2.2 Socio-economic Condition

2.2.1 National and Regional Economy

The Philippines has a diversified economy, with contributions of the key sectors to GDP in 2008 being services 53.7%, industry 31.6% and agriculture, forestry and fishing 15% (see **Table 2.2.1**). The real GDP growth has strengthened in the last few years from 1.8% in 2001 to 4-6% in the last 5 years despite regional financial setbacks. Metro Manila continues to lead the country with annual GDP growth of 5-7% that accounts for about 32% of country's GDP (see **Figure 2.2.1**). Another source of income not reflected in **Table 2.2.1** is remittance from overseas workers which in 2007 reached more than $16 billion.

There are several issues in Philippine economy which are also considered key indicators of development. One is unemployment which is high and has been rising. In the last 5 years, unemployment ranged from 7 to 12% of the population. The population below poverty line is also quite high, at 36.8-40.6%. The rural-urban migration is at increasing trend, which in 2006 urban population accounted for 63% of the total population. This signifies the lack of sustainability in rural agriculture and fisheries.

Table 2.2.1: GDP of the Philippines

Year	GDP at current prices (in million PhP)				
	Total	Real GDP growth (%)	Agriculture, fishery and forestry	Industry	Services
2003	4,316,402	4.9	631,970	1,378,870	2,305,562
2004	4,871,555	6.4	734,171	1,544,351	2,593,032
2005	5,444,038	4.9	778,370	1,735,148	2,930,521
2006	6,032,835	5.4	852,800	1,913,031	3,267,004
2007	6,648,245	7.3	936,415	2,107,287	3,604,542
2008	7,497,535	4.5	1,103,519	2,371,165	4,022,850

Source: National Statistical Coordination Board (2009)
GDP growth rate data from the Asian Development Bank (2008)

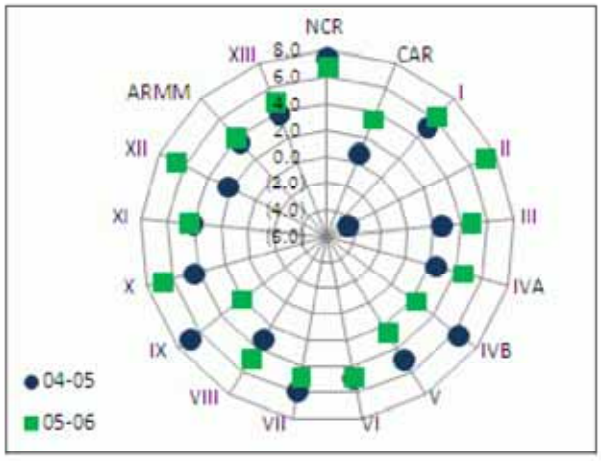

Figure 2.2.1: Comparative growth rates of regional economies 2004-2006 at constant prices (1985=100)

2.2.2 Land Use

The northern provinces being considered in this Survey are all part of the Central Luzon provinces or Region III. This region has a mixed economy but clearly dominated by agriculture being part of the Central Valley Basin. However, the Provinces of Bulacan and Pampanga, being just north of Metro Manila, are slowly converting their agricultural lands into industrial and service purposes as well as settlement areas resulting from the spillover from Metro Manila. Still, both provinces maintain a thriving fisheries economy centered in the floodplains of the Pampanga and Obando Rivers that open to the Manila Bay.

Metro Manila remains as the financial center of the country. Industrial and services sectors account for virtually entire of its economy. The strongest directions of growth have been towards northeast (Quezon City) and south (Muntinlupa). Another trend in Metro Manila is a move towards mixed-use high density residential/commercial developments to cater for its increasing population and higher level of commercial activities in future. **Figure 2.2.2** presents the comprehensive land use plan of Metro Manila prepared by the Metro Manila Development Authority (MMDA).

The Province of Rizal to the east of Metro Manila is still dominated by grass and shrub lands covering at least 53% of the provincial land area. Other dominant uses are agriculture (14%), forest (14%), built-up areas (12%) and some 2% are still unclassified. The proximity of Rizal Province to Metro Manila has resulted in its rapid urbanization.

Photo 2.2.1: New housing developments in Rizal Province
(Town of Rodriguez)

Similar to the other adjacent provinces, Cavite and Laguna are also experiencing rapid urbanization over the past 20 years because of their proximity to Metro Manila. The largely agro-fishery based economy of the area is being gradually converted to residential, commercial, industrial and institutional uses. In Cavite, commercial establishments intersperse the residential areas scattered in all the municipalities, the largest being concentrated in Bacoor and Imus towns. Commercial establishments within the MWSS service area cover an area of about 319 ha (1.5% of total area) while industrial activities cover an area of about 2,200 ha (10%).

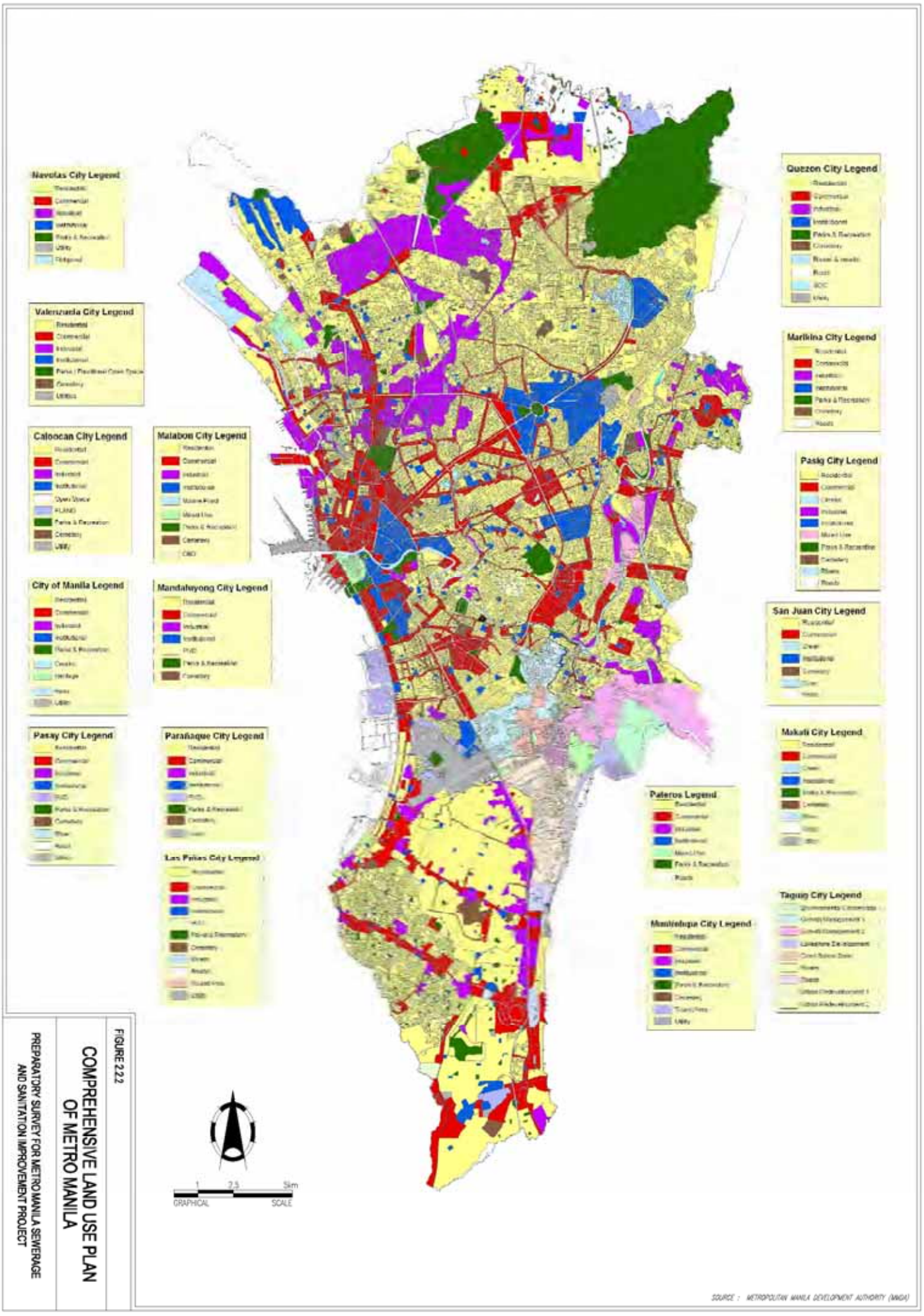

FIGURE 2.2.2

COMPREHENSIVE LAND USE PLAN OF METRO MANILA

PREPARATORY SURVEY FOR METRO MANILA SEWERAGE AND SANITATION IMPROVEMENT PROJECT

SOURCE : METROPOLITAN MANILA DEVELOPMENT AUTHORITY (MMDA)

2.2.3 Population

(a) Historical Population

Based on the latest National Census, the Philippines has a total population of 88.5 million. In the last 30 years, population growth rate has been steadily decreasing with 2007 posting the lowest rate since 1948 (see **Table 2.2.2**).

Table 2.2.2: Population of the Philippines

Year	Population	Average annual rate of increase (%)
1903	7,635,426	2.87
1918	10,314,310	2.03
1939	16,000,303	2.11
1948	19,234,182	2.07
1960	27,087,685	2.89
1970	36,684,486	3.08
1975	42,070,660	2.78
1980	48,098,460	2.71
1990	60,703,206	2.35
1995	68,616,536	2.32
2000	76,504,077	2.36
2007	88,574,614	2.04

Source: National Statistical Coordination Board (NSCB)

Table 2.2.3 tabulates population statistics per province encompassed in the Survey Area. Metro Manila dominates the region with close to 12 million people residing in this urban capital.

Table 2.2.3: Provincial population

Province	1990	1995	2000	2007	Annual growth rate
Metro Manila	7,946,086	9,454,040	9,932,560	11,553,427	2.3
Pampanga	1,532,615	1,635,767	1,878,139	2,226,127	2.6
Nueva Ecija	1,312,680	1,505,827	1,659,883	1,853,853	1.7
Bulacan	1,505,219	1,784,441	2,234,088	2,826,926	3.8
Bataan	425,803	491,459	557,659	662,153	2.7
Tarlac	859,708	945,810	1,068,783	1,243,449	2.3
Rizal	977,448	1,312,489	1,707,218	2,284,046	4.8
Laguna	1,370,232	1,631,082	1,965,872	2,473,530	3.7
Cavite	1,152,534	1,610,324	2,063,161	2,856,765	5.5

Source: Growth rate is computed from the period 2000-2007

The total population of these nine provinces (including Metro Manila) is 27.98 million, or 32% of the country's population. All provinces, except for Nueva Ecija, exceed the national growth rate. Metro Manila's expanding commercial and industrial sectors' spillover to adjacent provinces; consequently the highest provincial growth rates are recorded in Cavite, Rizal and Bulacan.

Comparing to the 2007 population of the whole Manila Bay watershed[11], Metro Manila accounts for about 47% of basin population, while MWSS service area population is 60%. It is estimated that about 30% of the population in the said watershed are residing in the coastal towns of the

[11] Estimated by adding up the city/municipality populations from NSO 2007 census; provinces within the watershed boundary but with minimal area covered were excluded (i.e. Nueva Vizcaya, Quezon, Batangas).

Manila Bay. **Table 2.2.4** presents the pertinent areas and basins under consideration in this Survey in relation to the Manila Bay watershed population.

Table 2.2.4: Comparison of populations in different regions (2007)

Region	2007 Approximate Population (millions)	% to Manila Bay Watershed Population
Manila Bay Watershed	24.78	100%
Metro Manila	11.55	47%
MWSS Service Area	14.85	60%
Pampanga River Basin	5.49	22%
Laguna de Bay Watershed	7.68	31%
Coastal Cities/Municipalities*	7.39	30%

**Total population of cities/municipalities surrounding the Bay. For Metro Manila, only cities/municipalities with coastlines fronting the Bay are included in the estimates.*

(b) Projected Population

In the MWSS Master Plan (2005), projection of future population (2005 to 2025) was carried out using the 2000 NSO census data. In the projection, ratio method rather than cohort component method (which was adopted in the NSO population projection) was utilized because of unavailability of city/municipal level data for fertility, mortality and migration data.

In the ratio method, the population of the subject city/municipality is assumed to follow the same trends as that of their respective provinces. From the population records of a series of census years, the ratio is plotted and then projected to the target year. For this, the 2000 to 2040 NSO projections were adopted as a basis for projecting the population of Metro Manila and the provinces of Cavite and Rizal (based on their ratio with Region IV).

The abovementioned projections, which serve as the basis of water demand projection, are presented in **Table 2.2.5**. Comparing the 2007 Census to these projections revealed a slight underestimate in above projection, as in most cases, the actual 2007 population even higher than the 2010 projections. Nevertheless, population trends can be deduced from these numbers. Noteworthy in this table is the decrease in population in the more congested areas of Metro Manila including the Cities of Manila, Malabon and Makati. The average density of Metro Manila is about 6,000 persons/km^2, however, in the highly urbanized areas such as the City of Manila, population density can reach up to 39,000 persons/km^2.

The projected growth rates for Cavite are seen to decrease from 1.92% in 2010 to 0.87% by 2025. As most of the areas of Rizal Province are still undeveloped, growth rates of the province until 2025 is estimated to be above 4% per annum. It is estimated that by 2025, Rizal will have around 5.85 million residents.

Table 2.2.5: Population projection for MWSS Service Area 2010-2025 under the MWSS Master Plan (2005)

	City/Municipality	NSO 2007	Population Projection (MWSS MP - *SKM*)				Projected Growth Rates (%)		
			2010	2015	2020	2025	'10-'15	'15-'20	'20-'25
	NCR *	**11,553,427**	**11,137,443**	**11,649,493**	**12,077,301**	**12,402,857**	**0.9**	**0.72**	**0.53**
1	Manila	1,660,714	1,542,856	1,498,306	1,437,495	1,361,717	-0.58	-0.83	-1.08
2	Pasay	403,064	350,412	342,295	330,334	314,760	-0.47	-0.71	-0.96
3	Quezon	2,679,450	2,376,485	2,442,754	2,480,588	2,487,164	0.55	0.31	0.05
4	Caloocan	1,378,856	1,428,308	1,546,404	1,654,073	1,746,872	1.6	1.36	1.1
5	Mandaluyong	305,576	310,882	322,918	331,374	335,752	0.76	0.52	0.26
6	Las Pinas	532,330	652,906	754,286	860,899	970,158	2.93	2.68	2.42
7	Makati	510,383	444,207	423,290	398,494	370,408	-0.96	-1.2	-1.45
8	Malabon	363,681	317,956	302,785	284,860	264,608	-0.97	-1.21	-1.46
9	Marikina	424,610	429,446	442,354	450,155	452,302	0.59	0.35	0.1
10	Muntinlupa	452,943	447,968	478,589	505,137	526,418	1.33	1.09	0.83
11	Navotas	245,344	258,011	268,413	275,867	279,944	0.79	0.55	0.29
12	Paranaque	552,660	544,239	588,518	628,723	663,185	1.58	1.33	1.07
13	Pasig	617,301	648,316	722,104	794,589	863,297	2.18	1.93	1.67
14	Pateros	61,940	56,673	55,357	53,419	50,897	-0.47	-0.71	-0.96
15	San Juan	125,338	118,932	117,541	114,765	110,638	-0.24	-0.48	-0.73
16	Taguig	613,343	642,775	741,048	844,040	949,194	2.89	2.64	2.38
17	Valenzuela	568,928	567,069	602,531	632,489	655,543	1.22	0.98	0.72
	Cavite	**1,008,863**	**1,001,005**	**1,100,829**	**1,179,874**	**1,231,998**	**1.92**	**1.4**	**0.87**
18	Cavite City	104,581	105,650	104,612	100,701	94,199	-0.2	-0.76	-1.33
19	Bacoor	441,197	395,270	431,607	458,171	472,635	1.77	1.2	0.62
20	Imus	253,158	255,332	280,220	298,977	309,981	1.88	1.3	0.73
21	Kawit	76,405	81,901	89,850	95,828	99,318	1.87	1.3	0.72
22	Noveleta	39,294	44,032	49,631	54,385	57,911	2.42	1.85	1.26
23	Rosario	94,228	118,820	144,910	171,812	197,955	4.05	3.46	2.87
	Rizal	**2,284,046**	**2,878,932**	**3,686,046**	**4,672,308**	**5,859,922**	**5.07**	**4.86**	**4.63**
24	Angono	97,209	133,373	175,297	227,726	292,250	5.62	5.37	5.12
25	Antipolo City	633,971	857,242	1,137,491	1,491,840	1,932,861	5.82	5.57	5.32
26	Baras	31,524	38,701	47,820	58,403	70,463	4.32	4.08	3.83
27	Binangonan	238,931	295,155	363,995	443,681	534,256	4.28	4.04	3.79
28	Cainta	289,833	387,364	481,453	591,452	717,776	4.44	4.2	3.95
29	Cardona	44,942	51,727	58,582	65,576	72,515	2.52	2.28	2.03
30	Jala-jala	28,738	34,948	42,110	50,151	59,003	3.8	3.56	3.3
31	Morong	50,538	59,966	70,059	80,900	92,286	3.16	2.92	2.67
32	Pillila	58,525	68,367	82,620	98,685	116,446	3.86	3.62	3.37
33	Rodriguez	223,594	190,309	240,584	300,610	371,061	4.8	4.56	4.3
34	San Mateo	184,860	245,853	325,552	426,083	550,900	5.78	5.53	5.27
35	Tanay	94,460	114,826	136,816	161,125	187,452	3.57	3.32	3.07
36	Taytay	262,485	354,825	466,906	607,260	780,232	5.64	5.4	5.14
37	Teresa	44,436	46,275	56,761	68,816	82,420	4.17	3.93	3.67
	Grand Total	**14,846,336**	**15,017,380**	**16,436,369**	**17,929,483**	**19,494,777**	**1.82**	**1.75**	**1.69**

(c) Informal Settlers

High population density in Metro Manila is partly due to large disparity of poverty between rural and urban areas, which results in the migration of people from provinces to Metro Manila as informal settlers. It is estimated that about 36% of Metro Manila's population are informal settlers. In 2007, a total of 544,609 informal settler families are distributed in about 276 major slum areas in Metro Manila (see **Figure 2.3.1**).

Table 2.2.6: Informal settlers in Metro Manila

Area/Location	Total No. of Households	
	1996	2007
North		
Caloocan	83,638	22,763
Navotas	18,483	19,030
Valenzuela	16,551	20,723
Malabon	22,094	20,138
East		
Quezon City	19,849	195,399
Pasig	15,978	10,151
Marikina	2,044	1,179
West		
Manila	91,356	111,094
Mandaluyong	19,460	24,706
San Juan	1,343	10,314
Makati	15,905	4,441
South		
Pasay	21,915	23,948
Paranaque	23,666	24,177
Muntinlupa	35,132	19,121
Las Pinas	17,527	10,770
Pateros	2,100	2,578
Taguig	25,408	24,077
Grand Total	432,449	544,609

Source: National Housing Authority (NHA), 2009

2.3 Sewerage and Sanitation Management

2.3.1 General Conditions

Sewerage and sanitation initiative in the Philippines is a product of a combination of concerns on water quality and public health that are being translated into policies, plans, and projects. The history of sewerage and sanitation management in Metro Manila spans more than 100 years (see **Table 2.3.1**). The first recorded effort was from the Spanish Law on Waters of 1866 which was extended to the Philippines in 1871 with the following provision: '*when an industrial establishment was found after the investigation, to have contaminated the waters with substances or properties noxious to the public health, the Governor General could suspend its operations until the owner adopted remedy*'.

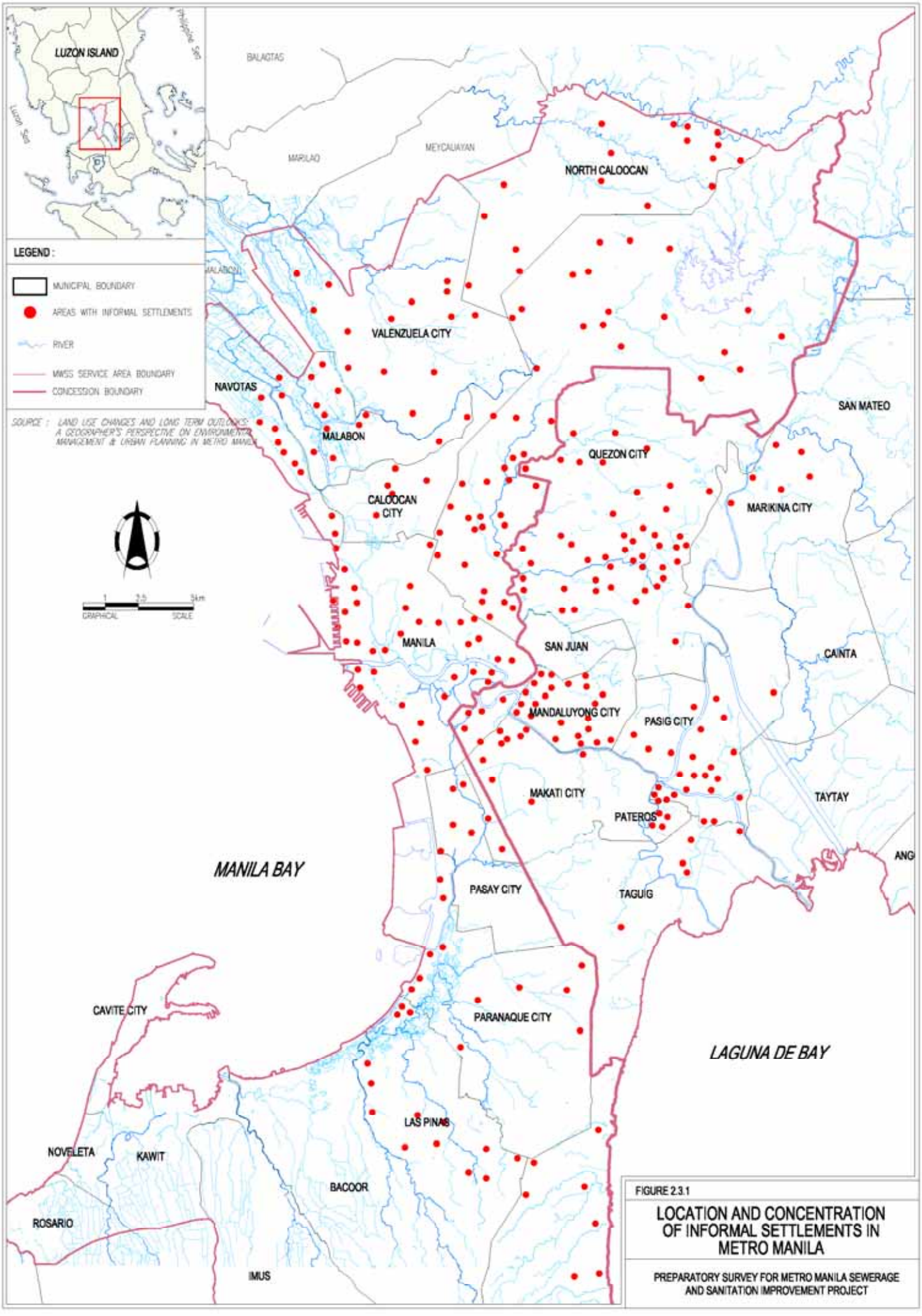

FIGURE 2.3.1

LOCATION AND CONCENTRATION OF INFORMAL SETTLEMENTS IN METRO MANILA

PREPARATORY SURVEY FOR METRO MANILA SEWERAGE AND SANITATION IMPROVEMENT PROJECT

Table 2.3.1: Metro Manila sewerage and sanitation milestones

Year	Major developments
1871	Spanish Law on Waters of 1866 applied in the Philippines.
1878	Carriedo Waterworks was established in Manila.
1904	First sewerage system in Manila serving 220,000 people.
1919	Organization of Metropolitan Water District to cover adjoining cities and municipalities.
1955	Creation of National Waterworks and Sewerage Authority (NAWASA) to cover all waterworks and sanitation nationwide.
1969	First sewerage master plan for Metro Manila.
1971	NAWASA was dissolved and was replaced by MWSS, LWUA and RWDC.
1979	Updating of the 1969 Master Plan on Sewerage System for Metro Manila and included sanitation; developed the first Metro Manila Sewerage and Sanitation Project (METROSS I).
1981-1990	Implementation period of METROSS I, which improved the major sewerage and sanitation systems in Metro Manila.
1988	The national government developed the 1988-2000 Water Supply, Sewerage and Sanitation Master Plan (WSSSMP) which included interventions for Metro Manila.
1996	Updating of the 1979 Master Plan on Sewerage and Sanitation which included combined sewerage system and septage management system; the Manila Second Sewerage Project was developed.
1997	Privatization of MWSS' water supply and sewerage service through a concession of 25 years.
2003	Rate rebasing exercise adjusting some targets contained in the concession agreement.
2005	Manila Third Sewerage Project was approved and started implementing; the 1996 Master Plan was updated
2008	Business plans developed by MWCI and MWSI.

The City of Manila, before expanded into a metropolitan area, pioneered the provision of piped water supply and sewerage services. In 1878, the first waterworks system in the country, the Carriedo Waterworks[12], was established to serve the City of Manila. The sewerage system was first constructed in 1904 covering a service area of 1,800 hectares. The capacity of the system was intended to serve 220,000 people. Thru Act 2832, the waterworks was reorganized in 1919 to become the Metropolitan Water District, cater to

[12] 1988-2000 Master Plan on Water Supply, Sewerage and Sanitation of the Philippines; MWSS powerpoint presentation, April 2009

the needs of increasing population. Its service area was then expanded to cover 14 adjoining cities and municipalities[13].

During the World War II, many of the water systems in the Philippines were damaged while others had deteriorated due to poor maintenance. To speed up reconstruction, the National Waterworks and Sewerage Authority (NAWASA) was created in 1955 thru the Republic Act 1383 to effect a centralized and consolidated control and supervision of all waterworks and sewerage systems in the country.

The 1969 Master Plan[14] on Sewerage System for the Metropolitan Manila Area was prepared by Black and Veatch during 1968-1969. It envisioned a diverse centralized concept for a separate sewerage system for Metro Manila. Consideration was given to a combined sewerage system but was not recommended due to the extent of the existing sewerage system at that time, the high intensity rainfall in Manila and the consequent increased cost of a combined system. Sanitation was not considered in this Master Plan. This Master Plan has never been implemented.

In 1970s, the Philippine government adopted a policy of providing water supply to every household. To facilitate its realization, NAWASA was dissolved and was replaced by three (3) specialized agencies[15] i.e., Metropolitan Waterworks and Sewerage System (MWSS), Local Water Utilities Administration (LWUA), and Rural Waterworks Development Corporation (RWDC) to take responsibilities for specific areas of the country. MWSS was made responsible to provide services to Metro Manila and its contiguous areas as per the Republic Act 6234 of 1971, while LWUA and RWDC thru separate mandates take charge in providing services in other parts of the country.

The changes in the sector's institutional set up accommodated the onset of global environmentalism initiatives in the 1970s. The Philippine government had initiated the issuance of several legislations concerning environment and sanitation, which either created specific offices on environment concerns, or developed standards and guidelines on how to address sewerage and sanitation issues. Some of these policy issuances are the Environment Code, Water Code, Environmental Impact Assessment System, and the Sanitation Code. Details of relevant policies and guidelines issued over the years are given in Chapter 3.

Triggered with these issuances, the government (including MWSS) came up with strengthened environment and sanitation programs. Cognizant of the inadequacies of sewerage and sanitation services in Metro Manila, MWSS updated the 1969 Master Plan in 1978-1979 and prepared a sewerage and sanitation master plan for the metropolis. The multi-stage plan prepared by James Montgomery/Kampsax Kruger/DCCD consists of a long-term sewerage program and an interim non-sewerage sanitation program.

This plan was discarded the 1969 plan on the basis of too costly for implementation. They went on to recommend a plan based on:

- A sewerage expansion program involving rehabilitation of existing facilities and a monitoring

[13] www.mwss.gov.ph
[14] 2005-2025 Water Supply, Sewerage and Sanitation Master Plan for Metro Manila prepared by SKM for MWSS, November 2005
[15] Ibid.

system called METROSS (Metro Manila Sewerage and Sanitation);

- Use of combined sewers;
- Secondary treatment of sewage with four outfalls into the Manila Bay; and
- Sanitation program comprising of minor drainage projects for the depressed areas (PROGRESS) and a septic tank desludging programme (STAMP).

Part of PROGRESS and STAMP were implemented as a component of METROSS – 1. Only METROSS – 1 was implemented, although rehabilitation of the Central Sewerage System remained uncompleted.

The METROSS I Project[16] was implemented in 1981-1990 with assistance from the World Bank and ADB. The total loan amount was about US$73 million. It accomplished the following:

- Constructed a 1.8-meter-diameter and 3.6-km long outfall in Tondo;
- Constructed a new pumping station to replace the obsolete Tondo main pumping station, increasing capacity from 3.6 to 5.5 m^3/s;
- Rehabilitated and upgraded seven sewage lift stations in Sta. Ana, Sta. Cruz, Legarda, Luneta, Port Area, Malate and Paco;
- Repaired clogged and broken sewer pipes and sea long connections to the Pasig River;
- Rehabilitated approximately 120 km of existing trunk sewers in the central service system;
- Constructed a sanitary sewage collection system, including house connections in Dagupan and Pandacan;
- Provided equipment for a septic tank emptying program, and maintenance of sanitary sewers and combined sewers.

When METROSS I was near completion, the national government developed the 1988-2000 Water Supply, Sewerage and Sanitation Master Plan (WSSSMP) for the Philippines. This plan emphasized the commitment of the national government to fulfill basic human needs (BHN) of the population, especially in depressed areas. WSSSMP was the result of an extensive interagency undertaking that involved DPWH, DILG, NEDA, MWSS, LWUA and NWRB. WSSSMP set the framework and agenda for organized, unified action by policy makers and program implementers, at all levels of the government, to execute and manage water supply, sewerage and sanitation programs and projects throughout the country.

The next milestone was the updating of the 1979 water supply and sewerage master plan with support from the World Bank and the Japan International Cooperation Agency (JICA). Studies on the new master plan were completed by Nippon Jogesuido Sekkei (NJS) in early 1996 with the following proposed items: a change from separate to combined sewerage systems and inclusion of the construction of interceptor sewers, septage treatment plants, and wastewater treatment plants.

With the updated master plan, the Manila Second Sewerage Project (MSSP) came out and

[16] http://www.nwin.nwrb.gov.ph

was approved in 1996 with a US$57 million loan from the World Bank. During the same period, the Government of the Philippines initiated the privatization of MWSS' operations. Thus, all parties agreed to delay loan effectiveness until the private operators are selected and have an opportunity to review the proposed investments.

In February 1997, Concession Agreements (CA) were signed with two private operators: Manila Water Company, Inc. (MWCI) for East Zone and Maynilad Water Services, Inc. (MWSI) for West Zone. The concessionaires were given the options to accept, modify, or reject their portion of the World Bank-financed project no later than one month after the start of the concession period i.e. August 1, 1997.

Both concessionaires accepted the project and opted to redesign some of the components. Project components associated with each area were to be implemented by the respective concessionaire. A Regulatory Office (RO) was created within MWSS to monitor concessionaires' performance in accordance with their CAs, review water supply and sewerage rates, and respond to service complaints against the concessionaires[17].

The terms of agreement set forth in the CA specified the population targets for the provision of sewerage and sanitation coverage for each city and municipality in the service area. The concessionaires are required to achieve the stipulated targets by the end of the concession period i.e. 2021. These targets are shown in **Table 2.3.2.**

Table 2.3.2: Sewerage and sanitation coverage targets for east and west service areas

Concessionaire	2001	2006	2011	2016	2021
MWSI					
Sewerage	16%	20%	21%	31%	66%
Sanitation	43%	46%	43%	39%	27%
MWCI					
Sewerage	3%	16%	51%	52%	55%
Sanitation	38%	32%	27%	24%	19%

The MSSP[18] was completed in June 2005 with the following major accomplishments[19]:

- Construction of a barge loading station at Napindan;
- Rehabilitation of the Ayala Sewerage System and Treatment Plant;
- Construction of 26 communal sanitation systems;
- Construction of barge loading stations at Estero de Vitas and Paranaque;
- Construction of a septage treatment plant and rehabilitation of the sewerage treatment plant at Dagat-Dagatan; and
- Rehabilitation of the Manila Central Sewerage System.

MSSP was succeeded by the Manila Third Sewerage Project (MTSP) which was approved by the World Bank in 2005. In the same year, the 1996 Master Plan was updated by the Sinclair Knights Merz to include improvement in sewerage and septage management systems.

[17] Staff Appraisal Report of the Manila Second Sewerage Project, World Bank, 1996.
[18] Implementation Completion Report, Manila Second Sewerage Project, World Bank, 2006
[19] Ibid.

In 2003 the World Bank has raised the issue of high implementation cost for the sewerage concepts proposed in the previous master plans. As a result, instead of separate sewerage-drainage system, combine sewerage-drainage has been adopted by both concessionaires, which not only requires less cost but avoid problems like disturbance of traffic during construction work. Also, in order to further reduce the implementation cost, as a temporary measure (final goal is to achieve 100% sewerage coverage), instead of 'sewerage service', both concessionaires have adopted the concept of 'combined sewerage-sanitation' concept, whereby only certain percentage of population will be served with sewerage service, while the rest will continue to use septic tanks but desludging service will be provided, and discharges from these septic tanks will be collected by 'interceptors' for further treatment by STPs. According to explanation by MWSS, at later stage, these systems can be gradually converted to separate systems.

In 2008, both MWCI and MWSI submitted their business plans to MWSS for rate rebasing exercise. Adjustments in concession targets are discussed in Chapter 5.

It must be highlighted here that over the years, several master plans have been developed, sectoral studies were conducted, complex projects were implemented, and potential projects were prepared to address the needs for sewerage and sanitation services in Metro Manila (see Chapter 4 for further details).

2.3.2 Status of Existing Sewerage and Sanitation Systems

In Metro Manila, sewerage and sanitation systems are a mix of individual septic tanks, public toilets, communal septic tanks, sewer lines, treatment facilities (sewage and septage), desludging, and reuse/recycling (sludge/effluent). Prior to 1997, except the individual septic tanks, most of the sewerage and sanitation facilities were managed by MWSS. In 1997 the operation of MWSS-managed facilities were handed over to the two concessionaires (the assets remained under MWSS ownership) where some of these facilities were improved and new facilities were constructed.

(a) Household Septic Tanks

According to the NSO 2000 Census, about 84 % of the households in Metro Manila are equipped with septic tanks (see **Table 2.3.3**), while it is about 72% for Rizal and Cavite Provinces. The requirements for septic tank usage (for those not connected to sewerage systems) are specified in the National Plumbing Code, National Building Code and Sanitation Code.

In Metro Manila, the use of septic tanks will most likely be continued, particularly in those areas not covered by sewerage systems. Even when sewerage system is available, some house owners reluctant to connect to sewers because of high connection fee and the additional 50% surcharge imposed on water bills for connected properties. Under the present condition, storm drains receive overflow from septic tanks due to poor or non-existent absorption fields. This is further aggravated by the faulty design and poor construction of some septic tanks. Bottom slabs are sometimes not included in the construction of septic tanks. This allows seepage from the bottom of the tanks. The existing drainage system most often functions as a 'combined' sewerage system. For those tanks not cleaned (desludged) regularly, high strength sewage may discharge into storm drains instead of sewage overflow from a correctly functioning septic tank.

Table 2.3.3: Number and percentage of households with septic tanks in MWSS service area, 2000

City/province/ municipality	Population	Number of household	Household with septic tanks	Average household size	% household with septic tank
NCR	9,862,978	2,132,989	1,798,672	4.6	84
Manila	1,568,092	333,547	294,902	4.7	88
Caloocan	1,174,673	249,567	212,939	4.7	85
Las Pinas	470,154	97,962	74,769	4.8	76
Makati	442,144	103,981	95,267	4.5	92
Mandaluyong	275,106	59,628	52,284	4.6	88
Marikina	389,763	80,160	70,111	4.9	87
Muntinlupa	370,333	78,016	55,910	4.8	72
Paranaque	446,766	94,109	76,840	4.8	82
Pasay	353,798	78,180	70,692	4.5	90
Pasig	503,013	107,835	93,541	4.7	87
Quezon	2,158,367	480,624	408,548	4.5	85
Valenzuela	481,047	106,382	88,350	4.5	83
Malabon	336,516	74,137	63,726	4.6	86
Navotas	229,717	48,450	36,746	4.6	74
Pateros	57,172	12,029	10,921	4.7	91
San Mateo	117,398	24,605	22,887	4.8	93
Taguig	4,625,891	102,723	70,239	4.5	68
Cavite	78,923	163,865	117,902	4.7	72
Bacoor	305,699	64,067	47,897	4.8	75
Cavite City	99,367	21,342	15,324	4.7	72
Imus	195,428	42,232	31,095	4.6	74
Kawit	62,751	13,510	10,759	4.6	80
Noveleta	31,959	6,934	4,208	4.6	61
Rosario	73,665	15,780	8,619	4.7	55
Rizal	1,702,110	356,578	255,776	4.7	72
Antipolo	468,123	97,415	72,087	4.8	74
Cainta	242,137	51,863	41,490	4.7	80
Rodriguez	114,859	24,524	17,167	4.7	70
San Mateo	135,357	28,162	20,277	4.8	72
Taytay	197,279	42,620	30,690	4.6	72
Angono	74,538	15,740	11,018	4.7	70
Binangonan	187,639	38,488	25,017	4.9	65
Cardona	38,994	7,953	5,170	4.9	65
Baras	24,476	4,971	3,056	4.9	61
Jala-jala	23,276	4,759	2,744	4.9	58
Morong	42,453	8,988	6,494	4.7	72
Pililla	45,254	9,001	5,978	5.0	66
Tanay	78,065	15,720	10,099	5.0	65
Teresa	29,660	5,374	4,489	4.7	70

Source: MWSS master plan, 2,005.

It is estimated that about 20% of the existing septic tanks[20] in Metro Manila are inaccessible for desludging because of the following reasons:

- Poor building practice (septic tanks are constructed beneath of building structures);
- Absence of manholes; and
- Narrow access roads to the houses are too narrow.

In the willingness-to-pay survey conducted as part of the Montgomery[21] (1991) study it was found out that only 32% of respondents could recall having had their septic tank emptied. Many

[20] NJS (2004), Feasibility Study Report, Manila Third Sewerage Project.
[21] James M. Montgomery (1991), Main Feasibility Study Report, Second Manila Sewerage Project, ADB TA 1423-PH

of them even appeared unaware when asked whether their septic tank had a manhole for pumping out sludge. Although 90% of those who answered the question believed a manhole is available.

(a) Public Toilets

Provision of public toilets could be designed to serve urban poor communities. To determine its status, an inspection of a sample of public toilets in the City of Manila was conducted under the preparation of the 1979 Sewerage and Sanitation Master Plan for Metro Manila[22]. It was found that in 1970 about 70% of the public toilets located in the MWSS service area were within the City of Manila. From 1957 to 1979, the number of public toilets in Metro Manila dropped from 172 to 54 with no public toilets have been constructed since 1962. From 1970 to present, the percentage of households without toilet facilities has dropped from 11.2% to 5%.

In the 1979 survey, seven public toilet facilities in the Tondo area were inspected. Only two of the facilities were found to be in a relatively clean condition, while others were found to be overused up to 20 times of the design capacity. The 1979 Master Plan recommended the rehabilitation of relatively large number of existing public toilets in the depressed areas that are still in relatively good structural condition. Public acceptance of the usefulness of public toilets especially for those that are maintained in a clean and serviceable condition was also recommended to be assessed.

Table 2.3.4 shows the status and locations of the public toilets in the city o Manila that identified in the MWSS Master Plan study in 2005. Out of the 43 public toilets, 29 were operating and were rated from poor to very satisfactory conditions, 12 were closed and two were under construction. Around 22 or 51% were assessed to be satisfactory to very satisfactory.

Even though the percentage of households without toilet facilities decreased to 5%, this still represents a substantial number of households. The willingness-to-pay survey indicated that more than 60% of households without toilets would like to access to a public toilet, wherein nearly 70% of these are willing to pay an average of PhP3 per use. Most respondents preferred to include bathing facilities to enhance the functions of public toilets.

Rehabilitation of existing public toilets and construction of new public toilets as recommended by the 1979 Master Plan are considered useful for informal settlers whose access to toilet facilities is limited. However, it was viewed that the provision of public toilets should be the responsibility of the LGUs but their connection to MWSS sewerage system could be allowed, if available in the area.

[22] Montgomery, 1979.

Table 2.3.4: Public toilets in the City of Manila, 2005

District I	Location	Sanitary Condition
1	Bgy 95, Zone 3	No longer exists
2	Bgy 95, Zone 8	No longer exists
3	Bgy 95, Zone 4	No longer exists
4	Bgy 50, Zone 4	No longer exists
5	Bgy 139, Zone 11	No longer exists
District II		
1	Bgy 163, Zone 14	Poor
2	Bgy 152, Zone 14	Satisfactory
3	Bgy 217, Zone 20	Poor
District III		
1	Bgy 300	Satisfactory
2	Bgy 272	Satisfactory
3	Bgy 286	Satisfactory
4	Quiapo	Satisfactory
5	Bgy 365	Satisfactory
6	Bgy 332	Satisfactory
7	Bgy 293	Poor
8	Bgy 353	Poor
9	Bgy 351	Poor
10	Quiapo	Closed
11	Quiapo	Closed
12	Bgy 369	Closed
13	Bgy 370	Under construction
District IV		
1	Bgy 464, Zone 46	Closed
2	Bgy 485, Zone 48	Under construction
3	Bgy 472, Zone 47	Satisfactory
4	Bgy 453, Zone 56	Satisfactory
5	Bgy 410, Zone 42	Satisfactory
6	Bgy 417, Zone 43	Satisfactory
7	Bgy 499, Zone 49	Satisfactory
8	Bgy 484, Zone 48	Closed
9	Bgy 409, Zone 42	Closed
District V		
1	Bgy 692, Zone 75	Satisfactory
2	Phil. Christian University	Satisfactory
3	Plaza Lawton in front of Metropolitan Theater	Satisfactory
4	Bgy 668, Zone 72	Satisfactory
5	Bgy 701, Zone 77	Very satisfactory
6	Bgy 666, Zone 72	Very satisfactory
7	Bgy 670, Zone 72	Satisfactory
8	Bgy 735, Zone 80	Satisfactory
9	Bgy 740, Zone 80	Closed
10	Bgy 825, Zone 89	Poor
11	Bgy 815, Zone 88	Poor
District VI		
1	Bgy 645, Zone 67	Satisfactory
2	Bgy 891, Zone 98	Satisfactory

Source: Water Supply, Sewerage and Sanitation Master Plan for Metro Manila, MWSS, 2005

(b) Existing MWSS Sewerage and Sanitation Facilities

Table 2.3.5 to **Table 2.3.7** shows the existing sewerage and sanitation facilities operated by MWCI and MWSI. **Figure 2.3.2** presents the location of these facilities.

MWCI sewerage facilities, excluding the communal septic tanks, are at present collecting and treating around 60,000 m^3 of sewage per day. Half of these are treated in the Makati South (also known as Magallanes) sewage treatment plant. With respect to septage treatment facilities, with two new septage plants commissioned in 2007, MWCI can now collect and treat 1,400 m^3 of

septage per day. MWSI has more extensive sewer systems, which has a reported capacity of at least 450,000 m^3 per day. However, treatment capacity is less than 20,000 m^3/day. The existing sewerage facilities of MWSS are further discussed hereafter.

Table 2.3.5: Sewerage and sanitation facilities operated by MWCI

Facility	System components	Location	Sewage volume treated	Rehabilitated/ constructed under
Sewerage Facilities				
Makati South STP	Separate System and Centralized Sewage Treatment Plant (STP)	Makati City	31,179	MSSP
Guadalupe BLISS STP	On-site STP (suggests minimal sewer system)	Makati City	311	MSSP
Mandaluyong MRH STP	On-site STP	Mandaluyong City	150	MSSP
Makati Pabahay STP	On-site STP	Makati City	462	
Fortville STP	On-site STP	Taguig City	788	MSSP
Centennial Village STP	On-site STP	Taguig City	904	MSSP
Bagong Lipunan Condominium (BLC) STP	On-site STP	Taguig City	807	MSSP
Pamayanang Diego Silang STP	On-site STP	Taguig City	497	MSSP
Lakeview Manors STP	On-site STP	Taguig City	376	MSSP
Majolica Village STP	On-site STP	Taguig City	333	MSSP
Valle Verde Homes STP	On-site STP	Pasig City	75	MSSP
Karangalan STPs 1 to 9	Separate System and STP	Cainta/Pasig City	5,635	MSSP
UP STP	Separate System and STP	Quezon City	3523	MSSP
Pagasa BLISS STP	On-site STP	Quezon City	621	MSSP
Sikatuna BLISS STP	On-site STP	Quezon City	499	MSSP
Fisheries STP	On-site STP	Quezon City	378	MSSP
Kalayaan STP	On-site STP	Quezon City	1,521	MSSP
A. Luna STP	On-site STP	Quezon City	2,144	MSSP
Belarmino STP	On-site STP	Quezon City	1,522	MSSP
Phil-Am Village STP	Separate System and Imhoff Tank	Quezon City	612	MSSP
Heroes Hill STP	Separate System and STP	Quezon City	1,145	MSSP
Palosapis STP		Quezon City	1,397	MSSP
Fort Bonifacio STP	Separate System and STP (facilities are not owned by MWSS)	Taguig City	3,200	
Communal Septic Tanks (see table below)	Separate System and Communal Septic Tanks	Quezon City	N/A	
		Total Sewage Volume:	58,079	
Sanitation Facilities				
FTI (South) Septage Treatment Plant	Screw Press-Activated Sludge System. Activated sludge STP also treats sewage from FTI.	FTI Complex, Taguig City	814	MTSP
San Mateo (North) Septage Treatment Plant	Screw Press-Activated Sludge System. MWCI in total operates 93 vacuum trucks which haul septage to either the North or South Septage Treatment Plant.	San Mateo, Rizal	586	MTSP
		Total	1,400	

Source: Manila Water, May 2009

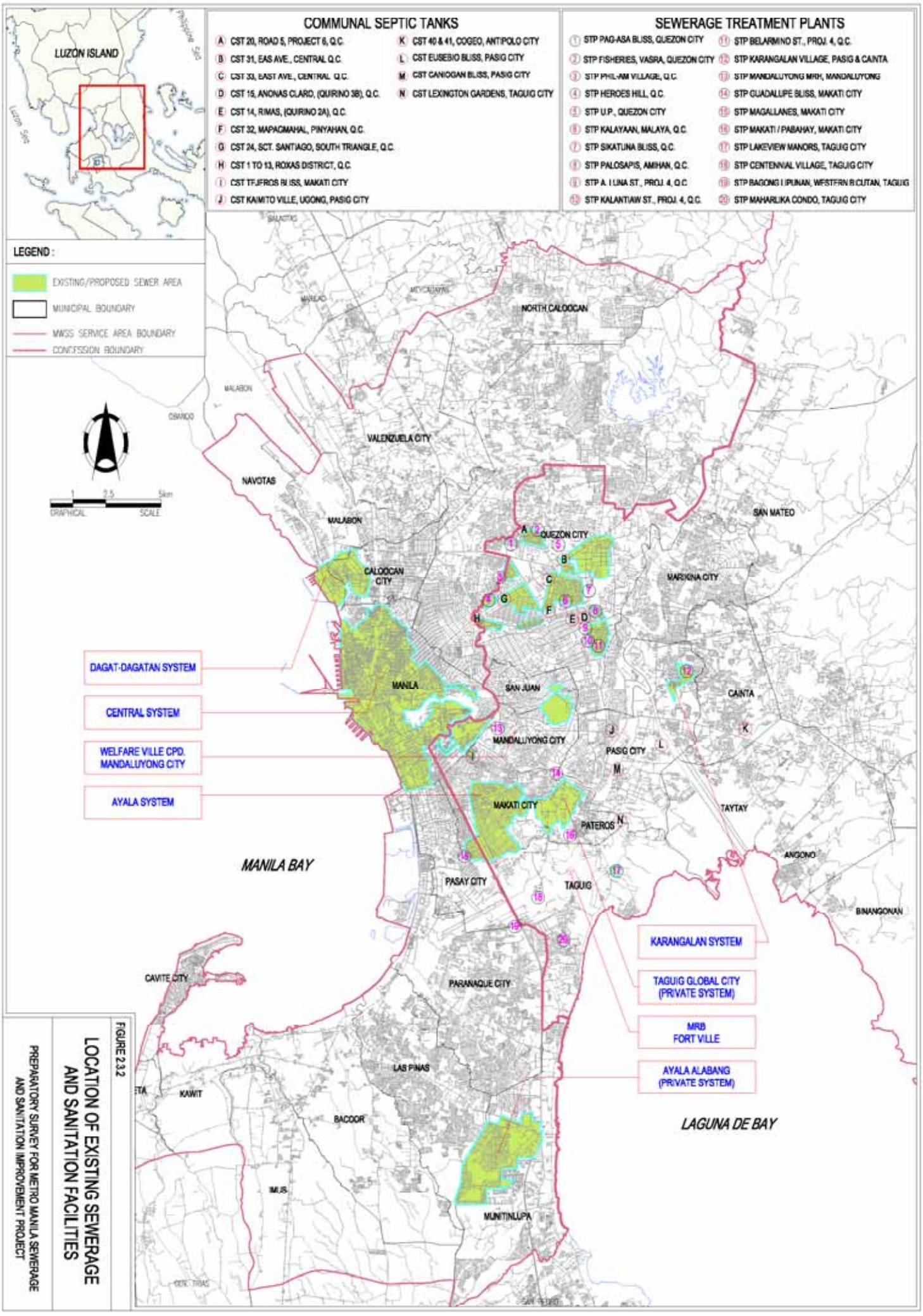
LUZON ISLAND
COMMUNAL SEPTIC TANKS
A CST 20, ROAD 5, PROJECT 6, Q.C.
B CST 31, EAS AVE., CENTRAL Q.C.
C CST 33, EAST AVE., CENTRAL Q.C.
D CST 15, ANONAS CLARD, (QUIRINO 3B), Q.C.
E CST 14, RIMAS, (QUIRINO 2A), Q.C.
F CST 32, MAPAGMAHAL, PINYAHAN, Q.C.
G CST 24, SCT. SANTIAGO, SOUTH TRIANGLE, Q.C.
H CST 1 TO 13, ROXAS DISTRICT, Q.C.
I CST TFJFROS RI ISS, MAKATI CITY
J CST KAIMITO VILLE, UGONG, PASIG CITY
K CST 40 & 41, COGEO, ANTIPOLO CITY
L CST EUSEBIO BLISS, PASIG CITY
M CST CANIOGAN BLISS, PASIG CITY
N CST LEXINGTON GARDENS, TAGUIG CITY
SEWERAGE TREATMENT PLANTS
1 STP PAG-ASA BLISS, QUEZON CITY
2 STP FISHERIES, VASRA, QUEZON CITY
3 STP PHIL-AM VILLAGE, Q.C.
4 STP HEROES HILL, Q.C.
5 STP U.P., QUEZON CITY
6 STP KALAYAAN, MALAYA, Q.C.
7 STP SIKATUNA BLISS, Q.C.
8 STP PALOSAPIS, AMIHAN, Q.C.
9 STP A. LUNA ST., PROJ. 4, Q.C.
10 STP KALANTIAW ST., PROJ. 4, Q.C.
11 STP BELARMINO ST., PROJ. 4, Q.C.
12 STP KARANGALAN VILLAGE, PASIG & CAINTA
13 STP MANDALUYONG MRH, MANDALUYONG
14 STP GUADALUPE BLISS, MAKATI CITY
15 STP MAGALLANES, MAKATI CITY
16 STP MAKATI / PABAHAY, MAKATI CITY
17 STP LAKEVIEW MANORS, TAGUIG CITY
18 STP CENTENNIAL VILLAGE, TAGUIG CITY
19 STP BAGONG ILIPUNAN, WESTERN BICUTAN, TAGUIG
20 STP MAHARLIKA CONDO, TAGUIG CITY
LEGEND :
EXISTING/PROPOSED SEWER AREA
MUNICIPAL BOUNDARY
MWSS SERVICE AREA BOUNDARY
CONCESSION BOUNDARY
GRAPHICAL SCALE
NORTH CALOOCAN
VALENZUELA CITY
NAVOTAS
MALABON
CALOOCAN CITY
QUEZON CITY
SAN MATEO
MARIKINA CITY
MANILA
SAN JUAN
CAINTA
MANDALUYONG CITY
PASIG CITY
MAKATI CITY
TAYTAY
PATEROS
ANGONO
BINANGONAN
TAGUIG
PASAY CITY
PARANAQUE CITY
CAVITE CITY
LAS PINAS
BACOOR
KAWIT
IMUS
MUNTINLUPA
MANILA BAY
LAGUNA DE BAY
DAGAT-DAGATAN SYSTEM
CENTRAL SYSTEM
WELFARE VILLE CPD. MANDALUYONG CITY
AYALA SYSTEM
KARANGALAN SYSTEM
TAGUIG GLOBAL CITY (PRIVATE SYSTEM)
MRB FORT VILLE
AYALA ALABANG (PRIVATE SYSTEM)
FIGURE 2.3.2
LOCATION OF EXISTING SEWERAGE AND SANITATION FACILITIES
PREPARATORY SURVEY FOR METRO MANILA SEWERAGE AND SANITATION IMPROVEMENT PROJECT

Table 2.3.6: Existing communal septic tanks operated by MWCI

No.	Location	Tank capacity (m^3)
1	Violeta St., Roxas District, QC	113
2	Umbel St., Roxas District, QC	53
3	Gumamela St., Roxas District, QC	114
4	Gumamela St., Roxas District, QC	121
5	Waling Waling St., Roxas District, QC	192
6	Waling Waling St., Roxas District, QC	153
7	Everlasting St., Roxas District, QC	230
8	Azucena St., Roxas District, QC	191
9	Azucena St., Roxas District, QC	90
10	Azucena St., Roxas District, QC	70
11	Champaca St., Roxas District, QC	143
12	Camia St., Roxas District, QC	84
13	Everlasting St., Roxas District, QC	79
14	Alley nr. Rimas St., Project 2, QC	338
15	J. Zobel St., Project 4, QC	252
16	Near Sianghio St, Kamuning, QC	410
17	Matiwasay St., U.P. Village, QC	829
18	Mapagmahal St., U.P. Village, QC	432

Source: MWSS Master Plan, 2005.

Table 2.3.7: Sewerage and sanitation facilities operated by MWSI

Facility	System Components	Location	Capacity (m^3/day)	Rehabilitated/ Constructed under
Sewerage Facilities				
Manila Central Sewerage System	300 km of sewers 3.5 km outfall to the Manila Bay	Manila	432,000 (average loading is 130,000 m^3/day)	MSSP
Dagat-Dagatan Sewerage System	Aerated Lagoon System 67 km of sewers	Malabon, Navotas and Caloocan City	13,000 m^3/day (average loading is 4,000 m^3/day)	MSSP
Quezon City Communal System	4 communal septic tanks, 1 Imhoff Tank 18 km of sewers	Project 7 and 8, Quezon City	N/A	
Sanitation Facilities				
Dagat-Dagatan Septage Treatment Plant	Screw Press System, filtrate is conveyed to aerated lagoon system which also treats sewage. Septage is collected by 7 mobile dewatering units and 25 vacuum trucks		450 m^3/day (two hour shifts)	MSSP

Source: Maynilad, May 2009

Photo 2.3.1: Sedimentation basin during maintenance

Photo 2.3.2: Aeration basin

Photo 2.3.3: Flume flow measurement facility

Photo 2.3.4: Mechanical screening facility

Photo 2.3.5: Sedimentation tank at the Global City STP operated by MWCI

Photo 2.3.6: Centennial STP, an underground STP serving medium-rise residential condominiums. Operated by MWCI

(c) Major Sewerage and Sanitation Systems Turned Over by MWSS to MWSI/MWCI in 1997

For the east concession zone, MWCI inherited the operation of the following facilities from MWSS:

- The Ayala System which includes the Makati South (Magallanes) STP;
- One bio-module STP in Cainta;
- One Imhoff tank in Phil-am Village; and
- 33 communal septic/imhoff tank systems in Quezon City and Antipolo with separate systems.

For the west concession zone, MWSI took over the operation of the following systems:

- Central (Manila) Sewerage System;
- Dagat-Dagatan Sewerage System; and
- 5 separate systems in Quezon City with communal septic tanks.

The major facilities operated by MWSS until 1997, and later on turned over to MWCI and MWSI are discussed below.

Makati Sewerage System (MWCI)

The Makati sewerage system is composed of a network of local and trunk sewers ranging from 200 to 1500 mm in diameter and a by-pass pumping station. The service area is around 600 ha. The treatment plant is situated at the southwestern tip of Magallanes Village, the lowest point in the service area and the effluent discharges into Dilain Creek, which runs along southern boundary of the plant site.

In 1966, a trickling filter was first constructed and operated until 1971. During that period, the plant did not function effectively, thus it was replaced by a 22.7 MLD activated sludge plant in 1971. In 1979, the plant was further expanded to a nominal capacity of 40 MLD to serve a population of about 120,000 people. Under the MSSP, the treatment plant's pumping station and sedimentation tank were rehabilitated.

Manila Central Sewerage System (MWCI)

The Manila Central Sewerage System is the oldest system in Metro Manila which was built in 1904. It is composed of two collection networks, one north and one south of the Pasig River. Its sewer length is about 305 km with a diameter ranging from 125 mm to 1425 mm; and seven lift stations located in Legarda, Luneta, Malate, Paco, Port Area, Sta. Ana and Sta. Cruz. It has an estimated service area of 2,620 ha.

The two networks end at the Tondo pumping station which pumps the sewage via an 1800 mm diameter outfall and a 300 mm diffuser section at a depth of about 11 m discharging into the Manila Bay. The design flow capacities of the Tondo Pumping Station are 5.0 m^3/s during peak flow and 3.3 m^3/s during average flow.

The sewer network and the pumping stations were rehabilitated under the MSSP.

Dagat-Dagatan Sewerage System (MWSI)

The Dagat-Dagatan Wastewater Treatment Plant (WWTP) was originally developed by the National Housing Authority (NHA) from 1979 to 1986. It is a waste stabilization pond with natural clay lining. It has a service area of 332 hectares located on a reclaimed land adjacent to the sea. Its sewer length is about 67 km with piped diameter ranging from 200 to 750 mm. The treatment facility is approximately 5 hectares which was rehabilitated under the MSSP.

Figure 2.3.3: Central (Manila) sewerage system
(Source: MWSS Master Plan, 2005)

(d) Sewerage Facilities Improved and/or Developed by MWCI and MWSI (1997 to 2009)

Table 2.3.8 summarizes the improvements initiated by the concessionaires since 1997, particularly under the Manila Second and Third Sewerage Projects. These projects are further discussed in Chapter 4.

To date, except for the septage-sewage treatment plant in FTI, Taguig (which was originally designed only as a septage treatment plant), no new sewerage project has been commissioned under the Manila Third Sewerage Project (MTSP), but several are nearing completion.

Table 2.3.8: Existing sewerage systems rehabilitated/developed by MWSI/MWCI (1997-2009)

Sewerage system	Concessionaire	Improvement by MWSI/MWCI (1997-2009)	Rehabilitated/ Developed under
Manila Central Sewerage System (Manila)	MWSI	– Improvement of Tondo pumping station – Rehabilitation of 7 lift stations – Sewer lines improvement involving CCTV and line cleaning and repair – Additional mechanical bar screens, aerated grit removal plates	MSSP
Dagat-Dagatan Sewerage System (Caloocan, Malabon, Manila, Navotas)	MWSI	– Dewatering of and sludge removal from the four lagoons – Construction of baffled walls – Installation of eight floating mechanical aerators on the two aerated lagoons – Replacement of pumps	MSSP
Magallanes Sewerage System (Makati)	MWCI	– STP rehabilitation (pumping station and sedimentation tank)	MSSP
Various CSTs and new STPs	MWCI	– 18 STPs constructed, either as CST upgrades or new construction	MSSP (under the Community Sanitation Program)
FTI sewage treatment plant	MWCI	– Part of the septage-sewage treatment plant. The plant can accept 2,000 m^3/day of sewage from the locators in the FTI complex	MTSP
Pineda-Capitolyo sewage treatment plant	MWCI	– Includes a combined system interceptor and a 5 MLD sewage treatment plant. The STP is presently being commissioned.	MTSP

The MSSP works for the Manila Central Sewerage System also included the installation of 10,000 sewer connections, but this was not materialized, which mainly because of the high cost for the sewer connection and its associated tariff.

(c) Sanitation Facilities Improved and/or Developed by MWCI and MWSI (1997-2009)

During pre-concession period, MWSS provided limited desludging services. The main constraints in the desludging program are the inaccessibility of many septic tanks, unavailability of vacuum tankers and difficulty in identification of appropriate sludge disposal sites acceptable to DENR. Since September 1995, the only inland disposal site previously used by MWSS (near

Marilao, Bulacan) became unavailable and the desludging work ceased. The MWSS equipment had also exceeded their useful life with the desludging units becoming only partly operational. The Dagat-Dagatan lagoons were used for disposal of septage before it was rehabilitated in 2003 and a septage treatment plant was constructed.

Prior to 2007, septage collected by MWCI was transported and discharged to an Imhoff tank located at Phil-Am Village, Quezon City. The Imhoff tank served as a temporary storage for septage, with private hauling contractors of MWCI coming to collect the septage, and transporting it to *lahar* areas in Pampanga and Tarlac. The septage was spread over the *lahar* areas, which are later planted with sugarcane. A research study by the Sugar Regulatory Administration[23] indicated an increased tonnage in the range of 46-74 % as a result of septage application ranging from 40-120 tons per hectare.

In 2007, under the Manila Third Sewerage Project, MWCI commissioned two septage treatment plants:

- **FTI (South) SpTPs**: MWCI's combined septage and sewage treatment plant with 2,814 m^3/day capacity was completed in 2007. It is located on a 1.0 ha land within the FTI Complex, an industrial estate in Taguig City. The plant is designed to cater for 2,000 m^3/day of sewage from FTI Complex and 814 m^3/day of septage from households in the southern portion of the concession area. It serves San Juan, Mandaluyong, Pasig, Makati, Pateros and Cainta.
- **San Mateo SpTP (North)**: This facility with a capacity of 586 m^3/d was completed in May 2007. It serves about 167,000 homes in San Mateo, Rodriguez town, Marikina City and some areas in Quezon City.

Photo 2.3.7: FTI (South) SpTP

Photo 2.3.8: A 10 m^3 vacuum truck unloading septage at the MWCI San Mateo (South) septage treatment plant

[23] E.B. Estanislao et. al, 2002.

Photo 2.3.9: Screw press equipment used to dewater sludge at the MWCI San Mateo (South) septage treatment plant. This type of equipment is also used at the MWCI North and MWSI Dagat-Dagatan septage treatment plants.

Photo 2.3.10: Aeration tanks (activated sludge process) used for treating filtrate coming from the screw presses.

With the commissioning of the new septage treatment plants (SpTP) in 2007, MWCI launched a program called "Sanitasyon Para Sa Barangay" (Sanitation for the Community Program), whereby septic tanks are emptied and cleaned once every five years. In 2009 alone, Manila Water earmarked PhP101 million for its desludging program targeting a total of 57,576 septic tanks to be desludged all over the east concession area with an estimate volume of 231,780 m^3. Expected to benefit from this program are nearly 180,000 households or more than a million residents.

At present MWCI operates 93 desludging tankers and performs regular, scheduled septic tank cleaning services for its customers free of charge (subject to terms and conditions). Besides, emergency services are also provided at a fee.

For MWSI, prior to the completion of the septage treatment plant at Dagat-Dagatan, MWSI undertook its collection, treatment, and disposal of septage using the so-called Mobile Dewatering Units (MDU), which are truck-mounted dewatering systems. Private contractors were employed to transport dry sludge to *lahar* areas in Pampanga and Tarlac.

Since May 2005, the septage treatment plant in Dagat-Dagatan became operational and reportedly treats up to 400 m^3/day of septage on a 16-hour day basis. Seven MDUs and 25 vacuum tankers are presently fully utilized for desludging activities.

(f) Bio-solids Management

MWCI's sewerage and sanitation (desludging) services generate a huge amount of bio-solids. These bio-solids are organic sludge produced from the physical and biological treatment of wastewater. For the period of January to December 2007, a total of 11,000 cubic meters of bio-solids was produced. Instead of treating bio-solids as waste, MWCI recycles the bio-solids through land application on *lahar* areas. Soil quality is enhanced and studies have shown that the practice is effective in increasing crop yield.

Both MWCI and MWSI are licensed by the Fertilizer and Pesticides Authority (FPA) as a soil conditioner manufacturer and distributor. MWCI was recognized by the Sugar Regulatory Administration (SRA) for their efforts to improve the yield of sugar cane farms by bio-solids application.

MWCI also recognizes the impact of bio-solids with respect to global warming. MWCI is now

studying means to recycle bio-solids to enhance yields of biodiesel-producing Jathropa curcas. They have also initiated steps towards generating electricity from biogases generated by digesting bio-solids.

(g) Recycled Wastewater

In MWCI's Effluent Reuse Program, recycled water is being collected and used for other more productive purposes. MWCI is the first to introduce the use of recycled water in 2005 (in collaboration with MMDA) to green the center islands along the main thoroughfares of the metropolis.

In 2007, MWCI signed an agreement to provide recycled water to the UP-Ayala technological park in Quezon City. This marked the first ever sale of recycled water. It was reported that Manila Water will deliver at least 4 MLD of recycled water to the park.

(h) NHA Sanitation Systems in Metro Manila

There are various communal systems with sewer networks (**Table 2.3.9**) built by the National Housing Authority (NHA) but not all turned over to MWSS (and eventually to MWCI / MWSI) due to various reasons.

Table 2.3.9: NHA communal system and other private systems

System/location	Owner	Year built	Service area	Communal septic tank
West Zone				
Tangos System, Daang Hari, Tangos Navotas	NHA	1980s		Septic tank
Capri System, Novaliches, Quezon City	NHA	1980s		Septic tank
Maricaban System, Maricaban, Pasay City	NHA	1980s		Septic tank
Leveriza Zystem, Malate, Manila	NHA	Now connected to Manila Central System		
Juan Luna System, Tondo, Manila	NHA	Now connected to Manila Central System		
Bagkal System, Bangkal, Pasay City	NHA	MWSS PROGRESS pilot project		
Quezon Institute, E. Rodriguez Ave, Quezon City	Quezon Institute			Septic tank
Veterans Memorial Hospital, Quezon City	Veterans Memorial	1953-55	55 ha, 200-600 mm dia. & 2,581 length	Septic tank
Philam Life, Las Pinas	Private			Imhoff tank
East Zone				
Martin de Porres System, Cubao, Quezon City	NHA			Septic tank
Bagong Nayon System, Antipolo City	NHA			Septic tank
Camp Aguinaldo System, Camp Aguinaldo, Quezon City	DND			Septic tank
Kamuning District, Quezon City	QC Govt.			Septic tank 5.8m x 19.0m x 3.4m
Parks & Wildlife, Quezon Ave, Quezon City	Bureau of Forest Dev.			Septic tank 8.0m x 22.6m x 5.0m

Source: MWSS Master Plan, 2005.

(i) Private Facilities

Besides the abovementioned systems, there are various other private sewerage systems serving various residential and commercial developments in Metro Manila, including new systems serving real estate property developments by private developers (see **Table 2.3.10**). Shopping

malls and commercial centers located in non-sewered areas have also built individual wastewater treatment plants e.g. SM Megamall in Mandaluyong City, Global City at Fort Bonifacio, and Greenhills Shopping Center at San Juan.

Table 2.3.10: Private sewerage facilities

MWSI Area	MWCI Area
Ayala-Alabang system	Global City-Fort Bonifacio -Activated sludge (5.3 MLD) -Sewer lines (16 km)
Filinvest Alabang system	Old NHA systems
Smokey Mountain System (Manila)	SM Megamall (Mandaluyong)
Old NHA System	Greenhills Shopping Center (San Juan)

Source: Water Supply, Sewerage and Sanitation Master Plan for Metro Manila, MWSS, 2005.

(j) Private Septic Tank Desludgers

Private septic tank desludgers have been operating in Metro Manila prior to the privatization but their exact numbers could not be determined. It is difficult to ascertain their ownership considering that not all of them are registered with their respective local government units.

The Department of Health issued a regulation on septage management in 2004 and an operation manual in 2008. They shall be used as a guide by LGUs to implement and enforce the Sanitation Code and Clean Water Act. Operators of desludging services are required to secure an environmental sanitation clearance (ESC) and sanitary permits. To date, DOH reported that only the two concessionaires have been issued with ESCs, therefore all the private desludgers are operating without any legal permits.

A serious issue that confronts the private desludgers is that they operate without any proper septage treatment facility. There have been several incidences where desludgers were caught disposing septage into rivers, drainage and the Manila Bay. In May 2006, a case was reported in local newspapers saying that the DENR Secretary ordered the closure of a "Pozo Negro" excavator for illegally dumping of its collected human waste into an open street drainage system in Barangay Bagong Ilog in Pasig City.

2.4 Pollution Load Mapping and Assessment

Pollutant load is the mass or weight of pollutant transported in a specified unit of time from pollutant sources to a water body (Richards, 1997). Pollutant load estimation is a fundamental element in the development of many watershed management plans. Reliable estimates of the quantity of pollutants delivered from various sources within a watershed are essential in developing plans that will address identified water quality problems or issues.

For the MWSS service area, pollution loads discharged into the rivers are originated mainly from domestic, commercial and industrial establishments. Although agricultural activities still take place especially in the eastern part of the zone, agricultural fields are rapidly being replaced by residential and commercial developments, which form satellite cities or bed towns for Metro