

THE ISLAMIC REPUBLIC OF PAKISTAN
CAPITAL DEVELOPMENT AUTHORITY

THE REGIONAL STUDY
FOR
WATER RESOURCES DEVELOPMENT POTENTIAL
FOR
THE METROPOLITAN AREA
OF
ISLAMABAD-RAWALPINDI

APPENDIX C
(WATER DEMAND PROJECTION)

APPENDIX D
(PRELIMINARY DESIGN OF THE FACILITIES)

FEBRUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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APPENDIX C.

WATER DEMAND PROJECTION

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C.1. Urban Water Demand

C.1.1. Urban Development Plan

(1) Urban Development Status of Islamabad

a. Historic Decision an Artificial Build as Capital City

Islamabad, the Capital of Pakistan is a new artificial city. On independence, Karachi was made the seat of the Federal Government but facilities were lacking. Several schemes for building the capital near Karachi were considered by the Government but not found feasible and physical. Finally, the Government of President Muhammad Ayub Khan appointed a Site Selection Commission in February 1959 to consider the suitability of Karachi as the Capital from view points of location, climate, availability of adequate water and food supply, communication and defence and if Karachi was considered unsuitable, to recommend another side. After comprehensive survey and study of all possibilities the Commission unanimously recommended the terraced table-land of the Potwar Plateau near Rawalpindi. The Government accepted the recommendations of the Commission in June 1959 and took the historic decision to build the capital which was later named "Islamabad" - the city of Islam.

In September 1959, Federal Capital Commission was formed to prepare a Master Plan. Various Sub-Committees were formed to study and prepare detailed reports on topography, communication, regional power, welfare, sanitary, water supply, sub-area development plans, and

land use, etc. On the basis of these studies/reports, a Master Plan was prepared in October 1960 by the Greek Consultants, Messrs. Doxiadis Associates of Athena. The Master Plan fixed the location of the site, its size in successive stages of development and its relation with the surrounding areas and divided it into various self-contained sectors basing on the principle of dynapolis - an arrangement under which all functions of life grow concurrently and the city centre moves with the movement of residential sectors. The Consultants also furnished detailed designs of various development projects including some of the water supply projects.

The Capital Development Authority came into being under CDA Ordinance, 1960 with the task of building the capital as one of its functions, then the actual building process started in October 1961.

b. The Master Plan for the Metropolitan Area

The Master Plan for the Metropolitan area of Islamabad and Rawalpindi has been prepared on the principle of "Dynapolis" which means a dynamic city where the city centre grows in direct proportion to the growth of residential functions.

Four highways with a right of way of 365.8 m from the frame work within which a grid of squares, each measuring 3.1 sq.km have been planned. Two of these highways namely Shahrah-e-Islamabad and Shahrah-e-Kashmir link Islamabad with the rest of the country and through Shahrah-e-Pakistan, with Lahore, Peshawar and Kashmir. Master Plan covers an area of 1,125.50 sq.km as follows:

1. Islamabad proper including Institutional and Industrial area	220.15 sq.km
2. Islamabad Park (Semi-Urban)	220.15 sq.km
3. Islamabad Rural Area	466.20 sq.km
Total	1,125.50 sq.km
4. Region (Specified area of Islamabad)	3,626.00 sq.km

The area mentioned at 2, 3, above has been named as Federal Capital area and has been declared as Islamabad district w.e.f. 6th January, 1981.

c. Salient Features of the Plan

The structure of the plan provides for a dynamic and parallel development of several functions. It has been planned in a way that it should be able to face in the future the problems arising out of its proximity with the expanding large city of Rawalpindi. The idea is that Islamabad should be severed by Rawalpindi yet not face the danger of being intermingled with it. It would help the simultaneous and coordinated, but not necessarily equal, growth of the two cities. In this way the twin cities would retain their individual character while at the same time they will become a part of one and the same Metropolitan area.

- Islamabad Proper

Between Margalla Hills and the Shahrah-e-Kashmir is the city of Islamabad south of Shahrah-e-Kashmir and north of Khyaban-e-Sir Syed is located Institutional and Industrial area to serve both the cities of Islamabad and Rawalpindi.

Islamabad proper is located on a plateau with a height ranging from 502.0-609.6 m above sea level. It is planned in parallel belts and includes Administrative Sector, Diplomatic Enclave, Public Building Area, Residential Sectors, Blue Area, and the Industrial Zones.

- Islamabad Park

Islamabad park extends over an area of 220.15 sq.km and is earmarked for semi-urban functions. Institutions of national importance such as the Atomic Research Institute and the National Health Laboratories are already functioning in this area. Institutions, requiring large areas of land would be located in this area. It would also have spacious sports centres, parks and exhibition grounds, agricultural, dairy and poultry farms have also been located in this area. Its functional scope has also been enlarged to include establishment of a few Model Villages, Agrovilles, Sub-urban Centres and suitable places to facilitate the settlement of the displaced families near their ancestral surroundings as far as possible.

d. Review of the Master Plan

During the implementation of the plan prepared by the Chief Consultants in 1960, it was felt that the plan had some limitations as well as over-provision of certain functions. To solve this problem some amendments have been made in the original concept. For example, the number of shopping centers has been decreased keeping in view the requirements. Similarly some changes have been made in road network. In certain cases, cul-de-sacs have been eliminated and also the right-of-way of some roads has been reduced.

Initially the projections in the Master Plan were made for 20 years. It was intended that the requirements would be reassessed with the passage of time and adjustments made accordingly. A review of the Master Plan has now become due and is being undertaken. The CDA would be taking steps to implement the decisions made in the light of this review.

e. Development Status of Islamabad

- Administrative Sector

The city of Islamabad, the new Capital of Pakistan was envisaged as the permanent abode of the Federal Government. The Master Plan of the city caters to the functional requirements. The same pattern is distinctly visible in the style and outlay of the buildings. Accordingly, the administrative sector has the major important structures. This sector located at the eastern end of Islamabad, has been divided into three zones namely, the Secretariat Zone, the Central Square Complex and the Cultural Zone.

o The Secretariat Block

The nerve-centre of policy formulation is aptly located in the impressive Pakistan Secretariat Buildings. The secretariat rises four to six storeys in which angular shapes, covering an area of 92,900 sq.m. The complex, divided into two group of four inter-connected blocks each, was built in about five years.

o The Central Square Complex

The Secretariat Buildings acting as the trend setter, the landmark in Centre Square is the Aiwan-i-Sadar. The built up area of 30,193 sq.m includes the State Guest Rooms, Banquest Halls and the Presidential Secretariat.

Other important construction work in the square includes the Parliament and the Cabinet Buildings. Equipped with most modern systems and fittings, the Parliament Building houses members of the National Assembly and the senate and also has adequate space for visitors. The Cabinet building is also a continuation of the construction them in the Central Square. The parliament building has a covered area of 55,717 sq.m. The parliament house was inaugurated on 28th May, 1986.

° The Cultural Zone

The Cultural Zone will occupy the space between the Aiwan-i-Sadar and the Diplomatic Enclave. They will include the National Library, National Museum, Armed Forces Museum, Supreme Courts and National Arts Council. The projections and designs of these buildings again envisage individuality within the large perspective.

The special building area house some of the important institutions like the Pakistan Broadcasting House, the Ministry of Foreign Affairs, National Archives building, Academy of Sciences, Government Hostels and the State Bank Building. These buildings will be completed within two years with prominence for its design and spaciousness.

- Diplomatic Enclave

The south of the Administrative Sector, space has been provided for the diplomatic enclave and residences of Foreign Missions. Set in picturesque surroundings, this area has witnessed rapid construction activity only to be replaced by growing diplomatic international, as the style, decor and design of the structures suggest.

These Administrative Sector and Diplomatic Enclave as mentioned above are much relation with the water consumption under the category as public uses.

- Residential Area

Life is bestowed upon a city by the inhabitants. The Government, alive to this need started construction of houses in various Categories, distinguished by covered area, the type of accommodation required in each category and its size. Alongside the development of the public sector housing, the CDA has encouraged construction in the private sector, always keeping a vigilant eye on the quality and standard of buildings.

In this residential area, there are classified two housing sectors, private housing sector like F-sector series and combined type with private and public housing sector like G/I sector series. Residential area occupies more than 30 percent of each sectoral area as shown Table C-1-1. CDA is under encouraging to develop up to No. 11 series.

- Blue Area

Islamabad is increasingly becoming a centre of commercial and trading activity. Proper care has been taken to facilitate the development of these vital functions. The Blue Areas are commercial building belts attached with F-sector running East to West along the main avenue Khyaban-e-Quaid-i-Azam. Various impressive structures have already been tenanted up to F-6 sector, and concrete structures have been coming up in F-7 sector along with said avenue.

- Commercial Centre

There are also various Commercial Centres in all the Sectors which are fully developed. These Centres, known as 'Markaz' for example, are the Melody Cinema, Islamabad Hotel, Banks and shopping centres. The development of each Markaz is an attempt to bring the civic and the commercial activity nearer to each other and make people participate in all these activities. In addition to this Markaz, some public services and governmental functions are provided for the civilian service.

- Industrial and Trading Centre

Located on the Northern side of Khyaban-e-Suhrawardy, this sector aims at establishment of light consumer and service industries. The site has been carefully chosen in close proximity to the residential sectors. The area is reserved for providing basic services and commodities like dairy products, flour mills, laundries, specialized textiles, rubber and plastic products, grinders, automobiles service stations and workshops, repairs of household goods and effects, printing and publishing, art studios etc. So far, CDA has allotted Industrial and Trading Centre plots in Sectors G-6 to G-10.

- Manufacturing Industrial Area

This area has been located along Khyban-e-Sir Syed in the I-Series sectors where all type of industrial small, medium and large have been proposed.

All types of industries can be permitted here except those industries which create environmental pollutions, some nuisance of smoke, dust, obnoxious smell, noise, vibration and explosion etc.

Sector I-9 has already been developed and industrialists are coming up with the request for more industrial plots in Islamabad.

Table C-1-1 show the Islamabad land use areas by sectors.

(2) Urban Development Status of Rawalpindi

a. History and Development

Rawalpindi is the headquarters of the Rawalpindi District which one of the divisions in the Punjab Province. It is divided into three parts in this study report, namely, municipal corporation area and cantonment area separated by the Pakistan Railway's line and the sluggish stream Lei Nallah, and suburban area surrounding cantonment.

There were existed as a village for many centuries. The British Cantonment was established in this village in 1849, which later became headquarters of the Northern Command. The Municipal Corporation was formed in 1867, some 18 years after the founding of the British Cantonment in Rawalpindi.

In August 1947 when Pakistan emerged as an independent country, Rawalpindi also gained special significance. A shift of the British Army's headquarters into the General headquarters of the Pakistan Army brought the increase in military personnel and more economic activity, and immigration from India also brought a large number of people into the city though Hindus and Sikhs emigrated.

The city undertook national importance in 1959, when shifting of the Federal Capital of Pakistan near Rawalpindi was decided. The construction of the Capital started in 1961 and it was actually shifted in 1968. In the intervening time from 1959 upto 1968, Rawalpindi remained as the interim capital of Pakistan. These brought substantial incentive into the development of Rawalpindi and growth in all parts of the city has accelerated since the early 1960's. Development of the twin cities of Islamabad and Rawalpindi has now reached the point where the urban areas merge together in places.

b. The Master Plan for Greater Rawalpindi

The Master Plan for Greater Rawalpindi, target year of 1990, was established in 1970 by the Town Planning Department (changed name to Regional and Physical Planning in recent years) of Punjab Province.

The rapid urbanization has been obliged to make the said Master Plan to the administrators and physical planners because the already inadequate facilities in the cities have been choked and constipated. The absence of any comprehensive development programme has further aggravated the situation. Rawalpindi is distinct in this respect because it received a large number of migrants as a result of the shifting of the Capital from Karachi in 1960. Rawalpindi being declared as "Interim Capital" had to accommodate a large number of government servants both in offices and residences along with an unprecedented number of people for the provision of various services.

c. Salient Features of the Plan

It is apparent that the plan was originally of the form of a recommendation only and was not enforceable either by the Municipal Corporation (RMC) or Cantonment Board (CB), with the result that development has not necessarily proceeded according to the plan, particularly in the Cantonment. It is understood that the plan has now been fully adopted and should be followed by RMC.

There is, however, an urgent need for the plan to be updated and although this has been talked about it appears that there is no specific commitment in this regard. In the absence of an up to date plan of development, the facing rapid urbanization has obliged to acquiesce in the haphazard sprawl development and encroachments in the urban area except a few scheme area as well as in rural area.

d. Development Status of Rawalpindi

- Rawalpindi Municipal Corporation (RMC)

The total existing Rawalpindi urban area amounts to approximately 8,800 ha, of which about 2,700 ha is belonged to RMC. According to the Census Report, RMC is divided into 50 numbers of ward as a matter of convenience to survey. Recent land use pattern for each ward is considered and grouped 5 classifications to the method of absorptive capacity by increasing population in accordance with the existing characteristics and density as follows:

- ° Old City Constitutes the center of RMC since 1850, before RMC was formed with the terrible congested but most activity area by conglomerate built-up residence and various kind of commerce, services and work shop etc., with a most high density of population estimated more than 740 persons/ha.
- ° Inner City Located surrounding area of old city and developed after 1940 approximately, mainly used as mixed a commercial area with activity and medium low/low income housing area with a high density estimated more than 360 persons/ha.
- ° Semi Developed Area Located outside of Inner City, consists of residential area for medium/low income class, variety of commerce services and work shops also much activity, with a density estimated more than 250 persons/ha.
- ° Scheme Area Located in the north and south RMC with schemed development area. Mainly residential area for medium high income class. Moreover, many public facilities such as hospital, college, high school and government offices are located in this area. Still, many houses are under construction according to housing plans.
- ° Neglected Area According to crude land demand mainly by medium low/low income class, some area has been happened as haphazard sprawl phenomenon, but this area have land available to absorb more population.

Rawalpindi Cantonment (CANTT)

The Cantonment area amounts to approximately 6,100 ha, of which about 70 percent occupies of Rawalpindi urban area. This area is divided into ten Wards in accordance with Census Report. As mentioned in Article a. "History and Development", this area is characterized not only general headquarters of the Pakistan Army and its relationship but also top level of Pakistan Government Presidential Residence, Prime Minister's Residence and so on.

The characteristics of each sub-area in terms of recent land use are briefly described as follows:

- ° Chaklala Cantonment Located in the east side of Rawalpindi urban with Islamabad International Airport and broad area amounted more than 1,200 ha.

Consists of government officers colony and mainly residential area for medium and or more high income classes. Moreover, many governmental offices as much as public facilities are located in the area.

- ° Central Area Constitutes the center of Rawalpindi Cantonment since 1900, and intermingles with governmental offices, public facilities, government and private residence for medium level and various commerces.

- Ward No.2: Located in the North side of Civil Line (RMC Ward No.26) and most narrow area amounted 150 ha only with a high density estimated more than 300 persons in the Cantonment area. Jhanda Chichi is typical name of this area.

- Ward No.3: Located between Pakistan National Railway and Grand Trunk Road in the West side of Ward No.2 with animated area such as Railway Station, Babu Mahalla and Sadar Bazar.

- Ward No.4: Placed in the West side of Civil Line and top level of Pakistan Government House - Presidential Residence and Prime Minister's Residence are typical as well as Lalkurti.

- Ward No.7: Placed in the West side of Ward No.4 and second narrow area amounted 170 ha with second density estimated 210 persons, RA Bazar is typical name of this area.

- ° South Area Located in the South side of Central Area mentioned above. Constitutes Ward Nos.5 and 6, intermingles with governmental facilities, residential housing area, industrial commerce area and park.

Ayub National Park is one of the famous country's park, and 502 Workshop and Air Force Base are typical of Ward No.5, Tanch Bata is typical name of Ward No.6.

- ° Westridge Area Spreaded over both the North and South side of Grand Trunk Road, mainly used as a governmental offices and also as a residential area for high income class at north side of Grand Trunk Road and for medium low income class at south of this Ward. Dhoke Chaudhrian, Millat Colony and Westridge are typical name.

- ° West area Located in neighbour area with No.13-Series of CDA boundary. Used as an industrial area and also as a residential area with most high absorptive capacity area of increasing the population.

- Rawalpindi Rural Area

Rural area enclosed by the final decision of sub-committee for this study and just same area by the Master Plan for the Metropolitan area of Islamabad and Rawalpindi prepared on the Principle of "Dynapolis".

Enclosed area as rural amounted 13,000 ha but numbers of population estimated 91,000 only in 1987 formed as villages.

Along with each main road spreaded from Cantonment area has been happened as haphazard sprawl in accordance with crude land demand mainly by medium low/low income classes.

C.1.2. Population Projection

(1) Islamabad

a. Review of Census Data

The total population of Islamabad urban and rural areas in March 1981 was 340,286 as compared to 234,813 in September 1972. The past data on population is available every a decade from 1951. Before the establishment of the new Capital of Islamabad, the area was all rural area and was under the control mostly of Rawalpindi District. The urban area comprises Islamabad Proper area (220 sq.km) and a part of Islamabad Park (91 sq.km) including many villages in both the areas. The past population trend of Islamabad is shown in Table C-1-1.

Table C-1-1. Population Census Records in Islamabad Urban and Rural Area

Year	Population		
	Total	Urban	Rural
1951	83,170	-	83,170
1961	110,307	-	119,307
1972	234,813	76,641*	158,172
1981	340,286	204,364**	135,922

Note: * ... Population in proper area of 65 sq.km.

** .. Population in developed and planned proper area of 220 sq.km.

As shown in the table, the annual population growth rate from 1951 up to 1981 was 4.8 percent in average. High growth rate of 7.1 percent by annum during 1961-72 period was mostly contributed by the migration due to the construction of the new Capital. Those migrants live in urban area. Such high growth rate decreased at 4.2 percent per annum during 1972-81 which is similar rate as 4.8 percent during 1951-81 period.

As for the census population in urban area in 1981, the population includes not only those in Islamabad proper area already developed but also those in villages located in the proper area to be developed and its surroundings. According to CDA's future city planning, villages in planned proper area are scheduled to be shifted to the outside according to the development plan. Therefore, the population in Islamabad proper area in 1981 was adjusted at 143,902 based on the detailed area-wise population distribution in the Census as shown in Table C-1-2. The above population includes those in villages of Golra and Nurpur Shahan where important remains are located, and a part of Islamabad Park. The population in the proper area in 1972 was also adjusted at 73,598 as of March 1972 from 76,641 in September 1972 using the growth rate during 1972-81.

The population increased by 95.5 percent in the 1972-81 period as shown in Table C-1-3. This was due to the expansion of the proper area and migration from the other districts with the construction of the new Capital. The population in 1987 was estimated at 284,570 based on the manner as described in next section (b) Population Projection.

Table C-1-3. Historical Population Growth in Islamabad Proper Area

<u>Year</u>	<u>Population</u>	<u>Percentage Increase (%)</u>	<u>Annual Growth Rate (%)</u>
1972	73,598	-	-
1981	143,902	95.5	7.73
1987	284,570	97.8	12.04

Table C-1-2 Population Statistics in Islamabad Urban Area
(as of 1981)

Urban Localities	Population			Religion		House Hold Size
	Both Sexes	Male	Female	Muslim	Others	
<u>ISLAMABAD</u>						
<u>URBAN AREA</u>	<u>204,364</u>	<u>113,341</u>	<u>91,023</u>	<u>196,076</u>	<u>8,288</u>	<u>5.7</u>
BADIA QADIA						
BAKSHSH G-11	350	169	181	349	1	6.1
BADIA RUSTAM KHAN G-12	779	420	359	774	5	5.3
BARKHANZADA F-09	251	119	132	251		7.2
BHAIKAR AKHU E-11	663	336	327	663		4.7
BHAIKAR FATEH BAKHSH E-12	282	134	148	282		5.9
BHAKHA SAIYDAN F-11	862	424	438	862		5.3
BOKRA H-12	301	154	147	301		7.0
CHAHAN H-10	770	403	367	770		6.4
CHAUNTRA	598	379	219	580	18	4.3
CHHELD G-14	560	293	267	560		4.9
DHAREK MOHRI F-12	1,492	830	662	1,486	6	5.1
DHERI QILA E-09	341	170	171	341		4.9
DHERMIAN F-11	295	158	137	295		10.5
DHOK ABDULLAH G-12	84	41	43	84		5.6
DHOK HASHU I-15	409	212	197	409		6.5
DHOK JORI	1,626	845	781	1,626		4.7
DHOK KASHMIRI E-15	442	234	208	442		5.3
DHOK MAKHANWALI H-16	295	168	127	295		5.6
DHOK MIAN ABDULLAH I-14	103	50	53	103		5.7
DHOK MOHRA MALAH	150	85	65	150		5.8
DHOK MUNDEYWALI H-16	67	37	30	67		4.2
DHOK NOOR KHAN	729	388	341	728	1	7.0
DHOK PARACHA G-15	1,159	613	546	1,159		5.5
DHOK SAIYDAN I-16	913	470	443	913		6.1
DHOK SANDEMAR	707	356	351	707		5.9
DHOK SAWAIYAN F-14	299	152	147	299		4.5
SHOK TAMMAN	762	395	367	762		5.9
DHOK ZAKARI H-10	116	66	50	116		4.0
DORA	1,000	526	474	1,000		5.4
GARH E-10	489	247	242	487	2	5.1
GLIEA	1,028	524	504	830	198	4.5
*GOLRA E-11	2,851	1,475	1,376	2,846	5	6.0
GOVT. TECHNOLOGY						
COLLEGE H-14	705	348	357	681	24	5.9
JHANG BAGIAL	1,108	589	519	1,105	3	6.1
JHANGI SAIYDAN H-15	1,286	654	632	1,286		6.4
JOND E-14	675	344	331	666	9	4.8
KALANJAR	576	322	254	576		6.8
KAMIAL E-09	372	194	178	372		5.6

Cont'd-

Urban Localities	Population			Religion		House Hold Size
	Both Sexes	Male	Female	Muslim	Others	
KHATAR G-10	97	52	45	97		4.0
KOKA F-10	732	392	340	731	1	6.7
KORAK G-11	231	112	119	231		6.2
LABOUR COLONY F-09	2,219	1,271	948	2,218	1	5.2
LUNDA H-10	248	128	120	248		5.6
MADRASA G-10	191	95	96	191		4.7
MAIRA	1,252	666	586	1,251	1	6.8
MAIRA BERI D-11	579	293	286	577	2	4.5
MAIRA SAMBAL AKKU F-12	2,183	1,172	1,011	2,169	14	5.2
MAIRA SAMBAL JAFFAR G-12	2,670	1,330	1,340	2,571	99	5.5
MALPUR	1,318	660	658	1,309	9	6.4
NIRA DHOK G-13	21	11	10	21		3.5
MUSLIM COLONY	1,915	1,187	728	1,873	42	4.7
NAUGAZI	1,058	532	526	1,046	12	5.3
NOON	1,586	813	773	1,586		6.4
*NUPPUR SHAHAN	5,157	2,804	2,353	5,147	10	5.7
OJHRI KALAN	333	181	152	322	11	7.1
OJHRI KHURD	336	175	161	336		6.9
PADDO REMAS	615	333	282	614	1	6.2
PADHANA KALAN G-16	2,215	1,212	1,003	2,215		5.7
PARI D-11	256	135	121	256		4.7
PIND HANNA I-15	396	209	187	396		7.3
PIND PARACHA G-15	1,191	614	577	1,191		6.1
PIND PARIAN	670	346	324	670		6.2
PIND SANGRAL D-13	746	387	359	744	2	4.8
POONA FAQIRAN	678	388	290	674	4	6.7
*QUAID-E-AZAM UNIVERSITY						
CAMPUS	755	469	286	746	9	4.7
RUPPAR F-09	482	226	256	482		7.4
SAIDPUP	3,839	2,138	1,701	3,649	190	4.9
SANG JANI	825	439	386	811	14	5.5
SARAI KHARBUZA D-15	1,037	521	516	1,037		4.8
SARAI MADHO D-16	423	220	203	423		5.9
*SECTOR E-07	1,051	840	211	1,014	37	8.3
*SECTOR E-08	3,762	1,973	1,789	3,542	220	4.5
*SECTOR F-05, G-05 & DEP. ENCLAVE	802	602	200	756	46	3.9
*SECTOR F-06	13,856	7,897	5,959	12,394	1,462	5.0
*SECTOR F-07	6,971	4,038	2,933	6,099	872	5.5
*SECTOR F-08	6,448	3,675	2,773	6,334	114	5.6
*SECTOR G-06	31,503	17,137	14,366	30,272	1,231	6.2
*SECTOR G-07	38,818	22,016	16,802	36,146	2,672	6.1
*SECTOR G-08	10,166	5,662	4,504	9,637	529	5.7
*SECTOR G-09	11,103	6,384	4,719	10,864	239	5.6
*SECTOR H-08	821	497	324	813	8	6.0
*SECTOR H-09	511	322	189	504	7	4.3
*SECTOR I-08	1,609	894	715	1,607	2	5.3

Cont'd-

Urban Localities	Population			Religion		House Hold Size
	Both Sexes	Male	Female	Muslim	Others	
*SECTOR I-09	4,688	2,757	1,931	4,628	60	6.5
*SECTOR I-10	1,964	1,086	878	1,899	65	5.4
SERI SAIHAL D-12	1,188	610	578	1,188		4.9
SHAH ALLAH DITTA	2,241	1,200	1,041	2,227	14	6.2
SIMALA E-10	300	147	153	300		5.2
*SPORTS COMPLEX/ ISLAMABAD CLUB	1,066	822	244	1,055	11	5.9
SURRAIN I-11	641	336	305	640	1	7.5
TALI MOHRI	1,269	660	609	1,265	4	5.9
TARNOL F-15	1,055	551	504	1,055		5.2
THATTA GUJRAN G-10	281	137	144	281		6.0
THATTA SAIYDAN G-14	494	256	238	494		4.9
TIAL	7	7	0	7		1.4

Note : * Populations of localities with mark remain in Islamabad proper area, but those without mark is planned to shift toward outside.

Source: UR-1

The above population in 1972 and 1981 are adjusted from the original figures in the Population Census reducing population of many villages in the proper areas and a part of Islamabad Park.

b. Population Projection

For the purpose of water demand projection, only the population in Islamabad proper area is considered and future population projection of Islamabad will be made on the population of Islamabad proper.

It is necessary to take new developing plans for residential, institutional and industrial sectors into consideration on the basis of perspective development programme in this water demand projection.

While the work on the review of the Capital Development Master Plan shall begin shortly by CDA and may take some time to complete and generate a final short term as well as long term programme for the development of Islamabad.

The population projection in the sectoral area is made based on the census of 1981, expansion of the proper area according to the CDA development plan and site survey.

The methodology of population projection in a nutshell is as follows:

In the first place yearly population in the future is projected based on its past trend/movement and the original Master Plan of CDA with the ultimate population in 2030 set at around one million. Then, yearly population in a certain year, is distributed over each sector. In doing so, original sectoral plan and actual

sectoral situation are fully taken into consideration. Sectoral plan has been mapped out in such a way that Islamabad urban proper will be developed starting from north-eastern sectors gradually towards western and southern directions. When the density of population in a particular sector reaches a certain level no more growth of population in that sector is assumed and in its stead other sparsely populated sectors are selected for population distribution. This way balanced coverage of population over the entire area has been worked out up to the target year 2030.

Detailed methodology of population projection is described as follows:

First, the Islamabad proper area is divided for analysis into the following sectors:

- Existing Urban Sectors

Existing urban sectors, where part of Administrative Sector, Diplomatic Enclave, Blue Area and residential sectors have been completed one or more years before last, such E-7-8, F-6-8, G-6-9 and I-9-10.

- Developing Urban Sectors

Extending areas, where part of Administrative Sector, Diplomatic Enclave and Blue Area, and E-9, F-10-11, G-10-11, H-8-9, I-8-10, where new housing and building are being constructed now-a-day.

- Remain Sectors to be Executed

The schedule of land acquisition and sector's development plans obtained through CDA are shown in Table C-1-4 and C-1-5.

Table C-1-4 Schedule of Land Acquisition in Islamabad

<u>Year</u>	<u>Sectors</u>
1986	D-12, E-12, H-12
1987	F-12, G-12, H-13
1988	D-13, E-13, F-13
1989	G-13, D-14, H-14
1990	E-14, F-14, G-14
1991	D-15, E-15, H-15
1992	F-15, G-15, D-16
1993	E-16, F-16, G-16, H-16

Source: Planning Wing, CDA.

Table C-1-5 Schedule of Urban Development Plan in Islamabad

<u>Five Year Plan</u>	<u>Residential Sectors</u>	<u>Industrial Sectors</u>	<u>Institutional Sectors</u>
6th (1983)-1988	E- 9	I-10	H-11
	E-10	I-11	
	F-11		
	G-11		
	D-11		
7th 1988 - 1993	D-12	I-12	F- 9
	E-12	I-14	H-10
	F-12		H-12
	G-12		H-13
	D-13		
8th 1993 - 1998	E-13	I-15	H-14
	F-13		
	D-14		
	E-14		
	F-14		
	G-14		

Source: Planning Wing, CDA

Second, population in the each sector is estimated in the following manner:

- Existing Urban Sectors

The habitant of each house or apartment is quoted from the number of various allotment houses by plot scale obtained from CDA, and conducted through site survey and hearing.

- Developing Urban Sectors

The number of habitant in some new sectors, such as F-10-11, G-10-11, H-8-9 and I-8 where are being allotted and constructed, are distributed through site survey, time schedule to intermittent water supply and allotment schedule obtained from CDA.

- Remain Sectors to be Executed

According to the original planning of plot scale by sector, final target inhabitant shall be estimated and saturated in this study in agreement with CDA for this study.

Furthermore, for estimation by tenant of various commercial centers in all the sectors as known Markaz, and Blue Area of F-6, 5 percent to 20 percent of total habitants in each sector are distributed and assigned to its sectors.

Finally the results of population projection in the target year 2010 and 2030 are estimated at 760,500 and 1,006,800 respectively, as shown in Table C-1-1 supposed to be served by CDA's water supply system is 100 percent of its population.

Table C-1-6 Projected Population by Sector in Islamabad

Sector No.	Land Use	1981	1987	1990	2000	2010	2020	2030
Quaid-i-Azam University	G	755	1,210	1,700	3,400	3,400	3,400	3,400
Nürpur Shahan	R	5,157	6,170	7,000	9,100	9,100	9,100	9,100
Administrative Sector	G	160	440	2,000	4,000	4,000	4,000	4,000
Public Building Area	G	642	1,740	3,000	15,100	15,100	15,100	15,100
Diplomatic Enclave								
Sports Complex/Islamabad Club	G/P	1,066	2,290	5,000	12,000	12,000	12,000	12,000
F- 6	R	13,856	20,950	21,000	21,000	21,000	21,000	21,000
G- 6	R	31,503	33,490	36,000	40,000	40,000	40,000	40,000
E- 7	R	1,051	3,350	4,000	4,000	4,000	4,000	4,000
F- 7	R	6,971	14,780	16,000	20,000	20,000	20,000	20,000
G- 7	R	38,818	41,320	42,000	45,000	45,000	45,000	45,000
E- 8	R	3,762	7,040	6,500	6,500	6,500	6,500	6,500
F- 8	R	6,448	15,500	18,000	20,000	20,000	20,000	20,000
G- 8	R	10,166	39,630	42,000	50,000	50,000	50,000	50,000
H- 8	G/P	821	1,235	2,000	3,000	3,000	3,000	3,000
I- 8	I/R	1,609	2,865	5,000	15,000	15,000	15,000	15,000
E- 9	R	-	-	5,000	10,900	10,900	10,900	10,900
F- 9	P	-	-	100	3,000	5,000	5,000	5,000
G- 9	R	11,103	35,220	40,000	50,000	50,000	50,000	50,000
H- 9	G/P	511	1,050	2,000	5,000	5,000	5,000	5,000
I- 9	I/R	4,688	17,080	22,000	25,000	25,000	25,000	25,000
E-10	G	-	-	5,000	10,000	10,000	10,000	10,000
F-10	R	-	1,540	3,000	17,000	17,000	17,000	17,000
G-10	R	-	3,430	6,000	36,000	39,800	39,800	39,800
H-10	G/P	-	-	3,000	3,000	5,000	5,000	5,000
I-10	I/R	1,964	24,180	28,000	30,000	30,000	30,000	30,000
D-11	R	-	-	1,000	5,000	5,000	5,000	5,000
E-11 (Golra)	R	2,851	4,240	6,000	25,000	25,000	25,000	25,000
F-11	R	-	1,530	3,000	17,000	17,000	17,000	17,000
G-11	R	-	4,290	6,000	45,000	45,000	45,000	45,000
H-11	G/P	-	-	-	3,000	5,000	5,000	5,000
I-11	C	-	-	-	3,700	5,000	5,000	5,000
D-12	R	-	-	-	6,400	8,000	8,000	8,000
E-12	R	-	-	-	8,200	10,000	10,000	10,000
F-12	R	-	-	-	9,000	12,000	12,000	12,000
G-12	R	-	-	-	33,900	40,000	40,000	40,000
H-12	G/P	-	-	-	2,500	5,000	5,000	5,000
I-12	C	-	-	-	3,100	5,000	5,000	5,000
D-13	R	-	-	-	1,600	8,000	8,000	8,000
E-13	R	-	-	-	-	8,000	10,000	10,000
F-13	R	-	-	-	-	9,500	12,000	12,000
G-13	R	-	-	-	-	28,000	35,000	35,000
H-13	G/P	-	-	-	-	4,000	5,000	5,000
C-14	G/P	-	-	-	-	2,000	3,000	3,000
D-14	R	-	-	-	-	6,500	8,000	8,000
E-14	R	-	-	-	-	9,500	12,000	12,000
F-14	R	-	-	-	-	7,000	10,000	10,000
G-14	R	-	-	-	-	27,200	40,000	40,000
H-14	G/P	-	-	-	-	3,000	5,000	5,000
I-14	I/R	-	-	-	-	-	10,000	12,000
C-15	G/P	-	-	-	-	-	4,000	5,000
D-15	R	-	-	-	-	-	8,000	10,000
Sub-Total		143,902	284,570	341,300	621,400	760,500	817,500	822,800

Cont 'd-

<u>Sector No.</u>	<u>Land Use</u>	<u>1981</u>	<u>1987</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>2020</u>	<u>2030</u>
E-15	R	-	-	-	-	-	10,000	12,000
F-15	R	-	-	-	-	-	12,000	15,000
G-15	R	-	-	-	-	-	32,000	40,000
H-15	G/P	-	-	-	-	-	4,000	5,000
I-15	I/R	-	-	-	-	-	10,000	12,000
C-16	G/P	-	-	-	-	-	-	5,000
D-16	R	-	-	-	-	-	-	10,000
E-16	R	-	-	-	-	-	-	10,000
F-16	R	-	-	-	-	-	-	15,000
G-16	R	-	-	-	-	-	-	40,000
H-16	G/P	-	-	-	-	-	-	8,000
I-16	I/R	-	-	-	-	-	-	12,000
Sub-Total		-	-	-	-	-	68,000	184,000
Total		143,902	284,570	341,300	621,400	760,500	885,800	1,006,000 (4.05%)

Note: 1. Abbreviations R: Residential; G: Government;
C: Commercial; I: Industrial;
P: Park or Green Area

2. Projected population by sector is equal to population served.

3. Adjusted based on the information from CDA and AESL Report.

(2) Rawalpindi

a. Review of Census Data of Rawalpindi Urban Area

Population census data of Rawalpindi, consisting of the Rawalpindi Municipal Corporation and Rawalpindi Cantonment, are available for 1901 up to 1981, as presented in Table C-1-7. Except for the initial setback from 1901 to 1911 when the city lost population due to the spread of plague, population had been growing steadily. At the time of partition in 1947, Rawalpindi lost its population when Hindus and Sikhs migrated but in return received a large number of refugees. The establishment of GHQ of the Pakistan Army brought the increase in military personnel to the Cantonment. These factors contributed to the 28 percent growth rate in the decade 1941-51. The decade of 1961-72 recorded much more population growth which was because of Rawalpindi's recognition as an important administration and commercial center of the region. Shifting of the Federal Capital next to Rawalpindi and the interim capital in the intervening time from 1959 to 1968.

According to the census record, urban area divided into 10 wards and 50 wards of Cantonment and Municipal Corporation respectively as shown in Table C-1-8. 50 wards of RMC was changed in 1982 and divided population into new wards are shown in Table C-1-9.

Table C-1- 7. Population Census Records in Rawalpindi Urban Area

<u>Year</u>	<u>Population</u>	<u>Percentage Increase</u> (%)	<u>Annual Rate</u> (%)
1901	87,638		
1911	86,483	- 1.4	- 0.14
1921	101,142	17.0	1.58
1931	119,284	17.9	1.66
1941	185,042	55.1	4.49
1951	237,219	28.2	2.52
1961	340,175	43.4	3.67
1972	598,023*	75.8	5.26
1981	794,843	32.9	3.21

Note: * ... The population in 1972 is adjusted as of March 1, 1972, based on the population of 641,809 on September 16, 1972 and the percentage increase during the 1961-72 period.

The population in 1987 was estimated at 945,148 based on the past census date urbanized situation as described in next section d. Population Projection.

b. Review of Census Data of Rawalpindi Rural Area

Rawalpindi rural area in Rawalpindi Tehsil is out of Rawalpindi urban, Taxila urban and Wah Cantonment, and many town and village lie scattered on all sides.

According to the population census the rural part of Rawalpindi had a population of about 271,000 and 333,000 in 1972 and 1981 respectively.

During the 1972-81 inter census period the rural component of population shows an increase of 22.9 percent and the population growth rate was 2.31 percent annually. This growth rate was much below not only the national growth rate for Pakistan but also Punjab Province.

Table C-1-8 Population Statistics by Ward in Rawalpindi
(as of 1981)

Localities	Population			Religion		House Hold Size
	Both Sexes	Male	Female	Muslim	Others	
RAWALPINDI						
CANTT.	337,752	185,845	151,907	326,612	11,140	6.1
WARD NO. 01	45,456	24,572	20,884	44,844	612	6.2
WARD NO. 02	38,876	21,653	17,223	37,609	1,267	6.0
WARD NO. 03	32,594	17,860	14,734	30,607	1,987	6.0
WARD NO. 04	29,099	15,928	13,171	26,891	2,208	6.6
WARD NO. 05	36,771	19,928	16,843	35,680	1,091	6.1
WARD NO. 06	36,036	19,699	16,337	35,762	274	6.2
WARD NO. 07	31,778	17,123	14,655	29,089	2,689	6.1
WARD NO. 08	35,644	19,975	15,669	35,239	405	6.4
WARD NO. 09	20,376	11,268	9,108	20,265	111	5.7
WARD NO. 10	31,122	17,839	13,283	30,626	496	5.7
RAWALPINDI						
MUNICIPAL CORP.	457,091	242,981	214,110	444,952	12,139	7.0
WARD NO. 01	11,585	6,252	5,333	11,403	182	6.9
WARD NO. 02	15,444	8,212	7,232	13,187	2,257	7.3
WARD NO. 03	10,248	5,431	4,817	8,977	1,271	7.3
WARD NO. 04	13,849	7,197	6,652	13,605	244	7.2
WARD NO. 05	10,856	5,657	5,199	10,761	95	7.2
WARD NO. 06	5,930	3,170	2,760	5,916	14	7.2
WARD NO. 07	9,801	5,190	4,611	9,758	43	6.6
WARD NO. 08	18,306	9,896	8,410	17,735	571	6.6
WARD NO. 09	23,429	12,975	10,454	22,874	555	7.0
WARD NO. 10	16,269	8,629	7,640	15,519	750	6.4
WARD NO. 11	6,168	3,374	2,794	6,074	94	6.1
WARD NO. 12	10,771	5,697	5,074	10,658	113	6.9
WARD NO. 13	9,202	4,841	4,361	9,081	121	7.5
WARD NO. 14	7,973	4,256	3,717	7,942	31	6.7
WARD NO. 15	6,136	3,211	2,925	6,131	5	6.8
WARD NO. 16	8,960	4,723	4,237	8,806	154	7.7
WARD NO. 17	8,394	4,409	3,985	8,332	62	6.9
WARD NO. 18	11,367	5,987	5,380	11,147	220	7.2
WARD NO. 19	19,066	10,032	9,034	16,570	2,496	7.0
WARD NO. 20	15,942	8,880	7,062	14,266	1,676	7.4
WARD NO. 21	4,914	2,527	2,387	4,833	81	7.7
WARD NO. 22	4,219	2,226	1,993	4,216	3	7.0
WARD NO. 23	5,000	2,641	2,359	4,778	222	7.3
WARD NO. 24	7,522	4,051	3,471	7,435	87	8.1
WARD NO. 25	6,737	3,465	3,272	6,716	21	7.7
WARD NO. 26	9,955	5,295	4,660	9,939	16	8.5
WARD NO. 27	5,411	2,912	2,499	5,222	189	6.3
WARD NO. 28	5,792	3,503	2,739	5,690	102	6.6
WARD NO. 29	6,013	3,121	2,892	5,990	23	7.1
WARD NO. 30	22,765	12,259	10,506	22,696	69	6.8
WARD NO. 31	6,394	3,419	2,975	9,363	1	6.2
WARD NO. 32	9,387	5,124	4,263	9,363	24	6.1
WARD NO. 33	12,164	6,487	5,577	12,154	10	6.8

Cont'd.

Localities	Population			Religion		House Hold Size
	Both Sexes	Male	Female	Muslim	Others	
WARD NO. 34	4,176	2,202	1,974	4,176		6.2
WARD NO. 35	7,473	3,915	3,558	7,440	33	8.3
WARD NO. 36	13,109	6,751	6,358	13,068	41	6.3
WARD NO. 37	7,022	3,654	3,368	7,022		6.4
WARD NO. 38	7,411	3,886	3,525	7,337	74	7.4
WARD NO. 39	8,960	4,770	4,190	8,960		6.9
WARD NO. 40	7,843	4,136	3,707	7,818	25	7.1
WARD NO. 41	6,411	3,394	3,017	6,411		7.9
WARD NO. 42	5,853	3,045	2,808	5,832	21	8.0
WARD NO. 43	4,578	2,390	2,188	4,575	3	7.5
WARD NO. 44	5,301	2,809	2,492	5,284	17	7.0
WARD NO. 45	5,031	2,664	2,367	5,001	30	6.6
WARD NO. 46	4,361	2,242	2,119	4,360	1	7.1
WARD NO. 47	3,818	2,094	1,724	3,762	56	7.2
WARD NO. 48	6,811	3,525	3,286	6,804	7	7.3
WARD NO. 49	5,545	2,919	2,626	5,528	17	7.3
WARD NO. 50	7,419	3,986	3,433	7,407	12	7.4

Source: UR-2

Table C-1-9 Divided Population into New Ward in R.M.C.

New Ward			Old Ward	
Ward Nos.	Area (ha)	Population	Ward Nos.	Divided Population
WARD NO.01	197.94	12,826	No.01, No.33	9,539, 3,287
WARD NO.02	89.49	16,268	No.02, No.03	15,444, 824
WARD NO.03	91.72	9,039	No.03	9,039
WARD NO.04	66.07	14,243	No.03, No.04	385, 13,849
WARD NO.05	70.81	10,856	No.05	10,856
WARD NO.06	39.87	6,970	No.06, No.07	5,930, 1,040
WARD NO.07	69.14	8,761	No.07	8,761
WARD NO.08	139.39	12,730	No.08	12,730
WARD NO.09	61.05	5,576	No.08	5,576
WARD NO.10	203.23	15,785	No.09	15,785
WARD NO.11	98.41	7,644	No.09	7,644
WARD NO.12	56.59	13,009	No.10	13,009
WARD NO.13	95.07	9,428	No.10, No.11	3,260, 6,168
WARD NO.14	57.43	10,771	No.12	10,771
WARD NO.15	169.50	8,269	New Area (CANTT WARD NO.1)	
WARD NO.16	22.02	9,202	No.13	9,202
WARD NO.17	19.24	7,973	No.14	7,973
WARD NO.18	21.47	6,136	No.15	6,136
WARD NO.19	29.93	8,960	No.16	8,960
WARD NO.20	25.37	9,241	No.17, No.18	8,394, 847
WARD NO.21	41.54	10,520	No.18	10,520
WARD NO.22	40.98	8,944	No.19, No.20	8,638, 306
WARD NO.23	53.25	11,390	No.19, No.20	10,428, 962
WARD NO.24	65.24	10,232	No.20	10,232
WARD NO.25	18.40	7,849	No.21, No.22	4,914, 2,935
WARD NO.26	35.96+117.36	9,472	No.20, No.23	4,472, 5,000
WARD NO.27	19.79	8,806	No.22, No.24	1,284, 7,522
WARD NO.28	23.98	6,737	No.25	6,737
WARD NO.29	19.79	9,955	No.26	9,955
WARD NO.30	39.03	11,203	No.27, No.28	5,411, 5,792
WARD NO.31	18.96	8,098	No.29, No.30	6,013, 2,085

Cont'd-

New Ward			Old Ward	
Ward Nos.	Area (ha)	Population	Ward Nos.	Divided Population
WARD NO.32	19.24	5,754	No.30	5,754
WARD NO.33	34.29	10,257	No.30	10,257
WARD NO.34	54.64	19,940	No.30, No.31, No.33	4,669, 6,394, 8,877
WARD NO.35	117.09	9,387	No.32	9,387
WARD NO.36	119.32	2,046	No.01	2,046
WARD NO.37	47.39	6,910	No.34, No.35	4,176, 2,734
WARD NO.38	25.65	10,321	No.35, No.36	4,739, 5,582
WARD NO.39	24.81	7,527	No.36	7,527
WARD NO.40	18.12	7,022	No.37	7,022
WARD NO.41	13.10	7,411	No.38	7,411
WARD NO.42	17.84	8,689	No.39	8,689
WARD NO.43	19.24	7,843	No.40	7,843
WARD NO.44	17.01	6,682	No.39, No.41	271, 6,411
WARD NO.45	15.33	10,394	No.42, No.48	5,853, 4,541
WARD NO.46	10.32	5,934	No.43, No.44	4,578, 1,356
WARD NO.47	12.82	8,976	No.44, No.45	3,945, 5,031
WARD NO.48	15.61	10,449	No.46, No.47, No.48	4,361, 3,818, 2,270
WARD NO.49	7.81	5,545	No.49	5,545
WARD NO.50	5.85	7,419	No.50	7,419
<u>Total</u>	<u>2,713.50</u>	<u>465,390</u>		

Table C-1-10 Population Statistics in Rawalpindi Rural Area
(as of 1981)

<u>Ward Nos.</u>	<u>Area</u>	<u>Rural Localities</u>	<u>Population</u>	<u>House Hold Size</u>
WARD NO.61	2,177.50		3,290	
		Shiekhpur	938	5.1
		Kak	221	4.9
		Dhok Kalas	213	6.3
		Rupa	113	5.9
		Narala	87	4.6
		Kolian	678	5.9
		Jatal	615	5.5
		Lakhu	425	5.2
WARD NO.62	1,082.50		3,386	
		Chakra	667	5.5
		Jalaluddin	2,719	6.9
WARD NO.63	1,002.50		7,319	
		Lakkhan	3,284	6.1
		Renial	1,753	5.7
		Garja	2,282	7.0
WARD NO.64	1,073.75		1,409	
		Dhok Telian	1,098	5.7
		Pind Dadu	311	7.1
WARD NO.65	1,178.75		3,929	
		Banda Nagial	700	6.1
		Hayal Ranial	633	5.9
		Ping Lar	322	5.2
		Kohara	1,175	
		Misriot	1,099	6.0
WARD NO.66	517.50		2,361	
		Malikpur	101	7.2
		Dhamial	1,335	6.5
		Mohra Ghazan	338	6.1
		Mohra Chhappar	587	5.7

Cont'd-

<u>Ward Nos.</u>	<u>Area</u>	<u>Rural Localities</u>	<u>Population</u>	<u>House Hold Size</u>
WARD NO.67	888.75		2,962	
		Jaurian	506	6.1
		Mohra Faqiran	225	5.4
		Jarahni	1,093	6.2
		Dhaman	1,138	5.4
WARD NO.68	1,743.75		699	
		Dhok Karam Bakhsh	75	4.7
		Dhok Gangal	624	4.6
WARD NO.69	1,051.25		18,227	
		Kaliol	829	5.8
		Morgah	8,117	5.8
		Kotha Kalan	9,281	6.4
WARD NO.70	1,733.00		1,006	
		Jabbi Kot	1,006	6.0
		Gharibabad	(7,500 estimated as of 1987)	
WARD NO.71	230.40		16,169	
		Chaklala	16,169	5.2
WARD NO.72	353.70		11,143	
		Shakrial	6,213	7.0
		Dhok Gangal	4,760	6.2
		Dhok Abdullah	170	5.2
<u>Total</u>	<u>13,033.35</u>		<u>71,900</u>	

Note: Area Hectare

The population of the project area in Rawalpindi rural defined in 4.1.1 was counted up 71,900 persons as shown in Table C-1-10. Following Table C-1-11 are shown up to date annual growth rate as of the served area.

Table C-1-11. Population Census Record in Rawalpindi Rural Area

(As of the served area)

<u>Year</u>	<u>Population</u>	<u>Percentage Increase (%)</u>	<u>Annual Growth Rate (%)</u>
1981	71,900+4,780*		
1987	90,817	18.4	2.86

Note: * ... 4,700 was estimated as of 1981 for Gharibabad.

The population in 1987 was estimated at 90,817 based on the census data and urbanized situation as described in next section d. Population Projection.

c. Methodology of Population Projection

Methodology of population projection is described as follows.

First, the served area of Rawalpindi can be categorized into three major groups.

- Urban Area

- RMC (inner urban of Rawalpindi city)
- CANTT (link urban of Rawalpindi city)

- Rural Area

- Rural Rawalpindi (outer of Rawalpindi city)

All these served area is divided for analysis into same classifications on wards for census to consider the absorptive capacity by increasing inter-dynamic population on the basis of land absorption and crude land demand.

Second, the population of each existing urban sub-area is projected on the basis of actual site investigation and the result of many discussion with town planner of RMC as well as the past trend of population growth thereof. Then, the population of each developing areas is quoted from the land absorption and potenciality for the simplicity of analyzing procedures although it may be necessary to project the population by using more sophisticated method such as age cohort survival method.

Finally, the annual population growth rates by classification or locality is quoted with various rates depending upon the absorptive capacity and pontenciality by the period of each ten years up to the final target year in 2030. Projected population each classification on locality are calculated by the following equation:

$$P = P_0 \times (1 + r)^n \dots\dots\dots (C-1-1)$$

Where P : Projected population (the year 1987, 1990, 2000, 2010, 2020 and 2030)

P₀: Population of the base year (start from census in 1981)

r : Estimated annual growth rate by classification. Values for each classification are plus or minus mentioned in the Table.

n : The time period from the base year to each target year.

- RMC

50 wards of total locality mentioned in Census Report can be grouped into 5 classifications as mentioned in Table C-1-12 (Refer to Section (2) Article C.1.1 also).

Table C-1-12. Classification for Land Absorption

<u>Classification</u>	<u>Nos. of Wards</u>
Old City (6-Wards)	45, 46, 47, 48, 49, 50
Inner City (18-Wards)	18, 19, 22, 25, 27, 28, 29, 30, 31, 32, 37, 38, 39, 40, 41, 42, 43, 44
Semi Developed Area (8-Wards)	2, 5, 14, 16, 17, 23, 24, 33
Scheme-Area (8-Wards)	1, 3, 4, 6, 7, 12, 13, 26
Neglected-Area (10-Wards)	8, 9, 10, 11, 15, 21, 34, 35, 36

In addition to classification, Old City is most congested area with high density of population estimated more than 740 persons per hectare, hence annual growth rate is estimated minus value after the year 2000.

On the basis of each average annual growth rate by the period of ten years, projected population in the target year 2010 and 2030 are estimated at 849,000 and 1,050,000 respectively as shown in Table C-1-13.

- CANTT

As mentioned in Section (2) Article C.1.1, many city functions are located in 10 Wards.

Table C-1-14 shows each annual growth rate and projected population by localities which summed up about 782,000 and 1,100,000 in the target year 2,010 and 2,030 respectively.

Table C-1-13 Projected Population by Classification in Rawalpindi M.C.

Classification	Area (ha)	Item	1981		1987		1990		2000		2010		2020		2030			
			Population	Density	Population	Density	Population	Density	Population	Density	Population	Density	Population	Density	Population	Density	Population	Density
Old City (6-Wards) (45, 46, 47, 48, 49, 50)	67.74	A.G.R.	0.5		0.5		0.3		-0.1		-0.7		-0.8					
		Population	48,717		50,197		50,954		52,503		51,980		48,454		44,714			
		Density	719		741		752		775		767		715		660			
Inner City (18-Wards) (18, 19, 22, 25, 27, 28, 29, 30, 31, 32, 37, 38, 39, 40, 41, 42, 43, 44)	434.73	A.G.R.	1.3		1.3		1.0		0.7		0.4		0.1					
		Population	144,847		156,518		162,702		179,724		192,708		200,556		202,570			
		Density	333		360		374		413		443		461		466			
Semi Developed Area (8-Wards) (2, 5, 14, 16, 17, 23, 24, 33)	411.77	A.G.R.	3.1		3.1		2.6		1.9		1.1		0.3					
		Population	86,949		104,427		114,443		147,932		178,568		199,211		205,268			
		Density	211		254		278		359		434		483		499			
Scheme-Area (8-Wards) (1, 3, 4, 6, 7, 12, 13, 26)	769.72	A.G.R.	2.8		2.8		2.6		2.2		1.8		1.2					
		Population	83,739		98,829		107,365		138,785		172,522		206,215		252,540			
		Density	109		128		139		180		224		267		302			
Neglected Area (10-Wards) (8, 9, 10, 11, 15, 20, 21, 34, 35, 36)	1,029.54	A.G.R.	3.7		3.7		3.2		2.8		2.2		1.5					
		Population	101,138		125,772		140,256		192,184		253,507		314,888		365,440			
		Density	98		122		136		187		246		306		355			
Total	2,713.50	A.G.R.	2.59		2.43		2.13		1.79		1.33		1.01					
		Population	485,390		535,743		575,720		711,126		849,085		969,524		1,050,532			
		Density	172		197		212		262		313		357		387			

Note: A.G.R. Annual Growth Rate (%)

Area ha = Hectare

Density Persons Per Hectare

Table C-1-14 Projected Population by Ward in Rawalpindi Cantt.

Localities	Area (ha)	Item	1981	1987	1990	2000	2010	2020	2030
Ward No.01 A.P.	1,274.85	A.G.R. Population Density	37,187 29	45,447 36	50,243 39	66,222 52	82,321 65	95,536 75	108,707 85
Ward No.02	151.20	A.G.R. Population Density	38,876 257	46,150 305	50,282 332	60,102 398	64,444 426	66,403 459	66,403 459
Ward No.03	262.35	A.G.R. Population Density	32,594 124	39,834 152	44,037 167	58,042 221	72,152 275	82,914 316	87,154 332
Ward No.04	356.00	A.G.R. Population Density	29,099 82	35,770 100	39,658 111	53,297 150	67,561 190	79,966 225	90,097 255
Ward No.05 Ayub N.P. A.F.	1,346.85	A.G.R. Population Density	56,771 27	45,992 34	51,437 38	71,167 53	95,801 70	116,604 87	140,752 105
Ward No.06	267.00	A.G.R. Population Density	36,036 135	44,041 165	48,687 182	62,325 235	73,044 275	78,321 295	82,326 308
Ward No.07	176.00	A.G.R. Population Density	31,778 181	38,388 218	42,193 239	52,450 298	59,094 336	61,500 349	62,741 356
Ward No.08	1,175.85	A.G.R. Population Density	35,644 30	46,953 40	55,889 46	81,316 69	116,940 99	161,795 138	215,235 181
Ward No.09	540.45	A.G.R. Population Density	20,376 38	26,534 49	30,280 56	45,254 84	64,454 119	87,465 162	115,059 209
Ward No.10	581.40	A.G.R. Population Density	31,122 54	40,296 69	45,853 79	65,940 113	88,617 152	112,335 193	135,599 235
Total	6,131.95	A.G.R. Population Density	329,483 54	409,405 67	456,559 74	616,113 100	782,428 128	942,839 154	1,100,091 179

Note: * Census was recorded 45,456 for Ward No.01, but 8,269 of it was shifted to R.M.C. New Ward No.15 in 1982.

A.G.R. Annual Growth Rate (%)
 Density Persons Per Hectare
 A.P. Islamabad International Airport
 Ayub N.P. Ayub National Park
 A.F. Air Force Base

Table C-1-i5 Projected Population by Localities in Rawalpindi Rural Area

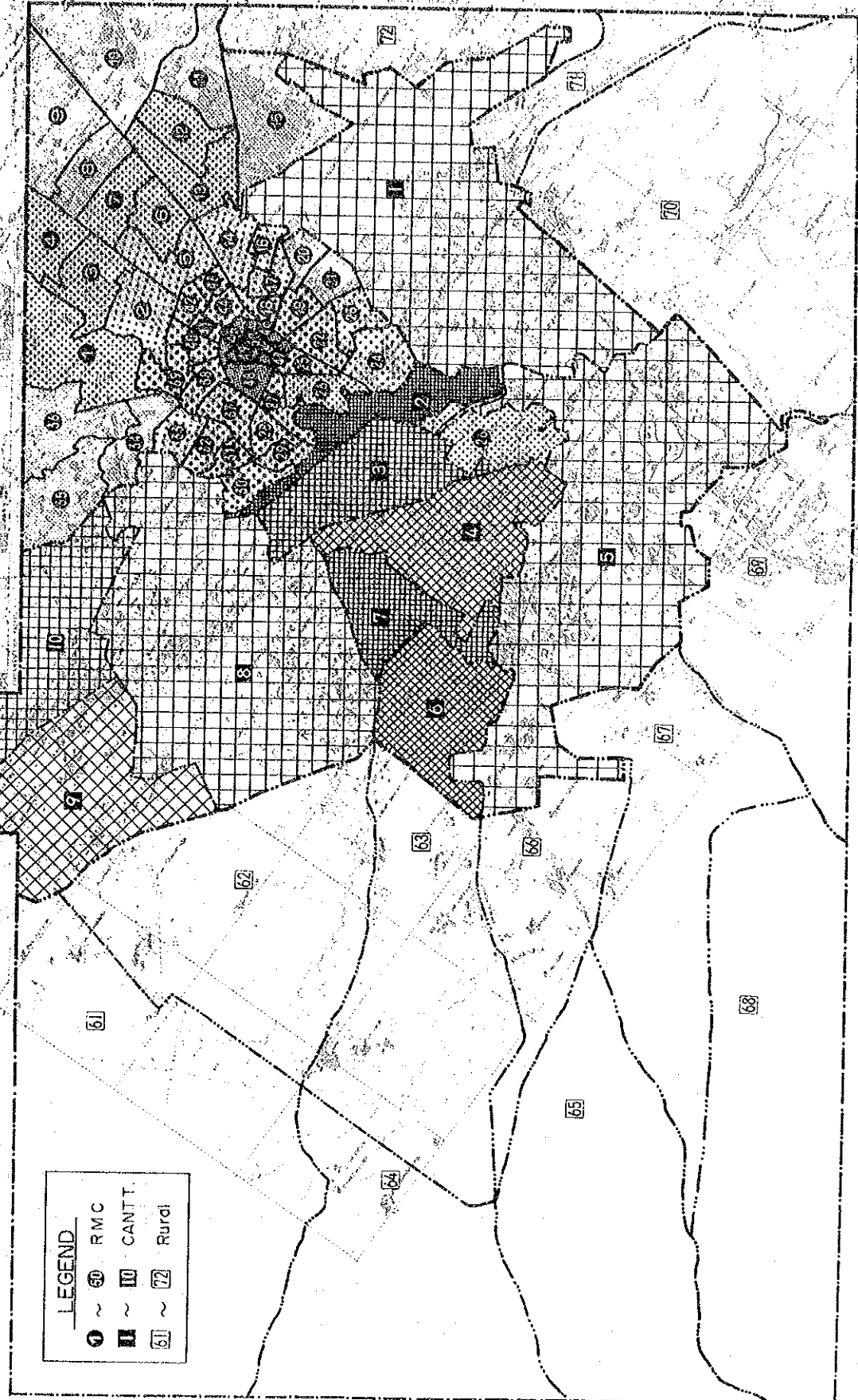
Localities	Area (ha)	Item	1981	1987	1990	2000	2010	2020	2030
WARD No.61	2,177.50	A.G.R. Population	1.4 3,290	1.4 3,576	1.6 3,728	2.0 4,369	2.5 5,325	2.9 6,816	9,071
WARD No.62	1,082.50	A.G.R. Population	2.5 3,386	2.5 3,926	2.2 4,228	1.8 5,255	1.7 6,281	1.5 7,434	8,627
WARD No.63	1,002.50	A.G.R. Population Density	2.5 7,319	2.5 8,388	2.1 8,981	1.9 11,055	1.6 13,344	1.4 15,639	17,971
					11	11	13	16	18
WARD No.64	1,073.75	A.G.R. Population	1.5 1,409	1.5 1,522	1.4 1,582	1.8 1,817	2.3 2,171	2.7 2,725	3,556
WARD No.65	1,178.75	A.G.R. Population	1.5 3,929	1.5 4,296	1.6 4,492	1.8 5,264	2.2 6,292	2.6 7,822	10,110
WARD No.66	517.50	A.G.R. Population Density	2.7 2,561	2.7 2,770	2.2 5,000	1.8 3,729	1.6 4,457	1.0 5,223	5,769
								10	11
WARD No.67	888.75	A.G.R. Population	2.5 2,962	2.5 3,435	2.0 3,699	1.6 4,509	1.2 5,384	0.9 5,953	6,510
WARD No.68	1,743.75	A.G.R. Population	1.2 699	1.2 750	1.3 778	1.4 885	1.5 1,017	1.7 1,180	1,396
WARD No.69	1,051.25	A.G.R. Population Density	2.8 18,227	2.8 21,511	2.1 25,569	1.7 28,767	1.5 34,048	1.3 39,514	44,961
			17	20	22	27	32	38	43
WARD No.70	1,733.00	A.G.R. Population Density	2.7 1,006	2.0 1,180	2.7 10,373	2.5 13,539	2.0 16,995	1.5 20,716	24,041
				+7,500			10	12	14
				=8,680					
WARD No.71	230.40	A.G.R. Population Density	2.2 16,169	2.2 18,424	2.0 19,667	1.7 25,973	1.4 28,374	1.0 32,606	36,017
			70	80	85	104	123	142	156
WARD No.72	353.40	A.G.R. Population Density	3.5 11,143	3.3 13,539	2.5 14,924	1.8 18,734	1.5 22,392	0.9 25,479	27,867
			52	58	42	53	63	72	79
Total	15,093.35		3.97 71,900	2.86 90,817	2.12 98,821	1.82 121,896	1.60 145,980	1.36 171,107	195,896

Note: Area Hectare

A.G.R. Annual Growth Rate (%)

Density ... Persons Per Hectare (indicated more than 10 person per hectare only)

Figure C-1-1
 Ward Location in Rawalpindi Area



- Rawalpindi Rural

Rural component of the service area of water supply in the future consists of about 40 villages of Rawalpindi Tehsil, and belt zone along with each main road spread from out cantonment area has been happened phenomena of haphazard sprawl for medium low/low income classes housing.

Consequently, rural area of the service area is divided into 12 wards along with each main road considering actual situation in accordance with final discussion among town planners of concerned authorities.

Projected population in the target year 2010 and 2030 are estimated at about 146,000 and 196,000 respectively, on the basis of each average annual growth rate, are shown in Table C-1-15.

All ward numbers for this study in Rawalpindi area is illustrated in Figure C-1-1.

d. Population Project of Rawalpindi Area

The background and results of population projection are summarized as under:

- RMC Area

- ° Old City - This is the oldest, smallest and most densely populated part of RMC area closed in by the surrounding Inner City with population density reaching 741 persons/ha in 1987. Only little growth of population (0.30% annually) is expected due to spatial limitations, and from 2000 onward it is estimated that population will take a downward trend due to accumulation of negative factors deriving from overcrowdedness. Overflowed

population will move to Inner City and other surrounding areas.

- Inner City - This area which is newer than Old City in its origination has more absorptive capacity with the space more than 6 times and the population density less than one half compared with Old City. The annual growth rate of population is limited (1.3%), but it will not turn negative up to 2030.
- Semi-Developed area - This area where middle or lower middle class people predominate retains a considerable absorptive capacity with the present population density of 254 persons/ha. It is estimated that population will grow at the annual rate of 3.1 percent with the growth rate gradually thinning out toward 2030.
- Scheme Area - This is the only area where schemed development has been applied. This area where middle or upper middle class people are concentrated has now the population density of 128 persons/ha, which is nearly a half compared with Semi Developed Area. In spite of that, annual growth rate of population is estimated to be lower than that of Semi-Development area (2.8%). This is because a part of upper middle class people is estimated to migrate to Islamabad.
- Neglected Area - This area with the lowest population density of 122 persons/ha and the largest space of over 1,000 ha plays the role of a haven for overflowed population from Old City and Inner City. At the same time it provides the abodes for rural migrants. Population is estimated to grow at the highest annual rate of 3.7 percent maintaining a certain level of growth rate for many years to come.

- Conclusion - RMC area as a whole is estimated at present to have the population density of 197 persons/ha, and population in this area is estimated to grow at the annual rate of 2.43 percent with the growth rate gradually declining to 1.01 percent toward the ultimate target year of 2030. The growth rate of 2.43 percent is the same as the annual inter-census growth rate of RMC population. The rate is markedly lower than the annual inter-census growth rate of urban population in Pakistan, which was 4.4 percent. This can be explained by the situation where a sizable proportion of RMC population centering around upper middle class people migrated to Islamabad and Rawalpindi Cantonment areas. This situation is expected to continue in future. The average annual growth rate of RMC population throughout the entire period 1987 to 2030 is calculated at 1.6 percent.

- Rawalpindi Cantonment

- Chaklala Cantonment - This area where Islamabad Airport is located nonetheless, has a strong absorptive capacity with the second largest space and the second lowest population density of 36 persons/ha. The growth rate of population is estimated to be 3.4 percent declining to 1.3 percent toward 2030.
- Central Area - This is the central area of Rawalpindi Cantonment where government office, public facilities, high level government and private residences and various commercial establishments are located. Ward No.2 has the smallest space and the highest population density of 305 persons/ha.

Nevertheless, population is estimated to grow at the annual rate of 2.9 percent because of the attractiveness of the place, although the growth rate will rapidly thin out due to density pressure. Ward No.3 is characterized as a commercial areas and has an attraction comparable to Ward No.2. With the population density of 152 persons/ha it has a considerable absorptive capacity and population is estimated to grow at the annual rate of 3.4 percent. In Ward No.4 official residences of the President and Prime Minister of Pakistan are located. This Ward where upper class people reside has much room for population absorption with the population density of 100 persons/ha. Annual growth rate of population is estimated at 3.5 percent. Ward No.7 has the second smallest space and the second highest population density of 218 persons/ha. The annual growth rate of population will be high (3.2%) due to the continued migration of lower middle class people. However, it will rapidly decline owing to spatial constraints.

- ° South Area - Ayub National park and Air Force Base are located in Ward No.5. This ward with the largest space and the lowest population density of 34 persons/ha lies farthest from the central area of Cantonment. Because of its strong absorptive capacity it is expected that inflow of middle class people will continue at the annual rate of 3.8 percent. The rate will gradually decline as years go by, but will maintain a certain level up to the target year. Ward No.6 is known for Tanch Bhata Bazar, one of large bazar in Rawalpindi. It has a comparatively high population density of 165 persons/ha due to the occupancy of the bazar.

However, annual growth rate of population is estimated to be relatively high (3.4%) due to the continued migration of middle or lower middle class people.

- Westridge and West Areas - Population is settling along GT Road. Government offices are moving to Ward No.8. Ward No.9 and No.10 form the so-called industrial zone. The area with the population density of 40 to 70 persons per ha has a very strong absorptive capacity and population is estimated to grow at the annual rate of 4.4 percent to 4.7 percent with the growth rate maintaining a certain level up to 2030.
- Conclusion - Population of Rawalpindi Cantonment as a whole is estimated to grow at the annual rate of 3.70 percent, while the annual inter-census population growth rate of the area was 4.02 percent. During the inter-census period the annual growth rate of urban population in Pakistan was 4.4 percent. There exists a certain closeness between the two rates. The average population density in the area is only 67 persons/ha, and the comparatively high growth rate attained can be attributed to the inflows of overflowed population of RMC area and urbanized population of Rawalpindi rural area. Also, migration of population to Islamabad may explain the slightly lower growth rate of Cantonment population than that of the national average. The average annual population growth rate of the area throughout the entire period 1987 to 2030 is calculated at 2.3 percent.

Projected population in Rawalpindi urban area is summarized in Table C-1-16.

Table C-1-16 Projected Population in Rawalpindi Urban Area

Localities	Area (ha)	Item	1981	1987	1990	2000	2010	2020	2030
Rawalpindi CANTT.	6,151.95	A.G.R.	3.69	5.70	5.04	2.42	1.88	1.56	1.56
		Population	329,483	409,405	456,559	616,113	782,428	942,839	1,100,091
		Density	54	67	74	100	128	154	179
Rawalpindi M.C.	2,713.50	A.G.R.	2.39	2.45	2.13	1.79	1.55	1.01	1.01
		Population	465,390	555,743	575,720	711,126	849,085	969,524	1,050,532
		Density	172	197	212	262	313	357	387
Total	8,845.70	A.G.R.	2.92	2.98	2.55	2.09	1.60	1.18	1.18
		Population	794,873	945,148	1,032,279	1,327,239	1,631,513	1,912,165	2,150,423
		Density	90	107	117	150	184	216	245

Note: A.G.R. Annual Growth Rate (%)
 Density Persons Per Hectare

- Rawalpindi Rural Area - This area plays the role of receptacle for overflowed population from surrounding urban areas. Population are settling along trunk roads, Wards No.69 to No.72 receive direct populational impacts from Rawalpindi urban area. Remaining wards will virtually remain rural for many years to come. On average, areal population is estimated to grow at the annual rate of 2.86 percent, which is slightly higher than the annual inter-census growth rate of rural population in Pakistan, which was 2.6 percent. The growth rate of areal population will decline toward the target year and the average annual growth rate over the entire period 1987 to 2030 works out at 1.8 percent.

(3) Summary of Population Projection

The results of population projection are summarized in Table C-1-17.

Table C-1-17. Summary of Projected Population

(Unit: Persons)

Service Area	1987	2000	2010	2030
Islamabad Proper	284,000	621,000	760,000	1,006,000
Rawalpindi Area	1,036,000	1,449,000	1,777,000	2,346,000
Urban Area*	945,000	1,327,000	1,631,000	2,150,000
CANTT	409,000	616,000	782,000	1,100,000
RMC	536,000	711,000	849,000	1,050,000
Rural Area	91,000	122,000	146,000	196,000
Total	1,320,000	2,070,000	2,537,000	3,352,000

Note: This Table was obtained by consolidating Tables C-1-6, C-1-13, C-1-14 and C-1-15.

* Projected population in Rawalpindi urban area is summarized in Table C-1-16.

Population in the service area is estimated to reach 2,537,000 in 2010 and 3,352,000 in 2030. Trend of population increase towards final target year 2030 is shown in Figure C-1-2 for Islamabad and Figure C-1-13 for Rawalpindi respectively.

It is evident that the value of population between CANTT and RMC will be reversed after the year in 2030 as shown in Figure C-1-3.

(4) Future Served Area and Population Served

The future served area and population served are projected considering the population increase, socio-economic condition, and the target of the future city plan.

a. Islamabad

The future served area of Islamabad should be projected on the basis of the population increase in the proper area and saturated population in each sectoral area according to the CDA development programme. While the work on the review of the development programme shall begin shortly by CDA and the future served area is estimated to expand up to the series 16 in accordance with the original development plan as shown Figure IV-1-1 of Main Report.

The present service ratio is estimated at 100 percent based on the Housing Census Report in 1980. The service ratio in the future is therefore to be 100 percent, the future served population is estimated in Table C-1-18.

b. Rawalpindi

The future served area of Rawalpindi is projected to over all the administrative area of RMC and CANTT including surrounding rural area as shown Figure IV-1-1 of Main Report.

The present and future service ratio are estimated with gradual increase ratio and living level, the future served population is estimated and shown in Table C-1-18.

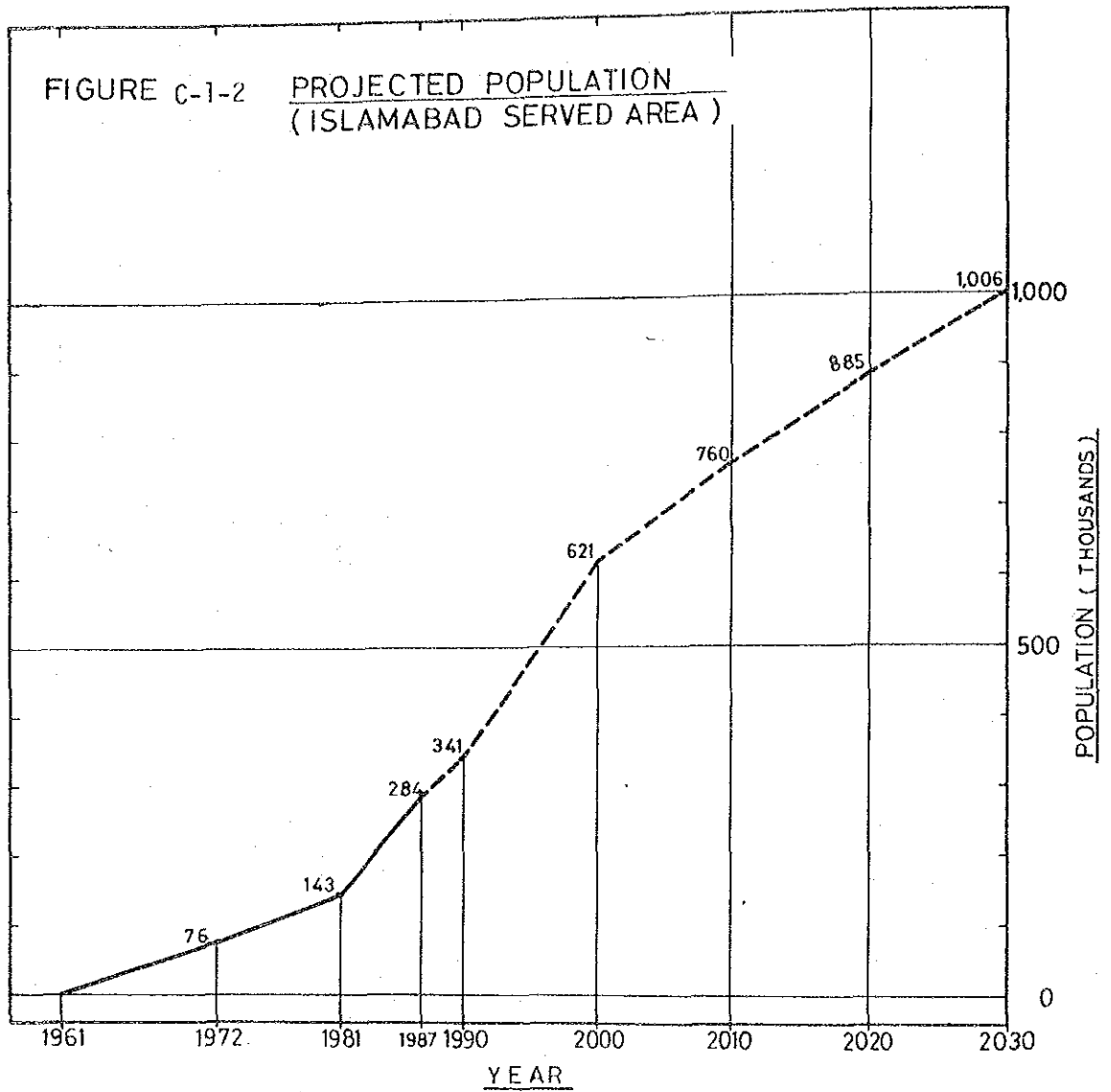


FIGURE C-1-3 PROJECTED POPULATION AND POPULATION SERVED (RAWALPINDI SERVED AREA)

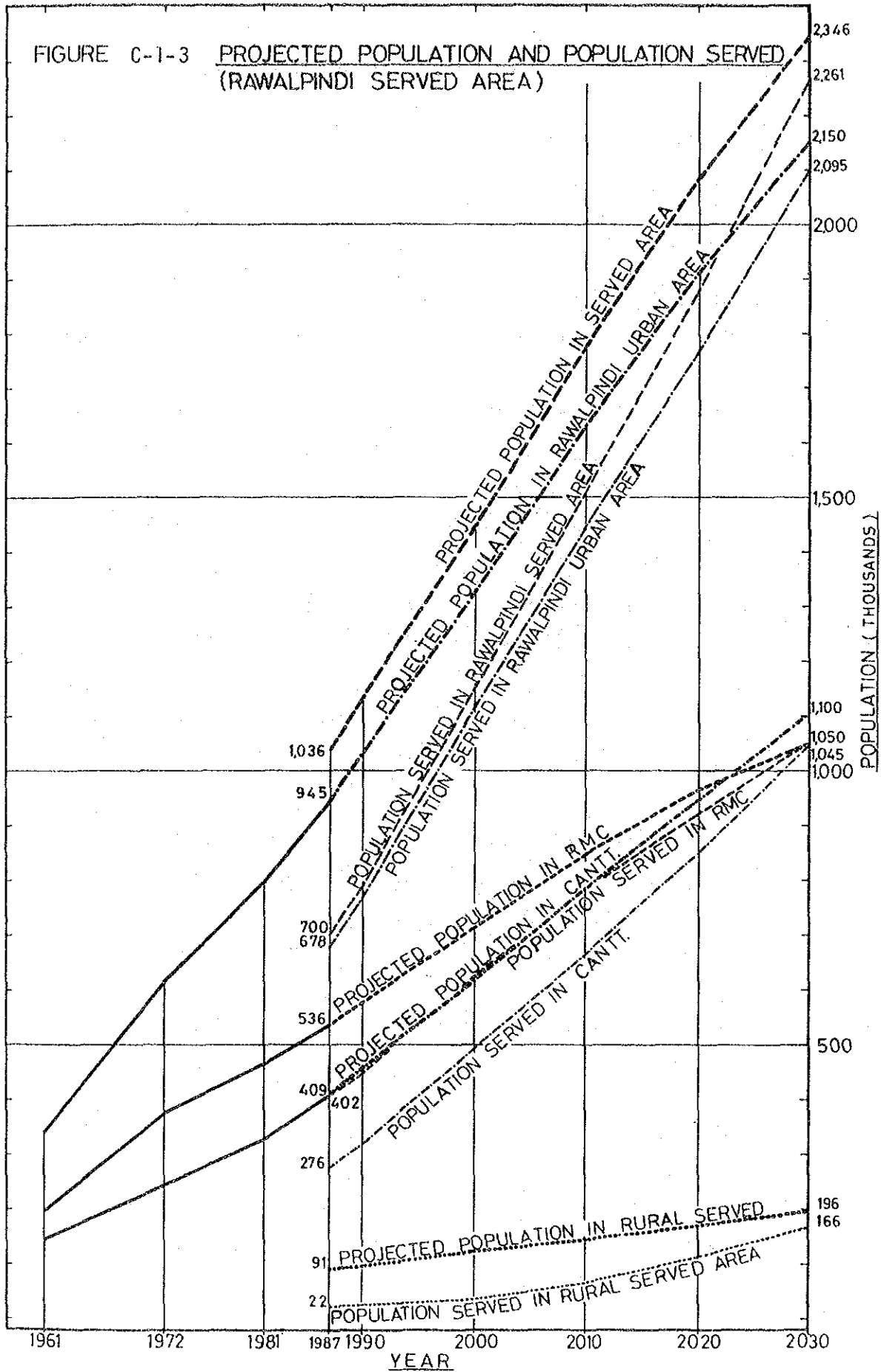


Table C-1-18 FUTURE SERVICE RATIO AND POPULATION SERVED

<u>Service Area</u>	<u>Item</u>	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Islamabad Proper	Population	284	621	760	1,006
	Service Ratio	100	100	100	100
	Population Served	284	621	760	1,006
Rawalpindi CANTT.	Population	409	616	782	1,100
	Service Ratio	67.5	80	85	95
	Population Served	276	492	664	1,045
RMC	Population	536	711	849	1,050
	Service Ratio	75	87.5	92	100
	Population Served	402	622	781	1,050
Sub-Total	Population	945	1,327	1,631	2,150
	Population Served	678	1,114	1,445	2,095
	(Service Ratio)	(71.7)	(83.9)	(88.6)	(97.4)
Rural	Population	91	122	146	196
	Service Ratio	25	30	45	85
	Population Served	22	36	65	166
Total	Population	1,036	1,449	1,777	2,346
	Population Served	700	1,150	1,510	2,261
	(Service Ratio)	(68.5)	(79.4)	(85)	(96.4)
Grand Total	Population	1,320	2,070	2,537	3,352
	Population Served	984	1,771	2,270	3,267

Note ; Population -- 1,000 persons

Service Ratio -- Percent

C.1.3. Water Demand Projection

(1) Definition of Water Demand

In general, urban water is supplied for domestic, public, commercial and industrial purposes, and it includes wastage and leakage. In an area like Rawalpindi CANTT, military water should be taken into consideration in addition to the above categories of water uses.

Respective components mentioned above are further divided into the following;

<u>Categories</u>	<u>Water Uses in Detail</u>
Domestic Use:	<u>Individual Use</u> ; Drinking, Washing, Shower, Shampoo, Flush Lavatory and Prayers' Purification <u>Household Use</u> ; Cooking (Preparation and Washing), Laundry, Cleaning, Car Washing, Bathing and Garden Irrigation
Public Use:	Governmental Offices, Educational Institutions, Schools and Universities, Embassies, Hospitals, Railway Stations, Mosques, Churches, and Parks.
Commercial/Industrial Use:	Commercial Entities (Retailers, Wholesales), Hotels, Restaurants, Theaters, Industries, Factories and Workshops
Military Use:	Military Facilities in Rawalpindi Cantonment
Leakage and Wastage:	

Water demand in the future could be defined as the sum of the net total consumers' demand and leakage/wastage. The net total consumers' demand is estimated from the present water consumption in each category in consideration of the future development plans, population increase and the other data concerned. Leaking and wastage of a system are estimated from the present measured quantities and the target figures of them which are obtained under

the existing conditions of the present water supply system in consideration of its improvements to be made in the future.

(2) Domestic Water Consumption

The domestic water consumption in the metropolitan area of Islamabad-Rawalpindi is classified into Classes A, B, C, D, and E by water consumption levels which are mainly attributable to the living conditions of citizens.

The domestic water consumption by families is computed in consideration of different water uses such as cooking, laundry, cleaning, car washing and sprinkling, and then the consumption per capita is computed, taking into account drinking, washing face and hands, shower, lavatory and prayers' purifying, from the above mentioned consumption by families and based on the analytical data obtained in the socio-economic survey.

The daily consumption per capita at the beginning of year 1987 by classes in each city is as follows;

<u>Sub-areas</u>	<u>(Unit; lcd (gcd))</u>					
	<u>Class A</u>	<u>Class B</u>	<u>Class C</u>	<u>Class D</u>	<u>Class E</u>	<u>Stand Pipe</u>
Islamabad Proper	350 (77.0)	299 (65.8)	230 (50.6)	193 (42.5)	153 (33.7)	-
Rawalpindi Urban	289 (63.6)	248 (54.6)	190 (41.8)	121 (26.6)	121 (26.6)	50 (11.0)

On the other hand, the served population as of the beginning of 1987 by classes in each urban sub-area has been projected based on the actual site investigation and discussions made with Town Planners of CDA and RMC as follows;

<u>Classes</u>	<u>Islamabad Proper</u>	<u>Rawalpindi Urban</u>
A	32,300(11.4 %)	16,100(2.4 %)
B	28,000(9.9 %)	28,600(4.2 %)
C	51,800(18.2 %)	69,900(10.3 %)
D	127,700(45.0 %)	151,300(22.3 %)
E	44,200(15.5 %)	225,200(33.2 %)
Stand Pipe	--	186,900(27.6 %)
<u>Total</u>	<u>284,000(100.0 %)</u>	<u>678,000(100.0 %)</u>

The averaged daily consumption per capita in each urban sub-area at the beginning of 1987 has been computed based on the above-mentioned daily consumption per capita and the served population by classes as follows (refer to Table C-1-19 and C-1-20).

<u>Islamabad Proper</u>	<u>Rawalpindi Urban Area</u>
222lcd (49 gcd)	118 lcd (26 gcd)

The above figures show a distinct difference in the water consumption per capita between the twin urban sub-areas, Islamabad Proper and Rawalpindi urban area, mainly due to different living conditions of citizens in the twin cities.

The future daily water demand per capita for domestic uses has been projected below based on its past trend and movement, its elasticity, the income of citizens, the combined growth rate of the served population and the economy, and the extend and level of the said demand in other comparable cities until the target years;

<u>Sub-areas</u>	(Unit: lcd (gcd))			
	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Islamabad Proper	222(49)	236(52)	245(54)	257(56)
Rawalpindi Urban	118(26)	151(33)	177(39)	227(50)
Rawalpindi Rural	-	150(33)	177(39)	227(50)

Table C-1-19 Average Water Consumption for Domestic Use
of Islamabad Proper Area

(as of beginning of 1987)

Class	Per Capita		Population Served	Consumption	
	lcd	(gcd)	Persons	cmd	(mgd)
A	350	(77.0)	32,300	11,305	(2.49)
B	299	(65.8)	28,000	8,372	(1.84)
C	230	(50.6)	51,800	11,914	(2.62)
D	193	(42.5)	127,700	24,646	(5.42)
E	153	(33.7)	44,200	6,762	(1.49)
<u>Total</u>			<u>284,000</u>	<u>62,999</u>	<u>(13.86)</u>
<u>Average Per Capita</u>				<u>222 lcd</u>	<u>(49 gcd)</u>

Table C-1-20 Average Water Consumption for Domestic Use
of Rawalpindi Urban Area

(as of beginning of 1987)

Class	Per Capita		Population Served	Consumption	
	lcd	(gcd)	Persons	cmd	(mgd)
A	289	(63.6)	16,100	4,652	(1.02)
B	248	(54.6)	28,600	7,092	(1.56)
C	190	(41.8)	69,900	13,281	(2.92)
D	121	(26.6)	151,300	18,306	(4.03)
E	121	(26.6)	225,200	27,249	(5.99)
Stand Pipe	50	(11.0)	186,900	9,345	(2.06)
<u>Total</u>			<u>678,000</u>	<u>79,925</u>	<u>(17.58)</u>
<u>Average Per Capita</u>				117.9	
				≅ 118 lcd	(26 gcd)

The average daily demand for domestic water in the target years has been basically estimated by multiplying the served population by the daily demand per capita for domestic water in respective target years as follows;

(Unit: MLD (MGD))

<u>Sub-areas</u>	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Islamabad Proper	63.0 (13.9)	146.6 (32.2)	186.2 (41.0)	258.5 (56.9)
Rawalpindi Urban	80.0 (17.6)	166.9 (36.7)	256.3 (56.4)	475.6 (104.6)
Rawalpindi Rural	-	5.5 (1.2)	11.5 (2.5)	37.6 (8.3)

(3) Public Water Consumption

The public water consumers include such establishments as governmental offices, educational institutions, embassies, hospitals and dispensaries, railway stations, mosques, churches and parks.

As a salient feature of Islamabad Proper Area, this new capital has structurally provided itself with dynamic and parallel development of several functions such as administrative, diplomatic and public ones. The public water consumption is high ranked in Islamabad Proper after the domestic water consumption, accordingly.

On the other hand, the public water consumption in Rawalpindi Urban Area is very small in comparison with that in Islamabad Proper. The public water consumption at the beginning of 1987 in each urban sub-area has been estimated from the number of the above-mentioned establishments informed by Town Planners and Municipal Engineers of CDA and RMC, and the number of employees and the consumption data obtained in the socio-economic survey. The total consumption in this category of water use is summarized below;

	<u>Islamabad Proper</u>	<u>Rawalpindi Urban</u>
Averaged Daily	42.9 MLD (9.4 MGD)	12.1 MLD (2.7 MGD)
Per Capita	151 lcd (33 gcd)	18 lcd (4 gcd)

The average daily demand for water in public use in the target years is estimated from the present average daily consumption, the growth rates of the served population and the regional economy especially for Rawalpindi, while the same use in Islamabad is estimated by using a lower increasing rate than that in Rawalpindi due to high functions of the city having been already attained.

Future average daily demand for public use in respective target years is prospected below;

<u>Sub-area</u>	(Unit: MLD (MGD))			
	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Islamabad Proper Area	42.9 (9.4)	44.0 (9.7)	45.8 (10.1)	65.5 (14.4)
Rawalpindi Urban	12.1 (2.7)	32.3 (7.1)	53.6 (11.8)	93.2 (20.5)
Rawalpindi Rural	-	0.7 (0.2)	1.7 (0.4)	5.9 (1.3)

(4) Commercial and Industrial Water Consumption

The commercial and industrial water is consumed by commercial retailers, wholesalers, hotels, restaurants, theaters, industries, factories, manufacturers and workshops, and its consumption in each urban sub-area as of beginning of 1987 is estimated from numbers of commercial and industrial units, the combining scale of enterprise, the numbers of employee, and other consumption data obtained in the socio-economic survey as shown below;

<u>Item</u>	<u>Islamabad Proper</u>	<u>Rawalpindi Urban</u>
Average Daily	34.6 MLD (7.6 MGD)	20.9 MLD (4.6 MGD)
Per Capita	122 lcd (27 gcd)	31 lcd (7 gcd)

The projection of the average daily consumption of commercial and industrial water in the twin urban sub-area reveals that Islamabad proper area is blessed with abundant water in comparison with Rawalpindi urban area.

The average daily demand for commercial/industrial water in respective target years has been computed from the present average daily consumption taking into consideration the combining growth rates of the served population and the economical development up to the target years. The future average daily demand is estimated as follows;

<u>Sub-areas</u>	<u>(Unit: MLD (MGD))</u>			
	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Islamabad Proper Area	34.6 (7.6)	72.4 (15.9)	92.7 (20.4)	126.4 (27.8)
Rawalpindi Urban	20.9 (4.6)	37.9 (8.3)	63.1 (13.9)	118.5 (26.1)
Rawalpindi Rural	- -	0.7 (0.2)	2.0 (0.4)	8.4 (1.8)

(5) Military Water Consumption

The consumers in this category include Army, Air Force, and their residents in Rawalpindi CANTT, and International Airport as well. According to the information of Military Engineering Service (MES) in Rawalpindi, the military water consumption at the beginning of 1987 was about 11.8 MLD (2.6 MGD).

The average daily demand for water military use in year 2000 has been estimated at 31.8 MLD (7.0 MGD) in accordance with the request by MES. Future average daily demand after 2000 has been forecasted with a low incremental rate as indicated below;

	<u>(Unit: MLD (MGD))</u>			
	<u>1987</u>	<u>2000</u>	<u>2010</u>	<u>2030</u>
Military Use	11.8 (2.6)	31.8 (7.0)	37.8 (8.3)	52.2 (11.5)

(6) Leakage and Wastage

The sum of leakage and wastage is larger than any other categories of water use in both cities. Reportedly it reaches about 30 percent of the total water production. Water charge is collected without measuring water consumption in quantity. Moreover, due to the present intermittent water supply, users forget to turn off a water tap after using water, resulting in a large wastage. People pay no attentions to wastage. Materials being used for the present water system are poor in quality. There are some technical problems which has caused leakage and wastage. These constraints are complicatedly linked, and caused the above-mentioned sum of leakage and wastage.

In formulating a long range plan of water supply in the final target year 2030, it is important to reduce the leakage and wastage as much as possible. It is important for reducing the cost of related water resources facilities.

Therefore, the causes of leakage and wastage will be clarified so as to reduce the sum of leakage and wastage at some 20 percent in year 2030 by comprehensive effort for improvement. The figures of leakage and wastage in target years before the final one are 30 percent in 1987, 27.5 percent in 2000, and 25.0 percent in 2010.

(7) Determination of Average Daily Water Demand

A trend of average daily water demand in years 2010 and 2030 was projected based on the basic unit of water consumption in each category mentioned in the previous paragraph in consideration of an increasing demand due to the improvement of social and environmental circumstances which is anticipated at present, and a result of the projection is shown in Tables C-1-21, C-1-22 and C-1-23.

Table C-1-21 Projected Population and Water Demand of Islamabad Proper Area

Item	1987	2000	2010	2030
Total Population	284,000	621,000	760,000	1,006,000
Population Served	284,000	621,000	760,000	1,006,000
Service Ratio (%)	100	100	100	100
Water Demand				
				Unit: MDL (MGD)
Domestic Use	63.0 (13.9)	146.6 (32.2)	186.2 (41.0)	258.5 (56.9)
Public Use	42.9 (9.4)	44.0 (9.7)	45.8 (10.1)	65.5 (14.4)
Commercial / Industrial Use	34.6 (7.6)	72.4 (15.9)	92.7 (20.4)	126.4 (27.8)
Leakage / Wastage Use	60.3 (13.3)	99.7 (21.9)	108.3 (23.8)	112.6 (24.7)
(Percentage of L/W to demand)	(30)	(27.5)	(25)	(20)
<u>Total</u>	<u>200.8 (44.2)</u>	<u>362.7 (79.7)</u>	<u>433.0 (95.5)</u>	<u>563.0(123.8)</u>
Average Daily Demand	200.8 (44.2)	362.7 (79.7)	433.0 (95.5)	563.0(123.8)
Maximum Daily Demand	251.0 (55.2)	453.4 (99.7)	541.3(119.1)	703.8(154.8)
Per Capita Daily Demand				
				Unit: LCD (GCD)
Domestic Use	222 (49)	236 (52)	245 (54)	257 (56)
<u>Total</u>	<u>707 (155)</u>	<u>584 (128)</u>	<u>570 (125)</u>	<u>560 (123)</u>

Note: Average daily demand in 1987 is actual existing value.

Table C-1-22 Projected Population and Water Demand of Rawalpindi Urban Area

Item	1987	2000	2010	2030
Total Population	945,000	1,327,000	1,631,000	2,150,000
Population Served	678,000	1,114,000	1,445,000	2,095,000
Service Ratio (%)	71.7	83.9	88.6	97.4
Water Demand				
				Unit: MLD (MGD)
Domestic Use	80.0 (17.6)	166.9 (36.7)	256.3 (56.4)	475.6 (104.6)
Public Use	12.1 (2.7)	32.3 (7.1)	53.6 (11.8)	93.2 (20.5)
Commercial / Industrial Use	20.9 (4.6)	37.9 (8.3)	63.1 (13.9)	118.5 (26.1)
Military Use	11.8 (2.6)	31.8 (7.0)	37.8 (8.3)	52.2 (11.5)
Leakage / Wastage Use	53.5 (11.7)	102.0 (22.4)	137.0 (30.1)	184.9 (40.6)
(Percentage of L/W to demand)	(30)	(27.5)	(25)	(20)
<u>Total</u>	<u>178.3 (39.2)</u>	<u>370.9 (81.5)</u>	<u>547.8 (120.5)</u>	<u>924.2 (203.5)</u>
Average Daily Demand	178.3 (39.2)	370.9 (81.5)	547.8 (120.5)	924.2 (203.3)
Maximum Daily Demand	222.9 (49.0)	463.6 (102.0)	684.8 (150.6)	1,155.3 (254.1)
Per Capita Daily Demand				
				Unit: LCD (GCD)
Domestic Use	118 (26)	151 (33)	177 (39)	227 (50)
<u>Total</u>	<u>263 (58)</u>	<u>333 (73)</u>	<u>379 (83)</u>	<u>441 (97)</u>

Note: Average daily demand in 1987 is actual existing value.

Table C-1-23 Projected Population and Water Demand of Rawalpindi Rural Area

Item	1987			2000			2010			2030		
	West Area	East Area	Total	West Area	East Area	Total	West Area	East Area	Total	West Area	East Area	Total
Population	29,000	62,000	91,000	37,000	85,000	122,000	44,000	102,000	146,000	63,000	133,000	196,000
Population Served	8,000	14,000	22,000	11,000	25,000	36,000	19,000	46,000	65,000	46,000	120,000	166,000
Service Ratio (%)	27.6	22.6	24.2	30	29.4	30	43	45	44.5	73	90	85
Water Demand												
Domestic Use	1.7	3.8	5.5	3.4	8.1	11.5	3.4	8.1	11.5	10.4	27.2	37.6
Public Use	0.2	0.5	0.7	0.5	1.2	1.7	0.5	1.2	1.7	1.6	4.3	5.9
Commercial / Industrial Use	0.2	0.5	0.7	0.6	1.4	2.0	0.6	1.4	2.0	2.3	6.1	8.4
Leakage / Wastage Use	0.8	1.8	2.6	1.5	3.6	5.1	1.5	3.6	5.1	3.6	13.0	15.0
<u>Total</u>	<u>0.3</u>	<u>0.8</u>	<u>0.5</u>	<u>2.9</u>	<u>6.6</u>	<u>9.5</u>	<u>6.0</u>	<u>14.5</u>	<u>20.3</u>	<u>17.9</u>	<u>47.0</u>	<u>64.9</u>
Average Daily Demand	0.3	0.5	0.8	2.9	6.6	9.5	6.0	14.3	20.3	17.9	47.0	64.9
Maximum Daily Demand				(0.6)	(1.5)	(2.1)	(1.3)	(3.1)	(4.4)	(3.9)	(10.3)	(14.2)
				7.5	17.9	22.4	(1.6)	(3.9)	(5.5)	22.4	58.8	81.2
										(4.9)	(12.9)	(17.8)
Per Capita Daily Demand												
Domestic Use												
<u>Total</u>												
				150	(33)	117	177	(39)	138	227	(50)	187
				264	(58)	206	312	(69)	243	391	(86)	305

Note: Average daily demand in 1987 is actual existing value.

The average daily water supply for each service area is tabulated below.

Sub-area	(Unit: cmd (MGD))		
	1987	2010	2030
Islamabad Proper Area	200,800 (44.2)	433,000 (95.3)	563,000 (123.8)
Rawalpindi RMC	102,000 (22.4)	284,300 (62.5)	446,400 (98.2)
CANTT	76,300 (16.8)	263,500 (58.0)	477,800 (105.1)
Rural East Area	500 (0.1)	14,300 (3.1)	47,000 (10.3)
Rural West Area	300 (0.1)	6,000 (1.3)	17,900 (3.9)
Sub-total	179,100 (39.4)	568,100 (124.9)	989,100 (217.5)
Total	379,900 (83.6)	1,001,100 (220.2)	1,552,100 (341.3)

This table show that the total average daily demand in Islamabad proper area, Rawalpindi urban area and Rawalpindi rural area in 2010 will be 433 MLD (95.3 MGD), 547.8 MLD (120.5 MGD) and 20.3 MLD (4.4 MGD), respectively. As a result, the total average daily demand for urban water in Metropolitan service area as a whole comes to 1,001.1 MLD (220.2 MGD) in the target year 2010. The total daily demand per capita in Islamabad, Rawalpindi urban area and Rawalpindi rural area in year 2010 is calculated at 570 lcd (125 gcd), 379 lcd (83 gcd) and 312 lcd (69 gcd) by dividing the total average demand by the forecasted served population.

The percentage of the water demand for each usage to the total demand in sub-areas in year 2010 is as follows;

Usage	Islamabad	Rawalpindi	
	Proper Area (%)	Urban Area (%)	Rural Area (%)
Domestic Use	43.0	46.8	56.7
Public Use	10.6	9.8	8.4
Commercial/Industrial Use	21.4	11.5	9.9
Military Use	-	6.9	-
Leakage/Wastage	25.0	25.0	25.0
<u>Total</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

The total average daily demand in Islamabad proper area, Rawalpindi urban area and its rural area in 2030 will be 563 MLD (123.8 MGD), 924.2 MLD (203.3 MGD) and 64.9 MLD (14.2 MGD), respectively, and the total average daily demand for urban water in the metropolitan service area as a whole comes to 1,552.1 MLD (341.3 MGD) in the target year 2030. The total daily demand per capita in year 2030 in the said sub-area is calculated at 560 lcd (123 gcd), 441 lcd (97 gcd) and 391 lcd (86 gcd) as shown in Tables C-1-21, C-1-22 and C-1-23, respectively.

The percentage of water demand for each usage to the total demand by sub-areas in year 2030 is as follows;

Usage	Islamabad	Rawalpindi	
	Proper Area (%)	Urban Area (%)	Rural Area (%)
Domestic Use	45.9	51.5	57.9
Public Use	11.6	10.1	9.1
Commercial/Industrial Use	22.5	12.8	13.0
Military Use	-	5.6	-
Leakage/Wastage	20.0	20.0	20.0
<u>Total</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

(9) Determination of Maximum Daily Demand Projection

In the feasibility study report prepared by JICA in 1985 the maximum daily demand is estimated at 125 % of the average daily demand in consideration of the weather conditions of fluctuating temperatures and rainfalls and the size of both cities. According to the information of Lahore city which is similar to

Islamabad/Rawalpindi in the scale of water demand in year 2000, the ratio of the maximum demand against the average demand was 1.22 in 1985.

Therefore, the maximum daily demand equivalent to 125 % of the average daily demand is adopted in the Study. This value is considered to be reasonable compared with those of the similar cities in size and type in the world including Japan.

The designed maximum daily water supply for each service area is tabulated below;

Sub-area	(Unit: cmd (MGD))		
	1987	2010	2030
Islamabad Proper Area	251,000 (55.2)	541,300 (119.1)	703,800 (154.8)
Rawalpindi RMC	127,500 (28.0)	355,400 (78.2)	558,000 (112.7)
CANTT	95,400 (21.0)	329,400 (72.4)	597,300 (131.4)
Rural East Area	600 (0.1)	17,900 (3.9)	58,800 (12.9)
Rural West Area	400 (0.1)	7,500 (1.6)	22,400 (4.9)
Sub-total	223,900 (49.2)	710,200 (156.1)	1,236,500 (271.9)
Total	474,900 (104.4)	1,251,200 (275.2)	1,940,300 (426.7)

The total maximum daily demands in Islamabad proper area, Rawalpindi urban area and its rural area in each target year are computed by multiplying the maximum daily factor by the average daily demand, and shown in Tables C-1-21, C-1-22 and C-1-23, respectively. As shown in tables, the total maximum daily demand in the said sub-areas in 2010 will be 541.3 MLD (119.1 MGD), 684.8 MLD (150.6 MGD) and 25.4 MLD (5.5 MGD), respectively. As a result, the total maximum daily demand for urban area in the Metropolitan service area as a whole comes to 1,251.5 MLD (275.2 MGD) in the target year 2010.

The total maximum daily demand in the said sub-areas in 2030 will be 703.8 MLD (154.8 MGD), 1,155.3 MLD (254.1 MGD) and 81.2 MLD (17.8 MGD), respectively, and the total maximum daily demand for urban water in the Metropolitan service area as a whole is 1,940.3 MLD (426.7 MGD) in the target year 2030. This maximum daily demand will be applied to the planning of intake facilities and main conveyance pipelines for raw water.

The trend of the projected daily water demand towards year 2030 in Islamabad proper area and Rawalpindi urban area is illustrated in Figures C-1-4 and C-1-5, respectively, while the summary of the projected daily water demand in each sub-area in the target year is illustrated in Figure C-1-6.

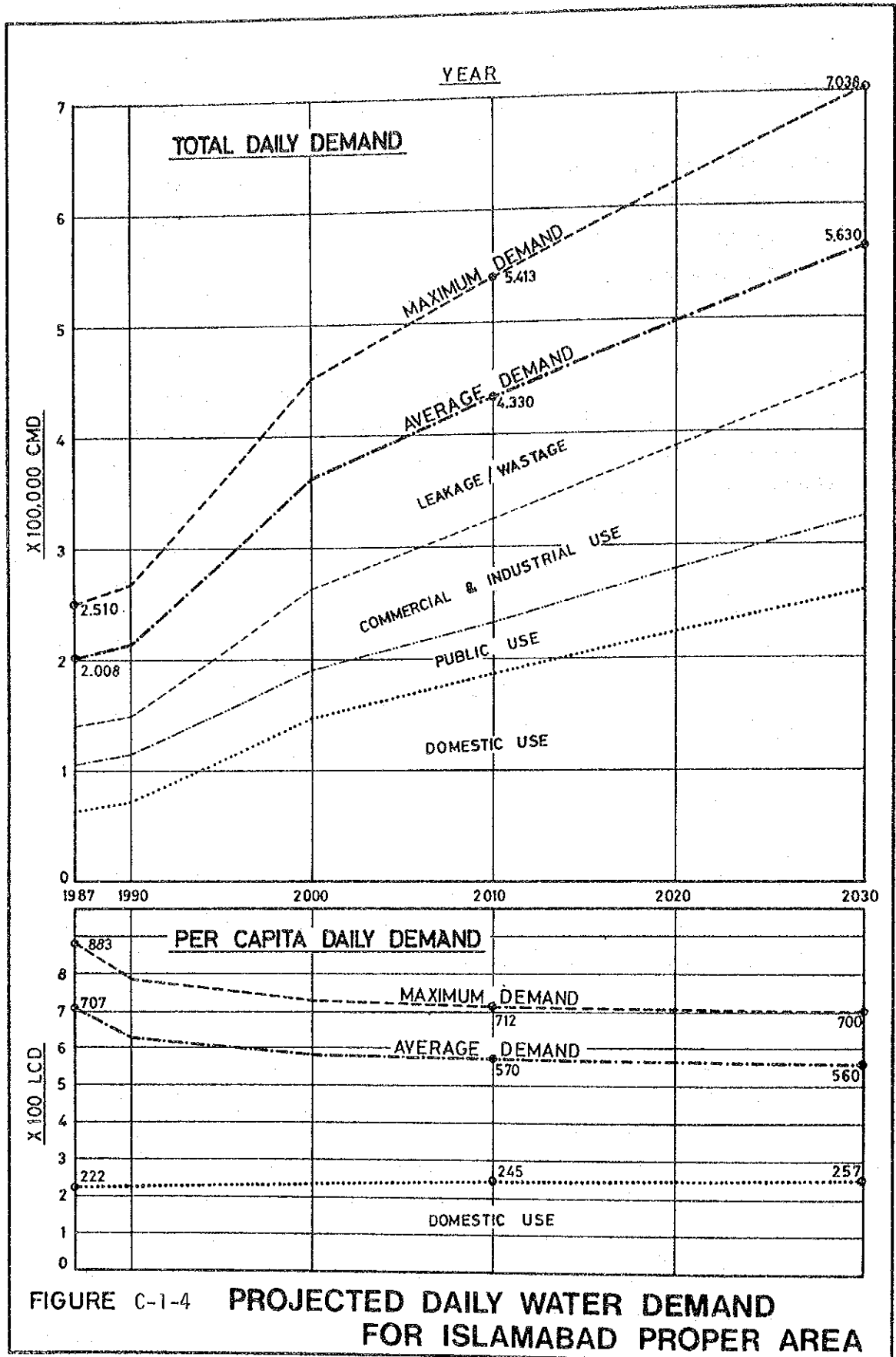


FIGURE C-1-4 PROJECTED DAILY WATER DEMAND FOR ISLAMABAD PROPER AREA

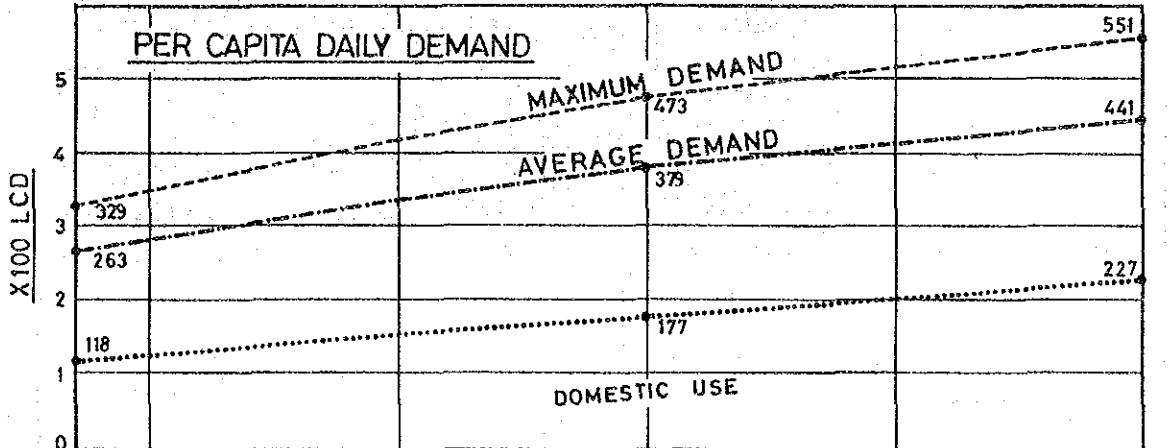
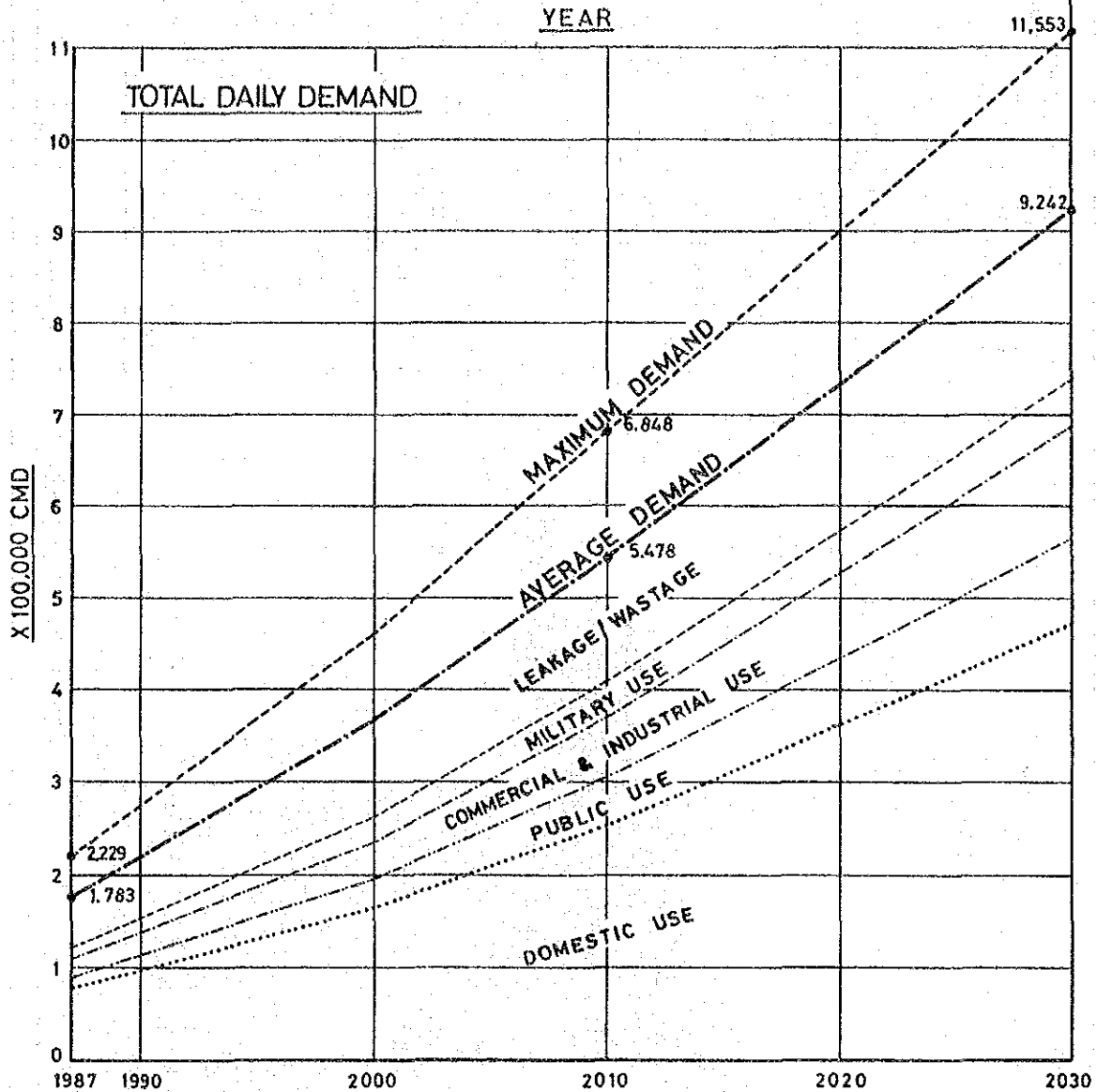
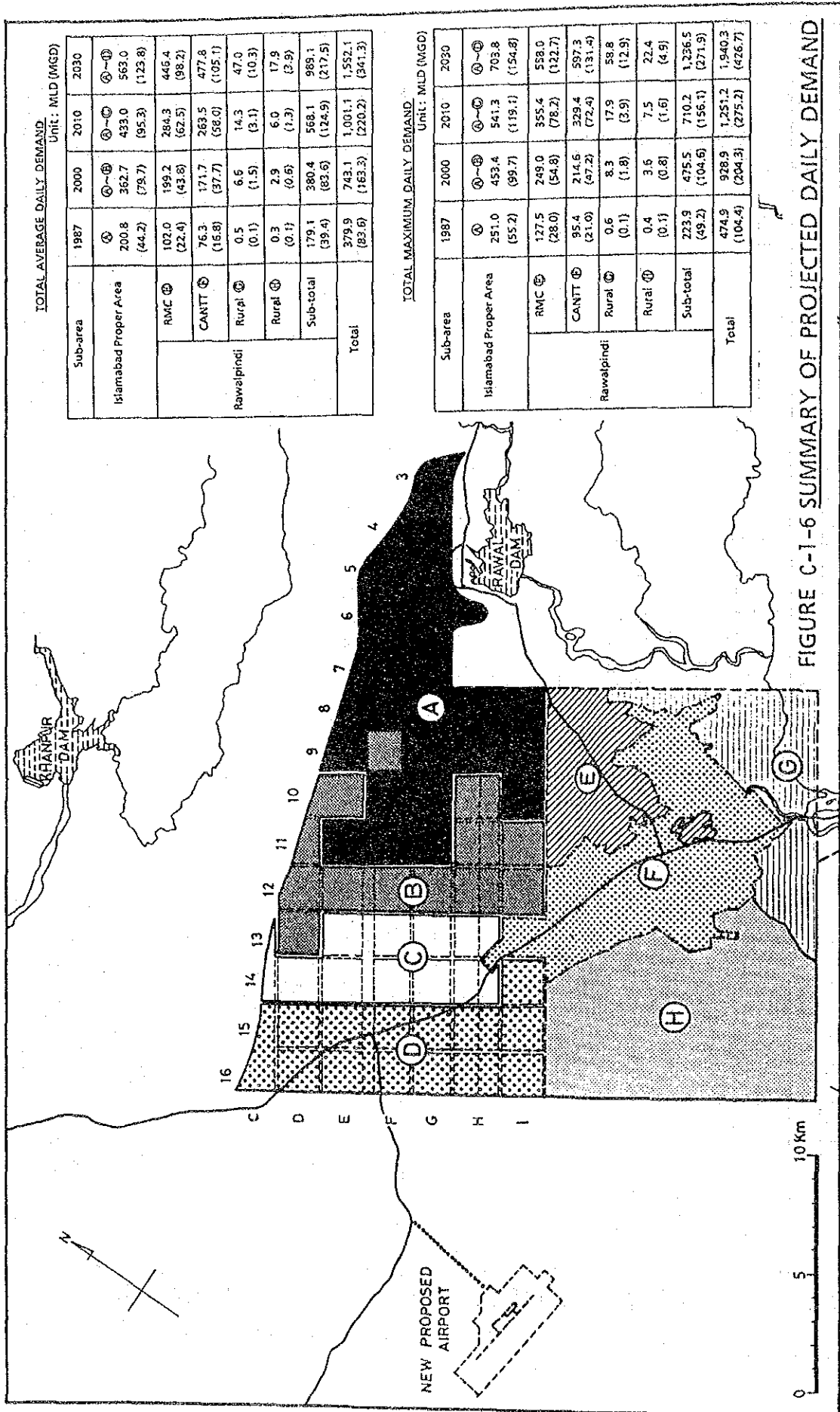


FIGURE C-1-5 PROJECTED DAILY WATER DEMAND FOR RAWALPINDI URBAN



TOTAL AVERAGE DAILY DEMAND
Unit: MLD (MGD)

Sub-area	1987	2000	2010	2030
Islamabad Proper Area	200.8 (44.2)	362.7 (79.7)	433.0 (95.3)	563.0 (123.8)
RMC	102.0 (22.4)	199.2 (43.8)	284.3 (62.5)	446.4 (98.2)
CANTT	76.3 (15.8)	171.7 (37.7)	263.5 (58.0)	477.8 (105.1)
Rural	0.5 (0.1)	6.6 (1.5)	14.3 (3.1)	47.0 (10.3)
Rural	0.3 (0.1)	2.9 (0.6)	6.0 (1.3)	17.9 (3.9)
Sub-total	179.1 (39.4)	380.4 (83.6)	568.1 (124.9)	989.1 (217.5)
Total	379.9 (83.6)	743.1 (163.2)	1,001.1 (220.2)	1,552.1 (341.3)

TOTAL MAXIMUM DAILY DEMAND
Unit: MLD (MGD)

Sub-area	1987	2000	2010	2030
Islamabad Proper Area	251.0 (55.2)	453.4 (99.7)	541.3 (119.1)	703.8 (154.8)
RMC	127.5 (28.0)	249.0 (54.8)	355.4 (78.2)	558.0 (122.7)
CANTT	95.4 (21.0)	214.6 (47.2)	329.4 (72.4)	597.3 (131.4)
Rural	0.6 (0.1)	8.3 (1.8)	17.9 (3.9)	58.8 (12.9)
Rural	0.4 (0.1)	3.6 (0.8)	7.5 (1.6)	22.4 (4.9)
Sub-total	223.9 (49.2)	475.5 (104.5)	710.2 (156.1)	1,236.5 (271.9)
Total	474.9 (104.4)	928.9 (204.3)	1,251.2 (275.2)	1,940.3 (426.7)

FIGURE C-1-6 SUMMARY OF PROJECTED DAILY DEMAND