REPUBLIC OF THE PHILLIPINES

DATA COLLECTION SURVEY FOR SEWERAGE SYSTEMS IN WEST METRO MANILA

FINAL REPORT (VOLUME 1 MAIN REPORT)

September 2016

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd. (NK)

KRI International Corporation (KRI)

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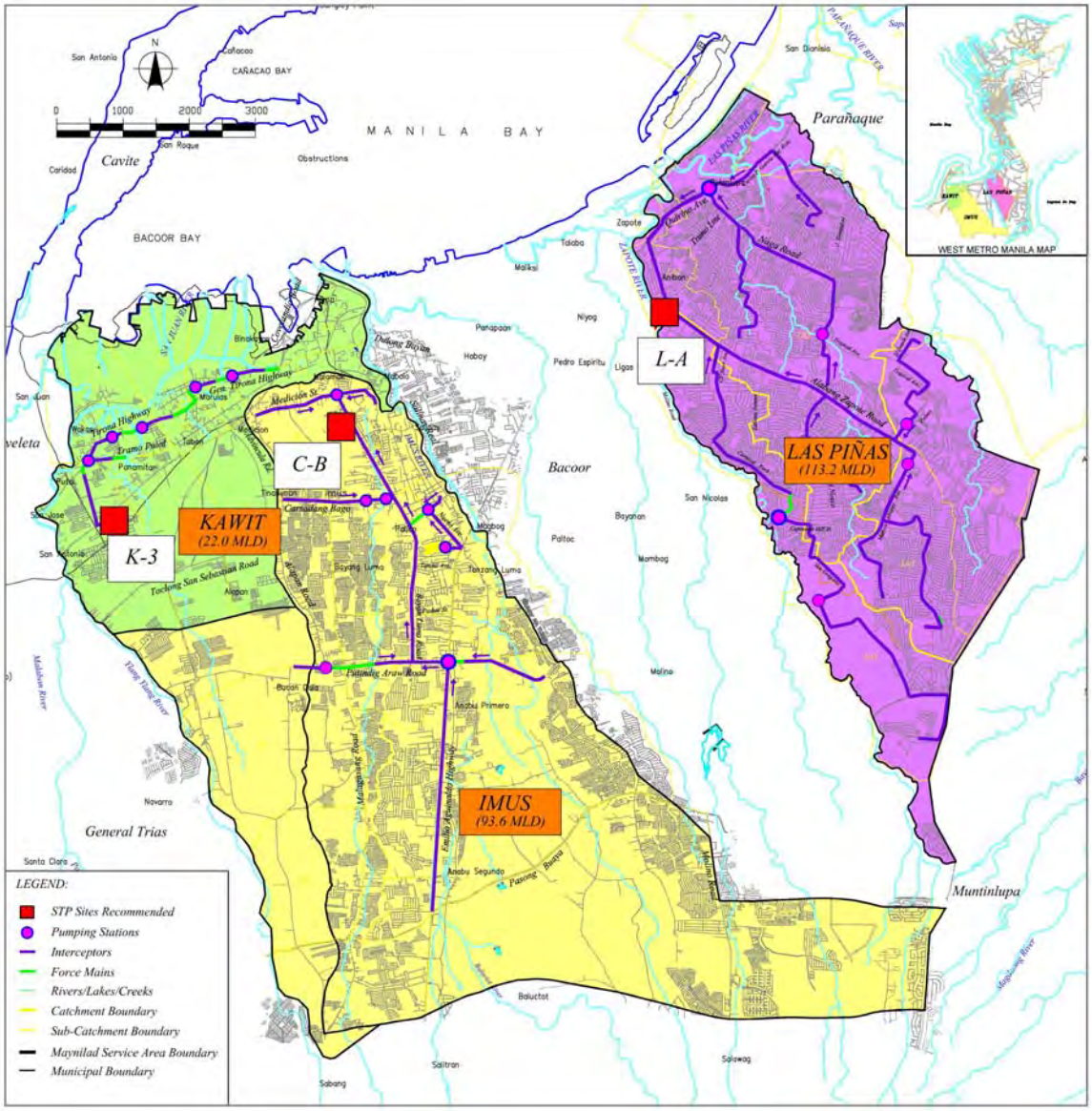


Sewerage System in Target Areas

Executive Summary

CHAPTER 1 Introduction

1.1 Background of the Study

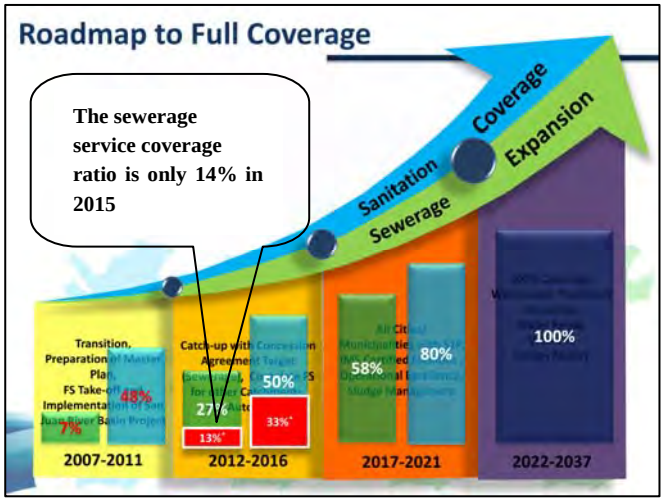
Service coverage of the water supply in Metro Manila has been over 95%. However, sewerage service coverage in Metro Manila remains at the low level which is still approximately 14% in 2015.

Corresponding to the social requirements toward sewerage service, Maynilad is planning to implement 10 major sewerage projects from 2017 to 2022.

However, due to the delay of land acquisition process for STPs, the actual progress is behind the development schedule. Because, currently, the land price is increasing and it is difficult to find suitable lands in West Metro Manila.

1.2 Objectives of the Survey

Maynilad has to achieve a sewerage coverage target of 27% by 2016, 58% by 2021, and 100% by 2037 in accordance with the concession agreement. A total of 56 STPs will be constructed. However, due to the delay of land acquisition process for STPs, the actual progress is behind the development schedule.



Source: Maynilad

Figure 1.2.1 Sewerage Development Plan of Maynilad

In addition, the delay in the construction work of some sewerage projects due to various causes prevented Maynilad from achieving the coverage target ratio; as a result, the sewerage service coverage ratio was only 14% in 2015.

The main reasons of the delay are land acquisition issue due to rapid rise in land price, traffic congestion, and difficulty of construction in small areas and in high density residential areas.

The purpose of the Survey is to draft several sewerage system plans in which various innovative technologies applicable to the conditions in Metro Manila are introduced considering the abovementioned background and present them as options. As for the number of STPs to be required, the treatment capacity, the pipeline plan, the initial and maintenance costs, and life cycle cost (LCC) evaluation for each alternative shall be identified together with the merits and demerits.

1.3 Main Scope of the Survey

The scope of the Survey is as follows:

- Review on the existing documents such as F/Ss which were conducted by Maynilad and JICA;
- Identify candidate sites for STP in the target areas;
- Collection of data and information about the target area (geology, hydrology, food record, outfall, development plan, city plan, regulation, environmental condition, etc.);
- Case study on sewerage system with applicable sewage treatment process in the target area;
- Cost estimation (initial cost and O&M cost)
- LCC calculation;
- Environmental and social consideration;
- Economic and financial analysis; and
- Identification of possible financial schemes.

1.4 Survey Area

The survey area are Las Pinas city, Imus city and Kawit town in the West Zone of Metro Manila.

1.4.1 Las Piñas City

(1) General Description

Las Piñas City, officially called the city of Las Piñas (Filipino: *Lungsod ng Las Piñas*), is a city in the National Capital Region of the Philippines. According to the 2010 Census, it has a population of 552,573.

1.4.2 Imus City

(1) General Description

Imus City is the officially designated capital city of the province of Cavite in the Philippines. The former municipality was officially converted into a city following a referendum on June 30, 2012. Based on the 2010 local government unit (LGU) income of Imus, the former town is classified as a first-class component city of Cavite with a population of 301,624 people according to the 2010 Census.

1.4.3 Kawit Town

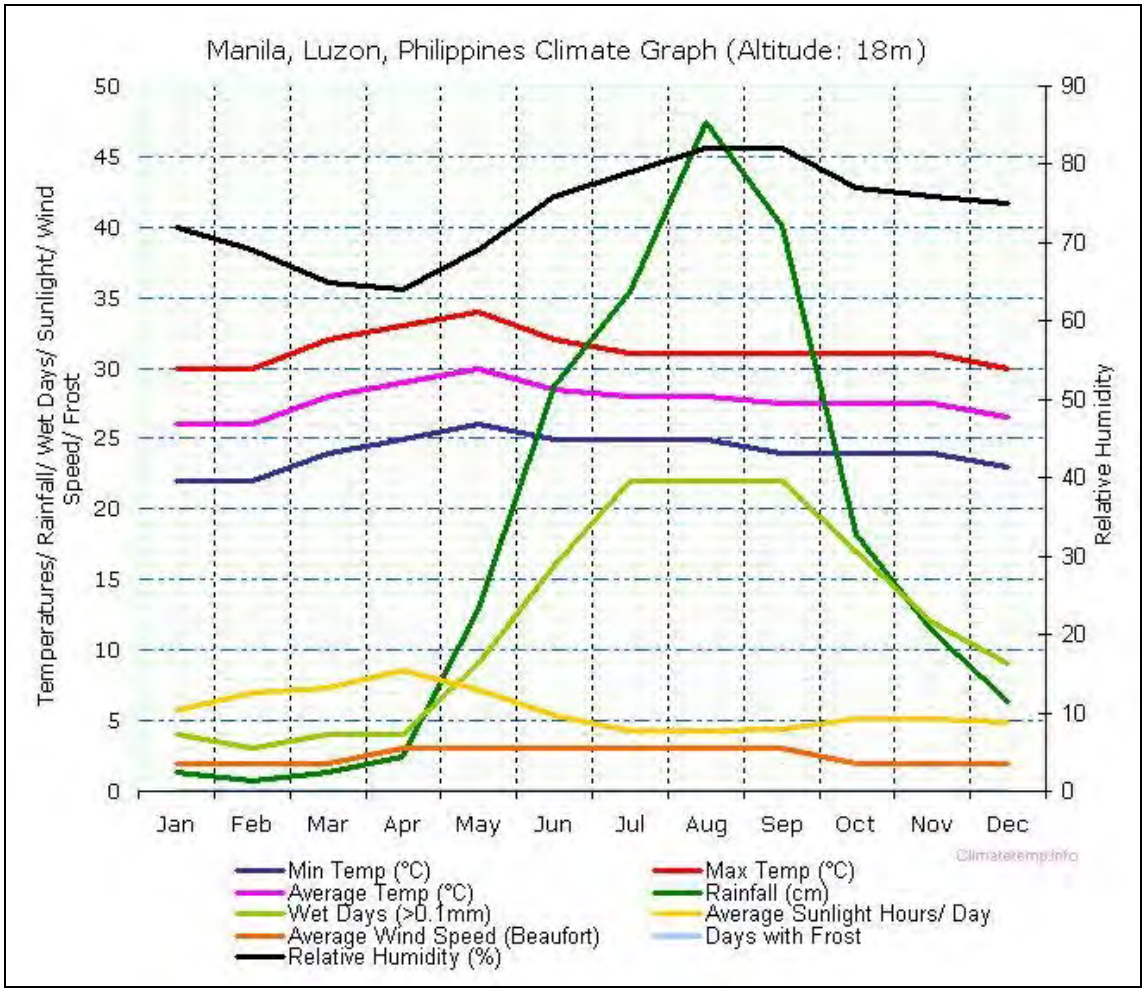
Kawit Town covers a land area of 1,340 ha (13.40 km^2), approximately 1.0% of the total land area of the province of Cavite, which is 1,427.06 km^2.

Kawit Town is situated in the northern part of the province. It is bounded by Cavite City and Bacoor Bay in the north and Bacoor in the east. Noveleta can be found beyond the western

boundary while General Trias and Imus share its southern limits. It is about 25 km south of Metro Manila and about 4 km south of Cavite City across Bacoor Bay.

1.5 Natural and Physical Conditions of Metro Manila

Based on the available climatological data from the Science Garden Station of PAGASA, the climatic conditions in the study area are shown in Figure 1.5.1.



Source: PAGASA Science Garden Station, Period of Records: 1981-2010

Figure 1.5.1 Average Monthly Climate Condition

1.5.1 Water Body

(1) Classification of Water Bodies in the Philippines

Surface waters are classified to maintain its safe quality and satisfactory condition according to their best usages. Table 1.5.1 shows the current classification for fresh surface water and coastal and marine waters, accordingly.

Table 1.5.1 Current Classification of Water Bodies for Fresh Surface Water According to Beneficial Use

Classification	Beneficial Use
Inland Surface Water	
Class AA	Public Water Supply Class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the Philippine National Standards for Drinking Water (PNSDW)
Class A	Public Water Supply Class II. For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the PNSDW
Class B	Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes)
Class C	1) Fishery Water. For the propagation and growth of fish and other aquatic resources 2) Recreational Water Class II (e.g., boating, etc.) 3) Industrial Water Supply Class I (For manufacturing processes after treatment)
Class D	1) For agriculture, irrigation, livestock watering, etc. 2) Industrial Water Supply Class II (e.g., cooling, etc.) 3) Other inland waters, by their quality, belong to this classification
Marine Water	
Class SA	1) Waters suitable for the propagation, survival, and harvesting of shellfish for commercial purposes 2) Tourist zones and national marine parks and reserves established under the Presidential Proclamation No. 1801; existing laws and/or declared as such by appropriate government agencies 3) Coral reef parks and reserves designated by law and concerned authorities
Class SB	1) Recreational Water Class I (Areas regularly used by the public for bathing, swimming, skin diving, etc.) 2) Fishery Water Class I (Spawning areas for *Chanos chanos* or *"Bangus"* and similar species)
Class SC	1) Recreational Water Class II (e.g., boating, etc.) 2) Fishery Water Class II (Commercial and sustenance fishing) 3) Marshes and/or mangrove areas declared as fish and wildlife sanctuaries
Class SD	1) Industrial Water Supply Class II (e.g., cooling, etc.); 2) Other coastal and marine waters, by their quality, belong to this classification

Source: DAO No. 1990 – 34, Revised Water Usage and Classification Water Quality Criteria Amending Section Nos.

1.6 Population Projection

The population projection, which was provided by Maynilad based on the Census 2010, is shown in Table 1.6.1. The annual growth rate is shown in Table 1.6.2.

Table 1.6.1 Population Projection

City/Municipality (West Zone)	2010	Population Projection 2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Overall	**9,149,177**	**9,239,503**	**9,334,889**	**9,433,663**	**9,536,103**	**9,641,496**	**9,740,053**	**9,840,924**	**9,943,940**	**10,049,020**	**10,156,124**	**10,248,217**	**10,341,852**	**10,437,026**	**10,533,743**	**10,632,019**
NCR	**7,984,378**	**8,049,596**	**8,118,935**	**8,190,673**	**8,265,031**	**8,341,439**	**8,409,329**	**8,478,580**	**8,549,031**	**8,620,590**	**8,693,201**	**8,752,686**	**8,812,857**	**8,873,691**	**8,935,177**	**8,997,307**
Manila	1,486,400	1,484,568	1,483,043	1,481,875	1,481,122	1,480,549	1,480,134	1,479,844	1,479,630	1,479,477	1,479,368	1,479,289	1,479,232	1,479,191	1,479,162	1,479,140
Quezon City	1,744,493	1,767,483	1,790,776	1,814,375	1,838,286	1,862,512	1,883,248	1,904,214	1,925,414	1,946,849	1,968,524	1,986,213	2,004,062	2,022,071	2,040,242	2,058,576
Caloocan	1,513,521	1,528,535	1,543,698	1,559,011	1,574,476	1,590,094	1,605,469	1,620,993	1,636,667	1,652,492	1,668,470	1,680,980	1,693,583	1,706,281	1,719,075	1,731,964
Malabon	351,181	346,739	344,539	342,716	341,325	340,431	339,752	339,260	338,917	338,665	338,485	338,355	338,262	338,195	338,147	338,112
Navotas	249,942	252,841	255,774	258,741	261,743	264,779	267,102	269,446	271,810	274,195	276,600	278,444	280,300	282,169	284,050	285,943
Valenzuela	576,729	583,710	590,777	597,928	605,167	612,492	618,055	623,667	629,331	635,046	640,813	645,268	649,754	654,271	658,819	663,399
Las Piñas	556,965	565,387	573,937	582,616	591,426	600,370	608,253	616,240	624,331	632,529	640,834	647,831	654,904	662,054	669,282	676,589
Makati	57,142	56,426	55,837	55,389	55,102	54,885	54,727	54,618	54,538	54,480	54,439	54,409	54,388	54,372	54,361	54,353
Muntinlupa	461,439	469,250	477,194	485,271	493,486	501,839	508,839	515,936	523,132	530,428	537,827	544,118	550,482	556,921	563,436	570,026
Parañaque	595,937	606,526	617,303	628,272	639,435	650,797	661,619	672,622	683,807	695,178	706,738	716,782	726,968	737,300	747,778	758,405
Pasay City	390,629	388,129	386,058	384,478	383,462	382,690	382,131	381,741	381,455	381,250	381,103	380,997	380,921	380,866	380,827	380,798
CAVITE	**1,164,799**	**1,189,908**	**1,215,954**	**1,242,990**	**1,271,072**	**1,300,057**	**1,330,724**	**1,362,345**	**1,394,909**	**1,428,430**	**1,462,923**	**1,495,531**	**1,528,995**	**1,563,334**	**1,598,566**	**1,634,712**
Bacoor	538,718	552,721	567,087	581,828	596,951	612,468	629,174	646,336	663,966	682,076	700,681	718,239	736,237	754,686	773,597	792,982
Cavite City	100,401	99,682	99,087	98,633	98,341	98,119	97,959	97,847	97,765	97,706	97,664	97,634	97,612	97,596	97,585	97,577
Imus	313,042	322,036	331,289	340,807	350,598	360,671	371,612	382,884	394,499	406,465	418,795	430,513	442,558	454,941	467,670	480,755
Kawit	78,597	80,835	83,136	85,503	87,938	90,441	92,583	94,776	97,021	99,319	101,671	103,863	106,102	108,390	110,726	113,114
Noveleta	42,202	43,358	44,545	45,764	47,017	48,305	49,470	50,662	51,884	53,135	54,416	55,611	56,832	58,080	59,355	60,659
Rosario	91,839	91,277	90,811	90,455	90,226	90,052	89,926	89,839	89,774	89,728	89,695	89,671	89,654	89,642	89,633	89,626

City/Municipality (West Zone)	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Overall	**10,712,772**	**10,794,674**	**10,877,737**	**10,961,979**	**11,047,418**	**11,114,992**	**11,183,442**	**11,252,783**	**11,323,030**	**11,394,197**	**11,446,438**	**11,499,335**	**11,552,899**	**11,607,141**	**11,662,073**
NCR	**9,044,956**	**9,092,987**	**9,141,397**	**9,190,186**	**9,239,354**	**9,273,968**	**9,308,782**	**9,343,796**	**9,379,012**	**9,414,430**	**9,434,724**	**9,455,100**	**9,475,557**	**9,496,097**	**9,516,718**
Manila	1,479,125	1,479,114	1,479,106	1,479,100	1,479,096	1,479,093	1,479,091	1,479,090	1,479,089	1,479,088	1,479,087	1,479,087	1,479,087	1,479,086	1,479,086
Quezon City	2,072,526	2,086,571	2,100,711	2,114,947	2,129,280	2,139,240	2,149,246	2,159,299	2,169,399	2,179,546	2,184,988	2,190,443	2,195,911	2,201,393	2,206,889
Caloocan	1,741,609	1,751,308	1,761,062	1,770,869	1,780,731	1,786,853	1,792,996	1,799,160	1,805,345	1,811,551	1,814,303	1,817,060	1,819,821	1,822,586	1,825,355
Malabon	338,087	338,069	338,056	338,046	338,040	338,035	338,031	338,029	338,027	338,026	338,025	338,024	338,024	338,023	338,023
Navotas	287,316	288,696	290,082	291,474	292,874	293,674	294,477	295,282	296,089	296,898	297,053	297,208	297,364	297,519	297,674
Valenzuela	666,760	670,137	673,531	676,942	680,371	682,395	684,425	686,461	688,504	690,552	691,149	691,747	692,345	692,944	693,544
Las Piñas	681,970	687,394	692,861	698,371	703,925	708,025	712,148	716,295	720,466	724,662	727,280	729,908	732,546	735,193	737,849
Makati	54,348	54,343	54,340	54,338	54,337	54,336	54,335	54,334	54,334	54,334	54,333	54,333	54,333	54,333	54,333
Muntinlupa	575,553	581,134	586,769	592,459	598,203	602,688	607,207	611,760	616,346	620,967	624,210	627,470	630,747	634,041	637,352
Parañaque	766,884	775,458	784,127	792,894	801,758	808,894	816,093	823,357	830,685	838,078	843,568	849,093	854,655	860,253	865,888
Pasay City	380,778	380,763	380,752	380,745	380,739	380,735	380,732	380,730	380,729	380,728	380,727	380,726	380,726	380,726	380,726
CAVITE	**1,667,816**	**1,701,687**	**1,736,340**	**1,771,793**	**1,808,064**	**1,841,024**	**1,874,660**	**1,908,987**	**1,944,018**	**1,979,767**	**2,011,713**	**2,044,234**	**2,077,341**	**2,111,045**	**2,145,355**
Bacoor	810,700	828,814	847,333	866,265	885,620	903,169	921,066	939,317	957,930	976,912	993,847	1,011,075	1,028,601	1,046,432	1,064,571
Cavite City	97,571	97,567	97,564	97,561	97,560	97,559	97,558	97,557	97,557	97,557	97,556	97,556	97,556	97,556	97,556
Imus	492,839	505,226	517,926	530,944	544,290	556,529	569,044	581,841	594,925	608,303	620,405	632,748	645,336	658,175	671,269
Kawit	115,256	117,438	119,662	121,928	124,237	126,287	128,370	130,488	132,641	134,830	136,699	138,595	140,516	142,464	144,440
Noveleta	61,830	63,023	64,240	65,480	66,744	67,868	69,010	70,172	71,354	72,555	73,596	74,651	75,722	76,808	77,909
Rosario	89,622	89,618	89,616	89,614	89,613	89,612	89,611	89,611	89,611	89,610	89,610	89,610	89,610	89,610	89,610

Table 1.6.2 Annual Population Growth

City/Municipality (West Zone)	Annual Growth Rate 1990-1995	1995-2000	2000-2007	2007-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
Overall	4.06%	1.28%	2.32%	1.27%	1.05%	1.05%	0.92%	0.77%	0.62%	0.47%
NCR	3.73%	1.08%	2.12%	0.91%	0.88%	0.83%	0.69%	0.53%	0.38%	0.22%
Manila	0.66%	-0.98%	0.76%	-0.14%	-0.08%	-0.02%	0.00%	0.00%	0.00%	0.00%
Quezon City	3.57%	3.01%	3.48%	1.16%	1.32%	1.11%	0.90%	0.68%	0.47%	0.25%
Caloocan	6.03%	2.85%	2.28%	2.60%	0.99%	0.97%	0.75%	0.56%	0.34%	0.15%
Malabon	4.41%	-0.50%	1.02%	-0.96%	-0.62%	-0.11%	-0.02%	0.00%	0.00%	0.00%
Navotas	4.09%	0.12%	0.90%	0.51%	1.16%	0.88%	0.67%	0.48%	0.27%	0.05%
Valenzuela	5.14%	2.12%	2.29%	0.38%	1.21%	0.91%	0.70%	0.51%	0.30%	0.09%
Las Piñas	6.81%	2.74%	1.71%	1.25%	1.51%	1.31%	1.09%	0.80%	0.58%	0.36%
Makati	1.33%	-2.75%	0.69%	-2.00%	-0.80%	-0.16%	-0.03%	-0.01%	0.00%	0.00%
Muntinlupa	7.51%	-1.05%	2.57%	0.51%	1.69%	1.39%	1.17%	0.97%	0.75%	0.52%
Parañaque	4.89%	2.83%	2.99%	2.09%	1.78%	1.66%	1.42%	1.12%	0.89%	0.66%
Pasay City	2.10%	-2.78%	1.85%	-0.89%	-0.41%	-0.08%	-0.02%	0.00%	0.00%	0.00%
CAVITE	7.60%	3.13%	3.96%	4.01%	2.22%	2.39%	2.25%	2.04%	1.83%	1.62%
Bacoor	9.45%	4.04%	5.38%	5.65%	2.60%	2.73%	2.51%	2.23%	1.98%	1.73%
Cavite City	0.22%	1.41%	0.73%	-1.12%	-0.46%	-0.09%	-0.02%	0.00%	0.00%	0.00%
Imus	14.00%	1.96%	3.76%	6.01%	2.87%	3.03%	2.80%	2.51%	2.25%	1.99%
Kawit	3.60%	1.94%	2.85%	0.78%	2.85%	2.37%	2.16%	1.89%	1.65%	1.39%
Noveleta	6.00%	3.20%	3.00%	1.98%	2.74%	2.41%	2.20%	1.93%	1.68%	1.43%
Rosario	3.56%	6.37%	3.58%	-0.70%	-0.39%	-0.08%	-0.02%	0.00%	0.00%	0.00%

1.7 Standard

(1) Design/Planning/Construction Guideline for Sewerage Facilities

1) Existing Standard

Maynilad prepared its own guideline and was supposed to proceed with its planning in accordance with the guideline; however, the details are not described and the technologies used are outdated, so the application (operation) seems to be limited.

2) New Standard

Accordingly, Maynilad has created a new and more practical guidelines for sewerage treatment improvement (plan and design including standard drawings, bidding (consultants and construction companies), technical specifications, execution of works, operation and management) since 2015 through 2016 and planned to be put into practice from 2018.

(2) Water Quality Standard

The new effluent standards, DAO 2016-08 in Table 1.7.1, was issued on 24th May 2016 and applied on 14th June 2016. Therefore, all new sewage treatment facilities should meet the new requirements. The value of nitrogen should be less than 20 mg/L and phosphorus should be less than 1.0 mg/L in Class SB.

Table 1.7.1 Effluent Quality Standards for Each Category (DAO 2016-08)

Parameter	Unit	Water Body Classification								
		AA	A	B	C	D	SA	SB	SC	SD
Ammonia as NH_3-N	mg/L	NDA	0.5	0.5	0.5	7.5	NDA	0.5	0.5	7.5
BOD	mg/L	NDA	20	30	50	120	NDA	30	100	150
Boron	mg/L	NDA	2	2	3	12	NDA	2	20	80
Chloride	mg/L	NDA	350	350	450	500	NDA	n/a	n/a	n/a
COD	mg/L	NDA	60	60	100	200	NDA	60	200	300
Color	TCU	NDA	100	100	150	300	NDA	100	150	300
Cyanide as Free Cyanide	mg/L	NDA	0.14	0.14	0.2	0.4	NDA	0.04	0.2	0.4
Fluoride	mg/L	NDA	2	2	2	4	NDA	3	3	6
Nitrate as NO_3-N	mg/L	NDA	14	14	14	30	NDA	20	20	30
pH (Range)		NDA	6.0-9.0	6.0-9.0	6.0-9.5	5.5-9.5	NDA	6.5-9.0	6.0-9.0	5.5-9.5
Phosphate	mg/L	NDA	1	1	1	10	NDA	1	1	10
Selenium	mg/L	NDA	0.02	0.02	0.04	0.08	NDA	0.02	0.2	0.4
Sulfate	mg/L	NDA	500	500	550	1,000	NDA	500	550	1,000
Surfactants (MBAS)	mg/L	NDA	2	3	15	30	NDA	3	15	30
Temperature(h)	°C change	NDA	3	3	3	3	NDA	3	3	3
Total Suspended Solids	mg/L	NDA	70	85	100	150	NDA	70	100	150
Arsenic	mg/L	NDA	0.02	0.02	0.04	0.08	NDA	0.02	0.04	0.08
Barium	mg/L	NDA	1.5	1.5	6	8	NDA	1.5	2	8
Cadmium	mg/L	NDA	0.006	0.006	0.01	0.02	NDA	0.006	0.01	0.02
Chromium as Hexavalent Chromium (Cr^{6+})	mg/L	NDA	0.02	0.02	0.02	0.04	NDA	0.1	0.1	0.2

Source: Department of Environment and Natural Resources (DENR) Water Quality Guideline and General Effluent Standards of 2016

The effluent standard in the new sewerage guidelines of Maynilad will cover the condition above.

Influent and effluent water quality standards specified in the new guidelines are shown in Table 1.7.2 and Table 1.7.3, respectively.

Table 1.7.2 Influent Standard in the Maynilad New Sewerage Guidelines

Parameter	Units	Minimum Values	Maximum Values
BOD_5	mg/L	70	240
TSS	mg/L	70	210
COD	mg/L	140	470
Oil and Grease	mg/L	20	60
Total Coliform	MPN per 100 mL	$10x10^7$	$50x10^8$
TP	mg/L	3.7	8
TN	mg/L	34.6	46
pH			6-9
Temperature	°C	25	29
NO3	mg/L	0.1	2.7
NH4	mg/L	41.3	45

** - BOD_5 shall include dissolved and suspended pollutants taken at 20°C.*
Source: Maynilad

Table 1.7.3 Effluent Standard in the Maynilad New Guidelines

Parameter	Unit	Parameter Maximum Value
TSS	mg/L	30
BOD_5 at 20°C *(dissolved and suspended)*	mg/L	30
COD	mg/L	60
Oil and Grease	mg/L	5
pH	-	6.5 – 9.0
Total coliform	MPN per 100 mL	10,000
Sludge	%DS	Not less than 20% dry solids
*NO_3	mg/L	14
*NH_3-N	mg/L	0.5
*Phosphate	mg/L	1

Source: Maynilad

(3) Applicable Treatment Technologies Specified in the Maynilad New Guidelines

In the new guidelines, secondary treatment is through aerobic biological process. The following treatment processes are considered equally acceptable if design and installation consistently meet the requirements, especially the effluent quality standard:

1) Activated Sludge Process (ASP)
2) Sequencing Batch Reactor (SBR)
3) Moving Bed Biofilm Reactor (MBBR)
4) Membrane Bio Reactor (MBR)
5) Fixed-bed Biofilm Activated Sludge (FBAS)

The treatment processes, which will be applied for the case study of sewerage system in this Survey, are selected in Chapter 5.

CHAPTER 2 Institutional Aspects Related to the Water Business Operations

2.1 Profile of the Concessionaire in West Metro Manila

Table 2.1.1 shows the profile of Maynilad as of 2015.

Table 2.1.1 Profile of Maynilad

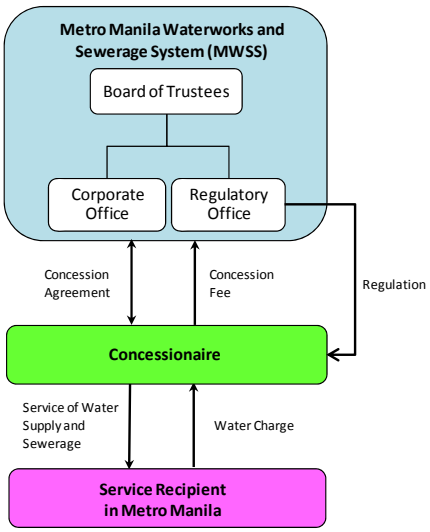
	Maynilad Area (West Zone)	
1. Profile		
Name	Maynilad Water Service, Inc. (MWSI)	
Shareholders	- Metro-Pacific Investment Corporation (MPIC) 5.19%	
	- Maynilad Water Holding Company (MWHCI) 92.85% (MPIC 51.27%, DMCI Holdings Inc. 27.19%, Marubeni Corporation 21.54%)	
	– Employeer Stock Option Plan (ESOP) 1.96%	
2. Service Area	(17 cities and municipalities)	
Service Area	540	km^2
Population in Service Area	9,500	1,000 persons
3. Financial Status		
Assets	81,353	million PhP
Operating Revenue	19,098	million PhP
Costs and Expenses	7,245	million PhP
Net Income	9,551	million PhP
4. Service Status		
Served Population	8.4	million persons
Service Connection	1,265,625	nos
Average Billed Volume	1,319	1,000 m^3/day
Water Supply Coverage Ratio	93.7	%
Sewerage Coverage Ratio	14.1	%

Source: Maynilad Annual Report and Website

2.2 Outline of the Concession Agreement

2.2.1 Structure of Operation

Figure 2.2.1 illustrates the structure of the general framework of the water business operation under the Concession Agreement (CA) between MWSS and Maynilad signed on 21 February 1997.



Source: JICA Study Team

Figure 2.2.1 Structural Framework of the Water Business Operation under the Concession Agreement

2.2.2 Major Arrangements in the Agreement

Main arrangements are stated as follows:

(1) Term of the Concession Agreement (CA)

Maynilad has been awarded the concession to provide service for 25 years starting from 1 August 1997 to 6 May 2022. Thereafter, the term of the concession was extended

for an additional 15 years in 2010.

(2) Rights and Obligations of Maynilad

Under the CA, Maynilad was granted the following rights and obligations: i) to make sufficient connections to meet the target service coverage ratio of the population at the time of the target year; ii) to ensure the availability of an uninterrupted 24-hour supply of water to all connected customers in the service area; iii) to ensure supply of water at a level of positive pressure sufficient to secure the system against the ingress of untreated water and other contaminations; iv) to ensure that the water supplied complies with the Philippine National Standard for Drinking Water (PNSDW); v) to offer sewerage services to all customers in the service area, and provide connections to a public sewer; vi) to comply with all national and local environmental laws and standards related to sewage treatment; and vii) to offer septic and sanitation cleaning services.

(3) Concession Fee

In consideration for the grant of concession, Maynilad shall pay MWSS a concession fee. If the concession fee is not paid on time, the US dollar equivalent of such unpaid amount may be drawn under the performance bond.

(4) Rate Adjustment

Maynilad is authorized to charge the customers a standard rate, which is also stipulated in the CA for water and sewerage services. Water and sanitation tariffs are explained in Section 2.3.

(5) Water Sources

Under the CA, MWSS likewise assigned, in favor of Maynilad, its water rights under the existing water permits, as well as further water permits to be issued to MWSS.

(6) Penalties

Failure of Maynilad to meet the service obligations entitles MWSS to assess the penalties such as 25% of the costs, which Maynilad will incur in order to meet the service obligations.

2.3 Water and Sewerage Tariff

2.3.1 Present Water and Sewerage Tariff and Historical Trend

(1) Present Water and Sewerage Tariff

The payment of users to Maynilad is mainly composed of water charge, environmental and sewerage charge, maintenance service charge, and value-added tax (VAT). The users are categorized into four types, namely: residential, semi-business, commercial, and industrial users, as determined in the CA.

The sewerage and environmental charges are calculated by multiplying the fixed rate against

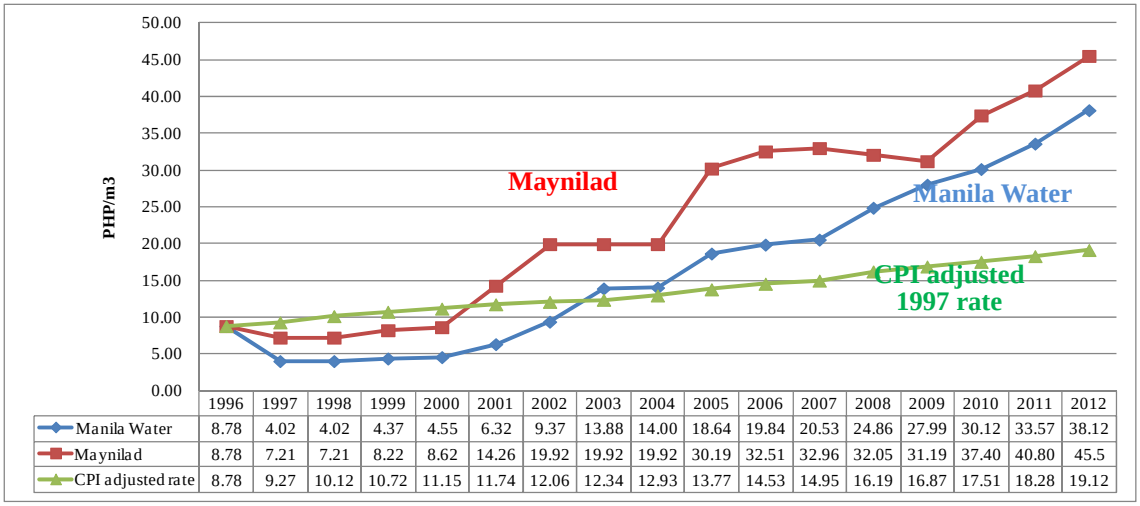
water charge. The environmental charge, set at 20% of water charge, is added on the whole users. Sewerage charge, also fixed at 20% of water charge, is levied on the users in Business I and II categories with sewerage pipe connections only.

From the view of charge type, water charge, environmental charge, and sewer charge take the share of 82%, 16%, and 2% of whole revenue in 2015, respectively. The revenue amount of sewer charge was limited to PHP 306 million in 2015 as it was collected from business entities with sewer connections.

(2) Past Trend of Water Tariff

The past trend of water tariff level of two concessionaires is summarized in Figure 2.3.1. This tariff level includes water charge, environmental charge, maintenance service charge, and VAT, but excludes sewer charge. The latest data after 2013 is not officially published influenced by the arbitration implemented between MWSS and Maynilad for tariff rebasing.

The tariff rate was once reduced after the concession started in 1997, but the rate has been continuously increased to make the financial conditions of two concessionaires healthier.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Manila Water	8.78	4.02	4.02	4.37	4.55	6.32	9.37	13.88	14.00	18.64	19.84	20.53	24.86	27.99	30.12	33.57	38.12
Maynilad	8.78	7.21	7.21	8.22	8.62	14.26	19.92	19.92	19.92	30.19	32.51	32.96	32.05	31.19	37.40	40.80	45.5
CPI adjusted rate	8.78	9.27	10.12	10.72	11.15	11.74	12.06	12.34	12.93	13.77	14.53	14.95	16.19	16.87	17.51	18.28	19.12

Source: Annual Report and Financial Statements 2013, MWSS

Figure 2.3.1 Historical Trend of Average Unit Water Rate of Maynilad and Manila Water

2.3.2 Tariff Setting Mechanism of Water and Sewerage Services

Pursuant to the CA, tariff for water and sewerage tariff is adjusted through the following three methods presented in Table 2.3.1.

Table 2.3.1 Adopted Method for Tariff Rate Setting

Method	Frequency	Purpose
i) Rate rebasing	Every five years	As the concession period is quite long, the service plan and its tariff level is reviewed and updated every five years. Past service performance and future plan will be reviewed by MWSS. The rate

		is determined at the level of securing the full cost recovery of water and sewerage services managed by the concessionaires.
ii) Rate adjustment	Every year	The tariff rate is automatically adjusted based on the consumer price index (CPI) provided by the National Statistics Office (NSO) to consider the price escalation. The impact of exchange rate is adjusted to alleviate the burden of Concessionaires after 2002.
iii) Extraordinary price adjustment	When needed	The impact of extraordinary case, which could not be controlled by concessionaires, will be considered by this adjustment method. The items of special cases are defined in the CA.

Source: JICA Study Team

2.3.3 Issues Related to Rate Rebasing in 2013

(1) History of Rate Rebasing Process of 2013

As of May 2016, the rate rebasing process to determine the tariff rate from 2013 to 2017 has not been terminated because of it entered into the arbitration process.

Firstly, Maynilad submitted the first edition of the “Business Plan 2013” to the MWSS-RO in March 2012. After Maynilad accepted the feedback from MWSS-RO and held several meetings, Maynilad submitted the second and third editions of their business plan in September 2012 and March 2013, respectively. The tariff adjustment amount proposed by Maynilad has been gradually reduced from an additional PHP 10.51 (first edition) to PHP 4.06 (third edition) per m^3 considering the opinion of MWSS-RO.

(2) Outline of Arbitrations related to Rate Rebasing of 2013

Both concessionaires, Maynilad and Manila Water, could not reach the agreement between MWSS-RO and they challenged the arbitration process pursuant to Article 12.4 of the CA. The results of the two separate arbitrations were awarded in December 2014 and April 2015. The proposal of Maynilad was fully approved, but the tariff rate of Manila Water was reduced compared with the proposed rate.

In the CA, the "Arbitral Award" is defined to be “final and binding”, and the tariff rebasing should be implemented afterwards. The rate rebasing of Manila Water case was settled but MWSS further requested to Maynilad for reduction of the tariff rate (approximately PHP 3/m^3) because there was an inequity in the definition of the corporate income tax (CIT) in the calculation of rate rebasing between Maynilad and Manila Water.

Maynilad denied the rate reduction as it offends the rule of the CA, and submitted the Demand Letter to the Republic of the Philippines to compensate the revenue losses that should have been collected from 2013 caused by the delay of rate rebasing in March 2015. In the same month, after the Government denied the payment, Maynilad served a Notice of Arbitration to enter into

the new arbitration held in Singapore. According to the responsible person of Maynilad, the arbitration hearings would be conducted and the Arbitral Award would be given in 2017. The rate rebasing of 2013 of Maynilad could be settled after the arbitration.

CHAPTER 3 Sewerage System and Sanitation Service in West Manila and Survey Area

3.1 Outline of the Existing Sewerage System and Sanitation Service

3.1.1 Present and Future Sewerage and Sanitation Coverage Ratio

Present and future target service coverage for sewerage and sanitation services are presented in Table 3.1.1.

Table 3.1.1 Target Coverage Ratio for Sewerage and Sanitation Services

Items	As of	Target Ratio in the Investment Plan			
	2015	2011	2016	2021	2037
Sewerage	14%	7%	27%	58%	100%
Sanitation	33%	48%	50%	80%	100%

Source: JICA Study Team

3.1.2 Existing Conditions of Sewerage and Sanitation Systems

(1) Existing Sewage Treatment Systems

The previous sewerage projects of Maynilad seemed to have applied separated sewer systems, but the implementation rate of separated systems is slow. Therefore, in order to provide maximum coverage quickly, interceptor sewer systems which can be utilized existing drainage have being applied by Maynilad.

The list of existing sewerage system in West Metro Manila is shown in Table 3.1.2.

Table 3.1.2 Existing Sewerage System

Wastewater Facility (STP)	Technology	Design Capacity (CMD)	Date of Operation	Sludge Technology
Tondo Sewage Pumping Station	Grit Removal & Aeration System	432,000	1904/2005*	-
Paco STP	Moving Bed Bioreactor	410	2013	-
Dagat-dagatan STP	Waste Stabilization Pond	26,000	1981/2005*	-
Alabang STP	Conventional Activated Sludge	10,000	1983/2009 (turned over to MWSI)	-
Congressional	Sequencing Batch Reactor	567	2011	-
Legal	Sequencing Batch Reactor	409	2012	-
Grant	Sequencing Batch Reactor	621	2012	-
Baesa	STM Aerotor	390	2011	-
San Antonio	Moving Bed Bioreactor	3,310	2013	-
Del Monte	Moving Bed Bioreactor	3,510	2013	-
Paltok	Moving Bed Bioreactor	4,900	2013	Filter Press
Tandang Sora	STM Aerotor	1,200	2013	-
Bahay Toro	Conventional Activated Sludge	13,400	2014	Filter Press
Samson	STM Aerotor	1,900	2015	-
Tatalon	Sequencing Batch Reactor	8,100	2013	Belt Press
Bagbag	Sequencing Batch Reactor	10,400	2014	Belt Filter Press
Kapiligan	Moving Bed Bioreactor	6,000	2015	Belt Filter Press
Talayan	Conventional Activated Sludge	15,400	2015	Belt Press
Project 7 STp	Sequencing Batch Reactor	2,400	2013	-

(2) Existing Wastewater Collection System

In West Metro Manila, a combined sewer system as shown in Figure 3.1.2 has been adopted for the area where the drainage structure exists. Unlike the combined system used in Japan, the system adopted in West Metro Manila intercepts only wastewater and discharge to a pump station or a wastewater treatment plant.

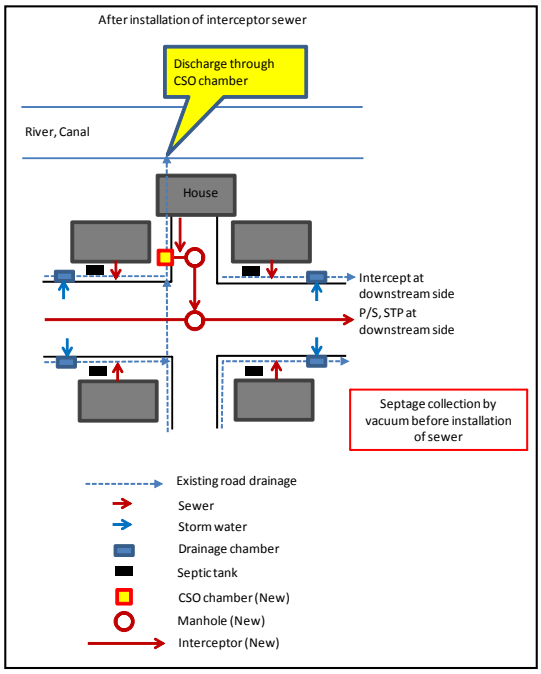


Figure 3.1.1 Collection System

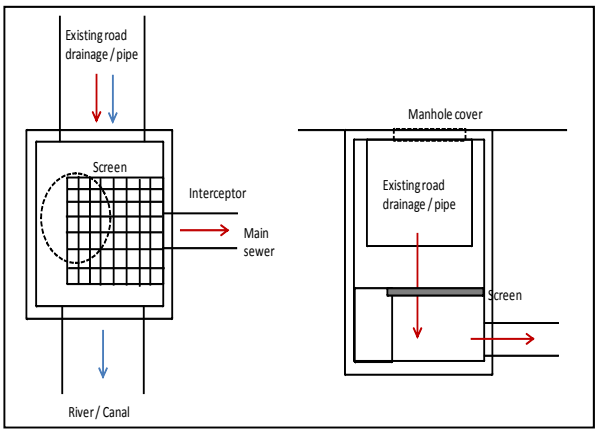


Figure 3.1.2 Screen in CSO Chamber

Since the volume of the garbage flowing into sewers is very high in West Metro Manila, screen is installed to catch the garbage in the existing combined sewer overflow (CSO) as described in Figure 3.1.2. However, huge amount of garbage flows into the public water courses during rainy days and sewers are frequently clogged with garbage.

(3) Existing Sanitation Systems

Maynilad provides sanitation service to its customers who are not connected to the sewereage system. The sanitation service includes removal of accumulated sludge from septic tanks by vacuum trucks for a five-year period. Collected sludge of 120 m^3/day is transported to the existing Dagat-dagatan Septage Treatment Plant, which is located at the site of Dagat-dagatan Sewage Treatment Plant, 240m^3/day to Project 7 and another 120 m^3/day to South Septage Treatment Plant which is currently under the commissioning.

3.2 Current Development Plan of the Sewerage System and Sanitation Service

3.2.1 On-going Facility Plans for the Sewerage System by West Metro Manila

The ongoing projects, which were planned by Maynilad, are listed in Table 3.2.1.

Table 3.2.1 Ongoing Project, as of August 2016

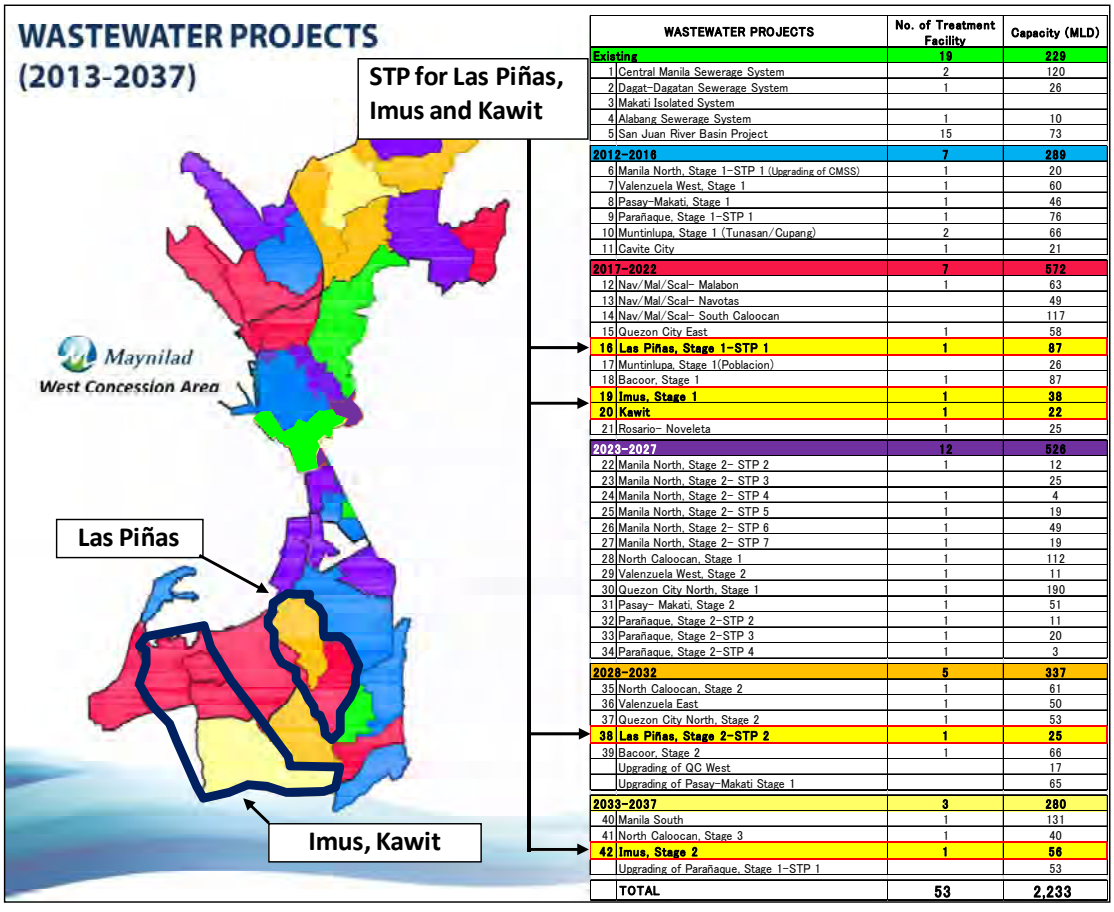
No.	Name of Wastewater Treatment Plant	Wastewater Treatment Process	Design Capacity (CMD)
1	Pasay STP	CAS	46,000
2	Muntinlupa - Cupang	CAS	46,000
3	Muntinlupa - Tunasan	CAS	20,000
4	Paranaque	CAS	76,000
5	Valenzuela	CAS	60,000

Source: Maynilad

The Parañaque Sewage Treatment Plant (STP) is currently being constructed by a Japanese contractor under a 2-step-loan scheme.

3.2.2 Future Sewerage and Sanitation Project in West Metro Manila

Figure 3.2.1 shows the features of sewerage and sanitation facilities to be implemented in the future.



	WASTEWATER PROJECTS	No. of Treatment Facility	Capacity (MLD)
Existing		19	229
1	Central Manila Sewerage System	2	120
2	Dagat-Dagatan Sewerage System	1	26
3	Makati Isolated System		
4	Alabang Sewerage System	1	10
5	San Juan River Basin Project	15	73
2012-2016		7	289
6	Manila North, Stage 1-STP 1 (Upgrading of CMSS)	1	20
7	Valenzuela West, Stage 1	1	60
8	Pasay-Makati, Stage 1	1	46
9	Parañaque, Stage 1-STP 1	1	76
10	Muntinlupa, Stage 1 (Tunasan/Cupang)	2	66
11	Cavite City	1	21
2017-2022		7	572
12	Nav/Mal/Scal- Malabon	1	63
13	Nav/Mal/Scal- Navotas		49
14	Nav/Mal/Scal- South Caloocan		117
15	Quezon City East	1	58
16	**Las Piñas, Stage 1-STP 1**	**1**	**87**
17	Muntinlupa, Stage 1(Poblacion)		26
18	Bacoor, Stage 1	1	87
19	**Imus, Stage 1**	**1**	**38**
20	**Kawit**	**1**	**22**
21	Rosario- Noveleta	1	25
2023-2027		12	526
22	Manila North, Stage 2- STP 2	1	12
23	Manila North, Stage 2- STP 3		25
24	Manila North, Stage 2- STP 4	1	4
25	Manila North, Stage 2- STP 5	1	19
26	Manila North, Stage 2- STP 6	1	49
27	Manila North, Stage 2- STP 7	1	19
28	North Caloocan, Stage 1	1	112
29	Valenzuela West, Stage 2	1	11
30	Quezon City North, Stage 1	1	190
31	Pasay- Makati, Stage 2	1	51
32	Parañaque, Stage 2-STP 2	1	11
33	Parañaque, Stage 2-STP 3	1	20
34	Parañaque, Stage 2-STP 4	1	3
2028-2032		5	337
35	North Caloocan, Stage 2	1	61
36	Valenzuela East	1	50
37	Quezon City North, Stage 2	1	53
38	**Las Piñas, Stage 2-STP 2**	**1**	**25**
39	Bacoor, Stage 2	1	66
	Upgrading of QC West		17
	Upgrading of Pasay-Makati Stage 1		65
2033-2037		3	280
40	Manila South	1	131
41	North Caloocan, Stage 3	1	40
42	**Imus, Stage 2**	**1**	**56**
	Upgrading of Parañaque, Stage 1-STP 1		53
	TOTAL	53	2,233

Source: Maynilad

Figure 3.2.1 Process of Septage Treatment Plant (South Septage Treatment Plant)

(1) Septage Treatment Plant

According to the plan as of 2016, Maynilad proposed to increase the sanitation service coverage

to 80% by 2021 and 100% by 2037

Table 3.2.2 Ongoing and Future Sewerage and Sanitation Projects

Type of Facility	2012 - 2016	2017 - 2022	2023 - 2027	2028 - 2032	2033 - 2037
Sewage Treatment Plant	6 plants: 409,000 m^3/day	15 plants: 595,000 m^3/day	10 plants: 497,000 m^3/day	7 plants: 356,000 m^3/day	4 plants: 280,000 m^3/day
Septage Treatment Plant	2 plants: 490 m^3/day	-	-	-	-

Source: JICA Study Team

3.3 Key Issues on Development of Sewerage Facilities

3.3.1 General Issues on Related Activities

The development of sewerage system in West Metro Manila is behind the schedule as explained in Chapter 1. The following issues on development of sewerage system need to be improved to accelerate the works.

Table 3.3.1 Issues on the Sewerage Developent Project in the Project Area

Issues	Necessary Actions
STP	
• Land acquisition is difficult due to increase in land price value • Availability of land in urban area is less.	• To find alternative sites • Study on the treatment method to construct in smaller site
• There is always traffic jam in urban area due to narrow and congestion roads • Sewer pipe installation works by open-cut method lead to traffic congestion	• Adoption of a non-open cut method • Adoption of technologies for shortening the construction period
• In some areas, manual pipe cleaning work is required everyday due to loads of garbage and sands inflow from the drainage	• Installation of equipment for automatic cleaning • Employment of additional O&M staffs
• Rapid sewerage facilities development is required along with population increase due to rapid economic growth.	• Adoption of combined sewer system
O&M	
• High electricity cost	• Adoption of energy saving equipment and facilities
• Shortage of O&M staffs due to a lot of STPs with small capacity	• Installation of mid-sized STP by integrating the catchment area
Environment	
• Manila Bay is highly polluted and the effluent standards will be strengthened in the near future	• Study on the adoption of advanced treatment process
• Shortage of disposal site for generated sludge	• Reduction of sludge volume • Sludge recycling (composting)
Finance	
• Financial shortage	• Installation of appropriate sewerage system considering the life cycle cost • Equalization of financial source for facility development and O&M

Source: JICA Study Team

3.3.2 Issues on Combined Sewer System

One of the fundamental problems of a combined system is the overflow of pollutant loads into the river or sea together with storm water from rainfall.

3.3.3 Issues on Effluent Water Quality

As explained in Chapter 1, in March 2010, DENR issued an order which stated that effluent into

the Manila Bay should be categorized as Class SB under the category of protected water bodies, instead of Class SC under the category of usual coastal waters.

Therefore, Maynilad was forced to improve the effluent quality of discharged water into Manila Bay from a BOD of 100 mg/L to 30 mg/L. Also, in the new standards, DAO 2016-08, the allowable concentration of nitrogen and phosphorus is regulated and applied. Therefore, all of the new sewage treatment facilities should meet the new requirements.

3.3.4 Issues on Sludge Treatment Management

(1) Increasing sludge generation

Sludge volume will rapidly increase due to the expansion of the sewerage system.

Although sludge volume will not increase in one or two years, it is certain that this will increase as the sewerage development progresses. If this issue is left unattended and increased sludge is treated in erratic ways without long-term vision, it may lead to social and environmental problems.

(2) Integrated sludge management plan

There are several processes of the sludge treatment. A study on the integrated sludge management plan for the entire service area will be necessary, separately from the Survey to show the future sludge treatment system; needed investment; and timeline for the development of the management system. On the formulation of the plan, future sludge volume, sludge component, location of plant, investment cost, and implementation schedule shall be studied.

3.3.5 Issues on the Operations and Maintenance of Increasing Facilities

As many as 53 newly sewage treatment facilities will be constructed by 2037. Moreover, O&M of sewer networks will also increase significantly.

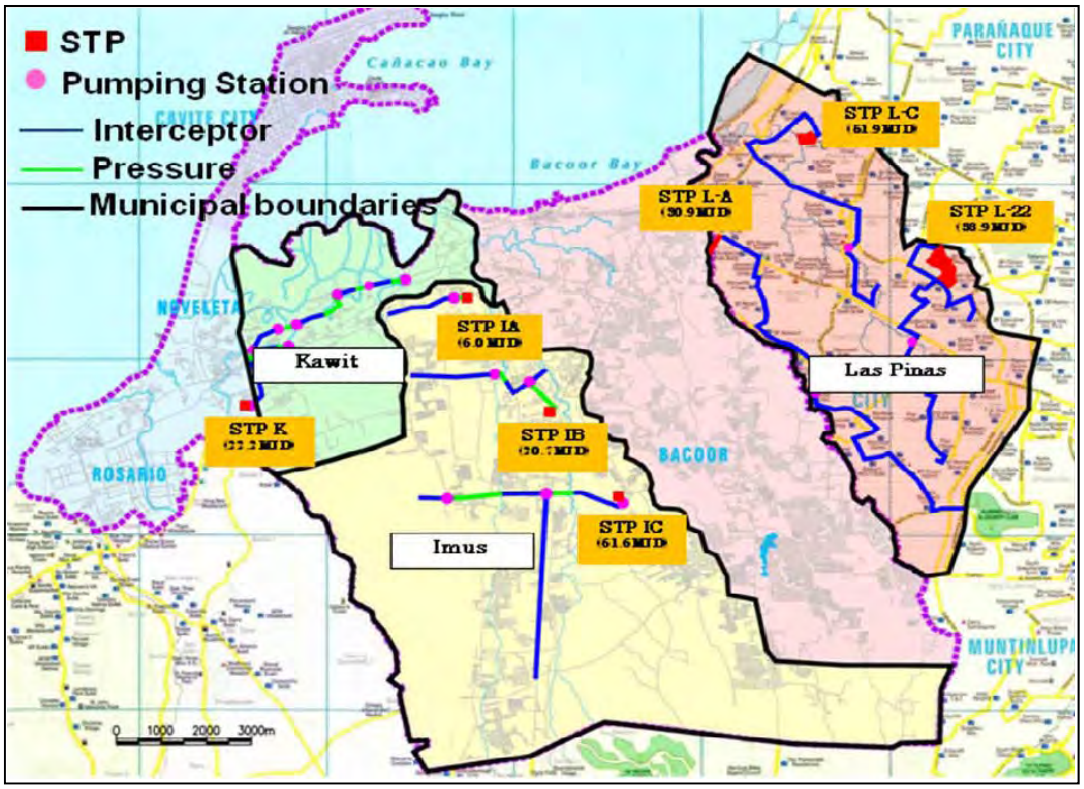
Although Maynilad already has experience in O&M for existing sewerage and sanitation facilities, it will face the following difficulties in the near future:

- ✓ The work volume of O&M of treatment facilities will significantly increase especially in the next ten years. Moreover, sludge and septage treatment in the future will require larger works than in the present. Furthermore, it will require significant number of additional human resources.
- ✓ Treatment facilities consist of combined sewer systems. The trend of inflow volume and quality of combined systems are much different and complex since they are more affected by climate and drainage conditions compared with the separated systems.
- ✓ If the effluent standard is revised to require the removal of nitrogen and phosphorus, advanced treatment processes will be necessary, and the operations will be much more complex.

3.4 Sewerage System for the Survey Area Planned by the Existing F/S

The sewerage system in Las Piñas City has been planned by the "Preparatory Survey for Metro Manila Sewerage and Sanitation Improvement Project – Phase 2". And also, the sewerage system in Imus City and Kawit Town has been planned by the "Feasibility Study of the Three River System".

The location and capacity of STP in the area and the route of planned trunk pipeline are shown in Figure 3.4.1.



Source: JICA Study Team

Figure 3.4.1 STP Plan and Trunk Pipeline in the Existing F/S Report

3.4.1 Las Piñas City

The planned sewerage system in Las Piñas City in the existing F/S report is summarized in Table 3.4.1.

Table 3.4.1 Planned Sewerage System in Las Piñas City in the Existing F/S Report

Target Area	STP		Sludge	Sewer		Major P/S	Construction Cost (Million Pesos)	Completion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
1.Las Piñas	38.9 (L-22)	OD	Thickening	75-1350	25.3	0.277 (PS-6)	2,726	2021
	30.9 (L-A)	SBR	Thickening	75-700	26.3	0.319 (PS-2)	2,597	2021
	51.9 (L-C)	OD	Thickening	75-1350	37.3	0.227 (PS-4)	3,756	2025

Note1: The completion year of Imus and Kawit is not mentioned in the F/S; Maynilad plan is referred.

Note2: OD: Oxidation Ditch, SBR: Sequencing Batch Reactor
Source: JICA Study Team based on existing F/S report

3.4.2 Imus City

The planned sewerage system in Imus City in the existing F/S report is summarized in Table 3.4.2.

Table 3.4.2 Planned Sewerage System in Imus City in the Existing F/S Report

Target Area	STP		Sludge	Trunk Sewer		P/S	Construction Cost (Million Pesos)	Com-pletion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
Imus	6.0 (IA)	SBR	Digestion	300-500	1.6	0.047 (PS Ia) 0.100 (PS IA)	3,279	2022
	20.7 (IB)	SBR	Digestion	300-700	3.9	0.135 (PS IC) 0.308 (PS Ie) 0.347 (PS IB)		2022
	61.6 (IC)	SBR	Digestion	400-1400	8.2	0.207 (PS Ih) 0.858 (PS F) 1.003 (PS IC)		2037

Source: JICA Study Team based on existing F/S report

3.4.3 Kawit Town

The planned sewerage system in Kawit Town in the existing F/S report is summarized in Table 3.4.3.

Table 3.4.3 Sewerage System in Kawit Town in the Existing F/S Report

Target Area	STP		Sludge	Trunk Sewer		P/S	Construction Cost (Million Pesos)	Com-pletion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
Kawit	22.2	SBR	Digestion	300-900	5.5	0.099 (PS Kc) 0.210 (PS Ka1) 0.378 (PS Ka2) 0.378 (PS K)	1,100	2022

Source: JICA Study Team based on existing F/S report

3.4.4 Key Issues on the Existing Plan of Sewerage System and Sanitation Service in the Survey Area

The following key issues to be studied are observed in the existing plan and are also mentioned in the existing F/S report.

- ✓ In Las Pinas City and Imus City, the sewerage facilities were planned for small-scale treatment systems. However, this led to numerous small STPs for which land acquisition were proven difficult. The population of the area is rapidly increasing, and O&M of many smaller sewerage facilities is daunting. For such reasons, centralized medium to large sized sewerage systems should be considered with integrating the catchment area.
- ✓ Effluent standard to be applied in the survey area will be changed from Class SC (Marine

Waters: BOD 100mg/L) to Class SB (Protected Waters: 30mg/L) as mentioned in Section 1.8.4. Also, advanced treatment methods should be studied to comply with new effluent standard DAO 2016 08.

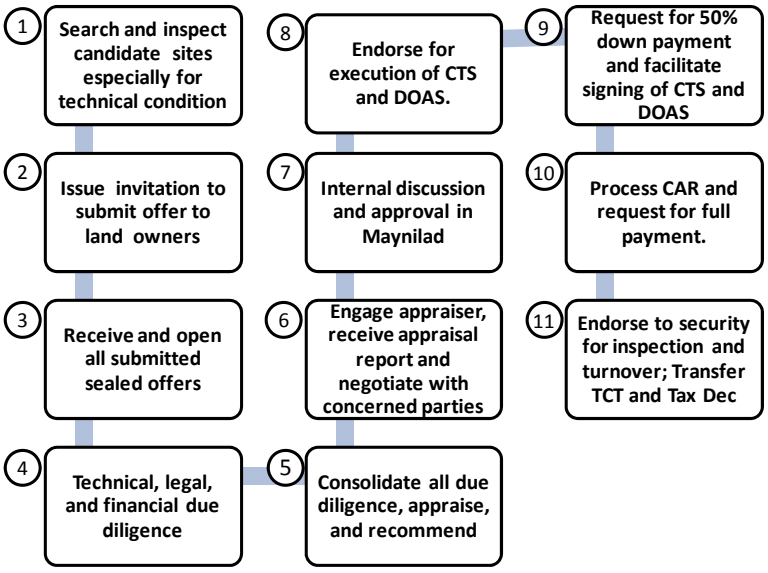
- ✓ For sequencing batch reactor (SBR) method; aeration, sedimentation, and discharge of treated wastewater are proceeded in the same treatment tank. To respond to the fluctuation of influent flow rate of the combined sewerage system, the aeration time and sedimentation time should be controlled. As a result, compared with the conventional activated sludge process (CAS), higher skills for O&M will be required. Other treatment methods including CAS, membrane bio reactor (MBR) shall be examined as alternatives.
- ✓ In Las Piñas City, oxidation ditch process (OD) is proposed in the existing F/S report. However, since it requires a larger area compared with other treatment methods, OD is normally not adopted in the urban area. Also, OD is not a recommended treatment process in the new sewerage guideline of Maynilad.
- ✓ The maximum diameter of the sewer pipe in the survey area is 1,400 mm, which is to be installed under the main road by open-cut method. However, non open-cut method needs to be considered especially if the installation work occurs in a highly traffic congested area.
- ✓ The proposed P/Ss for Imus and Kawit in Cavite F/S are not categorized whether each P/S require the land or can be constructed under the roads as manhole P/Ss. Those should be categorized with the design flows and possible land should be considered.
- ✓ The estimated construction cost of STPs in the existing F/S report is higher than the actual cost in the past project under Maynilad. The cost shall be reviewed in the Survey.

CHAPTER 4 Existing Project Site Condition

4.1 Selection of Candidate Site for STP

4.1.1 Policy on Selection of Candidate Site for STP

Figure 4.1.1 shows the land acquisition procedure of Maynilad. Maynilad has been looking for candidate sites for new sewage treatment plants (STPs) in Las Piñas City, Imus City, and Kawit Municipality.



Note:

- CTS: Contract to Sell (Document signed by seller and Maynilad stipulating all conditions of the sale prior to signing of the DOAS)
- DOAS: Deed of Absolute Sale (Document conveying ownership of property from the seller to Maynilad upon payment)
- CAR: Certification Authorizing Registration (Document issued by the Bureau of Internal Revenue (BIR) certifying that all taxes related to the sale of the property have been paid, and that the ownership may already be transferred from the seller to Maynilad)
- TCT: Transfer Certificate of Title (Proof of ownership of the property)

Source: JICA Study Team based on information from Maynilad

Figure 4.1.1 Land Acquisition Procedure for Construction Facilities of Maynilad

Considering the procedure in Figure 4.1.1 and the situation where there are few available lands for STP, this study sets the minimum requirements for new STP candidate sites, which have been discussed and agreed with Maynilad as follows:

1) The land which Maynilad has already acquired or has started acquisition procedure (Figure 4.1.1),
2) Technically appropriate location for STP (proximity to river, width of road, contour, and lot size),
3) No future plans by the government, and
4) No construction restriction for STP.

4.1.2 Selection of Candidate Site for STP

Referring to the information Maynilad has collected, existing feasibility study (F/S) reports, and requirements in Section 4.1.1, three sites in Las Piñas, five sites in Imus, and two sites in Kawit were selected as candidate sites after the site investigation for confirmation and checking availability of the site by the Survey team, which are shown in Table 4.1.1 and Figure 4.1.2. Detailed information of the sites is mentioned in the following sections.

Table 4.1.1 List of Candidate Sites

City/Municipality	Serial No.	Area (ha)	Remarks
Las Piñas	L-A	2.50	
	L-C	7.00	
	L-22	19.00	- Listed in the previous F/S reports*
Imus	C-2	1.80	- Same serial number with the F/S
	C-3	2.35	
	C-4	15.22	
	C-A	1.38	
	C-B	5.60	- Not listed in the previous F/S report*
Kawit	K-2	0.95	- New serial number
	K-3	1.59	

Note *: The previous F/S reports are "Preparatory Survey for Metro Manila Sewerage and Sanitation Improvement Project Phase 2, JICA, 2011" and "Three-River System Feasibility Study (Volume 4 Cavite Catchment), Maynilad, 2011".
Source: JICA Study Team

Source: JICA Study Team based on the Existing F/S

Figure 4.1.2 Location Map of Candidate Sites

CHAPTER 5 Planning of Sewerage System in the Survey Area

5.1 Review and Setting of Basic Parameters

In this survey, the basic design parameters of the sewerage system in the target area have been reviewed. Summary of the review results under the survey is shown in Table 5.1.1 and Table 5.1.2.

Table 5.1.1 Basic Parameter of Las Piñas City

No.	Parameter	Unit	Existing F/S Report				Reviewed				Reference Source/Note
			Pa1+Lb1 L-22	La1 L-A	La2+Lb2 L-C	Total	Pa1+Lb1 L-22	La1 L-A	La2+Lb2 L-C	Total	
A	**General**										
1	Catchment Area	ha	1,125.65	965.31	1,279.90	3,370.86	1,125.65	965.31	1,279.90	**3,370.86**	F/S, JICA T/A 2012
2	Population 2037	capita	216,165	171,392	288,520	676,077	233,377	185,039	311,493	**729,908**	Latest water demand by Maynilad, each catchment same proportion with existing JICA F/S
3	Water Consumption 2037	lpcd	186	186	186	186	160	160	160	**160**	Latest water demand by Maynilad
4	Water Demand 2037										Latest water demand by Maynilad
	Domestic	MLD	40.2	31.9	53.7	125.8	37.340	29.606	49.839	**116.785**	
	Non-Domestic	MLD	-	-	-	7	1.978	1.568	2.640	**6.187**	Proportion based on domestic water demand
5	Return Factor	%	80	80	80	80	80	80	80	**80**	F/S, JICA T/A 2012
	Domestic Flow per capita 2037	lpcd	149	149	149	149	128	128	128	**128**	From latest water demand, JICA T/A 2012
	Daily average domestic flow 2037	m3/d	32,209	25,537	42,989	100,735	29,872	23,685	39,871	**93,428**	From latest water demand, JICA T/A 2012
6	Industrial and Commercial Flows 2037	m3/d	Not included				1,583	1,255	2,112	**4,949**	From latest water demand
7	Groundwater infiltration (GWI)	%	15	15	15	15	15	15	15	**15**	F/S, JICA T/A 2012
		m3/d	Assume included in 5 above				4,718	3,741	6,297	**14,757**	From latest water demand, JICA T/A 2012
8	Average Dry Weather Flow (ADWF)	m3/d	32,209	25,537	42,989	100,735	36,173	28,681	48,281	**113,134**	From latest water demand, JICA T/A 2012 Domestic + Non-domestic + GWI
9	Daily Maximum Dry Weather Flow 2037	m3/d	38,910	30,851	51,934	121,694	42,464	33,669	56,677	**132,810**	From latest water demand, JICA T/A 2012 (Domestic + Non-domestic) x 1.2 + GWI
10	Peak Flow/Flow to conveyance system	m3/d	70,037	55,531	93,480	219,049	61,337	48,632	81,867	**191,836**	From latest water demand, JICA T/A 2012
		m3/sec	0.8106	0.6427	1.0820	2.5353	0.7099	0.5629	0.9475	**2.2203**	(Domestic + Non-domestic) x 1.2 x 1.5 + GWI
B	**STP**										
11	Planed Capacity	m3/day	38,910	30,851	51,934	121,694	36,200	28,700	48,300	**113,200**	
12	Influent Water Quality										
	BOD5	mg/L	200	200	200	200	200	200	200		Maynilad New Guideline, Paranaque, F/S, JICA T/A 2012
	TSS	mg/L	200	200	200	200	200	200	200		Maynilad New Guideline, F/S, JICA T/A 2012
	TN	mg/L	-	-	-	-	40	40	40		Maynilad New Guideline
	TP	mg/L	-	-	-	-	5	5	5		Maynilad New Guideline
	pH	-	-	-	-	-	6-9	6-9	6-9		Maynilad New Guideline
13	Effluent Water Quality										
	BOD5	mg/L	50	50	50	50	30	30	30		Maynilad New Guideline
	TSS	mg/L	70	70	70	70	30	30	30		Maynilad New Guideline
	NO3 (Future)	mg/L	-	-	-	-	14	14	14		Maynilad New Guideline
	Phosphate (Future)	mg/L	-	-	-	-	1	1	1		Maynilad New Guideline

Note) JICA T/A Team 2012: Technical Assistance of Paranaque Sewerage System Development Project【Technical Assistance of Loan Account】Site Works Report, Dec 2012, JICA/Nippon Koei

Source: JICA Study Team

Table 5.1.2 Basic Parameter of Imus City and Kawit Town

No.	Parameter	Unit	Existing F/S Report					Reviewed					Reference Source/Note
			Imus				Kawit	Imus				Kawit	
			IA	IB	IC	Total	K	IA	IB	IC	Total	K	
A	**General**												
1	Catchment Area	ha	655	2,276	6,572	9,502	1,340	655	2,276	6,572	9,502	1,340	F/S Appendix B Design Flow
2	Population 2037	capita	37,278	129,616	374,284	541,178	146,061	43,586	151,548	437,615	632,748	138,595	Latest water demand by Maynilad, each catchment same proportion with existing Maynilad F/S
3	Water Consumption 2037	lpcd	160	160	160	160	160	160	160	160	160	160	Latest water demand by Maynilad
4	Water Demand 2037												Latest water demand by Maynilad
	Domestic	MLD	6.0	20.7	59.9	86.6	23.4	6.974	24.248	70.018	101.240	22.175	
	Non-Domestic	MLD	N/A	N/A	N/A	N/A	N/A	0.021	0.071	0.206	0.298	1.640	Proportion based on domestic water demand
5	Return Factor (Sewage Generation	%	80	80	80	80	80	80	80	80	80	80	F/S, JICA T/A Team 2012
	Domestic Flow per capita 2037	lpcd	128	128	128	128	128	128	128	128	128	128	From latest water demand, JICA T/A Team 2012
	Daily Average Domestic Flow 2037	m3/d	4,772	16,591	47,908	69,271	18,696	5,579	19,398	56,015	80,992	17,740	Ditto
6	Industrial and Commercial Factor per domestic flow	%	12	12	12	12	12	N/A	N/A	N/A	N/A	N/A	
	Industrial and Commercial Flows 2037	m3/d	573	1,991	5,749	8,312	2,243	16	57	165	239	1,312	From latest water demand
7	Groundwater infiltration (GWI)	%	N/A	N/A	N/A	N/A	N/A	15	15	15	15	15	JICA T/A Team 2012
		m3/d	614	2,135	6,164	8,913	1,257	839	2,918	8,427	12,185	2,858	From latest water demand, JICA T/A Team 2012
8	Average Dry Weather Flow (ADWF)	m3/d	5,958	20,716	59,822	86,496	22,196	6,435	22,374	64,607	93,415	21,910	From latest water demand, JICA T/A Team 2012 Domestic + Non-domestic + GWI
9	Daily Maximum Dry Weather Flow 2037	m3/d	5,958	20,716	59,822	86,496	22,196	7,554	26,265	75,843	109,661	25,720	From latest water demand, JICA T/A Team 2012 (Domestic + Non-domestic) x 1.2 + GWI
10	Peak Flow/Flow to conveyance system/Full Flow to Treatment (FFT)	m3/d	8,630	30,007	86,650	125,288	32,666	10,911	37,938	109,550	158,399	37,152	From latest water demand, JICA T/A Team 2012
		lps	99.89	347.31	1,002.90	1,450.09	378.08	126.28	439.09	1,267.94	1,833.32	429.99	(Domestic + Non-domestic) x 1.2 x 1.5 + GWI
B	**STP**												
11	STP Capacity	m3/d	6,000	20,700	61,600	88,300	22,200	6,500	22,400	64,700	93,600	22,000	To be considered in the study
12	Influent Water Quality												
	BOD5	mg/L	125	125	125	125	125	200	200	200	200	200	Maynilad New Guideline, Paranaque, F/S, JICA T/A 2012
	TSS	mg/L	40	40	40	40	40	200	200	200	200	200	Maynilad New Guideline, F/S, JICA T/A 2012
	TN	mg/L	43	43	43	43	43	40	40	40	40	40	Maynilad New Guideline
	TP	mg/L	6	6	6	6	6	5	5	5	5	5	Maynilad New Guideline
	pH		-	-	-	-	-	6-9	6-9	6-9	6-9	6-9	Maynilad New Guideline
13	Effluent Water Quality Standard												
	BOD5	mg/L	50	50	50	50	50	30	30	30	30	30	Maynilad Effluent Standard
	TSS	mg/L	70	70	70	70	70	30	30	30	30	30	Maynilad Effluent Standard
	NO3 (Future)	mg/L	-	-	-	-	-	14	14	14	14	14	Maynilad Effluent Standard
	Phosphate (Future)	mg/L	-	-	-	-	-	1	1	1	1	1	Maynilad Effluent Standard

Note) JICA T/A Team 2012: Technical Assistance of Paranaque Sewerage System Development Project【Technical Assistance of Loan Account】Site Works Report, Dec 2012, JICA/Nippon Koei

Source: JICA Study Team

5.2 Sewerage Technology to be Applicable in West Metro Manila

5.2.1 Screening of Sewerage Technologies and Products which are Considered as Effective to Apply in Metro Manila

The latest sewerage technologies have been investigated, and the screening study to narrow the options of the effective sewerage technology products has been conducted in regard with the technologies and the products which can be introduced to West Metro Manila as shown in Table 5.2.2.

Table 5.2.1 Classification and Selection of Sewerage Technologies

Items	Classification Method			
1.Needs	Whether or not the needs and backgrounds are clear. (mainly according to the results of interview)	**A** The needs and backgrounds are clear.	**B** There are only interest and concerns.	**C** Not applicable to the cases mentioned in the left.
2. Current Adaptability (Short-term)	Whether or not the technology is effective to introduce at present.	**A** The technology has already been adopted in the existing facilitiy (including a pilot plant).	**B** The technology has a potential to resolve the urgent issues and is considered as effective.	**C** The technology is considered too early to adopt.
3. Future Adaptability (Long-term)	Whether or not the technology is effective to introduce in the future.	**A** The technology is considered as indispensable for the future improvement of sewerage system.	**B** The technology has a potential to resolve the conceivable issues in the future.	**C** The technology has a potential to be introduced, however, the application should be limited because it totally depends on the specific specification or conditions of each case.
Selection results	Sewerage technologies have been evaluated according to the criteria described in the right, considering the above mentioned three points (needs, current adaptability and future adaptability).	**A** A technology which has more than 1 A for the 3 items shall be considered as the most potential technology to be adopted.	**B** A technology which has more than 2 B for the 3 items shall be considered as the next candidate technology to be adopted.	**C** Other technologies not mentioned in the left. The priority is low at present.

Source: JICA Study Team

After evaluating the above mentioned 3 items for each technology, the study has conducted a screening of the products with the criteria where a technology which has more than 1 A for the 3 items shall be considered as the most potential technology to be adopted.

Table 5.2.2 Screening of Applicable Sewerage Technologies

Classification	Facility	Sewerage Technology	West Metro Manila				
			Needs	Current Adaptability	Future Adaptability	Selection Result	Remarks
1. Pipeline System	1) Pipeline	a) Trench-less Method (Long distance pipe-jacking method, Shield method, Hume concrete pipe for curved pipe-jacking method, etc.)	A	A	A	A	Pipe-jacking method (not Japanese company) has been applied for a part of the area.
		b) Pipe rehabilitation method (SPR, etc.)	C	C	B	C	Needed for future.
	2) Manhole	a) Manhole anti-floating measures at the time of liquefaction	C	C	C	C	No particular needs found.
		b) High performance manhole iron cover	C	B	B	B	Can be applied. However, no particular needs found.
	3) Pump	b) Gate pump (low water level operation)	C	C	C	C	Needed when a simple drainage pump is required.
	4) Collection system	a) Vacuum sewerage system	C	C	C	C	Not recommended as maintenance and management are time consuming.
2. Watewater Treatment System	1) Whole treatment plant	a) Pre-treated Trickling Filtration method (PTF method)	B	A	B	B	Advanced treatment needs to be supported in future.
		b) Membrane Separation Bioreactor (MBR)	A	A	A	A	Manila Water Company, Inc. has used the MBR produced by a foreign company.
		c) Compact MBR + RO System	B	B	C	B	It is questionable whether reuse of treated water is required, since the water supply coverage is high.
		d) Deep type Conventional Activated Sludge process (CAS method)	A	A	A	A	Japanese CAS method has been used.
	2) Primary treatment facility	a) Plastic trash screen (scummer)	C	C	B	C	High corrosion resistance and long life.
		b) Vacuum sand lifting device	C	C	B	C	Easy maintenance because there is no moving part in water.
	3) Reactor	a) Energy-saving blower	A	B	A	A	These are general-purpose equipment and can be utilized at the existing treatment plants.
		b) Energy-saving type diffuser (Ultra-fine air bubble)	A	B	A	A	
		c) Energy-saving type diffuser (Aerator type)	A	B	A	A	
		e) Mixer for reactor	C	B	C	B	No specific technology as a Japanese product.
	4) Sedimentation Tank	a) Fin chain sludge scraper	C	C	C	C	
		b) Long life chain	C	C	C	C	
		c) Scum collection/separation system	C	C	C	C	
	5) Disinfection Facility	a) UV disinfection device	C	C	C	C	No specific technology as a Japanese product.
		b) Ozone	C	C	C	C	
	6) Advanced treatment	a) Upward stream type high-speed fiber filter media filter	C	C	C	C	Not enough performance records.
	7) Odor removal	a) Dry type ozone deodorizing equipment	C	C	C	C	No particular needs found.
(3) Sludge Treatment System	1)Dehydrator	a) Energy-saving dehydrator (volute-type)	A	A	A	A	Already used in Manila and Cebu cities.
		b) Energy-saving dehydrator (double screw type, pressing rotary outer cylinder type, etc.)	A	B	A	A	competing technology with a volute type which has already been used.
		c) Sludge dehydration power generation	C	C	B	C	The usage is limited and not enough records.
		d) Polymer	C	C	B	C	The usage is limited and not enough records.
		e) Deodorizing material	C	C	B	C	No specific technology as a Japanese product.
	2)Drying	a) Composting	B	B	B	B	Introduction is not realistic in terms of profitability unless there is a public aid.
	3)Thickening	a) Differential speed rotation screw sludge concentration machine	B	B	B	B	There is a need to reduce the amount of sludge.
	4)Digestion	a) Digestion gas power generation	B	C	C	C	It is not so effective to use at a small scale treatment plant.
		b) Digestion tank mixer	C	C	C	C	
		c) High efficiency gas collection type sludge digestion device	C	C	C	C	
	5)Incineration	a) Energy-saving type sludge incinerator (Supercharging fluidized bed furnace, circular fluidized bed type, etc.)	B	C	B	B	It is possible to apply depending on the future improvement of the legal system. In this regard, however, a master plan for a sludge treatment plant is mandatory.
		b) Sludge derived solid fuel	C	C	B	C	
(4) Maintenance and Management System	1) Pipeline	a) Pipeline auto cleaning device (Flash Gate)	A	A	A	A	Maynilad is currently performing a verification test.
		b) Pipeline cleaning vehicle	C	C	B	C	It is possible to apply to the existng treatment plant as this is general-purpose equipement.
	2) Manhole	a) Improved technology for confluence (Vortex flow type water surface control device)	C	C	A	B	Structural modification of diversion manhole is required. It has been adopted overseas.
	3) Treatment plant/pump station	a) DCS system (SCADA)	A	B	B	A	Foreing-made systems have been introduced and it is necessary to defferenciate from them. Some Japanese companies have already made presentations to Maynilad.
	4) Overall	a) Asset Management system	B	B	A	A	This will be needed for water supply system at first.
		b) Sewer Optical Fiber Network	A	A	A	A	It will contribute to ease of operation and maintenance work

Note: Highlighted cell: Selected technology

Source: JICA Study Team

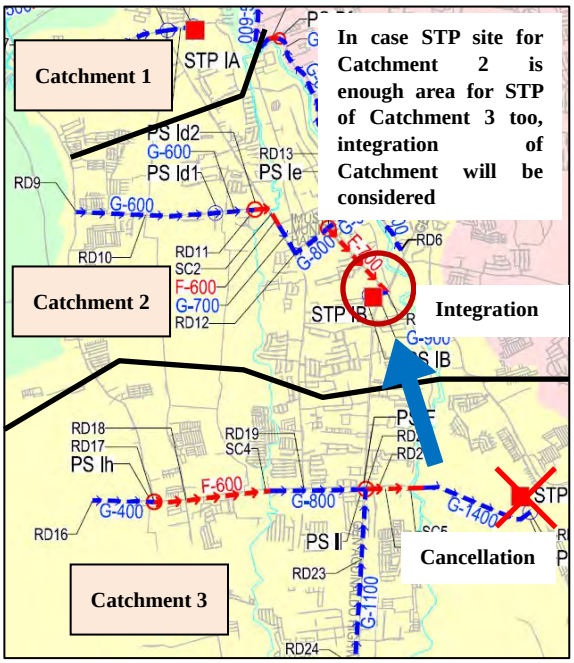
5.3 Policy and Condition on Study of Sewerage System

5.3.1 Policy on the Plan of Sewerage System in the Target Area

The land price of the target area has been on the rise due to the recent economic growth in Manila. Consequently it is getting more difficult to acquire relatively large land available for a sewage treatment plant and this is one of the reasons that the sewerage coverage rate is behind the plan.

Therefore, in this study a sewerage system shall be examined for each target area in accordance with the following policies;

- ✓ In case there is acquired land, a treatment plant of which capacity is as large as possible shall be planned to construct at the site. If the land is not big enough to build a treatment plant which can support the whole sewerage treatment capacity for the target area, another plant shall be planned to construct at other site for the remaining capacity.
- ✓ In case there is no acquired land in the target area, a treatment plant of which capacity is as large as possible shall be planned to construct at a candidate site locating at the most downstream side. If the land is not big enough to build a treatment plant which can support the whole sewerage treatment capacity for the target area, another plant shall be planned to construct for the remaining capacity at other site locating at the next most downstream side, on condition that carrying out the sludge will not affect local residents.



Source: JICA Study Team

Figure 5.3.1 Image of Integration of Catchment Area

- ✓ Considering the above mentioned issues, the foremost priority is reducing the number of treatment plants by integrating the catchments as much as possible as Maynilad Water Service Inc, requests.
- ✓ Conduct a case study for each combination of water treatment processes and sludge treatment processes and present the results including the following items.
  - STP general facility layout plan
  - Construction cot
  - LCC
  - Advantages and Disadvantages

In this case study, a recommended plan shall not be selected and only the results of each option

shall be presented.

5.3.2 Combination of Wastewater Treatment Process and Sludge Treatment Process for Facility Layout Plan

The option of wastewater treatment process and sludge treatment process for study on facility layout plan, which will be studied for each candidate site of STP, shall be as follows.

(1) Wastewater Treatment Process

Table 5.3.1 Option of Wastewater Treatment Process

1	(Deep type) Conventional activated sludge process (CAS)
2	Sequencing Batch Reactor (SBR)
3	Membrane Separation Bioreactor (MBR)
4	Moving Bed Biofilm Reactor (MBBR)

Note: In this study, CAS means the one with advanced treatment method, A2O (anaerobic/anoxic/oxic), which can treat nitrogen and phosphorus.

(2) Sludge Treatment Process

Table 5.3.2 Option of Sludge Treatment Process

1	Thickening + Dewatering
2	Thickening + Digestion + Dewatering

The comparative study on the sewerage system in the candidate site will be carried out with the combination among the options of wastewater treatment process and sludge treatment process above.

However, wastewater treatment process shall be same in each target area, Las Piñas, Imus and Kawit, for the efficient operation and maintenance work.

5.4 Results and Promising Option in Each Area

Table 5.4.1 shows the results of the comparative study, and promising option in each target area which is highlighted, in the available sewerage systems with digestion process. And Table 5.4.2 shows the results of the comparative study, and promising option without digestion process in each target area.

Table 5.4.1 Promising Option in each Target Area (Sewerage System with Digestion Process)

Las Pinas						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Treatment Process (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (113,200m3/day)	CAS-LP-1	CAS with Digestion Process	L-A	113,200	2.55	0.00	2,229.97	3,836.93	6,066.90	228.25	43.31	271.56	6,402
MBR (113,200m3/day)	MBR-LP-1	MBR with Digestion Process	L-A	113,200	2.55	0.00	2,858.98	3,836.93	6,695.91	342.82	43.31	386.13	7,544
SBR (113,200m3/day)	SBR-LP-1	SBR with Digestion Process	L-A	56,600	2.55	0.00	2,598.92	3,284.71	5,883.63	252.95	37.22	290.18	6,058
			L-C	56,600	2.99	113.62							
MBBR (113,200m3/day)	MBBR-LP-1	MBBR with Digestion Process	L-A	80,000	2.55	0.00	2,807.24	3,497.63	6,304.87	225.01	38.00	263.01	6,717
			L-C	33,200	1.32	50.16							

Imus						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Area Name (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (93,600m3/day)	CAS-IMS-1	CAS with Digestion Process	C-A	93,600	2.18	65.40	1,947.14	1,703.07	3,650.21	190.62	20.74	211.37	4,043
	CAS-IMS-3	CAS with Digestion Process	C-B	93,600	2.34	46.80	1,947.52	1,671.42	3,618.94	190.62	20.32	210.94	4,015
MBR (93,600m3/day)	MBR-IMS-1	MBR with Digestion Process	C-A	93,600	2.18	65.40	2,789.65	1,703.07	4,492.73	300.23	20.74	320.98	5,330
	MBR-IMS-3	MBR with Digestion Process	C-B	93,600	2.05	41.00	2,773.88	1,671.42	4,445.31	300.23	20.32	320.55	5,289
SBR (93,600m3/day)	SBR-IMS-1	WTF	C-2	57,800	1.75	54.00	2,232.91	1,576.74	3,809.65	210.89	18.58	229.47	4,145
		STF with Digestion Process	C-A	(57,800)	0.77	23.10							
		SBR with Digestion Process	C-3	35,800	1.90	52.25							
	SBR-IMS-3	SBR with Digestion Process	C-A	50,000	2.18	65.40	2,275.99	1,590.03	3,866.02	213.52	19.81	233.33	4,212
			C-3	43,600	2.07	56.93							
	SBR-IMS-5	SBR with Digestion Process	C-B	93,600	3.27	65.40	1,977.85	1,671.42	3,649.27	204.48	20.32	224.80	4,104
MBBR (93,600m3/day)	MBBR-IMS-1	WTF	C-2	33,200	1.23	36.90	2,451.85	1,600.66	4,052.51	186.20	22.89	209.08	4,520
		STF with Digestion Process	C-A	(33,200)	0.72	21.60							
		MBBR with Digestion Process	C-3	60,400	2.06	67.10							
	MBBR-IMS-3	MBBR with Digestion Process	C-A	65,000	2.18	65.40	2,420.36	1,670.82	4,091.19	187.79	20.53	208.33	4,548
			C-3	28,600	1.27	34.93							
	MBBR-IMS-5	MBBR with Digestion Process	C-B	93,600	2.71	54.20	2,242.56	1,671.42	3,913.98	210.20	20.32	230.52	4,422

WTF: Water Treatment Facilities, STF: Sludge Treatment Facilities

Kawit						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Area Name (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (22,000m3/day)	CAS-KWT-1	CAS with Digestion Process	K-3	22,000	1.20	111.30	722.78	308.00	1,030.77	47.24	6.59	53.83	1,050
MBR (22,000m3/day)	MBR-KWT-1	MBR with Digestion Process	K-2	22,000	0.91	44.46	948.82	247.51	1,196.33	82.16	6.18	88.34	1,369
	MBR-KWT-3	MBR with Digestion Process	K-3	22,000	1.04	72.80	980.89	308.00	1,288.89	82.16	6.59	88.75	1,439
SBR (22,000m3/day)	SBR-KWT-1	SBR with Digestion Process	K-3	22,000	1.40	111.30	659.03	308.00	967.02	50.00	6.59	56.59	1,015
MBBR (22,000m3/day)	MBBR-KWT-1	MBBR with Digestion Process	K-3	22,000	1.36	111.30	718.65	308.00	1,026.65	49.09	6.59	55.68	1,070

Source: JICA Study Team

Table 5.4.2 Promising Option in each Target Area (Sewerage System without Digestion Process)

Las Pinas						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Treatment Process (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (113,200m3/day)	CAS-LP-2	CAS without Digestion Process	L-A	113,200	2.55	0.00	2,204.36	3,836.93	6,041.29	228.25	43.31	271.56	6,149
MBR (113,200m3/day)	MBR-LP-2	MBR without Digestion Process	L-A	113,200	1.95	0.00	2,821.94	3,836.93	6,658.87	342.82	43.31	386.13	7,351
SBR (113,200m3/day)	SBR-LP-2	SBR without Digestion Process	L-A	64,900	2.55	0.00	2,547.20	3,403.94	5,951.13	252.95	37.23	290.18	5,978
			L-C	48,300	2.53	96.14							
MBBR (113,200m3/day)	MBBR-LP-2	MBBR without Digestion Process	L-A	113,200	2.55	0.00	2,584.56	3,836.93	6,421.49	219.95	43.31	263.26	6,875

Imus						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Area Name (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (93,600m3/day)	CAS-IMS-2	CAS without Digestion Process	C-A	93,600	1.90	65.40	1,919.12	1,703.07	3,622.19	190.62	20.74	211.37	3,874
	CAS-IMS-4	CAS without Digestion Process	C-B	93,600	1.74	34.80	1,899.28	1,671.42	3,570.70	190.62	20.32	210.94	3,831
MBR (93,600m3/day)	MBR-IMS-2	MBR without Digestion Process	C-A	93,600	1.96	65.40	2,757.77	1,703.07	4,460.84	300.23	20.74	320.98	5,216
	MBR-IMS-4	MBR without Digestion Process	C-B	93,600	1.67	33.40	2,729.20	1,671.42	4,400.62	300.23	20.32	320.55	5,166
SBR (93,600m3/day)	SBR-IMS-2	WTF	C-2	57,800	1.75	54.00	2,190.90	1,576.74	3,767.64	210.89	18.58	229.47	4,001
		STF without Digestion Process	C-A	(57,800)	0.34	10.20							
		SBR without Digestion Process	C-3	35,800	1.82	50.05							
	SBR-IMS-4	SBR without Digestion Process	C-A	57,800	2.18	65.40	2,230.29	1,622.73	3,853.02	213.49	19.94	233.42	4,089
			C-3	35,800	1.82	50.05							
	SBR-IMS-6	SBR without Digestion Process	C-B	93,600	3.21	64.20	1,953.60	1,671.42	3,625.02	204.48	20.32	224.80	3,936
MBBR (93,600m3/day)	MBBR-IMS-2	WTF	C-2	33,200	1.23	36.90	2,387.24	1,600.66	3,987.90	186.20	22.89	209.08	4,308
		STF without Digestion Process	C-A	(33,200)	0.34	10.20							
		MBBR without Digestion Process	C-3	60,400	1.91	52.53							
	MBBR-IMS-4	MBBR without Digestion Process	C-A	93,600	2.18	65.40	2,200.55	1,703.07	3,903.62	208.92	20.74	229.66	4,373
	MBBR-IMS-6	MBBR without Digestion Process	C-B	93,600	2.58	51.60	2,212.20	1,671.42	3,883.63	210.20	20.32	230.52	4,311

WTF: Water Treatment Facilities, STF: Sludge Treatment Facilities

Kawit						Initial Cost							
						Land Cost	STP Cost	Collection Facility Cost	Construction Cost (Tax excluded) (million Php) (10)=(8)+(9)	STP Cost	Collection Facility Cost	Total O&M Cost (million Php/year)	LCC (million Php)
Area Name (Required Capacity)	Option	Process	Site	Planned Capacity (m^3/day) (1)	Required Land Area (ha) (3)	Land Cost (million Php) (7)	Total of STP, incl. land (million Php) (8)	Total of Collection facility (million Php) (9)		Total of STPs (million Php /year)	Total of Collection Facility (million Php /year)		
CAS (22,000m3/day)	CAS-KWT-2	CAS without Digestion Process	K-3	22,000	0.90	63.00	660.78	308.00	968.77	47.24	6.59	53.83	978
MBR (22,000m3/day)	MBR-KWT-2	MBR without Digestion Process	K-2	22,000	0.91	44.46	935.87	247.51	1,183.38	82.16	6.18	88.34	1,349
	MBR-KWT-4	MBR without Digestion Process	K-3	22,000	0.81	56.70	950.46	308.00	1,258.45	82.16	6.59	88.75	1,407
SBR (22,000m3/day)	SBR-KWT-2	SBR without Digestion Process	K-3	22,000	1.29	111.30	651.77	308.00	959.76	50.00	6.59	56.59	984
MBBR (22,000m3/day)	MBBR-KWT-2	MBBR without Digestion Process	K-3	22,000	0.99	69.30	664.80	308.00	972.80	49.09	6.59	55.68	1,024

Source: JICA Study Team

The option is extracted from technical point and LCC point of view. The main reasons for extraction are described below.

5.4.1 Las Piñas City

The promising option will be CAS-LP-1 with the reasons below.

- ✓ The required site is only one (1) which has been already acquired. No procedure for the land acquisition is necessary.
- ✓ LCC of CAS is much lower than MBR and MBBR.

- ✓ LCC of SBR is the lowest, however, two (2) STPs will be required. Considering the land acquisition procedure, CAS-LP-1 will be better option because only one (1) site is necessary.
- ✓ Operation work of CAS is easier than SBR considering operation for advantage treatment. Because in case of SBR, the operation for anoxic process will be required for nitrogen removal.
- ✓ The digestion process contributes to reducing the generation of sludge. Because the STP capacity is large scale; the digestion process should accommodate.

5.4.2 Imus City

The promising option will be CAS-IMS-3 with the reasons below.

- ✓ The required site is only one (1), C-B site, which is the most suitable for STP among other candidate sites considering the location for the sewerage system and access for operation / maintenance.
- ✓ The land C-B is not residential area. Environmental impact is less than the other sites.
- ✓ The digestion process contributes to reducing the generation of sludge. Because the STP capacity is large scale.
- ✓ LCC is the lowest among options with digestion process.

5.4.3 Kawit Town

The promising option will be both CAS-KWT-1 and CAS KWT-2 with the reasons below.

- ✓ The required site is only one (1) site.
- ✓ LCC is lower than the other options.
- ✓ The site K-3 is more suitable than another site K-2 considering the location for the sewerage system and access for operation / maintenance because the main road is close to the site.
- ✓ The digestion process contributes to reducing the generation of sludge. However, the STP scale is small and the sludge generation volume will be small. The installation of digestion process can be considered based on the detailed plan and policy in Maynilad.

The economic analysis will be carried out for CAS-LP-1, CAS-IMS-3 and CAS-KWT-1.

CHAPTER 6 Economic and Financial Analysis

6.1 Financial Condition of Maynilad

6.1.1 Evaluation of Income Statement

The billed volume of the Maynilad's service area in 2015 at 1,319 million liters per day was increased by 29% since 2010. This high increase ratio has been induced due to the high population growth rate and service area expansion. The Non Revenue Water (NRW) rate has been drastically improved from 64% to 31% after 2008 due to the significant amount of investment injected during this period.

According to the income statement, the total revenue recorded PHP 19,098 million in 2015. It was increased by 58% compared with the amount in 2010. Not only the increase of billed volume, but the increase of tariff level contributed to the increase of total revenue.

The "costs and expenses" summed up to PHP 7,245 million in 2015 which was increased by 47% from 2010. The labor cost for employees and utilities costs has remained rather stable, whereas the amortization cost at PHP 2,037 million in 2015 has been almost doubled since 2008. This higher amortization cost was induced from the recent proactive investment.

In conclusion, the increased revenue clearly surpassed the increase of operating cost, and the financial condition of Manilad has been recovered year by year. The income before tax in 2015 and 2014 recorded as high as PHP 9,618 and 8,255 million respectively. The net profit margin became 50% and 46% at the respective years, which is higher than the value of Manila Water (at 36% in 2015 and 2014).

6.1.2 Evaluation of Balance sheet

According to the balance sheet, total assets amounted PHP 81,353 million in 2015, which was increased sharply by 91% after 2010. The average increase of total assets is PHP 7.8 billion per year.

18% of total assets are categorized into "current assets" and the rest (82%) are "non-current assets". The "service concession assets", which is a value of facilities used for the water and sewerage services, takes major share of "non-current asset". The previous construction works implemented by MWSS and the additional capital investment and rehabilitation cost implemented by Maynilad during the concession period are categorized into this item.

Non-current liabilities are divided into two major items. One is "Interest bearing loans" and the other is "Service concession obligation payable to MWSS". The "Interest bearing loans" is PHP 23,337 million in 2015, which takes 74% of total liabilities, has increased by 50% since 2010.

Regarding to "Interest bearing loans", by virtue of the "Term Loan" agreement with several

banks in 2013, the financial costs are kept lower in the recent years. The ODA loans are also granted from the World Bank and JICA in 2012 and 2014 by two step loan scheme through two public financial institutes, and they contribute lowering the financial cost.

6.2 Applicable Financial Sources for the Project

6.2.1 Present Financial Sources for the Investment

There are three applicable financial sources which Maynilad could utilize for the investment including the construction of WWTP as follows;

1) Own Fund, 2) Commercial Loans, 3) ODA Loans (from Foreign Donors)

"1) Own Fund" can be used for the investment as much as the Maynilad has enough cash accumulated in the company. The disbursement is quicker and this mode could be preferred for any small scale investment.

The total amount of interest bearing loans which Myanilad hold reached at PHP 23.3 billion in 2015 as described in Chapter 6.1. Out of it, majority has been procured by mean of "2) Commercial Loan" from local commercial banks. These commercial loans could be injected on the rather large-scale investment.

The financial cost of "3) ODA Loans" is normally lower than the other mode as the Government basically gives guarantee on it. However, the ODA loans are only provided to the public entities, and Maynilad could not be the direct borrower. In order to receive the advantage of ODA loans, the loan should be transferred from the public organizations as explained in the next chapter.

6.2.2 Comparison of ODA Loan Financing Schemes

At present, there are two ways which Maynilad would take to receive an ODA loan. The first one is procuring the "(i) loan through the MWSS", regulator of the Concession Agreement, and the Maynilad repays back the predetermined amount of money by the "Concession Fee" every year. The other one is the ""(ii) Two Step Loan scheme through the Government Financial Institutions (GFIs)", such as Development Bank of Philippines (DBP) and Land Bank of Philippines (LBP).

The financial cost could be lower under "(i) Loan through the MWSS". Whereas the administration process takes longer time and the project scope will not be changed flexibly. Regarding the terms and conditions of original ODA loan, application of preferential terms is expected for the project of sewerage sector. In addition to the basic cost, the guarantee fee at 1.0% per year is assumed to be added for covering the cost of the guarantee given by the Government.

Under the "(ii) Two Step Loan scheme through the GFIs", conditions could be estimated referring to the past Project cases including the Environmental Development Project implemented through

DBP. Assuming the loans given in PHP or US$, the exchange rate fee should be added on the basic interest rate of original loan. In addition to the normal ODA loan provided in JPY currency, the currency conversion option to provide the original loan in US$ (or Euro) is invented. Adoption of this new system could be considered if the interest rate of final loan provided to Maynilad from DBP becomes lower.

From the interview to the responsible person of the Maynilad, they prefer the "(ii) Two Step Loan scheme through the GFIs" to "(i) Loan through the MWSS" as it is more flexible and fast on decision making. The MWSS, regulator of water and sewerage services in Metro Manila, transferred the responsibility of investment on sewerage on two concessionaires. Considering this environment, the "(ii) Two Step Loan scheme through the GFIs" would be a first option to be selected for the Project funding.

6.3 Financial Analysis of the Project

In this sub section, financial analysis is conducted to evaluate the financial viability of the Project.

6.3.1 Basic Assumptions

- ✓ Evaluation Period: 19 years including 4 years of construction period.
- ✓ Residual Value: Not considered
- ✓ Inflation: Not considered
- ✓ Discount Rate: 6.0% (interest rate given by DBP for the past project)
- ✓ Model Projects: CAS-LP-1 (Las Pinas), CAS-IMS-3 (Imus) and CAS-KWT-1 (Kawit)
- ✓ Revenue: The revenues of environmental charge and sewer charge are considered as incremental revenue on purpose of evaluating
- ✓ Cost Items: Initial construction cost, additional O&M cost (replacement cost and maintenance cost are included)

6.3.2 Results of Financial Analysis

The present value of construction cost, O&M cost and estimated revenue from 2016 to 2037 is estimated. The total Present Value of the whole Project becomes negative at PHP 9,264 million.

Table 6.3.1 Result of Financial Analysis

City	Present Value (PHP million)			
	1) Las Pinas	2) Imus	3) Kawit	Total
(i) Construction Cost	-4,952	-2,966	-761	-11,665
(ii) O&M Cost	-1,450	-1,246	-290	-2,986
(iii)Revenue	+1,262	+895	+244	+2,401
Total	-5,140	-3,317	-806	-9,264

Source: JICA Study Team

In the simulation, the revenue could not surpass the O&M cost during operation period in every city, and the FIRR could not be obtained because the total cost could not be recovered by revenue even the discount rate is set lower.

This result indicates the financial difficulty if the revenue and cost of sewerage service is independently compared. As it has been explained in the previous sub section 2.3.2, the financial stability of Maynilad is secured by the CA to make the equability of revenue and cost during a concession period until 2037 by the precise control of tariff rebasing procedure. Therefore, the result implies that the revenue of water charge covers the deficit of sewerage service by cross-subsidy.

6.4 Economic Analysis of the Project

The economic analysis is conducted to compare the benefit and cost induced from the Project implementation from the economic view.

6.4.1 Basic Assumptions

- ✓ Evaluation Period: 30 years including 4 years of construction period.
- ✓ Residual Value: Not considered as the life period matches to the evaluation period.
- ✓ Inflation: Not considered
- ✓ Discount Rate: 10%, commonly used value for evaluating development projects in developing countries.
- ✓ Economic Cost Items: Initial construction cost, additional O&M cost (replacement cost and maintenance cost are included)

6.4.2 Economic Benefits

(1) Improvement of living welfare: Better hygiene and sanitary condition achieved by the Project results in the higher satisfaction of living of service users.

(2) Economic Impact on Health: Occurrence of water borne diseases in the project area will be reduced, and the medical cost, productivity loss by treatment, premature mortality will be reduced as influence by the project.

(3) Land price escalation: Land price would be increased as the impact of better living condition in the project area.

6.4.3 Results of Economic Analysis

From the estimated benefits and costs, the EIRR of the project is calculated at 13.1 % and NPV is calculated at PHP1,367 million with the discount rate of 10%. The EIRR is higher than 10%, and the economic feasibility of the Project is secured from the economic aspect.

Table 6.4.1 Result of Economic Analysis

	EIRR	B/C	NPV (D.R.=10.0%)
(i) Las Pinas City	13.4 %	1.16	PHP 961 million
(ii) Imus City	9.6 %	0.99	- PHP 28 million
(ii) Kawit Town	23.5 %	1.49	PHP 452 million
Whole Project	13.1 %	1.12	PHP 1,367 million

Source: JICA Study Team

6.4.4 Sensitivity Analysis

Table 6.4.1 Summary of Sensitivity Analysis

Condition	EIRR	B/C	NPV (D.R.=10.0%)
Base case	13.1%	1.12	PHP 1,367 million
Case1: Benefit－10%	10.6%	1.02	PHP 258 million
Case2: Cost＋10%	10.3%	1.01	PHP 122 million
Case3: Benefit－10%, Cost＋10%	7.6%	0.92	PHP -987 million

Source: JICA Study Team

In order to make the project more sustainable, it is important to avoid the cost increase by achieving the prudent budget/schedule control and cost economization during operation period. The monitoring of project impact is also important for users to receive the expected benefit from the Project.

CHAPTER 7 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

7.1 Environmental Management System of the Philippines

7.1.1 Legislative Framework on Environment

In Philippines environment is managed by relevant national Policy, EIA, Environmental Conservation and Standers on environment as well as international agreements and treaties on environment ratified and singed by the Government.

7.1.2 Institutional Framework

The nodal administrative organization in charge of environmental management in the Philippines is the Department of Environment and Natural Resources (DENR). The Environmental Management Bureau (EMB) of DENR performs various mandates on environmental management based on the relevant environmental laws of the Philippines.

7.1.3 Philippine Environmental Impact Statement System (PEISS)

- The Philippine Environmental Impact Statement System (PEISS) was set up by the Presidential Decree 1586 (1987).
- PEISS requires any project with potential negative impacts on the environment, to obtain an ECC (Environmental Compliance Certificate) from DENR.
- CNC (Certificate of Non Coverage) is granted by DENR for all projects without significant impacts on the environment.
- The Environmentally Critical Project (ECP) types and Environmentally Critical Areas(ECAs) categories have been declared by the PP 2146 (1981) and 803 (1996).
- MC005(2014) stipulates that in order to determine coverage under PEISS, projects or undertakings shall be screened according to the four categories of (A, B, C and D).
- MC005 (2014) stipulates documentary requirements, the processing and deciding authority.
- DMC14(2010) stipulates that guidelines ECC Approval Authority and Maximum Timeframe shall be applied for reviews of ECC application.
- Sewerage system projects are not fall under “Category A” as ECP, but fall under “Category B or C” as Non-ECP or “Category D” as Not Covered (may secure CNC) depending on size and capacity of the projects.
- Online Application are available for CNC/ECC/ Compliance Monitoring Report (CMR) through the EMB web site.

7.2 Land Acquisition and Resettlement System of the Philippines

The principal policies and laws on land acquisition and resettlement in the Philippines are the Constitution of the Philippines (1987), RA 7160 (1991), RA 7279 (1992), RA 8974 or RA 8974 (2000) and IPRA (1997) as well as others specified in Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP).

7.3 Other Guidelines on Environmental and Social Considerations

The following relevant guidelines on environment and social contestations apply to the projects

- Environmental and Social Safeguards Framework (ESSF)
- Resettlement Policy Framework (RPF) in ESSF
- JICA Guidelines for Environmental and Social Considerations
- Development Bank of Philippines (DBP) Policy and Requirements on Environment

7.4 Environmental and Social Conditions

In order to understand environmental and social conditions in Las Pinas City, Imus City and Kawit Municipality, the JICA Survey Team reviewed the environmental and social conditions of the cities and municipality based on relevant documents, reports and site visits.

7.5 Initial Environmental Examination

By referring to the JICA Guidelines, an Initial Environmental Examination (IEE) is made an attempt in preparing a preliminary scoping, a draft terms of reference (TOR) for environmental and social considerations studies, points to consider as follows.

7.5.1 Project Components and Lands

- Project components for the two Cities and one Municipality are composed of Sewerage Treatment Plants (STPs) and sewage collection facilities (pumping stations and sewer lines) as well as lands for STPs
- Environmental and social situations of each STP land in the Las Pinas, Imus and Kawit are summarized in Table, 7.5.1.

Table 7.5.1 STP Land Situations

Site	Las Pinas City	Imus City	Kawit Municipality
Environmental Situation	• Flat land • Basically Vacant land • West: V.A.A. Builders' property • East: Zapote river	• Flat land • Basically Vacant land with some trees • Flood prone area in typhoon seasons (water immersion: about 1m from GL)	• Flat land • Basically Vacant land with some trees • East: Antero Soriano Highway

Site	Las Pinas City	Imus City	Kawit Municipality
Social Situation	• A guard house operated by Las Pinas City to oversee the city motor pool, garbage compactors and vehicle impounding are, was permitted by Maynilad within their acquired land for a while. • Maynilad already gave the City Government a formal notice to vacate their land before stating STP. • Maynilad is waiting for Las Pinas City Government's plans of relocating the office to a new location within the boundaries of Coastal Road, C-5.	• In the both sides of approach area for the land, there are two houses (two households but one extended family of total 16 people are living). • Those families are living on the premises as a land keeper for the land assigned by the landowner without land rent. • However, this portion of the land will be outside of STP premises. • The landowner has willingness to sell this portion as soon as. • In addition, the family has willingness to relocate their houses due to frequent flooding. • In cases where the land is sold, the owner will make necessary arrangements for the family relocations	• In the approach area for the land, there are two small shanties (not households but tool shads) • Therefore, no resettlement is predicted.

Source: JICA Survey Team

7.5.2 Zero Option (without projects)

Considering minor environmental and social impacts caused by the projects and the financial constraints of Maynilad, it is evaluated that the selection of zero options are not realistic.

7.5.3 Scoping

Table 7.5.2 shows the preliminary scoping results for the projects.

Table 7.5.1 Preliminary Scoping Results for Projects in 2 Cities and 1 Municipality

Category	No.	Environmental Item	Rating	
			Con. Phase	Ope. Phase
Pollution Control	1	Air Quality	B-	D
	2	Water Quality	C	D
	3	Wastes	B-	C
	4	Soil Contamination	C	D
	5	Noise and Vibration	C	C
	6	Subsidence	D	D
	7	Odor	D	C
Natural Environment	8	Protected Areas	D	D
	9	Ecosystem	D	D
	10	Hydrology	C	D
	11	Topography and Geology	D	D
Social Environment	12	Land Acquisition /Resettlement	D/C	D
	13	Impoverished Peoples Ethnic Minorities and Indigenous Peoples	D	D
	14	Living and Livelihood	B+/-	B+
	15	Land use and Regional Resources	B-	C
	16	Water Right/Use of Water	D	D
	17	Social Infrastructures and Services	B-	D
	18	Heritage	D	D
	19	Social Capital and Social Organization such as decision making bodies	D	D
	20	Damage and Benefit	D	D
	21	Landscape	D	D
	22	Gender Issue	D	D
	23	Rights of the Child	D	D
	24	Risk of infectious diseases such as HIV/AIDS	B-	D
	25	Working Conditions/Work Safety	C	D
	26	Accidents	C	C
Others	27	Transboundary or Global Issues	D	D

A+/-	: Positive/negative impact is expected to some extent.
B+/-	: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
C+/-	: No impact is expected.
D	: No impact is expected.

Note: Con. Phase: Construction Phase (includes Construction work and Installation work), Ope. Phase: Operation Phase

Source: JICA Survey Team

7.5.4 Draft TOR for Environmental and Social Considerations Study

A draft Terms of Reference (TOR) for the environmental and social consideration studies for the projects is prepared as reference as shown in Table 7.5.3.

Table 7.5.2 Draft TOR for Environmental and Social Considerations Study

Environmental Item	Study Item	Study Method
Air Pollution	i. Present traffic volume ii. Air quality in and around the site iii. Impact during construction and installation	i. Review of existing available data and others ii. Review of existing data and others, site reconnaissance and monitoring surveys (if necessary) iii. Based on the above surveys, simple calculation of necessary numbers of construction vehicles and equipment, and trucks to be used for the construction and installation is evaluated.
Water Pollution	i. Water quality in and around the site ii. Impacts during construction and operation phases	i. Review of existing data and others and site reconnaissance ii. Based on the reviews and reconnaissance as well as construction methods, the impacts during construction and operation are evaluated.
Wastes	i. Construction solid waste management ii. Domestic solid waste management	i. Interviews with relevant official entities ii. Interviews with relevant official entities
Soil Contamination	i. Construction method to be applied ii. Construction vehicle and equipment to be used	i. Site reconnaissance and construction plans ii. Site reconnaissance and construction plans
Noise and Vibration	i. Construction method to be applied ii. Construction vehicle and equipment to be used iii. Pump facilities	i. Site reconnaissance and construction plans and designs ii. Site reconnaissance and construction plans iii. Site reconnaissance and construction plans and designs
Odor	i. Designs of STPs	i. Site reconnaissance and construction plans, designs and layouts
Ecosystem	i. Present condition of flora and fauna in the project site and surrounding marine environment	i. Review of existing data, field reconnaissance and review of DPR/EIA
Hydrology	i. River crossing points in the sewer line routs ii. Construction method and period in such points	i. Site reconnaissance ii. Construction plans
Land Acquisition/ Resettlement	i. Land Acquisition plans for STPs in Imus and Kawit ii. Land Acquisition plans for earth-based pump stations in Las Pinas and Imus iii. Resettlement Action Plan for Imus STP site (if required)	i. Site reconnaissance ii. Construction plans and layouts iii. Stakeholder meetings
Living and Livelihood	i. Project policy ii. Impacts on Livelihood	i. Discussion with relevant official entities ii. Prediction of impacts on livelihood
Land use and Regional Resources	i. Construction method and equipment ii. Waste water treatment facility	i. Site reconnaissance and construction plan ii. Site reconnaissance and construction plan
Social Infrastructures and Services	i. Present traffic volume ii. Construction vehicle and equipment to be used	i. Review of existing data and construction plan ii. Site reconnaissance and construction plan
Risk of infectious diseases such as HIV/AIDS	i. Heath situation in the project area and the Philippines ii. Health education activates	i. Review of relevant documents ii. Review of relevant laws and regulations
Working Conditions/Work Safety	i. Occupational safety systems ii. Relevant to law and regulation	i. Review of relevant laws and regulations ii. Review of relevant documents
Accidents	i. Present traffic volume	i. Review of existing data and interviews

Source: JICA Survey Team

7.5.5 Points to Consider

(a) Procedures on ECC/CNC

✓ Point to consider ECC/CNC is as follows.

- Project Category B in ECA are required to secure ECC for the projects.

(b) Odor Control of STP

✓ Points to consider odor control are as follows.

- For the designs of STPs, the Employer's Requirement for Plant Odor control system of Maynilad shall be utilized by the contractors to be contracted in the project.
- Past engineering designs on the odor control systems in STPs of Maynilad shall be referred in the project.

(a) Environmental Management System

✓ Points to consider management on environmental and social considerations for Sewerage Systems in West Metro Manila are summarized in Table 7.5.4.

Table 7.5.3 Points to Consider Management on Environment and Social for the Projects

Site	Environmental Considerations			Social Considerations					
	Odor Control			Land Acquisition			Resettlement		
	Pre.	Con.	Op.	Pre.	Con.	Op.	Pre.	Con.	Op.
Las Pinas	-	-	STP	STP, PS	-	-	-	-	-
Imus	-	-	STP	STP, PS	-	-	STP*	STP*,**	STP*,**
Kawit	-	-	STP	STP, PS	-	-	-	-	-

Pre.: Preparation Phase, Con. Construction Phase, Op.: Operation Phase, STP: Sewerage Treatment Plant, PS: Pump Station

*: Depending on land acquisition plan, resettlement will be necessary.
**: In cases where resettlement is necessary, after care of the resettled households is required based on relevant guidelines and laws and regulations

Source: JICA Survey Team

7.5.6 Environmental Check List (No. 15 of JICA Guidelines)

In accordance with the JICA Guidelines, a preliminary Environmental Check List (No. 15 for wastewater projects) was prepared.

CHAPTER 8 Conclusions

8.1 Sewerage System in the Target Area

8.1.1 Integration of Catchment Area

The sewerage projects of Maynilad were planned for small-scale treatment systems in the past time. However, this led to numerous small STPs for which land acquisition were proven difficult. Metro Manila's population is rapidly increasing, and O&M of many smaller sewerage facilities is daunting. For such reasons, centralized medium to large sized sewerage systems are now regarded as more desirable and effective than distributed systems by integrating the catchment areas. As a result, three (3) STPs in Las Pinas City and Imus City, which were planned in the F/S, were integrated into one (1) STP.

8.1.2 Advanced Treatment Process

In order to clean up the Manila Bay, advanced treatment processes, such as nitrogen and phosphorus removal, will be required based on the upgrading of environmental guidelines by DENR. At present, Maynilad is preparing the new sewerage design standard. In the new standards, the allowable concentration of nitrogen (NO_3<14mg/L, NH_3-N<0.5mg/L) and phosphorus (P<1.0mg/L) are introduced in accordance with the new standard of DENR. Therefore, all STP should perform as advanced treatment, in other words, STP without advanced treatment performance is not able to be adopted in West Metro Manila.

8.1.3 Promising Option of Sewerage Treatment Method

(1) Wastewater Treatment

As studied in Chapter 5, the options with CAS (deep type) are considered the most suitable process among the others in each area as following reasons.

- ✓ Only one (1) site is required for STP in each area. Land acquisition process will be much easier than the other options which require plural number of the sites.
- ✓ Maynilad has enough experience to operate STP with CAS process because recently CAS is mainly adopted in several areas as a treatment system. Therefore, the skilled maintenance staff can keep stable operation and maintenance.
- ✓ The operation of CAS is easier than SBR for advance wastewater treatment.
- ✓ CAS is advantage on LCC evaluation compared with the other options.

Especially, in case of Las Pinas city, the site for the STP has been already acquired. Maynilad can proceed to next implementation stage after design works as scheduled without land acquisition

process.

Also, power-saving and high efficiency sewerage products and equipment, which are introduced in Section 5.2, can be installed in CAS process to improve the performance.

(2) Sludge Treatment

Digestion process can contribute to reducing the sludge generation volume and odor impact. Therefore it will be better to install the process. However, the power generation by digestion gas is small and it can be utilized only for the building facility. Therefore, it will be subject to study in Maynilad in future if the technology will be installed in the STP.

Also, incineration process, contributes to reduction of the sludge volume certainly, however, as mentioned Section 3.3.4, study on the integrated sludge management plan for the entire service area will be necessary separately from this Survey to establish the proper and efficient treatment for the generated sludge in whole area but not only in the target area.

(3) Pipeline System

In Las Pinas City, the wastewater generated in catchments L-22 and L-C can be conveyed to STP L-A with additional trunk sewers under Alabang-Zapote Road and Quirino Avenue. Since those roads are ones with heavy traffic as main roads, utilization of long distance pipe jacking method were proposed to mitigate the impact to traffic and surrounding environment during the construction. It can accelerate the road excavation permit by mayor of Las Pinas City.

In Imus City thanks to the geographic condition, the wastewater generated in catchments IC and IB can be flown down to STP C-B in catchment IA with the additional trunk sewer under General Yengco Street but without the additional pumping station. Imus City is ideal condition to integrate 3 catchments in F/S into one.

In Kawit Town, the wastewater can be conveyed to STP K-3 with adjustment of downstream section from proposed STP site in F/S.

In addition, the outfall locations in the target area were updated based on field work in the course of this study. It can help the interception, conveyance, and treatment of all the wastewater generated in target area.

However, some areas in the target areas, especially in Kawait Town, no drainage system exists. Interceptor method cannot be adopted without drainage system, therefore, it is necessary to discuss with the relevant authority such as LGU who will take responsibilities to install the system before the detailed design.

8.2 Project Evaluation for the Prioritized Projects

Out of alternative schemes in each area, CAS-LP-1 (Las Pinas), CAS-IMS-3 (Imus) and CAS-KWT-1 (Kawit) are chosen as model cases as the Project for the economic and financial

analysis.

8.2.1 Result on Economic Analysis

The economic analysis was conducted to evaluate the economic feasibility of the above model cases. Taking account of the benefits induced by the Project implementation, such as i) improvement of welfare, ii) reduction in medical costs, and iii) land price increase, the EIRR values of three municipalities become 13.4%, 9.6% and 23.5% in Las Pinas city, Imus city and Kawit town, respectively. The EIRR of th whole Project becomes 13.1%. It exceeded 10%, and the Project was proven to be economically viable. To make the Project sustainable, appropriate supervision of construction works and tentative monitoring of the project impact are expected.

8.2.2 Result on Financial Analysis

The presently imposed environmental charge and sewer charge are considered as the incremental revenue. The said revenues and the cost related to the Project are compared until 2037 in the financial analysis. It became clear that the current tariff level of these charges is set lower, and the revenue could not even cover the annual O&M cost of the STP. As the financial feasibility of the concessionair is secured by the present CA, the deficit of the construction cost and O&M costs of the Project will be covered by the cross subsidy granted from the water service. The study team suggests that the high transparency of the tariff system should be ensured.

8.2.3 Procurement of Funds

Maynilad could procure the investment fund of the Project by either 1) own fund, 2) commercial loans, or 3) conventional loans from donors. The conventional loans from donors are preferred by Maynilad as its financial cost is lower than others. As JICA and other donors could not directly lend loans to private company, the loan should be firstly provided to MWSS or GFIs, and then transferred to Maynilad afterward. Maynilad prefers the scheme which the loan is provided from one GFIs, DBP by two step loan scheme. The basic conditions of the loan are presented in the main report.

8.2.4 Present Condition of Tariff Rebasing

As of July 2016, tariff rebasing process to determine the tariff level from 2013-17 has not been terminated. MWSS and Maynilad continued discussing on it from 2012. The Maynilad won the first arbitration regarding the tariff level in 2014, but MWSS asked for the further PHP 3/m3 reduction. Maynilad disagreed on it and ask for the compensation to DOF of the lost tariff revenue due to the delay of revision since 2013. The new arbitration is continued and expected to be finished in the end of 2016.

8.3 Next Deployment By Maynilad

The examination of sewerage treatment systems under the Survey revealed that it would be possible to reduce the number of sewerage treatment plants at each area to 1 STP by integrating the catchments of STPs, which had been planned in the existing F/S, by adopting the deep type of CAS.

This method could improve the current situation where the sewerage plant construction has been delayed due to the difficulties of land acquisition.

And the facility layout plans of the sewerage treatment plants and the estimated costs have been presented assuming that the most suitable waste water treatment method from 4 options including CAS deep type is selected for each candidate site, which has different characteristics. This could be an indicator for future sewerage improvement plan to be carried out under various circumstances.

The Survey also showed that the deep type CAS is an effective treatment method in case that a high capacity treatment plant is required to construct at a limited area. Since this result has been shared with Maynilad, this treatment method is most likely to be the first option for the future treatment plan.

The Survey results are expected to be references for the sewerage improvement plan for not only the target areas in this study but also West Metro Manila and contribute to future economic development and environmental improvement.

LIST OF FINAL REPORT

■	**VOLUME 1 (MAIN REPORT)** Chapter 1 Introduction Chapter 2 Institutional Aspects Related to the Water Business Operations Chapter 3 Sewerage System and Sanitation Service in West Manila and Survey Area Chapter 4 Updating Site Information and Data Chapter 5 Planning of Sewerage System in the Survey Area Chapter 6 Economic and Financial Analysis Chapter 7 Environmental and Social Considerations Chapter 8 Conclusions
□	**VOLUME 2 (DRAWINGS)** Drawings-1 Layout of Sewage Treatment Plant Drawings-2 Sewerage Plan Drawings-3 Pump Station

REPUBLIC OF PHILIPPINES
DATA COLLECTION SURVEY FOR SEWERAGE SYSTEMS IN WEST METRO MANILA

FINAL REPORT
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Abbreviations

ABS	Acrylonitrile-Butadiene-Styrene
ACD	Activated Carbon Deodorizer
ADB	Asian Development Bank
ADR	Appropriate Discount Rate
AMSL	Above Mean Sea Level
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of South-East Asian Nations
ASP	Activated Sludge Process
B/C	Benefit Cost Ratio
BIR	Bureau of Internal Revenue
BOD	Biochemical Oxygen Demand
BOI	Board of Investment
CA	Concession Agreement
CAPEX	Capital Expenditure
CAR	Certification Authorizing Registration
CAS	Conventional Activated Sludge
CCA	Climate Change Adaptation
CEZ	Cavite Economic Zone
CIT	Corporate Income Tax
CLUP	Comprehensive Land Use Plan
CMD	Cubic Meter per Day
CNC	Certificate of Non-Coverage
COD	Chemical Oxygen Demand
CPI	Consumer Price Index
CSO	Combined Sewer Overflow
CTS	Contract to Sell
DBP	Development Bank of Philippines
DCRA	Debt and Capital Restructuring Agreement
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DO	Dissolved Oxygen
DOAS	Deed of Absolute Sale
DOF	Department of Finance
DOH	Department of Health
DPWH	Department of Public Works and Highway
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDP	Environmental Development Project
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
EMB	Environmental Management Bureau

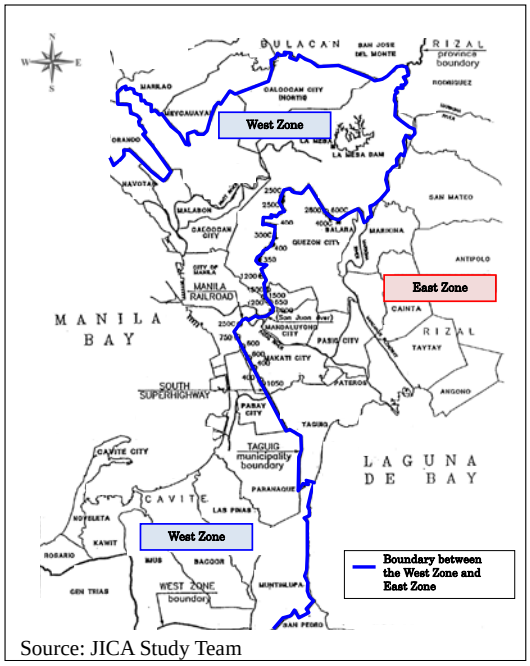
ESSF	Environmental and Social Safeguards Framework
FBAS	Fixed-bed Biofilm Activated Sludge
FCDA	Foreign Currency Differential Adjustment
FHSIS	Field Health Service Information System
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
FY	Financial Year
GDP	Gross Domestic Product
GFIs	Government Financial Institutions
GHS	Globally Harmonized System
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IMF	International Monetary Fund
IP	Investment Plan 2008-2037
ITTO	International Tropical Timber Organization
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
LBP	Land Bank of Philippines
LCC	Life Cycle Cost
LGU	Local Government Unit
LWUA	Local Water Utilities Administration
MBR	Membrane Bio Reactor
MBBR	Moving Bed Biofilm Reactor
MGB	Mines and Geosciences Bureau
MLD	Million Litter per Day
MP	Master Plan
MPIC	Metro-Pacific Investment Corporation
MPN	Most Probable Number
MWCI	Manila Water Company, Inc.
MWSI	Maynilad Water Service, Inc.
MWSS	Metropolitan Waterworks and Sewerage System
NAMRIA	National Mapping and Resource Information Authority
NEDA	National Economic and Development Authority
NIPAS	National Integrated Protected Areas System
NPCC	National Pollution Control Commission
NPV	Net Present Value
NRW	Non Revenue Water
NSO	National Statistics Office
O&M	Operation and Maintenance
OD	Oxidation Ditch
ODA	Official Development Assistance
OPEX	Operating Expense
PAGASA	Philippine Atmospheric, Geophysical, and Astronomical Services

	Administration
PCU	Platinum Cobalt Units
PEISS	Philippine Environmental Impact Statement System
PEZA	Philippine Economic Zone Authority
PHP	Philippine Peso
PM	Permanent Magnet
PMU	Project Management Unit
PNSDW	Philippine National Standards for Drinking Water
RPF	Resettlement Policy Framework
P/S	Pumping Station
PTF	Pre-treated Trickling Filtration
PVC	Polyvinyl Chloride
RA	Republic Act
RO	Regulatory Office
ROW	Right of Way
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition
SDS	Safety Data Sheet
SMR	Self-monitoring Report
SS	Suspended Solids
STF	Sludge Treatment Facilities
STP	Sewage Treatment Plant
TCA	Transitional and Clarificatory Agreement
TCT	Transfer Certificate of Title
TN	Total Nitrogen
TOR	Terms of Reference
TP	Total Phosphorus
TSL	Two Step Loan
TSS	Total Suspended Solids
UN	United Nations
UV	Ultraviolet
VAT	Value Added Tax
WB	World Bank
WTF	Water Treatment Facilities

CHAPTER 1 Introduction

1.1 Background of the Study

Metropolitan Manila (Metro Manila) is the capital region of the Republic of the Philippines and one of the largest capital cities in the world. The water supply and sewerage services (hereinafter called as the "water services") had been operated and managed by the Metropolitan Waterworks and Sewerage System (MWSS) under the control of the Department of Public Works and Highway (DPWH). However, in the 1990s, water services of the capital area were significantly behind compared with the area's development, which resulted in serious social issues. Therefore, water services were privatized in 1997 and divided into two areas, namely: West Zone and East Zone. This privatization was directed by the Philippine government with the assistance of the International Finance Corporation (IFC). Now, the West Zone, which is the object of the Metro Manila Sewerage and Sanitation Improvement Project (hereinafter called as "the Project"), is operated by the Maynilad Water Services, Inc. (Maynilad or MWSI), and the East Zone is handled by the Manila Water Company, Inc. (Manila Water or MWCI) under a concession agreement with MWSS as shown in Figure 1.1.1.



Source: JICA Study Team

Figure 1.1.1 Service Area of Concessionaire

After the privatization, service coverage of the water supply in Metro Manila has been over 95%. However, sewerage service coverage in Metro Manila remains at the low level which is still approximately 14% in 2015. Most of the household effluents are discharged to public water bodies without treatment through septic tanks which have low treatment capacity. Low sewerage service coverage has affected water pollution problem in public water bodies such as Manila Bay.

Corresponding to the social requirements toward sewerage service, Maynilad is planning to implement 10 major sewerage projects from 2017 to 2022. Among them are the sewerage projects in Las Piñas, Imus, and Kawit, which are the target areas of this Survey.

The Japan International Cooperation Agency (JICA) conducted the Preparatory Survey for Metro Manila Sewerage and Sanitation Improvement Project Phase 2 (2010.7-2011.7) to prepare the feasibility study (F/S) of the sewerage systems in the Parañaque-Las Piñas catchment to be developed by Maynilad.

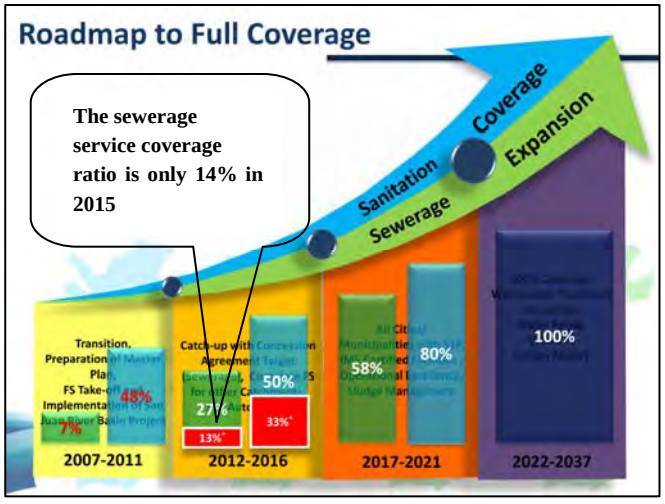
JICA also provided the Technical Assistance of Parañaque Sewerage System Development Project (2012.11-2012.12) to review and update the existing F/S prepared under the above preparatory survey. The revised preparatory survey has been subsequently materialized through Phase-1 of the Parañaque sewerage system financed under the Environmental Development Project (EDP).

In the seminar which was held in July 2015, Maynilad expressed its interest in the technology which can contribute to minimize the area of land acquisition for the sewage treatment plant (STP). The present Data Collection Survey for Sewerage System in West Metro Manila (hereinafter referred to as "the Survey"), therefore, seeks to clarify the possibility to introduce the innovative and appropriate sewage treatment technologies, which can be applicable to the conditions in Las Pinas city, Imus city and Kawit town to minimize land space and optimize the total cost of the sewerage systems to be developed by the private concessionaries, by collecting necessary information, including hydrological, topographical, and socioeconomic potential financial data, similar to the case of Phase-1 of the Parañaque sewerage system.

The data collected in the Survey might be used by relevant stakeholders involved in the identification of potential projects.

1.2 Objectives of the Survey

Maynilad has to achieve a sewerage coverage target of 27% by 2016, 58% by 2021, and 100% by 2037 in accordance with the concession agreement. A total of 56 STPs will be constructed. However, due to the delay of land acquisition process for STPs, the actual progress is behind the development schedule.



Source: Maynilad

Figure 1.2.1 Sewerage Development Plan of Maynilad

In addition, the delay in the construction work of some sewerage projects due to various causes prevented Maynilad from achieving the coverage target ratio; as a result, the sewerage service coverage ratio was only 14% in 2015.

The main reasons of the delay are land acquisition issue due to rapid rise in land price, traffic congestion, and difficulty of construction in small areas and in high density residential areas.

The purpose of the Survey is to draft several sewerage system plans in which various innovative technologies applicable to the conditions in Metro Manila are introduced considering the

abovementioned background and present them as options. As for the number of STPs to be required, the treatment capacity, the pipeline plan, the initial and maintenance costs, and life cycle cost (LCC) evaluation for each alternative shall be identified together with the merits and demerits.

In addition, the options of possible financial schemes shall be studied.

1.3 Main Scope of the Survey

The scope of the Survey is as follows:

- Review on the existing documents such as F/Ss which were conducted by Maynilad and JICA;
- Identify candidate sites for STP in the target areas;
- Collection of data and information about the target area (geology, hydrology, food record, outfall, development plan, city plan, regulation, environmental condition, etc.);
- Case study on sewerage system with applicable sewage treatment process in the target area;
- Cost estimation (initial cost and O&M cost)
- LCC calculation;
- Environmental and social consideration;
- Economic and financial analysis; and
- Identification of possible financial schemes.

1.4 Survey Area

Source: Maynilad eddited by JICA Study Team

Figure 1.4.1 Location Map of Survey Area

The survey area is Las Piñas city, Imus city and Kawit town in the West Zone of Metro Manila, as shown in Figure 1.4.1. The area comprises most of the cities and municipalities of Metro Manila and some municipalities of Cavite. To the east of the survey area is the Cordillera Mountains, Laguna de Bay in the southeast, Central Luzon in the north, and the Southern Tagalog Region in the south. The total land area includes zones for residential, industrial, institutional, and agricultural uses as well as unclassified public forests.

West Metro Manila is also located in a region with adequate facilities and services in terms of

mass transportation, housing and commercial infrastructure, communications, power supply, and recreational facilities. It has excellent seaport facilities of international standards situated in Batangas City and Subic Bay in Olongapo City, and an aviation center through the Clark International Airport in Angeles City. The government has envisioned an integrated road network and rail-based mass transport system within the metropolis. Moreover, it has a world-class malls and commercial centers.

Details of the natural and physical conditions, as well as social and environmental conditions are described in Sections 1.5 and 1.6, respectively.

1.4.1 Las Piñas City

(1) General Description

Las Piñas City, officially called the city of Las Piñas (Filipino: *Lungsod ng Las Piñas*), is a city in the National Capital Region of the Philippines. According to the 2010 Census, it has a population of 552,573.

Las Piñas City is bounded to the northeast by Parañaque; to the southeast by Muntinlupa; to the west and southwest by Bacoor; and to the northwest by Manila Bay. Half of its land area is residential and the remaining half is used for commercial, industrial, and institutional purposes. The present physiography of Las Piñas consists of three zones: Manila Bay, coastal margin, and the Guadalupe Plateau.

(2) Area

The city has a total land area of approximately 3,298.6 ha, making it the sixth largest city in Metro Manila. It has two congressional districts covering 20 barangays including the island located within the reclamation area. District 1 covers about the north half portion of the city abutting Manila Bay while District 2 are the southern barangays.

1.4.2 Imus City

(1) General Description

Imus City is the officially designated capital city of the province of Cavite in the Philippines. The former municipality was officially converted into a city following a referendum on June 30, 2012. Based on the 2010 local government unit (LGU) income of Imus, the former town is classified as a first-class component city of Cavite with a population of 301,624 people according to the 2010 Census.

Located about 19 km (12 mi) from Metro Manila, Imus was the site of two major Katipunero victories during the Philippine Revolution against Spain. The Battle of Imus was fought on

September 3, 1896 and the Battle of Alapan on May 28, 1898, the day when the first Philippine flag was flown making Imus the "Flag Capital of the Philippines". Both events are celebrated annually in the city. The Imus Historical Museum honors the city's history with historical reenactment of scenes from the revolution.

(2) Area

Imus City covers a land area of 6,470 ha (64.70 km^2), approximately 6.8% of the total land area of the province of Cavite, which is 1,427.06 km^2. The almost rectangular inland city of Cavite is bounded by the municipalities of Kawit and Noveleta to the north, and General Trias to the west, by the cities of Bacoor to the east, and Dasmariñas to the south.

The city is located near the Metropolitan Manila area, just 21 km south of Manila. With the continuous expansion of Metro Manila, this local government unit is now included in the Greater Manila Area, which reaches Lipa City in its southernmost part.

1.4.3 Kawit Town

Kawit Town covers a land area of 1,340 ha (13.40 km^2), approximately 1.0% of the total land area of the province of Cavite, which is 1,427.06 km^2.

Kawit Town is situated in the northern part of the province. It is bounded by Cavite City and Bacoor Bay in the north and Bacoor in the east. Noveleta can be found beyond the western boundary while General Trias and Imus share its southern limits. It is about 25 km south of Metro Manila and about 4 km south of Cavite City across Bacoor Bay.

1.5 Natural and Physical Conditions of Metro Manila

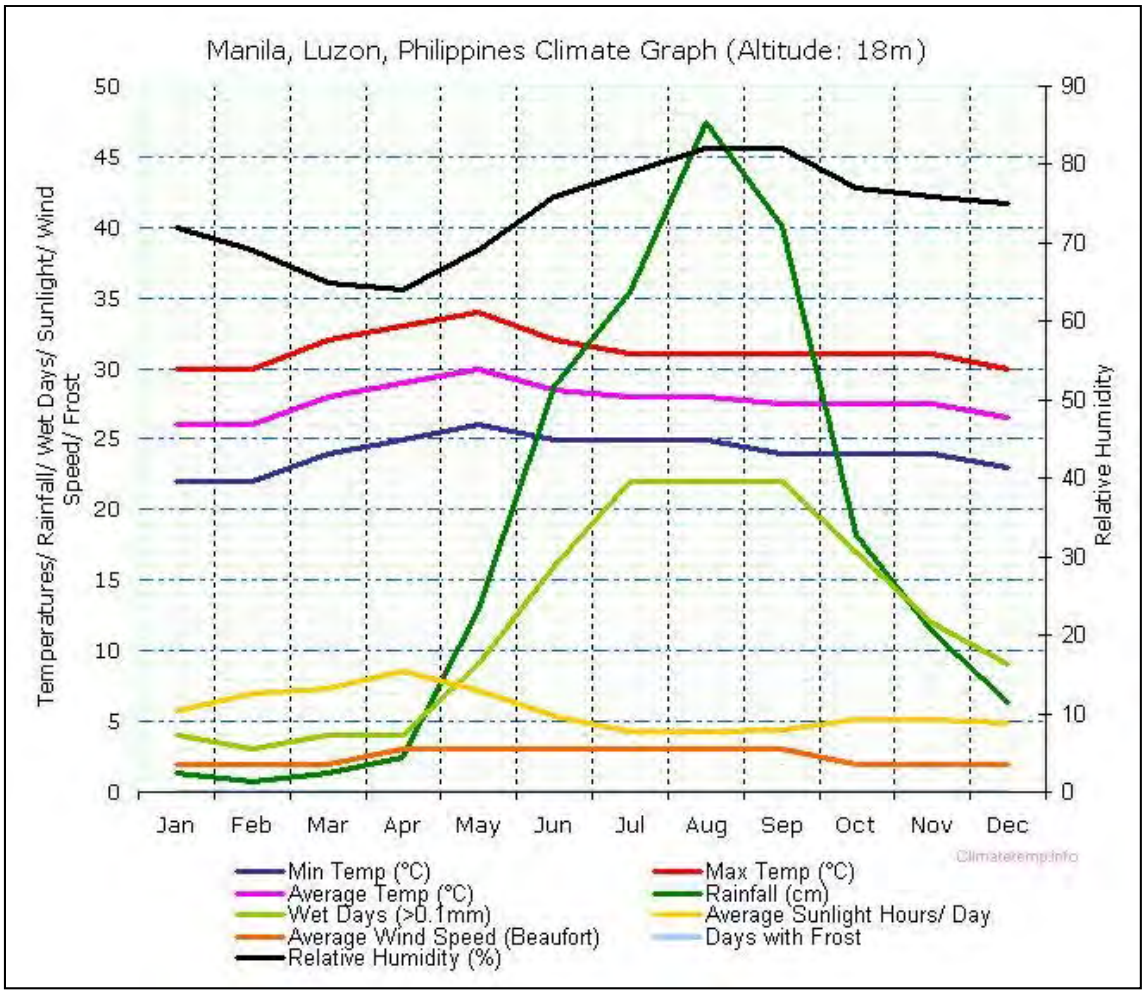
1.5.1 Climate

The Philippines has a tropical maritime climate. It is characterized by relatively high temperature, high humidity, and abundant rainfall. Based on the Modified Coronas Climate Classification of the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) the climate in the study area belongs to Type 1, that is, dry from November to April and wet during the rest of the year. Typhoons have a great influence on the climate and weather conditions in the Philippines. A great portion of the rainfall, humidity, and cloudiness are due to the influence of typhoons. These typhoons generally originate from the region of the Marianas and Caroline Islands of the Pacific Ocean, which have the same latitudinal location as Mindanao. Their movements follow a northwesterly direction.

Based on the available climatological data from the Science Garden Station of PAGASA, the climatic conditions in the study area are shown in Figure 1.5.1. Figure 1.5.1 shows the summaries

of average climate condition based on recorded data from 1981 to 2010.

The hottest temperature was recorded in May while the coldest was in January, with an average temperature of 29.7 ºC and 25.7 ºC, respectively. The mean annual temperature for the 30-year record of observation is 27.7 ºC. Records indicated that the least humid month is in April with an average value of 67% while the most humid months are in August and September with an average of 84%. Mean monthly relative humidity from 1981 to 2010 was 78%.



Source: PAGASA Science Garden Station, Period of Records: 1981-2010

Figure 1.5.1 Average Monthly Climate Condition

The annual rainfall in Metro Manila is 2,201 mm and the annual average temperature is 28.1 ºC. The dry season is from November to April and the rest of the year is rainy. The monthly average humidity from 1981 to 2010 was 78%. The typhoon season starts from June through September, causing floods in some parts of the cities.

Table 1.5.1 Climate in Metro Manila (1971–2000)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Average maximum temperature °C	29.5	30.5	32.1	33.5	33.2	32.2	31.1	30.6	30.9	30.9	30.7	29.7	31.24
Average daily temperature °C (°F)	26.5	27.2	28.5	29.9	30.0	29.2	28.5	28.1	28.2	28.2	27.1	26.2	28.13
Average lowest temperature °C (°F)	18.5	20.8	25.9	26.2	26.7	26.2	25.8	25.5	25.5	25.5	24.9	23.9	24.62
Rainfall mm (inch)	19.0	7.9	11.1	21.4	165.2	265.0	419.6	486.1	330.3	270.9	129.3	75.4	2,201.2

Source: PAGASA (The Philippine Atmospheric, Geophysical, and Astronomical Services Administration)

1.5.2 Topographic Condition

Majority of the West Metro Manila lies entirely in a neck of swampland with an average elevation of 10 m above mean sea level (AMSL), while the municipalities of Bacoor, Kawit, Noveleta, and Rosario have extremely low ground elevation ranging from 0 to 2 m above AMSL. Towards the Quezon City area, the topography becomes largely rolling with alternating ridges and lowlands. Steep portions are evident in the eastern part of the city, which run parallel with the Marikina River and West Valley Fault.

The topography in northern Caloocan is characterized by gentle to steep, undulating to rolling terrain with slopes ranging from 3% to 18%. This landscape is noted in the northern and central portions and gradually transforming into a southward trend of flat lands down to the southwestern tip of the boundary. The highest elevation is 120 m above AMSL, which was determined in the Tala Estate, Pangarap Village.

1.5.3 Geography and Geology

(1) Geography

Metro Manila has no states and consists of 16 cities and 1 town including Manila and the former capital Quezon City. The land area includes zones for residential, industrial, public facilities, agricultural uses as well as unclassified public forests.

To the east of Metro Manila is the Cordillera Mountains, Laguna de Bay in the southeast, Central Luzon in the north, and Southern Tagalog Region in the south. West Metro Manila is also located in a region with adequate facilities and services in terms of mass transportation, housing and commercial infrastructure, communications, power supply, and recreational facilities. Furthermore, well-equipped port facilities and an international airport are sited and additionally, a world class port facility is available as an off-site facility at the Subic Bay complementing both Batangas City and Olongapo City seaports.

The Government of the Philippines has envisaged constructing an integrated road system and a railway system that will make mass transportation possible within Metro Manila. Moreover, there are world-class shopping malls and commercial facilities available.

(2) Geology

According to the Mines and Geosciences Bureau (MGB), Metro Manila and its adjoining vicinity is underlain by recent alluvial deposits, a clastic sequence of conglomerates, mudstones, and sandstones (Alat Conglomerate), and a pyroclastic– sedimentary unit (Diliman Tuff). The eastern portion of Metro Manila is underlain by Angat Ophiolitic Complex, composed of basalts, diabases, and gabbros.

The Quaternary (Recent) alluvial deposits are made up of unconsolidated and poorly sorted pebbles/cobbles and boulders of older rocks, sand, silt, and mud. These are deposited along the Manila deltaic plain and Marikina Valley alluvial plain. The thicknesses of these alluvial deposits vary from 50 m for the coastal area of the Manila deltaic plain to over 130 m in the Marikina area and even up to 200 m in the Cainta-Pasig area.

For the Pleistocene Guadalupe Formation, most of the deposits are believed to be water-laid. The Alat Conglomerate, which is about 100 m thick, is mapped to be made up of massive conglomerates, deeply weathered silty mudstone, and tuffaceous sandstone. The Diliman Tuff, with thickness of 1,300 m to 2,000 m, is composed predominantly of fine-grained vitric tuff and welded volcanic breccia with subordinate amount of fine to medium grained tuffaceous sandstone. The Alat Conglomerate and Diliman Tuff are considered members of the Pleistocene Guadalupe Formation, which extends from Bulacan to the north and all the way to Cavite to the south.

1.5.4 Water Body

(1) Classification of Water Bodies in the Philippines

Surface waters are classified to maintain its safe quality and satisfactory condition according to their best usages. Table 1.5.2 shows the current classification for fresh surface water and coastal and marine waters, accordingly.

Table 1.5.2 Current Classification of Water Bodies for Fresh Surface Water According to Beneficial Use

Classification	Beneficial Use
Inland Surface Water	
Class AA	Public Water Supply Class I. This class is intended primarily for waters having watersheds which are uninhabited and otherwise protected and which require only approved disinfection in order to meet the Philippine National Standards for Drinking Water (PNSDW)
Class A	Public Water Supply Class II. For sources of water supply that will require complete treatment (coagulation, sedimentation, filtration and disinfection) in order to meet the PNSDW
Class B	Recreational Water Class I. For primary contact recreation such as bathing, swimming, skin diving, etc. (particularly those designated for tourism purposes)

Classification	Beneficial Use
Class C	1) Fishery Water. For the propagation and growth of fish and other aquatic resources 2) Recreational Water Class II (e.g., boating, etc.) 3) Industrial Water Supply Class I (For manufacturing processes after treatment)
Class D	1) For agriculture, irrigation, livestock watering, etc. 2) Industrial Water Supply Class II (e.g., cooling, etc.) 3) Other inland waters, by their quality, belong to this classification
Marine Water	
Class SA	1) Waters suitable for the propagation, survival, and harvesting of shellfish for commercial purposes 2) Tourist zones and national marine parks and reserves established under the Presidential Proclamation No. 1801; existing laws and/or declared as such by appropriate government agencies 3) Coral reef parks and reserves designated by law and concerned authorities
Class SB	1) Recreational Water Class I (Areas regularly used by the public for bathing, swimming, skin diving, etc.) 2) Fishery Water Class I (Spawning areas for *Chanos chanos* or *"Bangus"* and similar species)
Class SC	1) Recreational Water Class II (e.g., boating, etc.) 2) Fishery Water Class II (Commercial and sustenance fishing) 3) Marshes and/or mangrove areas declared as fish and wildlife sanctuaries
Class SD	1) Industrial Water Supply Class II (e.g., cooling, etc.); 2) Other coastal and marine waters, by their quality, belong to this classification

Source: DAO No. 1990 – 34, Revised Water Usage and Classification Water Quality Criteria Amending Section Nos.

(2) River

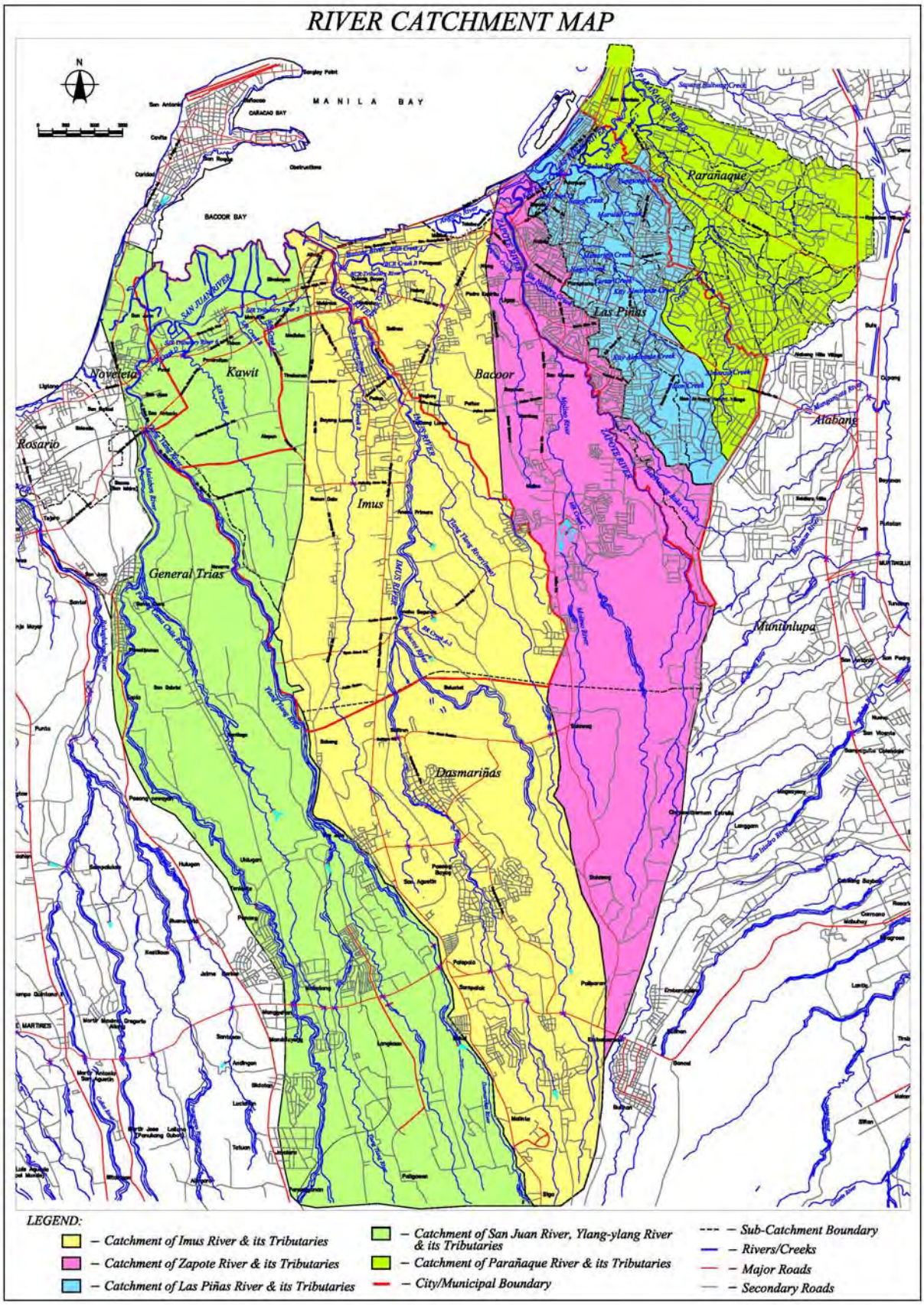
1) Location

The locations of the rivers in the target area are shown in Figure 1.5.2 and the general information of each main river and its tributary/creek is shown in Table 1.5.3. The detailed information of each river is attached in Appendix 1.

Table 1.5.3 General Information of the Rivers in the Target Area

Main River	Longest Length (km)	Number of Tributaries	Catchment Area (ha)	
			City/Municipality	Catcment Area Inside Municipal Boundary (ha)
Parañaque River	13.24	23	Las Piñas	582.98
Las Piñas River	13.38	16	Las Piñas	1,846.24
Zapote River	19.35	28	Las Piñas	878.03
Imus River	18.20	109	Imus	4,276.87
			Kawit	145.66
San Juan River	18.01	79	Kawit	1,571.63
			Imus	945.79

Source: JICA Study Team based on National Mapping and Resource Information Authority (NAMRIA) data



Source: JICA Study Team based on river map provided by NAMRIA

Figure 1.5.2 River Location

2) Water Quality

Tables 1.5.4 and 1.5.5 show the monitoring results of the rivers including the target area identified by the Environmental Management Bureau (EMB) in 2003-2015. The results of assessment revealed that all rivers have improved significantly from 2003 to 2008 in terms of dissolved oxygen (DO) level. All of the rivers that run into Manila Bay failed the Department of Environment and Natural Resources (DENR) criteria standards for both DO and Biochemical Oxygen Demand (BOD).

Table 1.5.4 Summary of DO Results for the Main Rivers in the Target Area

Region	Water Body	Class	Average DO (mg/L)				Passed/Failed in 2015	Connected River/Bay
			2003	2006	2008	2015		
NCR	Marikina River	C	3.1	2.2	2.6	N/A	Failed	Pasig River
	San Juan River	C	2.4	1.1	1.9	5.0	Failed	Pasig River
	Parañaque River	C	2.5	1.6	1.6	N/A	Failed	Manila Bay
	Pasig River	C	3.1	2.5	3.2	N/A	Failed	Manila Bay
IV-A	Imus River	C	3.0	4.7	4.1	5.3	Failed	Manila Bay
	Ylang-Ylang River	C	4.5	5.1	4.0	4.7	Failed	Manila Bay
	Rio Grande River	C	N/A	N/A	N/A	5.25	Failed	Manila Bay

Note: Blank means no available data. Dissolved oxygen is an indicator of how well the water can support aquatic life. DO criteria standard is 5.0 mg/L (minimum) for Class 'AA to C' and 3.0 mg/L (minimum) for Class D.
Bold-faced number means that it failed to reach the criteria standard.

Source: Compendium of Basic ENR Statistics for Operations and Management (Second Edition) (2000-2008), DENR (2011), Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

Table 1.5.5 Summary of BOD Results for the Main Rivers

Region	Water Body	Class	Average BOD (mg/L)				Passed/Failed	Connected River/Bay
			2003	2006	2008	2015		
NCR	Marikina River	C	18.2	15.0	18.2	N/A	Failed	Pasig River
	San Juan River	C	54.8	33.4	44.2	64.79	Failed	Pasig River
	Parañaque River	C	42.0	41.0	38.2	60.23	Failed	Manila Bay
	Pasig River	C	10.7	13.6	20.5	N/A	Failed	Manila Bay
IV-A	Imus River	C	8.0	9.1	11.1	11.98	Failed	Manila Bay
	Ylang-Ylang River	C	24.4	8.7	63.76	119.31	Failed	Manila Bay
	Rio Grande River	C	N/A	N/A	N/A	7.43	Failed	Manila Bay

Note: Blank means no available data. BOD criteria standard is 5.0 mg/L (maximum) for Class 'A' and 'B', 7.0 mg/L (maximum) for Class 'C' and 10.0 mg/L (maximum) for Class 'D'.
Bold-faced number means that it failed to reach the criteria standard.

Source: Compendium of Basic ENR Statistics for Operations and Management (Second Edition) (2000-2008), DENR (2011), Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

(3) Sea

Water quality of Manila Bay at the mouth of the river in the target area is shown in Table 1.5.6.

Source: JICA Study Team based on the Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

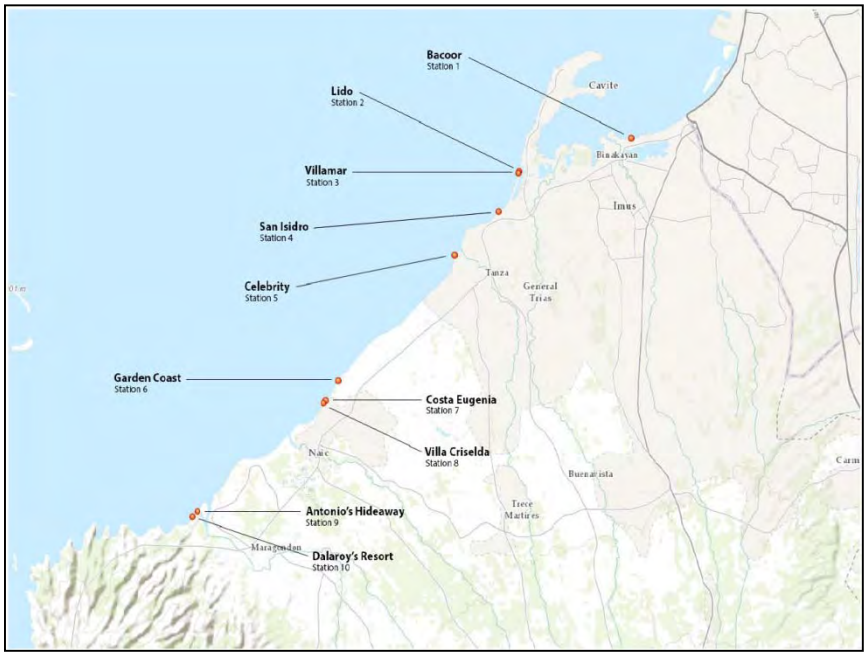
Figure 1.5.3 Sampling Location

Table 1.5.6 Water Quality of Manila Bay at the Mouth of the River in the Target Area

Region	River Mouth	Class	Average (mg/L)				
			DO	NH3	PO4	TSS	Coliform
IV-A	Imus River	C	8.33	1.31	1.00	18.07	42,614.53
	Ylang-Ylang River	C	5.11	0.44	0.87	42.96	55,024.15

Source: JICA Study Team based on the Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

Also, water quality of Manila Bay on the beach surrounding the target area is shown in Table 1.5.7.



Source: JICA Study Team based on the Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

Figure 1.5.4 Sampled Location

Table 1.5.7 Water Quality of Manila Bay on the Beach Surrounding the Target Area

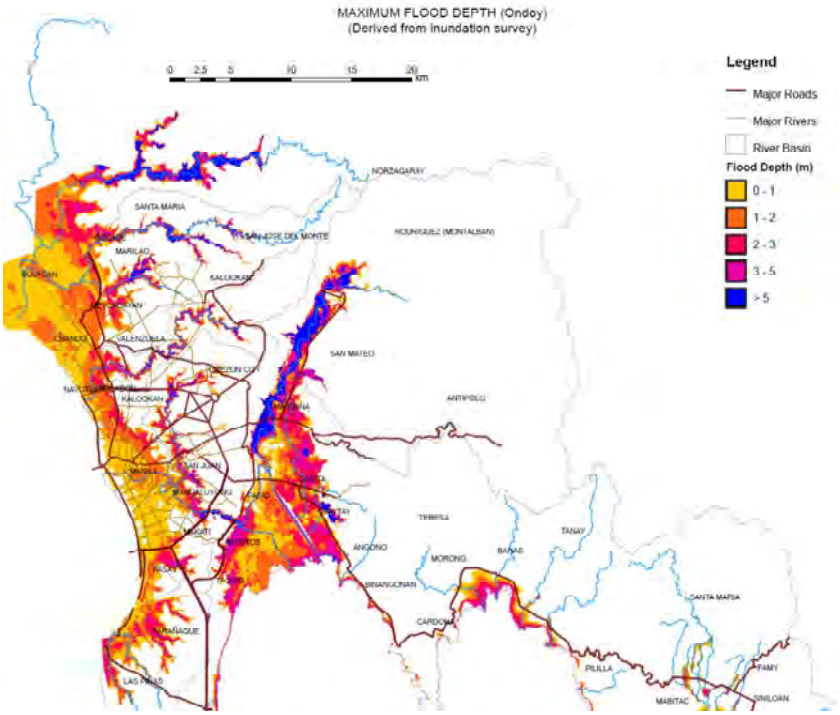
Station	Total Coliform (Geomean)	Fecal Coliform (Geomean)	DO	pH
1	112445.77	57259.23	2.14	7.57
2	2090.11	1362.35	6.23	8.03
3	1907.63	903.39	6.30	8.05
4	58347.75	37353.62	6.29	7.96
5	83765.71	67527.53	6.34	8.00
6	1615.58	1038.38	6.46	8.01
7	2335.65	1611.42	6.52	8.11
8	2987.58	1715.02	6.54	7.95
9	311.67	192.65	6.26	8.12
10	209.94	111.39	6.29	8.15
DAO No. 34 (Class SB)	1000 MPN/100mL	200 MPN/100mL	5.0 mg/L	6.5-8.5

Source: JICA Study Team based on the Annual Accomplishment Report of Manila Bay Unit CY 2015, Environmental Management Bureau, DENR Compound

Average value exceeds the value regulated by DAO No. 34 (Class SB). For cleanup of Manila Bay, the water quality of all of the rivers that run into the Manila Bay should be improved.

1.5.5 Flood Record

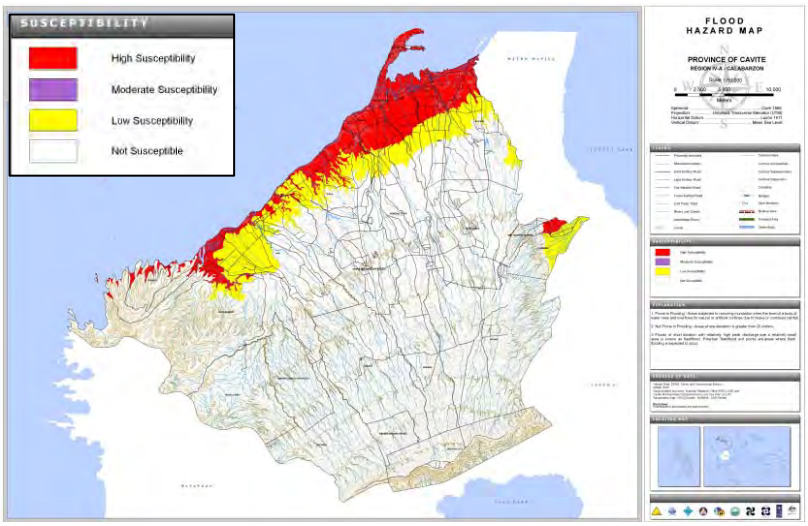
There are no expected effects from tidal fluctuations to floods in West Manila. However, flashfloods can still happen in several places, particularly during heavy rains and occurrence of typhoons along the Marikina River because the waterways, drainage inlets, and drainage pipes are clogged with garbage and plastic materials. The World Bank (WB) prepared an inundation map that shows the maximum flood depth caused by Typhoon Ondoy as shown in Figure 1.5.5.



Source: Metro Manila Flood Management Master Plan (2012), WB

Figure 1.5.5 Maximum Flood Depth Due to Typhoon Ondoy

Generally, flooding is only experienced in low lying towns of Cavite based on a study conducted by JICA in 2008. Figure 1.5.6 shows a flood hazard map of Cavite and it indicates most areas that are highly susceptible to flooding belong to municipalities located along the coastline of Cavite including Kawit and Imus.



Source: Provincial Disaster Risk Reduction and Management Plan 2011-2016, Cavite Province

Figure 1.5.6 Flood Hazard Map of Cavite Province

1.6 Population Projection

The population projection, which was provided by Maynilad based on the Census 2010, is shown in Table 1.6.1. The annual growth rate is shown in Table 1.6.2.

Table 1.6.1 Population Projection

City/Municipality (West Zone)	2010	Population Projection 2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Overall	**9,149,177**	**9,239,503**	**9,334,889**	**9,433,663**	**9,536,103**	**9,641,496**	**9,740,053**	**9,840,924**	**9,943,940**	**10,049,020**	**10,156,124**
NCR	**7,984,378**	**8,049,596**	**8,118,935**	**8,190,673**	**8,265,031**	**8,341,439**	**8,409,329**	**8,478,580**	**8,549,031**	**8,620,590**	**8,693,201**
Manila	1,486,400	1,484,568	1,483,043	1,481,875	1,481,122	1,480,549	1,480,134	1,479,844	1,479,630	1,479,477	1,479,368
Quezon City	1,744,493	1,767,483	1,790,776	1,814,375	1,838,286	1,862,512	1,883,248	1,904,214	1,925,414	1,946,849	1,968,524
Caloocan	1,513,521	1,528,535	1,543,698	1,559,011	1,574,476	1,590,094	1,605,469	1,620,993	1,636,667	1,652,492	1,668,470
Malabon	351,181	346,739	344,539	342,716	341,325	340,431	339,752	339,260	338,917	338,665	338,485
Navotas	249,942	252,841	255,774	258,741	261,743	264,779	267,102	269,446	271,810	274,195	276,600
Valenzuela	576,729	583,710	590,777	597,928	605,167	612,492	618,055	623,667	629,331	635,046	640,813
Las Piñas	556,965	565,387	573,937	582,616	591,426	600,370	608,253	616,240	624,331	632,529	640,834
Makati	57,142	56,426	55,837	55,389	55,102	54,885	54,727	54,618	54,538	54,480	54,439
Muntinlupa	461,439	469,250	477,194	485,271	493,486	501,839	508,839	515,936	523,132	530,428	537,827
Parañaque	595,937	606,526	617,303	628,272	639,435	650,797	661,619	672,622	683,807	695,178	706,738
Pasay City	390,629	388,129	386,058	384,478	383,462	382,690	382,131	381,741	381,455	381,250	381,103
CAVITE	**1,164,799**	**1,189,908**	**1,215,954**	**1,242,990**	**1,271,072**	**1,300,057**	**1,330,724**	**1,362,345**	**1,394,909**	**1,428,430**	**1,462,923**
Bacoor	538,718	552,721	567,087	581,828	596,951	612,468	629,174	646,336	663,966	682,076	700,681
Cavite City	100,401	99,682	99,087	98,633	98,341	98,119	97,959	97,847	97,765	97,706	97,664
Imus	313,042	322,036	331,289	340,807	350,598	360,671	371,612	382,884	394,499	406,465	418,795
Kawit	78,597	80,835	83,136	85,503	87,938	90,441	92,583	94,776	97,021	99,319	101,671
Noveleta	42,202	43,358	44,545	45,764	47,017	48,305	49,470	50,662	51,884	53,135	54,416
Rosario	91,839	91,277	90,811	90,455	90,226	90,052	89,926	89,839	89,774	89,728	89,695

City/Municipality (West Zone)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Overall	**10,248,217**	**10,341,852**	**10,437,026**	**10,533,743**	**10,632,019**	**10,712,772**	**10,794,674**	**10,877,737**	**10,961,979**	**11,047,418**
NCR	**8,752,686**	**8,812,857**	**8,873,691**	**8,935,177**	**8,997,307**	**9,044,956**	**9,092,987**	**9,141,397**	**9,190,186**	**9,239,354**
Manila	1,479,289	1,479,232	1,479,191	1,479,162	1,479,140	1,479,125	1,479,114	1,479,106	1,479,100	1,479,096
Quezon City	1,986,213	2,004,062	2,022,071	2,040,242	2,058,576	2,072,526	2,086,571	2,100,711	2,114,947	2,129,280
Caloocan	1,680,980	1,693,583	1,706,281	1,719,075	1,731,964	1,741,609	1,751,308	1,761,062	1,770,869	1,780,731
Malabon	338,355	338,262	338,195	338,147	338,112	338,087	338,069	338,056	338,046	338,040
Navotas	278,444	280,300	282,169	284,050	285,943	287,316	288,696	290,082	291,474	292,874
Valenzuela	645,268	649,754	654,271	658,819	663,399	666,760	670,137	673,531	676,942	680,371
Las Piñas	647,831	654,904	662,054	669,282	676,589	681,970	687,394	692,861	698,371	703,925
Makati	54,409	54,388	54,372	54,361	54,353	54,348	54,343	54,340	54,338	54,337
Muntinlupa	544,118	550,482	556,921	563,436	570,026	575,553	581,134	586,769	592,459	598,203
Parañaque	716,782	726,968	737,300	747,778	758,405	766,884	775,458	784,127	792,894	801,758
Pasay City	380,997	380,921	380,866	380,827	380,798	380,778	380,763	380,752	380,745	380,739
CAVITE	**1,495,531**	**1,528,995**	**1,563,334**	**1,598,566**	**1,634,712**	**1,667,816**	**1,701,687**	**1,736,340**	**1,771,793**	**1,808,064**
Bacoor	718,239	736,237	754,686	773,597	792,982	810,700	828,814	847,333	866,265	885,620
Cavite City	97,634	97,612	97,596	97,585	97,577	97,571	97,567	97,564	97,561	97,560
Imus	430,513	442,558	454,941	467,670	480,755	492,839	505,226	517,926	530,944	544,290
Kawit	103,863	106,102	108,390	110,726	113,114	115,256	117,438	119,662	121,928	124,237
Noveleta	55,611	56,832	58,080	59,355	60,659	61,830	63,023	64,240	65,480	66,744
Rosario	89,671	89,654	89,642	89,633	89,626	89,622	89,618	89,616	89,614	89,613

City/Municipality (West Zone)	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Overall	**11,114,992**	**11,183,442**	**11,252,783**	**11,323,030**	**11,394,197**	**11,446,438**	**11,499,335**	**11,552,899**	**11,607,141**	**11,662,073**
NCR	**9,273,968**	**9,308,782**	**9,343,796**	**9,379,012**	**9,414,430**	**9,434,724**	**9,455,100**	**9,475,557**	**9,496,097**	**9,516,718**
Manila	1,479,093	1,479,091	1,479,090	1,479,089	1,479,088	1,479,087	1,479,087	1,479,087	1,479,086	1,479,086
Quezon City	2,139,240	2,149,246	2,159,299	2,169,399	2,179,546	2,184,988	2,190,443	2,195,911	2,201,393	2,206,889
Caloocan	1,786,853	1,792,996	1,799,160	1,805,345	1,811,551	1,814,303	1,817,060	1,819,821	1,822,586	1,825,355
Malabon	338,035	338,031	338,029	338,027	338,026	338,025	338,024	338,024	338,023	338,023
Navotas	293,674	294,477	295,282	296,089	296,898	297,053	297,208	297,364	297,519	297,674
Valenzuela	682,395	684,425	686,461	688,504	690,552	691,149	691,747	692,345	692,944	693,544
Las Piñas	708,025	712,148	716,295	720,466	724,662	727,280	729,908	732,546	735,193	737,849
Makati	54,336	54,335	54,334	54,334	54,334	54,333	54,333	54,333	54,333	54,333
Muntinlupa	602,688	607,207	611,760	616,346	620,967	624,210	627,470	630,747	634,041	637,352
Parañaque	808,894	816,093	823,357	830,685	838,078	843,568	849,093	854,655	860,253	865,888
Pasay City	380,735	380,732	380,730	380,729	380,728	380,727	380,726	380,726	380,726	380,726
CAVITE	**1,841,024**	**1,874,660**	**1,908,987**	**1,944,018**	**1,979,767**	**2,011,713**	**2,044,234**	**2,077,341**	**2,111,045**	**2,145,355**
Bacoor	903,169	921,066	939,317	957,930	976,912	993,847	1,011,075	1,028,601	1,046,432	1,064,571
Cavite City	97,559	97,558	97,557	97,557	97,557	97,556	97,556	97,556	97,556	97,556
Imus	556,529	569,044	581,841	594,925	608,303	620,405	632,748	645,336	658,175	671,269
Kawit	126,287	128,370	130,488	132,641	134,830	136,699	138,595	140,516	142,464	144,440
Noveleta	67,868	69,010	70,172	71,354	72,555	73,596	74,651	75,722	76,808	77,909
Rosario	89,612	89,611	89,611	89,611	89,610	89,610	89,610	89,610	89,610	89,610

Source: Maynilad

Table 1.6.2 Annual Population Growth

City/Municipality (West Zone)	Annual Growth Rate 1990-1995	1995-2000	2000-2007	2007-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040
Overall	4.06%	1.28%	2.32%	1.27%	1.05%	1.05%	0.92%	0.77%	0.62%	0.47%
NCR	3.73%	1.08%	2.12%	0.91%	0.88%	0.83%	0.69%	0.53%	0.38%	0.22%
Manila	0.66%	-0.98%	0.76%	-0.14%	-0.08%	-0.02%	0.00%	0.00%	0.00%	0.00%
Quezon City	3.57%	3.01%	3.48%	1.16%	1.32%	1.11%	0.90%	0.68%	0.47%	0.25%
Caloocan	6.03%	2.85%	2.28%	2.60%	0.99%	0.97%	0.75%	0.56%	0.34%	0.15%
Malabon	4.41%	-0.50%	1.02%	-0.96%	-0.62%	-0.11%	-0.02%	0.00%	0.00%	0.00%
Navotas	4.09%	0.12%	0.90%	0.51%	1.16%	0.88%	0.67%	0.48%	0.27%	0.05%
Valenzuela	5.14%	2.12%	2.29%	0.38%	1.21%	0.91%	0.70%	0.51%	0.30%	0.09%
Las Piñas	6.81%	2.74%	1.71%	1.25%	1.51%	1.31%	1.09%	0.80%	0.58%	0.36%
Makati	1.33%	-2.75%	0.69%	-2.00%	-0.80%	-0.16%	-0.03%	-0.01%	0.00%	0.00%
Muntinlupa	7.51%	-1.05%	2.57%	0.51%	1.69%	1.39%	1.17%	0.97%	0.75%	0.52%
Parañaque	4.89%	2.83%	2.99%	2.09%	1.78%	1.66%	1.42%	1.12%	0.89%	0.66%
Pasay City	2.10%	-2.78%	1.85%	-0.89%	-0.41%	-0.08%	-0.02%	0.00%	0.00%	0.00%
CAVITE	7.60%	3.13%	3.96%	4.01%	2.22%	2.39%	2.25%	2.04%	1.83%	1.62%
Bacoor	9.45%	4.04%	5.38%	5.65%	2.60%	2.73%	2.51%	2.23%	1.98%	1.73%
Cavite City	0.22%	1.41%	0.73%	-1.12%	-0.46%	-0.09%	-0.02%	0.00%	0.00%	0.00%
Imus	14.00%	1.96%	3.76%	6.01%	2.87%	3.03%	2.80%	2.51%	2.25%	1.99%
Kawit	3.60%	1.94%	2.85%	0.78%	2.85%	2.37%	2.16%	1.89%	1.65%	1.39%
Noveleta	6.00%	3.20%	3.00%	1.98%	2.74%	2.41%	2.20%	1.93%	1.68%	1.43%
Rosario	3.56%	6.37%	3.58%	-0.70%	-0.39%	-0.08%	-0.02%	0.00%	0.00%	0.00%

1.7 Social, Environmental, and Economic Conditions in West Metro Manila

1.7.1 Economic and Political Conditions

(1) Economic Conditions

According to the International Monetary Fund (IMF), the gross domestic product (GDP) of the Philippines was USD 272 billion in 2013. GDP per capita was USD 2,790 which is less than about 25% of the world average.

Fundamentally, the Philippines is an agricultural nation like other emerging nations in Southeast Asia and about 40% of the total population is engaged in the primary industry. Since it is located in the subtropical region, it is possible to grow various kinds of crops, especially the production of sugarcanes, coconuts, copra, Manila hemp, tobacco (mainly for cigars), and bananas.

There are many overseas Filipino workers around the world and the Philippines has been considered as an exporter of labor force since the Marcos regime in the 1960s. Now, the total amount of overseas remittance from overseas Filipino workers exceeds the direct investment bringing valuable foreign currencies to the country but causes the entire economy depends too much on overseas work.

The recent economic growth rates are 7.3% for 2007, 4.6% for 2008, 0.9% for 2009, 7.6% for 2010, and 3.7% for 2011 (IMF data), except for the drop in 2009 due to the collapse of Lehman Brothers, the growth has been relatively stable. Compared with the time from the 1980s to the early 90s, the economy has greatly recovered.

Manila economy is quite diverse covering various fields. The city has an excellent port, the port of Manila, which functions as an ocean gateway in the Philippines. As for the manufacturing industry, chemical products, textile fabrics, clothes, and electronic devices are produced. In addition, products like food, drinks, and tobacco are also being made.

The influence of hacienda system (plantation), under which some privileged class monopolized the economy during the colonial and dictatorship period still remains; and the industries in Metro Manila are dominated by some family-run conglomerates. San Miguel Corporation, which is the parent of San Miguel Brewery Inc.; Ayala Corporation, which has been successful in real estate development; and the Araneta Family and Ortigas Family who diversified its business from sugar plantation to real estate development, are famous.

(2) Political Conditions

A city or municipality consists of several barangays. A barangay is considered to be the smallest administrative unit in the Philippines. The locality, like a city or a town, is called as LGU, and the Department of Interior and Local Government (DILG) has the jurisdiction over the LGUs.

1.7.2 General Social and Environmental Conditions

Compared with other Southeast Asian nations, the population is rapidly increasing and concentrated in urban areas. Currently, the country is facing serious environmental problems such as air pollution especially in Metro Manila; water pollution of the rivers, lakes, and marshes in urban areas; increase of waste discharge; environmental pollution associated with disposal of waste; and advancement of destruction of nature; thus there is an urgent matter to solve these problems.

On the other hand, the water quality in farm and mountain villages has deteriorated due to discharge from a wide range of sources such as agricultural chemicals, chemical fertilizers, mining wastewater, and deforestation. Sea pollution has rapidly got worse over the past decade caused by discharge of wastewater, industrial effluent, mining wastewater, fuel spillage from ship operation, deforestation, and runoff of soil from farmlands.

In order to prevent water pollution in the rivers, lakes, marshes, and oceans, and improve the water quality, it is very important to reinforce the effluent standard and ensure that corporations in the areas strictly observe the effluent standard and regulations. Environment-related laws have been developed again by legislating at the Congress and a lot of bills have been submitted and examined since 1992. Some of them are equivalent to new environmental basic law; however, they have not been passed yet since representatives who regard development and economic growth as important are the majority group compared with those who promotes importance of environmental conservation.

1.8 Relevant Laws, Regulations, Public Plan, and Standard

1.8.1 Laws

(1) Environmental Laws Related to the Project

The environmental laws related to the Project are referred to in Chapter 7.

1.8.2 Regulations

(1) Environmental Regulations Related to the Project

The environmental regulations related to the Project are referred to in Chapter 7.

(2) Ongoing Water Sector Infrastructure Projects by DPWH

In the three target LGUs, the following infrastructure projects in water sector are being constructed by DPWH.

Table 1.8.1 Ongoing Projects in Water Sector by DPWH

Project Outline	Project Cost (Php '000)	Schedule	Status
Las Piñas City			
Improvement/Clearing and Desilting of the Zapote River (Phase II)	44,245	Start Date: 8/6/2015 Target Completion: 3/2/2016	2%
Construction of Slope Protection at Kay Almirante Creek, Brgy. Talon 2, Las Piñas City	17,486	Start Date: 4/29/2015 Target Completion: 8/31/2015	52%
Zapote River Drive Project: Improvements Leading to the River Drive in Brgy. Pamplona and Talon	10,504	Start Date: 9/18/2015 Target Completion: 3/30/2016	98%
Flood Control Projects based on the Flood Management Master Plan for Metro Manila and Surrounding Areas - Improvement/Clearing and Desilting including Right of Way (ROW) of the Zapote River from Alido Bridge towards Manila Bay, Zapote, Las Piñas City	43,675	Start Date: 6/9/2014 Target Completion: 12/20/2014	80%
Flood Control Projects based on the Flood Management Master Plan for Metro Manila and Surrounding Areas - Improvement/Clearing and Desilting including ROW of the Las Piñas River, Quirino Avenue towards Manila Bay, Zapote, Las Piñas City	43,402	Start Date: 6/9/2014 Target Completion: 12/20/2014	82%
Imus City			
Revetment along the Imus River, Brgy. Manggahan, Kawit, Cavite	36,021	Start Date: 8/25/2015 Target Completion: 5/20/2016	92%
West River Bank Stabilization Project along the Imus River (Phase III), Cavite	18,032	Start Date: 7/5/2015 Target Completion: 5/29/2016	88%
Rehabilitation/Improvement of Drainage System, Malagasang Section, Cavite 3rd LD - Rehabilitation/Improvement of Drainage System, Imus River, Malagasang Section, Cavite 3rd Phase II (West Side)	13,524	Start Date: 9/8/2015 Target Completion: 5/5/2016	23%
Rehabilitation/Improvement of Drainage System along Daang Hari Road, Imus Section, Cavite	45,631	Start Date: 8/2/2014 Target Completion: 5/27/2016	91%
Rehabilitation/Improvement of Drainage System, Malagasang Section, Cavite 3rd LD - Rehabilitation/Improvement of Drainage System, Imus River, Malagasang Section, Cavite 3rd Phase I (East Side)	13,524	Start Date: 5/15/2014 Target Completion: 5/7/2016	43%
Widening of Malagasang including ROW and Drainage System	14,165	Start Date: 3/1/2013 Target Completion: 5/29/2016	93%
Kawit Municipality			
Construction/Rehabilitation of Flood Control Structure in Brgy. San Sebastian, Kawit, Cavite	23,397	Start Date: 9/19/2015 Target Completion: 5/15/2016	90%
Construction of the San Juan River, including ROW Acquisition, (Phase 17) Brgy. Marulas, Kaingan, Poblacion Wakas, Kawit, Cavite	18,581	Start Date: 4/7/2015 Target Completion: 5/28/2016	77%
Construction of Flood Control Projects, Cavite 1st LD - Construction of Flood Control in San Juan River, Brgy. Marulas, Kaingen, Poblacion	12,575	Start Date: 2/8/2014 Target Completion: 5/6/2016	95%

Note: as of April 30, 2016
Source: Department of Public Works and Highways (DPWH)

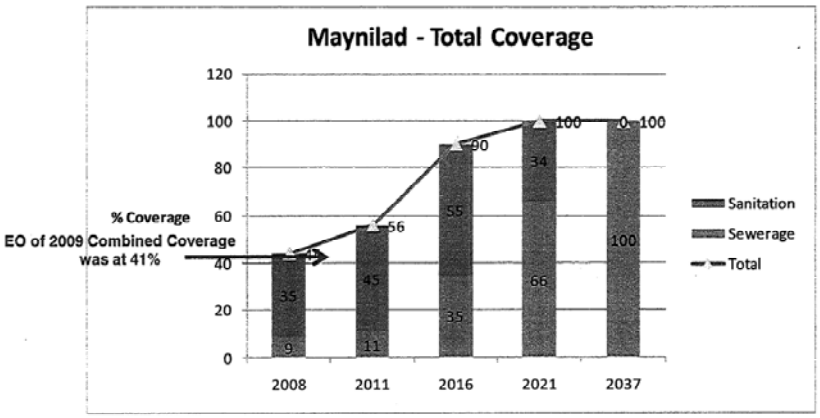
1.8.3 Master Plan

(1) Maynilad Sewerage and Sanitation Master Plan (Revised, January 2010)

In compliance with the Concession Agreement (CA) and the Transitional and Clarificatory Agreement (TCA), Maynilad submitted to the Regulatory Office (RO) several business plans as part of the requirements during the rate rebasing exercise conducted in 2008. The September 2008 Business Plan (Business Plan) was further refined and finally approved on December 12, 2008.

The Business Plan, prepared under the direction of the new sponsor (DMCI-MPIC), sets forth the substantial level of service improvements in the entire concession to eventually catch-up with the water and sewerage coverage targets by 2016 and the corresponding investments that Maynilad will pursue during the second rate rebasing period 2008-2012. This plan carefully struck a balance between the need to further increase its level of service while taking into account Maynilad's financial viability through increased investments, affordable tariff adjustments, and optimum financing scheme.

Maynilad is currently updating the plan as Business Plan 2018. (Details are described in Chapter 6.)



Source: Maynilad Sewerage and Sanitation Master Plan (Revised, January 2010)

Figure 1.8.1 Maynilad Sewerage and Sanitation Master Plan (Revised, January 2010)

However, as mentioned in Section 1.2, the actual coverage ratio in 2015 is still 13% compared with the planned ratio of 35% in the revised master plan.

1.8.4 Standard

(1) Design/Planning/Construction Guideline for Sewerage Facilities

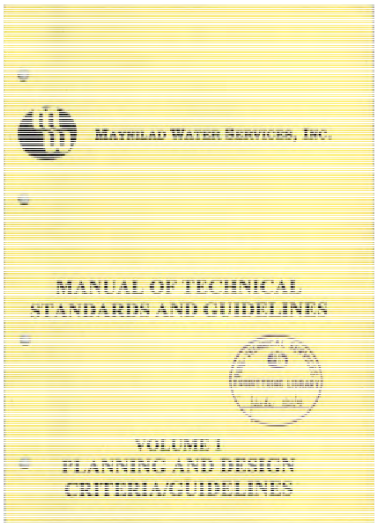
1) Existing Standard

Maynilad prepared its own guideline as shown in Figure 1.8.2 and was supposed to proceed with its planning in accordance with the guideline; however, the details are not described and the technologies used are outdated, so the application (operation) seems to be limited.

2) New Standard

Accordingly, Maynilad has created a new and more practical guidelines for sewerage treatment improvement (plan and design including standard drawings, bidding (consultants and construction companies), technical specifications, execution of works, operation and management) since 2015 through 2016 and planned to be put into practice from 2018.

The new sewerage guidelines of Maynilad are expected to include advanced technologies, which are not described in the existing guideline. Maynilad explains that the technologies which are not mentioned in the new guidelines will not be adopted in principle. The list of Maynilad's new sewerage guideline is shown in Table 1.8.2



Source：Maynilad

Figure 1.8.2 Existing Maynilad Sewerage Construction Guideline

Table 1.8.2 List of Maynilad's New Sewerage Guidelines

VOLUME	DESCRIPTION
1	Guidelines and Standards for the Design of STP
2	Guidelines and Standards for the Commissioning and Testing of STP
3	Guidelines and Standards for the Design of Conveyance System
4	Guidelines and Standards for the Commissioning and Testing of Conveyance System
5	Performance Specifications for the Design of STP
6	Performance Specifications for the Design of Conveyance System
7	Standard Drawings for STP
8	Standard Drawings for Conveyance System
9	Technical Specifications for STP and Conveyance System
10	Standard Terms of Reference for STP and Conveyance System Projects

Source: Maynilad

(2) Water Quality Standard

The Water Quality Criteria (DAO No. 34) and the Effluent Standards (DAO No. 35) were revised and issued in 1990. In March 2010, DENR issued an order which stated that effluent into the Manila Bay should be categorized as Class SB under the category of protected water bodies,

instead of Class SC under the category of usual coastal waters. Under the regulation, the effluent water quality in the survey area should be complied with Class SB.

In addition, the new effluent standards, DAO 2016-08 in Table 1.8.3, was issued on 24th May 2016 and applied on 14th June 2016. Therefore, all new sewage treatment facilities should meet the new requirements. The value of nitrogen should be less than 20 mg/L and phosphorus should be less than 1.0 mg/L in Class SB.

Table 1.8.3 Effluent Quality Standards for Each Category (DAO 2016-08)

Parameter	Unit	Water Body Classification								
		AA	A	B	C	D	SA	SB	SC	SD
Ammonia as NH_3-N	mg/L	NDA	0.5	0.5	0.5	7.5	NDA	0.5	0.5	7.5
BOD	mg/L	NDA	20	30	50	120	NDA	30	100	150
Boron	mg/L	NDA	2	2	3	12	NDA	2	20	80
Chloride	mg/L	NDA	350	350	450	500	NDA	n/a	n/a	n/a
COD	mg/L	NDA	60	60	100	200	NDA	60	200	300
Color	TCU	NDA	100	100	150	300	NDA	100	150	300
Cyanide as Free Cyanide	mg/L	NDA	0.14	0.14	0.2	0.4	NDA	0.04	0.2	0.4
Fluoride	mg/L	NDA	2	2	2	4	NDA	3	3	6
Nitrate as NO_3-N	mg/L	NDA	14	14	14	30	NDA	20	20	30
pH (Range)		NDA	6.0-9.0	6.0-9.0	6.0-9.5	5.5-9.5	NDA	6.5-9.0	6.0-9.0	5.5-9.5
Phosphate	mg/L	NDA	1	1	1	10	NDA	1	1	10
Selenium	mg/L	NDA	0.02	0.02	0.04	0.08	NDA	0.02	0.2	0.4
Sulfate	mg/L	NDA	500	500	550	1,000	NDA	500	550	1,000
Surfactants (MBAS)	mg/L	NDA	2	3	15	30	NDA	3	15	30
Temperature(h)	°C change	NDA	3	3	3	3	NDA	3	3	3
Total Suspended Solids	mg/L	NDA	70	85	100	150	NDA	70	100	150
Arsenic	mg/L	NDA	0.02	0.02	0.04	0.08	NDA	0.02	0.04	0.08
Barium	mg/L	NDA	1.5	1.5	6	8	NDA	1.5	2	8
Cadmium	mg/L	NDA	0.006	0.006	0.01	0.02	NDA	0.006	0.01	0.02
Chromium as Hexavalent Chromium (Cr^{6+})	mg/L	NDA	0.02	0.02	0.02	0.04	NDA	0.1	0.1	0.2

Source: Department of Environment and Natural Resources (DENR) Water Quality Guideline and General Effluent Standards of 2016

The effluent standard in the new sewerage guidelines of Maynilad will cover the condition above.

Influent and effluent water quality standards specified in the new guidelines are shown in Table 1.8.4 and Table 1.8.5, respectively.

Table 1.8.4 Influent Standard in the Maynilad New Sewerage Guidelines

Parameter	Units	Minimum Values	Maximum Values
BOD_5	mg/L	70	240
TSS	mg/L	70	210
COD	mg/L	140	470
Oil and Grease	mg/L	20	60
Total Coliform	MPN per 100 mL	$10x10^7$	$50x10^8$
TP	mg/L	3.7	8
TN	mg/l	34.6	46
pH			6-9
Temperature	°C	25	29
NO3	mg/L	0.1	2.7
NH4	mg/L	41.3	45

** - BOD_5 shall include dissolved and suspended pollutants taken at 20°C.*
Source: Maynilad

Table 1.8.5 Effluent Standard in the Maynilad New Guidelines

Parameter	Unit	Parameter Maximum Value
TSS	mg/L	30
BOD_5 at 20°C *(dissolved and suspended)*	mg/L	30
COD	mg/L	60
Oil and Grease	mg/L	5
pH	-	6.5 – 9.0
Total coliform	MPN per 100 mL	10,000
Sludge	%DS	Not less than 20% dry solids
*NO_3	mg/L	14
*NH_3-N	mg/L	0.5
*Phosphate	mg/L	1

Source: Maynilad

(3) Applicable Treatment Technologies Specified in the Maynilad New Guidelines

In the new guidelines, secondary treatment is through aerobic biological process. The following treatment processes are considered equally acceptable if design and installation consistently meet the requirements, especially the effluent quality standard:

1) Activated Sludge Process (ASP)

2) Sequencing Batch Reactor (SBR)

3) Moving Bed Biofilm Reactor (MBBR)

4) Membrane Bio Reactor (MBR)

5) Fixed-bed Biofilm Activated Sludge (FBAS)

The treatment processes, which will be applied for the case study of sewerage system in this Survey, are selected in Chapter 5.

CHAPTER 2 Institutional Aspects Related to the Water Business Operations

2.1 Profile of the Concessionaire in West Metro Manila

Two consortiums for water and sewerage service were established under the concession scheme in 1997. The one is Maynilad in the West Zone, and the other one is Manila Water for the East Zone.

After the start of the operation, the management of Maynilad was changed to a new consortium, which comprised two domestic companies in 2007, through a dispute with the Metropolitan Waterworks and Sewerage System (MWSS) over the rate setting and other contract matters. Table 2.1.1 shows the profile of Maynilad as of 2015.

Table 2.1.1 Profile of Maynilad

	Maynilad Area (West Zone)	
1. Profile		
Name	Maynilad Water Service, Inc. (MWSI)	
Shareholders	- Metro-Pacific Investment Corporation (MPIC) 5.19%	
	- Maynilad Water Holding Comparny (MWHCI) 92.85% (MPIC 51.27%, DMCI Holdings Inc. 27.19%, Marubeni Corporation 21.54%)	
	– Employeer Stock Option Plan (ESOP) 1.96%	
2. Service Area	(17 cities and municipalities)	
Service Area	540	km^2
Population in Service Area	9,500	1,000 persons
3. Financial Status		
Assets	81,353	million PhP
Operating Revenue	19,098	million PhP
Costs and Expenses	7,245	million PhP
Net Income	9,551	million PhP
4. Service Status		
Served Population	8.4	million persons
Service Connection	1,265,625	nos
Average Billed Volume	1,319	1,000 m^3/day
Water Supply Coverage Ratio	93.7	%
Sewerage Coverage Ratio	14.1	%

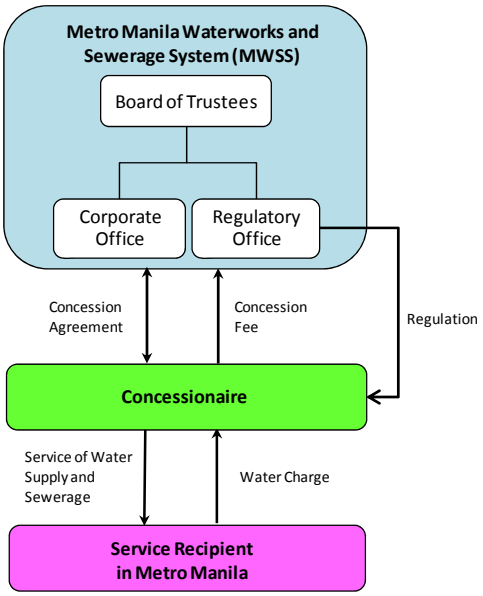
Source: Maynilad Annual Report and Website

2.2 Outline of the Concession Agreement

2.2.1 Structure of Operation

Figure 2.2.1 illustrates the structure of the general framework of the water business operation under the Concession Agreement (CA) between MWSS and Maynilad signed on 21 February 1997. According to the CA, Maynilad provides water services including water supply and sewerage to the service area, and collects water charge from the customers. Maynilad shall pay the concession fees to MWSS.

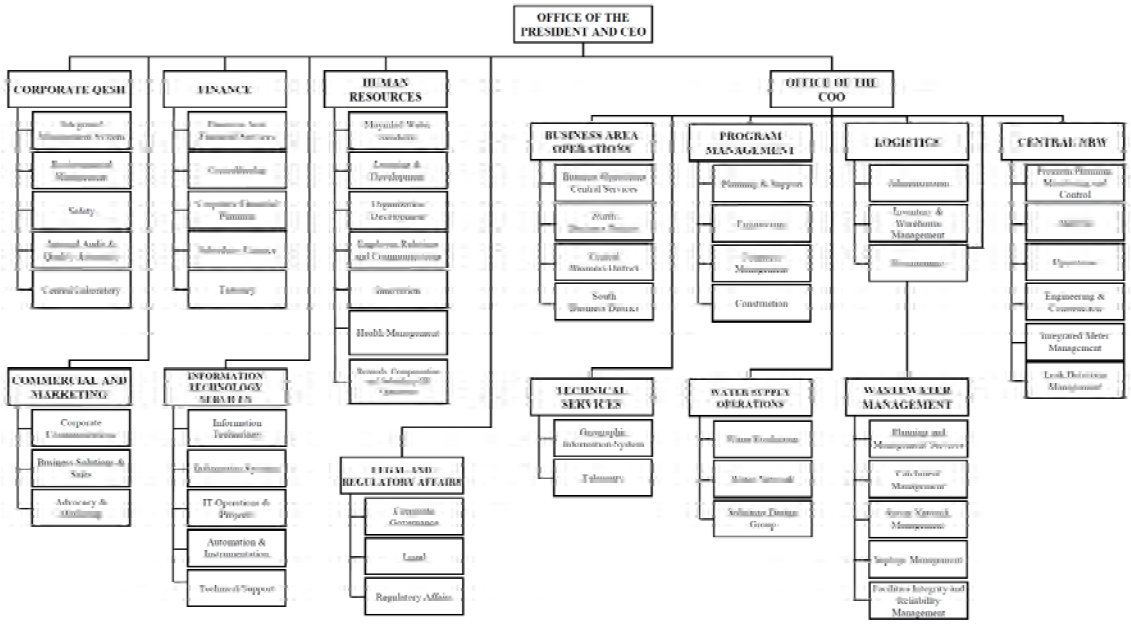
As shown in the figure, the Regulatory Office of the MWSS shall act as the regulator to monitor and ensure the compliance of the two concessionaires. While the Corporate Office of MWSS has the operational responsibilities including the management and operation of assets retained in MWSS such as the raw water transmission system.



Source: JICA Study Team

Figure 2.2.1 Structural Framework of the Water Business Operation under the Concession Agreement

The organizational chart, as of date, is shown in Figure 2.2.2.



Source: Maynilad

Figure 2.2.2 Organizational Chart of Maynilad

2.2.2 Major Arrangements in the Agreement

The CA stipulates the following: a) services to be provided by Maynilad; b) service obligations that should be met by Maynilad; and c) the respective responsibilities of MWSS and Maynilad. Main arrangements are stated as follows:

(1) Term of the Concession Agreement (CA)

Maynilad has been awarded the concession to provide service for 25 years starting from 1 August 1997 to 6 May 2022. Thereafter, the term of the concession was extended for an additional 15 years in 2010.

(2) Rights and Obligations of Maynilad

Under the CA, Maynilad was granted the following rights and obligations: i) to make sufficient connections to meet the target service coverage ratio of the population at the time of the target year; ii) to ensure the availability of an uninterrupted 24-hour supply of water to all connected customers in the service area; iii) to ensure supply of water at a level of positive pressure sufficient to secure the system against the ingress of untreated water and other contaminations; iv) to ensure that the water supplied complies with the Philippine National Standard for Drinking Water (PNSDW); v) to offer sewerage services to all customers in the service area, and provide connections to a public sewer; vi) to comply with all national and local environmental laws and standards related to sewage treatment; and vii) to offer septic and sanitation cleaning services. In addition, the CA stipulates the target obligation values for key service level indicators of service coverage of water and sewerage services, ratio of 24-hour service area, and ratio of over-7-psi (16-psi after 2016) water pressure area.

(3) Concession Fee

In consideration for the grant of concession, Maynilad shall pay MWSS a concession fee. If the concession fee is not paid on time, the US dollar equivalent of such unpaid amount may be drawn under the performance bond. In addition, the unpaid amount shall be subject to penalties or default interest.

(4) Rate Adjustment

Maynilad is authorized to charge the customers a standard rate, which is also stipulated in the CA for water and sewerage services. Water and sanitation tariffs are explained in Section 2.3.

(5) Water Sources

Under the CA, MWSS likewise assigned, in favor of Maynilad, its water rights under the existing

water permits, as well as further water permits to be issued to MWSS. In addition, Maynilad is entitled to receive 60% of the water allocated to MWSS from the Angat Reservoir.

(6) Penalties

Failure of Maynilad to meet the service obligations entitles MWSS to assess the penalties such as 25% of the costs, which Maynilad will incur in order to meet the service obligations.

2.3 Water and Sanitation Tariff

2.3.1 Present Water and Sanitation Tariff and Historical Trend

(1) Present Water and Sanitation Tariff

The water and sanitation tariff rates in Maynilad service area, as of May 2016, are summarized in Table 2.3.1.

Table 2.3.1 Maynilad's Water and Sanitation Rates (as of May 2016)

User Category		Residential	Semi-Business	Business Group I	Business Group II
1. Water Charge					
A. Basic Charge	**Less than 10 m^3** (PHP/month)	**84.70**	-	-	-
	First 10 m^3 (PHP/month)	144.37	144.37	656.07	709.91
	10 - 20 m^3 (PHP/m^3)	17.63	29.58	65.92	71.45
	20 - 40 m^3 (PHP/m^3)	33.52	36.46		
	40 - 100 m^3 (PHP/m^3)	44.02 - 53.77	46.23 - 56.26		
	100 - 200 m^3 (PHP/m^3)	56.23 - 58.74	58.74 - 61.22	66.10	71.90
	more than 200 m^3 (PHP/m^3)	61.22	63.62	66.30 - 73.41	72.46 - 86.62
B. Foreign Currency Differential Adjustment (FCDA)		**0.21% of A. Basic Charge (1st quarter of 2016)**			
2. Environmental and Sewerage Charges					
A. Environmental Charge		**20% of Charge 1**			
B. Sewerage Charge		None		**20% of Charge 1 (only for connected users)**	
3. Maintenance Service Charge		**1.5 - 50 PHP/month based on meter size**			
4. Value Added Tax (VAT)		**12% of Charges 1, 2, 3.**			

Source: Maynilad

The payment of users is mainly composed of water charge, environmental and sewerage charge, maintenance service charge, and value-added tax (VAT). The users are categorized into four types, namely: residential, semi-business, commercial, and industrial users, as determined in the CA.

The water charge rate is set higher for high consumption users to incentivize users to reduce water use. This system is called "progressive charging system", and popularly adopted for the calculation of water tariff in the world. In order to alleviate the burden of poor families, the tariff of residential users who consumes less than 10 m^3 per month, are charged at PHP 84.70 only, which is approximately 41% less than the basic rate at PHP 144.37. The users in Business I and II categories are charged approximately two to three times higher than the residential and

semi-business users in the consumption range of 10-40 m^3 per month.

The sewerage and environmental charges are calculated by multiplying the fixed rate against water charge. The environmental charge, set at 20% of water charge, is added on the whole users. Sewerage charge, also fixed at 20% of water charge, is levied on the users in Business I and II categories with sewerage pipe connections only.

The outline of water and sewerage charge in 2015 per user category and per charge type is summarized in the following Table 2.3.2, Figures 2.3.1 and 2.3.2 below.

Table 2.3.2 Billed Volume and Collected Revenue per User Category in 2015

User Category	Billed Volume		Revenue	
	Thousand m^3	%	PHP in millions	%
Residential	350,949	73	9,270	50
Semi-business	36,984	8	1,293	7
Commercial	71,616	15	5,907	32
Industrial	21,985	5	1,967	11
Total	481,533	100	18,436	100

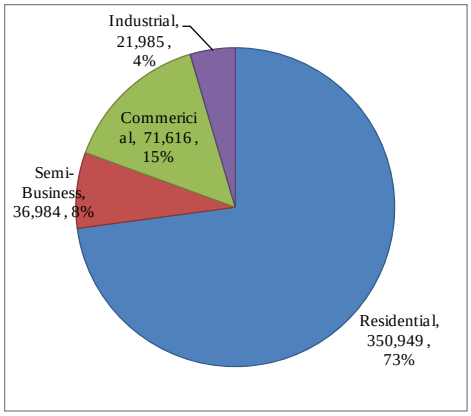


Figure 2.3.1 Billed Volume per User Category in 2015 (Thousand m^3)

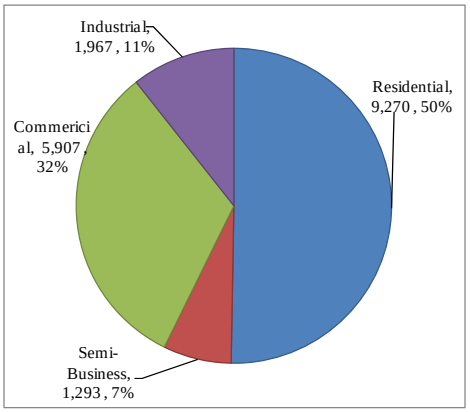


Figure 2.3.2 Collected Revenue per User Category in 2015 (PHP in millions)

Source: JICA Study Team based on Maynilad data

The residential users took the majority of whole consumption at 73% of the whole billed volume of 482 million m^3 in 2015. Whereas, the revenue collected from residential users composed only 50% of the whole revenue in 2015 at PHP 18.4 billion. It implies the significant amount of cross subsidy provided from commercial and industrial users. It was relived from the lower tariff charge on small consumption residential users and imposed higher tariff rate on commercial and industrial users.

Table 2.3.3 Collected Revenue per Charge Type in 2015

User Category	Revenue	
	PHP in millions	Share in %
Water Charge	15,059	82
Environmental Charge	3,071	17
Sewer Charge	306	2
Total	18,436	100

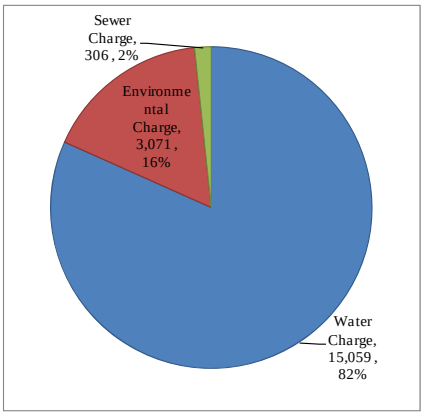


Figure 2.3.3 Billed Volume per Charge Type in 2015 (PHP in millions)

Source: JICA Study Team based on Maynilad data

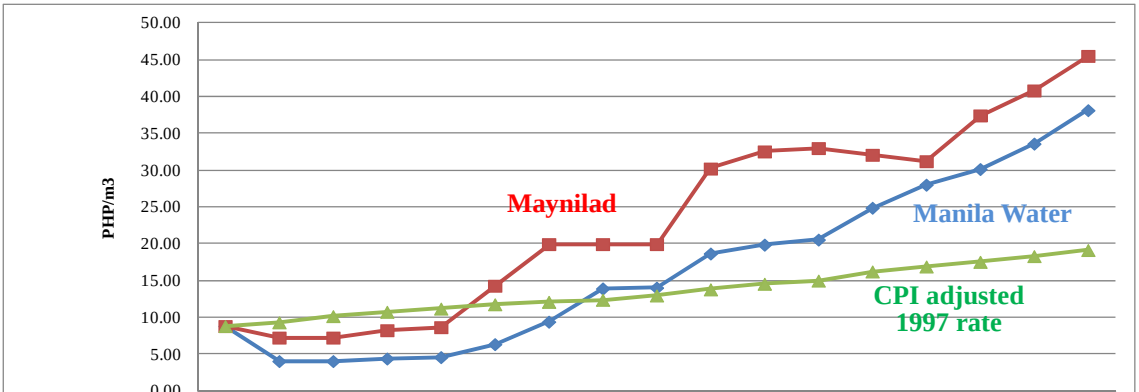
From the view of charge type, water charge, environmental charge, and sewer charge take the share of 82%, 16%, and 2% of whole revenue in 2015, respectively. The revenue amount of sewer charge was limited to PHP 306 million in 2015 as it was collected from business entities with sewer connections.

(2) Past Trend of Water Tariff

The past trend of water tariff level of two concessionaires is summarized in Figure 2.3.4. This tariff level includes water charge, environmental charge, maintenance service charge, and VAT, but excludes sewer charge. The latest data after 2013 is not officially published influenced by the arbitration implemented between MWSS and Maynilad for tariff setting. The rate of Maynilad is constantly higher than the one of Manila Water after the concession started in 1997.

The tariff rate was once reduced when the concession started in 1997 as the concession right was granted to the bidders who proposed the lowest tariff rate. However, the influence of the Asian financial crisis hit hard in 1997, and the financial condition of the two concessionaires worsened. After the long-term negotiation held between Maynilad and MWSS, Maynilad and its stakeholders entered into the debt and capital restructuring agreement (DCRA). MWSS-RO admitted the increase in tariff level so that the concessionaires' financial condition would be straightened up again.

The tariff rate in 1997 (PHP 8.78/m^3), which is adjusted by the annual price inflation, is indicated in the figure for comparison. The tariff rate of Maynilad exceeded the "adjusted tariff rate of 1997" after 2001, and the gap widened up to 238% in 2012.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Manila Water	8.78	4.02	4.02	4.37	4.55	6.32	9.37	13.88	14.00	18.64	19.84	20.53	24.86	27.99	30.12	33.57	38.12
Maynilad	8.78	7.21	7.21	8.22	8.62	14.26	19.92	19.92	19.92	30.19	32.51	32.96	32.05	31.19	37.40	40.80	45.5
CPI adjusted rate	8.78	9.27	10.12	10.72	11.15	11.74	12.06	12.34	12.93	13.77	14.53	14.95	16.19	16.87	17.51	18.28	19.12

Source: Annual Report and Financial Statements 2013, MWSS

Figure 2.3.4 Historical Trend of Average Unit Water Rate of Maynilad and Manila Water

2.3.2 Tariff Setting Mechanism of Water and Sewerage Services

Pursuant to the CA, tariff for water and sewerage tariff is adjusted through the following three methods presented in Table 2.3.4.

Table 2.3.4 Adopted Method for Tariff Rate Setting

Method	Frequency	Purpose
i) Rate rebasing	Every five years	As the concession period is quite long, the service plan and its tariff level is reviewed and updated every five years. Past service performance and future plan will be reviewed by MWSS.
ii) Rate adjustment	Every year	The tariff rate is automatically adjusted based on the consumer price index (CPI) provided by the National Statistics Office (NSO) to consider the price escalation. The impact of exchange rate is adjusted to alleviate the burden of Concessionaires after 2002.
iii) Extraordinary price adjustment	When needed	The impact of extraordinary case, which could not be controlled by concessionaires will be considered by this adjustment method. The special cases are defined in the CA.

Source: JICA Study Team based on interview to Maynilad

"i) Rate rebasing" is a process that determines the tariff level of water and sewerage services that allows the concessionaires to recover its operating cost, investment expenditures, and capital cost until the end of the concession. Basically, the full cost recovery for water and sewerage services of the concessionaires is ensured.

In terms of rate rebasing procedures, Maynilad submits documents such as the historical performance of the last five years, detailed business plan of the next five years, and updated

projection of the operating expense (OPEX) and capital expenditure (CAPEX) for the remaining concession period to MWSS. These past cash flow and future cash flow are accumulated and discounted by the appropriate discount rate (ADR)", which represents the general capital cost of water business. The tariff level is calculated to make the net present value (NPV) of the past and future cash flow (revenues and expenditures) at zero.

MWSS-RO reviews the entire document carefully and feedback their perception on the submitted business plan, revenue forecast, whole kind of expenditures, and rate of ADR. After the discussion and revision on their documents between Maynilad and MWSS, the tariff rate will be fixed for the next five years.

"ii) Rate adjustment" is implemented annually to adjust the influence of price escalation and exchange rate change.

"iii) Extraordinary price adjustment" is applied only in the circumstances listed in the CA such as changes regarding relevant laws and regulations.

2.3.3 Issues Related to Rate Rebasing in 2013

(1) History of Rate Rebasing Process of 2013

As of May 2016, the rate rebasing process to determine the tariff rate from 2013 to 2017 has not been terminated because of it entered into the arbitration process.

Firstly, Maynilad submitted the first edition of the "Business Plan 2013" to the MWSS-RO in March 2012. After Maynilad accepted the feedback from MWSS-RO and held several meetings, Maynilad submitted the second and third editions of their business plan in September 2012 and March 2013, respectively. The tariff adjustment amount proposed by Maynilad has been gradually reduced from an additional PHP 10.51 (first edition) to PHP 4.06 (third edition) per m^3 considering the opinion of MWSS-RO.

The outline of the business plans submitted by Maynilad and MWSS-RO is summarized in Table 2.3.5.

Table 2.3.5 Difference of Business Plan Provided by Maynilad and MWSS

Issuer of Business Plans	Maynilad (1st)	MWSS-RO	Maynilad (2nd)	Maynilad (3rd)
	March/2012	September/2012	September/2012	May/2013
Open Cash Position	- PHP 82.9 billion	- PHP 60.2 billion	- PHP 74.1 billion	- PHP 67.2 billion
ADR	8.95%	7.35%	7.89%	7.89%
Future CAPEX	PHP 269.5 billion	PHP 226.3 billion	PHP 269.5 billion	PHP 269.5 billion
Rate Adjustment	+ PHP 10.51/ m^3	- PHP 1.46/ m^3	+ PHP 8.58/ m^3	+ PHP 4.06/ m^3

Source: Annual Report and Financial Statements 2013, MWSS

Simultaneously, Manila Water, which operates the water and sewerage services in the east area of Metro Manila, was also undertaking the rate rebasing exercise with MWSS. The process of negotiation taken between Manila Water and MWSS-RO is shown in Table 2.3.6.

Table 2.3.6 Difference of Business Plan Provided by Manila Water and MWSS

Issuer of Business Plans	Manila Water (1st)	MWSS-RO	Manila Water (Arbitration)
	March/2012	September/2012	September/2013
Open Cash Position	- PHP 41.1 billion	- PHP 17.2 billion	- PHP 30.8 billion
ADR	8.95%	7.35%	7.89%
Future CAPEX	PHP 216.4 billion	PHP 112.1 billion	PHP 187.2 billion
Rate Adjustment	+ PHP 5.83/ m^3	- PHP 7.24/ m^3	+ PHP 3.60/ m^3

Source: Annual Report and Financial Statements 2013, MWSS

(2) Outline of Arbitrations related to Rate Rebasing of 2013

Both concessionaires, Maynilad and Manila Water, could not reach the agreement between MWSS-RO and they challenged the arbitration process pursuant to Article 12.4 of the CA.

The results of the two separate arbitrations were awarded in December 2014 and April 2015. The proposal of Maynilad was fully approved, but the tariff rate of Manila Water was reduced compared with the proposed rate.

Table 2.3.7 Results of the Arbitrations Conducted by Maynilad and Manila Water

	Maynilad	Manila Water
Starting Date	October 2013	September 2013
Awarded Date	December 2014	April 2015
Result	+ PHP 4.06/m^3 (As Maynilad requested)	OCP: PHP 28.1 CAPEX: PHP 199.6 billion ADR: 7.61% - PHP 2.77/ m^3
	Includes corporate income tax (CIT) in the expenditure	Excludes corporate income tax (CTI) from the expenditure

Source: Compiled by the JICA Study Team

In the CA, the "Arbitral Award" is defined to be “final and binding”, and the tariff rebasing should be implemented afterwards. The rate rebasing of Manila Water case was settled but MWSS further requested to Maynilad for reduction of the tariff rate because there was an inequity in the definition of the corporate income tax (CIT) in the calculation of rate rebasing between Maynilad and Manila Water. As a result of the Arbitral Award, the CIT of Maynilad was approved to be included in the expenditure, whereas, it was excluded from the expenditure in Manila Water case. This different definition makes the reduction of approximately PHP 3/m^3 for the Maynilad case.

Maynilad denied the rate reduction as it offends the rule of the CA, and submitted the Demand Letter to the Republic of the Philippines (through the Department of Finance (DOF)) to compensate the revenue losses that should have been collected from 2013 caused by the delay of rate rebasing in March 2015, pursuant to the CA and the Letter of Undertaking. In the same month, after the Government denied the payment, Maynilad served a Notice of Arbitration to enter into the new arbitration held in Singapore.

Referring to the responsible person of Maynilad, the arbitration hearings would be conducted and the Arbitral Award would be given in 2017. The final decision of rate rebasing could not be made before the judgment. Simultaneously, Maynilad is presently preparing the “Business Plan 2018”, which will be submitted in March 2017 to determine the tariff rate from 2018 to 2022.

CHAPTER 3 Sewerage System and Sanitation Service in West Manila and Survey Area

3.1 Outline of the Existing Sewerage System and Sanitation Service

3.1.1 Present and Future Sewerage and Sanitation Coverage Ratio

Present and future target service coverage for sewerage and sanitation services are presented in Table 3.1.1.

Only 14% of Maynilad's service area in 2015 is covered by sewerage service. This is not enough to create a suitable living environment with respect to the population and economic growth of Metro Manila.

Sanitation service is operated by using Maynilad's vacuum truck to remove sludge from septic tanks of households. The coverage ratio is calculated based on the number of households with sludge disposed from their septic tank within five years. In 2015, the present sanitation service coverage is at 33%, which is the accumulated serviced population since 2007 that disposed sludge using a vacuum truck against the water-served population.

Table 3.1.1 Target Coverage Ratio for Sewerage and Sanitation Services

Items	As of	Target Ratio in the Investment Plan			
	2015	2011	2016	2021	2037
Sewerage	14%	7%	27%	58%	100%
Sanitation	33%	48%	50%	80%	100%

Source: JICA Study Team

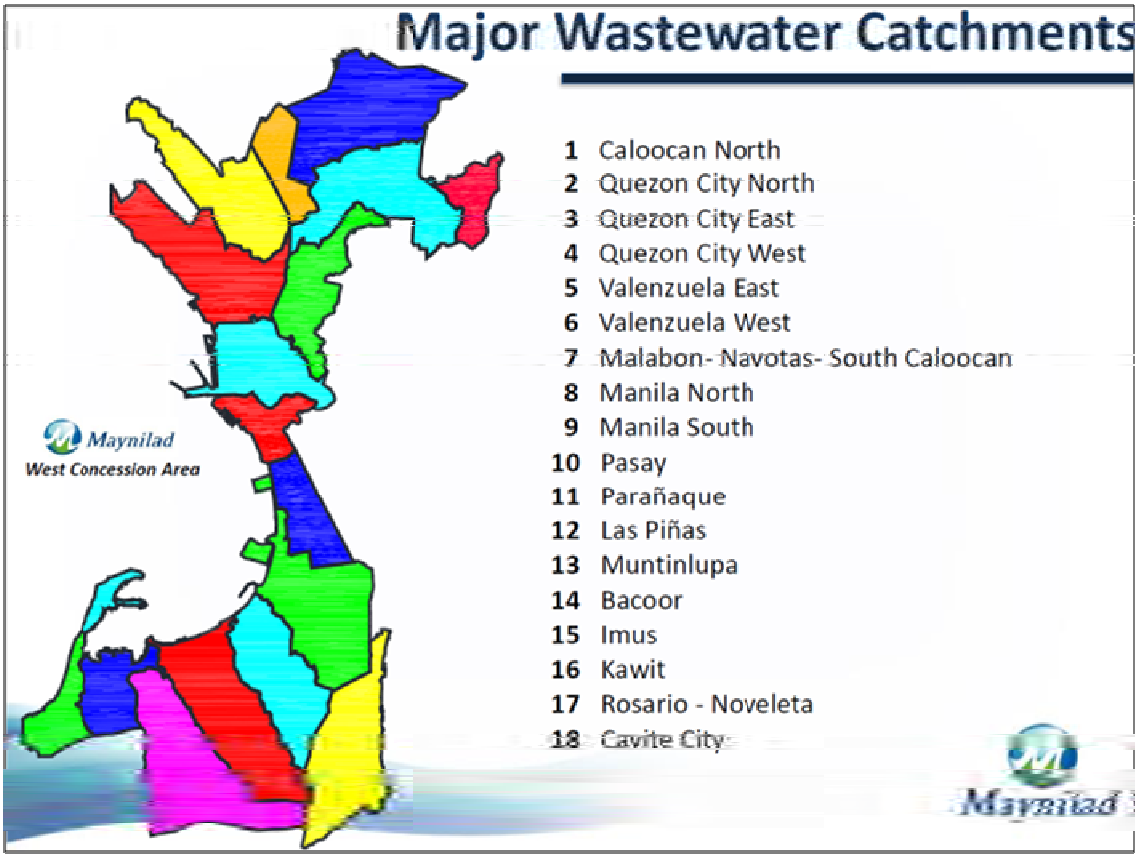
3.1.2 Existing Conditions of Sewerage and Sanitation Systems

(1) Existing Sewage Treatment Systems

The previous sewerage projects of Maynilad seemed to have applied separated sewer systems, but the implementation rate of separated systems is slow. Therefore, in order to provide maximum coverage quickly, interceptor sewer systems which can be utilized existing drainage have being applied by Maynilad. Also, in the catchment area shown in Figure 3.1.1, the sewerage projects of Maynilad are planned for small-scale treatment systems as shown in Table 3.1.2.

Overall, the sewage treatment process is well run with effluents exceeding the required standards of the Department of Environment and Natural Resources (DENR); with BOD_5 averaging at 6.2 mg/L for 2015. The most recent results in December 2015 showed a maximum BOD_5 of 8 mg/L, COD average at 22.3 mg/L, total suspended solids at 10.1 mg/L, oil and grease at 1.0 mg/L, and total coliforms at 681.7 MPN/100 mL (standard 10,000 MPN/100 mL). There is little or no odor

surrounding the plant with effluent standards meeting 100% of regulatory requirements at that time. Effluent data is attached in Appendix 2.



Source: Maynilad Wastewater Plan and Program, July 10, 2015

Figure 3.1.1 Existing Sewerage Catchment Basin

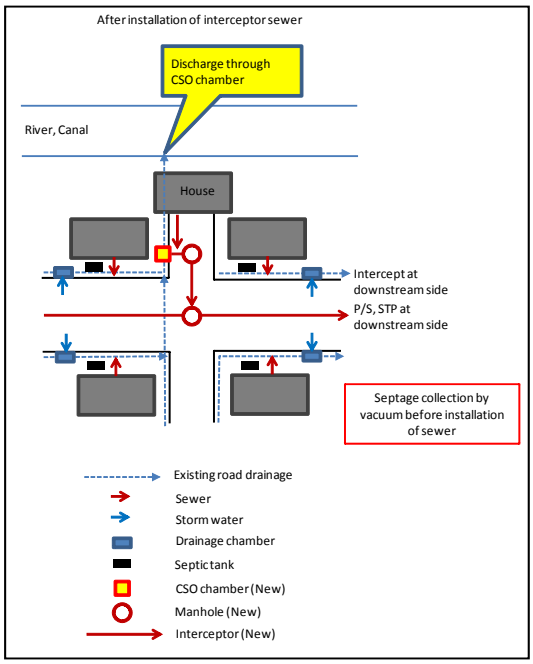
Table 3.1.2 Existing Sewerage System

Wastewater Facility (STP)	Technology	Design Capacity (CMD)	Date of Operation	Sludge Technology
Tondo Sewage Pumping Station	Grit Removal & Aeration System	432,000	1904/2005*	-
Paco STP	Moving Bed Bioreactor	410	2013	-
Dagat-dagatan STP	Waste Stabilization Pond	26,000	1981/2005*	-
Alabang STP	Conventional Activated Sludge	10,000	1983/2009 (turned over to MWSI)	-
Congressional	Sequencing Batch Reactor	567	2011	-
Legal	Sequencing Batch Reactor	409	2012	-
Grant	Sequencing Batch Reactor	621	2012	-
Baesa	STM Aerotor	390	2011	-
San Antonio	Moving Bed Bioreactor	3,310	2013	-
Del Monte	Moving Bed Bioreactor	3,510	2013	-
Paltok	Moving Bed Bioreactor	4,900	2013	Filter Press
Tandang Sora	STM Aerotor	1,200	2013	-
Bahay Toro	Conventional Activated Sludge	13,400	2014	Filter Press
Samson	STM Aerotor	1,900	2015	-
Tatalon	Sequencing Batch Reactor	8,100	2013	Belt Press
Bagbag	Sequencing Batch Reactor	10,400	2014	Belt Filter Press
Kapiligan	Moving Bed Bioreactor	6,000	2015	Belt Filter Press
Talayan	Conventional Activated Sludge	15,400	2015	Belt Press
Project 7 STp	Sequencing Batch Reactor	2,400	2013	-

Source: Maynilad

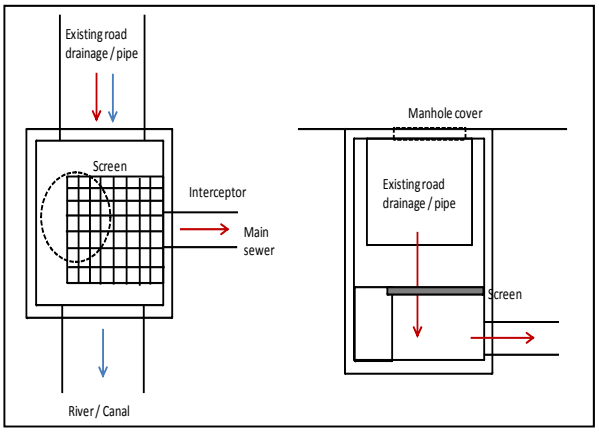
(2) Existing Wastewater Collection System

In West Metro Manila, a combined sewer system as shown in Figure 3.1.2 has been adopted for the area where the drainage structure exists. Unlike the combined system used in Japan, the system adopted in West Metro Manila intercepts only wastewater and discharge to a pump station or a wastewater treatment plant.



Source: JICA Study Team

Figure 3.1.2 Collection System



Source: JICA Study Team

Figure 3.1.3 Screen in CSO Chamber

Since the volume of the garbage flowing into sewers is very high in West Metro Manila, screen is installed to catch the garbage in the existing combined sewer overflow (CSO) as described in Figure 3.1.3. However, huge amount of garbage flows into the public water courses during rainy days and sewers are frequently clogged with garbage.

(3) Existing Sanitation Systems

Maynilad provides sanitation service to its customers who are not connected to the sewereage system. The sanitation service includes removal of accumulated sludge from septic tanks by vacuum trucks for a five-year period. Collected sludge of 120 m^3/day is transported to the existing Dagat-dagatan Septage Treatment Plant, which is located at the site of Dagat-dagatan Sewage Treatment Plant, 240m^3/day to Project 7 and another 120 m^3/day to South Septage Treatment Plant which is currently under the commissioning, shown in Figure 3.1.4.

Treatment process at the Dagat-dagatan Septage Treatment Plant and South Septage Treatment Plant shown in Figure 3.1.4 are accepting septage from the septic tanks of the residents which are transported by Maynilad's vacuum trucks with capacities of 4 m^3 and 10 m^3. The system consists of an acceptance unit to remove screenings and grit, equalization tanks, polymer dosing system, screw press dewatering units (complete with conveyor system), and gas/odor treatment system with a bio-filter (coconut fiber).

Figure 3.1.4 South Septage Treatment Plant

3.2 Current Development Plan of the Sewerage System and Sanitation Service

3.2.1 On-going Facility Plans for the Sewerage System by West Metro Manila

The ongoing projects, which were planned by Maynilad, are listed in Table 3.2.1.

Table 3.2.1 Ongoing Project, as of August 2016

No.	Name of Wastewater Treatment Plant	Wastewater Treatment Process	Design Capacity (CMD)
1	Pasay STP	CAS	46,000
2	Muntinlupa - Cupang	CAS	46,000
3	Muntinlupa - Tunasan	CAS	20,000
4	Paranaque	CAS	76,000
5	Valenzuela	CAS	60,000

Source: Maynilad

The Parañaque Sewage Treatment Plant (STP) is currently being constructed by a Japanese contractor under a 2-step-loan scheme.

Figure 3.2.1 Image of Parañaque STP

3.2.2 Future Sewerage and Sanitation Project in West Metro Manila

Table 3.2.2 shows the features of sewerage and sanitation facilities to be implemented in the future. Basic concepts for the sewerage and sanitation services to be implemented in the future are summarized below.

(1) Collection System

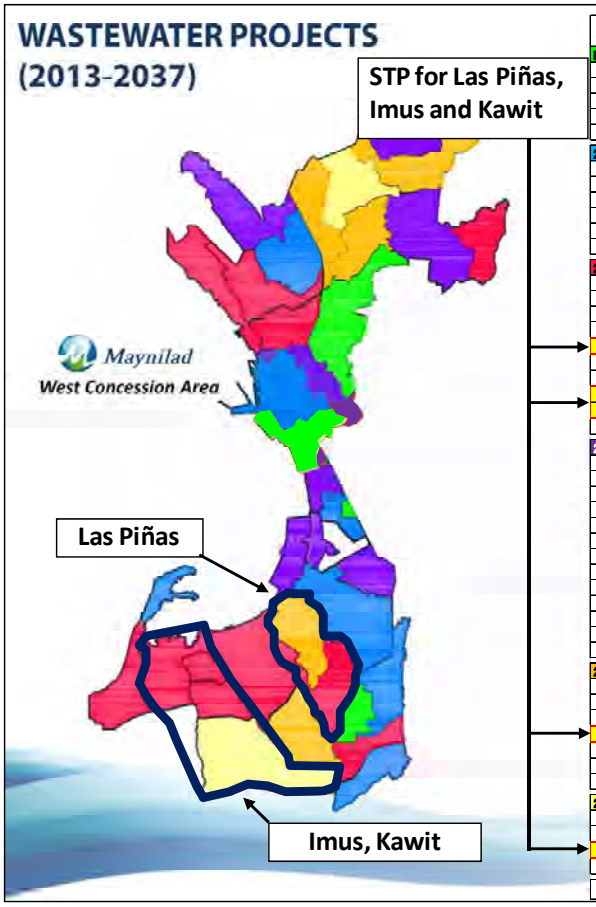
Future collection systems are planned as combined systems, which can save cost and shorten the construction period. In the planned system, newly installed interceptor will receive the sewage from the existing drainage being discharged to the river or sea. Intercepted sewage is transferred to sewage treatment facilities including the on-site treatment plants and community treatment plants with small-scale catchment areas.

(2) Pumping Station (P/S)

There are seven existing lift-up P/Ss in Central Manila. In the future, large-scale P/Ss and small-scale manhole pumps will be constructed in Valenzuela because of its undulating geographic condition. In addition, P/Ss and manhole pumps will be necessary in Pasay, Parañaque, and Cavite cities since they have flat and wide areas. In general, a large number of lift-up P/Ss will be necessary for a more centralized sewerage system in order to convey sewage in wide areas.

(3) Sewage Treatment Plant

A total of 53 sewage treatment facilities are planned by Maynilad as of March 2016 as shown in Figure 3.2.2. The 2009 Maynilad Water Services Inc. Master Plan (MWSI MP 2009) considered a larger number of treatment facilities, however, subsequent feasibility studies for specific projects have reviewed and modified the plans to reduce the number of plants as much as possible. This is to make the operation and maintenance (O&M) easier, and address the problem of limited land availability.



	WASTEWATER PROJECTS	No. of Treatment Facility	Capacity (MLD)
Existing		19	229
1	Central Manila Sewerage System	2	120
2	Dagat-Dagatan Sewerage System	1	26
3	Makati Isolated System		
4	Alabang Sewerage System	1	10
5	San Juan River Basin Project	15	73
2012-2016		7	289
6	Manila North, Stage 1-STP 1 (Upgrading of CMSS)	1	20
7	Valenzuela West, Stage 1	1	60
8	Pasay-Makati, Stage 1	1	46
9	Parañaque, Stage 1-STP 1	1	76
10	Muntinlupa, Stage 1 (Tunasan/Cupang)	2	66
11	Cavite City	1	21
2017-2022		7	572
12	Nav/Mal/Scal- Malabon	1	63
13	Nav/Mal/Scal- Navotas		49
14	Nav/Mal/Scal- South Caloocan		117
15	Quezon City East	1	58
16	**Las Piñas, Stage 1-STP 1**	**1**	**87**
17	Muntinlupa, Stage 1(Poblacion)		26
18	Bacoor, Stage 1	1	87
19	**Imus, Stage 1**	**1**	**38**
20	**Kawit**	**1**	**22**
21	Rosario- Noveleta	1	25
2023-2027		12	526
22	Manila North, Stage 2- STP 2	1	12
23	Manila North, Stage 2- STP 3		25
24	Manila North, Stage 2- STP 4	1	4
25	Manila North, Stage 2- STP 5	1	19
26	Manila North, Stage 2- STP 6	1	49
27	Manila North, Stage 2- STP 7	1	19
28	North Caloocan, Stage 1	1	112
29	Valenzuela West, Stage 2	1	11
30	Quezon City North, Stage 1	1	190
31	Pasay- Makati, Stage 2	1	51
32	Parañaque, Stage 2-STP 2	1	11
33	Parañaque, Stage 2-STP 3	1	20
34	Parañaque, Stage 2-STP 4	1	3
2028-2032		5	337
35	North Caloocan, Stage 2	1	61
36	Valenzuela East	1	50
37	Quezon City North, Stage 2	1	53
38	**Las Piñas, Stage 2-STP 2**	**1**	**25**
39	Bacoor, Stage 2	1	66
	Upgrading of QC West		17
	Upgrading of Pasay-Makati Stage 1		65
2033-2037		3	280
40	Manila South	1	131
41	North Caloocan, Stage 3	1	40
42	**Imus, Stage 2**	**1**	**56**
	Upgrading of Parañaque, Stage 1-STP 1		53
	TOTAL	53	2,233

Source: Maynilad

Figure 3.2.2 Process of Septage Treatment Plant (South Septage Treatment Plant)

(4) Septage Treatment Plant

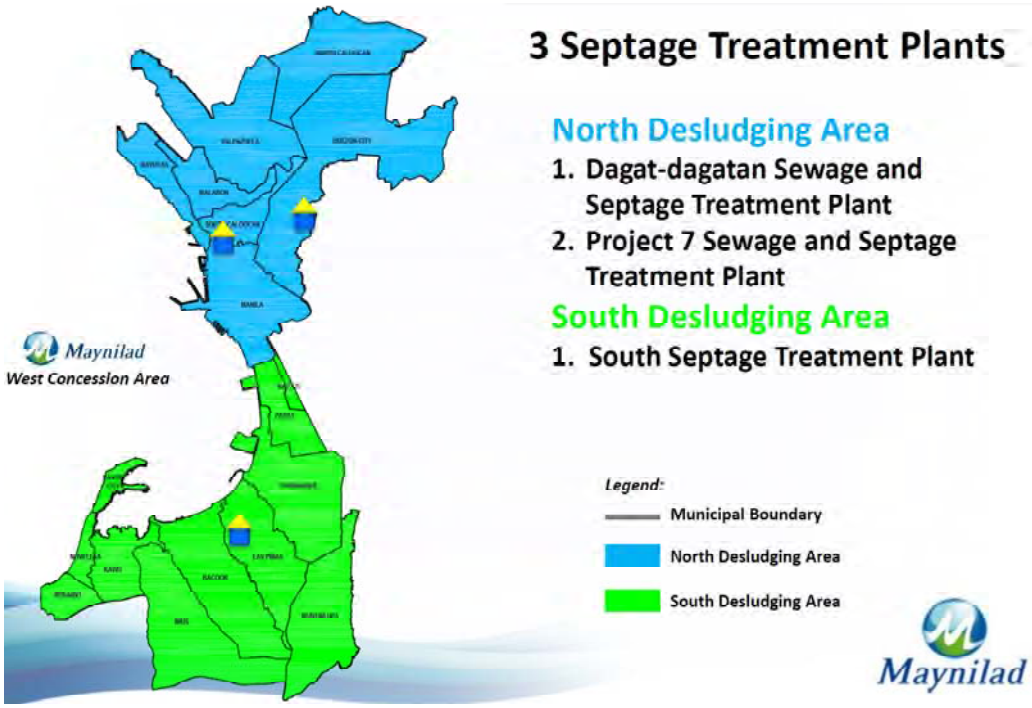
According to the plan as of 2016, Maynilad proposed to increase the sanitation service coverage to 80% by 2021 and 100% by 2037

The septage treatment plant development plan is to be revised to construct only two additional treatment plants including the South Septage Treatment Plant, which is currently operated under commissioning as shown in Table 3.2.2. The revision is made according to the actual sludge volumes from the septic tanks which are expected to be smaller than the original projection.

Total three (3) septage treatment plan are currently being operated for two (2) service areas as shown in Figure 3.2.3.

Table 3.2.2 Ongoing and Future Sewerage and Sanitation Projects

Type of Facility	2012 - 2016	2017 - 2022	2023 - 2027	2028 - 2032	2033 - 2037
Sewage Treatment Plant	6 plants: 409,000 m^3/day	15 plants: 595,000 m^3/day	10 plants: 497,000 m^3/day	7 plants: 356,000 m^3/day	4 plants: 280,000 m^3/day
Septage Treatment Plant	2 plants: 490 m^3/day	-	-	-	-



Source: Maynilad Wastewater Plan and Program, July 10, 2015

Figure 3.2.3 Service Area of Septage Treatment Plants

3.3 Key Issues on Development of Sewerage Facilities

3.3.1 General Issues on Related Activities

The development of sewerage system in West Metro Manila is behind the schedule as explained in Chapter 1. The following issues on development of sewerage system need to be improved to accelerate the works.

Table 3.3.1 Issues on the Sewerage Developent Project in the Project Area

Issues	Necessary Actions
STP	
• Land acquisition is difficult due to increase in land price value • Availability of land in urban area is less.	• To find alternative sites • Study on the treatment method to construct in smaller site
• There is always traffic jam in urban area due to narrow and congestion roads • Sewer pipe installation works by open-cut method lead to traffic congestion	• Adoption of a non-open cut method • Adoption of technologies for shortening the construction period
• In some areas, manual pipe cleaning work is required everyday due to loads of garbage and sands inflow from the drainage	• Installation of equipment for automatic cleaning • Employment of additional O&M staffs
• Rapid sewerage facilities development is required along with population increase due to rapid economic growth.	• Adoption of combined sewer system
O&M	
• High electricity cost	• Adoption of energy saving equipment and facilities
• Shortage of O&M staffs due to a lot of STPs with small capacity	• Installation of mid-sized STP by integrating the catchment area
Environment	
• Manila Bay is highly polluted and the effluent standards will be strengthened in the near future	• Study on the adoption of advanced treatment process
• Shortage of disposal site for generated sludge	• Reduction of sludge volume • Sludge recycling (composting)
Finance	
• Financial shortage	• Installation of appropriate sewerage system considering the life cycle cost • Equalization of financial source for facility development and O&M

Source: JICA Study Team

Figure 3.3.1 Traffic Congestion

Figure 3.3.2 Cleaning Work in Manhole

Figure 3.3.3 Sludge Transportation

3.3.2 Issues on Combined Sewer System

One of the fundamental problems of a combined system is the overflow of pollutant loads into the river or sea together with storm water from rainfall. Considerations for the structure will be necessary for environmental protection.

Although recent trials to improve the combined system have been successfully implemented in Japan, necessary investment after completion of expansion will be more costly than the case in which some considerations were made during the expansion stage. Therefore, it is recommended for Maynilad to study the mitigation measures to reduce pollutant loads and take possible actions that are appropriate for the current situation.

In Japan, the most focused subjects in technology development against CSO are the low cost, easy maintenance, and less or no power use. The methods used by Japan for this CSO problem can be a good practice to be considered by Maynilad.

3.3.3 Issues on Effluent Water Quality

As explained in Section 1.8.4, in March 2010, DENR issued an order which stated that effluent into the Manila Bay should be categorized as Class SB under the category of protected water bodies, instead of Class SC under the category of usual coastal waters.

Therefore, Maynilad was forced to improve the effluent quality of discharged water into Manila Bay from a BOD of 100 mg/L to 30 mg/L. Also, in the new standards, DAO 2016-08, the allowable concentration of nitrogen and phosphorus is regulated and applied. Therefore, all of the new sewage treatment facilities should meet the new requirements.

According to Maynilad, the existing STP should be improved to comply with the new effluent standards by 2022.

3.3.4 Issues on Sludge Treatment Management

(1) Increasing sludge generation

Sludge volume will rapidly increase due to the expansion of the sewerage system.

Although sludge volume will not increase in one or two years, it is certain that this will increase as the sewerage development progresses. If this issue is left unattended and increased sludge is treated in erratic ways without long-term vision, it may lead to social and environmental problems. In addition, inconsistent sludge treatments can increase the investment and disposal costs.

(2) Integrated sludge management plan

There are several processes of the sludge treatment. A study on the integrated sludge management plan for the entire service area will be necessary, separately from the Survey to show the future sludge treatment system; needed investment; and timeline for the development of the management system. On the formulation of the plan, future sludge volume, sludge component, location of plant, investment cost, and implementation schedule shall be studied. Also, a need survey including discussions with possible industries to accept recycled products are required in order to find out the alternatives in the treatment and disposal of generated sludge.

The details are explained in Section 5.6.2.

3.3.5 Issues on the Operations and Maintenance of Increasing Facilities

As many as 53 newly sewage treatment facilities will be constructed by 2037. Moreover, O&M of sewer networks will also increase significantly.

After the sewage treatment plant started its operation, its processes should keep on working even

during the maintenance or rehabilitation works, and it should continuously meet the effluent standards. Although Maynilad already has experience in O&M for existing sewerage and sanitation facilities, it will face the following difficulties in the near future:

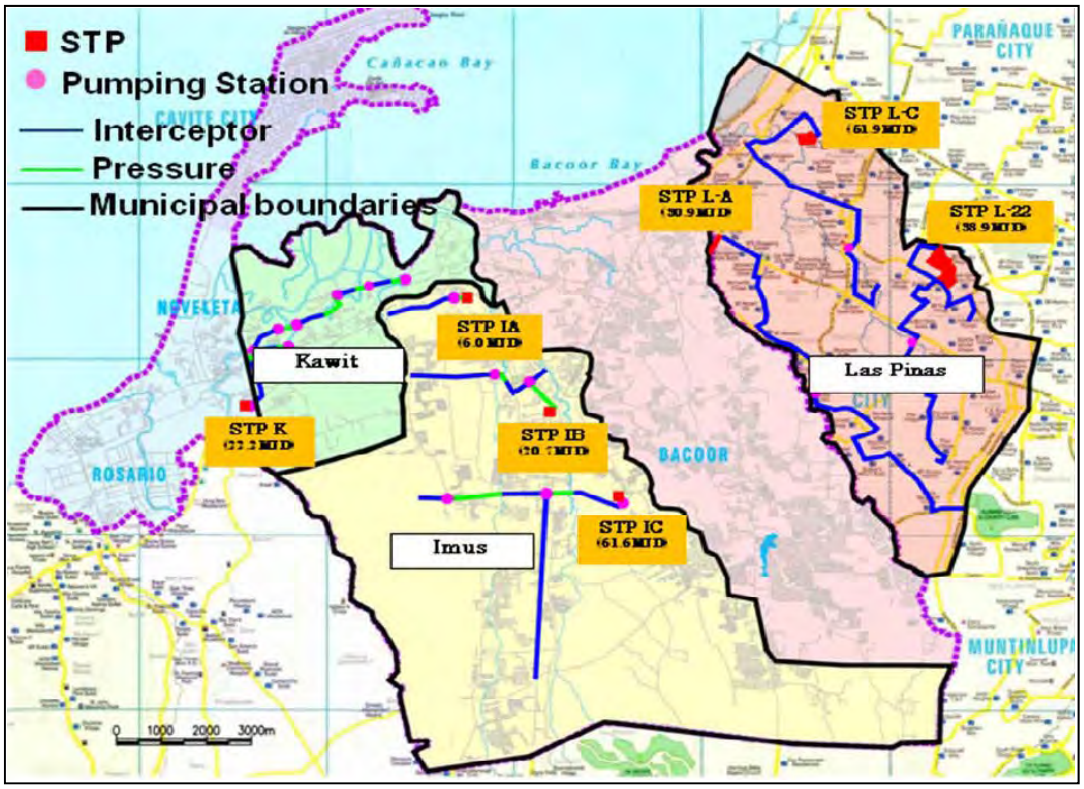
- ✓ The work volume of O&M of treatment facilities will significantly increase especially in the next ten years. Moreover, sludge and septage treatment in the future will require larger works than in the present. Furthermore, it will require significant number of additional human resources.
- ✓ Treatment facilities consist of combined sewer systems. The trend of inflow volume and quality of combined systems are much different and complex since they are more affected by climate and drainage conditions compared with the separated systems.
- ✓ If the effluent standard is revised to require the removal of nitrogen and phosphorus, advanced treatment processes will be necessary, and the operations will be much more complex.

In order to cope with the difficulty in O&M of quite a number of facilities, the automation of monitoring and operation is necessary. A remote monitoring system with web camera was planned in the F/S of the San Juan River Basin Project. Similarly, a system plan for efficient O&M works is expected for other planned projects. Considering that there is a rapid increase in the number of facilities, a more efficient and centralized system for O&M such as supervisory control and data acquisition (SCADA) is recommended.

3.4 Sewerage System for the Survey Area Planned by the Existing F/S

The sewerage system in Las Piñas City has been planned by the “Preparatory Survey for Metro Manila Sewerage and Sanitation Improvement Project – Phase 2”. And also, the sewerage system in Imus City and Kawit Town has been planned by the “Feasibility Study of the Three River System”.

The location and capacity of STP in the area and the route of planned trunk pipeline are shown in Figure 3.4.1.



Source: JICA Study Team based on existing F/S reports

Figure 3.4.1 STP Plan and Trunk Pipeline in the Existing F/S Report

3.4.1 Las Piñas City

The planned sewerage system in Las Piñas City in the existing F/S report is summarized in Table 3.4.1.

Table 3.4.1 Planned Sewerage System in Las Piñas City in the Existing F/S Report

Target Area	STP		Sludge	Sewer		Major P/S	Construction Cost (Million Pesos)	Completion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
1.Las Piñas	38.9 (L-22)	OD	Thickening	75-1350	25.3	0.277 (PS-6)	2,726	2021
	30.9 (L-A)	SBR	Thickening	75-700	26.3	0.319 (PS-2)	2,597	2021
	51.9 (L-C)	OD	Thickening	75-1350	37.3	0.227 (PS-4)	3,756	2025

Note1: The completion year of Imus and Kawit is not mentioned in the F/S; Maynilad plan is referred.
Note2: OD: Oxidation Ditch, SBR: Sequencing Batch Reactor
Source: JICA Study Team based on existing F/S report

3.4.2 Imus City

The planned sewerage system in Imus City in the existing F/S report is summarized in Table 3.4.2.

Table 3.4.2 Planned Sewerage System in Imus City in the Existing F/S Report

Target Area	STP		Sludge	Trunk Sewer		P/S	Construction Cost (Million Pesos)	Com-pletion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
Imus	6.0 (IA)	SBR	Digestion	300-500	1.6	0.047 (PS Ia) 0.100 (PS IA)	3,279	2022
	20.7 (IB)	SBR	Digestion	300-700	3.9	0.135 (PS IC) 0.308 (PS Ie) 0.347 (PS IB)		2022
	61.6 (IC)	SBR	Digestion	400-1400	8.2	0.207 (PS Ih) 0.858 (PS F) 1.003 (PS IC)		2037

Source: JICA Study Team based on existing F/S report

3.4.3 Kawit Town

The planned sewerage system in Kawit Town in the existing F/S report is summarized in Table 3.4.3.

Table 3.4.3 Sewerage System in Kawit Town in the Existing F/S Report

Target Area	STP		Sludge	Trunk Sewer		P/S	Construction Cost (Million Pesos)	Com-pletion Year
	Capacity (MLD)	Treatment Method	Process	Diameter (mm)	Length (km)	Capacity (m^3/s)		
Kawit	22.2	SBR	Digestion	300-900	5.5	0.099 (PS Kc) 0.210 (PS Ka1) 0.378 (PS Ka2) 0.378 (PS K)	1,100	2022

Source: JICA Study Team based on existing F/S report

3.4.4 Key Issues on the Existing Plan of Sewerage System and Sanitation Service in the Survey Area

The following key issues to be studied are observed in the existing plan and are also mentioned in the existing F/S report.

- ✓ In Las Piñas City and Imus City, the sewerage facilities were planned for small-scale treatment systems. However, this led to numerous small STPs for which land acquisition were proven difficult. The population of the area is rapidly increasing, and O&M of many smaller sewerage facilities is daunting. For such reasons, centralized medium to large sized sewerage systems should be considered with integrating the catchment area.
- ✓ Effluent standard to be applied in the survey area will be changed from Class SC (Marine Waters: BOD 100mg/L) to Class SB (Protected Waters: 30mg/L) as mentioned in Section 1.8.4. Also, advanced treatment methods should be studied to comply with new effluent standard DAO 2016 08.
- ✓ For sequencing batch reactor (SBR) method; aeration, sedimentation, and discharge of treated wastewater are proceeded in the same treatment tank. To respond to the fluctuation of

influent flow rate of the combined sewerage system, the aeration time and sedimentation time should be controlled. As a result, compared with the conventional activated sludge process (CAS), higher skills for O&M will be required. Other treatment methods including CAS, membrane bio reactor (MBR) shall be examined as alternatives.

- ✓ In Las Piñas City, oxidation ditch process (OD) is proposed in the existing F/S report. However, since it requires a larger area compared with other treatment methods, OD is normally not adopted in the urban area. Also, OD is not a recommended treatment process in the new sewerage guideline of Maynilad.
- ✓ The maximum diameter of the sewer pipe in the survey area is 1,400 mm, which is to be installed under the main road by open-cut method. However, non open-cut method needs to be considered especially if the installation work occurs in a highly traffic congested area.
- ✓ The proposed P/Ss for Imus and Kawit in Cavite F/S are not categorized whether each P/S require the land or can be constructed under the roads as manhole P/Ss. Those should be categorized with the design flows and possible land should be considered.
- ✓ The estimated construction cost of STPs in the existing F/S report is higher than the actual cost in the past project under Maynilad. The cost shall be reviewed in the Survey.

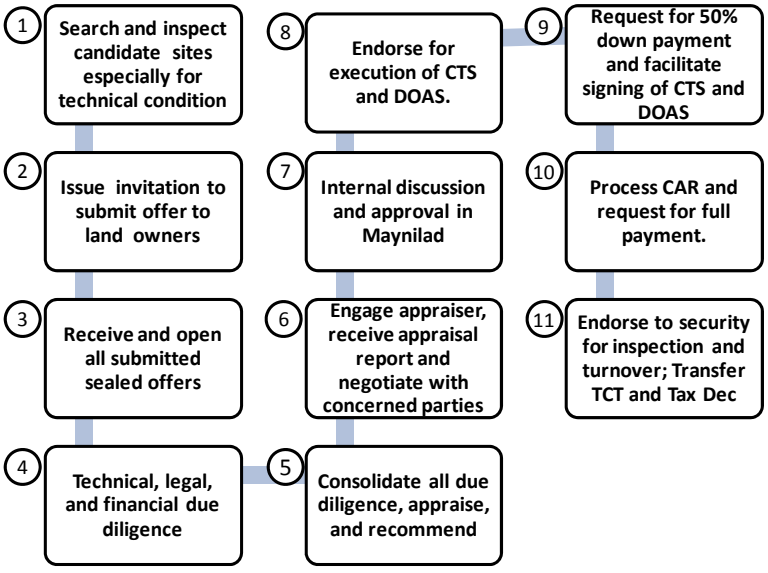
CHAPTER 4 Existing Project Site Condition

This chapter first describes the selection process for the ten candidate sites in accordance with the criteria determined by Maynilad. Subsequently, regulations on land use and construction, flood information, and land prices in the areas where the candidate sites are located are mentioned. Finally, basic information of each candidate site is described.

4.1 Selection of Candidate Site for STP

4.1.1 Policy on Selection of Candidate Site for STP

Figure 4.1.1 shows the land acquisition procedure of Maynilad. Maynilad has been looking for candidate sites for new sewage treatment plants (STPs) in Las Piñas City, Imus City, and Kawit Municipality. Although the procedure includes technical, legal and financial evaluation, land availability is the biggest bottleneck for smooth site selection and land acquisition. There are still some vacant lands found in the three local government units (LGUs) that are suitable locations for STP; however, most of them have development projects. Otherwise, most of the land owners are expecting to sell their lands to housing or commercial entities at higher prices to get good benefits.



Note:
- CTS: Contract to Sell (Document signed by seller and Maynilad stipulating all conditions of the sale prior to signing of the DOAS)
- DOAS: Deed of Absolute Sale (Document conveying ownership of property from the seller to Maynilad upon payment)
- CAR: Certification Authorizing Registration (Document issued by the Bureau of Internal Revenue (BIR) certifying that all taxes related to the sale of the property have been paid, and that the ownership may already be transferred from the seller to Maynilad)
- TCT: Transfer Certificate of Title (Proof of ownership of the property)

Source: JICA Study Team based on information from Maynilad

Figure 4.1.1 Land Acquisition Procedure for Construction Facilities of Maynilad

Considering the procedure in Figure 4.1.1 and the situation where there are few available lands for STP, this study sets the minimum requirements for new STP candidate sites, which have been discussed and agreed with Maynilad as follows:

1) The land which Maynilad has already acquired or has started acquisition procedure (Figure 4.1.1),
2) Technically appropriate location for STP (proximity to river, width of road, contour, and lot size),
3) No future plans by the government, and
4) No construction restriction for STP.

4.1.2 Selection of Candidate Site for STP

Referring to the information Maynilad has collected, existing feasibility study (F/S) reports, and requirements in Section 4.1.1, three sites in Las Piñas, five sites in Imus, and two sites in Kawit were selected as candidate sites after the site investigation for confirmation and checking availability of the site by the Survey team, which are shown in Table 4.1.1 and Figure 4.1.2. Detailed information of the sites is mentioned in the following sections.

Table 4.1.1 List of Candidate Sites

City/Municipality	Serial No.	Area (ha)	Remarks
Las Piñas	L-A	2.50	- Listed in the previous F/S reports* - Same serial number with the F/S
	L-C	7.00	
	L-22	19.00	
Imus	C-2	1.80	
	C-3	2.35	
	C-4	15.22	
	C-A	1.38	- Not listed in the previous F/S report* - New serial number
	C-B	5.60	
Kawit	K-2	0.95	
	K-3	1.59	

Note *: The previous F/S reports are "Preparatory Survey for Metro Manila Sewerage and Sanitation Improvement Project Phase 2, JICA, 2011" and "Three-River System Feasibility Study (Volume 4 Cavite Catchment), Maynilad, 2011".
Source: JICA Study Team

Source: JICA Study Team based on information from Maynilad

Figure 4.1.2 Location Map of Candidate Sites

4.2 Updating Site Information and Data in Each City/Municipality

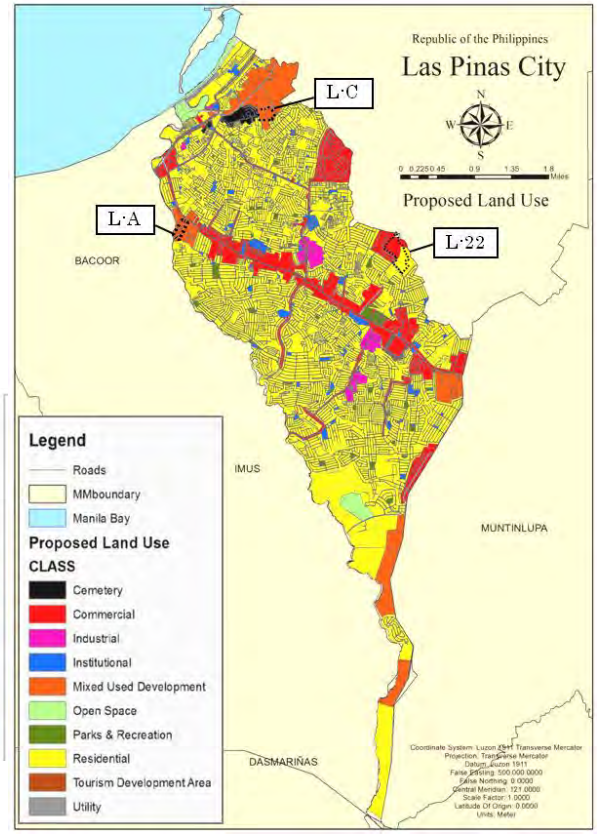
4.2.1 Las Piñas City

(1) Land Use Plan and Construction Regulation

According to Executive Order No. 841 (2009), all LGUs shall revisit/reformulate/update and assess the implementation and manner of execution of their existing comprehensive land use plans (CLUPs), which contain the comprehensive future land use plan of the LGU. Las Piñas City has formulated their CLUP 2016-2025 and it includes the future land use plan, which classifies land into specific uses as shown in Figure 4.2.1.

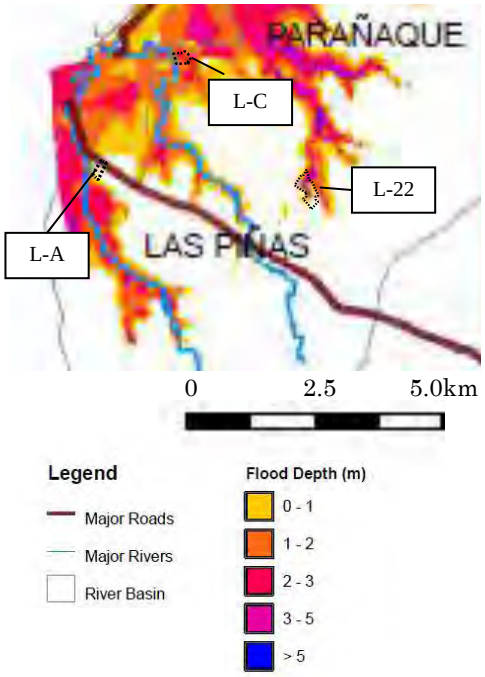
According to Zoning Ordinance 2011 of Las Piñas City, specific use and construction conditions of land including height and available maximum building footprint are basically regulated by the classification. However, for lands for special uses including STP, the City Planning Office of Las Piñas has the authority to appropriately change and determine the land classification. Therefore, it is not possible to determine the present building conditions of each candidate site in reference to the current land use plan.

Just for reference, L-A and L-C are located in the mixed use development area and L-22 is located in the residential and commercial area according to the current land use plan.



Source: Comprehensive Land Use Plan 2016-2025, Las Piñas

Figure 4.2.1 Land Use Plan of Las Piñas City



Source: Metro Manila Flood Management Master Plan (2012), World Bank

Figure 4.2.2 Maximum Flood Depth Due to Typhoon Ondoy in 2009

(2) Flooding

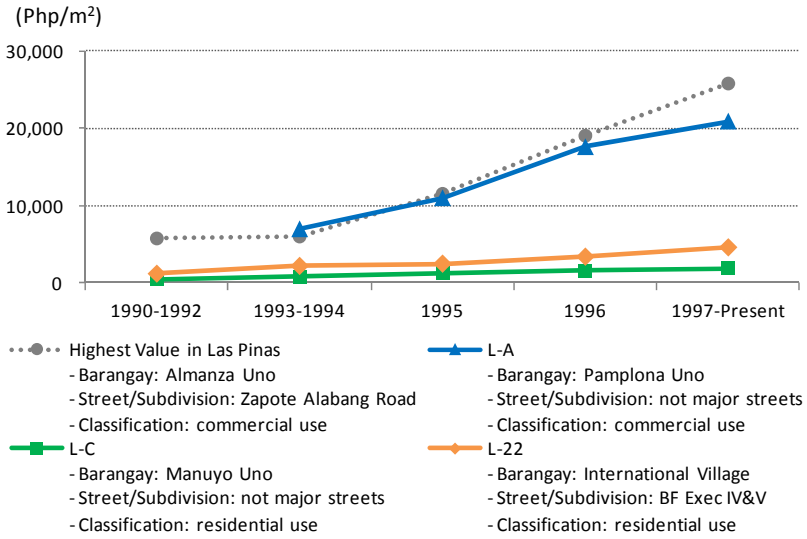
According to the hazard profile of the CLUP, the area most susceptible to flooding in Las Piñas City is the area along the shore, especially Barangay Manuyo Dos, while all of the three candidate sites are classified as areas moderately susceptible to flooding.

However, during large flooding events like the occurrence of typhoon, the candidate sites get flooded to some extent. Figure 4.2.2 shows the maximum flood depth due to Typhoon Ondoy in 2009, which is one of recent major flooding events. According to Figure 4.2.2, L-A got 0-1 m, L-C got 1-2 m, and L-22 got 0-2 m of flood depth.

(3) Land Price

Zonal values for land in each LGU have been determined or revised by the Commissioner of Internal Revenue to be used in computing any internal revenue tax. Zonal values in Las Piñas City have been increasing as shown in Figure 4.2.3. Because zonal value is also used as basis for market value, it suggests that the market values of lands in the city have also been increasing.

For cost calculation for STP, which is described in the following chapters of this report, the market value computed at twice the zonal value of each candidate site is temporarily adopted as the land price based on the following reasons:



Note: Zonal value of L-A in 1990-1992 is not shown because it was not opened at that time.
Source: JICA Study Team

Figure 4.2.3 Trend of Zonal Value for Land of Candidate Sites and Land with Highest Value in Las Piñas City

- Some benchmarks must be used to determine the land price because it is difficult to forecast the actual transaction price which involves not only the location but also particular circumstances of buyer and seller.
- The JICA Study Team interviewed more than 20 private developers to get the market value of the land with similar location as the candidate sites, however, there is not enough information obtained to serve as reference.
- Maynilad did not appraise the value of the candidate sites yet and recommended to refer to the zonal value.
- According to interviews with the city planning officers and some developers, computing the land price at twice the zonal value is generally adopted to forecast the market value of the land.

Regarding L-A, however, the market value of twice the zonal value is not adopted as the land is already acquired by Maynilad. The adopted land price of each candidate site is shown in Table 4.2.1.

Table 4.2.1 Land Price for Cost Calculation for STP in this Report (Las Piñas)

Candidate Site	Land Price for Cost Calculation for STP in This Report (PHP/m^2)	Calculation
L-C	3,800	Twice the zonal value (PHP 1,900/m^2)
L-22	9,200	Twice the zonal value (PHP 4,600/m^2)

Source: JICA Study Team

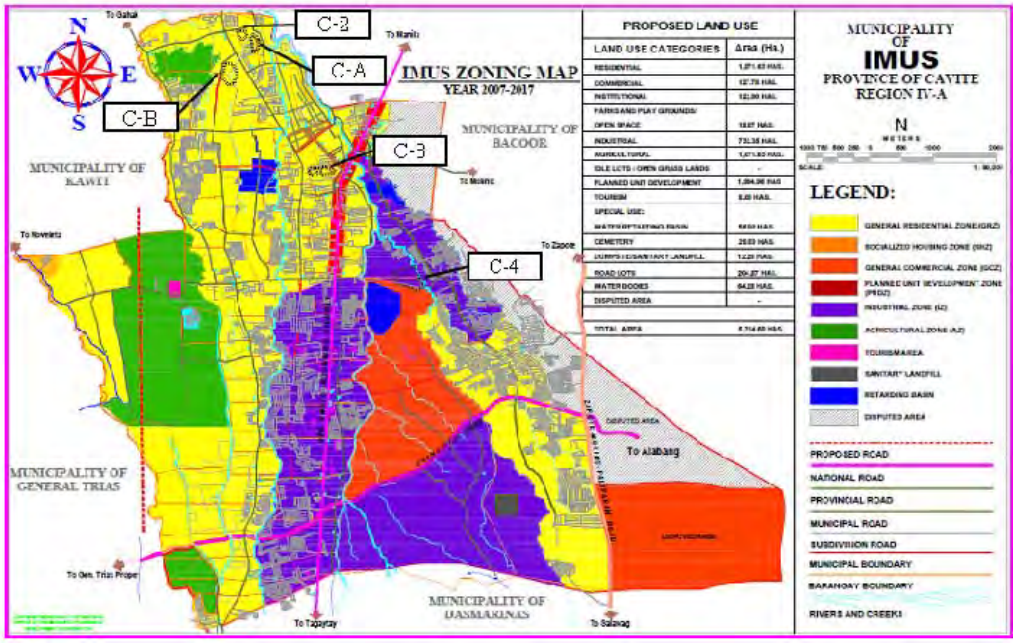
4.2.2 Imus City

(1) Land Use Plan and Construction Regulations

Imus City's land use plan can be referred to in the zoning map 2007-2016 (Figure 4.2.4).

According to the Comprehensive Zoning Ordinance of Imus City, like Las Piñas City, specific use and construction conditions of land are basically regulated by the classification, and the City Planning Office of Imus City has the authority to change and determine the land classification for the STP site. Therefore, the exact construction conditions of each candidate site should be checked by the city planning office.

Just for reference, C-2, C-3, C-A, and C-B are located in the general residential zone and C-4 is located in the industrial zone according to the current land use plan.

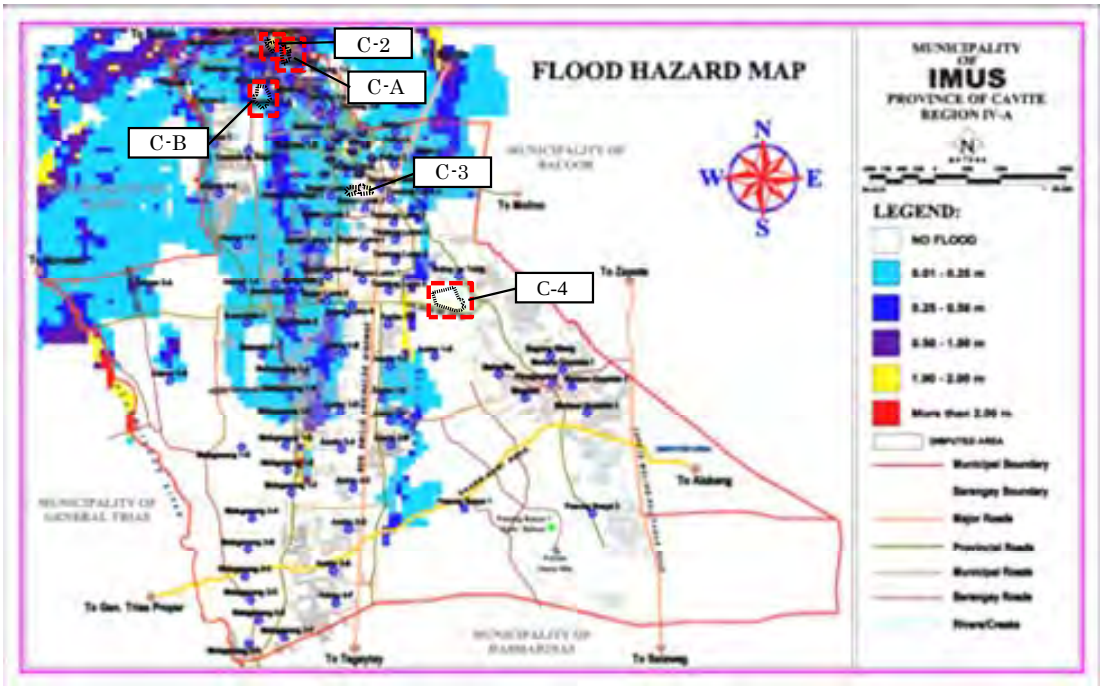


Source: Comprehensive Land Use Plan, Imus City

Figure 4.2.4 Land Use Plan of Imus City

(2) Flooding

According to the flood hazard map in the CLUP of Imus City, the northern part of the city and areas near the river are expected to get flood by large flooding (Figure 4.2.5). According to Figure 4.2.5, C-2 and C-A are expected to get flood depths of 0.25-0.50 m, and C-B with 0.01-0.25 m. On the other hand, C-3 and C-4 are located on flood-free areas.

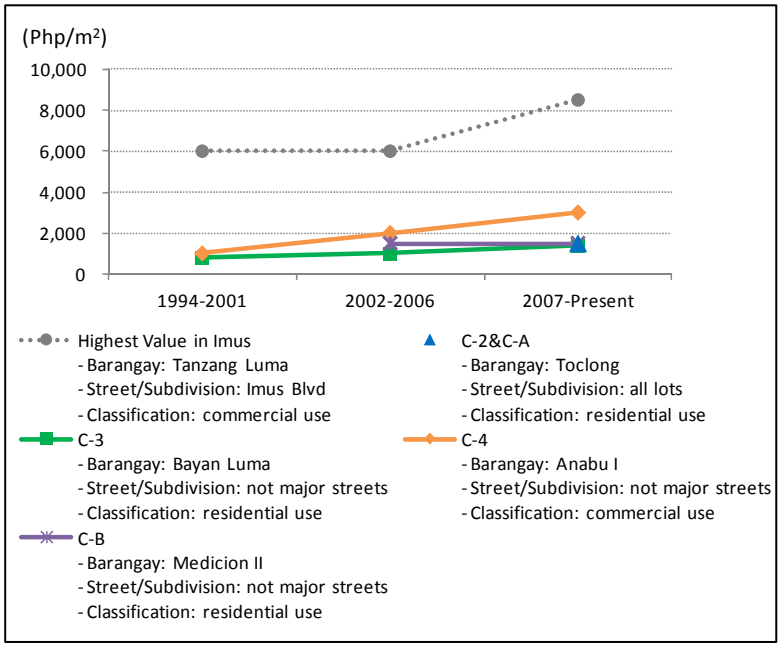


Source: Comprehensive Land Use Plan, Imus City

Figure 4.2.5 Flood Hazard Map of Imus City

(3) Land Price

Zonal values in Imus City have been increasing as shown in Figure 4.2.6. Since the zonal value is also used as basis for the market value, it suggests that the market values of lands in the city have also been increasing.



Note: Zonal values of C-2 and C-A in 1994-2006 and C-B in 1994-2001 are not shown because they were not opened at that time.

Figure 4.2.6 Trend of Zonal Value for Land of Candidate Sites and Land with Highest Value in Imus City

For cost calculation for STP which is described in the following chapters of this report, the practice of applying twice the zonal value of each candidate site is temporarily adopted as the land price because of the same reasons of Las Piñas City. Regarding C-B which is currently used as paddy field, however, land-filling cost is considered in addition to twice the zonal value. The adopted land price of each candidate site is

shown in Table 4.2.2.

Table 4.2.2 Land Price for Cost Calculation for STP in this Report (Imus)

Candidate Site	Land Price for Cost Calculation for STP in this Report (PHP/m^2)	Calculation
C-2	3,000	Twice the zonal value (PHP 1,500/m^2)
C-3	2,750	Twice the zonal value (PHP 1,375/m^2)
C-4	6,000	Twice the zonal value (PHP 3,000/m^2)
C-A	3,000	Twice the zonal value (PHP 1,500/m^2)
C-B	2,000	Twice the zonal value (PHP 1,500/m^2) minus PHP 1,000/m^2 for land-filling cost

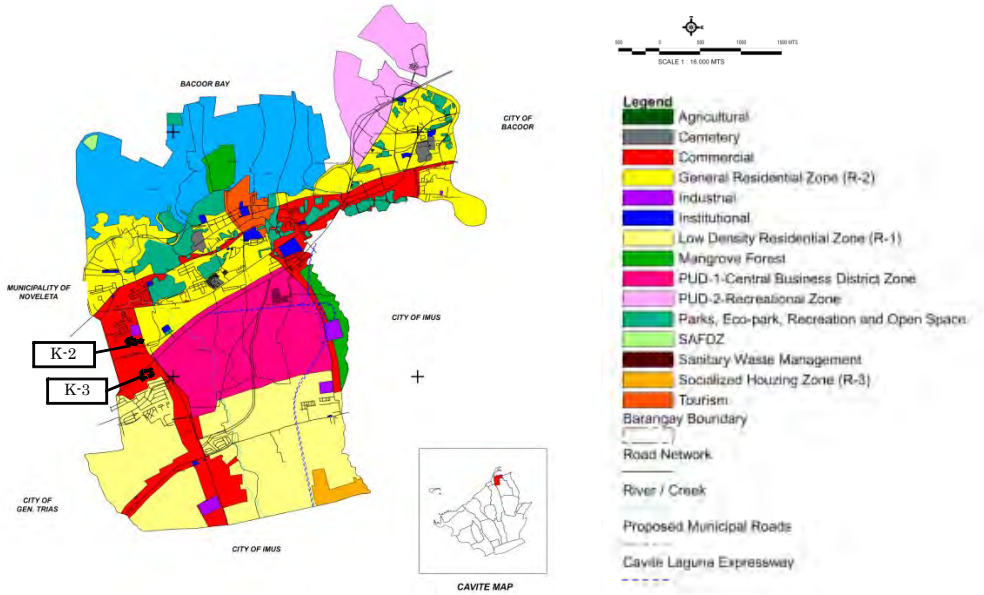
Note: C-B is currently used as paddy field and it needs additional cost for land formation.
Source: JICA Study Team

4.2.3 Kawit Municipality

(1) Land Use Plan and Construction Regulation

The CLUP 2012-2022 of Kawit Municipality includes the land use plan (Figure 4.2.7), which is to control land for specific use and to regulate construction conditions through the zoning classification.

For Kawit, unlike in Las Piñas and Imus, the land for STP must only fall into four types of land, namely; commercial, industrial, institutional, and planned unit development type. Because both K-2 and K-3 are located in the commercial zone of the land use plan, the construction regulations for commercial area shall be applied for STP construction at the sites. The major construction regulations of K-2 and K-3 according to the Comprehensive Zoning Ordinance of Kawit Municipality and National Building Code are listed in Table 4.2.3.



Source: Comprehensive Land Use Plan, Kawit Municipality

Figure 4.2.7 Land Use Plan of Kawit Municipality

Table 4.2.3 Major Construction Regulations on Site K-2 and K-3

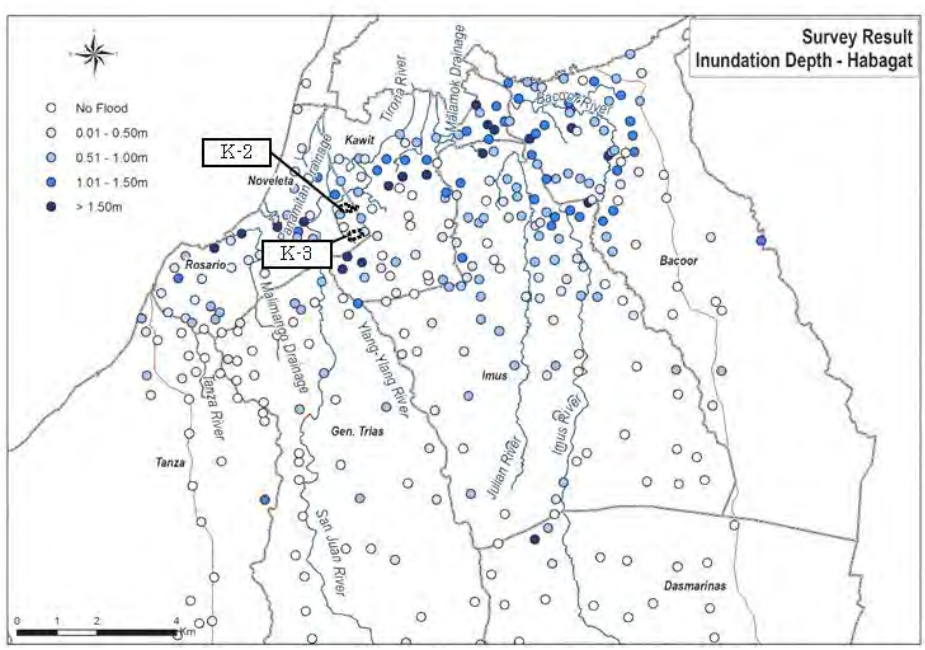
Item	Regulation
Maximum building height	16 m or 5-story
Minimum setback from public road	5 m
Allowable maximum building footprint	75%

Source: The Comprehensive Zoning Ordinance of the Municipality of Kawit and P.D. 1096 - National Building Code and its Implementing Rules and Regulations

(2) Flooding

According to Provincial Disaster Risk Reduction and Management Plan 2011-2016 of Cavite Province, the whole area of Kawit Municipality is categorized as highly susceptible to flooding. Actually, high levels of flood waters and frequent overflowing of rivers brought by storms were observed in the previous years. In 2006, Typhoon "Milenyo" brought 3 ft-8 ft of heavily silted floodwaters to almost all 23 barangays of Kawit. And most recently in 2013, the southwest monsoon rains intensified by Typhoon Habagat flooded all 23 barangays of Kawit again.

Figure 4.2.8 shows the flood depth in Cavite Province due to Habagat, which is according to an interview survey conducted by the JICA Study Team. It indicates the possibility that K-2 and K-3 have maximum flood depths of 1.0 m caused by a strong typhoon.



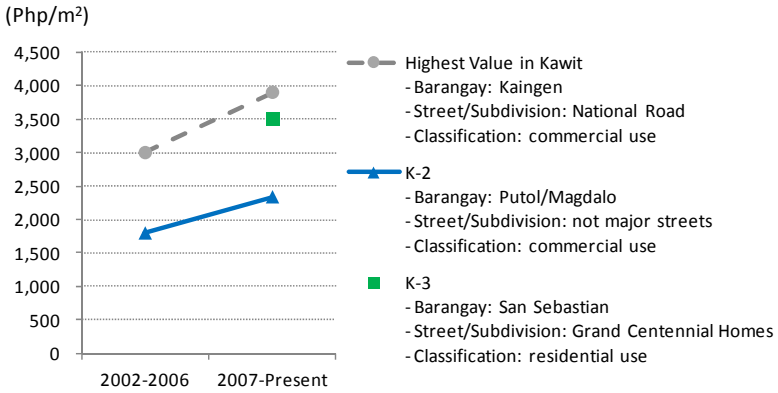
Source: Draft Final Report of Industrial Area (Cavite Province) Flood Management Projects by JICA

Figure 4.2.8 Flood Depth in Cavite Province Due to Habagat

(3) Land Price

Zonal values in Kawit Municipality have been increasing as shown in Figure 4.2.9. Because zonal value is also used as basis for market value, it suggests that the market values of lands in the city have also been increasing.

For cost calculation for STP, which is described in the following chapters of this report, the practice of applying twice the zonal value of each candidate site is temporarily adopted as land price for the same reasons accepted by Las Piñas above. The adopted land price for each candidate site is shown in Table 4.2.4.



Note: Zonal values of K-3 in 2002-2006 is not shown because it was not opened at that time.

Figure 4.2.9 Trend of Zonal Value for Land of Candidate Sites and Land with Highest Value in Kawit Municipality

Table 4.2.4 Land Price for Cost Calculation for STP in this Report (Kawit)

Candidate Site	Land Price for Cost Calculation for STP in this Report (PHP/m^2)	Calculation
K-2	4,680	Twice the zonal value (PHP 2,340/m^2)
K-3	7,000	Twice the zonal value (PHP 3,500/m^2)

Source: JICA Study Team

4.3 Land Information and Data of Candidate Site for STP

This section provides the summary of land information and data of candidate sites for STP.

4.3.1 Las Piñas City

(1) Site L-A

Table 4.3.1 shows the land information of Site L-A.

Table 4.3.1 Land Information of Site L-A

(1) Area	2.50 ha
(2) Current Land Condition	- Some construction materials of Maynilad are left behind. - There exists a small temporary building for the staff who is assigned by Las Piñas City to keep watch on illegal dumping.
(3) Access Road	Two access roads (Access Road 1: 5.5 m width, Access Road 2: 5.5 m width) via Alabang - Zapote Road (width: 14 m)
(4) Discharge Point	Zapote River
(5) Land Owner	Maynilad
(6) Resident	None
(7) Land Price	Transaction price: PHP 15,000/m^2 (2013)
(8) Land Acquisition Progress/Note	- Land is acquired by Maynilad - Although there is a small temporary building, Maynilad and Las Piñas City agreed to remove it before development.
(9) Flood	- Area is moderately susceptible to flooding - Maximum flood depth of 0-1 m during Typhoon Ondoy in 2009
(10) Construction Regulation	N.A. (to be determined by the city planning office)

Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road 1

2. Access Road 2

3. View of the Site

4. View of the Site

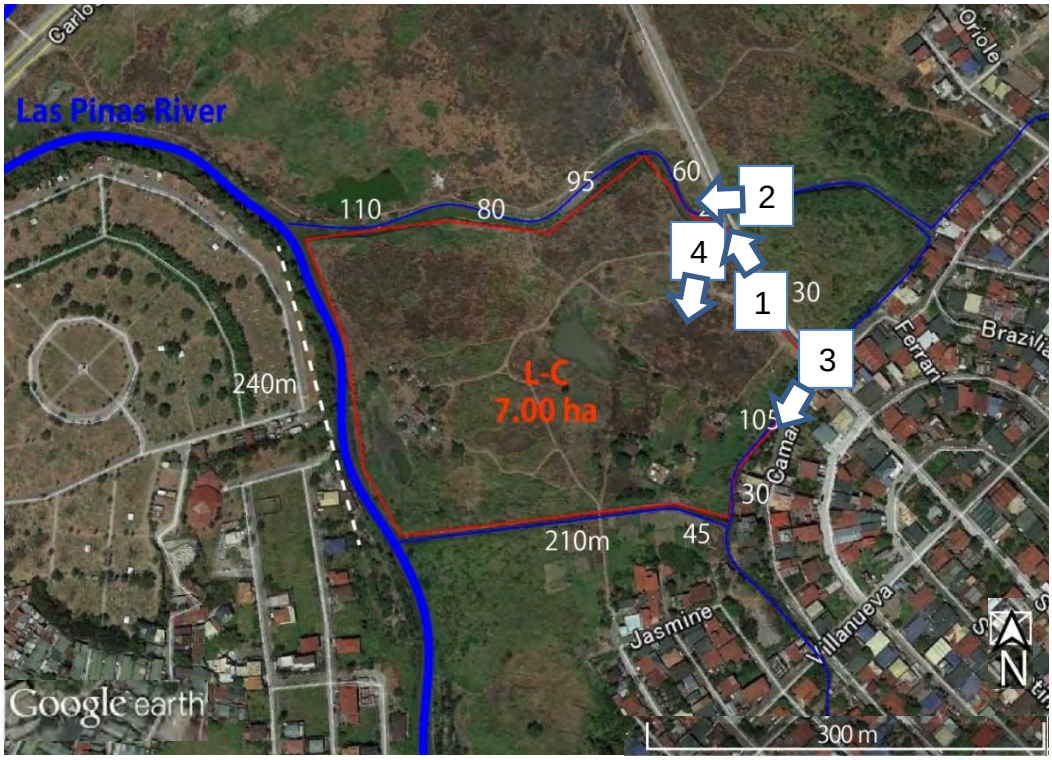
Source: JICA Study Team

(2) Site L-C

Table 4.3.2 shows the land information of Site L-C.

Table 4.3.2 Land Information of Site L-C

(1) Area	7.00 ha
(2) Current Land Condition	Grassland with no construction
(3) Access Road	S. Marquez Road (width: 5.5 m)
(4) Discharge Point	Las Piñas River or other surrounding creeks
(5) Land Owner	- Adelfa Properties - Adela and Maxima Ferrer
(6) Resident	None
(7) Land Price	- Zonal value: PHP 1,900/m^2, - Land price for cost calculation for STP: PHP 3,800/m^2
(8) Land Acquisition Progress/Note	Under technical, legal, and financial due diligence
(9) Flood	- Area is moderately susceptible to flooding - Maximum flood depth of 1-2 m due to Typhoon Ondoy in 2009 - Some flood countermeasures may be necessary because the location is susceptible to flooding which is close to the coastal area (about 1.2 km), adjacent to the Las Piñas River and surrounded by other creeks.
(10) Construction Regulation	N.A. (to be determined by the city planning office)



Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. Creek

3. Creek

4. View of the Site

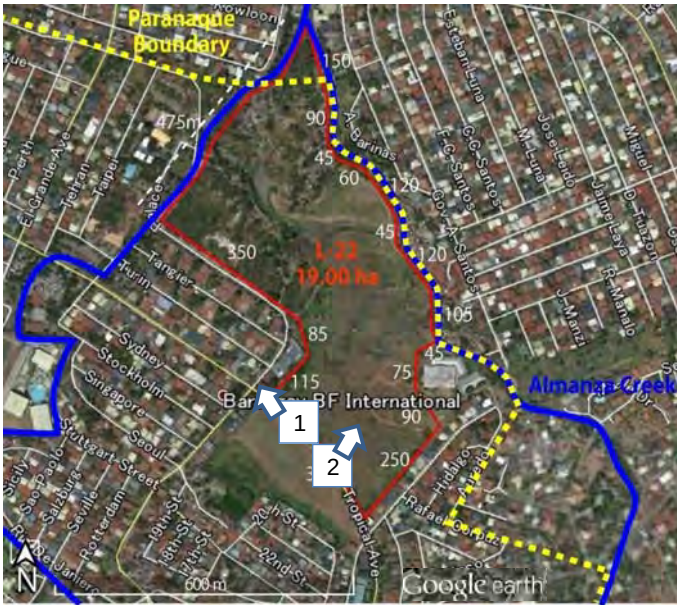
Source: JICA Study Team

(3) Site L-22

Table 4.3.3 shows the land information of Site L-22.

Table 4.3.3 Land Information of Site L-22

(1) Area	19.00 ha
(2) Current Land Condition	- Northern part: some temporary housing units - Middle part: vegetated land - Southern part: grassland
(3) Access Road	Tropical Avenue (width: 7.0 m)
(4) Discharge Point	Almanza Creek
(5) Land Owner	- Home Insurance & Guaranty Corp. - Aguirre, Tomas B. - Land Bank of the Philippines - Lucas, Rufino S. and Debbie N Sps - BF Homes Inc. - Sauler, Amando R.
(6) Resident	Few squatters in the northern part
(7) Land Price	- Zonal value: PHP 4,600/m^2, - Land price for cost calculation for STP: PHP 9,200/m^2
(8) Land Acquisition Progress/Note	- Under technical, legal, and financial due diligence - There is a risk that the expected land price of the owners may increase. (Source: Maynilad)
(9) Flood	- Area is moderately susceptible to flooding - Maximum flood depth of 0-2 m due to Typhoon Ondoy in 2009
(10) Construction Regulation	N.A. (to be determined by the city planning office)



Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. View of the Site

Source: JICA Study Team

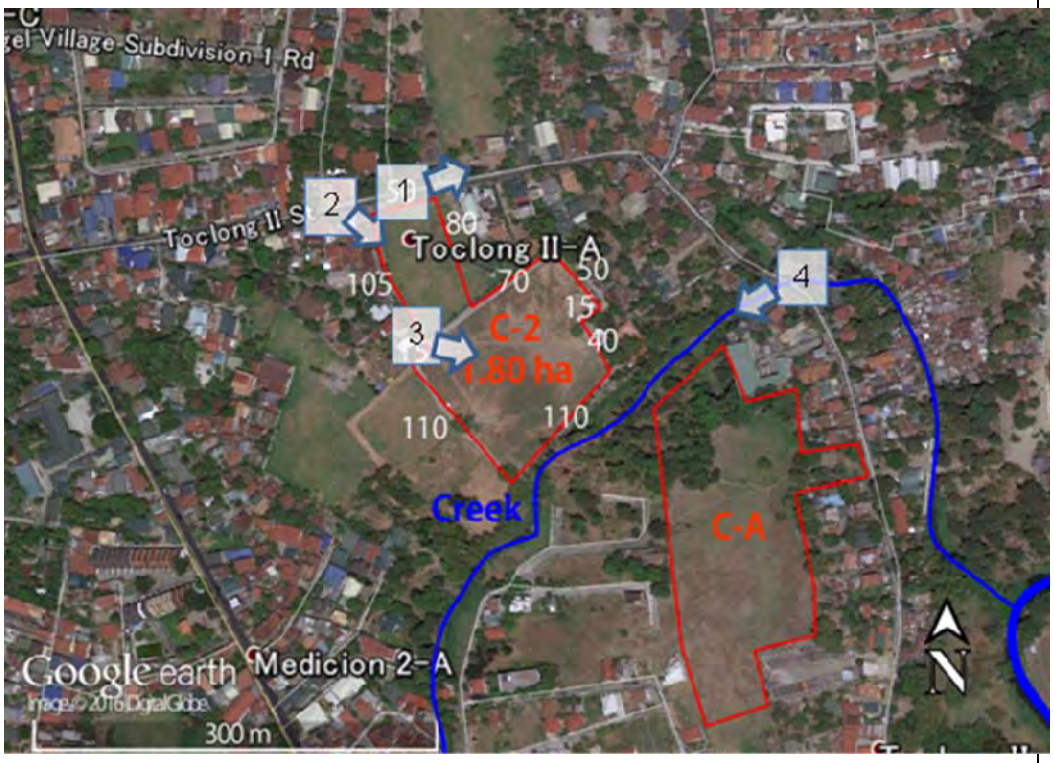
4.3.2 Imus City

(1) Site C-2

Table 4.3.4 shows the land information of Site C-2.

Table 4.3.4 Land Information of Site C-2

(1) Area	1.80 ha
(2) Current Land Condition	Grassland with no construction
(3) Access Road	Toclong II Street (width: 4.0 m)
(4) Discharge Point	Creek and the Imus River (330 m east from edge of the land)
(5) Land Owner	Private owner
(6) Resident	None
(7) Land Price	- Zonal value: PHP 1,500/m^2, - Land price for cost calculation for STP: PHP 3,000/m^2
(8) Land Acquisition Progress/Note	Under technical, legal, and financial due diligence
(9) Flood	Expected to get a maximum flood depth of 0.25-0.5 0m during strong typhoon
(10) Construction Regulation	N.A. (to be determined by the city planning office)



Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road	2. View of the Site	3. View of the Site	4. Creek

Source: JICA Study Team

(2) Site C-3

Table 4.3.5 shows the land information of Site C-3.

Table 4.3.5 Land Information of Site C-3

(1) Area	2.35 ha
(2) Current Land Condition	Grassland with no construction
(3) Access Road	Access Road 1 (width: 5.0 m) and Access Road 2 (width: 3.5 m) via Nueno Avenue (width: 10 m)
(4) Discharge Point	Imus River (320 m west from edge of the land)
(5) Land Owner	Private owner
(6) Resident	None
(7) Land Price	- Zonal value: PHP 1,375/m^2, - Land price for cost calculation for STP: PHP 2,750/m^2
(8) Land Acquisition Progress/Note	Under technical, legal, and financial due diligence
(9) Flood	Expected to be flood-free according to the CLUP of Imus City
(10) Construction Regulation	N.A. (to be determined by the city planning office)

Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road 1

2. Access Road 2

3. View of the Site

4. View of the Site

Source: JICA Study Team

(3) Site C-4

Table 4.3.6 shows the land information of Site C-4.

Table 4.3.6 Land Information of Site C-4

(1) Area	15.22 ha
(2) Current Land Condition	Vegetated and farm lands
(3) Access Road	Patindig Araw Road (width: 6.0 m)
(4) Discharge Point	Creek adjacent to the land
(5) Land Owner	Private owner
(6) Resident	None
(7) Land Price	- Zonal value: PHP 3,000/m^2, - Land price for cost calculation for STP: PHP 6,000/m^2
(8) Land Acquisition Progress/Note	Under technical, legal, and financial due diligence
(9) Flood	Expected to be a flood-free area according to the CLUP of Imus City
(10) Construction Regulation	N.A. (to be determined by the city planning office)

Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. Creek

3. View of the Site

4. View of the Site

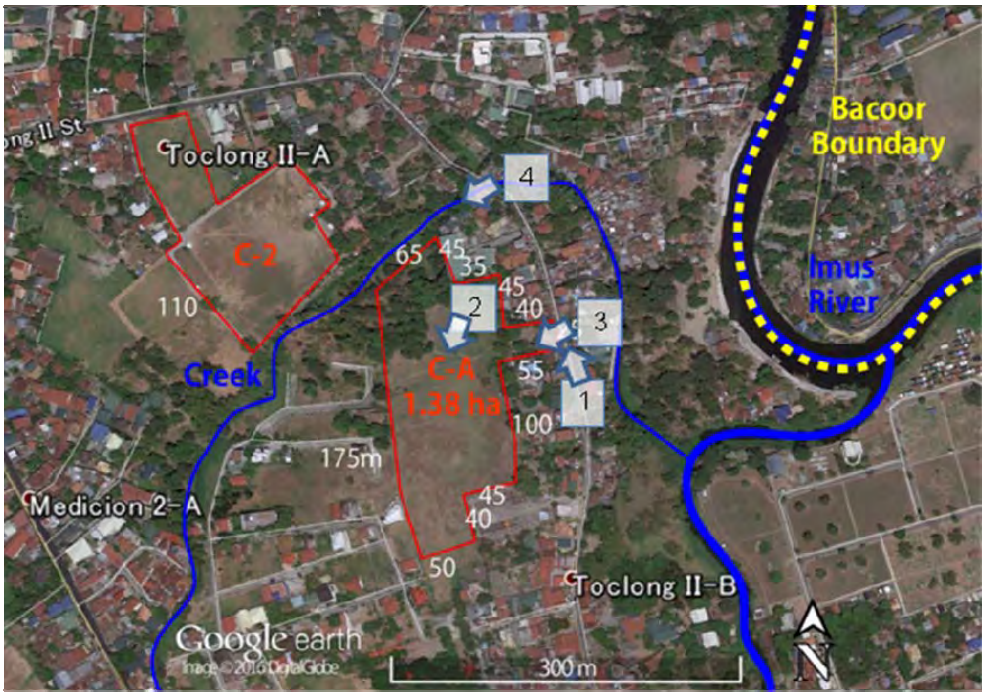
Source: JICA Study Team

(4) Site C-A

Table 4.3.7 shows the land information of Site C-A.

Table 4.3.7 Land Information of Site C-A

(1) Area	1.38 ha
(2) Current Land Condition	- On the access road (Toclong II Street): A family lives in two temporary houses with the approval of the land owner to keep watch on illegal settlement in the land. - The other part: grassland with no construction.
(3) Access Road	Toclong II Street (width: 5.0 m)
(4) Discharge Point	Creek and the Imus River (150 m east from edge of the land)
(5) Land Owner	Magdalena P. Esguerra
(6) Resident	Few illegal settlers on the access road
(7) Land Price	- Zonal value: PHP 1,500/m^2, - Land price for cost calculation for STP: PHP 3,000/m^2
(8) Land Acquisition Progress/Note	- All the due diligence reports in Maynilad are consolidated. - Being appraised. - Although there are two temporary houses, Maynilad and the land owner agreed to remove them before development.
(9) Flood	Expected to get a maximum flood depth of 0.25-0.50 m during strong typhoons
(10) Construction Regulation	N.A. (to be determined by the city planning office)

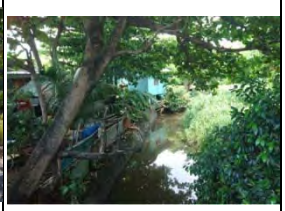


Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. View of the Site

3. View of the Site



4. Creek

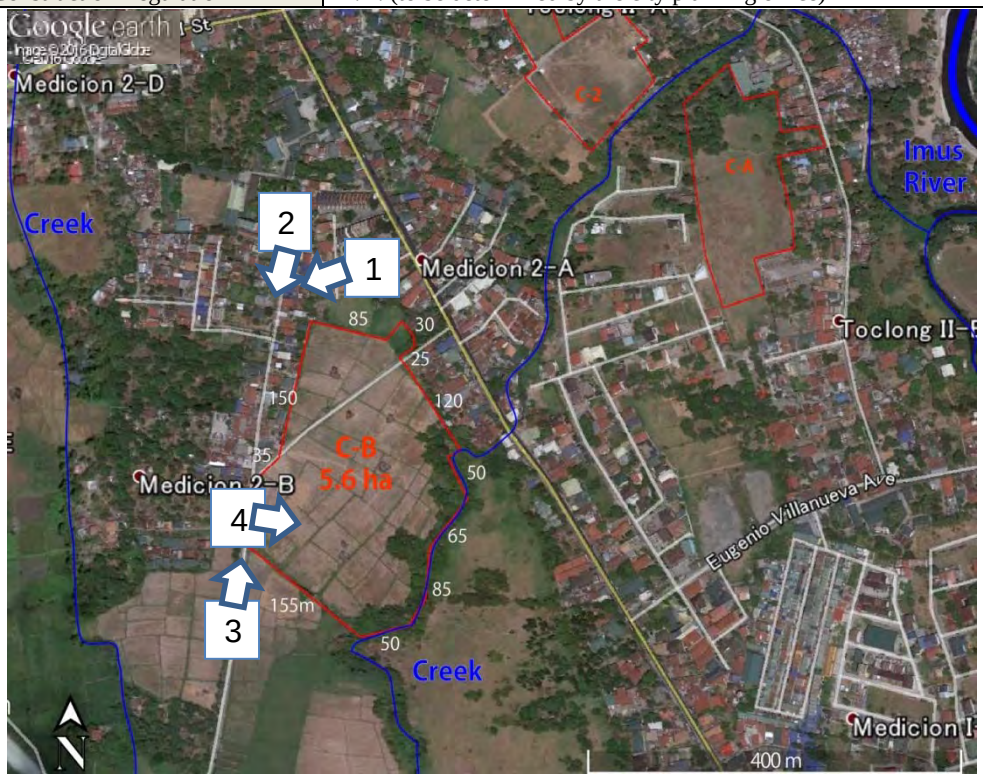
Source: JICA Study Team

(5) Site C-B

Table 4.3.8 shows the land information of Site C-B.

Table 4.3.8 Land Information of Site C-B

(1) Area	5.60 ha
(2) Current Land Condition	Paddy field with ground level lower than the access road
(3) Access Road	Access Road 1 (width: 3.0 m) and Access Road 2 (width: 5.0 m) via General Yengco Street (width: 5.5 m)
(4) Discharge Point	Creek and the Imus River (560 m east from the edge of the land)
(5) Land Owner	MT Virata Realty
(6) Resident	None
(7) Land Price	- Zonal value: PHP 1,500/m^2, - Land price for cost calculation for STP: PHP 2,000/m^2
(8) Land Acquisition Progress/Note	- All due diligence reports in Maynilad are consolidated. - Being appraised.
(9) Flood	Expected to get a maximum flood depth of 0.01-0.25 m during strong typhoons.
(10) Construction Regulation	N.A. (to be determined by the city planning office)



Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road 1

2. Access Road 2

3. Access Road 2

4. View of the Site

Source: JICA Study Team

4.3.3 Kawit Municipality

(1) Site K-2

Table 4.3.9 shows the land information of Site K-2.

Table 4.3.9 Land Information of Site K-2

(1) Area	0.95 ha
(2) Current Land Condition	Grassland with no construction
(3) Access Road	Kalayaan Road (width: 5.5 m)
(4) Discharge Point	Creek (330 m west from the edge of the land)
(5) Land Owner	No land title
(6) Resident	None
(7) Land Price	- Zonal value: PHP 2,340/m^2, - Land price for cost calculation for STP: PHP 4,680/m^2
(8) Land Acquisition Progress/Note	Under technical, legal, and financial due diligence
(9) Flood	- Area is highly susceptible to flooding - Expected to get a maximum flood depth of 1.0 m during strong typhoon.
(10) Construction Regulation	- Maximum building height: 16 m or 5-story - Minimum setback from public road: 5 m - Allowable maximum building footprint: 75%

Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. View of the Site

3. View of the Site

Source: JICA Study Team

(2) Site K-3

Table 4.3.10 shows the land information of Site K-3.

Table 4.3.10 Land Information of Site K-3

(1) Area	1.59 ha
(2) Current Land Condition	- Near the access road: two small sheds - Other parts: grassland
(3) Access Road	Antero Soriano Highway (width: 14 m)
(4) Discharge Point	Creek (350 m west from the edge of the land)
(5) Land Owner	Joventino Olaes
(6) Resident	None
(7) Land Price	- Zonal value: PHP 3,500/m^2, - Land price for cost calculation for STP: PHP 7,000/m^2
(8) Land Acquisition Progress/Note	- All due diligence reports in Maynilad are consolidated. - Being appraised. - Although there are two small sheds, Maynilad and the land owner agreed to remove them before development of the land.
(9) Flood	- Area is highly susceptible to flooding - Expected to get a maximum flood depth of 1.0 m during strong typhoon.
(10) Construction Regulation	- Maximum building height: 16 m or 5-story - Minimum setback from public road: 5 m - Allowable maximum building footprint: 75%

Site Map (The numbers in the photo above correspond to the numbers of the photos below.)

1. Access Road

2. View of the Site

3. View of the Site

Source: JICA Study Team