribution system**
- **Lack of autonomy**
- **Weak financial capacity**
- **Absence of measured supplies and volumetric charging system**

Our assessment indicated that these problems have either directly or indirectly emanated from the KW&SB's financial constraints. **Figure S35.1.1** illustrates the vicious circle of the KW&SB's operations. It shows how KW&SB's financial constraints keep intensifying and thereby deteriorating the quality of the service. It is also because of its financial constraints that KW&SB have to rely on government subsidies to sustain its operations, which in turn makes KW&SB quite vulnerable to political interference in the day-to-day management and operation of its services.

These problems have either directly or indirectly emanated from the KW&SB's financial constraints.

A substantial improvement to water service quality will be required to break this vicious circle. It is the considered opinion of this JICA Study team that a substantial improvement to water service quality can be achieved by significantly reducing leakage and other water losses and introducing metered supplies with a volumetric tariff to all consumers. This view is shared by ADB in its Draft Karachi Sustainable Mega City Water & Wastewater Roadmap, May 2007.

A substantial improvement to water service quality will be required to break this vicious circle.

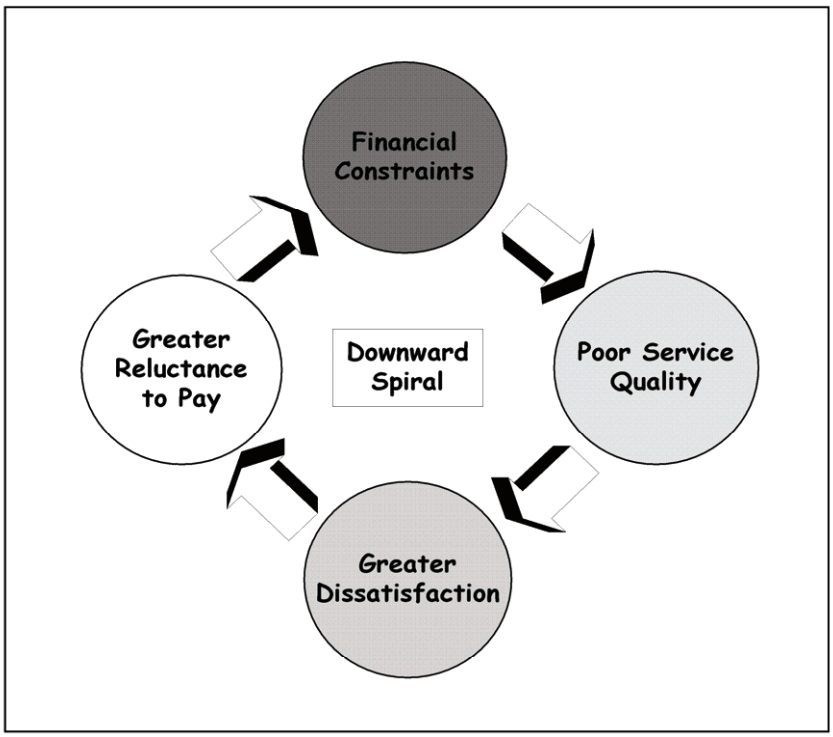

Figure S35.1.1 Vicious Circle of KW&SB Operation

S3.5.2 Sewerage System

Major problems about sewerage system are identified as follows.

Absence of comprehensive master plan

The master plan for sewerage implementation was once prepared in 1988, but the plan itself was not comprehensive and hence was not pursued in the later stage. It is needed to prepare comprehensive master plan for sewerage implementation in line with the city planning, to implement sewerage facilities based on it and to revise the plan on regular basis taking social and physical changes into account.

Limited budget allocation for sewerage facilities

Since the tariff collected in water supply and sewerage sector is very limited, the budget allocated for sewerage sector is limited, too. With the limited budget, it is almost impossible to operate and maintain existing sewerage facilities so as they function as planned and to extend or newly construct sewerage facilities to meet the future requirements.

Improper operation and maintenance of sewerage facilities

Mainly due to the limited budget and personnel allocated for operation and maintenance of sewerage facilities, existing facilities are not operated properly. Improper maintenance might lead to earlier aging of facilities and non-compliance with the effluent quality standard.

Insufficient sewerage facilities

As described above, existing sewerage facilities for sewage collection and its treatment are far from sufficient in quantity to serve the large population of Karachi City. Additional sewage collection system including branch sewers, trunk sewers and pumping stations need to be constructed to improve living environment of the citizen. In the same manner, existing sewage treatment plants need to be extended and new plant(s) has to be implemented to treat all the generated sewage to improve water qualities of public water bodies, especially of Arabian Sea.

Insufficient information on facilities

Sewers, pumping stations and sewage treatment plants consist of civil structures, mechanical and electrical equipment. For efficient and effective operation and maintenance of these facilities, it is needed to equip their as-built drawings, list and specifications on site. However, site surveys by the JICA Study Team found that there was little information on these items, especially about sewers except for Lyari interceptor.

Insufficient record of operation and maintenance works

In the same manner, little information in written form is available on the performance of pumping and treatment facilities such as flow rates, operation hours, influent/effluent qualities, facility failures and repairs and so forth.

Absence of operation and maintenance manual

Manuals for operation and maintenance of sewerage facilities (O/M) are not available. It is very difficult to operate and maintain sewerage facilities in a proper way without O/M manuals.