CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 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 in line with 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.

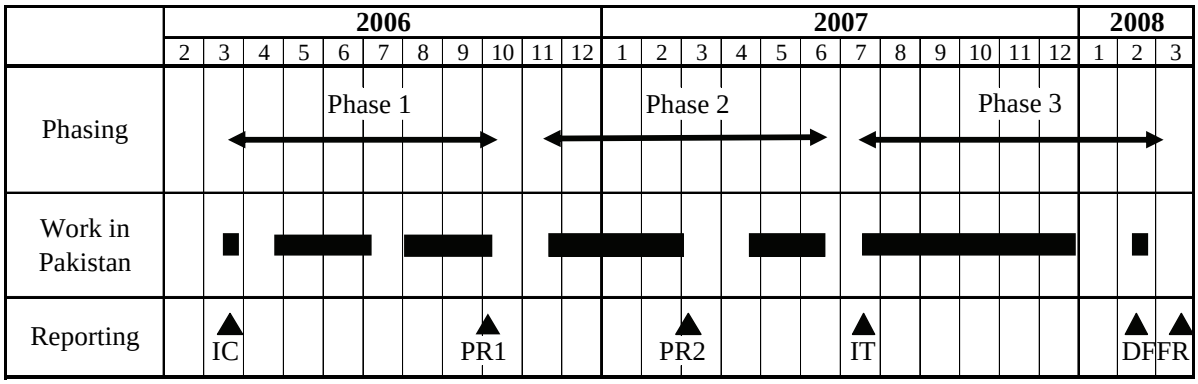
Against the background mentioned above, the Government of Pakistan officially requested the Government of Japan to conduct a master plan study to formulate a phased development plan of water supply and sewerage system for Karachi up to the year 2025.

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 'Scope of Work' or '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. The agreed S/W and the minutes of the meeting which discussed the S/W are attached as **Appendixes A11.1** and **A11.2**.

1.1.2 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 11.2.1**.

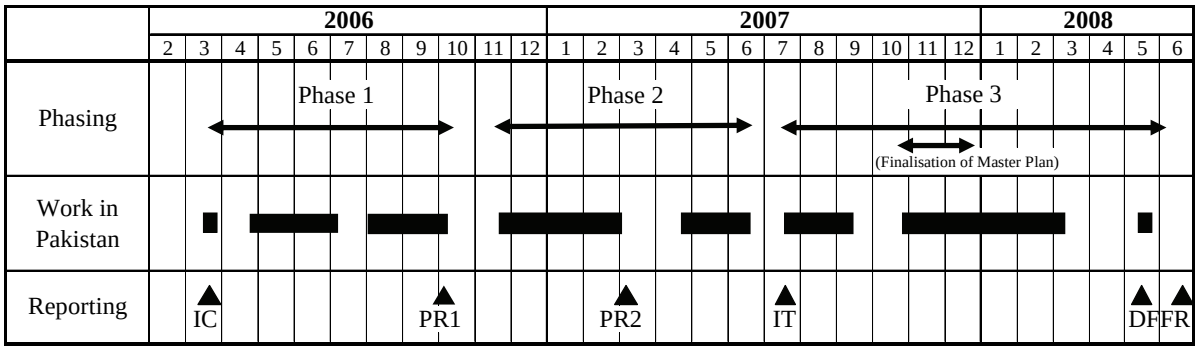
Phase 1: Basic Study (March 2006 to October 2006)
Phase 2: Master Plan (November 2006 to June 2007)
Phase 3: Feasibility Study (July 2007 through March 2008)



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

Figure 11.2.1 Original Implementation Schedule of JICA Study

However, due to the additional work required for the finalization of the water supply and sewerage master plan as described in **Section 1.4**, the Study period was extended for approximately 3 months until June 2008. **Figure 11.2.2** shows the final implementation schedule, according to which the JICA Study was actually carried out.



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

Figure 11.2.2 Final Implementation Schedule of JICA Study

1.2 PHASE 1: BASIC STUDY

In March 2006, the JICA study team visited Pakistan for two weeks for presentation and discussion of the Inception Report on the Study. At a meeting held in Karachi on March 14, 2006 at the Committee Room of the Planning and Development (P&D) Department of the Government of Sindh, the JICA study team presented the Inception Report and it was accepted without any modification. The meeting was chaired by the Additional Chief Secretary (Dev), P&D Department of the Government of Sindh. The minutes of the meeting are attached as **Appendix A12.1** to this report. In the meantime, the Government of Sindh through its letter No.SO (C-I)/SGA&CD/4-23/2006 dated March 30, 2006 notified the constitution of the Steering Committee (SC) for the Study, which consists of a chairman and nine members as

follows.

1.	The Additional Chief Secretary, Planning & Development Department, Government of Sindh	: Chairman
2.	The City District Nazim, City District Government Karachi	: Member
3.	The Secretary, Local Government, Katchi Abadis & Spatial Development Department, Government of Sindh Karachi	: Member
4.	The District Coordination Officer, City District Government Karachi	: Member
5.	The Chief – Foreign Aid Planning & Development Department, Government of Sindh, Karachi	: Member
6.	The Special Secretary, Planning & Development Department, Government of Sindh Karachi	: Member
7.	The Managing Director & EDO (Water & Sanitation) CDGK, Karachi Water & Sewerage Board	: Member
8.	The EDO Master Plan Group of Offices, City District Government Karachi	: Member
9.	The Chief Engineer (Projects), Karachi Water & Sewerage Board	: Member
10.	The Chief (PP&H), P&D Department, Government of Sindh Karachi	: Member

The JICA study team returned to Pakistan in late April 2006 to undertake the rest of the "Phase 1: Basic Study", which comprised the following study components.

- Review of water supply and sewerage master plans prepared in the past
- Assessment of existing water sources
- Assessment of existing water supply, sewerage and drainage facilities
- Evaluation of water quality
- Review of existing land use
- Assessment of existing laws, policies and administration systems related to water supply, sewerage and drainage services
- Assessment of KW&SB's institutional and managerial capacity
- Study on environmental and social considerations
- Review and analysis of relevant studies and projects
- Evaluation of existing water supply, sewerage and drainage conditions and identification of major problems
- Identification of quick impact programmes

In undertaking these studies, the JICA study team collected and analyzed various data and information related to the Study, including study reports prepared in the past. It was then followed by the field inspections of key water supply and sewerage infrastructure located in and out of Karachi as well as by intensive discussions with officials of the KW&SB and other government agencies concerned. Further, in order to obtain accurate information on the actual conditions of the existing water supply and sewerage services in Karachi, the JICA study team also conducted the following field survey works.

- Water Quality Sampling and Analysis Survey in which water samples were taken and analyzed two times - one in the dry season and the other in the wet season.
- For water supply : 29 samples (raw water, treated water and water in the distribution system) at each season
- For sewerage: 7 samples (effluent discharging point, Lyari River, Malir River, domestic and commercial wastewaters) at each season
- Leakage Surveys at two locations – one in Landhi Town and the other in Gadap Town
- Water Consumption and Public Perception Survey which covered a total of 1,200 households in Karachi

The JICA study team organized and convened a workshop on June 27, 2006 in Karachi, in which all the Superintendent Engineers (SEs) of KW&SB were invited to participate to express their views and opinions on various problems of the existing water supply and sewerage

services. The JICA study team also assisted KW&SB in organizing and convening the first stakeholders meeting in Karachi on September 7, 2006, which complied with the procedures required under the 'JICA Guidelines for Environmental and Social Considerations'.

In late September 2006, the JICA study team prepared the Progress Report No.1 compiling the outcome of the Phase 1: 'Basic Study'. The report consisted of two separate volumes, namely, Volume I: Main Report and Volume II: Appendices. It was presented to the Steering Committee at a meeting held in Karachi on October 2, 2006 and was accepted in principle. The minutes of the meeting of this Steering Committee are attached as **Appendix A12.2**.

1.3 PHASE 2: MASTER PLAN

The JICA study team started the Phase 2: 'Master Plan' in late November 2006, which, among others, included the following study components.

- Water demand forecast
- Forecast of future quality and quantity of sewage
- Formulation of basic planning framework, policies, goals and strategies
- Equitable water distribution
- Bulk water sources and conveyance system
- Reduction of energy costs
- Formulation of facility development plans
- Strengthening of KW&SB's management capacity
- Preliminary cost estimates
- Formulation of phased implementation programmes
- Evaluation of Master Plan and selection of priority projects

In the development of the institutional aspects of the Master Plan, the JICA study team convened the 'Human Resources Management and Development' workshop on February 6, 2007 in Karachi. The workshop provided a forum where senior KW&SB managers could express their ideas and concerns in an open and honest environment with the idea of transforming KW&SB into a customer focused efficient and financially sustainable professional organization. 40 senior managers mostly from non-engineering departments were invited of which 26 attended.

In late February 2007, the JICA study team produced the Progress Report No.2 which presented the progress of Phase 2: 'Master Plan Study' made up to mid February 2007. The report was presented to the Steering Committee at the meeting held in Karachi on February 28, 2007. The minutes of the meeting of this Steering Committee are attached as **Appendix A13.1**. As agreed at this meeting, follow-up meetings between KW&SB and JICA study team took place on March 1, 2007 and March 2, 2007 to discuss and resolve issues raised by KW&SB regarding the contents of the Progress Report No.2. The minutes of these follow-up meetings are attached as **Appendix A13.2**. At the meeting held on March 1, 2007, KW&SB provided the JICA study team with a questionnaire regarding the Progress Report No.2. JICA study team prepared and e-mailed KW&SB its replies to the questionnaire on April 15, 2007. The KW&SB's questionnaire and JICA study team's replies including e-mails exchanged between the two in this respect are attached as **Appendix A13.3**.

The issues described in Items 16 and 17 of the minutes of the February 28, 2007 meeting with the Steering Committee were discussed further at the meetings of JICA study team and the JICA delegation from Japan and Islamabad with (1) the Managing Director of KW&SB on May 7, 2007 and (2) the Additional Chief Secretary (Dev) of the Government of Sindh on May 8, 2007;

the following decisions were made by consensus of all those who participated in these meetings.

- The Secretary of the Steering Committee would distribute Progress Report No.2 (which KW&SB received from the JICA study team on February 24, 2007) to each member of the Steering Committee without further delay with (a) the minutes of the February 28, 2007 Steering Committee meeting, (b) the KW&SB's questionnaire delivered to the JICA study team on March 1, 2007, and (c) JICA study team's replies to the KW&SB's questionnaire attached to the report.
- It was therefore not necessary to convene the meeting of the Steering Committee referred to in the last sentence of Item 17 of the minutes of the February 28, 2007 Steering Committee meeting.

The minutes of the May 7, 2007 and May 8, 2007 meetings are attached as **Appendix A13.4** and **Appendix A13.5** respectively. Based on the decisions made at these meetings, the JICA study team submitted three letters to KW&SB. The first letter provided JICA study team's comments on the minutes of the February 28, 2008 Steering Committee. It informed the decisions made at the May 7, 2007 and May 8, 2007 meetings that neither the revision/ resubmission of Progress Report No.2 nor another meeting of the Steering Committee to review Progress Report No.2 was necessary. The second letter concerned about the minutes of the follow-up meetings held on March 1, 2007 and March 2, 2007. It enclosed the "Notes of the Meetings" prepared by the JICA study team, which represented their understanding of what was discussed and agreed at these meetings. The third letter pertained to the issues raised by KW&SB during the March 1, 2007 and March 2, 2007 follow-up meetings for consideration by the JICA Headquarters in Japan. It contained a document detailing the points raised by KW&SB for JICA's consideration with confirmation of JICA's response. Copies of these three letters are attached as **Appendix A13.6**, **Appendix A13.7** and **Appendix A13.8** respectively.

In accordance with the decisions made at the May 7, 2007 and May 8, 2007 meetings, the Secretary of the Steering Committee officially distributed Progress Report No.2 (Main Report & Appendixes) to the Chairman and members of the Steering Committee on May 25, 2007. The minutes of the February 28, 2007 Steering Committee Meeting along with the KW&SB's questionnaires on the report and the JICA study team's replies to those questionnaires were enclosed in the report. A copy of the letter sent to the Chairman and members of the Steering Committee in this regard is attached as **Appendix A13.9**.

1.4 PHASE 3: FEASIBILITY STUDY

In early August 2007, the JICA Study team issued the Interim Report. The report consisted of Volume I: 'Main Report' and Volume II: 'Appendices' and presented the outcome of Phase 2: 'Master Plan Study', which included water supply and sewerage master plan along with phased implementation schedules and preliminary cost estimates. The report also provided recommendations on the 'Priority Project' which would be subjected to feasibility studies in the Phase 3: 'Feasibility Study' stage of the JICA Study. At a meeting held in Karachi on August 8, 2007, the report was presented to the Chairman and members of Steering Committee including the City Nazim. JICA Study team informed the Steering Committee that the water supply and sewerage master plan shown in the report had been developed based on the town-wise population projections, land use plans and other basic data provided in the Karachi Strategic Development Plan 2020 (CV-3) that was prepared by CDGK and officially submitted to the Embassy of Japan in Islamabad in January 2007. The City Nazim then informed the Committee that the CV-3 of the Karachi Strategic Development Plan 2020 was still a draft version and its final version containing revised town-wise population projections that were significantly different from that of the CV-3 version would be issued very shortly. Also, he

insisted that the water supply and sewerage master plan should be developed based on the revised town-wise population projections provided in the final version of the Karachi Strategic Development Plan 2020. His view was supported by the Chairman and other members of the Steering Committee. On the following day, August 9, 2007, this issue was again discussed and the following consensus was reached among the parties concerned.

- CDGK would submit the final report of the KSDP-2020 to the Embassy of Japan and JICA Pakistan Office in Islamabad on August 15, 2007, which would be accompanied by a letter signed by the City Nazim certifying that the report was the final report of the KSDP-2020 while also requesting JICA to revise the water supply and sewerage master plan provided in the Interim Report so that the plan would become consistent with the town-wise population projections, land use plans and other basic data provided in the final report of the KSDP-2020
- The JICA Headquarters in Tokyo would review the request for the revision of the master plan and inform GOP, GOS, CDGK and KW&SB in writing within one month after the receipt of the report from CDGK its decision on whether it was possible to revise the master plan according to the request

The above consensus was subsequently documented in the form of Minutes of Understanding which were signed by the parties concerned on August 9, 2007. The minutes of the August 8, 2007 Steering Committee meeting and the Minutes of Understanding dated August 9, 2007 are attached as **Appendix A14.1**.

In line with the Minutes of Understanding dated August 9, 2007, the EDO Master Plan of CDGK with his letter Ref No. CDGK-MPGO/KSDP-2020/JICA/93 dated August 15, 2007 (See **Appendix A14.2**) provided JICA with a copy of the final report of the Karachi Strategic Development Plan 2020. Subsequently, the following two letters were exchanged between the JICA /Embassy of Japan and the City Nazim.

- JICA's letter Ref No. JICA/10-03007/Admn/2007 dated October 3, 2007 addressed to the City Nazim (See **Appendix A14.3**)
- City Nazim's letter Ref No. City/Nazim/Secy/2262/2007 dated October 4, 2007 addressed to the Embassy of Japan, Islamabad (See **Appendix A14.4**)

Finally, JICA through its letter Ref No. JICA/10-25008/Admn/2007 dated October 25, 2007 (See **Appendix A14.5**) informed the City Nazim of its decision that it would undertake additional work to revise the water supply and sewerage master plan provided in the Interim Report so that the plan would become consistent with the town-wise population projections, land use plans and other basic data provided in the final report of the Karachi Strategic Development Plan 2020. Since this revision work required an extension of the JICA Study period stated in the Scope of Work (S/W) dated July 13, 2005, Minutes of Meeting were prepared for the modification of the S/W and signed by the parties concerned on November 14, 2007. These Minutes of Meeting are attached as **Appendix A14.6**.

CHAPTER 2

OBJECTIVES OF THE STUDY AND STUDY AREA

2 OBJECTIVES OF THE STUDY AND STUDY AREA

2.1 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 the 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.

2.2 STUDY AREA

The Study area covers the entire administrative area of the City District Government Karachi (CDGK) plus 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 22.1.1** provides the names and areas of the 18 Towns and the number of UCs included in each Town.

Table 22.1.1 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

2.3 DESCRIPTION OF THE STUDY AREA

2.3.1 Natural Conditions

(1) Topography

Karachi is located in the south of Sindh, on the coast of the Arabian Sea. It covers an area of approximately 3,600 km^2, comprised largely of flat or rolling plains, with hills on the western and northern boundaries of the urban sprawl. The city represents quite a variety of habitats such as the sea coast, islands, sand dunes, swamps, semi arid regions, cultivated fields, dry stream beds, sandy plains, hillocks. Classified according to physiographic features, Karachi City District can be divided into three broad categories:

- Hilly Region (Mountain Highland)
- Alluvial Plain (Piedmont Plain)
- Coastal Areas (Valley Floor)

The metropolitan area is divided by two non-perennial river streams namely Lyari and Malir Rivers. The Malir River flows from the east towards the south and centre, and the Lyari River flows from north to the south west. Gujjar and Orangi are the two main tributaries of the Lyari River while Thaddo and Chakalo are the main tributaries of the Malir River. The dry weather flow of both rivers carries urban sewage that is ultimately drained in the Arabian Sea.

Among the various physiographic features, low flat-topped parallel hills devoid of vegetation, interspersed with widespread plains and dry riverbeds are the main topographic characteristics of the city. The greatest height of the region is 250 ft that gradually decreases to 5 ft above mean sea level along the coastline. The Karachi Harbour is a sheltered bay to the south-west of the city, protected from storms by the Sandspit Beach, the Manora Island and the Oyster Rocks. The Arabian Sea beach lines the southern coastline of Karachi. Dense mangroves and creeks of the Indus delta can be found towards the south east side of the city. Towards the west and the north is Cape Monze, an area marked with projecting sea cliffs and rocky sandstone promontories.

(2) Geology and Geomorphology

The present geological setup of the city is largely composed of sandstone, shales of Nari, Gaj and Mancher formation ranges from Oligocene to recent. The area comprises hills, valleys and the coast as the physical features. Rocks are deposited under shallow marine to deltaic condition. On the basis of the water bearing properties, the lithostraitigraphic units can be classified as consolidated and un-consolidated sediments. The area extends in the north to south east direction, sloping towards the Arabian Sea. The area between valley floor and mountain highland is covered by sub-recent deposits generally sloping towards the drainage system of the four river basins. Physiographical classification of the area establishes three separate landforms, namely mountain highland, piedmont plain and the valley floor. According to the geological classification, the rocks of the entire region of Karachi and its suburbs, upper valleys of Lyari and Malir rivers are almost exclusively of the tertiary system that belongs to the most recent geological period. The lower reach of the Lyari basin constitutes post-tertiary alluvial subsoil while the upper reach constitutes boulders and conglomerate. Malir River basin consists of alluvial deposits of boulders, gravels sand and clay. Mole and Khadeji streams form the uppermost tributaries of the Malir River. The thickness of the bed gradually increases downstream.

(3) Climate

Located on the coast, Karachi tends to have a relatively moderate climate with high humidity. The weather is hot and swelters during May-June with an average maximum temperature of about 34 °C. The winters are relatively mild and with an average minimum temperature of about 13 °C. For greater part of the year, the relative humidity around Karachi is high. The average relative humidity is at a minimum in the months of December to March while it is at a maximum during the monsoon months of July to September. **Table 23.1.1** presents typical climatological conditions in Karachi. The annual average rainfall is 203 mm which classifies the region as 'arid'. The rainfall is brought about mostly by the northwesterly monsoon during the period June to September.

Table 23.1.1 Typical Climatological Conditions in Karachi

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Temp. (°C)	Min.	12.8	14.4	19.4	22.8	26.1	27.8	27.2	26.1	25.0	22.2	17.8	13.9
	Max	25.0	26.1	29.4	32.2	33.9	33.9	32.8	31.1	31.1	32.8	30.6	26.7
Precipitation (mm)	Max	69	51	56	131	60	183	392	428	252	69	41	66
	Ave	13	10	8	3	3	18	84	41	13	2	3	5
	Max/ 24 hr	41	28	43	104	30	183	201	137	206	13	23	46
Average Relative Humidity (%)		54	61	58	75	78	78	81	82	80	70	59	55

Source: Karachi Airport (1947 – 1990)

Strong coastal winds are also the characteristic feature of the region. The wind direction during the southwest monsoon period is dominantly from the northeast and north. Wind intensity at the time when the southwest monsoon sets in is much dependent upon the low air pressure system prevailing over the sub-continent.

2.3.2 Socio-Economic Conditions

(1) Population

In terms of the number of population, Karachi is one of the ten largest cities in the world. The population of Karachi is estimated at 15.1 million in 2005 and 27.5 million in 2020 under the Karachi Strategic Development Plan 2020 (August 2007). The increase in population is putting heavy pressures on the physical, infrastructural, financial and institutional systems of the city.

A large segment of Karachi's population, roughly 40%, is afflicted with poverty. The living conditions of the deprived section and its economic wellbeing are therefore a major concern, as these impact the environment and growth potential of the city.

Karachi's population is diversified in terms of ethnicity and economic conditions. Apart from in-migrants from Pakistan's provinces, a large number of migrants from Afghanistan, Bangladesh and other South Asian countries have settled in the city.

With an average monthly household income of Rs. 15,000 (US$250), there is considerable variation in income distribution. Roughly 75% of the households fall in the category of poor and low income groups and 25% constitute the middle and high income groups.

In Pakistan, a nation-wide census is conducted once in every ten years. The last census was carried out in 1998 and it reported that Karachi's population was 9,960,000 at that time. On the grounds that the 1998 census undercounted Katchi Abadi residents and migrants, the KSDP-2020 (August 2007) corrected this baseline population as 11,335,000 and then projected

that the population would increase to 15.12 million by 2005 by applying the average annual population growth rate of 4.2% which comprises 3.5% of natural growth rate and 0.7% of social growth rate. The next census is scheduled for 2008.

(2) Land Use and Urban Planning

a) Land Use

The Karachi City District is spread across an area of approximately 3,600 km^2. A large portion of this area consists of vacant land including the area dedicated to the Kirther National Park. The KSDP-2020 (August 2007) indicated that Karachi has now an urbanised area of approximately 527 km^2 which comprises various types of land uses as shown in **Table 23.2.1**.

Table 23.2.1 Existing Land Use in Urbanised Area

Land Use	Urbanised Area 2006		
	Acres	km^2	%
Formal Residential	35,206	142.5	27.0%
Informal Residential	10,558	42.7	8.1%
Goth (Villages = Residential)	2,043	8.3	1.6%
Commercial	2,921	11.8	2.2%
Health	685	2.8	0.5%
Educational	3,320	13.4	2.6%
Government	3,036	12.3	2.3%
Other Institutional	1,218	4.9	0.9%
Industries	9,285	37.6	7.1%
Cottage Industries	28	0.1	0.0%
Transport	723	2.9	0.6%
Warehouses	563	2.3	0.4%
Mining	166	0.7	0.1%
Vacant Land	9,541	38.6	7.3%
Open Space	13,439	54.4	10.3%
Agriculture	7,296	29.5	5.6%
Water	2,392	9.7	1.8%
Road Space	23,089	93.4	17.7%
Other Land Uses	4,660	18.9	3.6%
Total	130,169	526.8	100.0%

Source: KSDP-2020 (August 2007), Annexure-I, 3. Existing Land Use and Housing

It should be noted that vacant land accounts for only 7% of all land and housing is the biggest user of land (with about 37% of the total), while roads and open spaces are also significant. Most of the developed areas are concentrated in the inner ring towns of Saddar, Jamshed, Lyari, Liaquatabad, Gulshan-e-Iqbal and Gulberg. These towns contain the most diverse mix of land uses and include most of the governmental and regional-scale industrial and commercial activities.

The KSDP-2020 (August 2007) stated that with mounting pressures exerted by the population growth over the last two decades, the following two basic trends in land use have recently been observed.

- Commercial growth has taken place along major arterials.
- While most residential neighbourhoods have acquired one or two storey structures, significant densification has taken places through construction of upper floors and subdivisions of large plots. In many old and new areas, apartment buildings, 5-6 storeys high, have replaced the low-density bungalow type housing.

b) Urban Planning

The key urban master planning exercises carried out for Karachi City are briefly described as follows:

(i) The Greater Karachi Resettlement Plan

In 1958, Ayub Khan (the then military ruler of the country) took a number of decisions that affected Karachi and its relationship with the rest of Pakistan. Ayub decided to shift the capital to Islamabad. He also decided that the refugees should leave the city and the working classes, migrating into the city from the other areas of Pakistan should also be discouraged from living within the city centre. To achieve these ends he hired a Greek planner, Doxiades, to prepare what is known as the 'Greater Karachi Resettlement Plan' (GKRP). The plan consisted of developing two satellite towns, Landhi-Korangi to the east and New Karachi to the north of the city. These satellite towns were to be about 25 km from the city centre. Industrial estates were developed as part of the satellite town plans and industrialists were offered incentives to invest here. At the same time, core houses were developed to house the refugee population and other squatter settlement residents. It was assumed that these people, who were being forcibly moved to these locations, would find employment here. However, that did not happen as industrialization was slow to develop and the owners of the new core houses refused to pay their installments which were to finance the continuation of the housing process. Consequently, by 1964, the program was abandoned.

(ii) The Karachi Master Plan 1974-85

The failure of the GKRP forced the governments in the mid to late 1960s to seek alternative solutions to the housing and infrastructure problems of the city. The government of Pakistan in 1968, asked for UNDP assistance for preparing a master plan for the city of Karachi. The resulting Karachi Master Plan 1975-85 was a landmark in the planning history of Karachi. It made plans for a rational road network; housing, consisting of site-and-services and the upgrading of katchi abadis; bulk water supply; transport terminals and warehousing; land management; bypasses to the city; mass transit and ecological issues. In the plan period, only the road networks were built and these too in a sub-standard manner. However, they eased and rationalized movement between different areas of the city. Most of the plan components could not be implemented, nor could the institutional arrangements be made that were envisaged by the plan for the management of the city. Legal cover was not given to the plan either.

(iii) The Karachi Development Plan 2000

On the expiry of the 1974-85 Karachi Master Plan period work on the Karachi Development Plan 2000 was begun by the KDA with UNDP assistance. The plan document was completed in 1990. Essentially the plan consisted of a computer model that would monitor developments in Karachi so that investments could be directed appropriately. It also contained important recommendations for planning and a related institutional set-up which included the setting up of an independent Karachi Division Physical Planning Agency (KDPPA) supported by a steering committee and an implementation board. Building control in this agreement was to be subservient to the KDPPA. However, the monitoring and related planning exercise could not be carried out without a constant supply of data for which no system was proposed by the plan. This and other related factors rendered the entire set-up created for the Karachi Development Plan 2000 ineffective. In addition, the plan was never given legal cover as its Steering Committee could not meet to approve it.

(iv) Karachi Strategic Development Plan 2020 (KSDP-2020)

A project for the formulation of a Master Plan 2020 for Karachi City is presently being carried out within the Master Plan Group of Offices (MPGO) of the City District Government Karachi (CDGK). It is undertaken under the Tameer-e-Karachi Program to set out a strategic framework and overall development direction and future pattern of the

city over the next 13 years up to 2020. The final report of the KSDP-2020 was issued in August 2007.

(3) Health

Karachi has a variety of medical facilities. It has all sorts of hospitals, clinics and dispensaries, both in the public and private sectors. However, a vast majority of the population also get treatment from medical practitioners, both qualified and unqualified and by hakims (traditional doctors using herbal medicines). Most of these doctors operate from small, one room clinics and have no proper diagnostic facilities. There is no record of the number of such clinics. However, they greatly outnumber public sector health facilities. Since public sector facilities remain highly centralized in a few locations, they become largely inaccessible to population of most city sectors. This provided the stage to the private sector to establish clinics and hospitals in the residential neighborhoods.

Although the access to public sector hospitals is unrestricted and is also non-discriminatory, treatment and hospitalization facilities are lacking so that there is considerable pressure on the present resources. Major deficiencies exist in both the quantity and quality of these public sector health care facilities. The current system has 33 hospitals, 271 health centres and 152 dispensaries. It includes an estimated 15,000 beds, of which 9,000 are in the tertiary and teaching hospitals and the remaining 6,000 dispersed among the primary and secondary facilities.

In contrast, private hospitals provide better facilities and better service but restrict access on account of affordability. The private sector health care system has 356 hospitals (of which 145 are large), 391 maternity homes, 2,347 dispensaries and about 6,600 beds.

(4) Education

According to a survey conducted by the Applied Economic Research Centre (AERC) in 1987, the literacy rate in Karachi was 76% in planned areas and 49% in unplanned areas. The Government of Sindh, the federal government, the City Government and the private sector are the main providers of education in Karachi. However, owing to the inadequacy of the government run educational facilities, such facilities have been supplemented in a very significant way by the private sector.

The KSDP-2020 (August 2007) indicated that approximately 75% of all children in need of basic education are enrolled in primary schools, while about 60-65% receives education at the secondary level. As for the quality of education, public sector institutions lag behind the private sector. However, the public education is much more affordable than the private education.

The Pakistan Social & Living Measurement Survey of 2004-05 showed a 72% literacy rate for the urban areas of Sindh. The rate was 80% for men and 62% for women. The overall literacy rate for urban areas in Pakistan was 71%. A socio-economic survey conducted as part of the KSDP-2020 study in 2005 showed a similar literacy rate of 71% for the city of Karachi.

Social indicators representing the whole of Karachi may be misleading since there are major differences between the social indicators for the city’s planned areas and katchi abadis. There are also major differences in social indicators among low-income settlements themselves.

(5) Economy

Karachi is the financial capital of Pakistan; it accounts for the lion's share of GDP and revenue. In February 2007, World Bank has termed Karachi as the most business-friendly city in Pakistan. KSDP-2020 (August 2007) describes the Karachi’s economy as follows:

(Start Quote from KSDP-2020) Karachi, benefiting from its status as the country's principal port, and its capital until 1959 has emerged as the main industrial and commercial centre. Until the 1970s, the city's industrial expansion was driven by traditional industries such as food processing, textiles and garments, but in the 1980s a number of modern chemical, electronic and automotive industries began to make an increasingly important contribution to industrial growth. During this period, Karachi became the main attractor for foreign direct investment in manufacturing in Pakistan and its industrial structure was diversified through the establishment of large manufacturing units in the chemical, petroleum and metallurgical industries. However, owing to a deteriorating law and order situation resulting in production shutdowns and payment of extortion to various agencies, the increase in the cost of production through higher energy costs, power outages resulting in loss of output, the last 20 years have witnessed the physical shifting of small enterprises to the Punjab (the origin of most of the small-scale manufacturers) and medium-scale enterprises to Dubai (because of a secure location and employer-friendly labour laws), there has been a continuous decline in manufacturing activity. Despite these setbacks, Karachi has witnessed a substantial increase in the trade and services sectors. The financial services sector has seen the induction of a large number of international banks, the emergence of exchange companies, and a boom in the stock market.

As the largest city and the transportation, trade and financial gateway to the outside world, Karachi's economic fate is closely ties to that of the nation. Karachi's considerable presence can be portrayed best by showing the city's central role in various sectors of national economic activity:

- 40% of financial activity
- 30% of manufacturing, and 40% of large-scale manufacturing
- 50% of bank deposits
- 20% of federal tax revenue, 40% of Sindh's provincial revenues, and 62% of income tax collected
- 95% of foreign trade passes through Karachi's two ports and its airport

It is estimated that the city generates about 20% of the national output, creates more than 30% of value added in manufacturing, and accounts for 25% of national tax revenues. More importantly, the city provides jobs for a large population – 40% of national employment in large-scale manufacturing is based in Karachi. Karachi's economic underpinnings include industries in seven major concentrations namely the Sindh, Korangi and Landhi Industrial Estates, Federal 'B' Area, North Karachi, the Export Processing Zone, and Port Qasim.

One of the Karachi's key comparative advantages is the low cost of labour. The low wage work force lives primarily in Katchi Abadis (squatter settlements) that run along water ways and on government owned land in pockets throughout the urbanised area. Many poor people work near where they live, which reduces commuting costs and helps keep wages low. Inflation in Karachi is the lowest among all of the large cities (population in excess of 500,000) in Pakistan with the exclusion of Faisalabad. *(End Quote from KSDP-2020)*

(6) Government

The City of Karachi Municipal Act was promulgated in 1933. Initially the Municipal Corporation comprised the mayor, the deputy mayor and 57 councillors. The Karachi Municipal Corporation was changed to a Metropolitan Corporation in 1976. The administrative area of Karachi was a second-level subdivision known as Karachi Division, which was subdivided into five districts: Karachi Central, Karachi East, Karachi South, Karachi West and Malir. In 2000, the Government of Pakistan designed a new devolution plan of financial resources and responsibilities. This plan abolished the earlier second-level division and merged the five districts of Karachi into a Karachi District. When the devolution plan was

implemented in 2001, this district officially became a City District, with the City District Government of Karachi handling its government. Karachi now has a three-tier federated system formed by:

- The City District Government (CDGK)
    - Town Municipal Administrations (TMAs)
        - Union Council Administrations (UCAs)

The City-District of Karachi is divided into 18 towns governed by elected town municipal administrations (TMAs) responsible for infrastructure and spatial planning, development facilitation, and municipal services (water, sanitation, solid waste, repairing roads, parks, street lights, and traffic engineering), with some functions being retained by the CDG.K.

The towns are sub-divided into 178 localities governed by elected union councils (UC's), which are the core element of the local government system. Each UC is a body of 13 directly elected members including a Nazim (mayor) and a Naib Nazim (deputy mayor). The UC Nazim heads the union administration and is responsible for facilitating the CDG to plan and execute municipal services, as well as for informing higher authorities about public concerns and complaints.

The City Council comprises 255 elected councillors which consist of 178 UC Nazims, 59 representatives of women, 9 representatives of workers, and 9 representatives of minority groups.

CHAPTER 3

EXISTING WATER SUPPLY AND SEWERAGE SYSTEMS

3 EXISTING WATER SUPPLY AND SEWERAGE SYSTEMS

3.1 EXISTING WATER SUPPLY AND SEWERAGE MASTER PLANS

3.1.1 1985 Water Supply Master Plan

(1) Background

In 1985 when the Karachi Development Authority (KDA) prepared a water supply master plan for Karachi, the total population of metropolitan Karachi was 6.7 million and about 6.0 million people received treated water either directly through connections to the system or indirectly from tankers and standposts; the remainder of the people in the city obtained water from other sources such as private wells, ponds and water courses. On average, KW&SB provided 323 mgd (1,469,000 m^3/d) of potable water each day, which originated from the supply sources shown in **Table 31.1.1**.

Table 31.1.1 Water Supply Sources in 1985

Source	Capacity	
	mgd	m^3/d
Groundwater abstracted from the Malir basin at Dumlottee	4	18,000
Surface water taken form the Indus river through Kinjhar Lake, the Jam Branch canal and Haleji Lake	230	1,046,000
Surface water impounded by the Hub dam	89	405,000
Total	323	1,469,000

The Phase IV Project of the Greater Karachi Bulk Water Supply (GKBWS) Scheme was under implementation at that time and it was expected that the completion of the project would provide an additional 50 mgd (230,000 m^3/d) of water from the Indus River giving the total resource availability of 373 mgd (1,700,000 m^3/d) by mid 1987. However, treatment of this additional supply was not included in the Phase IV project.

In 1985, the KDA awarded a consultancy service contract for preparation of a master plan for the future expansion of the water supply system to Sir M. MacDonald and Partners (principal consultant) and Associated Consulting Engineers (ACE Ltd – local associated consultant). The study comprised three parts with the following objectives.

Part I
An evaluation of alternative means to supply 240 mgd (1,090,000 m^3/d) of additional water from the Indus River and identify the preferred system for conveyance of the water to Karachi.

Part II
To study alternative sources of water to augment the supplies by an additional 300 mgd (1,360,000 m^3/d) and to identify the preferred system for conveyance of the water to Karachi. Also to determine the sufficiency of 300 mgd.

Part III
To prepare preliminary designs, estimates and a phased programme for the works identified in Part I.

The contract agreement for the study was signed on 24 January 1985 with completion of the study scheduled for:

Part I and Part II: Feasibility Studies – 24 September 1985
Part III: Preliminary Designs – 24 June 1986

(2) Water Demand

The study forecasted that the population of Karachi would be 14.347 millions in the year 2000 and 30.91 millions in 2025. The average growth was projected at 5.48% from 1981 to 2000 and 3.04% from 2000 to 2005. Projection of water demand included domestic, commercial and non-domestic demand and was made assuming a full pressure supply in the future; losses and unaccounted consumption were allowed at 40% in 1985 reducing to 25% in 1995 and thereafter following the development of a proposed planned approach to leakage detection and repair. On the basis of these projections, the master plan estimated water demands to the year 2025 as shown in **Table 31.1.2**.

Table 31.1.2 Projected Water Demands

Year	Average Day Demand		Peak Day Demand	
	mgd	m^3/d	mgd	m^3/d
1985	371.9	1,691,000	437.49	1,988,000
1990	492.3	2,238,000	578.6	2,630,000
1995	614.2	2,792,000	721.2	3,278,000
2000	820.0	3,728,000	962.9	4,377,000
2010	1,338.6	6,086,000	1,571.7	7,144,000
2025	2,451.7	11,146,000	2,878.7	13,085,000

As a result, equivalent per capita demands for the period, based on average day figures were estimated to increase from 252 litres (55 gallons) in 1985 to 260 litres (57 gallons) in 2000 and to 368 litres (81 gallons) in 2025.

Based on the above water demand projections and the supply capacity of 373 mgd to be available upon completion of the Phase IV Project in mid 1987, the study concluded that:

1) The completion of the Part I Project (240 mgd or 1,090,000 m^3/d) would increase the total supply capacity to 613 mgd (2,787,000 m^3/d) which would be able to satisfy the average day demand up to 1995.
2) The supply increment of 300 mgd (1,360,000 m^3/d) originally suggested for the Part II Project was clearly insufficient to meet the future demand and consequently Part II Project should be reframed as:
   Part II a – 300 mgd (1,360,000 m^3/d)
   Part II b – 300 mgd (1,360,000 m^3/d)

(3) Water Resources

The 1985 master plan study made a review of all potential water sources in the Karachi region, which included the Indus River and other surface water and groundwater sources, desalination of sea water, and the indirect reuse of treated sewage effluents for substitution of existing non-potable uses and recharge of aquifers. As a result, the study concluded that only the Indus River and desalination could supply very large quantities of water needed for Karachi; the cost of desalination for the foreseeable future was prohibitive and only if technological advances were made to considerably reduce the costs of energy would it likely to become attractive for Karachi. Alternative surface water sources were found to have very small potential yields and in all cases the likely cost of development would exceed that for the Indus River. The review identified the Lasbela plain in the Porali river basin as the most promising groundwater source in the region. However, this source is located in Balochistan and was already proposed as a source of water for local irrigation development. The other groundwater sources in the region were found to be of relatively small magnitude with the total potential yield of all the

groundwater sources within 100 km of Karachi being as insignificant as 4 mgd (18,000 m^3/d). For these reasons, the study concluded that Indus River was the only viable water supply source for Karachi. At the same time, it also recommended that the following long-term requirement of Karachi should be made known to the Government so that it might be taken into account in the apportionment of Indus water between various users.

1) From 1997 to the year 2025 the basic need for Karachi would be a supply gradually increasing to 3,700 cusecs (9,050,000 m^3/d), this would be required at Kotri during the period November to June, in the form of guaranteed releases from upstream storage.
2) The above flow would be augmented by additional withdrawals when the river is in flood (June to October), which would be regulated through Kinjhar lake to provide Karachi with a total of 10,480,000 m^3/d in rabi and 12,050,000 m^3/d in kharif.

(4) Part I Project

The cost of the Part I Project to bring 240 mgd of Indus water to Karachi was estimated to be Rs 6,518 million at end 1985 price levels, which was equivalent to US$ 407 million at an exchange rate of US$1 = Rs 16.00. After allowing for inflation the anticipated total project cost increased to Rs. 8,233 million (US$ 515 million). Assuming that the construction of the Part I Scheme would be completed over the four years from 1988 to 1991, the estimated project costs implied an annual expenditure of Rs 1,630 million as compared with the then on-going Phase IV project of GKWBS (Rs 140 million/year) and the KW&SB's actual annual expenditure for the fiscal year 1983-84 (Rs 307 million for operating, distribution and administration plus some loan and other charges). Further, the annual O&M cost of the Part I Project when running at full capacity was estimated to be Rs 236 million at end 1985 price levels.

Financial viability of the proposed Part I Scheme was examined based on the estimated capital and recurrent costs of the scheme and the financial targets set by the World Bank for the Phase IV Project of GKBWS, which required water tariffs to recover the following expenditures.

- O&M costs
- 30% of its investment needs
- debt service charges (on 70% of its investment needs)

Based on the results of the above financial examination, KDA, KW&SB and the World Bank finally concluded that a full Part I scheme (240 mgd) costing Rs 8,233 million (US$ 515 million) was not financially viable. An analysis of alternatives showed that a scheme to supply 200 mgd (900,000 m^3/d) to be constructed in equal phases of 100 mgd (450,000 m^3/d) would match the budget ceiling. **Table 31.1.3** shows a revised scope of the Phase 1 of Part I (100 mgd) Project. The total project cost for the Phase 1 of Part I Project including physical and price contingencies was estimated to be Rs 3,641 million (US$ 227 million). The project would transmit 100 mgd of Indus water from Gujjo to NEK for treatment. In addition, it also included the construction of the following facilities at Pepri to treat additional water to be available upon completion of the Phase IV Project.

- a raw water pumping station that abstracts water from the GKBWS conduit
- a 40 mgd water purification plant
- a 500m-long, 1,000mm-dia raw water supply main which connects the pumping station to the water purification plant

Table 31.1.3 Scope of Phase 1 of Part I (100 mgd) Project

Item		Description	
		Capacity	Remarks
Canal	Gujjo to Gharo	100 mgd	20 km long
Conduit	Gharo to Dhabeji	100 mgd	9.8 km long
Dhabeji P/ST		100 mgd	
Pumping Mains	Dhabeji P/ST to High Point	100 mgd	2 lines × 1,500mm dia. × 4.6 km long
Conduit	High Point to Pipri	100 mgd	3.3 × 3.3 m, 27.7 km long
Pipri P/ST		40 mgd	
Pumping Main	Pipri P/ST to Pipri T/W	40 mgd	1,000 mm dia. × 500 m long
Pipri T/W		40 mgd	
Conduit	Pipri to N.E.K.	100 mgd	3.3 × 3.3 m, 25.2 km long
N.E.K P/ST(1)	Low Lift to T/W	100 mgd	
N.E.K T/W		100 mgd	
N.E.K P/ST(2)	High Lift to University Reservoir	70 mgd	
Pumping Mains	N.E.K. T/W to University Reservoir	70 mgd	2 lines × 1,400 mm dia. × 9.0 km long
Gravity Main	N.E.K. T/W to COD Hills T/W	50 mgd	1,800 mm dia. × 13.0 km long
Distribution Mains	Additional Primary Mains		1,200 to 2,100 mm dia. × 22.5 km long
Storage Reservoirs	Additional Volume	10 mg	

(5) Conclusions

Figure 31.1.1 illustrates the water demands projected by the 1985 master plan study and the system expansion plans proposed by the study to meet the projected water demands. It shows how significantly the master plan overestimated future water demands. It was mainly because of the large population growth rates and high per capita water demands adopted in the study.

The 1985 master plan study projected that the total population of Karachi (6.72 million in 1985) would increase to 9.01 million in 1990, 11.67 million in 1995, 14.35 million in 2000, 20.37 million in 2010 and to 30.91 million in 2025. However, the census conducted in 1998 reported that the total population of Karachi was only 9.8 million in the same year.

The study projected that the gross per capita average day demand would increase from 252 litres (55 gallons) in 1985 to 260 litres (57 gallons) in 2000, 299 litres (66 gallons) in 2010 and to 368 litres (81 gallons) in 2025. Subtracting from there leakage and other water losses that were assumed to be 40% in 1985 and 25% in 1995 and thereafter, and also non-domestic water demands assumed to be 12% in 1985 and 13% in 1995 and thereafter, net per capita average day domestic water demand was projected at 161 litres in 2000, 185 litres in 2010 and 228 litres in 2025. Given the fact that approximately 40 to 50% of people in Karachi live in Katchi Abadis and that an average household in Karachi has more than five persons, the levels of these per capita demands are considered to be much larger than the essential water needs of average people in Karachi

As can be seen in **Figure 31.1.1**, the implementation of the proposed system expansion projects delayed significantly from the original schedule envisaged by the master plan. It should be noted that only Phase 1 (100 mgd) and Phase 2 (100 mgd) of Part I Project have actually been implemented until today. Today, they are respectively referred to as the “K-II” and “K-III” projects. The K-II Project was completed in 1998 with a reduced scope of work. The facilities originally proposed to be installed at Pipri for treatment of additional Indus water were excluded from the final scope of the K-II Project. K-III Project was just recently completed in May 2006.

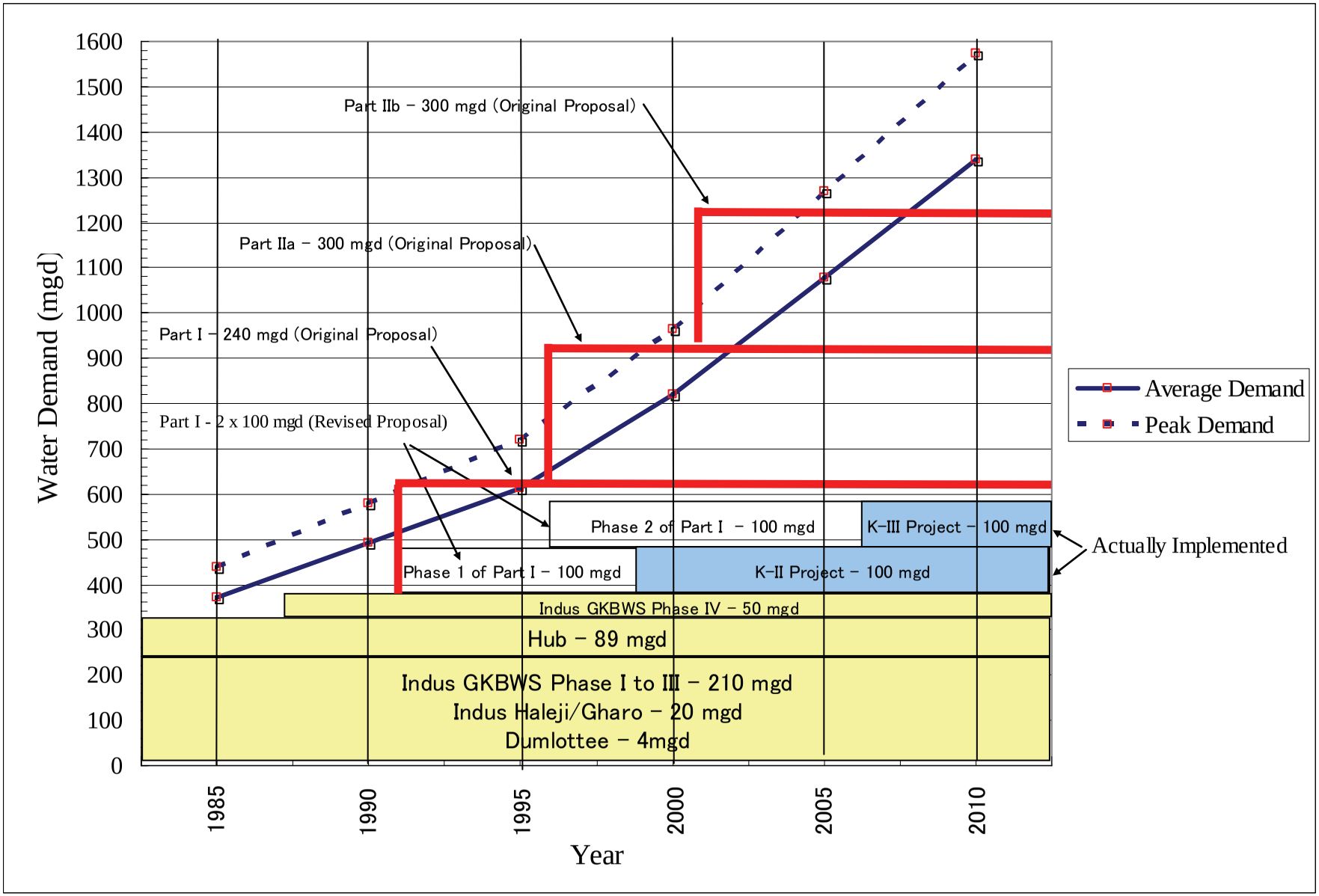


Figure 31.1.1 Water Demand Projection and Proposed System Expansion Projects

In summary, the 1985 water supply master plan study has the following characteristics.

- Rather than being a master plan study, it was a feasibility study conducted in a very short period of time (about 8 months)
- Proposed large-scale system expansion projects based on significantly large population growth rates and high per capita water demands
- Focused on the expansion of the existing bulk water supply system to bring additional water from the Indus River to Karachi (supply driven approach) while placing little emphasis on the improvement of the existing water distribution networks to reduce water losses and to enhance equitable water distribution and water conservation (demand driven approach)
- Did not address the institutional capacity strengthening of the water service provider, which is vital to ensure the financial viability and smooth implementation of the system expansion projects proposed by the study

3.1.2 1988 Sewerage Master Plan

(1) 1988 Master Plan

Karachi Water and Sewerage Board (KW&SB) prepared "Feasibility Study for Preparation of Sewerage and Waste Water Disposal Project in Karachi" in 1988. The Study is one and only comprehensive study on sewerage in Karachi to date and is regarded as Master Plan. Though the Master Plan describes that the city area is divided into 11 sewer districts, only three sewage treatment plants of TP-3, TP-4 and Baldia are planned in detail in addition to two existing sewage treatment plants (TPs) of TP-1 and TP-2 at the time of the Master Plan preparation.

a. Outline of Sewer Districts and TPs

Referring to the drawings of 1988 Master Plan (Volume VI Drawings), proposed sewer districts and TPs are outlined in **Tables 31.2.1** and **31.2.2**, respectively.

Table 31.2.1 Outline of Sewer Districts

Name of TP and its location	Conditions	Drainage area	Remarks
TP-1 Right bank of lower Lyari River	Existing and in operation	Part of left bank side included	Constructed in 1960s and rehabilitated in 1995
TP-2 Right bank of lower Malir River	Existing and in operation	Left bank side of Malir River and its right bank side (central part of the city, port area, cantonment and the area near airport)	Constructed in 1960s and rehabilitated in 1995
TP-3 or Mauripur TP Right mouth of Lyari River	Planned in MP Existing and in operation since 1998	Both right and left bank sides of Lyari River	Sewage exceeding capacities of TP-1 and TP-2 flows into TP-3 through Lyari Interceptor.
TP-4 Korangi TP	Planned in MP but not implemented yet. Pumping station and trunk sewers were financed by ADB and already constructed.	It was planned to divide the left bank area of Malir River into two parts and the sewage was to be treated either at TP-2 or at TP-4.	TP-4 has not been constructed because it was supposed to mainly treat industrial wastewater and hence was not agreed upon by the nearby residents. The site for TP-4 was owned by the government but was not coordinated among relevant agencies. Besides, the local NGOs did not admit its construction insisting that the construction be only locally funded.
TP-NK (North Karachi TP)	Constructed in 1993 but not operated	Drainage area of 1,200 ha. Hilly area of the northern part of city	The TP is not included among 10 TPs planned in MP. It was envisaged that the area would be covered by extended Lyari Interceptor and that the TP would be demolished in the future.
TP-5 （Baldia TP）	Planned but not implemented. Along Baldia Trunk Sewer	Baldia and Naval City area (residential area to be extended)	The location of TP is not identified. Pumping station was planned along the trunk sewer.
TP-6 （Taiser TP）	Just envisaged. Taiser area at northern part of the city of left bank side of upper Lyari River is targeted.	Residential area of left bank side of upper Lyari River.	Its location not identified. The effluent was to be discharged to Lyari River.
TP-7 (North-east Karachi)	Just envisaged	Middle part of left bank side of Lyari River Part of TP-1 service area to be diverted	To be located at the cross of Super highway extending towards northeast and Lyari River Satellite image shows vast area of housing development but little of which is inhabited. Illegal houses can be seen in undeveloped areas.
TP-8 Pipri TP	Just envisaged and its location unidentified.	Middle part of left bank side of Malir River	Near steel mill and might be near the cross of railway and Malir River
TP-9 Hawkes Bay TP	Just envisaged, western part of city Its location Unidentified	Far eastern area of city, along the seacoast	Future housing area along Hawkes Bay might be targeted.
TP-10 Halkani Town TP	Just envisaged Urbanized area Its location Unidentified	North-western part of city next to Orangi area	Halkani area North-eastern part of Orangi area. To be urbanized in future

In **Table 31.2.1**, the locations of the facilities of "envisaged" are not identified in the drawings of Master Plan. The information on sewer districts such as district areas and boundaries are not available, hence design flow rate and others cannot be verified.

Table 31.2.2 Capacities and Treatment Processes of Proposed 11 TPs

Name of TP	Capacity in 1993 Unit: mgd (Unit: m^3/day)	Capacity in 2003 Unit: mgd (Unit: m^3/day)	Treatment Process
TP-1 (existing at the time of the Master Plan preparation)	65 (300,000)	65 (300,000)	Trickling filter
TP-2 (existing at the time of the Master Plan preparation)	65 (300,000)	105 (480,000)	Trickling filter
TP-3 (Existing at present)	38 (170,000)	154 (700,000)	Anaerobic pond + Facultative pond
TP-4	48 (220,000)	37 (330,000)	Anaerobic pond + Facultative pond
TP-NK	5 (23,000)	5 (23,000)	No information available
TP-5 （Baldia TP）	3 (13,000)	12 (53,000)	Anaerobic pond + Facultative pond
TP-6 （Taiser TP）	- -	22 (100,000)	Facultative pond + Maturation pond
TP-7 (North-east Karachi)	No information available	No information available	No information available
TP-8 Pipri TP	No information available	No information available	No information available
TP-9 Hawkes Bay TP	No information available	No information available	No information available
TP-10 Halkani Town TP	No information available	No information available	No information available

b. Collection System

Details of respective sewer districts are described below.

TP-1 Area (existing at the time of M/P preparation)

Gulsman-e-Iqbar trunk sewer was planned to be implemented to collect the sewage generated at the left bank side of Lyari River and to connect to the right bank side of the river. However, the river crossing part has not been constructed and it is assumed that the collected sewage is discharged to the river with no treatment.

TP-2 Area (existing at the time of M/P preparation)

The sewage generated at the left bank side of Malir River had been pumped by Korangi pumping station to TP-2 at the other side of the river, but was stopped because pipes installed in the river were broken due to the flood in 1974. At present, the collected sewage is pumped and discharged to the river.

1988 Master Plan reports that the sewage generated at the left bank side of the river was supposed to be treated at TP-4, but the concept was not realized due to the several reasons shown in the above table. However, the plan itself is rated as appropriate.

TP-3 (planned in M/P and began its operation in 1998)

The sewage generated at SITE area is planned to introduce to the interceptor to be constructed at the right bank of Lyari River (box culvert of 2400 mm to 3500 mm) and then it will flow into TP-3.

No.48 Manhole is located at the confluence of Malir River and Orangi River. The sewage exceeding the capacity of TP-1 is planned to introduce to Lyari Interceptor. The first phase facility of the plan corresponds to the plant of 6 trains constructed in 1998. The second and third phase facilities are to be implemented at the western side of the existing plant.

TP-4 (planned)
It was planned to divert the sewage of the right bank side of Malir River which was originally a part of TP-2 area. The plant has not been implemented due to the objection of the residents and the insufficient coordination among agencies concerned. In addition, there was an objection to falling in foreign debt. At present, the collected sewage is discharged to Malir River through Korangi pumping station. The location of the plant is judged to be appropriate.

TP-5 (planned)
It was supposed to collect the sewage of Naval City and to treat the collected sewage at TP-5, but its location and other related information are not identified.

Other TPs
The locations of TPs of 6 through 10 are not shown in the available drawing.
Problems identified (referring to the plan and longitudinal sections of existing trunk sewers) are as follows.

c. Overall Evaluation of M/P

Trunk sewers were planned to enhance their capacities, but many of them were not implemented along main roads, at railway crossing and road crossing. As a result, much sewage does not reach treatment plants and is discharged to rivers. It is needed to connect existing sewers to sewage treatment plants by applying jacking methods or by implementing interceptors along rivers, which can avoid river crossing.
The 1988 Master Plan does not give clear blueprint about what sewerage facilities would be implemented in which order, which makes it difficult to trace and monitor how or to what extent the Master Plan has been implemented.
The facilities constructed based on the Master Plan were Lyari Interceptor and TP-3 only. TP-4 was not constructed mainly because there was no coordination with existing sewers and there were disputes on financial arrangement.

(2) Others

a. S-III

KW&SB also has a long-term sewerage development plan comprising three phases, namely S-I, S-II and S-III. The plan in each phase is summarized below.

S-I
S-I comprises the components of which the followings were implemented.

- Preparation of Master Plan for Wastewater Disposal and Sewerage Development 1988 – 2003 (1988 Master Plan)
- Upgrading of TPs-1 and 2

S-II
S-II comprises the components of which the followings were implemented.

- Construction of TP-3
- Construction of Lyari Interceptor
- Construction of Baldia trunk sewer
- Construction of secondary sewers in Baldia Town

Fate of S-I and S-II

While the components mentioned above were implemented, the following ones were left undone mainly due to the financial constraints.

- Construction of TPs at Korangi and other places
- Extension of Lyari Interceptor up to North Karachi
- Construction of trunk sewers

In spite of daily sewage generation of 400 mgd (1.8 million m^3/day), total capacity of existing three TPs is 151 mgd (0.7 million m^3/day). Furthermore, the amount of sewage actually flowing into three TPs is just 90 mgd (0.5 million m^3/day). If the K-III of supplying additional 100 mgd (450,000 m^3/day) is completed, the situations are expected to become worse. To solve these problems, S-III is planned in two stages.

S-III

S-III is divided into two stages. Stage-1 projects will be implemented in two phases shown below. Stage-2 projects have not been identified yet.

Phase-1

- Construction of interceptors on both sides of Malir River which convey the collected sewage to proposed TP-4 at Korangi.
- Connection of Chakora Nallah to Malir Interceptor
- Construction of interceptors along both sides of Nehr-e-Kahyyam to convey the sewage to Clifton pumping station and finally to TP-2.
- Connection of Manzoor Colony drain to Malir Interceptor
- Diversion of City Railway Nallah and Soldier Bazar Nallah to Clifton Pumping Station and then to TP-2.
- Construction of secondary interceptor to link Pitchard Nallah and Kalri Nallah finally connecting to TP-3.
- Extension of Layri Interceptor up to North Karachi
- Connection of Shershah Nallah, Gujro Nallah and Orangi Nallah to Lyari Interceptor
- Construction of TP-4 with the treatment capacity of 200 mgd (910,000 m^3/day).
- Extension of TPs-1, 2 and 3 with the total capacity of 300 mgd (1,360,000 m^3/day).

Phase-2

- Construction of more TPs to enhance treatment capacities
- Conversion of nallahs to interceptors and box culverts

PC-1, the documents to submit to the Government of Pakistan for its approval, for Stage-1 projects of S-III was approved in October 2007 by the Government of Pakistan. The implementation period for Stage-1 will be four years including the period for design works that is expected to commence in early 2008. The financial sources necessary to implement Stage-1 projects will be equally shared by central and provincial governments.

b. Common Effluent Treatment Plant (CETP)

Based on the discussion between Labour, Transport, Industries and Commerce Department, Government of Sindh, and KW&SB, the plan was formulated by Pakistan Industrial Development Corporation (PIDC) to construct four CETPs to treat both industrial and domestic wastewaters in four locations and to dispose of hazardous wastes at two locations as a part of Industrial Efficiency and Environmental Management (IEEM). Out of these CETPs and disposal sites, three CETPs will be located in Karachi, namely Landhi, Korangi and SITE, and one disposal site at Jam Chakro.

The CETPs will apply extended aeration system and produced sludges are to be conveyed and

disposed of at hazardous waste disposal site. The effluent is to meet the effluent standard stipulated by National Environmental Quality Standards (NEQS).
Table 31.2.3 summarizes these three CETPs and related collection system. The construction costs include land acquisition costs and taxes.

Table 31.2.3 Outline of CETPs

Name of CETP	Landhi	Korangi	SITE
Location	Lalabel Colony	Korangi	Mauripur
Capacity mgd (m^3/day)	6.82 (31,000)	13.2 (60,000)	40.9 (186,000)
Site area acre (m^2)	16 (64,700)	20.6 (83,400)	34.1 (138,000)
Kind of industrial Wastewater Flow rate (m^3/day)	20 major textile units with 300 industrial units 28,700	370 textile units with 1500 industrial units and commercial wastewater 55,400	210 textile units with 2200 industrial units and commercial wastewater 173,400
Domestic wastewater (m^3/day)	1,900	4,000	12,000 (within industrial estate)
Treatment process	Chemical and biological Process	Chemical and biological Process	Chemical and biological Process
Sludge yield (m3/day) and its disposal	46 HWHF(Hazardous Waste Handling Facility) at Jam Chakro, Gaddop Town	73 HWHF(Hazardous Waste Handling Facility) at Jam Chakro, Gaddop Town	131 HWHF(Hazardous Waste Handling Facility) at Jam Chakro, Gaddop Town
Drainage Area (acre, (ha.)) and Population	1600 (650) 102,000	4,000 (1,600) 607,000	4,500 (1,820) 240,000
Influent quality (mg/l)			
BOD_5	700	630	400
COD	1,400	1,200	1,100
TSS	500	1,000	600
TDS	3,200	6,100	5,300
Effluent quality (mg/l)			
BOD_5	80	80	80
COD	150	150	150
TSS	200	200	200
TDS	3,200	6,100	5,300
Construction cost (Rs.mil)	1,020.3	1,559	2,826
Sindh Government	166	86	184
PSDP	854.3	1,473	2641
Annual O/M cost (Rs.mil/year)	218.9	439.6	916.2
Tariff (Rs. /m^3 for industry only)	25	25	16
Pipe material	RCC lined with PVC or epoxy resin	RCC lined with PVC or epoxy resin	RCC lined with PVC or epoxy resin
Revenue form industrial product (Rs.mil/day)	1,600	255	1,560
Period for construction (years)	3	3	3
Sewers			
Trunk (more than 30”)	9.19 km	10.8 km	16.22 km
Collection (less than 30”)	5.32 km	22.2 km	33.3 km
Remarks	CETP 0.6 km away from drainage area CETP site available	CETP 3.4 km away from drainage area CETP site available	CETP 3.2 km away from drainage area CETP site not available

3.2 WATER SOURCES

3.2.1 Existing Water Sources

(1) Indus River

The Indus River, the main source of water for Karachi, is severely constrained by dry season 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 32.1.1**.

Table 32.1.1 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 32.1.2** 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 on the River Indus. It was completed in 1955 to command a gross area of 1.34 Mha (13,400 km^2) mainly on the left (east) bank of the Indus, southeast of Hyderabad. The right (west) bank command of 310,000 ha (3,100 km^2) gross is supplied by a single canal, the KB Feeder which also supplies Karachi 150 km west-southwest of the off-take. The KB Feeder Upper has a design capacity at its head of 9,075 cusecs (22,300,000 m^3/d) and terminates at the head of Kinjhar Lake. This is also the offtake for the Right Bank Link Canal which, since it was opened in 1982, has enabled water from the KB Feeder Upper to be supplied directly to the KB Feeder Lower without passing through the lake. This allows unsettled silty water to be supplied to downstream irrigators and also serves to reduce sedimentation of the lake. Flow data of Indus River upstream of the Kotri Barrage from 1976 to 1984 including average and minimum flows and allocation of quota from the Kotri Barrage for each feeder canal are compiled in **Appendix A32.1**.

Table 32.1.2 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 original design levels of the Kinjhar lake embankments are:

- top irrigation retention level 54.0 ft RL
- allowance for storm water storage 2.0 ft
- top storm retention level 56.0 ft RL
- freeboard 6.0 ft
- embankment top 60.0 ft RL

Because of excessive seepage through the southern part of this embankment, the top water level (TWL) of the lake was initially held at 51.6 ft RL, giving a maximum useable storage of 310,000 acft (377,000,000 m^3). The embankments were then raised and strengthened to increase the flood storage capacity and allow the normal retention level to rise to 54.0 ft RL whereby increase the useable storage to 390,000 acft (481,000,000 m^3). The surface area of the lake is about 30,000 acres (12,000 ha or 120 km^2). The lake has a catchment area of 910

km^2 which collects runoff from most of the area between the Baran Nai basin to the north and the Malir basin to the west. The Kinjhar catchment extends north of the Karachi-Hyderabad Superhighway and includes Kalu Khuhar.

Water leaves the lake through the KB Feeder Lower and the KG (Kinjhar - Gujjo) Canal. The latter was opened at the same time as the Right Bank Link Canal, to supply settled water directly to the intake at Gujjo. This replaced the previous arrangement whereby water destined for Karachi was released in the KB Feeder Lower and then conveyed through the irrigation system to Gujjo, which was found to be unfavourable due to the introduction of silty water through the Right Bank Link Canal.

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 32.1.3**.

Table 32.1.3 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 construction of the Lasbela Canal and Hub Main Canal was completed in September 1981 and September 1982 respectively. 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).

The Hub Dam was completed in 1981 and 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 above the mean sea level
Lowest Water Level	: 276 ft above the mean sea level
Effective Water Depth	: 63 ft

Rationing of supply from the dam normally starts when the water level in the dam subsides to the level 285 ft above the mean sea level. On May 13, 2006 when the Study Team visited the dam, the water level was very low at 285.6 ft above the mean sea level. The life storage of the dam at that level was 41,436 acft (51,000,000 m^3), which is equivalent to only 5.8% of the design capacity of the dam, i.e. 717,000 acft (884,000,000 m^3).

In the past, a yield analysis of the Hub River was conducted based on the 18 years discharge data collected at the Bund Murad Khan gauging station. The outcome of the analysis have been compiled in the report, "Feasibility Study for Future Expansion of Karachi Water Supply System, Final Report Volume III Water Resources Appendices, December 1985". They are summarized in **Table 32.1.4**.

Table 32.1.4 Outcome of Hub River Yield Analysis

Level of Reliability (%)	Allowable Abstractions		
	Mm^3/yr	mgd	cusecs
95	124	75	138
87	173	104	193
80.8	238	143	266
80	246	148	275

Source: Feasibility Study for Future Expansion of Karachi Water Supply System, Final Report Volume III Water Resources Appendices, December 1985

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. The well field was first developed some 120 years ago under the British Municipal Commission. 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 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 of water during only a few months after the rainy season. The system is almost dry in 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 an entirely reliable source of supply for Karachi.

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

The existing conduit from the Dumlottee Well Field was originally designed to convey 15 mgd of water by gravity to the Low Service Reservoir (LSR), Temple, Currie and Sydenham Reservoirs. It has an interconnection with the Greater Karachi Bulk Water Supply (GKBWS) system at their crossing point. At present, approximately 12 mgd of Indus water is diverted to the conduit from the GKBWS system by pumping from the 84 inch diameter trunk main that connects the end of the 280 mgd Tunnel to the NEK Old Pumping House. A 33 inch diameter trunk main which connects the conduit to one of the 84 inch diameter PRCC pipes installed at the end of the Siphon No.19 of the GKBWS system provides another interconnection between the two systems.

3.2.2 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 within its scope of work any new studies on the development of water sources, 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.

The PC-I of the scheme "Assured Water Supply for Karachi – upgrading Kinjhar Lake System" was discussed at the Central Development Working Party (CDWP) meeting held on June 29, 2002. The main objective of the scheme was to ensure the availability of 1,200 cusecs of drinking water for Karachi from the Indus River (sanctioned by the President of Pakistan in 1988) to meet the requirement of the city up to 2005 while also satisfying the requirement of agricultural water in the Thatta and Hyderabad Districts. The CDWP while recommending the project to the Executive Committee of the National Economic Council (ECNEC) requested the GOS to prepare a long term plan for drinking water supply to Karachi which should include on-going and pipeline projects along with suggestions for long term funding arrangements. In response, 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 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, the 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. Details of this feasibility study are provided in **Section 4.4.2**.

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. During the 8 years from 1995 to 2003, the dam was never filled up. The consequence was serious water shortages in areas where water was supposed to be supplied from the Hub dam. Those areas include the townships of Orangi, Baldia, SITE (both residential and industrial areas), Surjani, North Karachi and parts of Keamari Town. 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. The review identified the Lasbela plain in the Porali river basin as the most promising groundwater source in the region. However, this source is located in Balochistan and was already proposed as a source of water for local irrigation development. The review also found 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. This feasibility study was conducted by the consortium of M/s. Engineering Associates, Indusmens Corporation and Subzazar Agriculture Development (Pvt.) Ltd. The scope of the study included a) reconnaissance survey, b) resistivity survey, c) drilling of investigation boreholes, and d) construction of tube wells and piezometers.

a) Reconnaissance Survey
   - Inventory of private wells
   - Observation of selected wells
   - Chemical analysis of selected wells
   - Pumping test of selected wells

b) Resistivity Survey
   - 160 probes using Schelumberger - 4 electrode configuration

c) Drilling of Investigation Boreholes
   - Drilling of 30 investigation boreholes of 8 inch diameter up to a depth of 1200 feet for determining the underground strata and availability of potable water.

d) Construction of Tube Wells and Piezometers
   - Construction of 5 tube wells and 10 piezometers by reaming of test holes to 16 inch diameter and conversion into tube wells by providing casing pipes and strainers and development of tube well and pump test for these five tube wells.

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. Prior to this study, no extensive groundwater investigations in the Karachi district had been conducted, except for some geological studies in and around Karachi that were undertaken by the Geological Survey of Pakistan. The conclusion of this study is quite similar to that of the 1985 water supply master plan and is further reinforced by the significant depletion of yield from the Dumlottee Well Field as discussed in **Section 3.2.1**.

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. Over-pumping of groundwater may cause land subsidence and the lowering of groundwater tables, which is likely to result in the intrusion of seawater into aquifers and the further deterioration of groundwater quality 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. It reviewed the following basic processes available for seawater desalination.

- Distillation

- Reverse Osmosis
- Solar distillation
- Freezing

As a result, the study concluded that multi-stage flash (MSF) distillation was the only practical means to provide a large quantity of desalinated water. With regard to the other three processes, the study made the following assessments.

- Without energy recovery the costs of seawater reverse osmosis for large supplies would be very high and therefore the process was impractical to apply for the Karachi water supply;
- Solar distillation was only applicable for small supplies and therefore was irrelevant to the Karachi water supply; and
- Freezing of seawater as a means of desalination had been attempted but had not been technically successful.

The study also 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. The plant was initially planned to be fully operational in the first half of 2007 but it was still under construction in early November 2007 when the JICA Study team inspected the plant. **Table 32.2.1** presents a summary of various desalination schemes that emerged in the coastal region during the last five years.

Table 32.2.1 Summary of Desalination Schemes in Coastal Region

Organization	No. of Proposed Plants	Capacity (mgd)	Financing Scheme	Year of proposal	Desalination Process	Proposed Location	Status
Karachi Port Trust (KPT)	3	25	N/A	2002-2003	N/A	Keamari Groyne	Cancelled
		1	N/A	2004-2005	RO	Manora	Hold
		4	BOT	2004-2005	RO	Keamari Groyne	Pending
Port Qasim Authority (PQA)	1	25	BOO	2005-2006	N/A	East zone of Port Qasim	Pending
KW&SB/CDGK	1	25	BOO	2005	N/A	Behind PAF Korangi	Pending
Defense Housing Authority (DHA)	2	3	BOT	2006	MSF	Phase-VIII DHA	Construction in progress
		20	BOT	2006	MSF	N/A	Under consideration

N/A: Information Not Available; BOT: Build-Operate-Transfer; BOO: Build-Operate-Own; RO: Reverse Osmosis; MSF: Multi-stage Flash Distillation

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 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 Effluent

Reuse of treated effluent is practiced in TP-3 and Pakistan Steel Mill sewage treatment plant. In TP-3, one mgd (approximately 4,500 m^3/d) of effluent is pumped to nearby Pakistan Air Force (PAF) premise to water the plants there. Necessary costs for the implementation and operation of pumping and conveyance facilities are borne by PAF. No tariff is charged for obtaining treated effluent.

Pakistan Steel Mill has its own sewage treatment plant within its premise to treat domestic sewage generated in its company housing and part of pre-treated industrial wastewaters and to deliver the treated effluent to a nearby golf course and orchard.
The sewage treatment plant there began its operation in 1982. The plant is outlined below.

Site area: 46,000 m^2
Treatment capacity: 12,000 m^3/d
Construction cost: Rs.13 million
Design and construction: by M/S Lurgi (West Germany)
Treatment process: Activated sludge process consisting of pre-aeration, aeration and settling followed by thickening, sludge lagoon and natural drying
Sewage to treat: Domestic wastewater of around 100,000 people in Pakistan Steel Township and Gulshan Hadeed outside the factory, and of 15,000 employees working in the factory. Some portion of industrial wastewater also flows into the plant after pre-treatment.
Influent/Effluent qualities: SS 300/20 mg/l, BOD 180/25 mg/l, COD 200/120 mg/l

Treated effluent is used at a golf course and an orchard both within Pakistan Steel Mill premise.

- Golf course: around 2,200 m^3/d of effluent is supplied by pump. The charge is Rs. 15 per 1,000 gallons or Rs. 3.3/m^3.
- Orchard: It occupies 200 acres (81 ha.) of land. The charge is Rs.10,000 per acre of land per year or Rs. 24,700 per hectare per year.

No tariff is collected to operate and maintain the treatment plant, because it treats the sewage of company employees and their family members. The treatment cost is borne by Pakistan Steel Mill as a part of the factory operation cost.

Apart from treated effluent reuse, raw sewage is sprayed to grasses and trees at road dividers. CDGK's Works and Services Department waters grasses and trees in the city. The Department has installed a hydrant at Malir Nallah at Shara-e-Faisal from which substantial sewage is pumped to the tanker. The tanker sprays the pumped liquid to grasses and trees in the city. The necessary cost for watering is borne by the Department.

Other applications of raw sewage are found in some areas. One is Karsaz Golf Club where raw sewage application was being done from August 1986 through June 1992 at the charge of Rs.3 per 1,000 gallons (Rs.0.66 per cubic metre). The sewage was taken at a sewage pumping station and the golf club paid the amount to KW&SB. Later, the Club made its own arrangement to take the sewage from Malir trunk sewer free of charge. In DHA area, seven mgd of water is supplied to Clifton Cantonment Board on bulk basis. Out of generated sewage that is estimated to be five mgd, 0.1 mgd is 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 loan of Asian Development Bank. The outcome of the Study is expected to include the followings.

- Estimating the quantities, cost and potential revenues from water that could be made available for various municipal waste water re-uses such as agriculture and landscape irrigation, industrial recycling, groundwater recharges, recreational and environmental uses and non-potable urban uses etc. and developing options comparing these costs with the costs of abstracting additional water from the Indus River or with the cost of desalination.
- Preparation of strategic action plan for waste water reuse, detailed time bound costed action plan and institutional & operational mechanism.

Treated effluent can be used for various purposes as follows.

- Watering plants/grasses in parks and similar facilities
- Irrigation
- Agriculture
- Industrial use
- 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 in case additional and/or advanced level treatment is needed. Trial application of treated effluent is recommended prior to its full application.

3.3 WATER SUPPLY AND SEWERAGE SYSTEMS

3.3.1 Water Supply System

(1) Bulk Water Supply System

1) General

The existing bulk water supply system for Karachi City shown in **Figure 33.1.1** has a capacity of 600 mgd as summarised in **Table 33.1.1**. Actually as of the end of year 2006, KW&SB supplied bulk water of about 630 mgd beyond the capacity as shown in **Table 33.1.1**. However, it is noted that these figures may not be reliable because KW&SB have never measured any flow rates of bulk water supply system.

Table 33.1.1 Bulk Water Supply Capacity

Bulk Water System	Rated Capacity	Actual Supply
GK System*	280 mgd	300 mgd
Haleji System	20 mgd	30 mgd
K-II System	100 mgd	120 mgd
K-III System	100 mgd	100 mgd
Dumlottee Wells	20 mgd	0 mgd
Hub System	80 mgd	80 mgd
Total	600 mgd	630 mgd

*: downstream of Fore Bay source: KW&SB

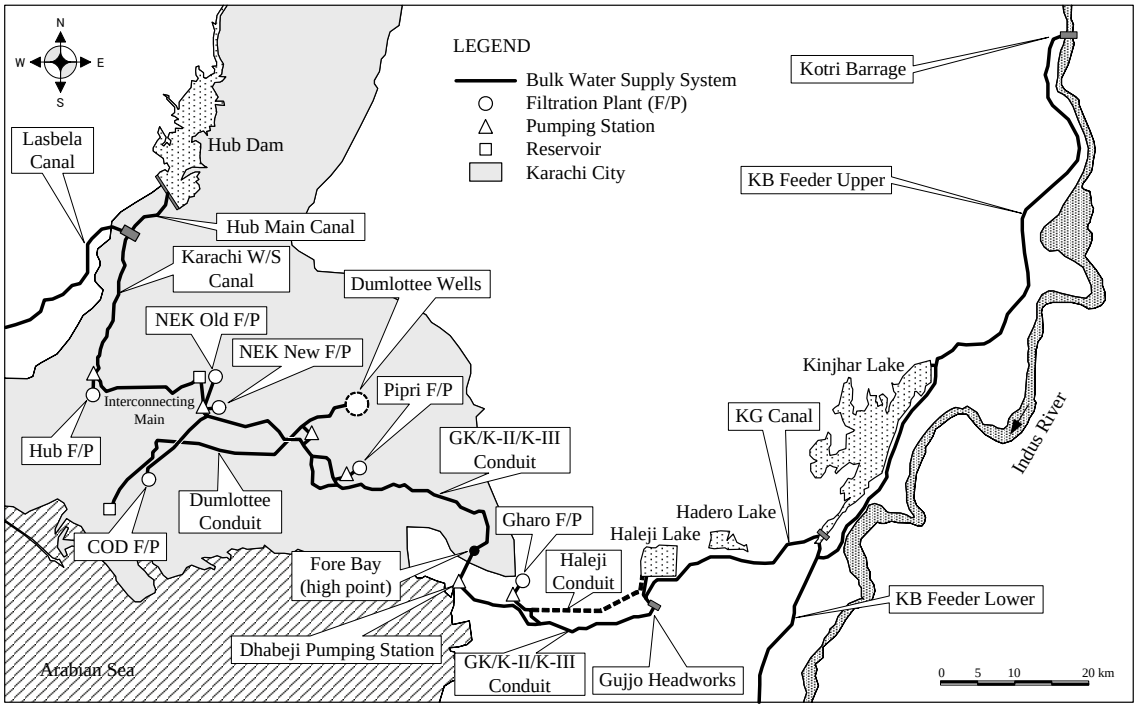


Figure 33.1.1 Existing Bulk Water Supply System

The existing bulk water supply system conveys water to Karachi from two main sources, namely, Indus River and Hub Dam.

2) Indus River System

Indus water is conveyed to Karachi through the following systems;

- Greater Karachi Bulk Water Supply (GKBWS) system
  (including GK Conduit, K-II Conduit and K-III Conduit),
- Haleji conduit, and
- Dumlottee conduit
  (originally the conduit is for conveying the groundwater from Dumlottee Wells).

a) Greater Karachi Bulk Water Supply (GKBWS) system

Since the lining works of the KG canal was completed in 1992, water from Kinjhar Lake has been conveyed to the Gujjo Headworks through the KG canal only. Before 1992, the Jam Branch canal was used to convey water from Kinjhar Lake to the Gujjo Headworks when KG canal was closed for maintenance and lining. At present, the Jam Branch canal is only used for emergencies. From the Gujjo Headwork water is further conveyed to Dhabeji pumping station through the RCC canal (315 mgd or 1,430,000 m^3/d) and the K-II/K-III canal (200 mgd or 910,000 m^3/d). The total conveyance capacity between Gujjo and the Dhabeji pumping station is 515 mgd (2,340,000 m^3/d) at present. The final section of the RCC canal to Dhabeji includes siphons and a 22-km long horseshoe-shape concrete conduit. The final section of the K-II/K-III canal for approximately 11 km in length is divided into two units of box culverts each sized 3.3 m by 3.3 m.

At Dhabeji, water is pumped over a distance of 4.5 km from the GK and K-II/K-III conduits to two units of receiving chambers located at a collection point (Forebay High Point) near the 200 feet contour through a number of pumping stations. Large diameter rising mains constructed in various development phases of the GKBWS system as shown in **Table 33.1.2** below. The details of the Dhabeji pumping stations are provided in **Table 33.1.2**.

Table 33.1.2 Dhabeji Pumping Stations and Rising Mains

Pumping Stations				Rising Mains			Receiving Chamber at Forebay High Point
Name		Rated Capacity (mgd)	Running Capacity (mgd)	Material	Diameter (mm)	Number	
K-I	Phase 1	70	48	PRCC	1,800	2	No.1
	Phase 2	70	100	MS	1,800	1	
	Phase 3	70	100	MS	1,800	1	
	Phase 4	70	100	MS	1,800	1	
K-II		100	140	MS	1,500	2	No.2
K-III		100	140	MS	1,800	2	

PRCC: Pre-stressed Reinforced Cement Concrete; MS: Mild Steel
Source: KW&SB

From the receiving chamber No.1 at the Forebay High Point, water gravitates through a horseshoe-shape concrete conduit to the COD filtration plant located at COD Hills in the Gulshan-e-Iqbal town of Karachi. En route, the conduit supplies water to raw water pump houses at Pipri and NEK New, which pump the water to the Pipri and NEK Old water filtration plants respectively. From the receiving chamber No.2, water gravitates to Karachi through twin rectangular-shape box culverts each sized 3.3 m by 3.3 m. The K-II conduit supplies raw water to the water filtration plants located at Pipri and NEK New. The K-III conduit feeds raw water to the K-III New pumping station at NEK New, which then pump the water through twin 66-inch diameter MS rising mains to the 10 mg NEK Old reservoir. From this reservoir water is distributed by gravity to areas in the north and north-eastern parts of Karachi. An interconnecting main has been provided under the K-III Project between this reservoir and the Manghopir pumping station of the Hub Dam system, which makes it possible for KW&SB to divert part of Indus water to the Hub filtration plant whenever it is necessary. The GKBWS system is illustrated in **Figure 33.1.2** including its actual flow rate as of the end of 2006.

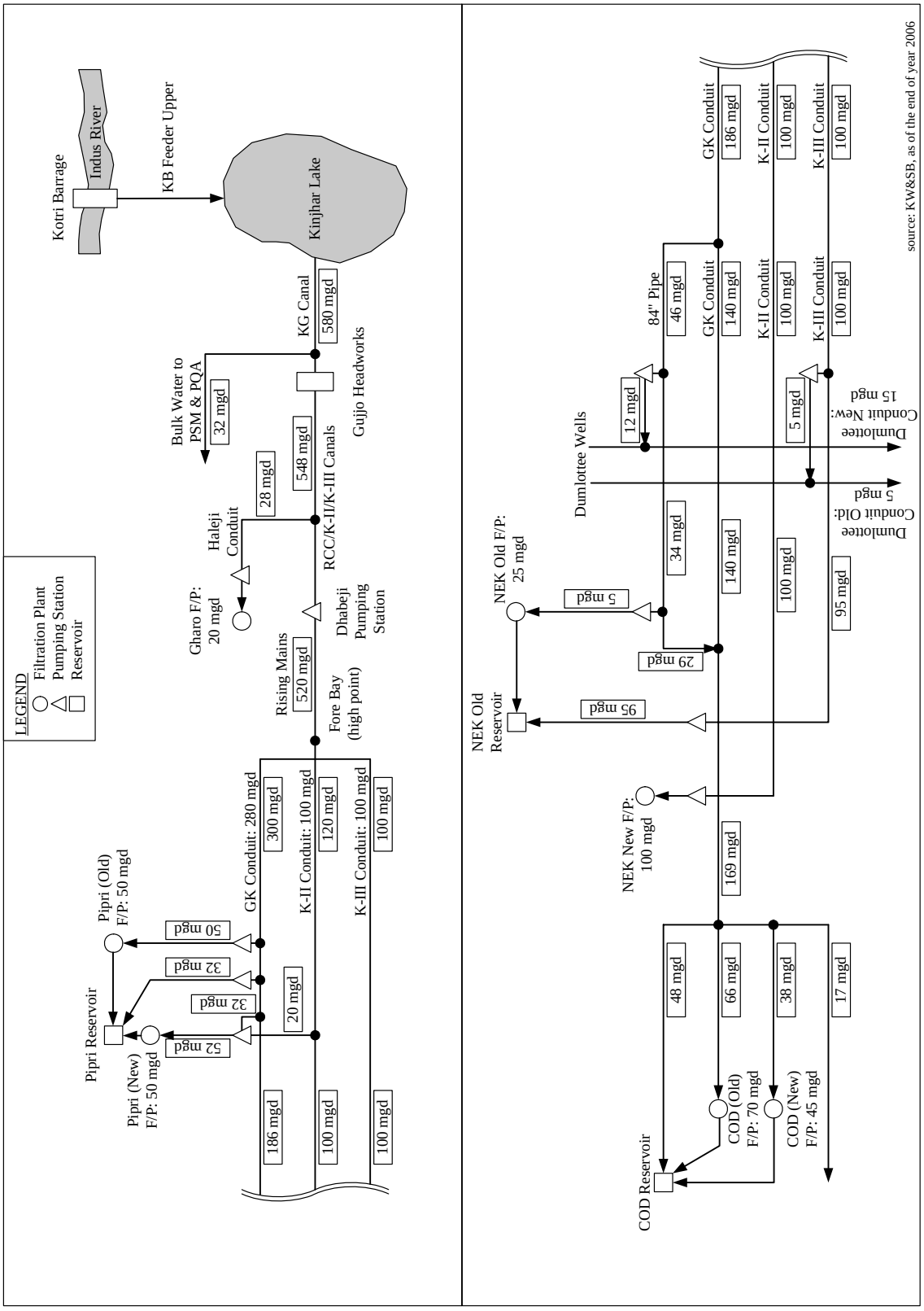


Figure 33.1.2 Existing Greater Karachi Bulk Water Supply System

b) Haleji conduit

Supplies were first obtained from Haleji Lake in the mid 1940s. The conduit which has a design capacity of 20 mgd (91,000 m^3/d) conveyed water from the lake to Gharo where it is pumped to the filter plant some 4 km along the route. Treated water is then conveyed, by gravity, to Karachi and the conduit terminates at the 9th Mile pumping station (20 mgd or 91,000 m^3/d).

Supplies are made from the conduit to Landhi, Pipri and Korangi residential and industrial areas in south-east Karachi and a connection from the Landhi/Pipri trunk main (supplied from the Pipri filtration plant) supplements supplies in the conduit. Since the Haleji reservoir has been abandoned as a regular source, supplies are made from the open (RCC) canal through a 72 inch diameter connection provided before Siphon No.1 near Gharo. The section of the conduit from this point to Haleji Lake is not used except for emergencies.

c) Dumlottee Conduit

The Dumlottee Conduit was originally constructed to convey groundwater from the Dumlottee Wells to the centre of the city. The Dumlottee Conduit crosses the 280 mgd (1,273,000 m^3/d) GK conduit system near the Malir River. At this point as shown in **Figure 33.1.3**, 17 mgd (77,000 m^3/d) of water is currently being pumped into the Dumlottee Conduit from the 84-inch diameter bulk water main which connects the end of the GK tunnel to the Old Pumping House and K-III Conduit which connects the NEK Old Reservoir through the K-III Pumping Station near NEK New F/P.

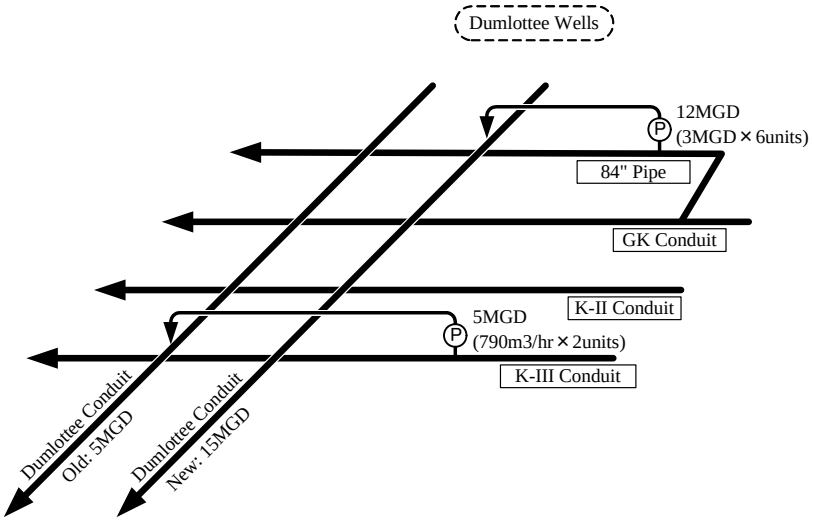


Figure 33.1.3 Flow Diagram at Dumlottee Pumping Station

Another interconnection with the GKBWS system is provided from Siphon No.19 to divert Indus water to the Dumlottee Conduit from the GK Conduit. At present, no water is produced from the Dumlottee Wells throughout the year, except for a few months immediately following the rainy season when approximately 1.4 mgd (6,300 m^3/d) of groundwater is produced from the well field. The Dumlottee conduit system feeds the Low Service reservoir and terminates at the Sydenham, Currie and Temple reservoirs near the centre of the city.

3) Hub Dam System

The catchment area of Hub dam extends across two provinces namely Sindh and Balochistan covering a total area of 3,410 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 will be diverted to the Karachi Water Supply Canal (Sindh) while 36.7% to the Lasbela Canal (Balochistan).

Both Hub Dam and the Hub Main Canal (about 8 km long) which connects the dam to the Regulator have been maintained by the WAPDA (Water and Power Development Authority). The Karachi Water Supply Canal which connects the Regulator to the Manghopir Pumping Station is currently maintained by KW&SB, although it was also maintained by WAPDA until only a few years ago. The existing capacities of these canals are as follows:

Hub Main Canal	: 370 cusecs (905,000 m^3/d or 199 mgd)
Karachi Water Supply Canal	: 210 cusecs (514,000 m^3/d or 113 mgd)
Lasbela Canal	: 160 cusecs (391,000 m^3/d or 86 mgd)

The Karachi Water Supply Canal is a 23 kilometre-long open channel. It conveys water from the Regulator to the Manghopir pumping station by gravity. Twin 66-inch diameter MS rising mains, each 2.2 km long, connect this pumping station to the Hub filtration plant. Both Manghopir pumping station and Hub filtration plant were completed in 2005 under the Karachi Water Supply Improvement Project financed under a JBIC loan. From a reservoir located at the Hub filtration plant water is distributed to the townships of Orangi, Baldia, SITE (both residential and industrial areas), Surjani, North Karachi and parts of Keamari Town.

4) Bulk Pumping Stations and Water Filtration Plants

Present water supply system of Karachi City has a supply capacity of 560 mgd as shown in **Table 33.1.3**.

Table 33.1.3 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

Actually as of the end of year 2006, KW&SB supply bulk water of about 630 mgd beyond the capacity as shown in **Table 33.1.3** (also see **Figure 33.1.2**). Out of the total supplied water of 630 mgd, water of 209 mgd is supplied without filtration, which is about one third of the total amount.

Table 33.1.4 provides the salient features of bulk pumping stations currently in service. There are a total of 10 water purification plants currently in operation with a total filtration capacity of 440 mgd. **Table 33.1.5** presents the salient features of those plants (see also **Appendix 33.1**).

Table 33.1.4 Bulk Pumping Stations in Service

Sr.No.	Name of Pumping Station	Name of the Town / UC No.	Year of Construction	Total Capacity (MGD)	Running Capacity (MGD)	Pumps & Motors							Generator		
						Total No. of Pumps	No, of Stand-By Pumps	Capacity of Each Pump (MGD)	Pump Head (ft)	Electric Motor (KW)	No. of Hours Operated per Day	Last Replacement (Year)	Existence	Capacity (MW)	Operative
1	Hub (Manghopir)	Gadap	1983	164	0	4	4	35	168	1050	-	-	Yes	3.5	No
						2	2	12	168	600	-	-			
2	Dhabeji (Phase-I)	Dhabeji	1959	120	48	5	3	24	210	Diesel+Gas	24	-	Yes	0.25	yes
3	Dhabeji (Phase-II)	Dhabeji	1971	125	100	5	1	25	210	1050	24	-	--	--	--
4	Dhabeji (Phase-III)	Dhabeji	1978	125	100	5	1	25	210	1050	24	-	--	--	--
5	Dhabeji (Phase-IV)	Dhabeji	1997	125	100	5	1	25	210	1050	24	-	Yes	4.52	No
6	K-II (Dhabeji)	Dhabeji	1998	175	140	5	1	35	210	1635	24	-	--	--	--
7	K-III (Dhabeji)	Dhabeji	2006	210	140	6	2	35	210	1635	24	-	--	--	--
8	Gharo (Old)	Thatta District	1943	37	23	3	1	5	170	Diesel	24	-	Yes	0.5	Yes
			1982			6	2	2.0	170	74.6	24	-			
			2002			2	1	5.0	170	149.1	24	-			
9	Gharo (New)	Thatta District	1953	40	21	2	1	10	170	Diesel	24	-	Yes	0.5	yes
			1997			5	2	2.0	170	93.2	24	-			
			2002			2	1	5.0	170	186.4	24	-			
10	Pipri (old)	Bin Qasim	1971	75	50	6	2	12.5	100	260	24	-	Yes	1.5	Yes
11	Pipri (Phase IV)	Bin Qasim	1994	50	37.5	4	1	12.5	56	132	24	-	Yes	1.25	Yes
12	Pipri (New)	Bin Qasim	2000	60.48	51.84	14	2	4.32	100	111.9	24	-	Yes	0.6	Yes
13	9th Mile	Gulshan-e-Iqbal	1988	13.2	6.6	4	2	3.3	200	149.1	24	-	-	-	-
14	LSR (Old)	Gulshan-e-Iqbal	1968	18	12	3	1	6.0	120	164	24	-	-	-	-
15	LSR (New)	Gulshan-e-Iqbal	1999	6.5	3.25	2	1	3.25	120	149.1	24	-	-	-	-
16	Ajmer Nagri	North Karachi	1999	46.53	33.84	11	3	4.23	150	149.1	24	-	-	-	-
17	Hub (New)	Gadap	2006	175	105	4	1	35	168	1350	24	-	-	-	-
	(Manghopir)					2	2	17.5	168	750	24	-			
18	T&C	Jamshed	1989	9	1.5	6	5	1.5	150	74.6	24	-	-	-	-
19	NEK (Old)	Gadap	1978	80	35	4	2	12.5	160	372.9	24	-	Yes	1.25	Yes
						6	4	5	160	111.9	24	-			
20	High Lift (at NEK New)	Gadap	1998	125	75	5	2	25	85	307.2	24	-	-	-	-
21	Low Lift (at NEK New)	Gadap	1998	175	105	5	2	35	40	232.7	24	-	-	-	-
22	K-III (at NEK New)	Gadap	2006	135	90	6	2	22.5	160	391.5	24	-	-	-	-
23	Dumlotte (Interconnection) To Old Dumlotee Conduit	Gadap	1971	16.8	11.2	6	2	2.8	40	22.4	24	-	Yes	1.35	Yes
			2006	10	5	2	1	5	40	37.3	24	-			
24	Board Office	North Nazimabad	2000	24	16	6	2	4	100	74.6	24	-	-	-	-
25	Kidney Hill	Gulshan-e-Iqbal	1982	15	5	3	2	5	200	164	12	-	-	-	-
26	Sakhi Hasan	North Nazimabad	1974	25.92	21.6	6	1	4.32	200	149.1	12	-	-	-	-

source: KW&SB

Table 33.1.5 Existing Water Filtration Plants

			Unit	Gharo		COD		Pipri			NEK Old	NEK New	Hub
				Plant 1	Plant 2	Plant 1	Plant 2	Plant 1	Plant 2	Plant 3			
Year of Construction				1943	1953	1962	1971	1971	1978	2006	1978	1998	2006
Rated Production Capacitty			mgd	10	10	70	45	25	25	50	25	100	80
			m^3/d	45,460	45,460	318,220	204,570	113,650	113,650	227,300	113,650	454,600	363,680
Inlet (Receiving) Chamber													
	Number of Basin		nos.	2	1	1	1	1	1	-	2	1	1
Mixing Chamber													
	Number of Basin		nos.	-	-	3	1	1	1	-	1	2	-
	Type of Mixer		-	-	-	Flush Mixer	Weir	Flush Mixer	Weir	-	Flush Mixer	Weir	Weir
Flocculation & Sedimentation Basin													
	Type of Basin		-	Rectangular Horizontal Flow	Circular Type	Center Feed Circular Type	Pulsation Type	Center Feed Circular Type	Pulsation Type	-	Center Feed Circular Type	-	-
	Number of Basin		nos.	1 Floc. Basin 8 Sed. Basin	2 Floc. Basin 2 Sed. Basin	3	2	2	2	-	2	-	-
	Size/Area			300 m^2	ϕ 21 m	ϕ 60 m	1,280 m^2	ϕ 43.5 m	710 m^2	-	ϕ 43.5 m	-	-
	Surface Loading		$m^3/m^2/d$	19	65	45	80	42	80	-	42	-	-
	Withdrawal of Sludge			Manual	Manual	Manual	Air-operated	Manual	Air-operated	-	Manual	-	-
Filter Bed													
	Number of Bed		nos.	8	8	24	14	8	8	10	8	20	16
	Filtration Area		m^2/bed	55	55	128	99	100	97.5	157	100	157	157
	Filtration Rate		$m^3/m^2/d$	104	104	105	148	142	146	145	142	145	145
	Type of Backwash		-	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water	Air Scour & Water
	Number of Backwash Pump		nos.	1 air blowers 2 bw pumps	2 air blowers 2 bw pumps	2 air blowers 3 bw pumps	2 air blowers 3 bw pumps	3 air blowers 4 bw pumps		3 air blowers 3 bw pumps	2 air blowers 2 bw pumps	3 air blowers 3 bw pumps	3 air blowers 3 bw pumps
Clear Water Reservoir													
	Volume		mg	6		10	6	10	6	-	10	10	15
Chemical Feeding Facilities													
	Alum	Applied Chemical	-	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum	Solid Alum
	Chlorine	Applied Chemical	-	Liquid Chlorine		Liquid Chlorine	Liquid Chlorine	Liquid Chlorine		Liquid Chlorine	Liquid Chlorine	Liquid Chlorine	Liquid Chlorine
		Number of Chlorinator	nos.	1		4	4	2		3	7	3	3
		Dosing Point	-	Post		Pre & Post	Pre & Post	Pre & Post	Pre & Post	Pre & Post	Pre & Post	Pre & Post	Pre & Post
	Other Chemicals		-	-	-	-	-	-	-	Sulphuric Acid and Lime for pH control	-	Lime for pH control	Sulphuric Acid and Lime for pH control
Power Substation (not including for P/S)													
	Transformer			300 KVA × 2 units		500 KVA × 2 units	500 KVA × 2 units	500 KVA × 2 units		750 KVA × 1 unit	630 KVA × 2 units	750 KVA × 1 unit	800 KVA × 1 unit
	Generator			219 KVA × 2 units		630 KVA × 1 unit	-	-	-	-	660 KVA × 1 unit (out of order)	-	800 KVA × 1 unit

source: KW&SB

(2) Water Trunk Mains

Water trunk main system in Karachi City is managed by the Superintendent Engineer of Water Trunk Main who functions under the Chief Engineer of Bulk Transmission. The water trunk main system transmits water from the bulk water system such as filtration plants (F/Ps), pumping stations (PSs) and distribution reservoirs to supply area through the water distribution network system as schematically shown in **Figure 33.1.5** and summarized in **Table 33.1.7**. Major routes of the water trunk mains are shown in **Figure 33.1.6**.

The water trunk main system consists of approximately 400 km pipelines with diameters ranging from 12 in to 84 in as listed in **Table 33.1.6**. Main material of the water trunk mains is pre-stressed cement concrete (PRCC), which is about 80 % of the total length (**Figure 33.1.4**).

Table 33.1.6 Water Trunk Mains

Diameter		Length
inch	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

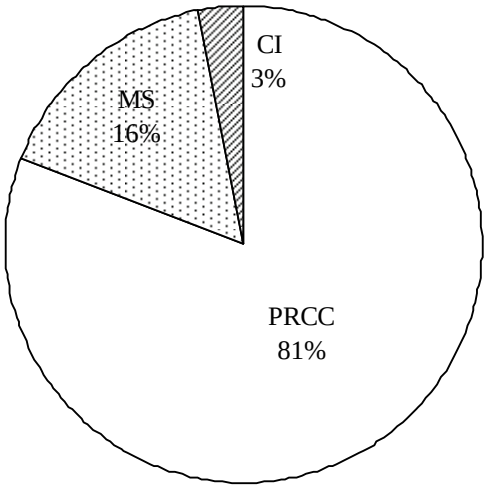


Figure 33.1.4 Proportions of Materials used for Water Trunk Mains

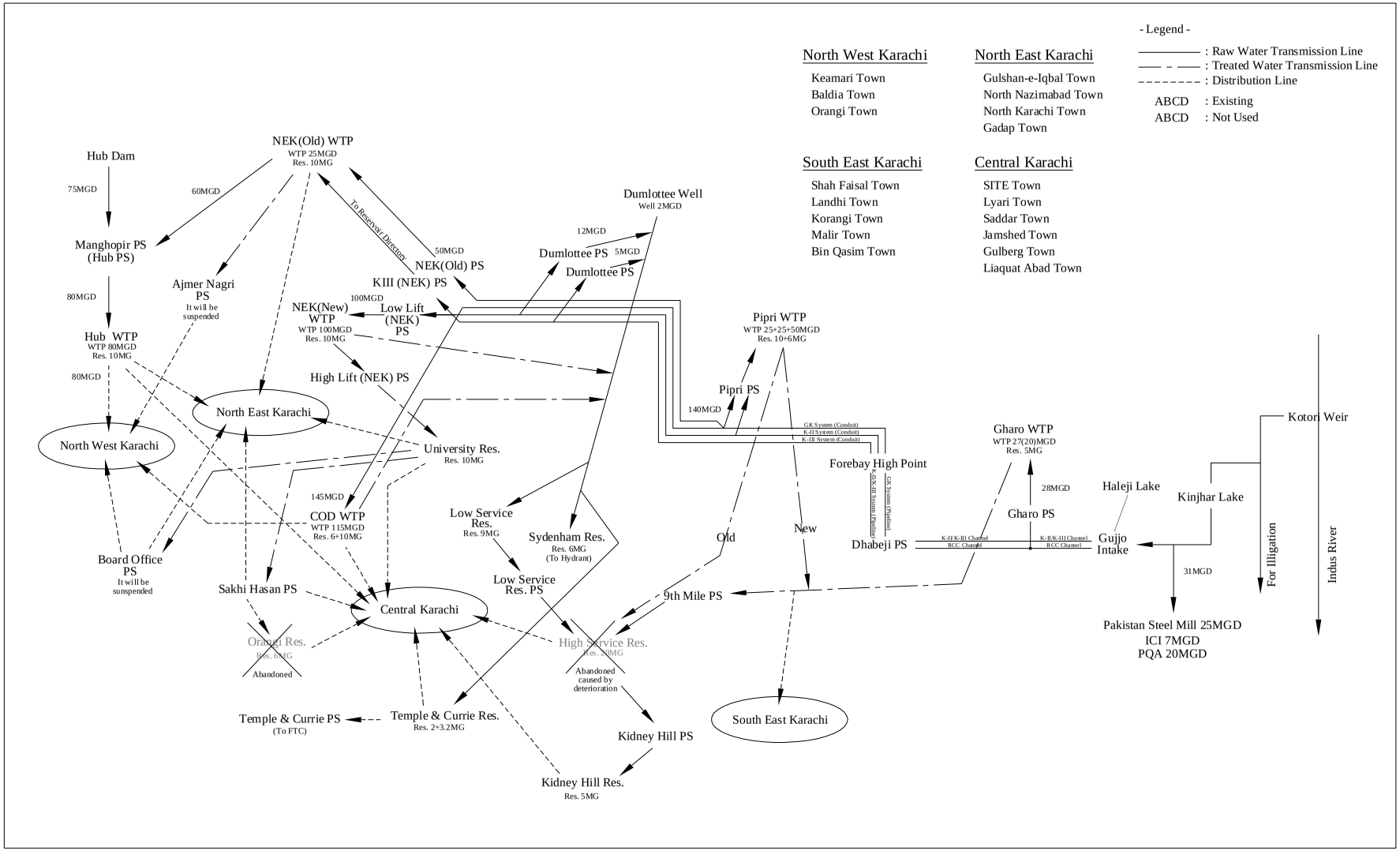


Figure 33.1.5 Water Transmission System

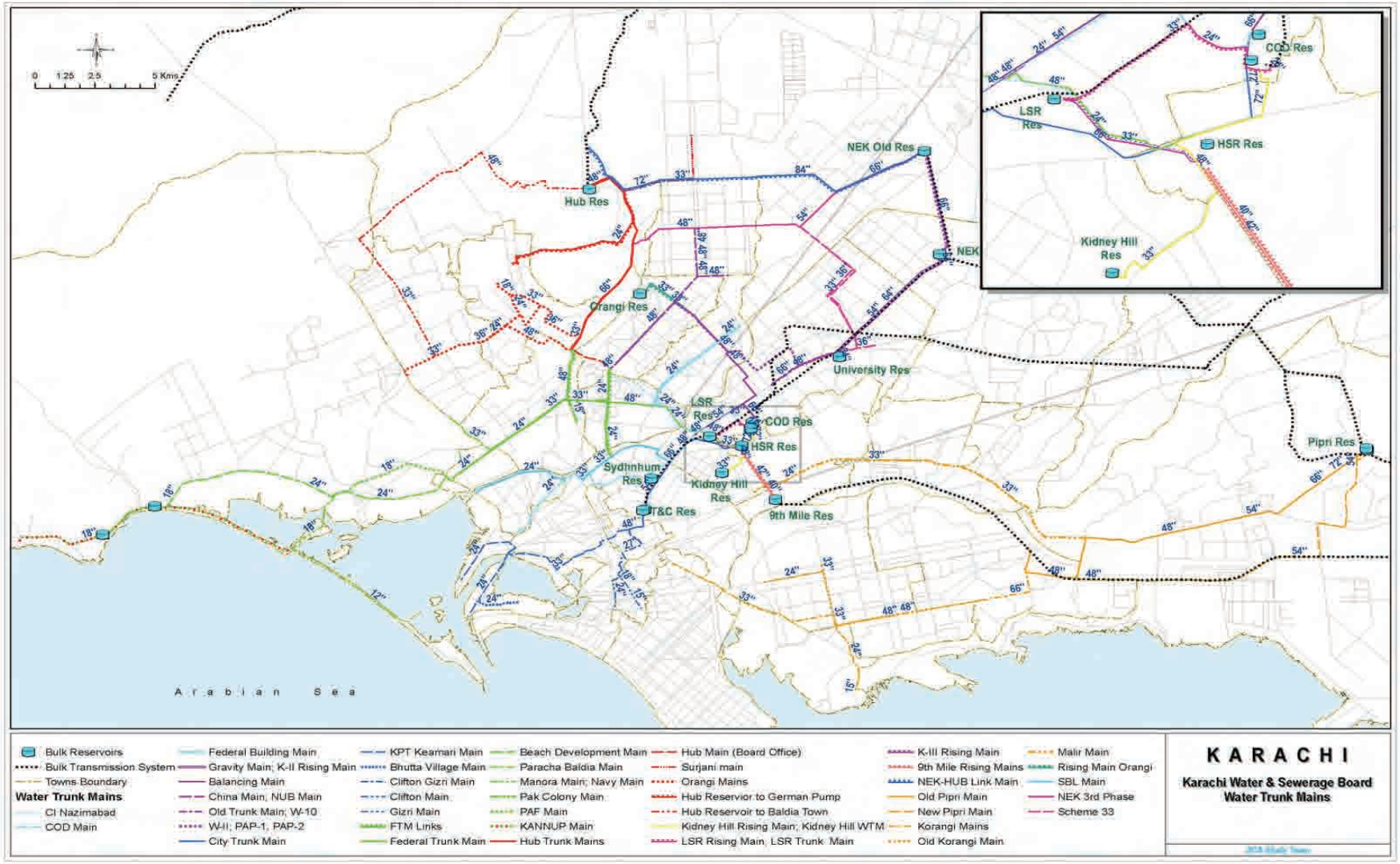


Figure 33.1.6 Route of Major Water Trunk Mains

Table 33.1.7 Supply Area from F/Ps, Reservoirs and Pumping Stations

WTPs	Reservoirs / PSs			Town supplied	Area
Gharo WTP (20 mgd)	9th Mile PS (6 mgd)	through abandoned H.S.R. Site		Jamshed	Central Karachi
				Bin Qasim	South East Karachi
Reservoir (5 mg)				Landhi	South East Karachi
				Korangi	South East Karachi
				Shah Faisal	South East Karachi
Pipri WTP (100 mgd)	through abandoned H.S.R. Site			Jamshed	Central Karachi
				Maril	South East Karachi
Reservoirs (16 mg)				Bin Qasim	South East Karachi
				Landhi	South East Karachi
				Korangi	South East Karachi
				Shah Faisal	South East Karachi
Dumlottee Wells (supplied	L.S.R. (9 mg)	L.S.R. PS (9.3 mgd)	through abandoned H.S.R. Site	Jamshed	Central Karachi
through the Dumlottee	T & C Reservoir (5.2 mg)	T & C PS (3 mgd)		Shah Faisal	South East Karachi
Conduit)				Lyari	Central Karachi
				Saddar	Central Karachi
additionally watered from	Sydenham Reservoir (6 mg)			Jamshed	Central Karachi
GK/K-II/K-III conduits				Gulshan-e-Iqbal	North East Karachi
NEK Old WTP (25 mgd)	Manghopir PS (105 mgd)	Hub WTP		-	-
	Ajmer Nagri PS			Orangi	North West Karachi
Reservoir (10 mg)				Norht Karachi	North East Karachi
				Orangi	North West Karachi
NEK New WTP (100 mgd)	High Lift PS (75 mgd)	University Reservoir (10 mg)	Sakhi Hasan PS	Gulberg	Central Karachi
				North Nazimabad	North East Karachi
Reservoir (10 mg)			Board Office PS	North Nazimabad	North East Karachi
				Orangi	North West Karachi
				Gulshan-e-Iqbal	North East Karachi
				Gulberg	Central Karachi
COD WTP (115 mgd)	Kidney Hill Res. (5 mg)			Jamshed	Central Karachi
				Kiamari	North West Karachi
Reservoirs (16 mg)				Lyari	Central Karachi
				Saddar	Central Karachi
				Jamshed	Central Karachi
				Liaquat Abad	Central Karachi
Hub WTP (80 mgd)				Orangi	North West Karachi
				Baldia	North West Karachi
Reservoir (15 mg)				SITE	Central Karachi
				Gadap	North East Karachi

Source: KW&SB

(3) Water Distribution Network

1) General

The water distribution network in Karachi covers 18 towns, 6 Cantonments and a Defense Housing Authority (DHA) Area. These 18 towns are included in 5 administrative water supply zones classified by KW&SB, which is shown on **Figure 33.1.7**. Keamari Town, Bin Qasim Town & Gadap Town which are located in eastern part, western part & northern part of Karachi respectively have huge administrative area, but most area in these towns are out of the KW&SB supply area because of very low population density. Some of the areas in these towns are used for agriculture or are barrens and are directly administrated by the City District Government Karachi (CDGK) Nazims and Union Councils (UCs) or by the some community participatory organizations. Remaining 15 towns are almost 100% of service ratio supplied by piped water supply, water tank-cars or other ways. Cantonments and Defense Housing Authority (DHA) area are out of management by KW&SB, but are supplied by bulk water system.

2) Water Distribution Network

Water is supplied through water trunk mains from water filtration plants, reservoirs, pumping stations or Dumlottee Wells in the city of Karachi. The distribution reservoirs which are the base of water supply are listed in **Table 33.1.8**. Pipelines with a diameter of 15 in (375 mm) and over in distribution network is called as distribution mains normally in Karachi. The list of the existing distribution pipelines including distribution mains of each town as of the year 2001 is shown in **Table 33.1.9**. The detail of the existing distribution pipelines is attached to **Appendix A33.1**. A total length of the existing distribution pipelines is about 4,850km as of the year 2001. This information was prepared by Water Distribution Wing of KW&SB, which does not exist in the current organisation. According to this table, about 65 % of the existing pipes are asbestos cements (AC) pipes as shown in **Figure 33.1.8**. If excluding distribution mains (15 in and over), AC pipes account for 70 % of the total. There are many aged pipes which were installed more than 40 years ago. In addition even relatively new pipelines are also mainly AC pipes. 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 and securing the water supply conditions in Karachi.

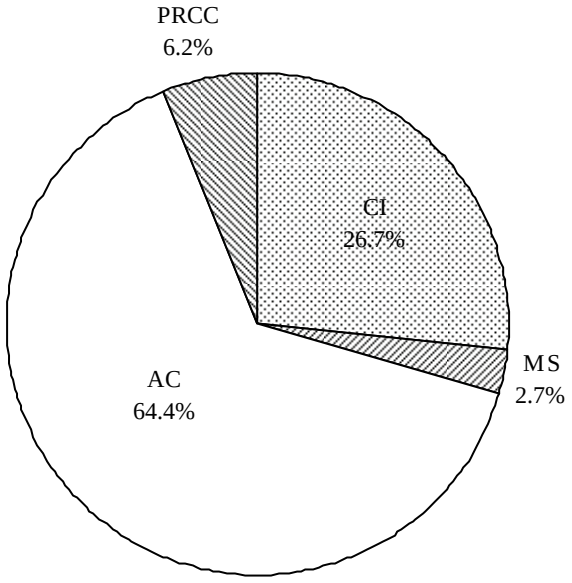


Figure 33.1.8 Proportions of Materials used for Distribution Pipelines

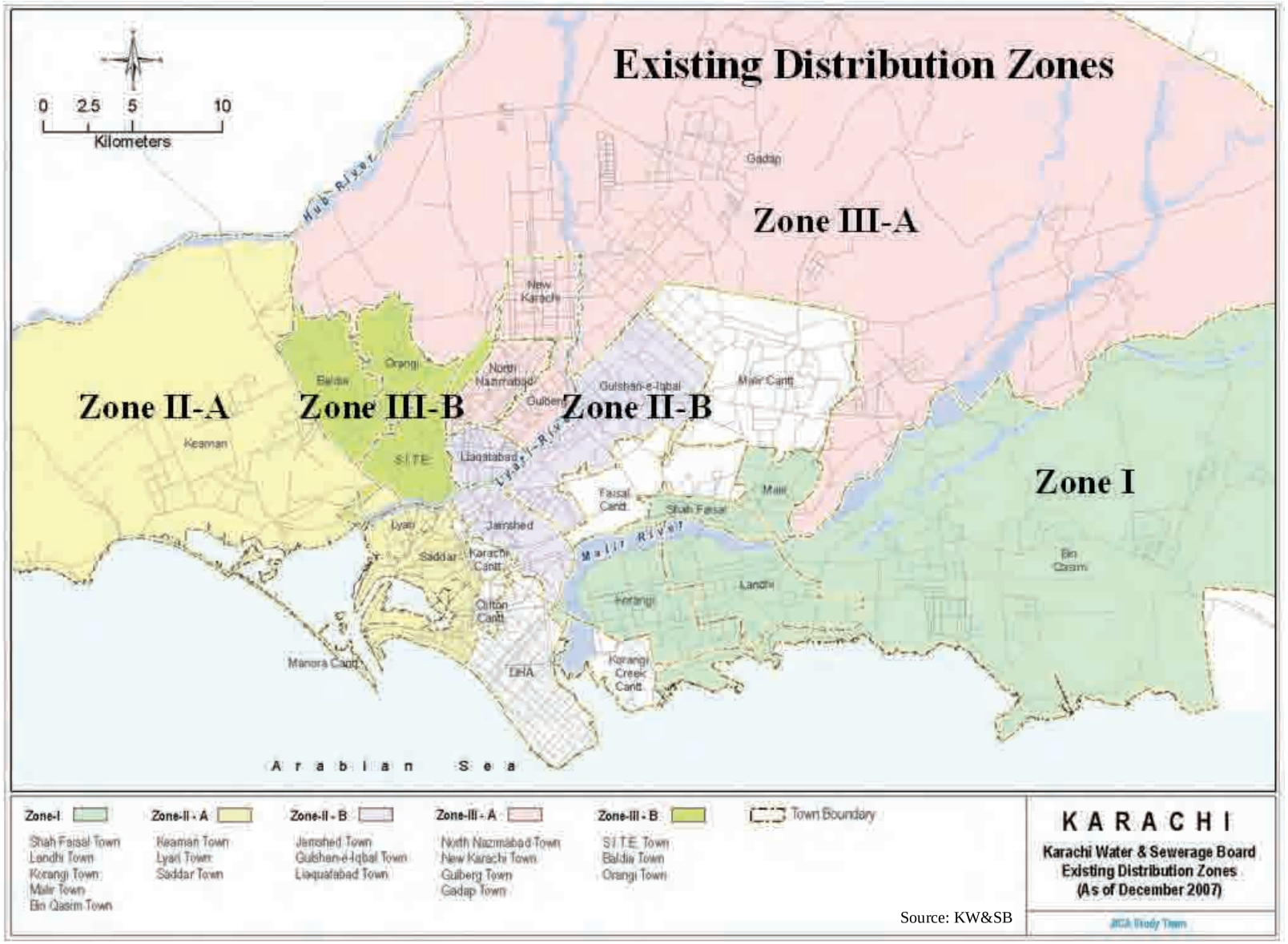


Figure 33.1.7 Present Water Supply Zones

Table 33.1.8 List of Distribution Reservoirs

Reservoir	Construction	Capacity		High Water Level		Low Water Level	
		Mg	m3	+Ft.	+m	+Ft.	+m
Gharo WTP Res. (Plant-1)	1942	6.0	27,277	155.0	47.24	150.0	45.72
Pipri WTP Res. (Plant-1)	1971	10.0	72,737	250.0	76.20	234.0	71.32
Pipri WTP Res. (Plant-2)	1978	6.0	72,737	250.0	76.20	234.0	71.32
NEK (OLD) WTP Res.	1978	10.0	45,461	260.0	79.25	244.0	74.37
NEK (NEW) WTP Res.	1998	10.0	45,461	185.0	56.39	169.0	51.51
COD WTP Res. (Plant-1)	1962	10.0	45,461	150.0	45.72	132.0	40.23
COD WTP Res. (Plant-2)	1971	6.0	27,277	150.0	45.72	132.0	40.23
HubWTP (Manghopir) Res.	1982	15.0	68,191	340.0	103.63	326.0	99.36
University Res.	1971	10.0	45,461	220.0	67.06	*204.0	*62.18
High Service Res. (Abandoned)	1945	20.0	90,922	150.0	45.72	*134.0	*40.84
Low Service Res.	1942	9.0	40,915	103.0	31.39	*87.0	*26.52
Temple Res.	1880	2.0	9,092	61.5	18.75	*45.5	*13.87
Currie Res.	1896	3.2	14,547	61.5	18.75	*45.5	*13.87
Sydenham Res.	1942	6.0	27,277	65.5	19.96	*49.5	*15.09
Orangi Res. (Abandoned)	1982	6.0	27,277	250.0	76.20	*234.0	*71.32
Kidney Hill Res.	1978	6.0	27,277	200.0	60.96	*184.0	*56.08

* : To assume 16ft of water depth
Source: KW&SB

Table 33.1.9 Distribution Pipelines

Name of Zone	Name of Town	Pipeline Length (km)				Total Length (km)
		CIP	MS	AC	PRCC	
Zone-I	Landhi	134.70	0.00	129.51	38.00	302.21
	Korangi	164.21	0.00	148.00	48.48	360.69
	Malir	3.00	0.00	206.20	11.40	220.60
	Bin Qasim	2.40	0.21	12.67	8.52	23.80
	Shah Faisal	0.00	0.00	247.00	10.00	257.00
Zone-IIA	Keamari	0.00	0.00	35.53	3.10	38.63
	Lyari	9.86	1.80	157.48	5.04	174.18
	Saddar	70.52	2.64	119.81	24.36	217.33
Zone-IIB	Jamshed	43.65	5.00	208.25	20.10	277.00
	Gulshan-e-Iqbal	84.34	2.53	293.16	15.72	395.75
	Liaquat Abad	224.00	0.40	535.70	2.50	762.60
Zone-IIIA	North Nazimabad	73.55	0.23	262.63	16.88	353.29
	New Karachi	370.16	0.00	184.08	4.85	559.09
	Gulberg	103.18	2.38	70.97	10.21	186.74
	Gadap	0.00	73.55	44.47	19.04	137.06
Zone-IIIB	SITE	3.16	18.15	145.03	11.74	178.08
	Baldia	4.40	2.49	92.04	7.56	106.49
	Orangi	5.35	19.52	233.87	45.10	303.84
Total Length (km)		**1,296.48**	**128.90**	**3,126.40**	**302.60**	**4,854.38**

Source: KW&SB

KW&SB are currently rationing its supply by regulating entry valves to sub-zones and operating hours of distribution pumps. **Figure 33.1.9** provides an overall picture of how KW&SB regulate its supplies to retail and bulk customers at present.

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 area, 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. The details of these distribution pumping stations are shown in **Appendix A33.1**. Some of distribution pumps are stopped during power break down, since there is no emergency power supply equipment such as power generator.

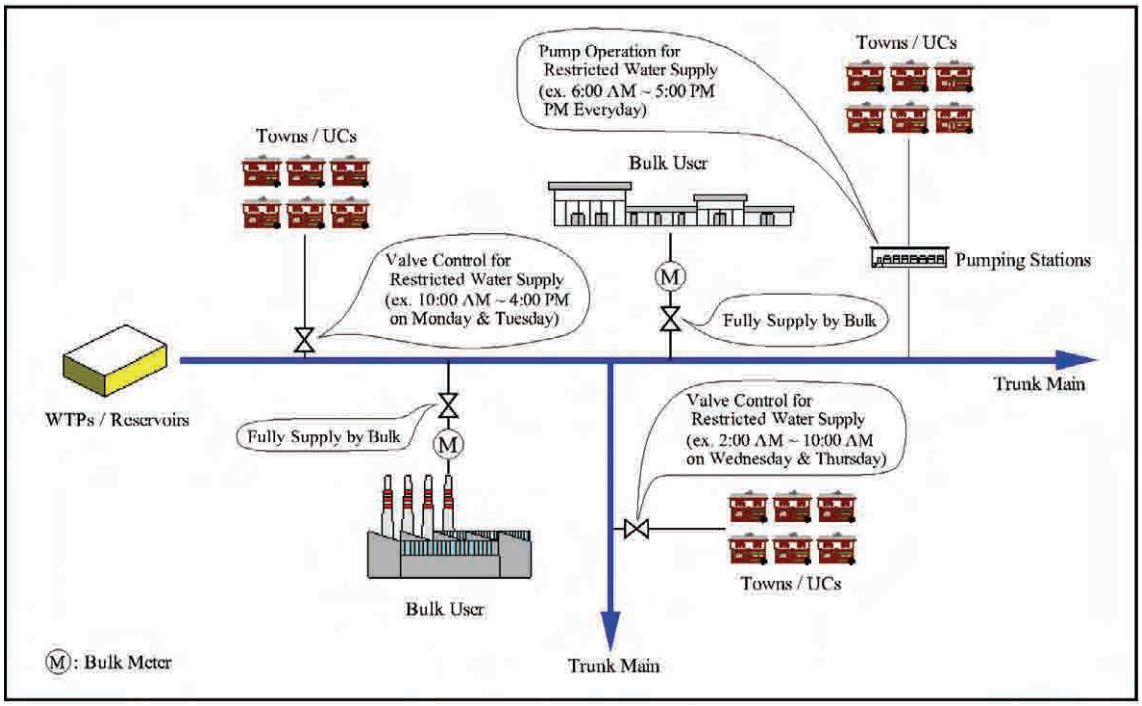


Figure 33.1.9 Methods Used for Water Rationing

Suspension of pumping makes water supply situation to accelerate worse. In order to cope with such serious water supply situation, many of the water consumers install individual small suction pumps and suck water from distribution pipes forcibly during supply hours. In addition to that, some consumers in low literate areas don't use float valve to avoid the overflow from the under ground and over head tanks and water continues to overflow from the tanks during the supply hours especially in the night time. These are 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. The details of the results of water quality analysis are described in **Section 4.1 "Water Quality Analysis"**.

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.

3) Water Losses in Distribution Network

KW&SB assume that the water loss in the distribution network is between 30% and 35%. According to Master Plan made in 1985 for Water Supply, water losses in 1985, 1990 and 1995 were assumed to be 40%, 33% and 25% respectively. Deterioration of existing pipes is one of reasons of water leakage at the connection parts of pipelines. And the water leakages at the connection parts are occurred by using low quality material of pipes and poor workmanship either attended by the KW&SB staff or by the contractors. In addition to these causes, there are so many illegal connections, and these illegal users also use water without concern for water usage. Improvement of distribution pipes and service pipes is necessary to cope with these problems, but the improvement does not progress, because of huge cost and the enormous amount of time for these improvement and development. JICA Study conducted the water leakage survey and its results are described in **Section 4.3 "Leakage and NRW Surveys"**. Through the survey it was observed that overflows of the individual water tanks and sacking

water by illegal connections were assumed to account for a large share of water losses.

4) Bowser Filling Stations and Water Supply Service by Tank-Cars

In the areas outside the piped water supply areas of KW&SB, water is mainly supplied from 10 Bowser Filling Stations (**Photo 33.1.2**) in the city area by water tankers (**Photo 33.1.1**). The operations and managements of these Bowser Filling Stations and Tank-Cars are under Rangers. The details about these systems are not clear. Monthly water consumption at each station recorded by Ranger in 2004 is shown in **Table 33.1.10**. According to KW&SB, there is no report from Ranger about water consumption other than this report.

Photo 33.1.1 Water Tank Cars

Photo 33.1.2 Bowser Filling Station

Table 33.1.10 Bowser Filling Stations

S.No.	Name of the Bowser filling station	Location	UC No.	Monthly Consumption in 2004 (MG)	Operation at Present
1	Muslimabad	Jamshed	UC No.11 (Garden East)	48	Yes
2	Sydhnem	Jamshed	UC No.11 (Garden East)	90	Yes
3	LSR	Gulshan-e-Iqbal	UC No.2 (Civic Center)	90	No
4	Sakhi Hassan	North Nazimabad	UC No.6 (Sakhi Hassan)	84	Yes
5	F.B. Area	Gulberg	UC No.5 (Naseerabad)	105	Yes
6	N.E.K	Gadap	UC No.3 (Gujro)	47.1	Yes
7	Shah Faisal	North Karachi	UC No.8 (Shah Faisal Colony)	4.8	Yes
8	Jamia Millia	Shah Faisal	UC No.7 (Al Falah Society)	19.5	Yes
9	Juma Goth	Shah Faisal	UC No.7 (Al-Falah Society)	16.50	Yes
10	L.I.A	Bin Qasim	UC No.3 (Cattle Colony)	2.04	Yes
			Total:	18.54	

Source: KW&SB

5) Service Connection

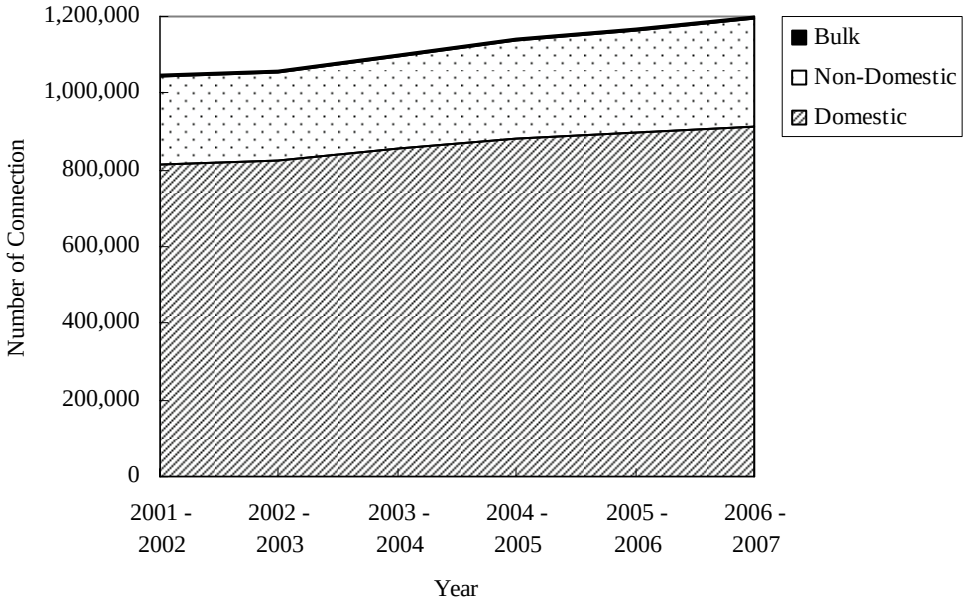
The information of the number of service connections counted by KW&SB in the last 6 years is shown in **Table 33.1.11**. And more detailed information of service connection is shown in

Appendix A33.1. The number of connections in Cantonments and DHA area is not included in this table. These areas independently supply water to their consumers after receiving water from the KW&SB's bulk water supply system. According to the census in 1998, population in Cantonments was 306,165 and population in DHA area was 250,000. It is recognized that number of connection have increased on average of about 3% yearly in the last 5 years. The increase of the number of service connections is shown in **Figure 33.1.10**. As mentioned previously, there are no water meters on the individual service connections in Karachi except some bulk users.

Table 33.1.11 Number of Service Connection

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



* Source: Revenue Data 2001 - 2007, KW&SB

Figure 33.1.10 Number of Service Connection

6) Water Quality

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 pipes. Detailed results of water quality analysis are referred to **Section 4.1 "Water Quality Analysis"**.

7) Operation and Maintenance

In order to cope with the problems of KW&SB, KW&SB implemented reformation of organisation and arranged operation and maintenance administration function in each town and started the system preparation responding directly to customers. 18 towns are divided into five

administration water supply zones as mentioned previously, and these five zones are controlled by each Chief Engineer (CE). Superintendent Engineer (SE) controls each town generally, and Deputy Director (Taxes), Assistant Executive Engineer (E&M), Executive Engineer (Water Supply) and Executive Engineer (Sewerage) function under SE. More detailed organisation of KW&SB is specified in **Section 3.5.1 "Organisation"**. Routine and non-routine works and operations in each town are listed in **Table 33.1.12**, which is obtained form the questionnaire surveys to Superintendent Engineers (SEs) of all 18 towns who are responsible to the distribution network. Each town SE is authorized to spend Rs.45,000/- to cope with any emergency maintenance within the limits of budget. However the KW&SB staff does not have enough equipment and tools for the emergency requirements. There is a shortage of skilled staff and the workmanship on both KW&SB and contractors is very poor. Among the KW&SB's facilities, Old Pumping House near NEK New F/P is well maintained and operated.

Table 33.1.12 Routine and Non-Routine Works and Operations (1/2)

Frequency	Routine Work / Operation
Daily:	1) Valve operation. 2) Pumping operation. 3) Repairing of leakage. 4) Removal of contamination. 5) Response to of water shortage complaints. 6) Coordination with area representatives of Karachi Electric Supply Cooperation Limited (KESC). 7) Daily progress reports. 8) Monitoring of development works. 9) Survey of the effected areas. 10) Distribution and collection of routine Dak. 11) Monitoring of Bulk Water Supply.
Weekly:	1) Weekly progress meeting with KW&SB officials. 2) Preparation of schemes / estimates / Planning Commission-1 (PC-1). 3) Meeting with area supervisors for improvement of Water Supply.
Fortnightly:	1) Fortnightly review meetings. 2) Fortnightly progress reports.
Monthly:	Check the following works: 1) Preparation of Salary Bill. 2) Preparation of Overtime Bill. 3) Submission of Quotation Bill. 4) Submission of Quotation for approval. 5) Attendance Report. 6) Meeting with Divisional Accountant (DA) & Finance members for monitoring of proper expenditure.
Quarterly:	1) Check the efficiency of pumping motors. 2) Check the condition of Sluice Valve. 3) Discuss the efficiency of area fitters with site Supervisors and reporting of Fitters on the basis of progress report.
Semi Annually:	1) Cleaning of reservoir. 2) Overhauling of Pumping Machinery. 3) Overhauling of defective Sluice Valve. 4) Rescheduling of water supply schedule as per requirement. 5) Survey of Extended Areas. 6) Replacement of old and leaked water lines. 7) Identifying the possible contaminated points. 8) Cleaning of water supply lines.
Annually:	1) Budget preparation. 2) Submission of Annual Confidential Report (ACR) 3) Closing of last budget expenditure. 4) White Wash of offices / Pump houses. 5) Maintaining of office record.
Other:	

Source: Result of Questionnaire Survey to SE of 18 Towns

Table 33.1.12 Routine and Non-Routine Works and Operations (2/2)

	Non-Routine Work / Operation
1)	Manage water supply of the area after any electric breakdown / out of order of Sluice Valve / disturbing of Sluice Valve / leakage of line / heavy contamination / broken line or heavy leakage.
2)	Maintaining of Government Vehicles.
3)	Damaging of water supply line by excavator.
4)	Survey / coordination with foreign delegation.
5)	Special assignments.
6)	Rescheduling of Bulk Water Supply and proposal.
7)	Additional Charge.
8)	Member of Enquiry committee and its report.
9)	Development works.
10)	Election of labor union.
11)	Special arrangements on public holidays.
12)	Special arrangements on important events.
13)	Submission of working papers.

Source: Result of Questionnaire Survey to SE of 18 Towns

8) Major Problems on Water Supply Service

KW&SB have quite many problems of operation, maintenance and management for water distribution as listed in **Table 33.1.13**.

Table 33.1.13 Major Problems Identified for the Existing System within Each Town

	Major Problems
1)	Shortage of technical skilled staff.
2)	Low Potential of Contractors working with KW&SB.
3)	General Disparity among officers and workers.
4)	Encroachments at various places on waterlines which put severe difficulty in reparing of hidden water leakages and cause water contamination besides wastage of potable water.
5)	Adjustment of valve operation by area residents.
6)	Interruption of valve operation by representatives.
7)	Illegal water connections / poor response from law enforcement agencies for disconnection.
8)	Illegal water connection of Katchi Abadies.
9)	Contamination problems, specially in old city areas, where sewerage & water supply systems are very close each other due to narrowness of streets / less working space.
10)	Insufficient financial capabilities to cope with minor / major works of important natures.
11)	Frequent power breakdowns at pumping stations thereby resulting in suspension of scheduled water supply to the dependent areas.
12)	Extraordinary work load on staff without additional financial support or reward.
13)	Shortage of field staff particularly Fitters, Valve operators, Welders and Line workers.
14)	Limited budgetary diversion.
15)	Long approval procedure.
16)	Political influence.
17)	Short bulk water supply.
18)	Influence of Labor Union.
19)	Old / chocked and contaminated water supply network.
20)	Old pumping machinery with low efficiency.
21)	Rapidly growth in population.
22)	Valve operation due to public / UC's involvement.
23)	Difference between demand and supply.
24)	Restricted water supply network.
25)	Non availability of water supply network in Katchi Abadies and Private.
26)	Low quality of installed pipe materials
27)	Shortage of vehicles for valve operation as well as maintenance work.
28)	Acute shortage of Oil grease & equipment for lubricating machineries.
29)	No security arrangement for safe guard of installed machineries.
30)	Inadequate budged provisions and power delegations to SE (Town).
31)	Non availability of materials, tools and plants for repair work.
32)	No facility of departmental mobile phone.

Source: Result of Questionnaire Survey to SE of 18 Towns

The problems listed as above were obtained form the questionnaire surveys to Superintendent Engineers (SEs) of all 18 towns who are responsible to the distribution network. These problems are almost common to each town and become an obstacle to do appropriate operation, maintenance and management. Conditions of the existing service pipes are shown in **Photos 33.1.3** and **33.1.4**. **Photo 33.1.5** shows a community pumping station which has been installed for sucking water from a nearby distribution main forcibly. **Photo 33.1.6** shows illegal connections in Katchi Abadis (Squatter Settlement) across a channel.

Photo 33.1.3 3/4" GIP Service Connection

Photo 33.1.4 4" PVC Plugging with Rubber Tube

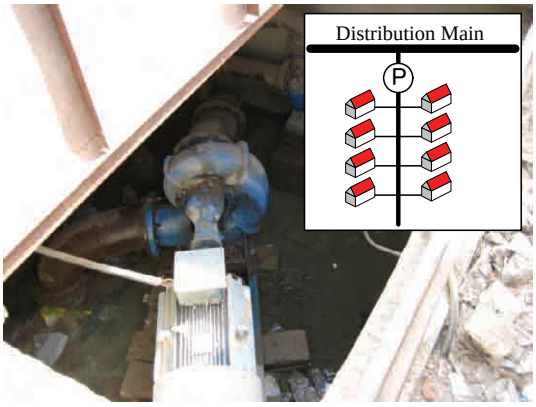


Photo 33.1.5
Suction Pump to Suck Water Forcibly

Photo 33.1.6
Piping for Illegal Connections across a Channel

(4) Design Criteria

There is no written design standard prescribed by KW&SB. KW&SB examine design values suggested for project or designs submitted by consultants on each project and allows to use these values or formulas if there is no problem.

KW&SB assume that the per capita demand per day is 54 gallons including non-domestic use and leaks. According to Master Plan for Water Supply prepared in 1985, the major criteria used for planning and designing of the water supply system are as follows;

- Peak factor of day maximum demand : 1.174
- Hourly peak factor : 1.50
- Minimum service water pressure: 0.98 N/cm^2
- Required capacity of service reservoir : 4 to 8 hours of day average demand
- The formula to calculate the water supply network : Colebrook & White formula
- Coefficients for the above formula: e=3.0mm for old age cast iron pipe,
  e=0.3mm for new concrete pipe.

3.3.2 SEWERAGE SYSTEM

(1) Collection System

There are three sewer districts in Karachi City, namely TP-1, TP-2 and TP-3 districts. New 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 to Lyari Interceptor. Korangi and Landhi Towns at the left bank side of Malir River have been isolated from sewer district of TP-2 after pressure main from these towns to TP-2 was destroyed by the flood in 1974. KW&SB has proposed new sewage treatment plant for these towns at the left bank side of Malir River. **Table 33.2.1** outlines sewer districts in Karachi City.

Table 33.2.1 Sewer Districts

Sewer District	Related Towns
TP-1 District	SITE, North Nazimabad, North Karachi, Gullberg, Liaquatabad
TP-2 District	Saddar, Jamshed, Faisal
TP-3 District	SITE, Baldia, Lyari, Saddar, Jamshed, Iqbal,
(Korangi District)	Landhi, Korangi
(Orangi District)	SITE, Orangi
(North Karachi District)	North Karachi

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 by KW&SB
(Orangi District)	2,900	No	Will be connected to TP-3
(North Karachi District)	2,700	No	Will be connected to TP-3

Note: Area is measured on map

Figure 33.2.1 shows geographical relation among these three sewer districts and the locations of three sewage treatment plants.

Figure 33.2.1 Sewer Districts of Karachi City

a. Trunk Sewers

Table 33.2.2 outlines major trunk sewers connected to existing sewage treatment plants. Also, **Figure 33.2.2** shows major trunk sewers whose diameters exceed 30 inch.

Table 33.2.2 Major Trunk Sewers Connected to Sewage Treatment Plant

Treatment Plant	Major Trunk Sewer to TP	Size at End / Length
TP-1	Federal Area Trunk Sewer	66 inch / -
	Upper Lyari Trunk Sewer	54 inch / -
	Lower Lyari Trunk Sewer	21 inch / -
TP-2	Malir Trunk Sewer	60 inch / -
	(Pressure Main from Clifton PS)	48 inch / 5.5 km
TP-3	Lyari Interceptor	Box 2 × 2.5 m × 2.0 m / 11.3 km

Lyari Interceptor is newly constructed sewer to intercept sewage generated at the right bank side of Lyari River except sewer district of TP-1. This interceptor will receive sewage from Orangi Town and New Karachi Town in future, and sewage intercepted by the interceptor is conveyed to TP-3. **Table 33.2.3** and **Figure 33.2.3** outline Lyari Interceptor. Flow capacity shown in average flow at the end of the interceptor is about 93 mgd, which is almost two times the treatment capacity of TP-3 of 54 mgd.

Table 33.2.3 Outline of Lyari Interceptor

Sr. No.	Stretch From/To	Size	Length (m)	Slope	Flow Capacity	
					Peak (m^3/sec)	Average (m^3/day)
1	KDA RC Bridge	Box 1.5 m × 1.5 m	2,700	1/440	3.96	171,000
	Overhead Bridge					
2		1.8 m in dia.	2,650	1/1000	3.15	136,000
	Goli Mar Bridge					
3		Box 2.0 m × 2.0 m	2,900	1/1176	5.21	225,000
	A Bridge connecting Sher Shah District and Mara Naka District					
4		Box 2 × 2.0 m × 2.0 m	2,150	1/2500	7.15	309,000
	From a railway Bridge					
5		Box 2 × 2.5 m × 2.0 m	950	1/2500	9.80	423,000 (93 mgd)
	TP-III					
Total			11,350			

Source: Design drawings (not as-built drawing)

Note: Capacity in m^3/sec shows peak capacity; Capacity in m^3/day shows average capacity, using Manning's formula with roughness coefficient of 0.015, peak factor assumed to be 2.0

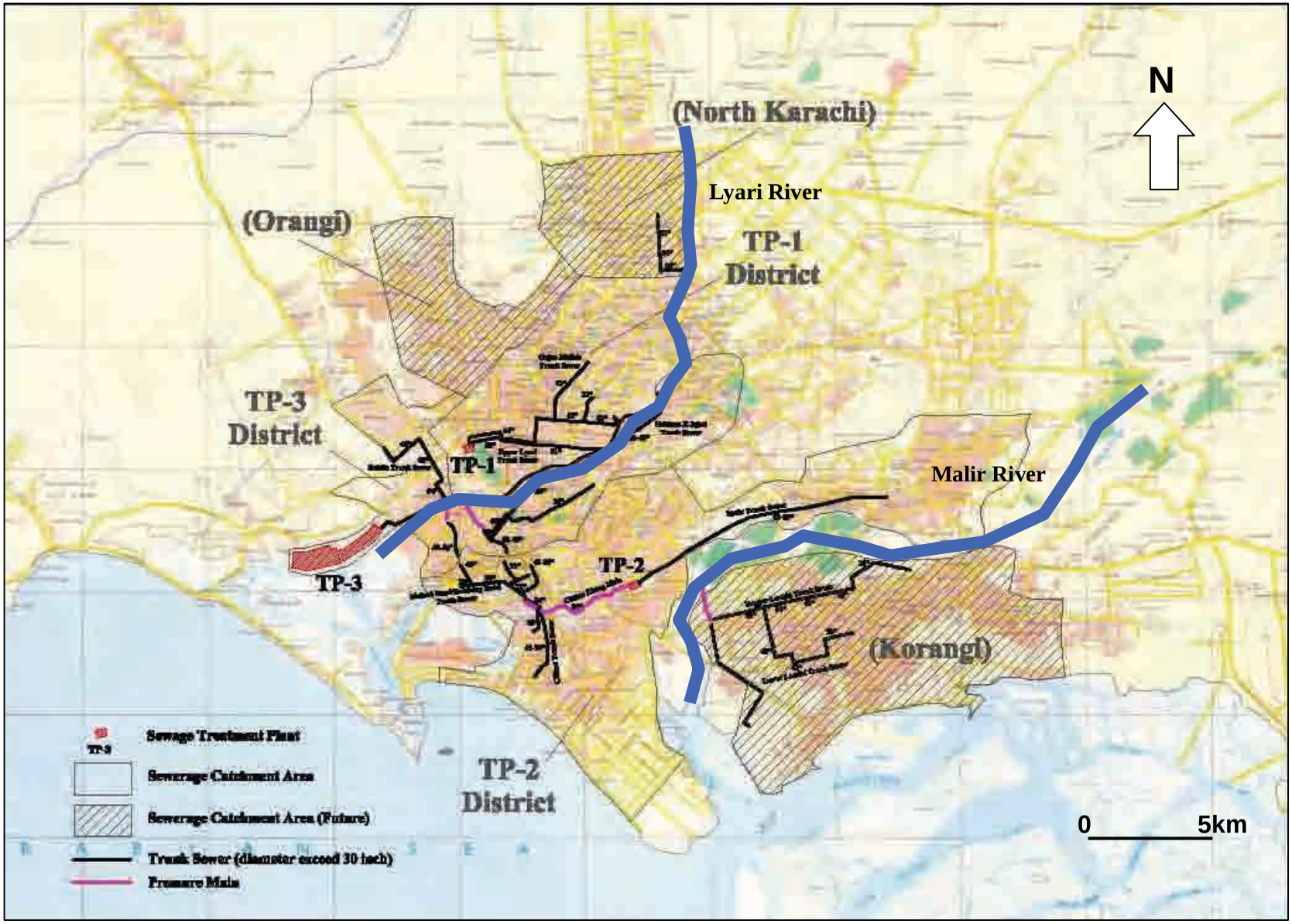


Figure 33.2.2 Major Trunk Sewers whose Diameter Exceed 30 inch.

Figure 33.2.3 Plan of Lyari Interceptor

b. Branch Sewers

Table 33.2.4 outlines branch sewers under each township administration. Sewers in some areas such as Katchi Abadis and Cantonments are not included in the table except those under township; therefore total sewer length shown in the table does not correspond to actual total length.

Table 33.2.4 Town-wise Diameter-wise Sewer Length

(km)

Diameter (inch)	8-15	16-24	27-84	Total
Diameter (mm)	200-380	410-610	690-2130	
(1) Keamari Town	32.2	2.5	0.0	34.7
(2) SITE Town	96.0	10.6	8.8	115.4
(3) Baldia Town	25.4	11.6	4.3	41.3
(4) Orangi Town	35.7	1.2	0.0	36.9
(5) Lyari Town	53.9	12.4	2.4	68.7
(6) Saddar Town	18.0	23.0	31.3	72.3
(7) Jamshed Town	435.3	11.1	13.3	459.7
(8) Iqbal Town	148.2	9.4	6.4	164.0
(9) Sha faisal Town	54.0	6.9	7.9	68.8
(10) Landhi Town	91.1	8.3	11.3	110.7
(11) Korangi Town	258.6	6.3	11.3	276.2
(12) North Nazimabad Town	370.1	17.3	9.5	396.9
(13) North Karachi Town	285.5	11.6	5.0	302.1
(14) Gulberg Town	442.0	36.6	8.5	487.1
(15) Liaquatabad Town	187.8	18.8	49.2	255.8
(16) Malir Town	121.6	24.3	0.2	145.1
(17) Bin Qasim Town	17.8	2.3	0.0	20.1
(18) Gadap Town	203.6	17.2	12.7	233.5
Total	2876.8	231.4	182.1	3,290.3

Source: KW&SB, Townships

c. Outline of TKP

As shown in **Tables 33.2.5** and **33.2.6**, new sewers construction, sewers rehabilitation including replacement, desilting and rerouting works have been done or planned under Tameer-e-Karachi Programme (TKP) initiated by the Government of Pakistan. TKP, subsidised mainly by the Government of Pakistan, Government of Sindh and CDGK, began in July 2004 and is expected to continue until June 2008.

So far, construction of 413,000 feet (126 km) of new sewers, rehabilitation/replacement of 512,000 feet (156 km) of sewers, desilting of 302,000 feet (92 km) of sewers and rerouting /bypassing of more than 177,000 feet (54 km) of sewers either were completed or are in progress. The total cost amounted to be Rs.896 million. In addition, new sewers of 95,000 feet (29 km) are planned to install with the expected budget of Rs.358 million. The total length of new sewers to be constructed under TKP will be 508,000 feet (155 km).

Table 33.2.5 TKP Works either Completed or in Progress

Town		New Line (ft)	Replacement Rehabilitation (ft)	Disilting (ft)	ReRounting or By Pass (ft)	Sanction Amount (in million Rs.)
1	Kemari			11,650		9
2	SITE		21,702	20,905	7,810	23
3	Baldia	3,500	26,300			30
4	Orangi					
5	Lyari	12,300	4,050	120,317		27
6	Saddar	10,300	35,681		3,785	67
7	Jamshed		28,800		35,500	54
8	G. Iqbal	8,740	69,990			70
9	Shah Faisal		22,540		8,700	38
10	Landhi	7,050	100,665		106,165	117
11	Korangi	13,886	52,230	8,861	6,670	50
12	North Nazimabad	41,600	550	100,350		93
13	New Karachi	76,000	49,700	36,550		111
14	Gulberg	31,326	32,081	2,700		61
15	Liaqatabad		41,590	700		45
16	Malir	208,460	13,968		8,850	83
17	Bin Qasim(manholes)					9
18	Gadap		12,250			8
Total (ft)		413,162	512,097	302,033	177,480	896
Total (m)		125,900	156,100	92,100	54,100	

Table 33.2.6 TKP Works under Awards

Town		New line (ft)	New line (meter)	Replacement Rehabilitation (ft)	Disilting (ft)	Re Rounting (ft)	Sanction Amount (in million Rs.)	Estimated Amount (PC-I) (in million Rs.)
5	Lyari			34,470			15	
				2,300	10,183			4
6	Saddar					9,470	13	
				11,650		3,785		36
7	Jamshed			5,600			3	
				39,200			14	
8	G. Iqbal	58,300	17,770				29	
9	Shah Faisal			Improvement no information on length			11	
		13,200	4,023	25,840		18,788		36
10	Landhi			Industrial Area no information on length			30	
11	Korangi			Industrial Area no information on length			47	
				1,670	Rcc no numerical data available	Slab and Rings no numerical data available		5
14	Gulberg			61,085				103
15	Liaqatabad	23,400	7,132				12	
total		94,900	28,926				174	184

(2) Pumping Stations

a. Large Scale Pumping Stations

Clifton Pumping Station

Table 33.2.7 outlines Clifton Pumping Station. This pumping station is located in Saddar Town. The function of the pumping station is pumping sewage generated in some parts of Saddar Town to sewage treatment plant TP-2 in Jamshed Town. Because existing 48 inch (1200 mm) dia. pressure main to TP-2 is old and fragile, it is difficult to pump the entire sewage received by the pumping station and increasing sewage in future. The pumping station has bypass pressure main to a nearby nallah for emergency purpose. It is supposed that fairly large amount of sewage is discharged to the nallah at present. KW&SB has proposed a new pressure main to TP-2 to relieve existing one and to reduce bypassed amount.

Table 33.2.7 Outline of Clifton Pumping Station

	Description
Commission	1975
Renovation	1995
Capacity	18 mgd (81,000 m^3/day)
Catchment Area	Part of UC1, 2, 3, 4, 5, 6, 7, 8, 9, 11 of Saddar Town
Facilities	
1. Inlet Pipe	72 inch (1800 mm) in dia.
2. Screen	Manual type bar screen
3. Pump	10,000 gpm (45.5 m^3/min) × 5 nos., Vertical type
4. Pressure Main	48 inch (1200 mm) in dia., 5.5 km length to TP-2
5. Bypass	33 inch (850 mm) in dia., 0.5 km length to Civil Line Nallah by pressure
6. Generator	Very old, out of use
7. Total Installed Capacity	328,000 m^3/day
Operation	Four of five pumps is for lifting to TP-2, working in turn, one pump works at a time
	One pump is for bypass (exclusive use)
Future Expansion Plan	New pressure main to TP-2 is proposed to relieve fragile existing pressure main and to reduce bypassed amount

Photo 33.2.1 Screen Facility of Clifton Pumping Station

Photo 33.2.2 Pumps of Clifton Pumping Station

Photo 33.2.3 Old Generator of Clifton Pumping Station

Photo 33.2.4 Civil Line Nallah, Bypass Outfall from Clifton Pumping Station

Pumping Station PS-2 in Korangi Town

Table 33.2.8 outlines Pumping Station PS-2 in Korangi Town. This pumping station is located in Korangi Town. Its function is to pump sewage generated in Korangi Town and Landhi Town to sewage treatment plant TP-2 in Jamshed Town. As 48 inch (1220 mm) dia. pressure main crossing Malir River to TP-2 was destroyed by a flood in 1974, sewage generated in these two towns is discharged to Malir River from this pumping station without any treatment. A treatment plant of Pakistan Tanners Association located at 3 km east of this pumping station will receive some sewage from this pumping station to dilute strong tannery wastewater for UASB process. Installation of pumps and pressure main for this purpose are in progress.

Table 33.2.8 Outline of Pumping Station PS-2 in Korangi Town

	Description
Commission	1960
Renovation	2006 (Install diesel generator)
Catchment Area	Korangi Town and Landhi Town
Capacity	22.6 mgd (103,000 m^3/day)
Facilities	
1. Inlet Pipe	48 inch (1200 mm) in dia.
2. Screen	Manual type bar screen
3. Pump	4,500 gpm (20.5 m^3/min) × 2 nos., Vertical 3,500 gpm (15.9 m^3/min) × 2 nos., Submergible
4. Pressure Main	48 inch (1220 mm) in dia., 2.0 km length to Malir River
5. Generator	320 kVA (installed in 2006)
6. Total Installed Capacity	105,000 m^3/day

Facilities for TP of PTA (In progress)

1. Pump for PTA (future)	1,200 gpm (5.5 m^3/min) × 5 nos., Vertical
2. Pressure Main	33 inch (840 mm) in dia., 3 km to TP of PTA

Photo 33.2.5 Screen Facility of Pumping Station PS-2 in Korangi

Photo 33.2.6 Pumps of Pumping Station PS-2 in Korangi

Photo 33.2.7 Pump of Pumping Station PS-2 in Korangi for TP of PTA

Photo 33.2.8 Outfall from Pumping Station PS-2 in Korangi to Malir River

Jamila Pumping Station

Table 33.2.9 shows outline of Jamila Pumping Station. This pumping station is located in the southeast of Lyari Town. The function of the pumping station is pumping sewage generated in some parts of Lyari, Saddar and Jamshed Towns to sewage treatment plant TP-3 at estuary of Lyari River through newly constructed Lyari Interceptor along Lyari River. The pumping station has bypass gravity line to a nearby nallah for emergency purpose. KW&SB has proposed new pump to increase capacity. Study team saw some parts of new pump facility at the pumping station site. New pump is expected to be installed in the near future.

Table 33.2.9 Outline of Jamila Pumping Station

	Description
Commission	1947
Renovation	1996
Catchment Area	Part of UC8, 9, 11, 12, 13 of Lyari Town
Capacity	15 mgd (68,000 m^3/day)
Facilities	
1. Inlet Pipe	48 inch (1220 mm) in dia. 36 inch (900 mm) in dia. 33 inch (850 mm) in dia.
2. Screen	Manual type bar screen
3. Pump	6,000 gpm (27.3 m^3/min) × 1 no., Horizontal 4,000 gpm (18.2 m^3/min) × 1 no., Vertical 4,000 gpm (18.2 m^3/min) × 2 nos., Submergible
4. Pressure Main	2 Pressure mains 36 inch (900 mm) in dia., 2.5 km length and 33 inch (850 mm) in dia., 2.5 km length, to an outfall manhole near dhobi ghat (washing place) at Lyari River then go to Lyari Interceptor by gravity
5. Bypass	Overflow pipe from receiving well to nearby Nallah by gravity
6. Generator	520kVA diesel generator
7. Total Installed Capacity	118,000 m^3/day
Future Expansion Plan	New pump will be installed (expected in 2006) 7,000 gpm (31.8 m^3/min) × 1 no., horizontal 4,000 gpm (18.2 m^3/min) × 3 nos., vertical

Photo 33.2.9 Screen Facility of Jamila Pumping Station

Photo 33.2.10 Vertical Pumps of Jamila Pumping Station

Photo 33.2.11 Submergible Pump of Jamila Pumping Station

Photo 33.2.12 Outfall Manhole from Jamila Pumping Station, near a Dhobi Ghat

Chakiwara Pumping Station

Table 33.2.10 outlines Chakiwara Pumping Station. This pumping station is located in the north of Lyari Town. The function of this pumping station is pumping sewage generated in some parts of Lyari, Saddar to sewage treatment plant TP-3 at estuary of Lyari River through newly constructed Lyari Interceptor along Lyari River just like Jamila Pumping Station.

Table 33.2.10 Outline of Chakiwara Pumping Station

	Description
Commission	1985
Renovation	-
Catchment Area	Part of UC8, 9, 11, 12, 13 of Lyari Town
Capacity	5.22 mgd (24,000 m^3/day)
Facilities	-
1. Inlet Pipe	36 inch.(900 mm) in dia
2. Screen	Manual type bar screen
3. Pump	3,400 gpm (15.5 m^3/min) × 4 nos., Vertical 2,000 gpm (9.1 m^3/min) × 1 no., Submergible 1,800 gpm (8.2 m^3/min) × 2 nos., Vertical
4. Pressure Main	27 inch (686 mm) in dia., 2.0 km length to Lyari Interceptor
5. Generator	Diesel generator
6. Total Installed Capacity	126,000 m^3/day

Photo 33.2.13 Grit Chamber of Chakiwara Pumping Station

Photo 33.2.14 Vertical Type Pumps of Chakiwara Pumping Station

Photo 33.2.15 Discharging Pipe of Chakiwara Pumping Station

Pumping Station PS-2 in SITE Town

Table 33.2.11 outlines Pumping Station PS-2 in SITE Town. This pumping station is located in the south of sewage treatment plant TP-1. The function of this pumping station was to pump sewage conveyed from Jamila and Chakiwara Pumping Stations at the left bank side of Lyari River to TP-1 before Lyari Interceptor was constructed. The interceptor receives sewage from these two pumping stations now. At present, this pumping station continues to exist as a facility for small pocket near the pumping station. Actual flow the pumping station receives is assumed to be less than 1 mgd depending on operation hour at present.

Table 33.2.11 Outline of Pumping Station PS-2 in SITE Town

	Description
Commission	1958
Renovation	-
Catchment Area	Part of SITE Town
Capacity	9.5 mgd (43,000 m^3/day)
Facilities	-
1. Inlet Pipe	21 inch.(530 mm) in dia
2. Screen	Manual type bar screen
3. Pump	2,200 gpm (15.5 m^3/min) × 3 nos., Vertical
4. Pressure Main	500 m to TP-1
5. Generator	None
6. Total Installed Capacity	22,000 m^3/day

Photo 33.2.16 Screen Facility of Pumping Station PS-2 in SITE Town

Photo 33.2.17 Pumps of Pumping Station PS-2 in SITE Town

b. Other Pumping Stations

Table 33.2.12 outlines other pumping Stations located in Lyari, Saddar, SITE Town, Korangi Town and Kimairi Town, which are located in lower and flat area in the west of Karachi City.

Table 33.2.12 Outline of Pumping Stations in Karachi City (1/2)

	Name of Pumping Station	Name of Drainage Area	Nominal Capacity (m3/day)	Nominal Capacity (mgd)	Capacity of Each Pump (m3/min)	Capacity of Each Pump (gpm)	Type of Pump	MotorPower /Engine Power	Number of Pump		Year of Construction
	Lyari Town										
1	Chakiwara Sewage PS	UC-8, 9, Lyari Town	23,725	5.220	8.18	1,800	Vertical	90 kW	2	7	1985
					15.45	3,400	Vertical	132 kW	4		1985
					9.09	2,000	Submergible	44 kW	1		1985
2	Khadda Market Sewage PS, (Ejector 19)	UC-4, Lyari Town	12,408	2.730	5.45	1,200	Vertical	40 HP	2	3	1968
					5.45	1,200	Submergible	22 kW	1		1993-94
3	Haji Pir Mohammad Village Sewage PS, (Ejector 18)	Ali Mohd Muhalla Daryabad, Billal Road, Baghdadi Thana, UC-4, 5, Lyari Town	4,909	1.080	5.45	1,200	Submergible	22 kW	1	1	1993-94
4	Moosa Lane Sewage PS, (Ejector 6)	Mir Mohd Baloch Road, Moosa Lane	5,890	1.296	5.45	1,200	Vertical	40 HP	2	2	1968
5	Juna Masjid Sewage PS	Some areas of UC-2, 6, 7, Lyari Town	5,890	1.296	5.45	1,200	Horizontal	40 HP	2	2	1999
6	Bihar Sewage PS	Some areas of UC-1, 8 and Bihar Colony Tennery Road	10,454	2.300	5.45	1,200	Vertical	40 HP	2	3	1968, 93-94
					5.45	1,200	Submergible	22 kW	1		2003
7	Bakra Piri Sewage PS	UC-11, Nawa Lane	5,863	1.290	5.45	1,200	Submergible	22 kW	1	1	1998
8	UC-36 Chakiwara Road Sewage PS	Lyar, Degree College Area, Lee Market, Moosa Lane, Haji Pir Mohd Road, Baghdadi	21,362	4.700	9.09	2,000	Submergible	33 kW	1	6	1999
					7.27	1,600	Submergible	22 kW	1		2002-03
					8.18	1,800	Vertical	50 HP	4		1998
9	Noor Mohd Village Sewage PS	UC-11, Noor Mohd Village	1,636	0.360	3.41	750	Horizontal	33 kW	2	2	1983-84
10	Jamila Sewage PS	UC-8, 9(portion), 11, 12, 13	68,175	15.000	27.27	6,000	Horizontal	33 kW	1	4	1995-1996
					18.18	4,000	Vertical	-	1		2000-01, 2006
					18.18	4,000	Submergible		1		2001
					18.18	4,000	Submergible	-	1		2005
	Saddar Town										
1	Ranchor Line Sewage PS (Ejector-12)	UC-5, 6, Saddar Town	9,163	2.016	5.45	1,200	Vertical	80 HP	3	5	1985
					4.55	1,000	Vertical	40 HP	1		1985
					5.45	1,200	Submergible	22 kW	1		1999
2	Sewage PS (Ejector-14)	Allah Rakha Park, Punjab, Custom House, Saddar Town	8,726	1.920	4.55	1,000	Horizontal	30 HP	2	3	1984
					5.45	1,200	Submergible	22 kW	1		1993-94
3	Pitcher Road Sewage PS	Memon Masjid, Bombay Bazarr, Kagzu Bazar, Quaid-e-Azam, Birth Place UC-3, Saddar Town	8,726	1.920	4.55	1,000	Horizontal	30 HP	2	3	1975
					5.45	1,200	Submergible	22 kW	1		1993-94
4	Clifton Sewage PS	Civil Line, Green Road, Bath Island, Free Road, Clifton Block 3, 4, 5, 7, Civil Hospital,	81,810	18.000	40.91	9,000	Vertical	30 HP	5	5	1984
											1993-94
5	Shereen Jinnah Sewage PS	Shereen Jinnah Colony, Clifton Block 1, 2, UC-2, Saddar Town, and UC-1, Kemari Town	13,635	3.000	8.18	1,800	Vertical	30 HP	4	4	1975
											1993-94

Table 33.2.12 Outline of Pumping Stations in Karachi City (2/2)

	Name of Pumping Station	Name of Drainage Area	Nominal Capacity (m^3/day)	Nominal Capacity (mgd)	Capacity of Each Pump (m^3/min)	Capacity of Each Pump (gpm)	Type of Pump	MotorPower /Engine Power	Number of Pump		Year of Construction
Kimairi Town											
1	Grax Village I Sewage PS	Partly Grax Village Area, Kimairi Town	2,273	0.500	2.27	500	Horizontal	10 HP	2	2	1992-93
2	Grax Village II Sewage PS	Partly Grax Village Area, Kimairi Town	2,273	0.500	2.27	500	Horizontal	10 HP	2	2	1992-93
3	Takri Village Sewage PS	Takri Village Area, Kimairi Town	2,273	0.500	2.27	500	Horizontal	10 HP	2	2	1992-93
4	Manripur Sewage PS	Masroor Colony, Marigi Pws Village	2,273	0.500	2.27	500	Horizontal	10 HP	2	2	1992-93
SITE Town											
1	Pumping station PS2 (Inlet of TP-1)	Bismillah Colony, Jahanabad, Mewashah Graveyyard and its surroundings	43,178	9.500	10.00	2,200	Vertical	-	3	3	1960
Korangi Town											
1	Pumping station PS2 (Inlet of TP-2)	Korangi Town and Landhi Town	102,717	22.600	20.45	4,500	Vertical	-	2	4	1960
					15.45	3,400	Submergible		2		1960/2001

(3) Sewage Treatment Plants

Table 33.2.13 summarizes three existing sewage treatment plants (TPs).

Table 33.2.13 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 – 7 units PST – 6 units TF – 8 units FST – 2 units Anaerobic digesters – 4 Sludge drying beds – 196 units	Influent pumps – 7 units PST – 6 units TF – 8 units FST – 2 units Anaerobic digesters – 4 Sludge drying beds – 196 units	Influent pumps – 3 units AP – 6units FP – 6 units 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/day)	46 mgd (209,000 m^3/day)	54 mgd (245,000 m^3/day)
Present Flow Rate	25 mgd (114,000 m^3/day)	24 mgd (110,000 m^3/day)	30 – 35 mgd (136,000 – 159,000 m^3/day)
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
NA: information not available

As shown in the table, the total actual flow to these three TPs is 79 to 84 mgd (360,000 to 380,000 m^3/day) which is around half their total capacity of 151 mgd (686,000 m^3/day). This is due to the absence of or damaged trunk sewers and malfunction of pumping stations. **Photos 33.2.18** through **33.2.25** show present conditions of these three sewage treatment plants and **Figures 33.2.4** through **6** show general plans of TPs-1, 2 and 3, respectively.

The whole plant has not been operated for two months because the inlet sewers are clogged with deposits and garbage.

Photo 33.2.18 Primary Settling Tank (TP-2, in August 2006)

Primary effluent is sprayed on the filter media.

Photo 33.2.19 Trickling Filter (TP-1, in May 2006)

Though primary settling tanks and trickling filters are operated, final settling tanks are not operated due to the clogging of sludge withdrawal pipes

Photo 33.2.20 Final Settling Tank (TP-1, in May 2006)

Pipes to convey sludges from PST/FST and boxes to distribute sludges to drying beds were broken.

Photo 33.2.21 Sludge Distribution Box (TP-2, August 2006)

A few sludge drying beds is working.
Sludge pipes and distribution boxes to drying beds are working. (TP-1)

Photo 33.2.22 Sludge Distribution Pipe and Box (TP-1, September 2006)

A truck conveying dried sludge from sludge drying lagoon can be seen.

Photo 33.2.23 Sludge Drying Lagoon (TP-1, September 2006)

This pipe is the inlet to anaerobic pond. The first desludsing of the anaerobic pond after 8 year operation was going to be done in early September 2006.

Photo 33.2.24 Inlet to Anaerobic Pond (TP-3, in September 2006)

Treated in facultative pond following anaerobic pond, the effluent is discharged to Arabian Sea.

Photo 33.2.25 Effluent (TP-3 in September 2006)

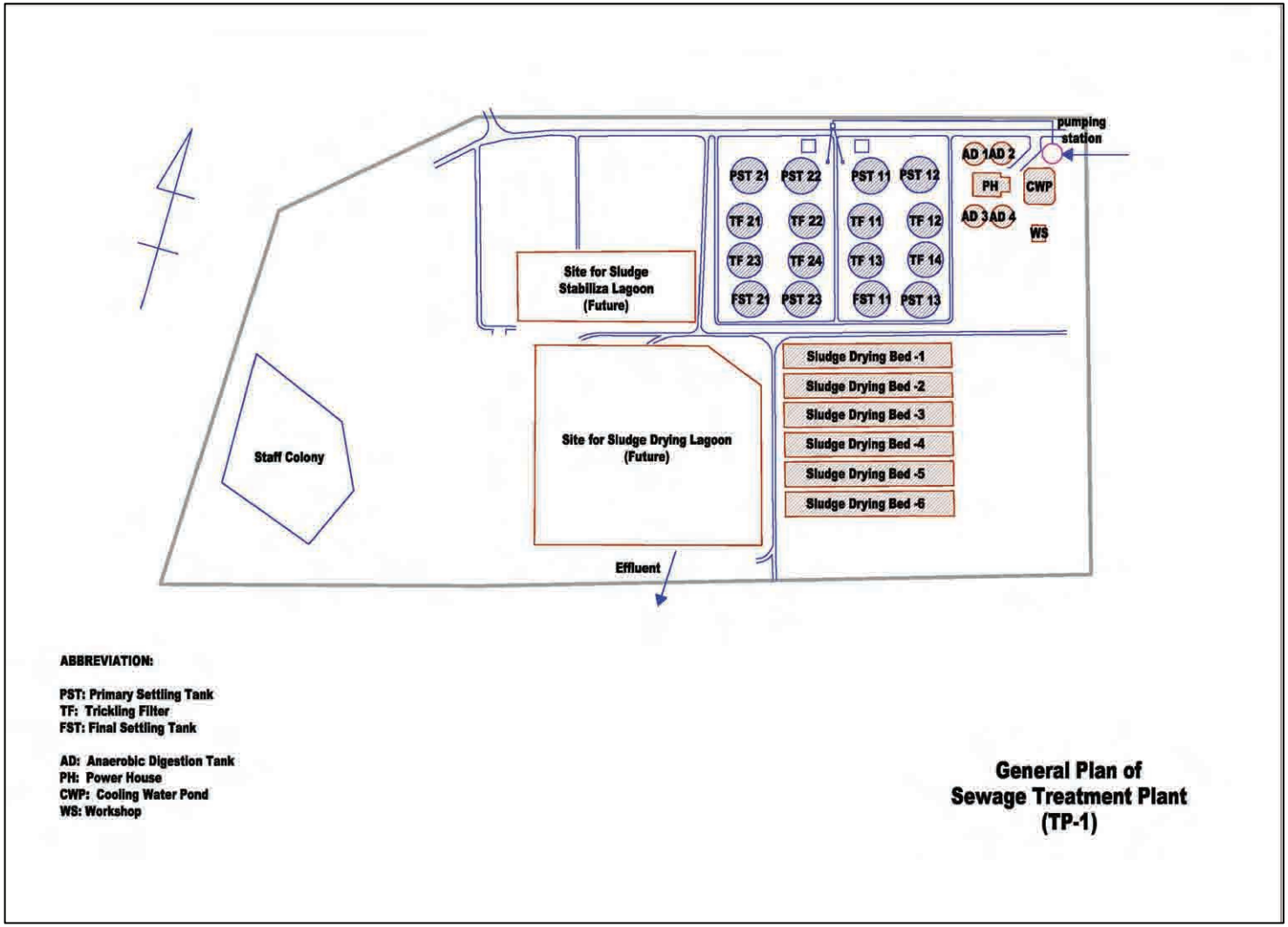


Figure 33.2.4 General Plan of Sewage Treatment Plant TP-1

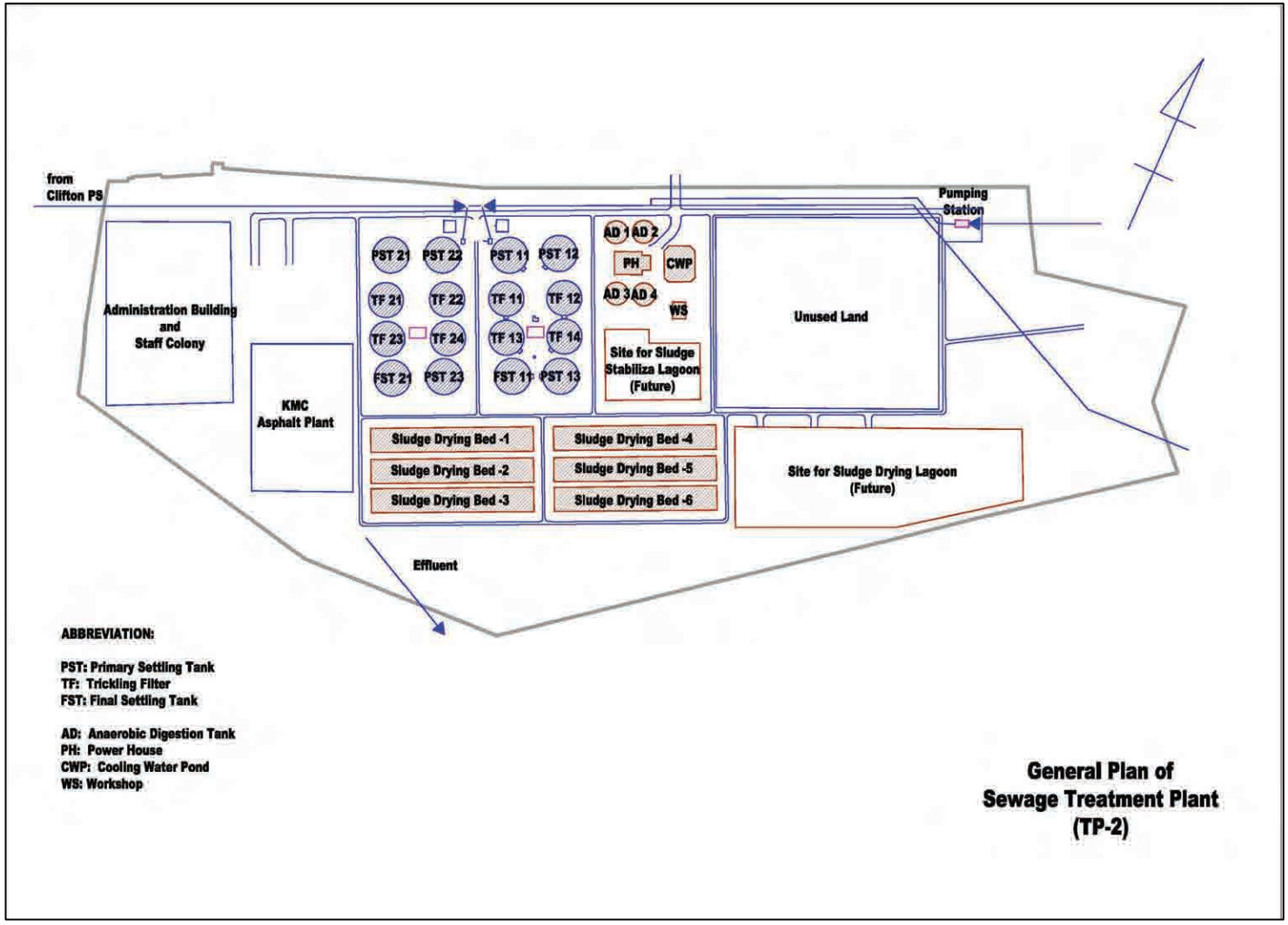


Figure 33.2.5 General Plan of Sewage Treatment Plant TP-2

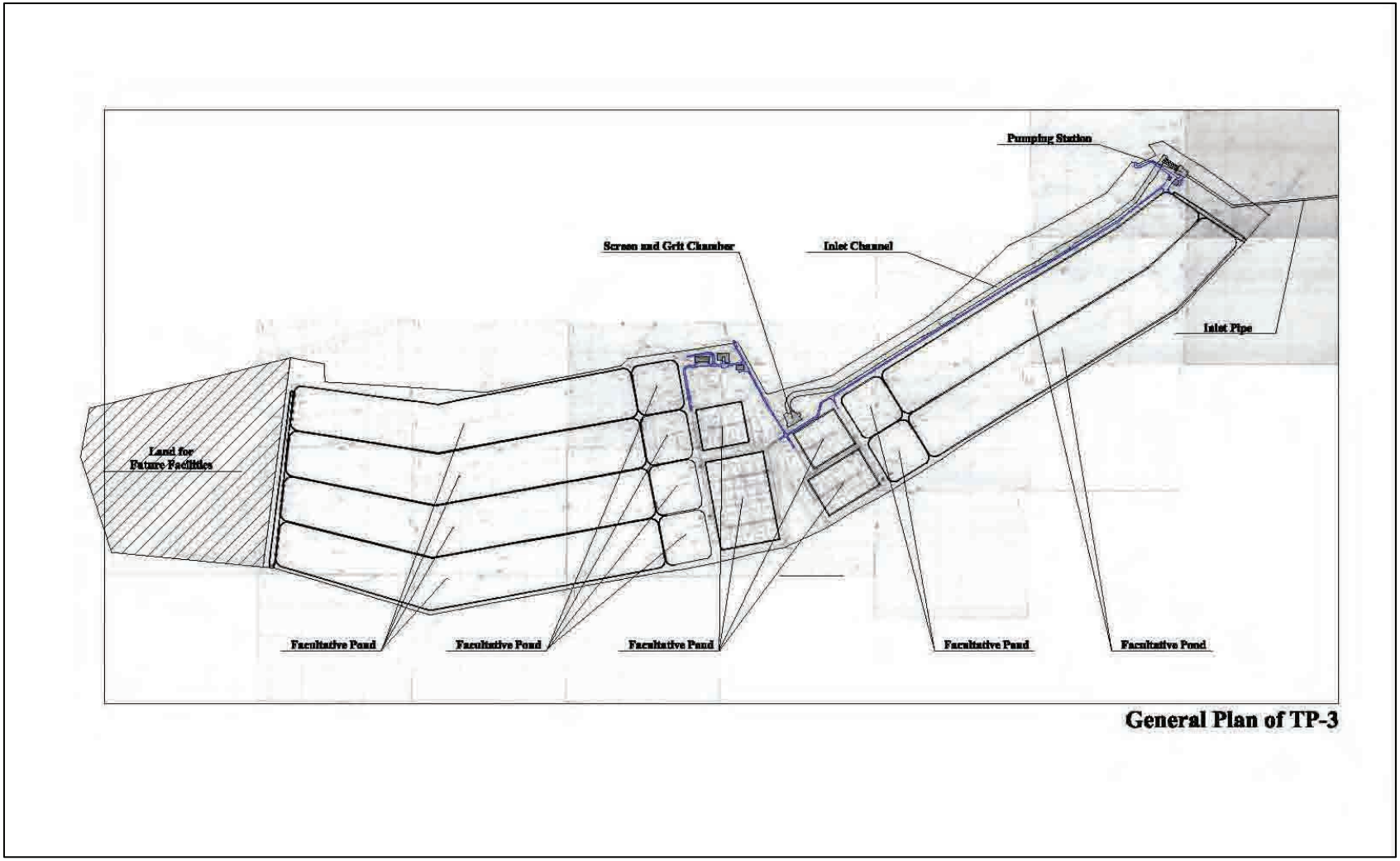


Figure 33.2.6 General Plan of Sewage Treatment Plant TP-3

North Karachi TP

In addition to these three TPs, there is an abandoned TP called North Karachi TP. The process applied is oxidation ditch process and the dimensions estimated based on the site visit and the satellite image are as follows.

Oxidation Ditch: 8 channels (2 channels comprise 1 circuit)*5.5(W)*2.5(H)*215(L)
Final Settling Tank: 2 tanks*9(W)*3(H)*20(L)
Sludge Drying Bed:

The construction of the plant began in 1989 and completed in 1993. The construction was done by Karachi Development Authority. However, no information was available about how long it was operated and why it was abandoned. Some dried sludge was seen at the bottom of final settling tank.

Aerators are installed at both ends of channels.

Photo 33.2.26 Oxidation Ditch (North Karachi TP, abandoned)

Some amount of dry sludge is seen at its bottom.

Photo 33.2.27 Final Settling Tank (North Karachi TP, abandoned)

The TP in Pakistan Tanners Association (PTA)

170 to 180 tanners are situated in Korangi area (Korangi Tanners Cluster). The sewerage system was planned and constructed comprising sewers to collect both tanneries and domestic wastewaters and a treatment plant in Korangi area. Construction cost of Rs.492 million consists of;

Export Development Fund (subsidy from Ministry of Commerce)	334
PTA	96
Government of Netherlands	40
Government of Sindh/CDGK	22
Total (R. million)	492

Capacity of a treatment plant called CETP (Common Effluent Treatment Plant)

10 mgd (45,450 m^3/day) comprising 4 mgd (18,180 m^3/day) of tannery wastewater and 6 mgd (27,270 m^3/day) of domestic sewage. The agreement was made upon in July 2005 between KW&SB and PTA Environmental Society to treat certain amount of domestic sewage at the CETP.

Treatment Process

Equalization, Primary sedimentation, Mixing with domestic sewage, UASB, Aeration with surface and submergible aerators, Secondary sedimentation

The CETP is designed to meet the NEQS; BOD of less than 80 mg/l and SS of less than 200 mg/l. The Society thinks that it might be necessary in the future to introduce the advanced treatment to use the effluent.

Conveyance of domestic sewage

Korangi Pumping Station of 3 km away from the CETP conveys 6 mgd of domestic sewage which is mixed with tannery wastewater after primary sedimentation.

As for tariff, each of 170 to 180 factories is to pay its tariff to be set based on the quantity and quality of its wastewater. Every facility and equipment related to the PTA-CETP including additional pumps and pipes to convey domestic sewage to the PTA-CETP from Korangi Pumping Station is borne by PTA Environmental Society.

The CETP was already constructed and was expected to begin its operation in a couple of months when pumps and pipes are installed. However, the plant is yet to be operated as of November 2007.

There is another TP within Pakistan Steel Mill premises that mainly treats the domestic sewage generated in the company housing complex. Refer to “3.2.2 (4) Reuse of Treated Effluent” for its details.

Photo 33.2.28 Inlet Pipes and Distribution Box of UASB (TP of PTA)

Photo 33.2.29 Both Surface and Submergible Aerator of Aeration Tank (TP of PTA)

(4) 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.

Water supply per capita per day

227 to 318 lpcd (50 to 70 gpcd) or 454 lpcd (100 gpcd) if the plot is more than 836 m^2 (1,000 square yard)

Ratio of sewage generation to water consumption

60 to 80 % of water consumption is supposed to be sewage generation or 100% of water consumption if the groundwater level is high.

Peak flow factor

3 times the average flow is maximum hourly flow

Flow velocity formula

Manning formula is used for the calculation of sewers.

Range of flow velocity
Velocity should be in the range between 0.7 and 3.7 m/sec (2.3 and 12 feet/sec) to avoid silting and corroded inner surface of sewers.

Manhole interval
It should be at every 91 to 152 m (300 to 500 feet) and at the changes of sewer direction and pipe diameter.

3.3.3 Stromwater Drainage System

Table 33.3.1 outlines stormwater drainages and nallahs under each township administration. Drainages are artificial water channels for stormwater drainage; on the contrary, nallahs are natural water channels. Many drainages are connected to nallahs and some drainages connected to river directly; Nallahs discharge into rivers such as Lyari River and Malir River receiving stormwater. As sewage collection system in Karachi City is not enough and its maintenance is not satisfactory, stormwater drainage and nallahs have to receive sewage all year long in addition to stormwater in rainy season.

Table 33.3.1 Town-wise Stormwater Drainage/Nallah Length

Town	Depth (m)	Width (m)	Length (km)
1. Keamari Town	1.21	0.91~3.04	7.62
2. SITE Town	2.13	3.65	16.08
3. Baldia Town	1.22	2.43	11.77
4. Orangi Town	1.52	2.43~3.65	34.1
5. Lyari Town	1.37	0.6~13.7	19.4
6. Saddar Town	1.37	3.05	11.14
7. Jamshed Town	1.5	2.43	33.8
8. Iqbal Town	3.64	2.4~15.2	28.0
9. Faisal Town	1.22~4.57	1.52~24.0	20.1
10. Landhi Town	1.22	2.43	35.36
11. Korangi Town	1.52	2.74	36.4
12. North Nazimadad Town	1.22	2.4	30.7
13. North Karachi Town	1.22	2.4	45.1
14. Gulberg Town	1.37	2.4	22.1
15. Liaquatabad Town	1.52	3.65	19.5
16. Malir Town	1.22	3.04	6.15
17. Bin Qasim Town	1.22	3.64	14.63
18. Gadap Town	1.22	3.65	24.43
Total			416.38

Source: KW&SB

There are no exclusive pumping facilities for stormwater drainage in Karachi City. However, many pumping stations called “ejector”, which were constructed for sewage discharge to natural nallahs or rivers have worked as stormwater pumping facilities in rainy season.
Roadside drains are cleaned by KW&SB one to two months before monsoon season comes every year. Removed and collected silt/garbage is conveyed to designated solid waste disposal sites. However, roads are cleaned afterwards by town administration and silt/garbage is transferred to drains again. This is said to be how inundation is caused.
In addition to above mentioned administrative issues, many drains and nallhas have been

already encroached on by illegal houses and buildings. Strong enforcement of building code and other relevant laws is expected.

Another major issue with malfunctioned drains/nallahs is that garbage is easily and routinely dumped to these facilities, which leads to their reduced sections. Comprehensive solid waste management system has to be introduced.

Due to the uncontrolled housing and garbage dumping, no space/access is available to clean it.

Photo 33.3.1 Typical Nallah in Saddar Town

North Karachi Drain receives the sewage of some 300 houses

Photo 33.3.2 North Karachi Drain

The flow is larger in monsoon season than in dry season.

Photo 33.3.3 Lyari River in August 2006

To prevent stormwater from entering into it, a muffler is equipped with rubber tube.

Photo 33.3.4 Improved Muffler

3.4 LAWS, POLICIES AND ADMINISTRATIVE FRAMEWORK

3.4.1 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. Also in force are the KW&SB APT Rules, 1987, the KW&SB Efficiency and Discipline Rules, 1987 and the KW&SB Delegation of Powers, 1991 amongst others. Some of these will have been superseded following devolution as the Government of Sindh (GOS) have issued a number of rules and regulations for local government departments. These include ‘Local Fund Budget Rules, 2001’; ‘TMA/UA, APT Rules, 2001’; ‘Contract Rules, 2001’, ‘TMA Rules of Business, 2002’, ‘Conduct of Business Rules, 2001’ amongst others.

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’. With the advent of these recent policies it may be prudent for the GOS to consider introduction of a unified provincial ‘Water Law’ that seeks to eliminate the overlaps and anomalies by combining, clarifying and simplifying the plethora of existing Acts. Whilst the policies act as ‘guiding principles’, the water laws would need to clearly define roles and responsibilities for all ‘actors’ involved to ensure an ‘integrated approach’ to water resource management, including the standards required for the supply of safe drinking water and disposal of waste water with due care for the environment.
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). Along with other ‘departmental heads’ (responsible for provision of services such as Health, Education, Agriculture, Transport, etc.,) the ‘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, for water quality and effluent quality, 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.

In conclusion, overall, there is sufficient legislation and policy pronouncement already in place, however, the motivation, coordination, resources, participation of beneficiaries and institutional capacity to effectively implement them appear to be sorely missing. Additionally, there would appear to be overlaps and lack of clarity in responsibilities for interrelated agencies and a lot of the legislation is very prescriptive and 'over-specified' which enforces strict bureaucratic routines and stifles the development of new ways of working. Therefore, with the concept of making KW&SB more 'accountable', there is a need for new legislation (or Water Byelaws) that more clearly defines what KW&SB can and cannot do in relation to fulfilling their constituted responsibilities for the provision of water and sanitation services. This will include raising finances, cost recovery mechanisms (tariff setting), service standards, management of human resources, asset O&M, asset creation/disposal 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 (see **Appendix A34.1**), 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 (see **Appendix A34.2**) 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.

3.4.2 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. In 1992, Pakistan participated in the Earth Summit and thereafter became party to various international environmental conventions and protocols. Pakistan developed its National Conservation Strategy (NCS) that became effective from March 1, 1992 and presently acts as the environmental agenda for the country. 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. The broad framework provides a comprehensive point of reference for all agencies, departments, private sector companies, financial institutions and donor agencies for undertaking systematic efforts to bring about an effective change for sustainable development.

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.

Environmental Reporting

Environmental reporting required as per the provisions of the Pakistan Environmental Protection Act, 1997 is broadly categorized as follows:

i. Initial Environmental Examination (IEE)

The Pakistan Environmental Protection Act, 1997 defines an IEE as "a preliminary environmental review of the reasonably foreseeable qualitative and quantitative impacts on the environment of a proposed project to determine whether it is likely to cause an adverse environmental effect for requiring preparation of an environmental impact assessment".

A proponent of a project falling in any category listed in Schedule I shall file an IEE with the Federal Agency, and the provisions of **Section 12** shall apply to such project.

ii. Environmental Impact Assessment (EIA)

The Pakistan Environmental Protection Act, 1997 defines an EIA as " an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, mitigation and compensatory measures, formulation of environmental management and training plans and monitoring arrangements, and framing of recommendations and such other components as may be prescribed".

A proponent of a project falling in any category listed in Schedule II shall file an EIA with the Federal Agency, and the provisions of **Section 12** shall apply to such projects.

(3) Other Relevant Environmental Legislation

Some relevant environmental legislations not falling within the ambit of the Pakistan Environmental Protection Act, 1997 are listed as follows:

a) Environmental Laws related to Water Pollution (applicable to the Sindh Province)

- The Canal and Drainage Act 1873 (amended in 1952, 1965, 1968 and 1970)
- Sindh Fisheries Ordinance, 1980
- The Factories Act, 1934
- The West Pakistan Water and Power Development Act, 1958 (amended in 1958, 1964 and 1967)
- The West Pakistan Land and Water Development Board (Authority for Payment from Board Fund) Rules, 1966
- The Pakistan Penal Code, 1860 (Section 277)
- Pakistan Environmental Protection Council (Procedure) Rules, 1993

b) Environmental Laws related to Solid and Effluent Management

- The Factories Act, 1934 (See **Section 14**)
- Pakistan Environmental Protection Council (procedure) rules, 1993

3.5 KW&SB'S ORGANISATION AND FINANCIAL MANAGEMENT

3.5.1 Organisation

Considering the size of the city, population density and the complex nature of its mandated responsibilities KW&SB has made significant strides in the water and sanitation arena. However, much is still to be done and the role of KW&SB is changing. KW&SB's changing role has been brought about by new priorities set at National and Provincial level with the introduction of new Water, Sanitation and Environmental Policies, Development and Devolution Plans resulting in a major shift in thinking and policy towards a decentralised, people centric and demand responsive approach. This paradigm shift incorporates the principles of:

- Adoption of demand responsive approaches based on empowerment, full participation in decision making, control and management by communities
- Shifting the role of government from direct service delivery to that of planning, policy formulation, monitoring and evaluation and partial financial support
- Partial cost sharing and 100% O&M responsibility by users (beneficiary groups including local bodies, CCB's)

The reforms also call for substantial 'institutional development' with regard to services, enhancement of technical and managerial capacity, appropriate forms of public-private partnership, private sector participation, use of information systems etc. to achieve sustainability. Additionally, pricing mechanisms to discourage excessive water use, reduction of leakage and UFW, reuse and recycling of sewage, rainwater harvesting etc; are advocated. KW&SB is yet to seriously take up this challenge, however, systematic implementation of 'Improvement Programmes' resulting from this JICA study will go some way in helping KW&SB meet their future obligations.

A diagnostic of the key issues affecting KW&SB are presented in **Table 35.1.1**. These were considered during the 'organisation review' conducted during the first and second phases of the study and have therefore influenced the recommendations, models and strategies in the Master Plan.

Table 35.1.1 Key Issues Requiring Intervention

Business Activity	Key Issues
Institutional Arrangements	Insufficient sector agency coordination/cooperation Insufficient community coordination/involvement Lack of IWRM approach
Utility Management	Lack of adequate regulation (Water Bye Laws) Lack of monitoring/enforcement of existing regulation Insufficient capacity (HR/management expertise) Lack of capacity (IS/IT/workflow systems) Lack of strategy, policy, process development Lack of Process and Performance Management (example UFW reduction, energy and process chemicals efficiency, plant utilisation, labour efficiency, billing/revenue efficiency etc.) Insufficient project management skills and tools for control
Community Participation/Management	Community participation not an accepted approach No formal structural arrangements for dealing with user/beneficiary groups such as NGO's, CCB's
Spatial Planning and Demographic	Fast growth of population – demand outstrips supply Poor compliance with mandated supply coverage
Resources	Insufficient funds/financing to meet current/future demands for services Lack of project and financial control measures Tariffs not based on full cost recovery Poor billing/revenue practices and performance Insufficient pricing mechanisms to regulate/conserve water Lack of sustainable practices/care for the environment/regulatory enforcement
Political Interference	Lack of financial and management autonomy Political influence on infrastructure projects and priorities and day-to-day management activities
Socio-Economics	Low and irregular incomes of a large part of the customer base, resulting in low capacity to pay for services Debt/disconnection policy not addressing underlying problems
Communication, Information and Education	Limited communications, consultation, involvement and public relations activities Lack of awareness campaigns/outreach programmes Low public enlightenment to report problems, water use efficiency and bill settlement (especially Local Bodies)
Operation & Maintenance and Service Provision	Contaminated/depleting (usable/accessible) water sources Low service levels/insufficient water supply and lack of sanitation services, insufficient infrastructure to meet demand Poor quality of water delivered High levels of leakage and NRW Lack of O&M strategy and planning Lack of planned preventative maintenance and supply chain management

Based on the above, it will be necessary for KW&SB to take a more holistic view of the 'water business' in Karachi and to consider the interactions and influences of the various stakeholders that impact KW&SB's operation. These will determine the key 'business drivers' that will need to be developed to ensure that KW&SB meet their business and service objectives now and in future.

(1) Responsibility for Provision of Water and Sewerage Services

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 35.1.1**.

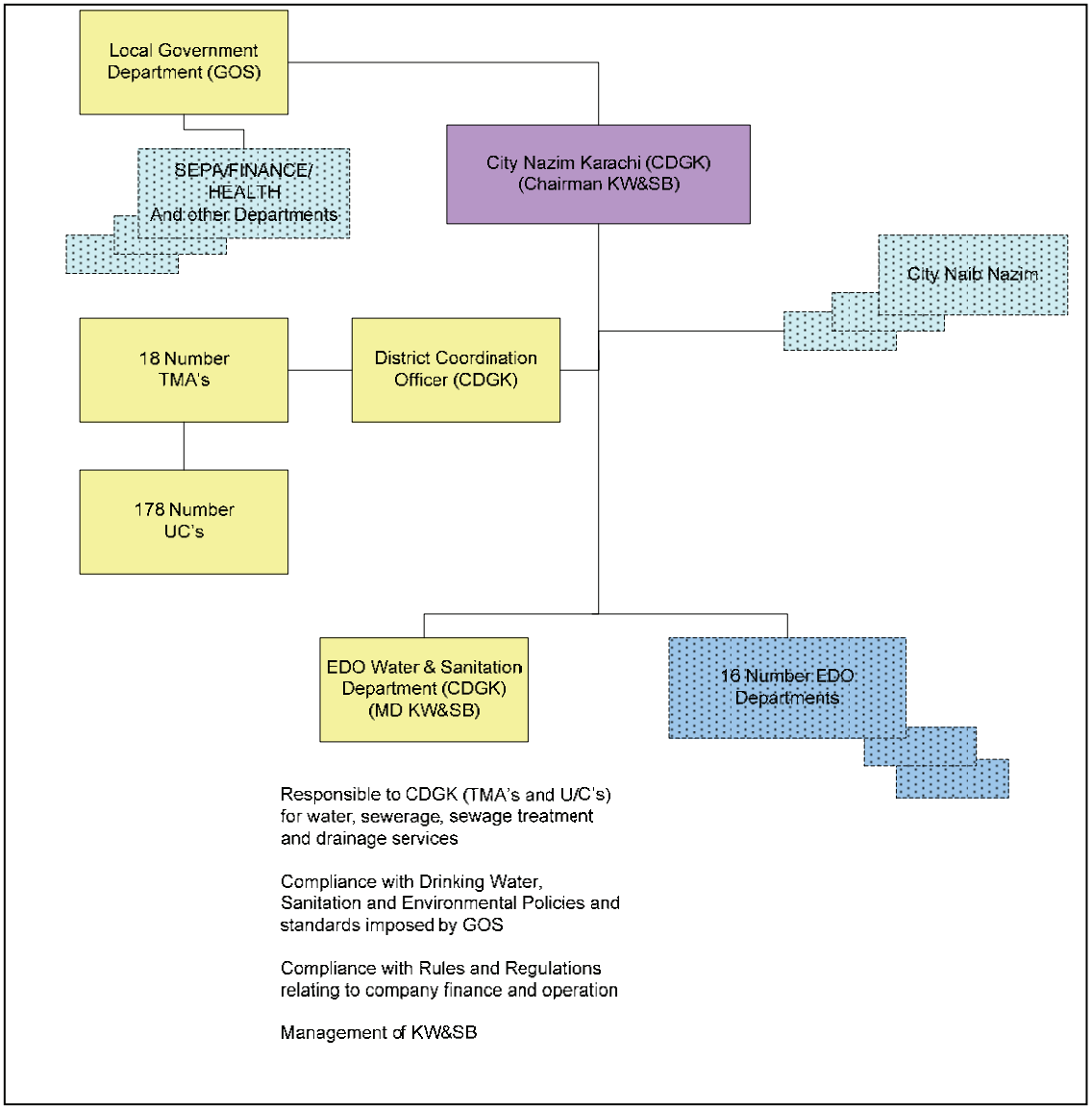


Figure 35.1.1 High Level Organisation Structure (As of February 2008)

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

KW&SB's stated commitments (according to published statement "KW&SB dedicated to serve") are to provide essential water and sewerage services to meet the basic needs of the ever increasing population of Karachi. In spite of all its limitations, KW&SB takes a number of measures to address the issues through efficient means and effective tools.

- Distribution of water in an equitable manner
- Facilitate better environmental conditions
- Water conservation
- Supply of good quality water to citizens
- Complaints management for redressal of complaints
- Fast-track implementation of K-III project
- Additional water from Indus source to meet long term water demand up to 2025
- Supplement existing sources of water by installation of sea-water desalination plant, groundwater recharging and recycling of
- Implementation of Tameer-e-Karachi program (TKP)
- Gradual transformation of KW&SB into a self-sustaining organisation through improved collection of water and sewerage charges
- Progressing towards self-sufficiency

(2) Provision of Services – Current Status

According to the 1998 census, the population of Karachi was 9.89 million at that time and is currently estimated at around 16.0 million. This is expected to double by 2025. It is also estimated that 40-50% of people in Karachi live in informal settlements (Katchi Abadis).

The main sources of water to Karachi are from the Hub and Indus surface water sources. KW&SB currently 'supply' an estimated 595 MGD being a mixture of raw and treated water. The extent of water supply coverage in Karachi is presently estimated at 80% however, supplies are intermittent and average approximately 4 hours/day or every few days. This is less than the national average. The remaining population depend on tankered supplies, open wells, ponds, natural streams, etc. The extent of sewerage coverage in Karachi is presently estimated at 60-65%, however, due to inadequate treatment capacity, only 40% is treated. Coupled with weak enforcement of environmental laws, KW&SB's ability to fulfil its effluent standards are further exasperated by largely 'unregulated' discharge of industrial waste.

Water is supplied via 6 supply schemes (10 plants) and there are currently 3 sewage treatment facilities.

The draft Sindh Water Supply Policy, 2006 states that for urban areas a minimum of 50 lpcd will be provided inside the home through a piped system. According to this it would appear that sufficient water is currently available in Karachi, however, the issue of water losses currently estimated at 30-35% of water into supply requires to be tackled urgently as is NRW currently estimated at 45% of sales. Due to the lack of ability to accurately measure actual production, distribution and consumptions volumes, it is impossible to accurately assess the level of commercial and physical losses. There is anecdotal evidence to suggest that losses due to 'water theft' is high, however, in the absence of systematic and regular auditing and control measures, the extent of this is impossible to ascertain.

As of June 2006 KW&SB's infrastructure included almost 1.5 million piped water supply "units" (connections or accounts) of which "bulk" (metered) supplies amount to just over 5,000 units. Domestic supplies (Retail) are not metered and due to the intermittent nature of supplies the general custom and practice is for properties to have ground level and roof level storage tanks. As these are generally not equipped with level controls and due to poor quality water, wastage due to overflows and flushing is high. It would also appear that a large number of suction pumps have been installed by customers to draw water from KW&SB mains at times when flows are 'rationed'. This exacerbates the contamination problems that already exist as a result of negative pressures and ingress of contaminated water resulting from intermittent supplies and deteriorating supply networks.

A certain amount of ambiguity is evident in a number of activities associated with the management and development of water resources and the provision of water and sanitation services. Where clear lines of responsibility are not assigned, close liaison and 'cross-process' understanding is crucial to ensure focus in a number of key areas including the following:

- Identification and development of conventional water sources
- Identification and development of non conventional water sources
- Conservation of the environment with respect to sustainable development
- Pollution control legislation and monitoring
- Provision of accurate information with regard to water resources to ensure that a balanced view is taken by all stakeholders with respect to integrated water resource management
- Public education and community relations with regard to water use and conservation
- Monitoring and maintenance of water quality standards
- Equitable pricing of water/ services

(3) Organisation Arrangements and Management Set-up

KW&SB faces a number of significant challenges in the delivery of its functions. These include funding problems, organisational issues and administrative/management constraints placed on them from the Government of Sindh and CDGK. We believe that KW&SB on the whole have shown considerable dedication and resourcefulness in working within this underlying framework of constraints, however, much could still be achieved to improve operational and commercial performance through increased focus on institutional strengthening and capacity building elements. This will require a focus away from 'supply responsive solutions' (the proposed K-IV project being a case in point) to 'demand responsive solutions', i.e. 'fixing' the existing underlying problems of the existing asset base (namely the poor state of the distribution and sewerage networks and treatment facilities). This requires systematic building of staff and organisation capacity.

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).

Based on the number of connections, the ratio of employees per 1,000 connections is approximately 6 which compares favourably with other major Pakistan cities as well as other major Asian cities where the number of employees per 1,000 connections ranges from 2 to 35. However, it should be noted that whilst the number of staff per 1000 connections is a measure of efficiency, it does not give an indication of the level or quality of service. For example, KW&SB's poor level of performance with regard to supply hours, water quality, revenue collection rate, etc., may compare less favourably with cities with a lower or higher staff ratio.

The latest (November 2007) high-level organisation structure with an indication of the main functional responsibilities is shown in **Figure 35.1.2**.

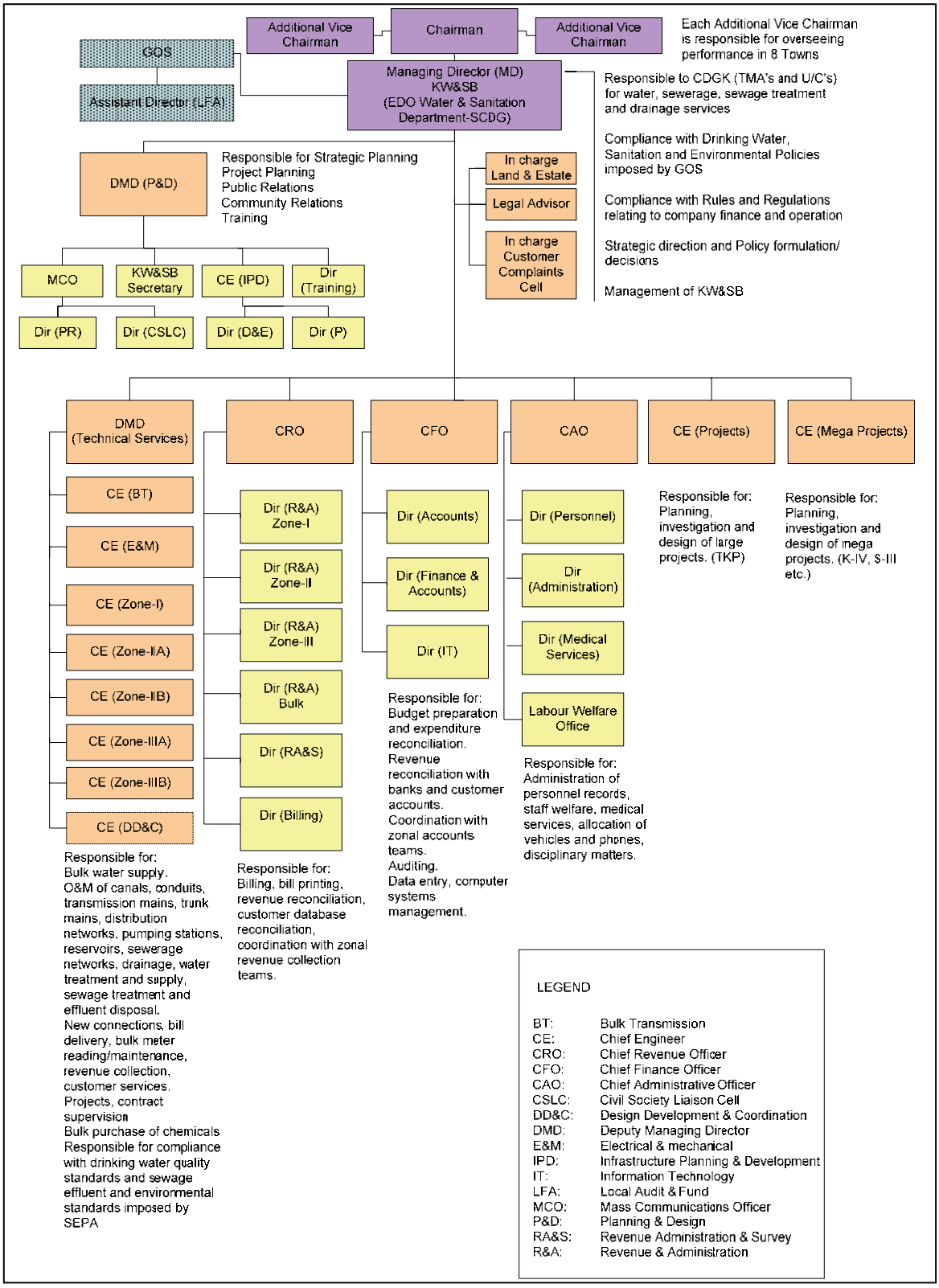


Figure 35.1.2 KW&SB High Level Organisation Structure with Key Responsibilities

Based on the current organisation chart, there appears to be a lack of 'focus' or 'ownership' at policy level for business critical activities such as Customer Services, Systems Development, Corporate Management (strategic planning, business planning, master planning), and HRD amongst other areas. These are discussed in more detail below.

a) Corporate Management

The Deputy Managing Director (Planning & Design) is currently tasked with providing support and strategic direction for the organisation. This department is currently being strengthened for this purpose; recent additions include responsibility for training, public relations and civil society liaison. Most recently, however, the Managing Director has initiated and implemented a number of initiatives, including reorganisations, contracting out of bill printing and customer accounts management and other projects to 'transform' KW&SB into a more 'demand responsive water & sanitation service provider'.

However, critical business activities at policy level such as Master Planning (strategic planning, source development, asset acquisition), Customer Services, Systems Development, Supply Chain Management, Operations & Maintenance Management, Business Development and Community Relations are not centrally 'managed' by 'process owners' or 'process champions' and as a result remain underdeveloped due to lack of focus. This has led to the absence of policy development in these areas as well as other areas such as HRD, Health and Safety, Security, Contingency planning etc. Having said that, the most recent organisation changes have sought to address some of these shortfalls

KW&SB is not 'driven' by a well developed 'Vision' or 'Mission' for the organisation. Whilst KW&SB have stated their intent in terms of their aims, objectives and responsibilities to transform into a more 'customer responsive service provider', this is not widely shared with customers or employees and is not linked to individual, team or departmental targets. With this regard, it is recommended that KW&SB review their strategic intent and modify their vision and mission statements accordingly. This should be done in consultation with as many 'key players' as possible throughout the organisation as well as other 'stakeholders' to ensure 'buy-in'.

There appears to be little coordination between agencies and as such ambiguity in responsibilities between KW&SB and other agencies is evident for pollution control, environmental control, sustainable development of water resources etc. Mechanisms for developing regulatory responsibilities as well as for reporting and coordination with other regulatory bodies do not appear to be a key focus for KW&SB. The current management set-up does not appear to assign specific responsibility or 'ownership' for this function. It is recommended that KW&SB review their focus in this area of activity. For example, working alongside KW&SB is the 'Sindh Katchi Abadis Authority' (SKAA), various Non-Governmental Organisations (NGO's) and 'City Community Boards' (CCB's) with the aim of improving W&SS and ensuring that all areas and communities throughout Karachi are represented. However, this currently appears to be a missed opportunity.

KW&SB's business and operational practices espouse an organisation that provides essential services for the enhancement of public health rather than a commercial entity seeking to make a return on investment. As such, the use of tariff or pricing mechanisms to regulate water usage is not actively or readily applied (KW&SB need to get GOS approval for price adjustments in any case) as the cost of services is highly politicised. KW&SB need to review their efforts and focus in this area and lobby the GOS to ensure a more appropriate cost recovery mechanism is put in place as current tariffs do not provide sufficient revenue for effective O&M, let alone infrastructure renewals.

The main objective of the KW&SB Act, 1996 was to establish an autonomous body, however, the amount of freedom extended to KW&SB in pursuing its mission without undue regulatory or political constraints, in practice, appears to be minimal. Autonomy is primarily constrained by KW&SB's reliance on the GOS and the CDGK for funding its operational deficit. Government approval is also required for large capital intensive schemes, recruitment/promotions for key

positions, service rules, pay and conditions etc. Whilst depreciation is currently applied in the accounts, there is no provision for asset renewals and therefore the current strategy will continue to require funding support from both the CDGK and GOS. This will do little to reduce political 'interference' in future.

b) Financial Management

As the KW&SB Act, 1996 is still followed, KW&SB are not required to seek approval of budgets from the CDGK, however, as the City Nazim is Chairman of the Board, he effectively 'approves' KW&SB's finances on behalf of the Board which we understand no longer operates. The rules and regulations relevant to financial management of KW&SB include the following amongst others:

- The Sindh Government and Taluka/Town Municipal Administration (Budget) Rules, 2002
- The West Pakistan Municipal Committees (Works) Rules, 1969,
- The Sindh Local Government (Contract) Rules, 2001
- The Sindh Financial Rules Volume I & II
- The Sindh Local Government (Accounts) Rules, 1983
- KDA Purchase of Store Regulations, 1978

The Finance Department is headed by the Chief Accounts Officer (CAO), supported by directors of 'IT', 'Accounts' and 'Finance & Accounts'. As the CE's and CO's and their DDO's have delegated authority for budgeted expenditure, the Finance Department are essentially responsible for budget preparation and expenditure reconciliation. Transactions, concerning budget expenditure, customer billing, payroll, provident fund/pensions, medical expenses etc. are 'processed' by the IT section. Whilst the Finance Department operate the computer systems associated with these transactions, the systems are decentralised (distributed databases) and therefore the Finance Department essentially perform data entry (batch update) tasks. Although, auditing is conducted, the current system is not robust and data is extremely difficult to reconcile due to the fact that KW&SB do not operate a central database (master data) system. Current systems have been progressively developed in-house and as part of a wider systems development plan it is recommended that these be updated/replaced with tried and tested 'proprietary' application software readily available.

Along with labour costs, the biggest budgeted expenditures are procurement of electricity and chemicals. There is a clear need, therefore, to conduct energy and process optimisation audits to ensure efficient procurement and use of electricity and chemicals. Furthermore, KW&SB may wish to consider introducing a 'central procurement department' for this purpose.

Due to poor revenue recovery, KW&SB do not collect sufficient income to manage their operation without support from the government. Customer arrears are currently approximately 23 billion Rupees.

c) Asset Management

With KW&SB's drive to meet it's obligations to supply an ever increasing demand for water, the prime focus and organisation arrangements (structure, skills, competencies) have been heavily geared towards implementation of new supply schemes. This 'supply driven approach' has led to the relative neglect of effective O&M of existing assets resulting in deteriorating asset condition, poor operational performance and underdevelopment of critical business, commercial and operational activities. The current tariff and revenue collection rate does not provide sufficient funds for effective O&M, let alone infrastructure renewals.

Provision of sanitation infrastructure and services does not appear to be high on KW&SB's agenda. At present there are three treatment facilities, however, it is understood that these are

not functioning sufficiently well to meet current effluent standards. The lack of focus on may stem from the fact that KW&SB do not appear to have a responsibility for legislation, management or monitoring of from domestic, non-domestic, industrial or local bodies. This is entrusted to SEPA. Additionally, the current charging mechanism does not provide sufficient revenue for effective O&M, let alone infrastructure renewals.

There is a general tendency for 'senior managers' to keep personal records with regard to recording of assets within their own areas of responsibility. This could lead to the loss of knowledge when staff are transferred or retire. There is a need for a computerised asset register of above and below ground assets. The current distribution network is undergoing digitised mapping as part of the JICA study. The asset register should be populated with asset information including a regular assessment of asset condition, asset valuation and plant criticality in order that asset maintenance, refurbishment and renewals are 'provided for' in a planned and strategic fashion in line with KW&SB's future strategic intent. In this way, an 'Asset Management System' can be developed and integrated with KW&SB's business development plans to ensure that assets are developed based on sound business principles, including the need to meet customer demands for new and improved services.

d) O&M Management

There is no central coordinating role or 'process owner' for O&M activities including the reduction and management of UFW. Currently the CE's report direct to the MD.

Responsibility for operations and maintenance rests primarily with the 3 zonal CE's, the CE (BT), CE (E&M) and the CE (DD&C). Between them, 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.

Policy formulation, setting of departmental targets and objectives is not in evidence at CE level or below.

Based on initial visits it would appear that the asset base is deteriorating, especially the distribution network. Safety standards in relation to the use of Chlorine gas is extremely haphazard in the major water treatment plant visited (COD) and presents a serious hazard to the safety of staff. This facility should be refurbished immediately.

Asset management plans are not in existence and asset information is generally not recorded.

Apart from 'running maintenance', major breakdown, including repairs to mains are contracted out. A system of 'reactive' or breakdown maintenance is practiced. Planned preventative maintenance' is not practiced or planned.

The distribution networks design and set-up as well as management practices have not been geared to reducing or managing leakage or UFW. For example, the various networks are not adequately modelled or set-up by discrete supply zones with adequate ability to measure network performance. The networks are lacking equipment such as flow and pressure measuring devices as well as basic equipment such as 'zonal' meters, isolation or pressure control valves to aid leakage detection, measurement and control. Further, leakage detection equipment and active leakage detection techniques are not practiced centrally or regionally. For best results, this would require the setting up of active leakage teams'. It is recommended

that responsibility for reduction of UFW be assigned to the 'asset owners', i.e., the managers and operators of the network, with overall responsibility for the 'process' assigned to a 'NRW process owner' who takes responsibility for reduction of both 'real'(physical) and 'apparent' (commercial) losses.

H&S policy/manuals and contingency/emergency plans are not in existence and H&S practices appear to be ad hoc and at the 'discretion' of individual managers within regions. H&S appears to be of low priority at all levels of operation of plants, street works activities etc.

Tankered water deliveries for emergency or other purposes are provided by the 'Rangers' who obtain supplies free from KW&SB. This practice should be reviewed as this presents a lost opportunity in terms of revenue and customer service provision.

Statistical process control techniques are not practiced at plants; however various logs are kept at each plant showing power use, run hours, chemical parameters, chemical use, breakdowns etc. There is little formal (written) reporting upwards of plant performance such as treatment volumes/costs/labour/plant breakdowns/power failures/treatment bypassing/quality parameters etc unless instigated by individual managers. Performance is not reported against targets and on the whole process and business reviews do not take place.

KW&SB are responsible for complying with water quality standards and currently uses the 'Pakistan Drinking Water Standards, (revised), 2002' and the WHO Standards, 1971 as a guide. However, due to the lack of computerised management and laboratory information systems it is difficult to determine the extent to which KW&SB comply with the relevant standards in force throughout the various stages of the water production/supply/customer process. Whilst water leaving the treatment facilities may comply with the relevant drinking water quality standards, due to the deterioration of the distribution networks coupled with intermittent supplies, the water reaching customer taps will not meet the standards.

The practice of 'over-chlorinating' at the treatment facilitates in the hope that residual chlorine will still be present at 'point of use' is widely practiced. It is recommended that KW&SB computerise and act on water quality data to verify compliance with and improve on current water quality standards.

Currently KW&SB is effectively 'self-regulating' for the purposes of meeting water quality standards, as there is little independent control from the Sindh Environment Protection Agency (SEPA) who are tasked with this responsibility. The same goes for compliance of effluent quality standards.

KW&SB places overall responsibility for various functional activities such as water distribution, sewerage networks, projects, O&M, HRD, customer, commercial, financial and administration under a single 'geographical head' (Regional CE and associated Divisional offices). This can lead to dilution of effort or lack of focus in key areas associated within each functional activity.

e) Customer Services Management

As a result or recent organisational changes, responsibility for billing and revenue collection has been contracted out as well as the establishment of complaints handling centres. However, KW&SB do not have a clear customer mandate or 'charter' describing the levels of services to be provided and the responsibilities of customers to pay bills, settle arrears and to comply with regulations with respect to illegal connections, tampering with supplies (use of suction pumps) etc. It is recommended that KW&SB review its policy on community relations and customer services in this respect.

Key responsibilities for various aspects of customer services, for example, strategic direction,

service aspirations, service initiatives, service ethos/culture etc., are not 'owned' at the 'Centre' or within the Regions. Currently the MD initiates and leads customer service improvement initiatives

KW&SB does not conduct regular customer surveys to ensure that all customers who receive a supply are registered on the billing database. Whilst there is evidence of illegal connections and 'stealing' of water on a large scale, audits are not systematically conducted. Opinion surveys are not used to improve service shortfalls.

Currently monthly billing is practiced (previously annually). In an attempt to increase revenues, current bills include a portion of outstanding arrears and an interest charge for outstanding debt. This is a good approach to revenue management as monthly billing makes the charges more affordable and allows customers to budget their outgoings; however, it remains to be seen to what extent this approach has on reducing receivables and improving collection rates.

Current legislation allows KW&SB to set tariffs and charges with approval from Government, however, it would appear that the current tariff has remained largely unchanged since 1998. Based on initial analysis it is evident that this is not based on a 'full cost recovery' basis and therefore coupled with the current poor billing and revenue recovery performance, revenues are not sufficient to fund KW&SB's operation.

Apart from 'bulk' (metered) customers, there is no metering of consumption and therefore the opportunity to base charges on actual consumption is being missed. Metering is accepted as the most appropriate method of charging and allows charging mechanisms to limit water wastage through applying block tariff pricing, with increased charges for consumption beyond essential use. This would also allow a fair system of subsidy/cross subsidy for those less able to pay.

Whilst KW&SB does have a 'bulk meter unit' (reporting to CE (BT)), responsible for meter reading and meter maintenance, they do not have a 'key accounts' team looking after large customers such as commercial, Industrial or Local Bodies to ensure regular and prompt payment. This warrants future consideration in order to improve collection rates.

The practice of billing or 'taxing' customers who do not have a water supply or sewerage connection does little to encourage payment or enhance revenues. This practice should be reviewed. It is estimated that 70-80% of customers either do not pay or have large arrears, not least the bulk customers, a number of which are government organisations. This is currently being tackled by KW&SB.

Due to lack of training in the customer services arena staff are not well placed to provide improved services, as the required 'skill sets' are not well developed.

KW&SB does not have a 'Customer Service Strategy' or service policy in place. Consequently, customer service practices and standards vary within and across Regions and are highly dependent on local management attitudes towards customer service provision. We therefore recommend that KW&SB considers a strategy that clearly details the organisation's strategic intent with regard to customer services. This should state short and long term service aspirations and service standards to be applied across the State.

Responsibility for key customer activities is fragmented, for example, contact management; head of the complaints cell at the 9th Mile complex reports to the MD, whilst it is understood the new contact centre to be operated by 'Millennium Consultants' will report to the CRO via

Director (Billing). The current set-up does not allow for clear ownership of the whole process from initial contact through to satisfactory resolution. There are no documented procedures relating to contact management and complaints statistics or analysis is not used as a means of eliminating route causes of problems.

f) Information Systems Management

A number of software applications are used and have been developed in-house over the years. These are used to monitor and control payroll, budgets, income, medical expenses, pensions etc. However, whilst KW&SB understand that information systems can be a key 'enabler' to ensuring sustained business improvements, it is not surprising, that office automation and systems in general remain underdeveloped due to the lack of 'ownership', strategic direction, funding and resource (sufficient numbers of qualified and technically competent staff).

Consequently, KW&SB do not have a 'Systems Strategy' in place that clearly details the organisation's strategic intent with regard to IS development and implementation. It is recommended that responsibility is assigned to a central 'process owner' to produce the strategy and for ensuring that systems are developed in accordance with business needs.

g) Human Resource Management (HRM)

The organisation does not have well defined policies or procedures in place for manpower planning, recruitment, performance management/improvement, motivation, succession planning, human resource development or training amongst other key activities. Human Resource Development (HRD) aspects are discussed in more detail in **Section 3.5.3**.

Like other government establishments, KW&SB are bound by various rules and regulation 'imposed' from time to time. Due to the fact that the KW&SB Act, 1996 was not repealed on introduction of the SLGO, 2001, it would appear that KW&SB have adopted both 'legislative paths'.

In relation to Human Resources Management (HRM), the prevalent rules followed include the following:

- KW&SB Employees Appointment, Promotion and Transfer (APT) Rules, 1987
- KW&SB Efficiency and Discipline (E&D) Rules, 1987
- KW&SB Promotion, Confirmation and Seniority Rules, 1987
- KW&SB General Condition of Service Rules, 1987
- The West Pakistan Municipal Committees (Works) Rules, 1969
- The Sindh Local Councils (Leave) Rules, 1961
- The West Pakistan Travelling Allowance Rules, 1961
- The Sindh Civil Servant (Pensions) Rules, 1963
- Pay Structure of Sindh Government (plus local allowances sanctioned under CBA agreement)

The more recent rules pertaining to HRM are shown below, however, at this stage it is not clear to what extent KW&SB are bound by or follow these:

- Sindh Local Government (TMA/UA, APT) Rules, 2001
- Sindh Local Government TMA/UA Servants (Efficiency & Discipline) Rules, 2001

Responsibility for HRM and HRD

Based on the most recent changes to the KW&SB organisation structure (June 2006), the Chief Administrative Officer (CAO) does not hold functional responsibility for HRD or Training activities. The CAO primarily holds administrative responsibility with regard to HRD and Training, along with the main functional responsibilities for his department as follows:

- Administrative processing of appointments, promotion, retirement, transfers, posting, leave etc.
- Conducting investigations and action in line with the relevant E&D Rules in force
- Administering employees welfare activities such as medical arrangement (this is delivered through appointed hospitals, doctors and pharmacies on contract to KW&SB)
- Liaison with the 10 registered unions on staff welfare matters such as grievances and for disbursement of monies for funerals, weddings, religious matters etc.
- Allocation of company vehicles (currently 297)
- Allocation of accommodation to staff (currently 1300 units)
- Allocation of phones at accommodation units and offices

Responsibility for the Training function rests with the DMD (Planning & Design).

Responsibility for HRD ("capacity building and enhancement of human resources") rests with the respective departments; i.e. the Chief Officers and Chief Engineers.

Current HR Practices

Many employees have long service with KW&SB, turnover of staff has been negligible (apart from retirement) and recruitment has effectively been put on hold for the past few years. The practice of promoting staff based almost entirely on seniority rather than on 'ability to do the job' does little to encourage the development of sustainable policies and processes for improved performance. At the same time valuable experience and knowledge is being lost as routines are not in place to capture and transfer knowledge. Unfortunately due to the lack of computerised employee information it is not possible to evaluate performance in the area of HR management generally due to the lack of availability of statistics.

The current policy of internal transfers and promotions from within the organisation and no external recruitment (until most recently, whereby graduate engineers are currently being recruited) despite some obvious skill gaps is becoming more and more evident, not least due to the need to introduce new systems and technologies etc. to improve business, commercial and operational performance.

The current organisational structure is a traditional functional hierarchy. It does not provide the most efficient or effective way of organising the business. The present arrangement reinforces functional 'silo' mentality where each department or function invariably operates in isolation to other departments with little coordination or teamwork across processes or lines of responsibility. This type of set-up potentially exacerbates bureaucracy, inhibits information flow and communications, prevents the sharing of best practice and stifles teamwork, creativity and initiative.

Due to the need for Systems and Process improvements, most of the functional departments within KW&SB are 'reactive' in nature with little time to assume a more 'pro-active' approach.

The current set-up does not encourage communication and as a result the sharing of ideas and learning is limited. When operating through functional lines of control, it is difficult to prevent inefficient practices developing as each department tends to be 'inward looking'. This type of functional arrangement can often result in employees not being aware of 'wider' corporate issues thus preventing the easy movement of employees between functions – based on performance or merit and the greater needs of the 'business'.

The above constraints result from KW&SB's constitution in as much that they are bound by rules and regulations as determined by the GOS from time to time. Like other government

establishments KW&SB are bound by standard rules and procedures that are designed as 'blanket' procedures and do little to allow KW&SB the autonomous freedom required.

KW&SB's low level of automation, particularly in the administrative field has led to labour intensive manual practices involving a large number of employees performing clerical, administrative or menial tasks compared to those performing skilled or technical/managerial tasks.

The industrial relations climate is poor which means that change initiatives are often stifled due to union opposition or intransigence. As water is highly politicised, local councillors and political parties are reluctant to 'rock the boat' or upset the 'steady state' by introducing or forcing through radical changes or reforms. This limits KW&SB's ability to initiate change within their own organisation, which in turn stifles initiative and enthusiasm for change.

h) H&S Management

It would appear that the general regard for and awareness of health and safety matters, particularly in relation to the handling of chemicals (chlorine gas especially) is low. There is also a lack of clarity concerning the coordination and 'ownership' for H&S, specifically with regard to ensuring adequate 'organisation arrangements' for H&S management.

There is a lack of formal H&S documentation; namely, 'H&S Policy', 'Local Organisation and Arrangements' document (which should stipulate specific responsibilities by job type for example, electrical testing, testing of lifting tackle, etc.), 'Safe Systems of Work' (for plant isolation, entry into 'confined' spaces, lone working, chlorine use etc.

There does not appear to be a 'process owner' assigned to take overall responsibility for H&S 'direction' and management across the organisation. This is compounded by a lack of formal training in all aspects of managing safety.

The failure to co-ordinate and apply appropriate levels of safety standards and practices and to meet statutory requirements, places KW&SB, its staff, contractors and the general public at risk. KW&SB will need to consider a number of changes to the current H&S set-up and adoption of documented best practice standards as well as ensure trained and qualified staff to co-ordinate and audit H&S practices, to reduce these risks.

i) Project Management

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.
It appears that project management is 'paper based' and therefore the extent to which project management tools (software applications) can be used in future to more effectively manage and control project implementation and expenditure is worthy of investigation. There are a number of proprietary software packages available for this purpose.

j) Public/Community Relations management

As a result of recent organisational changes a 'Mass Communications Officer' and a Civil Society 'Liaison Cell' have been established, however, it is not clear who has been assigned responsibility for the formulation of policies or plans for community or public relations or for the interaction of KW&SB with these groups. School liaison and public education in terms of water conservation, health and sanitation also falls into this category.

Responsibility for Public/Community relations has recently been assigned to the DMD (Planning & Design).

- KW&SB does not have a 'public/community relations communications strategy' in place or a Public Relations programme (campaign or schedule of planned events), although PR campaigns are organised when necessary such as the recent K-III publicity campaign.

- There does not appear to be a strategy in place for sharing information with the customer base such as information leaflets, annual performance reviews, revenue campaigns, hygiene campaigns etc. KW&SB do not have a programme of 'road shows', open days, school talks etc. to keep the general public informed of latest schemes or for raising KW&SB's profile in the community.

- There does not appear to be any formal arrangements in place for regular communications or liaison with other government departments, community groups, businesses, schools, local bodies etc.

k) Performance Management

Whilst some information is collated within regions and other information is collated centrally, this is not used for purposes of 'performance managing' the business, decision making, or for comparing inter-departmental performance. KW&SB does not have a system in place for performance management that establishes goals and measures for individuals, teams, departments or the board as a whole.

KW&SB does not have an established set of Key Performance Indicators (KPI's) that are agreed, understood, 'owned' or shared throughout the organisation. These would be used to improve processes, service provision etc. through the collection, sharing and acting on relevant management information.

- KW&SB does not have a system in place for performance management that uses internal or external benchmarking activities in order to compare/improve inter-departmental performance as well as overall KW&SB performance with industry best standards.

- KW&SB generates 'annual accounts', annual administrative reports' and 'annual budget estimates' but these are not widely distributed or shared amongst the staff. These appear to be the main reports or source of information that could be used by the CDGK to 'regulate' KW&SB's activities. However, there appears to be little regulation or sanction placed on KW&SB regarding compliance with water quality standards, standards, abstraction, or the level of business performance generally.

(4) Strengths and Weaknesses of Current Organisation Arrangements

Based on the foregoing and on discussions with senior KW&SB staff as well as a review of documentation provided regarding current organisation arrangements, practices and procedures, the following organisation strengths and weaknesses have been identified.

<u>Strengths</u>

KW&SB's workforce and management are technically competent and capable of delivering operational and service improvements. Staff are generally well experienced and exhibit a high degree of personal motivation despite obvious constraints brought about by limitations in organisational development, customer and operational systems and budgets. Managers are generally enthusiastic about the organisation and many have significant experience within the

sector. Staff members are loyal to the organisation and many are knowledgeable about the processes in which they are involved. Financial support continues to be provided to KW&SB from the GOS despite disappointing operational and commercial performance.

Weaknesses

Potential weaknesses with recommendations for mitigation are detailed in **Table 35.1.2**.

Table 35.1.2 Organisational Weaknesses Mitigation

Symptom	Recommendations for Mitigation
Lack of clearly defined strategic intent and how this links into individual, team and departmental performance.	Review the strategic intent, vision and mission statement and share these with the entire workforce. This includes the need to prepare and share a KW&SB-wide Corporate Business Plan. Performance targets should be set and measures put in place so that individual and departmental performance supports corporate objectives.
Lack of clearly defined Corporate Strategies.	Define corporate needs and prepare/share strategies with entire workforce. This includes the need for a strategy for asset planning/asset management and development/ asset acquisition; HRD, Customer Services development, etc.
Lack of clearly defined corporate policies and departmental business plans.	Define and share company wide and departmental policies and business plans with appropriate strategies and objectives to enable future improvements.
Lack of clearly defined Business Strategies (operations, customer, commercial, systems, people etc.)	Define departmental strategies, set and agree goals, key performance indicators, measures and action plans for continuous improvement.
There are no clearly defined mechanisms for 'performance managing' the business	Set up a system of performance management that establishes goals and measures for individuals, teams, departments and KW&SB as a whole. This should be a dynamic system that should change as the organisation develops over time.
The use of technology for future development of the business is not well understood or defined.	Prepare IT/Systems strategies that will meet the future corporate business and operational needs.
There are skill gaps in the organisation – human resource development, performance management, regulatory compliance, customer services, communications, corporate and strategic planning, risk management, contingency planning, systems development, community relations and health and safety.	Identify the gaps, train and/or recruit skilled personnel to fill them.
There is no effective job management or work planning system.	Introduce a Job Management System to give better control and information.
Systems for asset management/maintenance are not standardised across functions or departments and the use of computer software or systems to aid asset management/maintenance are not established.	Introduce appropriate technology for the effective management and maintenance of company assets.
Business critical processes are not well defined or 'owned'. For example, Agency Coordination/Government Liaison, Regulatory Compliance, Customer Services, Commercial management, Systems Development, HRD, H&S, Water Quality Management, Supply Chain Management, Operations & Maintenance Management etc.	Define, map and disseminate process routines. Assign key processes to owners or champions. Define and share key policies, strategies and procedures within each process area.
Work routines are generally not recorded to agreed quality standards and a process for sharing best practice is not established.	Codify work practices capturing best practice. Set up training and procedures to ensure the routines are adhered to. Encourage sharing of best practice on a formal basis by service level agreements across process boundaries.
Management information is inadequate and KW&SB	Establish the needs, design and introduce a meaningful

Symptom	Recommendations for Mitigation
struggles to provide any meaningful data to assist with the management of the organisation.	MIS. Train staff in the use of the system.
KW&SB have aspirations to improve customer services, however, does not demonstrate a commitment to being a customer service driven organisation.	All employees should be encouraged to 'think customer', internal and external. Structures need to be geared towards providing customer focus. Recording rather than solving complaints is not enough. Training on customer awareness and customer care should be provided to all existing and new employees.
Customer communication routes require development, including customer feedback.	Develop and agree a customer communications strategy to ensure customers are aware of services, performance against standards and opportunities for feedback. This will enable KW&SB to tailor services to meet changing customer perceptions.
Indications are that KW&SB are not fully utilising Human Resources in terms of efficiency levels as well as numbers of staff employed.	Implement new policies and procedures for staff appraisals, training, development and transfers. Introduce a system of 'succession planning' to ensure the organisation is 'equipped' with competent future leaders.
KW&SB has an aging workforce many of whom have worked for the organisation for many years. Ability to transfer knowledge is being lost.	The age profile will adjust if older employees are released and a programme of recruiting graduates and technicians is introduced. Ensure routines are in place for capture and transfer of knowledge. Ensure a system of equitable career progression based on ability to do the job as well as seniority.
Communications within KW&SB could be improved. There appears to be no mechanism for corporate messages to be cascaded throughout the organisation or for employees to give feedback.	Introduce a fully integrated communication strategy, including written communications, management and team meetings, toolbox talks etc. Feed back loops must be introduced to ensure the views of the workforce are known.
The culture within KW&SB is reactive rather than proactive.	Improve the planning processes and encourage managers and employees to consider the longer term and encourage initiatives for change.
H&S is not well understood or managed.	Assign responsibility for and set up a central H&S support function to ensure compliance with legislation and best practice. Ensure safe systems of work are introduced and that staff are well trained.

Whilst there appears to be a significant number of issues requiring consideration, with the right support from KW&SB's senior management team, each issue creates an opportunity for improvement.

3.5.2 Financial Management

KW&SB was reformed in accordance with the administration reform of Karachi Municipal Corporation (KMC) into City District Government of Karachi (CDGK) in 2001. At present, KW&SB is independently managed under the CDGK. The financial system was also reformed from the system under the former organization. Thus, the financial statements reviewed in this study are limited to those prepared after 2001.

In this study, the financial statements which have been certified by the chartered accountants of "Hashmi and Company" are used for our analysis. The original financial statements were prepared by the Chief Finance Officer of KW&SB. Then, they were subjected to the review and revision by the accountants. Finally, the accountants prepared its certified statements and submitted them to KW&SB with their opinions/comments. There were some differences between the two documents that have not yet been reconciled because of the division of opinions between KW&SB and the accountants. Some figures in balance sheets such as debtors (consumers' balance), deferred revenue, etc. constitute major differences between the two documents. The results of the analysis should therefore be reviewed and revised as necessary when the final versions of the financial statements are made available.

(1) Financial Conditions

a) Trend of Profit and Loss Statement

The financial statements including "profit and loss statement (P/L)" and "balance sheet" (B/S)" are the most fundamental documents to seize the financial management in KW&SB. The P/L for the recent five years is compiled in **Table 35.2.1**. The table shows the annual operation results of water supply and sewerage services. In recent five years, 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.

1. Ordinary profit/deficit: The ordinary results including the both operating and non-operating results recorded the serious deficit, as shown in **Table 35.2.1**. The annual deficit in 2004/05 was Rs.2.36 billion, although that was Rs.0.82 billion 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 amount 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 35.2.1**.

2. Revenues from water supply and sewerage services: The business revenue of KW&SB comprises sales of water supply and charges of sewerage service. The respective revenues are furthermore broken down to bulk consumer and retail individual users. As shown in **Figure 35.2.2**, the revenue from water supply accounted for more than 80% of the total revenue. A reason of drastic decrease of the revenue in 2001/02 compared with that in 2000/01 was caused by the application of new tariff effective from the beginning of the fiscal year 2001/02. All consumers were fairly classified into new categories. After 2001/02, the total revenue has increased as shown in the figure, although its trend was no steady.

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 0.35% 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.

Incidentally, the present tariff is listed in **Table A35.1.5** in **Appendix A35.1**. The bulk water

consumers are applied metered rate as follows: Rs.44 per 1000 gallons for domestic users; and Rs.73 per 1000 gallons for non-domestic users. Moreover, they have to pay 25% of surcharge of the aforesaid water charges for sewerage charge. Other retail water consumers are applied un-metered rate on the basis of their residential types for domestic users and their industrial categories for non-residential users. The water rates of domestic consumers are based on their plot area for independent houses and their floor area for multi-floor houses.

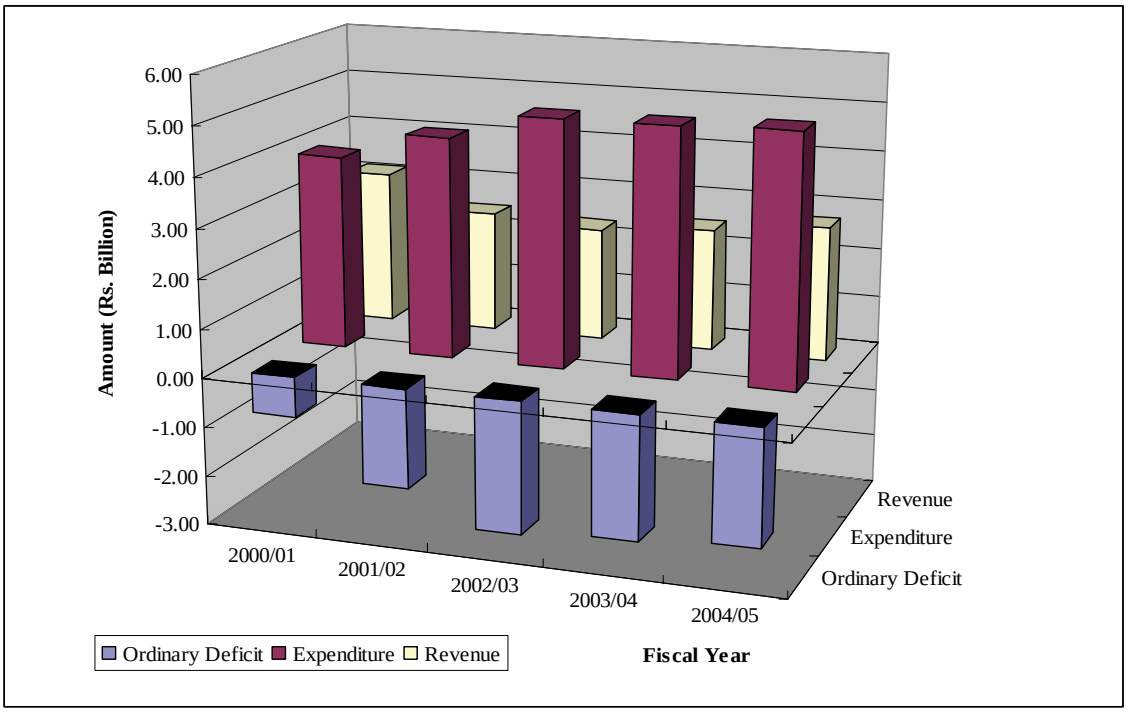


Figure 35.2.1 Operating Performance of KW&SB for Latest Five Years

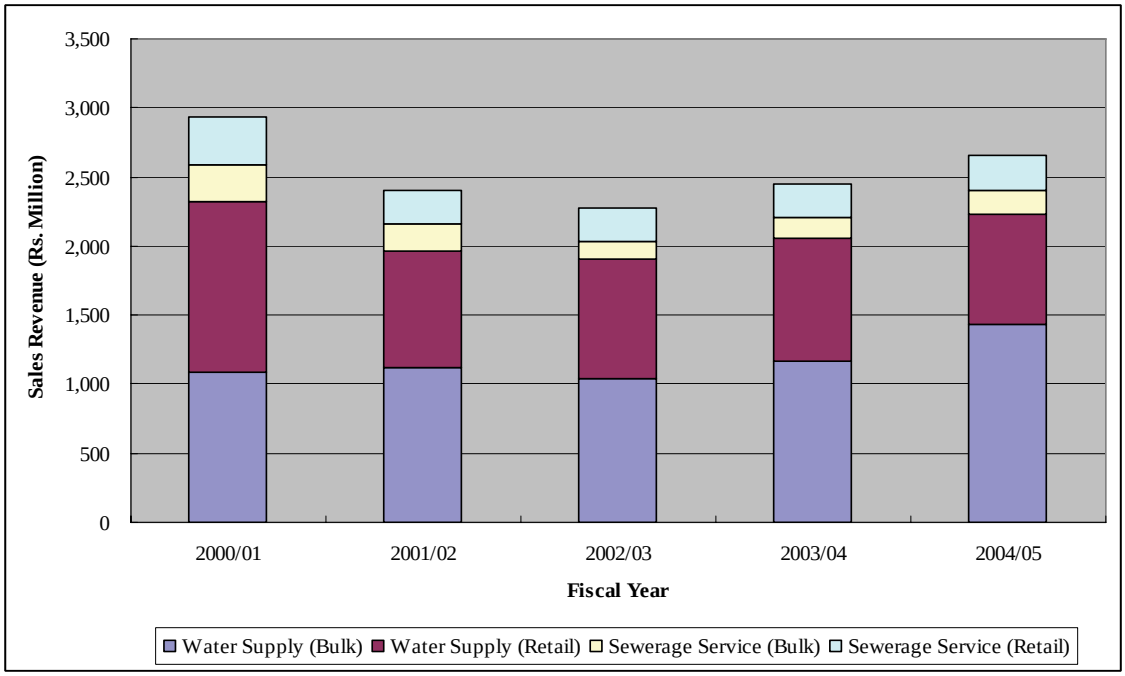


Figure 35.2.2 Details of KW&SB Revenue for Latest Five Years

Table 35.2.1 Profit and Loss Statement: 2000/01-2004/05

(Unit: Rs. in Million)

Item	2000/01	2001/02	2002/03	2003/04	2004/05
Operating Results					
Revenue					
Water Supply					
(1) Water Supply (Bulk)	1,080.62	1,124.06	1,034.88	1,161.49	1,431.15
(2) Water Supply (Retail)	1,236.86	844.85	866.74	899.71	800.89
Sub-total	2,317.49	1,968.91	1,901.62	2,061.20	2,232.04
Sewerage Service					
(3) Sewerage Charges (Bulk)	264.94	196.14	127.25	142.88	176.15
(4) Sewerage Charges (Retail)	350.49	240.61	242.64	250.26	244.42
Sub-total	615.43	436.75	369.89	393.14	420.57
Total	2,932.91	2,405.66	2,271.51	2,454.34	2,652.61
Expenditure					
Direct Expenditure					
(1) Charges of Raw Water to Sindh Gov.	1.05	0.09	0.64	1.41	0.95
(2) Compensation (Salaries and Benefits)	608.81	632.42	773.13	818.58	873.86
(3) Chemicals	15.27	23.59	29.40	15.83	29.22
(4) P.O.L. for Pumping Stations	63.91	60.38	61.92	38.79	44.79
(5) Electricity Charges	1,327.97	1,232.07	1,339.10	1,621.54	1,640.62
(6) Arrears of Electricity Charges			315.58		
(7) Gas Charges			29.14	28.43	23.34
(8) Repair and Maintenance /Improvement	206.80	134.33	108.23	185.04	160.79
(9) Water Supply through Tankers	18.48	1.42			
(10) Vehicles Running Expenses	34.39	29.47	28.93	23.88	37.84
(11) Printing and Stationary	5.26	5.96	5.95	6.58	5.32
(12) Medical	112.48	54.15	62.64	44.00	60.90
(13) Utilities	4.05	4.15	4.38	4.57	4.58
(14) Miscellaneous	10.06	7.80	7.85	8.41	15.68
Sub-total	2,408.52	2,185.82	2,766.90	2,797.07	2,897.88
Indirect Expenditure					
(1) Auditor' Remuneration	0.64	0.64	0.64		
(2) Bad Debts Expenses	315.88	120.28	113.58	122.72	132.63
(3) Depreciation	1,041.33	989.01	939.35	911.06	865.19
Sub-total	1,357.85	1,109.93	1,053.56	1,033.77	997.82
Total	3,766.37	3,295.76	3,820.46	3,830.84	3,895.70
Operating Profit and Loss	-833.46	-890.10	-1,548.95	-1,376.50	-1,243.09
Non-operating Results					
Non-operating Revenue					
(1) Interest Received from Banks	16.06	16.12	9.77	3.88	3.92
(2) Other Income	23.20	35.09	29.51	19.65	63.87
(3) Subsidy from KMC	143.00				
Sub-total	182.25	51.22	39.28	23.54	67.80
Non-operating Expenditure					
(1) Financial Charges on Foreign Loans	169.50	1,190.77	1,183.42	1,183.42	1,183.42
Non-operating Expenditure	169.50	1,190.77	1,183.42	1,183.42	1,183.42
Non-operating Profit and Loss	12.76	-1,139.55	-1,144.14	-1,159.88	-1,115.62
Ordinary Profit and Loss	**-820.70**	**-2,029.65**	**-2,693.09**	**-2,536.39**	**-2,358.71**
Beginning Surplus/Deficit of the Period	3.00	-817.70	-2,847.36	-5,540.44	-8,076.83
End Surplus/Deficit of the Period	**-817.70**	**-2,847.36**	**-5,540.44**	**-8,076.83**	**-10,435.54**

Source: Refer to Table 35.2.3

3. Expenditures: The operating expenditure in the fiscal year 2004/05 was Rs.3.90 billion, as shown in **Table 35.2.1**. Among 17 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. **Figure 35.2.3** illustrates percentage shares of the major expenditure items against the total expenditure including both operating and non-operating expenditures. The major expenditures against the total account for 32% of electricity charges, 23% of financial charges, 17% salaries and benefits and 17% of depreciation.

The financial charges seem to be a heavy burden for KW&SB because the share was 23% of the total expenditure in 2004/05. Although the charges were recorded as Rs.1.18 billion in the P/L, an actual charge was expected as Rs.2.41 billion. The rest charges of Rs.1.23 billion were deferred and recorded into accrued financial charges of long term loans as liabilities in the B/S. Although the charges consist of interest, service charges and commitment charges, the interest occupies the largest portion of the financial charge. The conditionality of foreign loans that KW&SB has borrowed so far is tabulated in **Table 35.2.2**. The annual interest rates were ranged from 11.0% to 2.6%. The outstanding of long term foreign loans was aggregated to Rs.14.48 billion in 2004/05. Incidentally, an average financial charge including local loans was estimated at 14.6% in the same year, that is, the annual financial charge of Rs. 2.41 billion against the outstanding at the beginning of Rs.16.59 billion of the all loans.

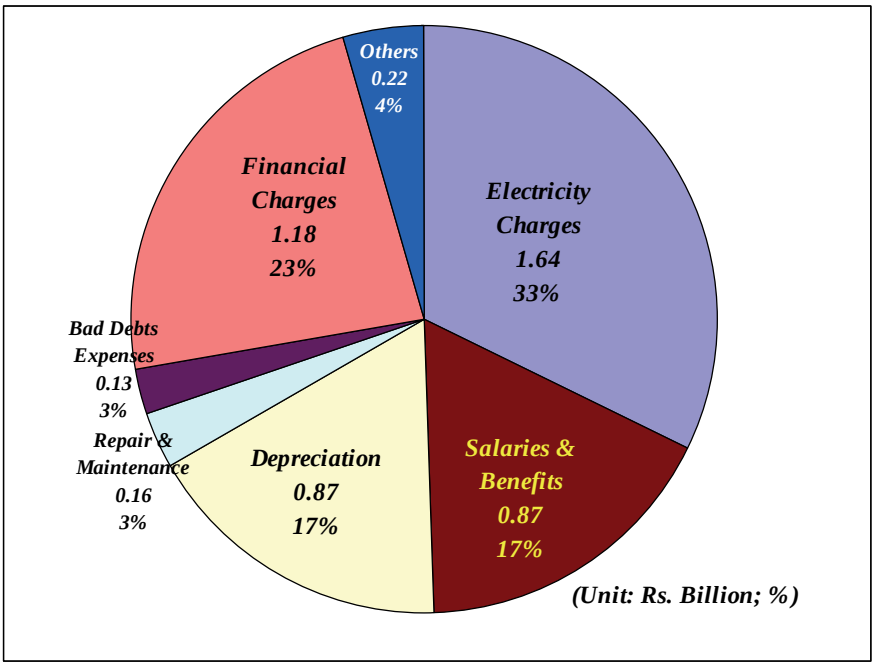


Figure 35.2.3 Share of Major Expenditure Items to Total

4. Expenses tied up with no revenue: At present, KW&SB supplies potable water through tankers and to some public offices at no charges. The expense of "Water Supply through Tankers" is shown in the **Table 35.2.1**. This water service is managed by the Ranger for the areas not served with KW&SB's piped water supply system. In addition, the expenses of no charge water for public offices were also included as a part of water production costs.

Table 35.2.2 Conditions of Foreign Loans and Outstanding at End of June 2005

	Item	A	B	C	D	E	F	G	H
1.	Loan Number	1374-Pak	1652-Pak	1987-Pak	SF-793Pak	SF-1001Pak	SF-1002Pak	L-2747-01	PK-P40
2.	Date of Main Agreement	30-06-1983	24-02-1986	19-05-1993	-	19-03-1990	19-03-1990	25-02-1990	-
3.	Lending Agency	IDA	IDA	IDA	ADB	ADB	ADB	CDC	JBIC (OECF)
4.	Agreed Amount of Loan*1 (in million)	23.00	19.45	163.50	17.89	39.91	26.61	£25.00	¥10,300
5.	Interest (% per annum)	11.0	11.0	11.0	7.0	7.0	7.0	11.0	2.6
6.	Commitment Charges (% per annum)	0.50	0.50	0.50	-	0.75	0.75	0.75	0.10
7.	Service Charges (% per annum)	0.75	0.75	0.75	-	0.10	0.10	-	0.10
8.	Repayment Period in Years	25	25	25	25	35	25	13	20.5
9.	Grace Period in Years	6	6	6	5	10	5	5	5
10.	No. of Biannual Installments	40	38	40	40	50	40	26	41
11.	Repayment Date Each Year	01 Mar & 01 Sep	15 May &15 Nov	01 Mar & 01 Sep	15 May & 15 Nov	15 Jun & 15 Dec	15 Jun & 15 Dec	15 Apr & 15 Oct	20 May & 20 Nov
12.	Repayment Starting Date	01-09-1996	15-05-2000	01-09-2004	15-05-2001	15-12-2007	15-12-2007	15-10-2002	20-11-2004
13.	Repayment Share of Agency against Major Works (%)	75	78	80	78	80	80	100	92
14.	Date of Financial Closure	31-10-1991	30-12-1993	30-06-1998	31-12-1995	30-09-1997	30-09-1997	-	30-09-1999
15.	Outstanding as of End of June 2005 (Rs. Million)	363	628	6,943	826	2,542		1,018	2,153
16.	Financial Charges Imposed by End of June 2005 (Rs. Million)	38	605	6,532	351	1,858		789	171

Remark: *1 In case of no monetary denomination, monetary unit is SDR in million

Furthermore, "Bad Debts Expenses" reckoned up as indirect expenditure every year. These expenses are allocated to a service for Katchi Abadis. The amount of this service corresponds to 5% of the total revenue of water supply and sewerage services. In another words, these expenses were written off as bad debts in the P/L under social consideration. These water supply and sewerage service arrangements come from historical and political vested rights.

b) Trend of Balance Sheet

The B/S of KW&SB for the recent five years from 2000/01 to 2004/05 is compiled in **Table 35.2.3**. In the fiscal year 2004/05, the total assets 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 the following items: Rs.25.2 billion of long term liabilities, Rs.4.6 billion of current liabilities and Rs. 7.1 billion of stockholders' equity.

1. Accounts receivable from consumers: The debtors (consumers' balance) in the current assets are an account receivable from consumers. The amount of the debtors consecutively increased from Rs.4.8 billion in 2000/01 to Rs.6.0 billion in 2004/05, as shown in **Table 35.2.4**. These figures are shown as "considered good" among the total debtors in the table below. Its annual increase rate was 5.8% on average. The total debtors of Rs.6.0 billion were furthermore broken down to Rs.2.6 billion of water supply and Rs.2.8 billion of sewerage services. By the end of the fiscal year 2004/05, the total amount of Rs.3.2 billion was already written off as bad debts, which were listed in "considered doubtful" among the total debtors. They were broken down to Rs.2.8 billion of water supply and Rs.0.4 billion of sewerage services. Thus, the debtors were aggregated to Rs.9.2 billion in 2004/05, if the bad debts had not been written off.

Table 35.2.4 Details of Debtors' Trend: 2000/01~2004/05

(Unit: Rs. Million)

Debtors (Unsecured) (in accumulation)	2000/01	2001/02	2002/03	2003/04	2004/05
Water	4,525	4,870	5,047	5,423	5,683
Considered Good	2,293	2,539	2,621	2,809	2,932
Considered Doubtful	2,232	2,331	2,426	2,615	2,751
Sewerage	2,826	3,008	3,155	3,298	3,480
Considered Good	2,486	2,646	2,775	2,900	3,061
Considered Doubtful	340	362	380	397	419
Total	7,351	7,878	8,202	8,721	**9,163**
Considered Good	4,779	5,185	5,396	5,709	**5,992**
Considered Doubtful	2,572	2,692	2,806	3,012	**3,171**
Bad Debts Expenses (annual figure in P/L)	316	121	114	123	**133**

The annual sales revenues should be included completely as annual income from operational services. As mentioned before, around 5% of the total revenue is set as bad debts and subtracted from the income as indirect expenditure at present. The rest of revenue is considered to be actual income in the year. In addition, approximately 20% of the total revenue becomes accrued income every year, which is named as "considered good for collection". This is reckoned as "debtors (consumers' balance)", i.e., accounts receivable. The accumulation of the debtors included as Rs.5,992 million in the B/S of 2004/05.

After July 2006, KW&SB has issued a newly designed bill to every consumer on monthly basis, although it has distributed its bill once a year before. The new bill includes not only the monthly charge of water supply, sewerage service, conservancy and fire charges, but also arrears in the past. Thus, the consumer has to settle his arrears account step-by-step, if he has left unpaid in the past. In terms of current charge, a consumer has to pay an arrearage charge monthly at an annual rate of 10%, if he does not pay within the due date.

Table 35.2.3 Balance Sheet: 2000/01-2004/05

(Unit: Rs. in Million)

Item	2000/01*1	2001/02*1	2002/03*1	2003/04*2	2004/05*2
Assets					
1. Fixed Assets					
(1) Operating Fixed Assets	22,240	21,231	20,273	19,633	19,069
(2) Work in Progress	4,696	5,196	5,971	6,979	10,301
Sub-total	26,937	26,427	26,243	26,612	29,370
2. Current Assets					
(1) Inventory	-	-	-	-	-
(2) Debtors (Consumers' Balances)	4,779	5,185	5,396	5,709	5,992
(3) Advances and Prepayments	65	61	13	11	9
(4) Receivable from KDA	98	98	98	98	98
(5) Receivable from KMC	206	206	206	206	206
(6) Cash in Bank	810	954	632	531	1,250
Sub-total	5,959	6,505	6,346	6,556	7,556
Total of Assets	**32,896**	**32,932**	**32,589**	**33,168**	**36,926**
Liabilities and Equity					
1. Long Term Liabilities					
(1) Consumer Deposits	130	143	157	172	216
(2) Long Term Foreign Loans	21,052	22,311	23,602	24,445	24,818
1) Principal	13,674	13,907	14,107	14,270	14,473
2) Accrued Financial Charges	7,377	8,404	9,495	10,174	10,344
(3) Long Term Loan from KDA	108	106	105	104	103
(4) Sindh Loan (Government)	58	58	58	58	58
Sub-total	21,348	22,618	23,921	24,779	25,194
2. Current Liabilities					
(1) Current Maturity of Long Term Foreign Loans	674	1,022	1,356	2,189	3,509
1) Principal	52	230	318	338	595
2) Accrued Financial Charges	623	792	1,039	1,851	2,914
(2) Current Maturity of Long Term Local Loans	24	26	27	28	29
(3) Contractor Deposit	399	392	407	444	543
(4) Creditors, Accrued & Other Liabilities	465	439	255	453	579
Sub-total	1,562	1,879	2,046	3,113	4,660
Total of Liabilities	22,909	24,497	25,967	27,893	29,854
3. Stockholders' Equity					
Capital Reserve	3,771	3,771	3,771	3,771	3,771
Internal Reserve/Withdrawals	-818	-2,847	-5,540	-8,077	-10,436
Grant in Aid (for Capital Works)	7,033	7,512	8,392	9,581	13,736
Total of Equity	9,986	8,436	6,622	5,275	7,072
Total of Liabilities and Equity	**32,896**	**32,932**	**32,589**	**33,168**	**36,926**

Remark: *1 Information was based on the documents of 1. and 2. below.
*2 Information was based on the documents of 3 below with some revision by the JICA team.

Source: 1. Chartered Accounts, KWSB Financial Accounts for the Year Ended 30 June 2002, Hashmi & Company
2. Chartered Accounts, KWSB Financial Accounts for the Year Ended 30 June 2003, Hashmi & Company
3. Final Draft, Financial Account 2003/04-2004/05, KWSB

2. Foreign loans: At the end of the fiscal year 2004/05, the foreign loans were recorded in the B/S, which were summarized in **Table 35.2.5**.

Table 35.2.5 Outstanding and Accrued Financial Charges of Foreign Loans in 2004/05

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 details of principal outstanding by lending agency regarding the long-term liabilities were broken down in the 15th line of **Table 35.2.2**. 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, as shown in the table above. 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.

KW&SB recorded an accumulated deficit of Rs.10.4 billion in 2004/05, as shown in **Table 35.2.3**. This deficit was covered by stockholders' equity and grant in aid. Since the equity was Rs.3.8 billion only, most of the deficit was covered by grants. The details of the respective fiscal years were tabulated in **Table 35.2.6**.

Table 35.2.6 Financial Sources for Accumulated Deficits: 2001/02~2004/05

Grant Sources	2000/01	2001/02	2002/03	2003/04	2004/05
From Federal & Provincial Government					
Grant-in-Aid	2.17	2.15	2.13	2.11	2.09
Grant-in-Funding	3.53	3.53	3.53	3.53	3.53
Grant-in-GOS	1.00	1.00	1.90	2.50	3.04
From Overseas Development Association	0.33	0.33	0.33	0.33	0.33
Greater 100 MGD Water Supply (K-III)	-	0.50	0.50	1.11	4.74
Total	7.03	7.51	8.39	9.58	13.73

Incremental deficits of the respective years were mainly covered by the following agencies, as shown in **Table 35.2.7**.

Table 35.2.7 Agencies for Covering Accumulated Deficits: 2001/02~2004/05

Grant Sources	2000/01	2001/02	2002/03	2003/04	2004/05
Grant-in-Aid	-	-0.02	-0.02	-0.02	-0.02
Grant-in-GOS	-	0.00	0.90	0.60	0.54
Greater 100 MGD Water Supply (K-III)	-	0.50	0.00	0.61	3.63
Total	-	0.48	0.88	1.19	4.15

As shown in the list above, the incremental deficit was covered by the grants from GOS and the K-III project. The total increment of Rs.6.7 billion for the four years was shared as follows: Rs.2.04 billion of GOS and Rs.4.74 billion of K-III project.

3. Inventory: In inventory accounts in the current assets, office supplies and furniture in addition to goods for operation and maintenance like chemicals, tools and parts of pipes, electrical equipment and machinery are included as of the end of the fiscal year. Shortages of these stocks in warehouse will hinder ordinary operation and maintenance of water supply and sewerage services as well as management works. In the B/S, the inventory did not have any figures, although its amount is naturally small as compared with other accounts. Accordingly, this means that the inventory stock may be quite small and in shortage conditions.

4. Operating fixed assets and work in progress: The fixed assets comprise Rs.19.1 billion of operational fixed assets and Rs.10.3 billion of work in progress. The book values of the operational fixed assets decreased year by year because of depreciation. The total fixed value in 2004/05 exceeded the 2000/01 level owing to the positive investment as work in progress during 2003/04 and 2004/05. In particular, the investment of K-III project contributed to the balance of the fixed assets. In order to catch up the water demand increase, consecutive

investments are inevitable for a set-up in water supply and sewage treatment capacity. As a result, the fixed assets increase in keeping with these investment activities. **Tables 35.2.8** and **35.2.9** show the detail conditions of the operating fixed assets and investment records of work in progress at the end of the fiscal year 2004/05.

Table 35.2.8 Schedule of Depreciation Charges up to June 2005 (1/2)

(Unit: Rs.Million)

	Name of Assets	Opening Balance 01-07-2004	Additions/Transfers During the Year	Total Cost	Rate of Depreciation	Depreciation During the Year	Written Down Value Balance
I.	Own Generated Assets (W&S)						
	Category A						
	1. Vehicles	10.90		10.90	10%	1.09	9.81
	2. Office Equipment & Furniture	8.44	1.05	9.49	10%	0.95	8.54
	3. Office Building	0.49		0.49	5%	0.02	0.46
	4. Plants & Machines	12.46		12.46	10%	1.25	11.21
	Total	32.29	1.05	33.33		3.31	30.02
	Category B						
	1. KCH Water Supply Project IDA 1374-Pak	563.34		563.34	5%	28.17	535.17
	2. KCH Water Supply Project IDA 1652	710.90		710.90	5%	35.55	675.36
	3. KCH Water Supply Project ADB793(SF)-Pak	914.02		914.02	5%	45.70	868.32
	4. K.S.D.P.-II ADB Credit 1001-1002 Pak	2,681.36		2,681.36	5%	134.07	2,547.30
	5. KCH Water Supply Project IDA 1987-Pak	11,125.04		11,125.04	5%	556.25	10,568.79
	6. Government Aided Projects	305.49		305.49	5%	15.27	290.21
	7. Work Executed by Self Faineance (KWSB)	4.53		4.53	5%	0.23	4.30
	Total	16,304.68	0.00	16,304.68		815.23	15,489.44
	Category C						
	1. Sewerage Cleaning Machine	14.71		14.71	10%	1.47	13.24
	Total	14.71	0.00	14.71		1.47	13.24
II.	Assets Transferred from KMC						
	1. Lands	2,137.38		2,137.38	-	0.00	2,137.38
	2. Buildings	121.41		121.41	5%	6.07	115.34
	3. Plants & Machineries	19.16		19.16	10%	1.92	17.24
	4. Sewerage Pipe Lines	241.82		241.82	5%	12.09	229.73
	Total	2,519.77	0.00	2,519.77		20.08	2,499.70
III.	Assets Transferred from KDA and KWMB						
	1. Capital Work KWSB	1.68		1.68	5%	0.08	1.60
	2. Capital Work from KDA	364.89		364.89	5%	18.24	346.65
	3. Spares and Stores	7.34		7.34	10%	0.73	6.61
	4. Machineries and Equipments	2.65		2.65	10%	0.27	2.39
	5. Laboratory Inventory	0.48		0.48	10%	0.05	0.43
	6. Other Minor Fixed Assets	0.01		0.01	10%	0.00	0.01
	Total	377.05	0.00	377.05		19.38	357.67

(To be continued)

Table 35.2.8 Schedule of Depreciation Charges up to June 2005 (2/2)

(Unit: Rs.Million)

	Name of Assets	Opening Balance 01-07-2004	Additions/Transfers During the Year	Total Cost	Rate of Depreciation	Depreciation During the Year	Written Down Value Balance
IV.	Capital Scheme (Sewerage)						
	1. Renovation Scheme of Sewerage in PECHS & KCHS	23.99		23.99	5%	1.20	22.79
	2. Lyan Sewerage Scheme	60.48		60.48	5%	3.02	57.45
	3. Ren & Rpl of Water Supply in N.N. & F.B.Area	29.91		29.91	5%	1.50	28.41
	Total	114.38	0.00	114.38		5.72	108.66
V.	Work-in-Progress (Water)						
	Category A						
	1. KCH Water Supply Project IDA 1987 II Pak	0.00		0.00			0.00
	2. KCH Water Supply Project ADB 793(SF) Pak	0.00		0.00			0.00
	3. KCH Water Supply Project ADB 1001 Pak	0.00		0.00			0.00
	4. KCH Water Supply Sanitation Project L2747-01	3,019.75		3,019.75			3,019.75
	5. Pumping Conveyance System	639.33		639.33			639.33
	6. Improvement Project PK-P40 Japan	2,135.99	551.88	2,687.87			2,687.87
	7. GKBWS Scheme K-III	1,136.09	3,110.27	4,246.35			4,246.35
	8. Bank Balance with FAP	8.08		8.08			8.08
	- ditto -	39.40	39.40	0.00			0.00
	Total	6,978.64	3,701.55	10,601.38		0.00	10,601.38
	Category B						
	1. Misc. C-W.I.P.	270.15		270.15			270.15
	Total	270.15	0.00	270.15		0.00	270.15
Grand Total		26,611.65	3,702.60	30,235.44		865.19	29,370.26

Source: Financial Accounts 2004-05 (Draft), March 2006, KWSB

(2) Management Characteristics

On the basis of the financial statements of the water supply and sewerage services, the management diagnosis was conducted to characterise the KW&SB's services in Karachi City. As a result of the diagnosis, several management indices show the management characteristics of KW&SB. **Table 35.2.10** shows the management indices. Referring to these indices, the management conditions in 2002/03 to 2004/05 were discussed from the following points of view: profitability, safety and productivity. Based on the financial indices, the study team points out some financial problems and issues for discussion on the management, aiming sound management solution in the future.

The water supply and sewerage services of KW&SB are managed in the manner of public corporative under CDGK in Karachi City. KW&SB management introduces an international account system and establishes its budgets based on objectively quantitative data and information. Management indices through the diagnosis are one of the most effective sources for reconsideration of management improvement. In **Table 35.2.10**, the indices of Japanese water supply services are listed as statistical standard data of the water supply business in Japan. Most of Japanese water supply services are managed by public service corporations under their municipal government.

a) Analysis of Profitability

During the three years from 2002/03 to 2004/05, the net profit was negative, so no ratio could be calculated as index as shown in **Table 35.2.10**. KW&SB has consecutively recorded operating deficit over recent years. The deficit increased from 2000/01 to 2002/03, but it decreased gradually after 2003/04.

"Turnover of capital" was 0.07 for the three years, as shown in the Line No.2 in the table. This rate of turnover was smaller than the Japanese index of 0.11. Among the capital, equity is recorded as Rs.3,771 million, 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, as discussed in the sub-section "Trend of Balance Sheet".

As understood from the ratio of net expense to net sales amount in Line No.5, the ratios are more than double of that of the Japanese index. The ratios in these years suggest that the net expenses were more than two times of net sales. The Japanese rate indicates 6% of ordinary profit. On the other hand, KW&SB has recorded almost the same amount of deficit as the total sales after the fiscal year 2002/03.

The Lines of No.16 and No.17 in the table confirm the obvious fact above. In 2004/05, an average unit price was estimated at Rs.21 per 1000 gallons. On the other hand, an average unit production cost 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 cost 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.

b) Analysis of Safety

The current ratio provides a measure of solvency in financial situation. The ratio of KW&SB was more than 300 in 2002/03. In the following two years, the ratios went down but still kept more than 100%. This means that its financial solvency is sufficiently high. It has enough financial capacity for payment. Thus, it is in good condition for solvency, from the viewpoint of index. However, most parts of current assets were account receivables, accounting for 83%

in 2004/05. These account receivables for KW&SB were considered to be low cashability. In consequence of this, the financial liquidity considered through actual current ratio is considered to face liquidity crisis in actuality.

Table 35.2.10 Management Indices of Water Supply and Sewerage Services by KW&SB: 2002/03-2004/05

	No.	Item	Unit	2002/03	2003/04	2004/05	Index in Japan*1
Management	1.	Ratio of Net Operating Profit to Total Capital	%	-	-	-	0.73
	2.	Turnover of Total Capital	-	0.07	0.07	0.07	0.11
	3.	Turnover of Stockholders' Equity	-	(0.60)	(0.65)	(0.70)	0.22
	4.	Capital Adequacy Ratio	%	11.6	11.4	10.2	52.6
	5.	Ratio of Net Expense to Net Sales Amount	%	220	204	191	94
Finance	6.	Current Ratio	%	310	211	163	273
	7.	Fixed Assets Ratio	%	538	521	506	176
	8.	Ratio of Fixed Assets to Long-Term Capital	%	73.2	68.8	65.8	95.3
	9.	Turnover of Account Receivable	-	0.42	0.43	0.45	7.4
	10.	Turnover of Fixed Assets	-	0.11	0.13	0.14	0.12
	11.	Ratio of Depreciation to Fixed Assets	%	4.6	4.6	4.5	3.5
	12.	Ratio of Depreciation to Net Expenses	%	18.8	18.2	17.0	28.6
	13.	Ratio of Interest to Net Expenses	%	23.5	23.5	23.2	18.5
Production	14.	Annual Production per Employee	Rs.1000/ Person	267	300	324	19,900
	15.	Turnover of Raw Material	-	1.4	1.3	1.4	14.1
	16.	Unit Price*2	Rs./ 1000 gallons	-	-	21	350
	17.	Unit Production Cost*2	Rs./ 1000 gallons	-	-	40	354
Labour	18.	Monthly Compensation per Employee	Rs./month /Person	7,579	8,229	8,902	379,000
	19.	Ratio of Compensation to Net Sales Amount	%	34.0	33.4	32.9	22.7
	20.	Ratio of Compensation to Net Expenses	%	15.5	16.3	17.2	22.5
	21.	Number of Employees per Water Supplied*2	Persons/mgd	-	-	22	6.4

Note: *1 Indices of Japanese water supply systems serving more than 300,000 residents with surface water sources.
*2 Annual served volume was estimated at 351 mgd in 2004/05, provided by IT Section as provisional.

The ratios of fixed assets were checked through (a) fixed asset ratio and (b) ratio of fixed assets to long-term capital. The former ratio is desirable to be less than 100%. The real ratio of the KW&SB was more than 500% for the latest three years, which was also more than the Japanese index of 178%. However, even if the former ratio were in worse condition but if the latter ratio were less than 100%, the safety might be fair within the permissible range of safety. The ratio of the KW&SB was less than 80% in the respective years. Thus, the composition of capital and liability is biased to long-term liabilities more than capital. At any rate, KW&SB seems to be in fair condition for fixed assets, as well.

In terms of equity, capital adequacy ratio in the Line No.4 was between 10.2% and 11.6%. This ratio was quite small as compared with the Japanese index. Water supply and sewerage service business is a kind of process industries, so a huge investment is indispensable to establish this business. It is quite important to procure a huge amount of investment capital through stable shareholders. From this point of view, the capital adequacy ratio was too small to keep the financial safety. This is one of the alarms for capital formation.

In terms of turnover of account receivable, it 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 16-18 times more time to collect bill than the Japanese water supply enterprises.

A period of bill collection is calculated applying the following formula:

Period of Bill Collection = 365 days / Turnover of Account Receivable

Applying this formula, the index 0.45 of the turnover of account receivable in 2004/05 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. Thus, the turnover of KW&SB should be improved as soon as possible for financial safety purpose.

The ratio of depreciation to fixed assets was 3.5% in most cases of Japanese water supply systems. The ratio of KW&SB was almost 4.5, so it was somewhat larger than the Japanese cases. This means that KW&SB set useful lives of major depreciable assets in slightly shorter than Japanese systems. The ratio of depreciation to fixed assts shows a size of depreciation against a book value of fixed assets. An inverse number of the ratio, then, shows an average durable life of fixed assets. For instance, 4.5% in 2004/05 indicates around 22 years of durable life.

The efficiency of fixed assets' utilisation is examined through the indices of "turnover of fixed assets". The smaller index indicates that the fixed assets are utilised more ineffectively. This turnover of KW&SB was between 0.11 and 0.14. These values were similar of the Japanese index, so the fixed assets are utilised almost the same effectiveness as those in Japan.

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% as shown in the Line No.13. These values were more serious than that of the Japanese index (18.5%). Moreover, KW&SB could not pay a part of interests within due time and carry forward it to the next year, which was reckoned in accrued financial charges in the B/S. Accordingly, if these accrued financial charges were added to this index calculation, the ratio jumped up to 50.2% in 2002/03, 29.8% in 2003/04 and 24.3% in 2004/05. This was brought about through KW&SB's negotiation with donors. However, KW&SB would rather negotiate with donors for better conditionality and/or look for better financial sources to decrease interest burden.

c) Analysis of Productivity

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, as shown in the Line No.19. This was higher than the Japanese index of 22.7%. Although the higher ratio is inevitable for process industry like water supply service, even so more than 30% was too large to manage the water supply and sewerage services. The latter ratio was between 15.5% and 17.2%, in the Line 20. This was lower than the Japanese one of 22.5%. These phenomena were caused by the huge difference between annual sales and expenditure of

KW&SB.
As shown in the number of employee per water volume supplied in the Line No.21, the number of staff for water supply services seems to be quite large as compared with the Japanese average. It was 22 persons per million gallons/day, which were more than three times of the Japanese index of 6.4 persons per million gallons per day (14 persons per 10,000 m^3 per day). Thus, the operation program might be improved considering the future management conditions.

Average monthly compensation of KW&SB was recorded to increase from Rs.7,600 in 2002/03 to Rs.8,900 in 2004/05, as shown in the Line No.18. On the other hand, average annual production per employee was calculated as from Rs.267,000 in 2002/03 to Rs.324,000 in 2004/05, as shown in the Line No.14. This annual production was recalculated as from Rs.22,300 per month in 2002/03 to Rs.27,000 per month in 2004/05. Thus, a ratio of compensation per production was calculated as from 0.34 in 2002/03 to 0.33 in 2004/05. In the same manner, the Japanese ratio of compensation per production was 0.23, i.e., Rs.19,900,000 per year of production against Rs.379,000 per month of compensation. These figures are completely the same as the ratio of compensation to net sales in the Line No.19. Eventually, KW&SB should improve the labour productivity from the viewpoint of productivity enhancement.

Yet, the analysis through management indices might be conducted with discretion. In the case of the comparison analysis like conducted in this analysis in particular, the economic and social background of the two countries is too different to compare with each other easily. KW&SB alters its management policy based on these analyses, it should consider its management conditions such as office-automation, telemetric system, labour-saving through remote-control, payment into bank account, outsourcing of meter reading, etc. as well as the results of index analysis.

Finally, purchasing and inventory system is considered in this section. It was usually conducted through an annual purchasing plan usually proposed at the beginning of the fiscal year. However, inventory stock was not included in the B/S. Moreover, turnover ratio of net sales amount to raw material was almost 1.4, as shown in the Line No.15. This value was quite small as compared with the Japanese index of 14.1. This is because the electricity expense was included in the raw materials, accounting for 88% of the total cost of raw materials. This phenomenon was quite distorted composition of expenditure. These important components should be reconsidered as soon as possible, as well.

(3) Problems

In this section, some financial problems are discussed, which were identified through the analysis of financial conditions and the diagnosis of financial statements.

a) 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. The accumulated deficit aggregated to Rs.10.4 billion in 2004/05, accounting for around four times of the annual revenue in the same year. Besides, the annual revenue has not been stable for these years. Moreover, some of the revenue can not be counted as actual income because of no charge water. This revenue problem would make KW&SB into difficult position to improve its management.

b) Too Large Operating Expenditure

The operating expenditure for last four years has consecutively increased year by year, in spite of the fluctuating operating revenue. For the recent three years in particular, the total expenditure including non-operating expenditure reached more than double of the total revenue.

Of the total expenditure in 2004/05, the top four expenditure items were as follows: (1) Rs.1.64 billion of electricity charges or accounting for 33%, (2) Rs.1.18 billion of financial charges, 23%, (3) Rs.0.87 billion of compensation, 17%, and (4) Rs.0.87 billion of depreciation, 17%. The total of these four items occupies 90% of the total expenditure.

Electricity charge is the most serious component to lift water production cost. It is an essential cost for KW&SB to convey water source from Indus River. Nevertheless, it is a critical cost in operational expenditure, so from the viewpoint of cost saving KW&SB would rather find another way out of purchasing electricity as it is.

Financial charge is also serious component for high water production cost. Moreover, KW&SB could not pay a part of interests within due time and carried forward it to the next year. That is reckoned in accrued financial charges in the B/S of the following year. This would obviously be proof of heavy burden for financial management.

Compensation for workers of KW&SB is an essential component for operation of water supply and sewerage services. This cost would still has plenty of room for improvement and cost saving. Management systems in use in countries that are advanced ought to be instructive with regard to this problem.

c) Financially Ailing Structure

KW&SB confronts structural fiscal deficits. In order to solve this structural problem, KW&SB has to bring about a much more radical reform of the management system. In the first step, it determines a management policy. In case that KW&SB aims to manage the water supply sewerage service as an independent entrepreneur, it would rather adopt a "cost recovery policy". To realize the policy, it must plan a step-wise programme with implementation schedule.

It would be necessary for KW&SB to take the following step for implementing the cost recovery policy:

1) To grasp precisely water production cost and sewage treatment cost. These costs are the most fundamental matter of cost recovery policy. Some investments of this first programme would be necessary to implement this research.
2) To formulate a new tariff system implementation programme to realize the policy. The tariffs correspond to the water production cost and the sewage treatment cost. In addition, they also reflect social welfare policy and public safety as well as KW&SB management policy.
3) To inform stakeholders of the tariffs with data and information, and to reach an accord on these tariffs with them through discussion. Freedom of information would be requisite for KW&SB to succeed in accomplishing its strategy.

d) Excessive Account Receivable

KW&SB has huge debtors (account receivable from consumers) 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, or around 15 times of the standard value as a normal utility business. KW&SB ought to be financially very tight due to these huge debtors. This heavy outstanding of the debtors might blunt KW&SB's new financial improvement strategy above. Thus, KW&SB has to work on reducing these debtors and to discuss with the local governments concerned.

e) 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), i.e., Rs.36.9 billion in 2004/05. Water supply and sewerage services are one of the processing industries, so huge capital investment is not indispensable to manage the business soundly. In fact, the average adequacy ratio is more than 50% among

many sound entrepreneurs of water supply business in Japan. Around 10% of KW&SB's capital is too small to manage its undertaking. Thus, KW&SB is thrown into a predisposition to rely on borrowing money. In the near future, KW&SB should make an effort to reinforce its equity through discussions with local governments concerned.

3.5.3 Human Resource Development

Human Resource Management aspects are detailed in **Section 3.5.1** above. However, this sections deals specifically with Human Resource Development (HRD).

There is no longer a 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. KW&SB will need to take care that the lack of a central HRD Department with competent staff to deliver training and development activities, does not dilute their development efforts.

(1) Building Staff Capacity

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.

KW&SB can gain significant improvements in business and staff performance by enhancing and aligning skill levels with the stated needs of the business. This will require considerable investment in assessing competencies and tailoring training and development needs of each employee throughout the organisation to meet agreed individual, departmental and corporate objectives. This would lead to the need for introducing a "corporate training and development plan", which will require continuous monitoring and development. Some of the key activities associated with building staff 'capacity', with suggested benefits of taking a planned approach to training and 'capacity building', are outlined below:

- A move towards a competency based organisation
- The ability to identify individuals who are capable of 'moving up' in the organisation
- Improvement in performance for individuals, teams and the organisation as a whole

Based on initial discussions, there appears to be a need to:

- Define and set a policy for human resource development and training that is centrally 'owned'
- Reviews the policy on staff promotions and system of job transfers and ensure that promotional and transfer decisions are based on first hand knowledge of the individual's performance and suitability to fulfil roles that will 'add value' to the individual and to the business
- More emphasis be placed on developing and motivating 'lower grade' staff, clerical staff and engineers at more junior level to enhance performance and output as these grades form the majority of employees compared to the more senior grades
- The introduction of new staff or graduate trainees with qualifications to match areas where expertise is limited, for example customer services, business planning, health and safety, information systems/technology, etc. This process has been recently initiated by KW&SB and is already underway.

(2) Training

Currently responsibility for training rests with the Director (Training) within the DMD (P&D) Department. However, resources are limited and those most training is conducted on-the-job.

KW&SB do not have a formal training policy or documentation regarding the training and

development needs of individuals or KW&SB as a whole. However, both internal and external training is provided as funds allow. It is recommended that all training in future is based on individual and departmental development needs and should be targeted and prioritised, rather than be made available to those who have time to attend.

The quality and success of training imparted is not measured or monitored. We recommend introduction of a system that measures the effectiveness of training delivered and the effects of training on the trainee's performance.

(3) Performance Appraisals

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. For KW&SB to be a successful service organisation, employees must know what is expected of them and to have the opportunity to learn new skills to improve their contribution to the 'Business'.

Considering the above, it is recommended that a system of performance appraisals is introduced that ensures:

- Each employee has a clear understanding of their role, its purpose, and how they contribute to the achievement of the team and KW&SB goals – performance and expectations are agreed and stated clearly for everyone
- Performance is managed in a way that is relevant to the type of work undertaken by an individual and with standards appropriate to the role
- Performance management is not 'done to people' but is a process in which the employee plays a full part. This will build employee commitment, motivation and job satisfaction
- Consideration is given to 'softer' issues or role specific behaviours such as 'customer service orientation' as well as 'harder' issues when determining performance achievement against targets
- Every employee has a clear performance plan agreed with their line manager and how performance will be measured
- Every employee has a clear understanding of how they are performing and the opportunity and support to build on their performance
- Individuals with responsibility for managing and addressing performance issues have the appropriate training and support to manage effectively
- Data from the performance appraisal process is used to support resource planning, training and development, career management and succession planning
- Objectives for the coming period are set and training and development needs are agreed

(4) Career Development and Progression Planning

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.

Little emphasis is given to training, development and promotional prospects of those lower down the organisation, for example clerical staff or labourers. The system of promoting to vacant positions based on seniority 'leaves them behind'. Equal emphasis and opportunities for further development and enhancement should be open to all employees.

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