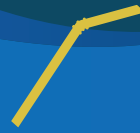


East Asia and Pacific Region: **MARINE PLASTICS SERIES**

An Assessment of Municipal Solid Waste Plans, Collection, Recycling and Disposal of Metro Manila





An Assessment of Municipal Solid Waste Plans, Collection, Recycling and Disposal of Metro Manila

Copyright © by International Bank for Reconstruction and Development / The World Bank
1818 H Street NW, Washington DC 20433
Telephone: 202-473-1000, Internet: www.worldbank.org

This work is a product of staff at The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy, completeness, or currency of the data included in this work and does not assume responsibility for any errors, omissions, or discrepancies in the information, or liability with respect to the use of or failure to use the information, methods, processes, or conclusions set forth. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, all of which are specifically reserved.

Citation:

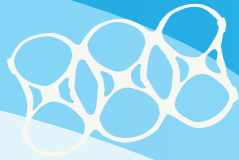
World Bank. 2022. *An Assessment of Municipal Solid Waste Plans, Collection, Recycling and Disposal of Metro Manila*. Washington DC.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

Cover photo: Shutterstock / Alex Traveler. Further permission required for reuse.



An Assessment of Municipal Solid Waste Plans, Collection, Recycling and Disposal of Metro Manila



THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP



Korea
Green Growth
Trust Fund

CONTENTS

Acknowledgments	7
Abbreviations.....	8
EXECUTIVE SUMMARY	10
CHAPTER 1. INTRODUCTION	18
CHAPTER 2. METHODOLOGY AND LIMITATIONS	20
CHAPTER 3. DEMOGRAPHIC AND GEOPHYSICAL SETTING	22
CHAPTER 4. SOLID WASTE MANAGEMENT SYSTEMS	26
4.1 Socio-economic Profile of the LGUs.....	27
4.2 Waste Composition.....	28
4.3 Waste Generation.....	31
4.4 Waste Diversion.....	32
4.4.1 Diversion of Recyclables	32
4.4.2 Diversion of Biodegradables	34
4.4.3 Infrastructures for Waste Diversion	34
4.4.4 Programs for Plastic Waste Management.....	38
4.4.5 Rates of Waste Diversion.....	41
4.5 Waste Collection	41
4.6 Disposal.....	43
4.7 Institutional Set-up	45
4.8 Ordinances	48
4.9 Waste Data Management System	49
4.10 SWM System Gaps	49
4.10.1 Gaps Affecting Plastic Waste Management.....	49
4.10.2 Gaps Affecting the Overall SWM System of the LGUs.....	52
CHAPTER 5. COMPARATIVE ASSESSMENT OF METRO MANILA LGUs	54
5.1 Waste Generation.....	54
5.2 Plastic Waste Management Programs	54
5.3 Passed Plastic Management Ordinance.....	55
5.4 Facilities for Waste Diversion.....	55

5.5 System for the Recovery of Recyclables.....	55
5.6 Population Density.....	55
5.7 Proximity to Waterways and Water Bodies	56
CHAPTER 6. INVESTMENT OPPORTUNITIES	58
6.1 Investments for Recycling	59
6.1.1 Centralized Recyclable Recovery Facility	60
6.1.2. Enhancement of Existing MRFs and MRS Arrangements	61
6.1.3 Additional Barangay Trading Centers for Plastics	62
6.1.4 Segregation Bins for Plastic Waste	62
6.2 Investments for Collection	63
6.3 Proposed Studies for the Recommended Investments	64
CHAPTER 7. CONCLUSIONS AND RECOMMENDATIONS.....	68
REFERENCES	71
ANNEX.....	73

LIST OF BOXES

Box 1. Basic vs. Mechanized or Automated MRFs.....	35
Box 2. Equipment Set for Chair Factory	62

LIST OF FIGURES

Figure 1. Map of Metro Manila showing the waterways and adjacent water bodies.....	24
Figure 2. Waste flow within the SWM systems of the Metro Manila LGUs.....	27
Figure 3. Percentage by weight of the major waste components across Metro Manila LGUs	29
Figure 4. Average waste composition of Metro Manila	30
Figure 5. Population and waste generation of Metro Manila from 2020 to 2025	32
Figure 6. Location of designated disposal facilities in Metro Manila.....	44

LIST OF TABLES

Table ES.1. Matrix of proposed investments and targeted LGU tiers.....	15
Table 1. Summary of demographic features of Metro Manila (in order of estimated 2020 population).....	23
Table 2. List of LGU plans and effectivity period.....	27
Table 3. Summarized results of the Waste Characterization and Assessment Surveys (WACS) of Metro Manila LGUs (in the order of decreasing per capita generation).....	28
Table 4. Waste composition of Metro Manila and the national average	30
Table 5. Projected daily waste generation of Metro Manila from 2020 to 2025 (in the order of decreasing generation)	31
Table 6. Buying price of recyclables at junkshops	33
Table 7. Distribution of waste diversion facilities in Metro Manila.....	37
Table 8. Features of the plastic waste management programs of Metro Manila LGUs	38
Table 9. Reported waste diversion rate of LGUs as of October 2020	41
Table 10. Summarized features of waste collection implemented by Metro Manila LGUs (arranged in the order of decreasing waste collection)	42
Table 11. Features of the Metro Manila solid waste disposal facilities.....	44
Table 12. Current disposal rates of Metro Manila LGUs ^a at the three designated sanitary landfills	45
Table 13. Functional groups within each LGU responsible for SWM	46
Table 14. Groups responsible for coordinating plastic waste management	47
Table 15. Summary of ordinances on plastic waste management.....	48
Table 16. Available and additional SWM data for LGUs and agencies responsible for waste management	50
Table 17. Features affecting SWM systems of LGUs.....	53
Table 18. Summarized assessment ratings of the Metro Manila LGUs	57
Table 19. Matrix of proposed investments and targeted LGU tiers.....	59
Table 20. Top 10 most common waste in Pasig River.....	63
Table 21. Required surveys and studies for the recommended investments	65
Annex 1. Target Respondents of Data Request and on-line Interviews	73

ACKNOWLEDGMENTS

The study was conducted by Reynar R. Rollan (Technical Consultant) under the supervision of Junu Shrestha (Senior Environmental Specialist). Agnes Chung Balota (Environmental Specialist) led the engagement with government agencies. The work was done under the guidance of Anjali Acharya (Senior Environmental Specialist), and leadership of Ndiame Diop (Country Director) and Mona Sur (Practice Manager). The report benefitted from comments provided by Hadji Huseynov (Senior Infrastructure Specialist) and Joop Stoutjesdijk (Lead Irrigation Engineer). Sarah Hollis produced the cover and report design. The team was assisted by Venessa Vaishali Sarkar.

The study team would like to thank the following offices for providing details about the institutional and operational aspects of their respective solid waste management systems, issues that deter implementation, and existing and proposed programs for improvement: City Environment and Natural Resources Offices of Caloocan, Las Piñas, Malabon, Navotas, Parañaque, Pasay, Pasig, Pateros, San Juan, Taguig, and Valenzuela; City Environment Management Office, Marikina; Municipal Environment and Natural Resources Office of Pateros; Department of Public Services – Manila; Department of Environmental Services of Makati; City Environmental Management Department of Mandaluyong; Environmental Sanitation Center – Muntinlupa; and Task Force on Solid Waste Management of Quezon City.

Appreciation is extended to the Metro Manila Development Authority's Solid Waste Management Office for providing data on the waste-collection practices of Metro Manila LGUs and data on the features of the three disposal facilities under its management; the National Solid Waste Management Commission for providing copies of the solid waste management plans of Metro Manila's 17 LGUs; Metro Manila Linis-Ganda, Inc., for providing a description of their plastic-recycling efforts; and the Solid Waste Management Section of the National Capital Region for providing data on the Materials Recovery Facilities, Material Recovery System, and the collection system of Metro Manila LGUs.

The Environment, Natural Resources and Blue Economy Global Practice enabled and supported the study.

Funding for this study was provided by the Korea Green Growth Trust Fund (KGGTF), a partnership between the World Bank Group and the Republic of Korea that aims to mainstream inclusive green growth throughout the World Bank's lending operations and to help World Bank client countries identify and implement the most innovative, technical, and operational solutions to their specific development challenges.

ABBREVIATIONS

CBD	Central Business District
CEMD	City Environmental Management Department
CEMO	City Environment and Management Office
CENRO	City Environment and Natural Resources Office
CESO	City External Services Office
DAO	Department Administrative Order
DES	Department of Environmental Services
DPS	Department Public Services
DENR	Department of Environment and Natural Resources
DILG	Department of Interior and Local Government
DOH	Department of Health
EMB	Environmental Management Bureau
EMB-NCR	Environmental Management Bureau-National Capital Region
EPWMD	Environmental Protection and Waste Management Department
ESC	Environmental Sanitation Center
GDP	Gross Domestic Product
HDPE	High-Density Polyethylene
IEC	Information, Education and Communication
IRR	Implementing Rules and Regulations
KILUS	Kababaihan Iisa ang Layunin Umunlad ang Sambayanan
LDPE	Low Density Polyethylene
LGU	Local Government Unit
LLDPE	Linear Low-Density Polyethylene
MENRO	Municipal Environment and Natural Resources Office
MMDA	Metro Manila Development Authority
MMFMP	Metro Manila Flood Management Project
MOA	Memorandum of Agreement
MRF	Materials Recovery Facility
MRS	Materials Recovery System
NGO	Non-Government Organization
NSLF	Navotas Sanitary Landfill
NSMSLF	New San Mateo Sanitary Landfill
NSWMC	National Solid Waste Management Commission
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCEX	Plastic Credit Exchange
PD	Presidential Decree
PET	Polyethylene Terephthalate

PP	Polypropylene
PS	Polystyrene
PSA	Philippine Statistics Authority
PVC	Polyvinyl Chloride
RA	Republic Act
RPSLF	Rizal Provincial Sanitary Landfill
SLF	Sanitary Landfill
SUP	Single Use Plastic
SWAPP	Solid Waste Management Association of the Philippines, Inc.
SWM	Solid Waste Management
tpd	tons per day
WACS	Waste Assessment and Characterization Survey

EXECUTIVE SUMMARY

This study performed an assessment of the solid waste management (SWM) plans and the collection, recycling and disposal conditions of the 17 Local Government Units (LGUs) of Metro Manila to determine the gaps and barriers hindering the effective implementation of Republic Act 9003 (RA 9003)—particularly the recovery and recycling of plastic waste. The results were used to identify potential investment opportunities that could contribute to improved plastic waste management and the overall SWM systems of LGUs.

The assessment focused on the approved 10-Year SWM plans, online reports of the National Solid Waste Management Commission (NSWMC), data provided by the Metro Manila Development Authority, interviews with the heads and staff of the SWM functional groups of each LGU and related government institutions, and a web search on government and private sector initiatives on recycling and plastic waste management.

Metro Manila is composed of 16 cities and 1 municipality, with a combined total 1,712 barangays. Its land area of 619.1 square kilometers is bounded by large bodies of water on the west (Manila Bay) and east (Laguna de Bay). The central section LGUs are traversed by the main channel of the Marikina-Pasig River and the rest are drained by the tributaries. These waterways and waterbodies are plagued by illegally disposed and uncollected waste. The condition is exacerbated during floods when additional uncollected waste and litter move down the gradient and clog man-made canals and natural waterways. Eventually, the waste is discharged into Manila Bay or deposited into the 50 existing pumping stations of Manila.

The institutional, legal and financial aspects as well as the management of hazardous waste were not covered in this assessment. The assessment did not consider the effects of the pandemic on waste generation. Due to the restrictions brought on by the pandemic, field verification of the data gathered through interviews was not conducted.

SOLID WASTE MANAGEMENT SYSTEMS

The actual implementation of the provisions of RA 9003 is anchored on the approved 10-Year SWM Plans. The Plans describe key components of the SWM systems, including socio-economic profiles and waste composition, generation, diversion, collection and disposal.

In the 2013-2014 Waste Characterization and Assessment Surveys (WACS), only three of the seven plastic types—Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE) and Polyvinyl Chloride (PVC)—were consistently reported. The remaining plastic types were usually lumped with other inorganic materials as residual waste.

Available data on waste density is limited with an indicative value of 174 kg/cubic meter. Considering the predominantly urban character of Metro Manila, the available per capita waste generation data is underestimated and translates to a similar underestimation of the waste generation of the LGUs. Based on the NSWMC data, Metro Manila generated 9,500 tpd of waste in 2020, which is projected to

increase to nearly 10,400 tpd by 2025. Waste generation projections should utilize an increasing per capita waste generation based on the results of previous WACS and the gross domestic product (GDP) of the region. This was not done; hence the projection is an underestimation.

Waste Diversion

Waste diversion in Metro Manila includes the recovery of recyclables and composting of biodegradables.

From source, the waste goes through four levels of recovery of recyclables.

- **Level 1:** Takes place at the source and is performed at households and establishments.
- **Level 2:** Is performed by mobile pickers at drop-off points of waste outside residences and waste generating establishments, at materials recovery facilities (MRFs) and at the pushcarts barangay eco-aides under the materials recovery system (MRS) arrangement.
- **Level 3:** Takes place at the collection vehicles of the LGU-managed collection system and is performed by the truck crew.
- **Level 4:** Is performed by the informal waste pickers at the disposal sites.

The progression from Level 1 to Level 4 in all the SWM systems highlights the incomplete recovery of recyclables in each level and the variable quality of the plastics. The recyclables recovered through these four levels are eventually sold to junkshops, where they are sorted and classified anew prior to sale and delivery to the consolidators. Residuals are generated from Level 2 to 4 and at junkshops. The plastics recovered at all levels include mainly PET, HDPE and PVC because these are preferred by the junkshops. Based on interviews of several junkshop operators in Quezon City, straws, styrofoam, sachets and other single use plastics (SUPs) are not accepted. These materials will most likely be missed during collection, disposed of improperly and potentially deposited into waterways.

The physical condition of the recovered plastics from the four levels are inherently different due to variable conditions during retrieval from the waste stream. Due to the limited practice of segregation at source, the recyclables recovered at Level 2, Level 3 and Level 4 usually come from mixed waste. This affects the quality

of the plastics sold to the junkshops and, ultimately, to the consolidators and recyclers.

There is no available data indicating the quantity of the recyclables separated from the waste stream and eventually sold to junkshops, consolidators and recyclers.

The rates of waste diversion for Metro Manila LGUs, as compiled by the Metro Manila Development Authority (MMDA), vary from a low of 10 percent in Taguig to a high of 77 percent in Malabon. In reality, the waste that is delivered into the landfills is not separated into the cited components and yields an overestimated diversion rate. The absence of data on the amount of waste that has been recycled and composted makes it challenging to generate a reasonable estimate. A memorandum order from the NSWMC on an accurate method for determination of waste diversion is needed.

Infrastructures for Waste Diversion

The primary government-mandated infrastructure for the recovery of recyclables and the processing of biodegradables is the MRF. Out of the 1,710 barangays of Metro Manila, only 334—or about 20 percent—have their own MRFs, usually a small shed or warehouse-type building with concrete floors where space is available for the receipt and manual or mechanized processing of source segregated or mixed municipal solid waste. The floor area of typical barangay MRFs varies from 20 to 100 m² and can usually accommodate sorting of recyclables and composting. The number of MRFs processing both the recyclables and biodegradables is not known.

The gap in the number of required barangays MRFs is partially attributable to the limited and expensive lots in the highly urbanized and densely populated LGUs of Metro Manila.

Recovery and trading of recyclables is also done at the private sector through the junkshops. Currently, there are at least 1,268 junkshops in Metro Manila. These facilities sort, pack and sell recyclables to consolidators or directly to recycling companies. The recyclables include paper, carton, metals, glass bottles and plastics such as PET, HDPE and PVC.

In the absence of MRFs, the barangays of Metro Manila entered into agreements with junkshops in their respective jurisdictions to directly sell recyclables recovered by sorting of waste at mobile vehicles (like pushcarts) by barangay-designated personnel or eco-aides. This arrangement is referred to as the

MRS. Monitoring of the placement and collection of the residuals at the designated locations is not performed by the barangays. This condition contributes to the leak in the collection system, which could pollute the waterways with plastics.

In reality, the outputs of the MRFs and MRS are not known and cannot be properly evaluated. These facilities and systems—which are inferred to recover the bulk of the recyclables in the SWM systems under Level 2—cannot process all the waste, as shown by the recovery of recyclables at the waste collection vehicles and the disposal facilities. The amount of recyclables that are recovered at Level 3 and Level 4 is referred to as the “recycling gap.” If there were sufficient and efficiently operated MRFs and MRS, then the recycling gap would be significantly reduced and the unsanitary practice of sorting at collection vehicles and disposal sites would be reduced, if not completely stopped.

Programs for Plastic Waste Management

Aside from existing diversion facilities and systems, various programs for recycling of plastics are currently implemented and/or planned for most of the LGUs of Metro Manila, in coordination with the private sector.

The most common program on plastic waste management in barangays is the production of chairs and bricks. In support of this method of diversion and to increase composting, the office of the Environmental Management Bureau of the National Capital Region (EMB-NCR) provided 14 LGUs of Metro Manila with a set of equipment for the operation of a small plastic chair factory, a composter and a shredder.

While the LGUs and the government focused on chair and brick production from SUPs, the private sector and non-government organizations (NGOs) established and operated plastic redemption or trading centers where cash or goods are given for an equivalent amount of plastic waste.

The recovery of SUPs through cash payments or trading for goods of manufacturing companies is performed in three LGUs, namely: Manila, Malabon and Valenzuela.

Waste Collection

Waste collection in Metro Manila LGUs is performed through the combined efforts of the barangays and LGUs.

As required in RA 9003, collection of segregated waste is performed by the barangays, who deliver

waste to the MRFs for segregation of recyclables and composting of the biodegradables. The LGUs are tasked with the collection of the residual waste. With the limited resources of the barangays and the small number of MRFs, this condition has not been attained in the 17 LGUs of Metro Manila.

In practice, the bulk of waste collection in Metro Manila is now performed by the LGUs together with their contracted private haulers due to the limited resources of the barangays. Out of the 17 LGUs, 15 use private haulers.

Based on data provided by MMDA, 33,000 m³ of waste is collected daily from all Metro Manila LGUs. Using the average density of 174 kg/m³, this translates to only about 5,742 tpd or about 60 percent of the projected 9,498 tpd for 2020. This collection rate is low compared to Jakarta and Bangkok,¹ which have waste collection rates of 74 percent in 2017 and 81 percent in 2018, respectively.

While LGU-operated or managed collection systems are present within Metro Manila with minor participation by barangay-managed systems, there is no information to indicate the actual coverage and efficiency of these two systems. Non-collection is expected in areas that are not covered by the barangay collection and not reached by the LGU collection trucks. These correspond to the narrow road networks that traverse the depressed or slum areas. Additional losses are incurred due to non-collection of residuals from barangay MRFs and residuals from MRS and junkshops at designated locations. These losses are not quantified, but are manifested by the presence of litter in streets, vacant lots and waterways—particularly during flood events.

Disposal

Waste disposal in Metro Manila is managed by the MMDA. Currently, three privately operated facilities can accept waste from the 17 LGUs. These are the Rizal Provincial Sanitary Landfill (RPSLF), New San Mateo Sanitary Landfill (NSMSLF) and Navotas Sanitary Landfill (NSLF).

The waste disposed into these three landfills is currently measured in cubic meters by using the number of trucks with known volumes. This method could lead to inconsistent results due to the variability in the fullness of the collection vehicles and the variability of density of waste from the different LGUs. Best

1 Booklet on Thailand State of Pollution, 2018.



Photo: Shutterstock / Kosol Phunjai.

disposal practice requires the use of automated weigh bridges at the gates of sanitary landfills for proper monitoring and systematic recording.

Data on the actual operation of the disposal facilities and the level of compliance with RA 9003 requirements on regular waste compaction, application of soil cover and collection and treatment of leachate are not available. There is no official documentation of the previously reported practice of sorting and picking at the disposal sites after the deposition of the waste.

Institutional Set-up

Metro Manila LGUs essentially comply with the RA 9003 requirement for the establishment of the City or Municipal Solid Waste Management Board and the Barangay Solid Waste Management Committee. The law effectively placed the burden of SWM to the barangays with limited technical and financial resources.

Actual implementation of the SWM plan is performed by functional groups under the office of the chief executives of the LGUs. Interviews with the heads and representatives of these groups showed that the basic tasks of collection, disposal, sanitation, enforcement and monitoring of the components of the SWM system are regularly performed—notwithstanding the difference in hierarchy level organizational name.

Waste Data Management

The maintenance and regular update of a waste data management system is vital for effective monitoring and implementation of collection, diversion and disposal of municipal solid waste of LGUs.

The barangays, LGUs and the Environmental Management Bureau (EMB) do not have the necessary and regularly updated data on waste management.

The basic quantitative data on collection and diversion are not available at the barangay level.

The quantified data available at the LGU level mainly covers its collection efforts. Quantitative data on waste diversion, however, is generally limited. The basic data on collection and diversion of the barangays under its jurisdiction is not available.

The EMB only has data on the number of MRFs and MRS, SWM plans and disposal facilities. It does not have data on diversion performed at the barangay and LGU levels. It relies on MMDA for the recording of the LGU-managed collection.

Coordination between the LGUs and the barangays is deficient or absent on the aspects of monitoring of collection and waste diversion through MRFs and MRS. This is manifested by the absence of a unit within the LGUs to monitor barangay MRF and MRS operations.

As the lead agency in SWM, EMB should initiate systematic waste data collection at the barangay and LGU levels. It must develop a data checklist to be regularly updated by the barangays and LGUs. Technical assistance could be extended by EMB to explain the filling-up and updating of the checklist. For its part, the NSWMC could issue a memorandum order requiring barangays and LGUs to regularly submit the collected data using conventional reporting methods or available and free online mobile phone applications such as Google Drive spreadsheets or Kobo Tool Box.

Ordinances

The seventeen LGUs have passed ordinances mandating waste segregation at source, prohibiting littering and open dumping, and the practice of segregated waste collection. Based on interviews, the level of enforcement of these ordinances varies with each LGU.

The Metro Manila LGUs have differing approaches to how plastic waste should be managed.

The cities of Las Piñas, Makati, Mandaluyong, Muntinlupa, Parañaque, Pasay, Pasig and Quezon ban the use of plastics in their respective areas. Malabon, Manila, Marikina, Pasig and Pateros prohibit the use of plastics for dry goods and regulate the use of plastics on wet goods. Caloocan and Marikina favor the regulated use of plastics over a total ban. Elsewhere, San Juan and Taguig are still planning to have ordinances regarding the use of plastics in their respective jurisdictions. Valenzuela, which hosts a lot of plastic recycling companies, does not have an ordinance on plastic use and management, but implements a program to recycle SUPs.

SWM System Gaps

The gaps of the SWM systems of the Metro Manila LGUs were classified into two groups: those that affect plastic waste management and those that affect the overall SWM systems of the LGUs.

Gaps affecting plastic waste management include:

- Incomplete waste collection.
- Limited number of MRFs and MRS arrangements.
- Variable quality of recyclables retrieved through the four levels of sorting and recovery.
- Incomplete plastic waste data from currently available WACS results.

Gaps affecting the overall SWM system of the LGUs include:

- Use of inappropriate method of determining waste diversion.
- Limited processing and composting of biodegradables.
- Use of the volumetric method and assumed waste density instead of weigh bridges at the designated disposal sites.
- Absence of monitoring and evaluation in existing SWM plans.
- Non-evaluation of the physical and socio-economic features of the LGUs, with respect to the various components of the SWM system.
- Limited SWM data at the barangay, LGU and agency levels.

COMPARATIVE ASSESSMENT OF METRO MANILA LGUS

A comparative assessment of the 17 LGUs was performed to determine their level of readiness and need to receive investments addressing gaps in the respective SWM systems. The assessment utilized the following features of the respective SWM systems: (1) waste generation, (2) existing plastic waste management programs, (3) passage of relevant plastic ordinances, (4) available infrastructure for diversion, (5) available system for recovery of recyclables, (6) potential space for infrastructure and (7) proximity to waterways that can potentially receive uncollected waste. Each criterion was assigned three equal grade levels of 1, 2 or 3, with 3 being the highest and 1 being the lowest.

The level of implementation of the SWM plans was considered but not used. This would have required an impartial assessment that could only be obtained through comprehensive visual surveys, a review of SWM records and person-to-person interviews. This would include, among others, segregation at source, segregated waste collection, operation of the MRFs, operation of the MRS, collection coverage and compliance to ordinances on littering and use of plastics.

The institutional set-up was also considered, but not used in the assessment due to the absence of clear-cut differences among the LGUs. The set-up—as presented in the SWM plans—varies, but the basic functions of collection, disposal, monitoring and enforcement

are present in differing degrees notwithstanding the absence of officially designated units within the organization. In some LGUs (e.g., Caloocan, Makati, Marikina and Parañaque), disposal and collection are lumped together under one unit. The rest of the LGUs have separate units for collection and disposal.

Based on the criteria, the LGUs were classified into four tiers.

- Tier 1 corresponds to LGUs with high ratings in the implementation of plastic waste management projects, passage of necessary plastic waste ordinances and diversion facilities, and moderate rating in MRS. These are Muntinlupa, Parañaque and Pasig.
- Tier 2 LGUs rank a close second in overall SWM management, but individually exhibit a wide range in ratings per evaluation criteria. Tier 2 includes eight LGUs with ratings of 16 to 15: Manila, Quezon City, Pasay City, Las Piñas, Makati, Malabon, Mandaluyong, and Marikina.
- Tier 3 LGUs rank significantly lower compared to Tier 2 in terms of overall SWM management. Tier 3 includes five LGUs within a rating of 13 to 11: Navotas, Pateros, Valenzuela, Caloocan and Taguig.
- The lone LGU under Tier 4 ranks lowest in overall SWM management and corresponds to the City of San Juan.

INVESTMENT OPPORTUNITIES

Investment opportunities have been identified to address the major gaps in recovery of recyclables and inadequate collection system.

Table ES.1 presents the recommended investments and the corresponding members of the Tiers that require the intervention. The investments per gap were arranged in the order of decreasing impact to the SWM systems.

The main consideration for the selection of primary and secondary targets for investments is the Tier classification of the LGUs. The selection was then based on the number of existing facilities or systems that could be enhanced and the inferred large gaps in collection and recycling.

Implementation of the recommended investments would require studies and surveys to gather data on the actual SWM conditions of the recipient LGUs. The investments should be accompanied by institutional strengthening of the concerned LGUs to ensure proper implementation as well as sustained operation and maintenance.

Table ES.1.

MATRIX OF PROPOSED INVESTMENTS AND TARGETED LGU TIERS

SWM System Gap	Proposed Investment	Primary Targets	Secondary Targets
Recycling Gap	Centralized Recovery Facility	Tier 1 LGUs	None
	Enhancement of MRFs	Pasay City and Quezon City of Tier 2	Caloocan of Tier 3
	Enhancement of MRS	Pasay City and Manila of Tier 2	Caloocan of Tier 3
	Additional plastic trading centers	Tier 2 LGUs except Manila and Mandaluyong	Tier 3 LGUs except Valenzuela
	Segregation bins	LGUs with major Central Business Districts (CBDs): Quezon City, Manila, Makati, Mandaluyong of Tier 2; Taguig of Tier 3; Muntinlupa of Tier 1	None
Collection Gap	Pushcarts	All LGUs	Not applicable
	Skip bins	All LGUs	Not applicable
	Small collection vehicles	Quezon City, Manila of Tier 2; Caloocan of Tier 3	Rest of Tier 2

CONCLUSIONS AND RECOMMENDATIONS

An analysis of the SWM systems of the 17 LGUs of Metro Manila showed the presence of gaps in collection, recycling and methodologies employed in planning, diversion and disposal, which hinder the effective implementation of RA 9003—particularly plastic waste management. Gaps in the available SWM data at the barangay, LGU and agency level are also present.

Investments to improve recovery of recyclables include the establishment of centralized facilities for the processing of dry, source-segregated dry waste, enhancement of the operation of the existing MRFs and MRS, establishment of additional plastic redemption centers in all of the LGUs and deployment of plastic segregation bins in major commercial establishments at LGUs with major CBDs.

Investments in collection include the combination of the following: acquisition and deployment of pushcarts to barangays, deployment of skip bins near MRFs, MRS routes, and junkshops and small collection vehicles that can pass through narrow roadways of depressed areas. The pushcarts can simultaneously be used to support the MRS of the barangays.

The 17 LGUs were assessed in terms of (1) waste generation, (2) existing plastic waste management programs, (3) passage of relevant plastic ordinances, (4) available infrastructure for diversion, (5) available system for recovery of recyclables, (6) potential space for infrastructure and (7) proximity to waterways. These

criteria were used to determine their comparative readiness and need to implement investments to improve the SWM systems.

The assessment led to a classification of the LGUs into four tiers that could serve as the basis for the prioritization of recipients of proposed improvements of the SWM system. Tier 1 (which includes Parañaque, Pasig and Muntinlupa) will be considered for the construction of centralized facilities for the processing of dry, potentially recyclable waste. The LGUs within each of the remaining Tiers shall be considered for the implementation of the other investments based on their respective needs.

The proposed improvements of the SWM systems of Metro Manila through appropriate investments in recycling and collection, better planning and the establishment of a SWM database can be replicated in other parts of the Philippines where similar gaps in the implementation of RA 9003 exist. The memorandum orders to be issued by the NSWMC on SWM planning, diversion and waste data collection will apply to all LGUs of the Philippines.

The assessment and the data contained therein could be used as the starting point in the formulation of the 25-Year SWM Plan for Metro Manila, subject to comprehensive field verification. Recommendations for monitoring and the parameters that need to be monitored could be adopted by the EMB to enhance its current system.



Photo: Shutterstock / junpinzon.

CHAPTER 1.

INTRODUCTION

In 2001, the Ecological Solid Waste Management Act, which is commonly referred to as Republic Act 9003 (RA 9003), was passed to address the growing problem of waste management of the, then, 80 million Filipinos. Nearly 20 years later, plus an additional 30 million residents, the issues concerning solid waste management have not been adequately addressed. Most of the 1,634 Local Government Units (LGUs) still employ the collect and dispose system with limited focus on reduction, reuse and recycling. This condition is aggravated by the limited number of sanitary landfills and materials recovery facilities (MRFs), restricted availability of funds for solid waste management (SWM) projects and the limited implementation of the law, among others. Based on the 2020 records of the National Solid Waste Management Commission (NSWMC), there are only 185 operational sanitary landfills in the country, mostly with capacities below 15 tons² per day, servicing 378 LGUs (23 percent of total LGUs) and 10,722 MRFs—which correspond to about 33 percent of the 42,036 barangays in the country³. Based on estimates by the NSWMC, the 2021 waste generation of the Philippines would reach 21.8 million tons and attain 23.6 million tons by 2025⁴. Related to these SWM conditions is the subsequent marine plastic pollution. In 2015, studies by Jambeck et al.⁵ indicated that the Philippines ranks third among the worst ocean plastic polluters in the world, after China and Indonesia. In 2019, Lebreton and Andrady⁶ estimated that the country generates 4.52 million metric tons of plastic waste per year, of which 0.81 million metric ton comes from Metro Manila.

The 2020 market study commissioned by the World Bank⁷ on plastics circularity in the Philippines delineated the size and scale of the country's plastics production and recycling industry. It showed that the Philippines recycled just 28 percent of the plastics it used in 2019. The value to the material loss is estimated to range from 790 to 890 million USD. The market study formulated the following measures to increase recovery and circularity of plastics:

- Increase waste collection and sorting efficiency of post-consumer plastics.
- Set recycled content targets across all major end-use applications.
- Mandate national design for recycling standards for plastics, (i.e. for packaging).
- Encourage increased mechanical and chemical recycling capacities.
- Create industry-specific requirements to increase waste collection rates.
- Restrict disposal of plastics in landfills and phase-out non-essential plastic items.

2 Under DAO 2006-10, which categorized the sanitary landfills of the Philippines into 4, the small LGUs with residual waste generation of less than 15 tons per day can build their own sanitary landfills that fall under Category 1. Due to smaller costs, most of the landfills were built to correspond to Category 1 sanitary landfills. Only a few LGUs were able to construct the bigger, more expensive sanitary landfills belonging to Category 2, 3 and 4.

3 NSWMC Database as of June 2020.

4 Source: NSWMC, Projected Waste Generation from 2020 to 2025.

5 Jambeck et al. (2015): *Plastic waste inputs from land into the ocean*.

6 Lebreton and Andrady (2019): *Future scenarios of global plastic waste generation and disposal*.

7 Market Study for the Philippines: Plastic Circularity Opportunities and Barriers. 2020.

The ongoing Top 10 Plastics Survey,⁸ which was also funded by the World Bank, confirmed the predominant presence of SUPs within the main channel of Pasig River in Metro Manila, Philippines.

This study corresponds to an assessment of the SWM plans and the collection, recycling and disposal conditions of the 17 LGUs of Metro Manila. It aims to provide an understanding of how these components

of the SWM system are implemented in each LGU and in Metro Manila as a whole, and determine the gaps and barriers that hinder the effective implementation of RA 9003—particularly the recovery and recycling of plastic waste. The results were used to identify potential investment opportunities that could improve plastic waste management.



Photo: Shutterstock / Jill Gulles.

8 Microplastic and Plastic Field Surveys on Pasig River (2021).

CHAPTER 2.

METHODOLOGY AND LIMITATIONS

Letters requesting SWM data and copies of the 10-Year SWM plans were sent to chief executives of the Metro LGUs and heads of the NSWMC Secretariat, National Capital Region-Environmental Management Bureau (NCR-EMB), the Metro Manila Development Authority, (MMDA), the Solid Waste Management Association of the Philippines, Inc. (SWAPP) and representatives of the plastic industry. The submitted LGU data was validated through phone interviews with the heads and staff of the SWM functional groups of each LGU and related government institutions, including the head of the cooperative of junkshops in Metro Manila.

A web search was conducted to gather additional information on government and private sector initiatives related to recycling and plastic waste management.

The results of the studies: *Market Study for the Philippines—Plastic Circularity Opportunities and Barriers* and *Microplastic and Plastic Field Surveys on Pasig River*, both commissioned by the World Bank, were used as references and sources of quantified data on plastic waste management.

An assessment of the solid waste management conditions of each LGU was performed. The assessment contributed to the identification and assessment of the gaps in SWM planning and the operational components of collection, diversion and disposal. Investment opportunities were identified, which—in combination with capacity building—could address the gaps in collection and diversion that affect plastic waste management. Based on a set of criteria that covers technical, legal and institutional aspects of the SWM systems, the LGUs were classified into four Tiers to designate where potential investments could be made to address the identified gaps.

The institutional, legal and financial aspects as well as the management of hazardous waste were not covered in this assessment.

The waste generation projection was based on data from the NSWMC for 2022-2025. This projection does not include the subsequent increase in plastic waste used in food packaging and in personal protection equipment such as masks, gloves, sanitizers, respirators, syringes and related equipment due to the on-going COVID-19 pandemic. In the absence of updated data, the increased waste generation at households due to lockdowns, restricted travel, work from home arrangements, increased online shopping and higher food consumption has not been included.



CHAPTER 3.

DEMOGRAPHIC AND GEOPHYSICAL SETTING

Metro Manila is composed of 16 cities and one municipality, with a combined total land area of 619.1 square kilometers (Table 1). Quezon City has the largest land area at 165.33 km², while the Municipality of Pateros is the smallest with a coverage of only 1.76 km². These 17 LGUs have a total of 1,710 barangays. The barangay corresponds to the lowest form of government unit that must establish and operate the required MRFs and collect and segregate recyclables and biodegradables. Manila, which makes up 6.9 percent of the land area, has the largest number of barangays at 897 or 52.5 percent of the total. Other LGUs with a large number of barangays include Caloocan, Pasay and Quezon City with 188, 201 and 142 barangays respectively.

Based on the 2015 census of the National Statistics Office, Metro Manila has a total population of 12.8 million. The estimated population as of 2020 is 14 million. The cities with high population and consequently large waste generation are Quezon City, Manila, Caloocan and Taguig. Manila and Mandaluyong have the highest density at 44,730 and 41,043 persons/km², respectively. LGUs with high population densities will likely have difficulties in selecting and acquiring lots for proposed SWM facilities. The LGUs that host major business districts include Quezon City, Manila, Makati, Mandaluyong, Taguig and Muntinlupa.

Metro Manila is bounded by large bodies of water on the west (Manila Bay) and the east (Laguna de Bay). As shown in Figure 1, seven LGUs—Navotas, Malabon, Caloocan, Manila, Pasay, Parañaque and Las Piñas—occupy the eastern rim of Manila Bay. The cities of Marikina, Pasig Mandaluyong, Makati and Manila are traversed by the main channel of the Marikina-Pasig River System. In addition to the main channel, Manila is drained by 30 major estuaries (esteros). The remaining LGUs are drained by the tributaries of the said river system. These waterways and waterbodies are plagued by illegally disposed and uncollected waste from residential, institutional and commercial establishments located adjacent to or above them. The condition is exacerbated during floods when additional uncollected waste and litter move down gradient into the main channel and contribute to their clogging. Eventually, the waste is discharged into Manila Bay or deposited into the 50 existing pumping stations of Manila. Data and updated information on the current operation and conditions of the pumping stations is unavailable.

Table 1.

SUMMARY OF DEMOGRAPHIC FEATURES OF METRO MANILA (IN ORDER OF ESTIMATED 2020 POPULATION)

No.	LGUs/with Major Business Districts	Land Area (km ²)	% Land Area	No. of Barangays	% Total Barangays	2015 Population	Estimated 2020 Population	Density (persons/km ²)
1	Quezon City	165.33	26.7	142	8.3	2,936,116	3,121,525	18,881
2	Manila	42.88	6.9	897	52.5	1,780,148	1,918,038	44,730
3	Caloocan	53.33	8.6	188	11.0	1,583,978	1,684,969	31,595
4	Taguig	45.18	7.3	28	1.6	804,915	1,005,299	22,251
5	Pasig	31.46	5.1	30	1.8	755,300	851,748	27,074
6	Parañaque	47.28	7.6	16	0.9	665,822	753,782	15,943
7	Valenzuela	45.75	7.4	33	1.9	620,422	669,018	14,623
8	Makati	27.36	4.4	33	1.9	582,602	641,588	23,450
9	Las Piñas	32.02	5.2	20	1.2	588,894	627,602	19,600
10	Muntinlupa	41.67	6.7	9	0.5	504,509	553,396	13,280
11	Marikina	22.64	3.7	16	0.9	450,741	478,999	21,157
12	Mandaluyong	11.06	1.8	27	1.6	386,276	453,939	41,043
13	Pasay City	18.64	3.0	201	11.8	416,522	441,599	23,691
14	Malabon	15.96	2.6	21	1.2	365,525	378,133	23,693
15	Navotas	11.51	1.9	18	1.1	249,463	249,795	21,702
16	San Juan	5.87	0.9	21	1.2	122,180	122,935	20,943
17	Pateros	1.76	0.3	10	0.6	63,840	63,534	36,099
	Total	619.7	100	1,710	100	12,877,253	14,015,900	

Figure 1.

MAP OF METRO MANILA SHOWING THE WATERWAYS AND ADJACENT WATER BODIES



Metro Manila is bounded by large bodies of water on the west (Manila Bay) and the east (Laguna de Bay). As shown in Figure 1, seven LGUs—Navotas, Malabon, Caloocan, Manila, Pasay, Parañaque and Las Piñas—occupy the eastern rim of Manila Bay. The cities of Marikina, Pasig, Mandaluyong, Makati and Manila are traversed by the main channel of the Marikina-Pasig River System. In addition to the main channel, Manila is drained by 30⁹ major estuaries (esteros). The remaining LGUs are drained by the

tributaries of the said river system. These waterways and waterbodies are plagued by illegally disposed and uncollected waste from residential, institutional and commercial establishments located adjacent to or above them. The condition is exacerbated during floods when additional uncollected waste and litter move down gradient into the main channel and contribute to their clogging. Eventually, the waste is discharged into Manila Bay or deposited into the 50 existing pumping stations of Manila. Data and updated information on the current operation and conditions of the pumping stations is unavailable.

9 Source: 10-Year Solid Waste Management Plan of Manila



CHAPTER 4.

SOLID WASTE MANAGEMENT SYSTEMS

The actual implementation of the provisions of RA 9003 is anchored on the 10-Year SWM Plans prepared by the 17 LGUs of Metro Manila as required under Rule VI, Section 2. As shown in Table 2, the approved plans have an effectivity period until 2023 or 2024. The SWM plan of the Municipality of Pateros, was completed and approved in 2019 and will be effective until 2028. Aside from the description of the socio-economic profile, each plan presents data on waste composition and generation, such as existing and planned collection, waste diversion and disposal systems including related equipment and facilities, collection vehicles and MRFs. The plans also describe the functional groups within each LGU, which are responsible for policy formulation, implementation and monitoring. In addition, ordinances presenting the legal basis for implementing the SWM system are presented.

Although not required by RA 9003, it would be in the best interest of the LGUs to update key sections of the plan for better implementation. These include population, urban development, waste diversion and collection. Population growth and increased urban development directly translate to increased waste generation, which will affect the ongoing and planned collection activities.

The plans were made in 2013 and 2014 using the latest available population data from the 2010 census. Since then, the 2015 census has been completed and results of the 2020 census will soon be published. These should be used to update the population and waste generation projections. Urban development will translate to different consumption and resource and space utilization, which will affect per capita waste generation and composition. Increases in population and urban development will affect the quantity and composition of the waste that needs to be diverted. Waste collection systems need to be upgraded in response to the increased waste generation. Timely and adequate updates in the SWM plans—notably in diversion and collection—will translate to improved waste management.

Figure 2 provides an overview of the flow of waste from the Metro Manila LGUs from generation through diversion, collection and disposal.

From source, the waste goes through four levels of recovery of recyclables.

- **Level 1:** Takes place at the source and is performed at households and establishments.
- **Level 2:** Is performed by mobile pickers at waste drop-off points outside residences and waste generating establishments, at MRFs and at the pushcarts barangay eco-aides under the MRS arrangement.
- **Level 3:** Takes place at the collection vehicles of the LGU-managed collection system and is performed by the truck crews.
- **Level 4:** Is performed by informal waste pickers at the disposal sites.

The progression from Level 1 to Level 4 in all the SWM systems highlights the incomplete recovery of recyclables at each level and the variable quality of the plastics.

Table 2.
LIST OF LGU PLANS AND EFFECTIVITY PERIOD

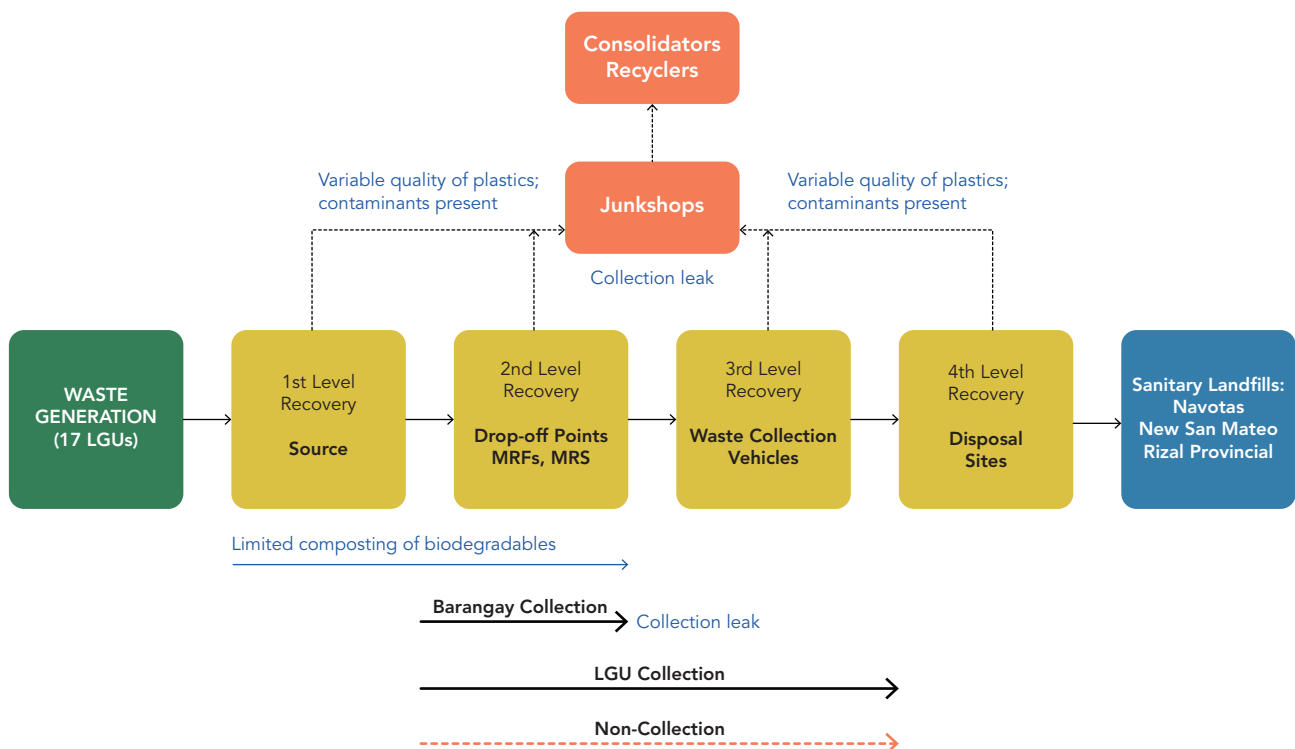
LGU	Approved Period of Effectivity
Caloocan	2015 - 2024
Las Piñas	2015 - 2024
Makati	2014 - 2023
Malabon	2015 - 2024
Mandaluyong	2015 - 2024
Manila	2015 - 2024
Marikina	2014 - 2023
Muntinlupa	2015 - 2024
Navotas	2015 - 2024
Parañaque	2015 - 2024
Pasay City	2015 - 2024
Pasig	2015 - 2024
Pateros	2019 - 2028
Quezon City	2015 - 2024
San Juan	2015 - 2024
Taguig	2015 - 2024
Valenzuela	2015 - 2024

The recovered recyclables eventually end up at the junkshops for final sorting and baling before being delivered to the recyclers by the consolidator. Composting is done in limited amounts at households, schools and MRFs under Level 1 and Level 2. Collection is performed by the barangays, the LGUs and their private haulers. Disposal takes place at the designated sanitary landfills. The flow highlights the gaps in the collection performed by the barangays and the LGUs, as well as the inferred leaks at MRFs, MRS and junkshops. These components of the SWM system are discussed and evaluated in the following sections along with key features of the 10-Year SWM plan. Gaps in composting and the quality of recyclables are also presented.

4.1 SOCIO-ECONOMIC PROFILE OF THE LGUS

The physical and socio-economic features of each LGU—such as land area, drainage, population growth, density, number and size of households, land use, institutions, economic activities, industries and economic establishments—were extensively discussed in their respective plans, but were not correlated with the various components of the SWM systems. The spatial distribution of households with various income classes,

Figure 2.
WASTE FLOW WITHIN THE SWM SYSTEMS OF THE METRO MANILA LGUS



commercial establishments and institutions—which affect generation, waste diversion, collection and potential illegal disposal—are not indicated and assessed. The proximities to natural and man-made drainage systems and large water bodies were not evaluated in relation to illegal disposal and consequent clogging and flooding. The impact on the availability of lots for SWM facilities was not evaluated with respect to population density, land area and land use. These gaps need to be incorporated in the next versions of the SWM plans, which will be submitted for approval before 2024.

4.2 WASTE COMPOSITION

Table 3 shows the compilation of the results of the WACS, which was performed primarily in 2014 and 2015. It includes data on per capita waste generation, density, number of days and year when the WACS was conducted, and the basic components of recyclables, biodegradables, residuals and hazardous and special waste.

The per capita waste generation exhibited a wide range from the low 0.265 kg/day in Taguig to the high of 1.065 kg/day in Parañaque City.

Based on the National Solid Waste Management Status Report (2008-2018), the synthesized per capita waste generation of Metro Manila for the base year 2010 ranged from 0.27 – 1.0 kg/person per day while the weighted average was 0.69 kg/person per day. All LGUs in the country, except Metro Manila, have a weighted average of 0.34 kg/person per day.

A comparison of the 2010 rate of Metro Manila with those presented in Table 3 showed that the per capita values obtained in 10 of the 17 LGUs of Metro Manila are still lower than 0.69 kg/person per day. These LGUs include Manila, Las Piñas, Caloocan, Pasig, Pateros, Muntinlupa, San Juan, Valenzuela, Navotas and Taguig. Realistically, per capita waste generation should increase over time due to economic growth and rise in consumption of resources. These values would lead to an underestimate of the waste generation.

The low per capita waste generation values are attributed to the implementation of the four-day,

Table 3.

SUMMARIZED RESULTS OF THE WASTE CHARACTERIZATION AND ASSESSMENT SURVEYS (WACS) OF METRO MANILA LGUS (IN THE ORDER OF DECREASING PER CAPITA GENERATION)

Metro Manila LGUs	Per Capita (kg/day)	Density (kg/m ³)	Year Conducted	Days Conducted	Recyclables, including Plastics (% Weight)	Bio-degradables (% Weight)	Residuals (% Weight)	Hazardous and Special (% Weight)	Plastics (% Weight)
Parañaque	1.065	115	2015	7	49.74	28.36	12.37	9.52	22.72
Quezon City	0.880	266	2013	7	20.30	53.95	18.75	7.00	9.64
Malabon	0.833	127	2014	3	22.10	41.94	28.71	7.25	26.53
Marikina	0.804	126	2014	4	41.17	40.69	10.85	7.29	15.41
Makati	0.773	No Data	2018	4	39.28	43.91	15.84	0.97	20.56
Mandaluyong	0.728	286	2014	4	32.00	46.00	8.00	14.00	23.2
Pasay City	0.673	141	2014	9	42.68	40.75	6.22	10.35	21.95
Manila	0.607	153	2015	4	32.21	49.88	5.13	12.78	17.75
Las Piñas	0.569	No Data	2014	4	32.85	39.19	14.98	12.98	15.37
Caloocan	0.508	225	2015	3	24.04	48.60	25.53	1.83	No Data
Pasig	0.450	145	2014	4	40.90	43.99	3.90	11.21	18.79
Pateros	0.443	109	2014	4	42.44	35.81	15.70	6.05	20.46
Muntinlupa	0.417	158	2011	7	47.94	43.35	8.34	0.37	26.53
San Juan	0.404	No Data	2014	4	40.45	44.18	7.38	7.98	20.96
Valenzuela	0.310	33	2012	4	38.00	46.00	15.00	1.00	20.00
Navotas	0.297	97	2015	4	39.03	40.56	9.97	10.44	19.37
Taguig	0.265	No Data	2015	4	46.93	40.33	5.39	7.35	23.58

non-consecutive day period instead of the usual seven-day continuous period for the WACS. The four-day WACS was performed in 13 of the 17 LGUs. Only Quezon City, Muntinlupa, Parañaque City and Pasay City employed the standard seven-day duration for waste characterization. The shorter period would lead to the averaging of all available per capita values, including the low ones. The longer period allows the judicious use of what are considered representative values. The WACS results in each of the plans did not indicate the statistical treatment of potential low, outlying values for the per capita generation, which could have affected the results.

Considering the predominantly urban character of Metro Manila, the range in the per capita waste generation should be higher and needs to be rectified by conducting another seven-day period WACS.

Waste densities obtained from the WACS exhibited a wide range from 33 kg/m³ in Valenzuela to 286 kg/m³ in Mandaluyong. The values obtained for Valenzuela, Navotas and Pateros are deemed low and unrealistic considering that the biodegradable components of the waste from these LGUs is significant. The average density of the Metro Manila LGUs—without considering the very low values obtained from Valenzuela, Navotas and Pateros—is 174 kg/m³. Waste density is important

in planning collection and disposal for LGUs and will directly affect payment of tipping fees once weigh bridges are installed in the designated disposal facilities. Accordingly, density should be properly determined in all LGUs during the next waste surveys.

The recyclables include plastics, metal, glass and paper, and range in weight percentage from 20.3 percent in Quezon City to 49.74 percent in Parañaque. The higher percentages of recyclables were recorded at LGUs with predominant commercial and business establishments like Parañaque, Muntinlupa, Taguig, Pasay City, Marikina, Pasig, San Juan, Makati and the small municipality of Pateros.

The lowest percentage of recyclables were recorded in Caloocan and Quezon City, which have the largest land areas and highest population densities, and correspond to the main residential areas of Metro Manila.

The last column of Table 3 shows the percentage of plastics with respect to the total weight of waste generation. The LGUs with comparatively higher percentages of plastics include Malabon, Muntinlupa, Taguig, Mandaluyong and Parañaque. With the exception of Malabon, which has a fish-based industry, the rest of the LGUs have established major commercial centers within their respective domains.

Figure 3.
PERCENTAGE BY WEIGHT OF THE MAJOR WASTE COMPONENTS ACROSS METRO MANILA LGUS

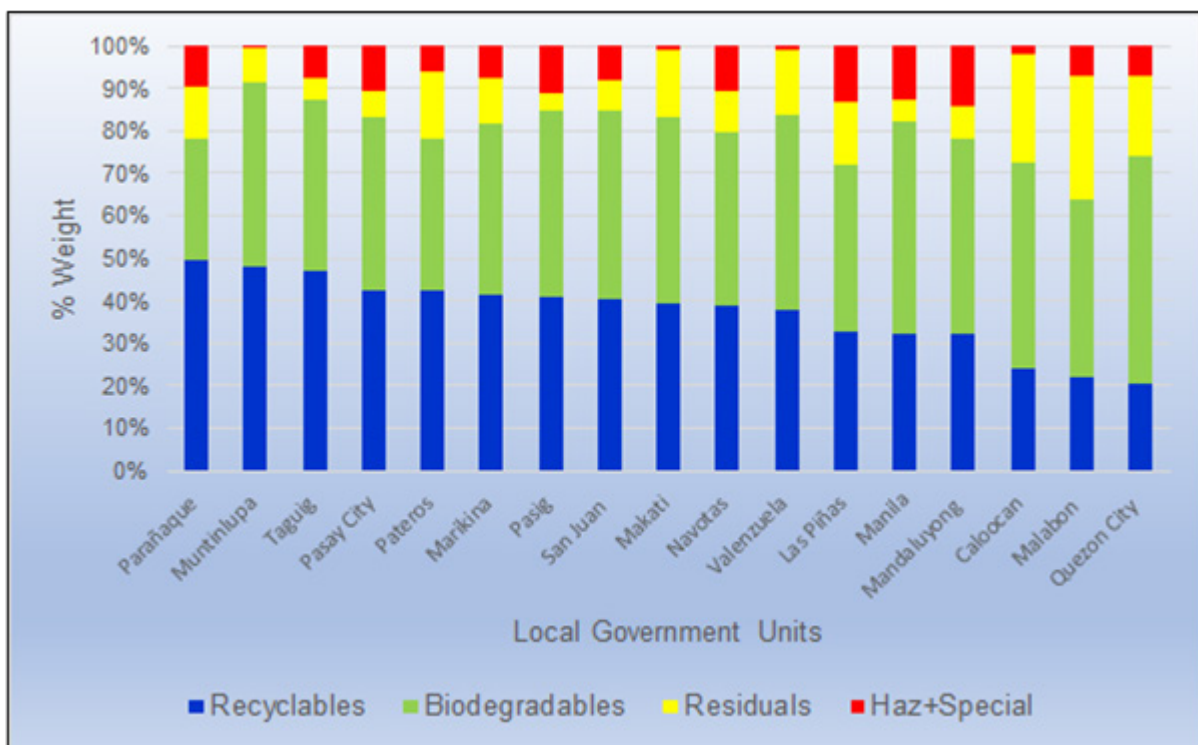


Figure 4.
AVERAGE WASTE COMPOSITION OF METRO MANILA

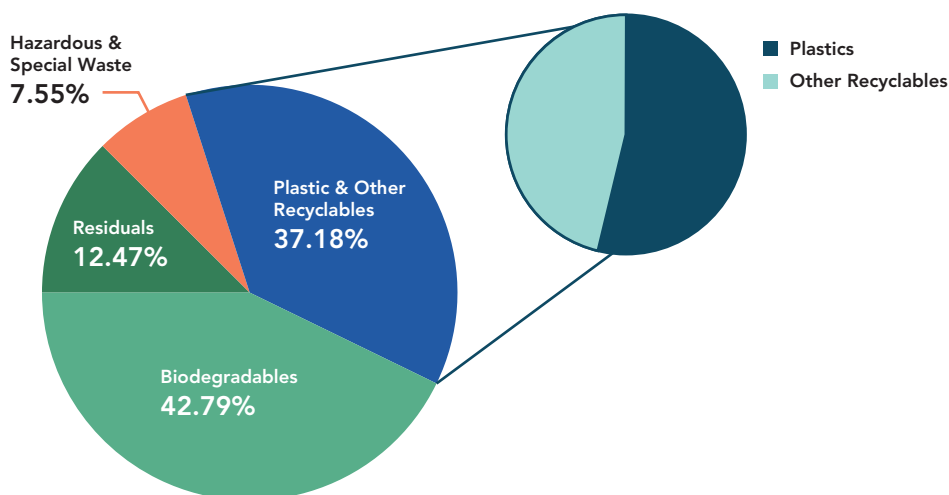


Figure 3 shows the waste composition of the different LGUs.

The biodegradables include kitchen waste, wood, yard waste and other organics. This component ranges from 28.36 percent of the weight in Parañaque and 53.95 percent in Quezon City.

The residuals consist of textiles, rubber, leather, fiberglass and other inorganic materials. The available WACS data did not indicate the composition of the inorganic materials, which could potentially include non-recyclable plastics. This component ranges from 3.9 percent of the weight in Pasig to 28.71 percent in Malabon.

The hazardous and special waste component ranges from 0.37 percent in Muntinlupa to 14 percent in Mandaluyong.

The average waste composition of Metro Manila is presented in Figure 4. The plastic components correspond to 54 percent of the potentially recyclable materials and 20 percent of the total waste generation, indicating both a high potential for recycling as well as for sources of pollution if not properly managed.

The major waste components of Metro Manila are significantly different from the national average reported in the National Solid Waste Management Status Report [2008-2018]¹⁰ (see Table 4). The biodegradables of Metro Manila are lower by 10 percent while the recyclables are higher by 10 percent. The special and hazardous wastes are also higher in Metro Manila. These differences are attributed to the highly urbanized condition of the 17

LGUs of Metro Manila. Although there is no current available WACS data, it is inferred that there will be a progressive increase in the quantity of potential recyclables and special waste and a decline in the quantity of biodegradables. This is due to a continuing shift toward the urban lifestyle, changes in consumption habits and resource utilization, increased packaging and the development of the manufacturing sector, which tends to use potentially recyclable materials.

Of the seven major plastic types, only three were consistently reported as a composite percentage in the WACS results. These are Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE) and polyvinyl chloride (PVC). These types of plastic command better prices in junkshops. The other plastic types include low density polyethylene (LDPE), Polypropylene (PP), polystyrene (PS) and polycarbonates, which are usually lumped with other inorganic materials as residual waste.

Future WACS should include the identification and quantification of all plastics components.

Table 4.
WASTE COMPOSITION OF METRO MANILA AND THE NATIONAL AVERAGE

Major Waste Components	National Average (%)	Metro Manila Average (%)
Biodegradables	52.31	42.79
Recyclables	27.78	37.18
Residual	17.98	12.47
Special and Hazardous	1.93	7.55

10 Prepared by the NSWMC.

4.3 WASTE GENERATION

Table 5 presents the waste generation projection of Metro Manila from 2020 to 2025¹¹. Current generation is around 9,500 tpd. This is expected to reach nearly 10,400 tpd by 2025, translating to an increase of 9 percent over five years. The projection utilized a fixed per capita waste generation of 0.678 kg/per person over a six-year period. In practice, waste generation projection utilizes an increasing per capita waste generation based on results of previous WACS and on the GDP of the region. Accordingly, the projected waste generation is deemed underestimated and must be updated.

The big waste generators include Quezon City, Manila and Caloocan—each of which generate over 1,000

tpd of waste. These LGUs have larger populations compared to the rest of Metro Manila. The next 11 LGUs have waste generation rates greater than 200 tpd, as of 2020. The small waste generators—Pateros, San Juan and Navotas—have lower populations than the rest of the Metro Manila LGUs and each generate less than 100 tpd of waste.

The projected annual waste generation and population of Metro Manila is shown in Figure 5. Aside from population, waste generation is also driven by increased economic activity. At 5.8 percent GDP, Metro Manila ranked third nationwide in real, per capita GDP—behind the Bicol Region and Ilocos Region. It had the highest per capita index¹² at 253.2 in 2019, which is more than twice the national average¹³.

Table 5.
PROJECTED DAILY WASTE GENERATION OF METRO MANILA FROM 2020 TO 2025 (IN THE ORDER OF DECREASING GENERATION)

Metro Manila LGUs	Projected Daily Waste Generation (tons)					
	2020	2021	2022	2023	2024	2025
Quezon City	2,851	2,908	2,966	3,025	3,085	3,146
Caloocan	1,222	1,246	1,270	1,295	1,321	1,347
Manila	1,129	1,138	1,147	1,156	1,165	1,174
Parañaque	757	777	797	818	839	861
Makati	506	513	520	527	535	542
Pasig	414	425	436	448	460	472
Marikina	392	395	399	403	407	410
Las Piñas	361	366	371	377	382	388
Mandaluyong	318	325	332	339	347	354
Malabon	311	313	314	316	317	319
Pasay City	308	311	314	317	320	324
Muntinlupa	299	305	311	316	322	328
Taguig	260	269	279	289	299	310
Valenzuela	215	219	222	226	229	233
Navotas	76	76	77	77	78	78
San Juan	49	50	50	50	50	52
Pateros	29	29	30	30	30	30
Total	9,498	9,664	9,834	10,008	10,186	10,368

Source: NSWMC, Projected Waste Generation from 2020 to 2025.

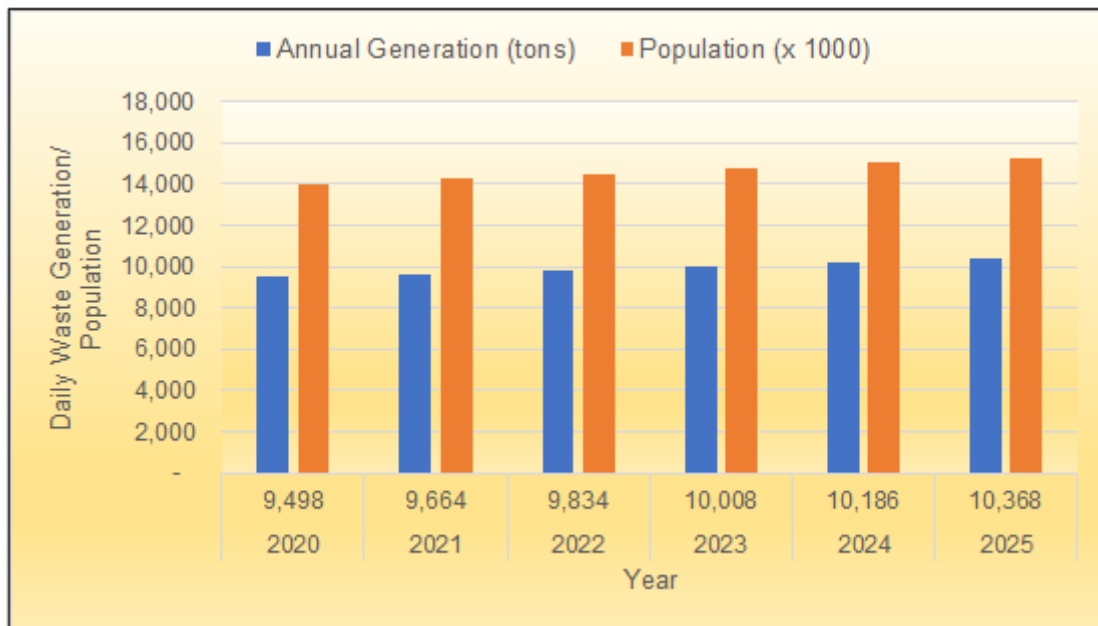
11 Source: NSWMC, Projected Waste Generation from 2020 to 2025,

12 A measure of the amount of money earned per person in a nation or geographic region.

13 Source, Philippine Statistics Authority, <https://psa.gov.ph/grdp/grdp-id/163299>

Figure 5.

POPULATION AND WASTE GENERATION OF METRO MANILA FROM 2020 TO 2025



4.4 WASTE DIVERSION

Rule VII, Section 7 of the Implementing Rules and Regulations (IRR) of RA 9003 requires all LGUs to attain a minimum of 25 percent diversion by 2006, with progressive increases every three years. Diversion, as defined in the IRR, refers to all activities that reduce the amount of solid waste deposited into disposal facilities. To attain the progressively increasing diversion target, all SWM plans encourage waste generators to practice the 3Rs (reduce, reuse and recycle recyclables) and to undertake composting of biodegradables, where practicable.

4.4.1 Diversion of Recyclables

In Metro Manila, potentially recyclable materials generated at households, institutions and commercial establishments typically go through four levels of sorting and recovery before reaching the junkshops or consolidators and recyclers. As shown in Figure 2, the recovery of recyclables takes place at source (Level 1), at MRFs and MRS of barangays and at drop-off points for collection (Level 2), at collection vehicles of LGU-managed collection vehicles (Level 3) and at disposal sites (Level 4). The consistent progression from Level 1 to Level 4 indicates the incomplete recovery of recyclables, particularly in Level 2 where the waste goes through established facilities and systems for the recovery of the recyclables.

The recovery is driven by the financial gain, no matter how small, which can be attained from the sale or trading of recyclable materials. The same conclusion was reached by the 2008 JICA study on recycling in the Philippines. The study noted the major role played by the informal sector—particularly in the recovery of recyclables. These conditions greatly affect the segregation of SUPs, which have limited value in the current market and innate low density, precluding the accumulation of an economically significant amount of said materials. The *2020 Market Study for Philippines: Plastic Circularity Opportunities and Barriers* established the preferential recovery of PET, PP and HDPE over LDPE and linear low-density polyethylene LLDPE from municipal solid waste.

First Level Recovery

This level entails the recovery of good quality recyclables at the generators’ level. Recovered materials include glass bottles, PET bottles from juices and mineral water, aluminum cans from sodas and cooking oils at households, carton boxes and packaging materials at commercial establishments, and paper at institutions and schools. The recovery of recyclables at high income residences is usually performed by the helpers. The recovery of the recyclables at the medium and low-income residences are usually performed by household owners or occupants. The output of the first level segregation is not usually captured in the

Table 6.
BUYING PRICE OF RECYCLABLES AT JUNKSHOPS

Recyclables	Price Range (PhP)
Paper	2 to 3
Carton	4 to 5
PET/PP	8 to 10
Hard plastic	14 to 15
Soda cans	7 to 8
Tin can	2 to 3
Metal	10 to 12

WACS conducted for LGUs.¹⁴ The quantity of recovered recyclables is limited by the storage availability at the households, commercial establishments and institutions. The bulk of the recovered materials are sold to junkshops or to ambulant buyers, and only a small fraction like large glass bottles and plastic jugs are reused. SUPs are generally not recovered and are considered as residuals. Data on the areas of the junkshops in 16 of the 17 LGUs is not available. In Malabon, the floor area of junkshops ranges from 20 to 370 m². Table 6 shows the typical buying price range of the recyclables in junkshops.¹⁵

Second Level Recovery

Recovery at the first level is not thorough and omits most of the recyclables within the remaining waste materials. These materials are subjected to a second round of sorting and recovery outside of the confines of the waste generators by: (1) mobile waste pickers who go through the bags or containers of mixed waste or partially segregated waste at drop off points; (2) barangay designated collectors who perform the sorting at mobile containers or pushcarts and deliver the recyclables directly to the junkshops; and (3) MRF workers who sift through the segregated waste collected by the barangays from households. The materials recovered at this level comprise the bulk of the recyclables sold to junkshops.

Third Level Recovery

This level of recovery is performed on waste loaded into the trucks of the LGUs and private haulers while

14 The WACS process entails the placement and collection of all waste generated daily at source. As observed and in practice, waste generators do not include the recyclables they recovered during the WACS survey due to economic reasons.

15 Prices based on interviews of ambulant waste pickers that sell recyclables to Quezon City junkshops.



Junkshops refer to warehouse-type structures made up of permanent or light materials where recyclables are purchased, re-sorted and baled for subsequent sale to consolidators and recyclers.

enroute to the disposal facilities. The collected materials correspond to the mixed and partially segregated waste picked up from the collection routes. The recovered recyclables are usually dropped off by the truck drivers to junkshops located along the roads leading to the disposal sites.

Fourth Level Recovery

This is performed by pickers at the two designated disposal sites in Rizal Province and at the transfer station of the Navotas Sanitary Landfill in Pier 18, Manila.

In practice and based on interviews, the recyclables acquired by the junkshops from the four levels of recovery are sorted and classified anew prior to sale and delivery to the consolidators. This final process also generates residuals, which are also collected under the existing system of the LGUs.

The informal sector plays a major role in the recovery of recyclables in all four levels. Potentially, this sector could provide the skilled labor for any proposed facility that will be established to increase recovery of plastics and other recyclables.

The plastics recovered at all levels include mainly PET, PP and HDPE, which are preferred by the junkshops. Based on interviews of several junkshop operators in Quezon City, straws, styrofoam, sachets and other SUPs are not accepted. These materials will be most likely missed during collection, disposed of improperly and could find their way into waterways. The preference for higher value plastics was also confirmed in the *Market Study for the Philippines: Plastics Circularity Opportunities and Barriers*. The study estimated the following percentages of recovery for four plastic types, which range from 48 percent for PET, 30 percent for

PP, 30 percent HDPE and 10 percent for LLDPE/LDPE. The Top 10 survey results recovered the following plastic materials from the channel of the Pasig River: noodle wrappers, polystyrene pieces, sando bags, snack wrappers, drink wrappers, candy wrappers, PCP plastics and PET bottles.¹⁶

Collection and disposal of the residuals, including low-value plastics left out during the second level of recovery and at junkshops, are not monitored. This condition contributes to the leaks in the collection system and aggravates the plastic pollution in waterways and water bodies within and around the Metro Manila LGUs.

The physical condition of the recovered plastics from the four levels are inherently different due to the variable conditions during retrieval from the waste stream. Good recyclables are usually recovered at source. Due to limited practice of segregation at source, the recyclables recovered at Level 2, Level 3 and Level 4 usually come from mixed waste. This condition affects the quality of the plastics sold to the junkshops and, ultimately, to the consolidators and recyclers. The Market Study reported the challenges recyclers face in sourcing high-quality plastics due to high contamination rates and the presence of organic materials.

There is no available data for the quantity of recyclables that have been separated from the waste stream and eventually sold to junkshops, consolidators and recyclers.

4.4.2 Diversion of Biodegradables

In the LGUs of Metro Manila, biodegradables generally consist of food waste, kitchen waste, peelings of fruits and vegetables, market waste and occasionally garden waste and tree cuttings. Given the urban character and limited space, the biodegradables of most LGUs are reduced or processed through a combination of the following: (1) feeding of unused food to pets and animals; (2) backyard composting usually in pots and cans; (3) burial; and (4) small-scale composting in barangay and centralized MRFs. Composting is generally performed using the rotating bin method. Mandaluyong City and Pasay City process their biodegradables into compost in their respective offsite facilities in Morong, a municipality in Rizal province located about 25 kilometers to the southeast. The

rest of the LGUs perform small-sale composting in their respective MRFs.

There is no available data indicating the quantity of biodegradables that has been processed into compost.

4.4.3 Infrastructures for Waste Diversion

The primary government-mandated infrastructure for the recovery of recyclables and processing of biodegradables is the MRF. As required under Part III, Rule XI, Section 1 of RA 9003, all barangays must establish their own MRFs. Out of the 1,710 barangays of Metro Manila, only 334 or about 20 percent have their own MRFs. See Box 1 for details on basic vs. mechanized MRFs.

A typical MRF is a small shed or warehouse-type building with concrete-paved floor where space is available for the receipt and manual or mechanized processing of source segregated or mixed municipal solid waste. The floor area of a typical barangay MRF varies from 20 to 100 m² and can usually accommodate sorting of recyclables and composting.

MRFs that accept both biodegradables and recyclables have separate processing and storage areas. Processing of the recyclables entails the separation, weighing and storage of plastics, metals, paper and carton for subsequent sale to junkshops.

Processing of biodegradables initially starts with shredding, using hammermills. Depending on the size of the MRF and the available equipment, the shredded materials could be treated in any of the following methods:

1. Placement in windrows or stockpiles, which are aerated or mixed regularly until compost is generated.
2. Placement in concrete or wooden bins, which are aerated regularly until compost is generated.
3. Placement in electric powered rotating bins or bioreactors for at least 24 hours followed by curing until the materials turn into compost.
4. Placement of shredded biodegradables in elevated beds filled with worms that will breakdown materials into vermicast.

Due to limited space, waste processing temporarily stops or is reduced when the MRFs are filled up with sorted recyclables or processed biodegradables. Sorting and composting resumes when the recyclables are

¹⁶ Source: Project Status Report, Microplastic and Plastic Field Surveys on Pasig River, Philippines.

BOX 1. BASIC VS. MECHANIZED OR AUTOMATED MRFs

Basic MRFs that process recyclables are equipped with weighing scales and sorting tables. Shredders are provided for facilities that process biodegradables. Processing of waste is done manually in most barangay MRFs. Facilities that utilize conveyor systems are referred to as semi-automated MRFs. Processing of waste at manual or non-mechanized MRFs utilize manual labor.

Mechanized or automated MRFs utilize a combination of trommel screens, conveyor belt systems, air classifiers and metal separators. Shredders and rotating bins are used for processing the segregated biodegradables. Considering the required equipment and trained manpower, mechanized MRFs are more expensive than manual MRFs. These MRFs can process more waste compared to the non-mechanized MRFs.

sold to the junkshops or when the processing time of the biodegradables has been attained. This can be addressed through proper management of the MRFs. Operationally, there should be a fast turnover of the sorted and baled recyclables to the junkshops to allow continuous facility operation. Depending on the incoming waste from the host barangay, the capacity of the MRF could be increased through expansion of its area. Income from the sale of the recyclables is divided among the MRF personnel. Accordingly, only limited personnel are engaged by the barangays.

If an MRF also processes biodegradables, the use of rotating bin technology is recommended. This technology facilitates the processing and production of compost in a shorter time period compared to the conventional windrows method. The rotating bin technology requires a higher operational cost, which should ideally be offset by revenues generated from the sale of the compost and recyclables.

EMB-NCR funded the construction of 130 of the existing 334 MRFs. Each of these government funded MRFs have a floor area of 50 m². 14 of these MRFs process both recyclable and biodegradable waste. The remaining 116 process only recyclable waste. Data on the nature of waste processed in the 204 barangay-constructed MRFs is not available.

Metro Manila has 13 centralized MRFs that process waste from the central section of the LGUs and nearby barangays. These are operated by the following LGUs: Caloocan (1), Mandaluyong (1), Marikina (1), Muntinlupa (2), Parañaque (1), Pasay City (1) and Pasig (6). These facilities range in size from 200 to 1,000 m² and are used mainly for composting. Caloocan intends to use its central MRF as the redemption center for its planned cash to trash program. Marikina uses its central MRF both for recovery of recyclables and for composting.

Aside from the five MRFs in Pasig, this LGU also hosts a mechanized MRF that can process non-segregated mixed waste. The facility is operated by IPM Environmental Services, Inc., through a contract that is renewed annually with the city. Reportedly, it can process 2,000 m³ of waste per day. The contract of IPM Environmental Services, Inc. with Pasig ended in February 2021. The new contractor, Eco-Waste, will also build its own mechanized MRF similar to the facility that was previously operated by IPM. The annual renewal of the solid waste collection and waste processing contract in Pasig prevents the sustained operation and recovery of investments from any contractor for the mechanized MRF. Based on the interview with SWM staff of Pasig, the LGU prefers an arrangement where the contractor construction and operation of a mechanized MRF does not require any expense on the part of the government.

The gap in the number of required barangay MRFs is partially attributable to the limited and expensive lots in the highly urbanized and densely populated LGUs of Metro Manila.

The recovery and trading of recyclables is also done at the private sector through the junkshops. Currently, there are at least 1,268 junkshops in Metro Manila. These facilities sort, pack and sell recyclables to consolidators or directly to recycling companies. The recyclables include paper, carton, metals, glass bottles and plastics such as PET, HDPE and PP.

In the absence of MRFs, the barangays of Metro Manila entered into agreements with the junkshops in their respective jurisdictions for the direct sale of segregated waste recovered by sorting at mobile vehicles like pushcarts by barangay designated personnel or eco-aides. This arrangement is referred to as the MRS. In a barangay, the MRS utilizes several

pushcarts or manual tricycles for collection and recovery of recyclables. Each vehicle is operated by one barangay designated eco-aide.

Under the MRS, the payment for recyclables is reportedly kept by the designated barangay personnel to augment their small income. Evidently, the intention of the barangay is to provide additional revenue to some of its employees. The residuals, which were left out after the recovery of the recyclables, are reportedly delivered by pushcarts to the designated locations within the LGU where they will be picked up by the collection crew. At present, there are about 1,022 barangays that use the MRS to collect, sort and sell recyclables to junkshops without the use of a fixed sorting or storage facility.

The central MRFs and the barangay MRFs are not included in the MRS system.

Recovery of recyclables through the MRS is usually performed at designated waste collection points in front of households and establishments, on the pushcarts and on other mobile equipment where they place the waste enroute to the junkshops. Given the limited time and space for proper segregation, the quality of recovered recyclables through MRS is expected to vary.

Under the MRS, the residuals—including SUPs that remained during the sorting process while enroute to the junkshops—could potentially be left out during the actual waste collection process. Monitoring of the placement and collection of the residuals at the designated locations is not performed by the barangays. This practice contributes to the leak in the collection system that could pollute the waterways with plastics.

Notwithstanding the issues on quality of recyclables, the absence of revenue for the barangays from the sale of these recyclables and the potential non-collection of residuals, the large number of the MRS arrangements presents an opportunity for increased recovery of recyclables and waste within the LGUs through enhancement of the system. This could be done through the deployment of additional pushcarts, training designated personnel on reporting and monitoring, and ensuring that residuals are properly collected.

Institutions like schools, offices and commercial establishments have their respective programs for the recovery of recyclables and subsequent sale to junkshops.

Among the Metro Manila LGUs, only Valenzuela (90+) and Malabon (2) have established plastic recycling

facilities. These facilities melt the plastics and turn them into pellets that can be used to manufacture other plastic products. Other than the initial generation of pellets, this study has no other data on the additional products and processes of the recycling facilities in Valenzuela.

The large number of plastic recycling facilities in Valenzuela is attributed to the historical preference of recyclers to establish their facilities in the said LGU, which has persisted to this day. This could be attributed to the local availability of skilled workers who have experience in recycling.

The distribution of the central MRFs, barangay MRFs, MRS and recycling facilities among the 17 LGUs of Metro Manila is presented in Table 7. Manila, which has 897 small barangays, has only three MRFs that are complemented by 642 MRS arrangements with the junkshops. Caloocan has 20 barangay MRFs and 120 MRS for its 188 barangays. Quezon City has 61 MRFs and 84 MRS for its 142 barangays. The dense population of Manila and the small land areas of barangays precluded the establishment of the required MRFs and led to the development of more MRS. Although Caloocan and Quezon City have large land areas, it has been utilized mostly for residential purposes, limiting the lots available for MRFs and favoring the development of MRS arrangements with junkshops.

As previously cited, the MRS arrangement could be enhanced to increase recovery of recyclables while the limited MRFs could be expanded to increase processing capacity.

Pasay City has 156 MRFs and 45 MRS for its 201 barangays. Based on information provided by EMB-NCR, the MRFs of Pasay City correspond to very small facilities with areas ranging from 5 to 10 m² that basically serve as storage for the recovered recyclables. Where space permits, the small MRFs of adjacent barangays can be replaced by a larger facility to optimize the recovery of recyclables. Unfortunately, data on the actual capacities of the MRFs and MRS are not available.

Muntinlupa, Pasig, San Juan and Taguig also have limited numbers of MRFs and each have one MRS. Based on interviews and on the existing 10-Year SWM Plans, only three cities intend to build additional MFs: Muntinlupa, Pasig, and San Juan.

According to the SWM head of Muntinlupa, the current number of MRFs in the LGU will be complemented by a single MRS. Pasig, which has five central MRFs,

Table 7.

DISTRIBUTION OF WASTE DIVERSION FACILITIES IN METRO MANILA

LGU	No. of Barangays	No. of Central MRF	No. of MRFs	No. of MRS	MRFs + MRS	No. of Barangays – (MRFs + MRS))	Junkshops	Recycling Facility
Pasay City	201	1	156	45	201	0	39	None
Quezon City	142	0	61	84	145	0	273	None
Caloocan	188	1	20	120	140	48	86	None
Taguig	28	0	19	1	20	8	114	None
Pasig	30	5	17	1	18	12	69	None
Malabon	21	0	12	10	22	0	28	2
Makati	33	0	10	16	26	7	33	None
Marikina	16	1	7		7	9	34	None
Muntinlupa	9	2	7	1	8	1	25	None
Parañaque	16	1	7	8	15	1	72	None
Navotas	18	0	4	14	18	0	22	None
Valenzuela	33	0	4	29	33	0	280	90+
Manila	897	0	3	642	645	252	62	None
San Juan	21	0	3	1	4	17	10	None
Las Piñas	20	0	2	18	20	0	52	None
Mandaluyong	27	1	2	27	29	0	58	None
Pateros	10	0	1	9	10	0	11	None
Total	1,710	12	335	1,026	1,361	355	1,268	92+

NOTES:

A *barangay* MRF serves as a waste processing facility for waste generated in that particular political unit.

A centralized MRF processes waste from the *población* or main barangay of the LGU, including those from adjacent barangays. It is comparatively bigger than a *barangay* MRF.

MRS refers to the memorandum of understanding between a barangay and a junkshop wherein the recyclables recovered from barangay waste collection are directly sold to the junkshop. The MRS is implemented in barangays without the MRF. Recovery of recyclables is performed at mobile vehicles, such as pushcarts, by the barangay-designated eco-aide or personnel.

The recycling gap refers to the potential quantity of recyclables that were not recovered under Level 2 through the established MRFs and MRs arrangements with the junkshops. These recyclables are sorted at the collection vehicles under Level 3 and at disposal sites under Level 4.

currently has a privately-operated mechanized MRF that can process 2,000 m³ of waste per day. Based on the interview with the CENRO-designate of San Juan, the LGU plans to build additional MRFs.

LGUs that plan to build additional MRFs need to consider the current capacities of the existing facilities and MRS (if present), the actual waste generation and collection of the host barangay or cluster of barangays, updated WACS and available space and funds. Based on interviews and the review of the 10-Year SWM plans, the timetable and funding for the new MRFs for Muntinlupa, Pasig, and San Juan have not been

respectively defined and appropriated. Marikina does not have an MRS arrangement with junkshops and prefers to utilize its centralized MRF and existing barangay MRFs for the recovery of recyclables.

While a limited number of MRFs can facilitate better sorting and recovery of the recyclables, the significantly greater number of MRS of the barangays could be improved through a combination of better pushcarts or mobile vehicles and monitoring of the disposal of residuals and the quantity of recovered recyclables through the use of portable weighing scales. An improved MRS can complement the limited capacity

and coverage of the MRFs. This assumes that each MRF or MRS can process and segregate recyclables in each of the served barangays. On paper, and assuming that the MRS and MRFs can process all of the recyclables in their respective barangays, the combination of MRFs and MRS arrangements would reduce the MRF requirement of Metro Manila to 355. In Caloocan, Quezon City, Malabon, Muntinlupa, Parañaque, Navotas, Valenzuela, Las Piñas, Mandaluyong and Pateros, this combination essentially matches the number of barangays. Manila has the largest need for more MRFs or MRS at 252.

In reality, the outputs of the MRS and the MRFs are not known and cannot be properly evaluated. These facilities, which recover the bulk of the recyclables in the SWM systems under Level 2, are unable to process all the waste as evidenced by the recovery of recyclables at waste collection vehicles and disposal facilities. The amount of recyclables that are recovered at Level 3

and Level 4 is referred to, in this assessment, as the recycling gap. If there are sufficient and efficiently operated MRFs and MRS, then the recycling gap would be significantly reduced and the unsanitary practice of sorting at collection vehicles and disposal sites will also be reduced, if not completely stopped.

4.4.4 Programs for Plastic Waste Management

Aside from existing diversion facilities and systems, various programs for recycling of plastics are currently implemented and/or planned in most of the LGUs of Metro Manila, mainly in coordination with the private sector as shown in Table 8. These programs vary in coverage from the entire city as in Malabon, Mandaluyong, Manila, Marikina, Muntinlupa, Pasig and Valenzuela and in select barangays as in Las Piñas, Makati, Navotas and Parañaque.

Table 8.

FEATURES OF THE PLASTIC WASTE MANAGEMENT PROGRAMS OF METRO MANILA LGUS

LGU	Plastic Waste Diversion Programs	Current/Planned Plastic Source
Caloocan	City plans to implement a trash to cash program to encourage segregation and trading of SUPs for equivalent product or food item. LGU still looking for company to support said program. This is a small-scale undertaking that needs to be supported.	Entire LGU
Las Piñas	Villar Foundation has a facility in Barangay Ilya that makes chairs from SUPs. The plastics are shredded, washed, dried, melted and molded into school chairs. The chairs are donated to different schools in various parts of the country.	Select barangays
Makati	Eco bricks from sachets are made at the existing MRF at Barangay East Rembo.	Single barangay
Malabon	Malabon started implementing the May Kita sa Basura Program in 2014, where plastics and other recyclables are sold to the members of the National Recyclers Organization of the Philippines (NROP). The purchased items include paper, PET, plastic containers, thin plastic bags, styrofoam, tires and car batteries. The Robinson's Mall serves as the venue for the sale of these recyclables.	Entire LGU
Mandaluyong	Mandaluyong has an on-going program which utilizes plastics for brick making, Bricks used on various pavement projects of the LGU.	Entire LGU
Manila	Plastic Credit Exchange (PCEX), together with Manila and with support from PepsiCo Foundation, established the Aling Tindera Waste to Cash Program in 2020. It uses the women-owned sari-sari stores as redemption centers for plastic sachets, wrappers and other SUPs. PCEX provides each store with a 20-foot container, one manual baler donated by the PepsiCo Foundation and starting capital. The baled plastic within the filled-up container is purchased with the help of PCEX by a partner company that processes these materials using environmentally sound technologies. The actual extent of this program is not known.	Entire LGU
Marikina	The central MRF uses a combination of used cooking oil, Styrofoam and plastic bags to make decorative bricks for pavements and benches.	Entire LGU
Muntinlupa	In coordination with the city, an NGO collects SUPs through redemption centers in every barangay. Instead of cash or goods, a competition is regularly held to award barangays with the largest volume of collected plastics. The soft plastics are used as components for brick making. The rest of the plastics are collected by the NGO.	Entire LGU

LGU	Plastic Waste Diversion Programs	Current/Planned Plastic Source
Navotas	Palit bigas and grocery program is implemented in two barangays. Plastics (PET, PVC, HDPE) are traded for rice and grocery items in the barangay MRFs. The program is funded by the two barangays. Traded plastics are sold by barangays to junkshops.	Select barangays
Parañaque	Under the Zero Plastic Project, all types of plastics from schools and homeowners' associations are collected by the city, brought to the central MRF for processing and used for reinforced polytrade and as brick components.	Schools and Homeowners Associations
Pasay City	Currently, the city has no existing program regarding SUPs. The city is still looking for partners to implement a program on SUPs.	Not applicable
Pasig	Implements recovery of recyclables via Mobile Recyclable Redemption using its own funds where recyclables, including plastic, are replaced with grocery items. In barangay Ugong, bags and slippers are produced from plastic juice pouches (Zest-O) through the Kababaihan Iisa ang Layunin Umunlad ang Sambayanan (KILUS) Foundation, Inc. The bags were exhibited in the April 2002 international trade fair organized by the Center for International Trade and Exposition Mission.	Entire LGU
Pateros	Planning to implement a project involving trading SUPs for groceries and other food items; looking for a private partner, but search is hampered by the amount of waste required by manufacturers.	Entire LGU
Quezon	Currently, the city has no existing program regarding SUPs. Its junkshops are included in the Linis Ganda Program, which accepts low-value, SUPs.	Not applicable
San Juan	Currently, the city has no existing program regarding SUPs.	Not applicable
Taguig	<p>Ayala Land built its pilot Arca South recycling plant in Taguig where plastics are shredded and mixed with sand, cement and gravel. Its partner, Green Antz Builders, uses these materials to produce eco bricks, eco pavers and eco casts, among others. Ayala Land buys these products and uses them for its construction projects.</p> <p>Taguig has an ongoing self-funded program that entails the construction of a centralized recovery facility with an area of 2,000 m². Source segregated waste is collected from the households by designated eco-aides. The recovered recyclables are offered for sale to the junkshops. The residuals, which include plastics not accepted by the junkshops, are delivered to the facility for processing into bricks and chairs.</p>	Ayala Malls in Quezon City, Makati and Taguig
Valenzuela	The LGU has implemented the May Balik sa Plastic Program with Nestle since 2019. Laminates and SUPs are traded for Nestle products at barangay redemption centers. The collected plastics are brought to a baling station in Barangay Dalandanan where they are shredded. These plastics are taken by Republic Cement who has a Memorandum of Agreement (MOA) with Nestle.	Entire LGU

The most common program on plastic waste management in barangays is the production of chairs and bricks. The technology involved is not complicated and can easily be done at the barangay level. In sequence, the recovered plastics are shredded, washed, dried, melted and molded into designed parts of chairs. The various parts can then be assembled to form the corresponding chairs. Shredded plastics are also used as components in making bricks.

In support of this method of diversion, and to increase composting, the office of the EMB-NCR provided 14 LGUs of Metro Manila with a set of equipment for the operation of a small plastic chair factory, a composter and a shredder. The recipient LGU is required to provide an area of at least 200 m² for the factory and 100 m² for composting. Pateros, Makati and Mandaluyong were not included in the grant.

The chair and brick program needs the following for sustained implementation:

1. Funds for the purchase of the low-value plastics and the operation of the facility.
2. A market for the chairs and the bricks. The current outputs are normally donated to schools and utilized within the barangays. A study is needed to assess the marketability of these products outside the barangays or LGUs where these are produced. Such a study needs to look into the durability and design of the chairs and the suitability of the bricks for infrastructure projects.
3. It should not be operated as a stand-alone program and should be integrated with the recovery and sale of major recyclable materials.

While the LGUs and the government focused on chair and brick production from SUPs, the private sector has also played a role in plastic waste management. The manufacturing companies supporting plastic waste management program of LGUs include Nestle Philippines Inc., Unilever Philippines, Coca-Cola Bottlers, Philippines Inc. and Tetra Pak Philippines, among others. These companies utilize plastics in their products and have their respective environmental programs aimed at reducing pollution and increasing circularity.

Recovery of SUPs through cash payments or trading for goods of manufacturing companies is performed in three LGUs of Metro Manila: Manila, Malabon and Valenzuela.

The cooperative of the junkshops in Metro Manila known as Linis Ganda has its own program on plastic waste management. This is implemented in coordination with Unilever and Tetra Pak Philippines. Under this program, participating junkshops reportedly purchase sachets, plastic bags, and other single-use packaging from different barangays in Quezon City, Valenzuela and Parañaque. These plastics are then brought to a facility in Valenzuela to produce chairs. The actual number of junkshops currently participating in this program is not known. This program could still be expanded as the network of junkshops has already been established.

Similar LGU-wide programs with the assistance of private companies include the May Kita sa Basura of Malabon, Aling Tindera Waste to Cash Program, Aling Tindera Waste to Cash Program of Manila, Zero Plastic Project of Parañaque and the May Balik sa Plastic Program of Valenzuela.

The trading and/or purchase of SUPs can be potentially implemented in the other 14 LGUs of Metro Manila by adopting the models used in Valenzuela, Malabon and Manila. The LGUs can take the lead by working out arrangements with the manufacturing companies and providing the necessary facilities and organizational support to expedite the recovery of plastics.

All the existing programs and projects of the LGUs, NGOs and the private sector entail the recovery of the single use and less valuable plastics for one or a combination of the following purposes:

- Sale or trade for goods of the manufacturing companies
- Manufacturing of bricks or chairs, or production of bags
- Sale to cement factories as fuel

Considering the low density of these materials, the weight of the materials and the equivalent payment for the recovered plastics would not be significant. A good market for the bricks, bags and chairs needs to be identified and developed.

Among the LGUs, only Taguig will construct a centralized facility to recover and purchase all plastic types and the more valuable recyclables like glass, metal, paper and cartons. The good quality recyclables, including plastics, will be offered for sale to junkshops or recyclers while the residuals, including low value plastics, will be processed and made into chairs and bricks. Aside from ensuring the proper disposal of the residuals,

this facility can potentially sustain its operation via the processing and sale of all potentially recyclable materials and products like bricks, bags and chairs.

The more affluent cities can adopt the ongoing program of Taguig.

For other LGUs, plastics can be baled and stored for a time and sold to cement companies for use as part of their fuel requirements. This would require significant quantities, which could be attained by pooling the collection of several barangays or LGUs and processing the waste in large, centralized facilities.

4.4.5 Rates of Waste Diversion

The rates of waste diversion of Metro Manila LGUs compiled by MMDA are presented in Table 9. Rates vary from a low of 10 percent in Taguig to a high of 77 percent in Malabon. The formula used by MMDA for estimating waste diversion is:

$$\text{Diversion Rate}^{17} = \frac{\text{Volume Collected}}{\text{Estimated Waste Generation}}$$

The volume collected is equal to the sum of the Recyclables + Biodegradables + Residuals with potential. In reality, the waste that is delivered into the landfills is not separated into the cited components. This method does not consider the uncollected amount and yields an overestimated diversion rate. The correct formula is:

$$\text{Diversion Rate} = \frac{\text{Processed Waste}}{\text{Generated Waste}}$$

Processed waste refers to the recyclables and biodegradables that are removed from the waste stream through recycling and composting. The issue here is the absence of data on the amount of waste recycled and composted.

The NSWMC has yet to come up with a memorandum order regarding the formula to be used for determining waste diversion.

4.5 WASTE COLLECTION

As shown in Figure 2, waste collection in Metro Manila LGUs is performed through the combined effort of the barangays and LGUs.

As required in RA 9003, the collection of segregated waste is performed by the barangays who deliver the waste to the MRFs for segregation of recyclables

Table 9.
REPORTED WASTE DIVERSION RATE OF LGUS AS OF OCTOBER 2020

LGUs	% Diversion
Caloocan	39.8
Las Piñas	50.4
Makati	54.0
Malabon	77.8
Mandaluyong	50.0
Manila	33.0
Marikina	50.0
Muntinlupa	33.8
Navotas	59.0
Parañaque	58.4
Pasay City	58.0
Pasig	60.0
Pateros	30.0
Quezon City	56.0
San Juan	21.6
Taguig	10.0
Valenzuela	79.0
Average	48.3

and composting of the biodegradables. The LGUs are tasked with the collection of the residual waste. With the limited resources of the barangays and the small number of MRFs, this condition has not been attained in the 17 LGUs of Metro Manila.

Table 10 shows that the bulk of waste collection in Metro Manila is now performed by the LGUs together with their contracted private haulers. This is done along defined routes, available MRFs and designated locations. The frequency varies from two to three times per week, with separate days for segregated biodegradables and recyclables. Daily waste collection is performed at main highways, markets and busy areas of the cities.

Out of the 17 LGUs, 15 use private haulers. Valenzuela uses its fleet of trucks to collect waste. Collection in Las Piñas is performed jointly by the city government and a private contractor. The amount of collected waste is measured by the number of trucks of known volume multiplied by the number of trips made per unit time to the three designated disposal sites.

17 MMDA letter dated March 19, 2021, on waste collection coverage and efficiency and diversion rate in Metro Manila.

Table 10.

SUMMARIZED FEATURES OF WASTE COLLECTION IMPLEMENTED BY METRO MANILA LGUS (ARRANGED IN THE ORDER OF DECREASING WASTE COLLECTION)

LGU	Daily Collection ^a (m ³)	Coverage ^b	Waste Collector
Quezon City	5,676	Residential and commercial areas of the LGU, except Barangay Holy Spirit which operates its own collection system	Six private haulers: 1. LEG Hauling Services Corp. 2. ACY Transport Corp. 3. OMNI Hauling Services, Inc. 4. IPM Construction and Development Corp. 5. 316 Metro Transport, Inc. 6. Halrey Construction, Inc. Collection from inaccessible areas through barangay managed pushcarts
Manila	5,507	Residential and commercial areas	Leonel Waste Management Corp.
Caloocan	4,511	Residential areas and institutions; commercial establishments have their own haulers ^c	Private hauler: International Solid Waste Integrated Management Specialist, Inc.
Parañaque	2,638	Residential and commercial areas	Leonel Waste Management Corp.
Makati	2,531	Residential and commercial areas	Private hauler: International Solid Waste Integrated Management Specialist, Inc.; Six affluent barangays have their own private collectors
Marikina	2,260	Residential and commercial areas	LGU Marikina
Taguig	1,708	Residential and commercial areas	Two private haulers: Leonel Waste Management Corporation and IPM Environmental Services, Inc.
Valenzuela	1,522	Residential and commercial areas	LGU Valenzuela
Pasig	1,433	Residential and commercial areas	Private hauler: IPM Environmental Services, Inc with support from e-collectors of the city; IPM was replaced by Eco-Waste in February 2021
Muntinlupa	1,234	Residential and commercial areas	Private hauler: IPM Environmental Services, Inc
Pasay City	938	Residential and commercial areas	Two private haulers: IPM Environmental Services, Inc, and International Solid Waste Integrated Management Specialist, Inc.
Malabon	826	Residential and commercial areas	Private hauler: Leonel in combination with barangay managed collection of recyclables using pushcarts
Navotas	641	Residential and commercial areas	LGU Navotas
Las Piñas	637	Residential and commercial areas	LGU Las Piñas and private hauler: L.E.G. Hauling Services Corporation
San Juan	581	Residential and commercial areas of the LGU, except barangay Greenhills which has its own garbage hauler ^d	Two private haulers: Dominus Construction and Services Corporation, International Solid Waste Integrated Management Specialist, Inc.
Mandaluyong	98	Residential areas and institutions; commercial establishments have their own haulers	Private hauler: IPM Environmental Services, Inc
Pateros	75	Residential and commercial areas	Leonel Waste Management Corp.
Total	33,017		

a Source: MMDA Solid Waste Management Office.

b There is no available data to indicate where the waste collected by haulers, other than those contracted by the LGUs, are delivered.

c Data on the amount of waste collected from commercial establishments of Caloocan is not available.

d Data on the amount of waste collected from Barangay Greenhills is not available.

The cities of Caloocan, Manila and Quezon have the largest daily collection volumes at 4,511, 5,507 and 5,676 m³, respectively. Pateros has the smallest collection rate of 75 m³ per day. Based on a 10-month average from January to October 2020, about 33,000 m³ of waste is collected on a daily basis from all Metro Manila LGUs. Using the average density of 174 kg/m³ (based on limited WACS data), the collected waste of 33,000 m³ per day translates to about 5.742 tons per day. This corresponds to about 60 percent of the projected 9,498 tpd projection for 2020. This collection rate is low compared to Jakarta¹⁸ and Bangkok,¹⁹ which had waste collection rates of 74 percent in 2017 and 81 percent in 2018, respectively.

According to MMDA, the density it uses is 287 kg/m³ based on historical records. Using this density, the daily collection rate of 33,000 m³ is equivalent to about 9,500 tpd, which matches the projected waste generation of NSWMC for 2020. The obtained value for collection is not realistic as it suggests 100 percent collection for Metro Manila. The representative density of the waste of Metro Manila should be determined by conducting WACS.

The barangays in the cities of Malabon and Mandaluyong perform actual collection and delivery to designated locations in the LGU for subsequent pick up by the private haulers. In the case of Malabon, collected waste is delivered to the Pier 18 transfer stations. The barangays in the rest of the Metro Manila LGUs reportedly perform waste collection using their limited resources. Most portions of the waste gathered by the barangays are eventually included in the collection performed by the LGUs through existing transfer stations and designated pick-up points for haulers. In the absence of monitoring data, this cannot be quantified.

While LGU-operated or managed collection systems are present within Metro Manila with minor participation by barangay-managed systems, there is no information to indicate the actual coverage and efficiency of these two systems. Non-collection is expected in areas that are not covered by the barangay collection and not reached by the LGU collection trucks. These correspond to the narrow road networks that traverse the depressed or slum areas. Additional losses are incurred due to non-collection of residuals from barangay MRFs and

residuals from MRS and junkshops at designated locations. These losses are not quantified, but are manifested by the presence of litter in streets, vacant lots and in waterways, particularly during flood events.

With the knowledge that collection gaps occur in depressed areas that are not reached by either the barangay or LGU-managed collection, the logical approach is to determine actual vehicular access to these areas, estimate waste generation, and adjust the size, number of collection vehicles and trip frequencies. The collection leaks at the MRFs, MRS routes and junkshops could be addressed through the deployment of large capacity bins that provide temporary storage of residuals and other waste components to be regularly covered by the LGU-managed haulers. Through effective coordination between barangays and LGUs, monitoring of expanded collection at depressed areas and at identified points of leakage could be attained

4.6 DISPOSAL

Waste disposal in Metro Manila is managed by the MMDA. Currently, there are three privately operated facilities that can accept waste from the 17 LGUs (Figure 6). These are the Rizal Provincial Sanitary Landfill (RPSLF), New San Mateo Sanitary Landfill (NSMSLF) and Navotas Sanitary Landfill (NSLF). The RPSLF and NSMSLF are inland facilities east of Metro Manila. Possible spillage of waste enroute to these sites does not pose a direct threat to Manila Bay due to distance.

The NSLF corresponds to an offshore facility constructed on a series of fishponds. Waste is delivered to this facility from the transfer station in Pier 18 using barges. Unexpected spillage from these barges during transport can cause significant pollution of Manila Bay.

The main features of the disposal facilities are presented in Table 11. The NSLF, which started operation sometime in 2006, has the largest capacity at 58.6 million m³. At the current waste acceptance of 7,415 m³ per day, this facility will be filled up by 2025. The NSMSLF has a capacity of 43 million m³ and is estimated to be filled up by 2029 given the current disposal rate of 13,054 m³ per day. The RPSLF, which receives an average of 16,571 m³ of waste per day, has an estimated remaining lifespan of 14 years.

18 Evaluation for The Implementation of New Presidential-Regulation on Solid Waste Management in Jakarta, Indonesia, 2019.

19 Booklet on Thailand State of Pollution, 2018.

Figure 6.
LOCATION OF DESIGNATED DISPOSAL FACILITIES IN METRO MANILA



Table 11.
FEATURES OF THE METRO MANILA SOLID WASTE DISPOSAL FACILITIES

As of November 1, 2020	Area (has)	Fill Area (has)	Start-up Year	Total Capacity (million m ³)	Volume Utilized (million m ³)	Remaining Capacity (million m ³)	Remaining Lifespan (years)	Daily Disposal Rate (m ³)
RPSLF	50	32.95	2007	50.14	11.56	38.58	14.25	16,571
NSMSLF	45	44	2011	43	9.34	33.66	9	13,054
NSLF	41.12	39.67	2006	58.61	49.16	9.45	4.5	7,415

In approximately four years, when the NSLF is full, the transport and disposal of waste from three of the six LGUs that currently utilize this facility will be affected. These include Malabon, Manila and Navotas, which are located at the western coastal section of Metro Manila. There is a longer distance of between these LGUs and the RPSLF and NSMSLF, which will affect the turnaround time of the collection trucks and impact efficiency.

Table 12 presents a summary of disposal records provided by MMDA based on a 10-month average from January to October 2020. 33,017 m³ of waste is collected daily from the 17 LGUs, while MMDA collects an additional 17 m³ per day through street sweeping and clean-up of the 50 pumping stations. The equivalent weight in tons of 33,033 m³ of collected waste using the WACS density of 174 kg/m³ is about 5,747 tons. This is the daily amount deposited at the three sanitary landfills.

Table 12.
CURRENT DISPOSAL RATES OF METRO MANILA LGUS^a AT THE THREE DESIGNATED SANITARY LANDFILLS

LGU/Other Sources	Daily Disposal Rate (m ³)	Disposal Sites
Quezon City	5,676	RPSLF, NSL
Manila	5,507	NSL
Caloocan	4,511	NSMSLF
Parañaque	2,638	NSL, NSMSLF
Makati	2,531	RPSLF
Marikina	2,260	NSMSLF
Taguig	1,708	NSL
Valenzuela	1,522	NSMSLF
Pasig	1,433	RPSLF
Muntinlupa	1,234	RPSLF
Pasay City	938	RPSLF
Malabon	826	NSL
Navotas	641	NSL
Las Piñas	637	RPSLF
San Juan	581	RPSLF
Mandaluyong	298	RPSLF
Pateros	75	RPSLF
Subtotal	33,017	
MMDA Special Operations	14 ^b	NSL
Pumping Station	2 ^c	NSL
Subtotal	16	
TOTAL	33,033	

- a Source: MMDA Solid Waste Management Office.
b Waste collected by street sweepers of MMDA.
c Waste collected by MMDA from pumping stations.

The waste disposed into the three sanitary landfills is currently measured in cubic meters, using the number of trucks with known volumes. This method could lead to inconsistent results due to the variability in the manner of filling up of the collection vehicles and the variability of density of waste from the different LGUs. Best disposal practice requires the use of automated weigh bridges at the gates of sanitary landfills for proper monitoring and systematic recording.

Data on the actual operation of the disposal facilities and the level of compliance with RA 9003 requirements on regular waste compaction, application of soil cover and collection and treatment of leachate are not

available. There is no official documentation of the previously reported practice of sorting and picking at the disposal sites after the deposition of the waste.

4.7 INSTITUTIONAL SET-UP

Under Rule VI, Sections 4 and 5 of the implementing rules and regulations of RA 9003, all LGUs should establish a City or Municipal Solid Waste Management Board and a Barangay Solid Waste Management Committee, respectively. The boards and committees have been established in all of the 17 LGUs of Metro Manila and are intended to provide the enabling environment for RA 9003.

The key management functions of the City and Municipal SWM Boards include:

1. Development of the city or municipal SWM plan, and oversight and monitoring of its implementation.
2. Adoption of specific revenue generating measures to promote the viability of the plan.
3. Review of the plan every two years or as the need arises to ensure its sustainability and relevance to local and international development in the solid waste sector.

As mandated, the Barangay Solid Waste Management Committee should have the actual operational SWM functions, which include the following;

1. Formulation of SWM programs consistent with the city to municipal SWM plan.
2. Segregation and collection of biodegradables, compostable and reusable waste.
3. Establishment of MRF.
4. Allocation of barangay funds and continued search for funding sources.
5. Organization of core coordinators.
6. Submission of monthly report to city or municipality.

The tasks assigned to the barangays effectively place the burden of SWM on the smallest government unit with limited technical and financial resources.

Actual implementation of the SWM plan is performed by functional groups under the office of the chief executives of the LGUs (Table 13).

The operating arrangements and set-up of these functional groups vary. In the case of Taguig, Pasig, Parañaque, Las Piñas, Valenzuela and Pasay City, CENRO corresponds to a big department made up of several divisions that include SWM.

Similar department level groups in charge of SWM have been established in Marikina, Caloocan, Manila, Makati, Mandaluyong, Muntinlupa, Quezon City, Valenzuela and Pateros.

In San Juan and Malabon, CENRO corresponds to a smaller division focused primarily on SWM.

Interviews with the heads and representatives of the functional groups showed that the basic tasks of collection, disposal, sanitation, enforcement and monitoring of the basic components of the SWM system are regularly performed, notwithstanding the difference in hierarchy level or the absence of officially designated units within the organization.

The groups responsible for coordination of plastic waste management programs or projects in the LGUs are presented in Table 14.

The LGUs do not have records of the waste collection, recovery of recyclables from MRFs, and recovery through MRS and composting, which are supposed to be performed at the barangay level.

On collection, the use of similarly sized vehicles at the barangay level could facilitate the determination of the quantity of collected waste. A record of the number of trips made by these vehicles would translate to the volume of collected waste for a particular day. This is the method used in the LGU-managed collection system.

Table 13.

FUNCTIONAL GROUPS WITHIN EACH LGU RESPONSIBLE FOR SWM

SWM Functional Group	Local Government Units
City Environment and Natural Resources Office (CENRO)	Las Piñas, Malabon, Navotas, Parañaque, Pasay City, Pasig, San Juan, Taguig
City Environment and Management Office (CEMO)	Marikina, Caloocan
Department Public Services (DPS)	Manila
Department of Environmental Services (DES)	Makati
City Environmental Management Department (CEMD)	Mandaluyong
Environmental Sanitation Center (ESC)	Muntinlupa
Task Force on Solid Waste Management	Quezon City
City External Services Office (CESO)	Valenzuela
Municipal Environment and Natural Resources Office (MENRO)	Pateros

Table 14.

GROUPS RESPONSIBLE FOR COORDINATING PLASTIC WASTE MANAGEMENT

LGU	Coordination/Monitoring Group
Caloocan	No designated unit
Las Piñas	Solid Waste Management Division
Makati	Plastic Monitoring Task Force
Malabon	Enforcement and Inspection
Mandaluyong	Collection Division
Manila	Operations Division
Marikina	Information Education and Communication (IEC ^a) Unit
Muntinlupa	MRF Division
Navotas	Under the barangays
Parañaque	Solid Waste Management Division
Pasay City	Solid Waste Management Division
Pasig	Solid Waste Management Division
Pateros	MRF operation
Quezon	Climate Change Division of Environmental Protection and Waste Management Department
San Juan	MRF Operation
Taguig	Operation and Enforcement
Valenzuela	Collection Unit

a This is the unit responsible for the information, education and communication campaign on various aspects of solid waste management.

Purchases made by junkshops are based on the type and quantity of recyclables. The issuance of receipts for the sale of the recyclables from the MRFs, MRS and ambulant pickers could facilitate monitoring. Although barangays do not directly benefit from the sales, they could require designated personnel for the MRS and MRFs to submit receipts on a daily or weekly basis and use them to monitor recycling activities. Alternatively, the barangays could require the registered junkshops to submit the sales receipts for monitoring.

In MRFS where compost is produced, the barangay could require their designated personnel to submit records of the quantity of compost produced on a monthly basis. The longer frequency of reporting is due to the extended time needed to produce compost from biodegradables.

Coordination between the LGU and the barangays is deficient or absent on the aspects of monitoring of collection and waste diversion through MRFs and MRS. This is manifested by the absence of a unit within the LGUs to monitor barangay MRF and MRS operations.

As the greater political unit, the LGU should extend assistance to its component barangays for monitoring of collection and diversion. In coordination with the SWM functional groups of the EMB, the LGU can conduct training of barangay personnel on the basic aspects of recording and monitoring. A monitoring checklist should be developed to include the following categories:

- Dimensions, capacity, equipment, inputs and outputs, manpower utilization and status of operation for MRFs.
- Counterpart junkshops, size of the junkshops, quantities of recyclables sold by the designated eco-aides and transaction dates.
- The monthly list of junkshops, consolidators and recyclers for the LGUs.
- Daily collection in cubic meters from regular routes for MRS and the number of truck trips and list of covered barangays for the LGU-managed collection.

Initially, monitoring can be jointly performed by LGU and barangay personnel. Overtime, this activity can be performed by the trained barangay personnel. Overall integration of monitoring data should be performed at the LGU level.

4.8 ORDINANCES

In response to the need for enabling policies on waste management, the 17 LGUs have passed ordinances mandating waste segregation at source, prohibiting littering, open dumping and segregated waste collection. Interviews with the heads and staff of the

solid waste functional groups revealed varying approach on how plastics and the corresponding waste could be managed, as shown in Table 15.

The cities of Las Piñas, Makati, Mandaluyong, Muntinlupa, Parañaque, Pasay, Pasig and Quezon ban the use of plastics in their respective areas. Malabon, Manila, Marikina, Pasig and Pateros prohibit the use of plastics on dry goods and regulates its utilization on wet goods, while Caloocan and Marikina favor the regulated use of plastics over a total ban.

On the other hand, San Juan and Taguig still plan to have ordinances regarding the use of plastics in

Table 15.

SUMMARY OF ORDINANCES ON PLASTIC WASTE MANAGEMENT

LGU	Ordinance/ Year	Main Feature
Caloocan	0503/2013	Regulates the use of plastic and polystyrene, and provides mechanisms for its recovery and recycling.
Las Piñas	1036-11/2012	Bans the use of plastic bags and polystyrene packs in all commercial establishments doing business in Las Piñas.
Makati	2003-095/2013	Bans the use of plastics, styrofoam and other non-biodegradable packaging.
Malabon	01/2013	Prohibits the use of plastic bags on dry goods, regulated use on wet goods and prohibits the use of styrofoam/styrophor.
Mandaluyong	523/2013	Prohibited the use of plastic bags beginning in 2014.
Manila	8282/2012	Prohibits the use of any form of plastic bags on dry goods and regulates their use on wet goods, as well as the use of polystyrene and similar materials as containers for food, goods and other products.
Marikina	18/2012	Regulates the use of plastic packaging/bags on wet goods and bans the use of plastic packaging on dry goods.
Muntinlupa	10-109/2010	Prohibits the use of plastic bags on dry goods, regulates its use on wet goods and prohibits the use of styrofoam/styrophor in the city.
Navotas	14/2015	Prohibits the sale and use of non-biodegradable polystyrene packaging materials and plastic bags, and regulates the sale and use of biodegradable plastic bags.
Parañaque	18-40/2020	Bans the use of SUPs for all dry goods, as well as the distribution of plastic bags, straws, spoons and forks, cups and stirrers.
Pasay City	4647/2011	Bans the use of plastic bags and promotes the use of recyclable paper carryout bags and reusable bags.
Pasig	09/2010	As of 2012, banned the use of any form of plastic on dry goods and regulated its use on wet goods. It also banned the use of styrofoam and similar materials for food, produce, and other products.
Pateros	MO 10/2011	Prohibits the use of plastics on dry goods and regulates its use on wet goods. It also prohibits the use of styrofoam and styrophor.
Quezon	SP 2876	Bans the distribution and usage of SUPs.
San Juan	Currently none	There is a proposal to pass an ordinance regarding plastic waste management.
Taguig	Currently none	Plastic waste management is planned to be included in the ongoing formulation of the Environmental Code of Taguig City.
Valenzuela	None	Implements a program to recycle SUPs.

their respective jurisdictions. Valenzuela, which hosts a lot of plastic recycling companies, does not have an ordinance on plastic use and management, but implements a program to recycle SUPs.

The results of the Microplastic and Plastic Field Surveys on Pasig River, Philippines²⁰ could be used as IEC materials by the LGUs in the enforcement of their respective plastic waste management ordinances.

4.9 WASTE DATA MANAGEMENT SYSTEM

The maintenance and regular update of a waste data management system is vital for effective monitoring and implementation of collection, diversion and disposal of municipal solid waste of LGUs.

Table 16 presents the available data on waste management at the barangay, LGU and agency levels based on interviews. The table also includes the basic data that must be available to facilitate effective waste management.

As shown, the barangays, LGUs and the EMB do not have the necessary and regularly updated data on waste management.

The basic quantitative data on collection and diversion are not available at the barangay level.

The quantified data available at the LGU level mainly covers its collection efforts. Quantitative data on waste diversion is generally limited. The basic data on collection and diversion of the barangays under its jurisdiction are not available.

The EMB only has data on the number of MRFs/MRS, SWM plans and disposal facilities. It does not have data on diversion performed at the barangay and LGU levels. It relies on MMDA for the recording of the LGU-managed collection.

The MMDA, which is mandated to manage waste disposal of Metro Manila solid waste, has the regularly updated records of LGU-managed waste collection and disposal data. The availability of updated data at MMDA is linked with the agency's role in the payment of tipping fees to the operators of the designated disposal facilities for each individual LGU. Accordingly, it requires all LGUs to regularly submit data on waste collection and perform their own monitoring at the gates of the designated sanitary landfills.

The limited data at the barangay and LGU levels is attributed to the lack of coordination between these political units. Monitoring at the barangay level is limited or absent. These conditions hamper the collection and assessment of the data by EMB, which is dependent on inputs from the LGUs and the results of self-monitoring activities. The limited data of EMB hinders updated assessments and the formulation of measures to improve waste management.

As the lead agency in SWM, EMB should initiate systematic waste data collection at the barangay and LGU levels. It must develop a data checklist that is regularly updated by the barangays and LGUs. Technical assistance could be extended by EMB to explain how landfills are filling up and update the checklist. For its part, the NSWMC could issue a memorandum order requiring barangays and LGUs to regularly submit the collected data using conventional reporting methods or available and free online mobile applications such as Google Drive spreadsheet or Kobo Tool Box.

4.10 SWM SYSTEM GAPS

The gaps of the SWM systems of the Metro Manila LGUs were classified into those that affect plastic waste management and those that affect the overall SWM systems of the LGUs.

4.10.1 Gaps Affecting Plastic Waste Management

Incomplete Waste Collection

This takes place in the areas that are not reached by the big collection trucks of the LGUs, private haulers and barangays. Due to the absence of monitoring, the extent of these areas cannot be determined. The areas could correspond to the depressed sections of the LGUs that are occupied by low-income households and informal dwellers, where the streets are narrow and occupied by informal structures. The World Bank²¹ estimated that 42.9 percent of the urban population in the Philippines live in slum areas. In the case of Metro Manila, this would correspond to about 6 million of the 14 million projected population. Collection loss also takes place during the second level of recovery of recyclables through junkshops for 335 MRFs and 1,206 barangay MRS. In the absence of monitoring, there is no available data to indicate that the residuals generated under this level were included in the LGU-managed

20 Performed by the University of the Philippines National Engineering Center (2021)

21 <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS>: Population living in slums (% urban population).

Table 16.

AVAILABLE AND ADDITIONAL SWM DATA FOR LGUS AND AGENCIES RESPONSIBLE FOR WASTE MANAGEMENT

Functional Group	Available Data	Additional Data for Effective Waste Management
Barangay	<ul style="list-style-type: none"> • Location and number of MRFs • Number of MRS • Number of vehicles and pushcarts for waste collection and MRS operation 	<ul style="list-style-type: none"> • Daily waste collection • Number of vehicle and pushcart trips per day • Capacity of vehicles and pushcarts • Capacity of MRFs • Capacity of MRS • Input/Output of MRFs/MRS • Recyclable output of each barangay and MRF • Processed biodegradable output of each barangay MRF • Recyclable output of each MRS
LGU	<ul style="list-style-type: none"> • Number and capacity of collection vehicles used by LGU and private hauler • Number of trips per day per collection vehicle of LGU and/or private hauler • Name of private waste hauler • Daily waste collection in volume • Location and number of barangay MRFs • Location and number of centralized MRFs • Number of MRS • Location and number of junkshops • Disposal facility for residual waste • List and location of plastic redemption/trading centers 	<ul style="list-style-type: none"> • Daily waste collection of each barangay • Capacity of each barangay and centralized MRF • Capacity of each MRS • Input/Output of each barangay/centralized MRF • Input/Output of each MRS • Residual collection schedule at each barangay/centralized MRF • Waste collection points along route of MRS pushcarts • Recyclable output of each barangay and centralized MRF • Processed biodegradable output of each barangay and centralized MRF • Recyclable output of each MRS • Amount of recyclables traded/redeemed in each trading center
EMB	<ul style="list-style-type: none"> • Number of central MRFs in each LGU • Number of barangay MRFs per LGU • Number of MRS per LGU • Location, number and name of designated disposal facilities • SWM Plans of Metro Manila LGUs 	<ul style="list-style-type: none"> • Location and capacity of each centralized MRF per LGU • Location and capacity of each barangay MRF per LGU • Capacity of each MRS per LGU • Input/output of each MRF and MRS • Diversion rate of each LGU • Daily waste collection per LGU • Daily waste disposal per LGU • Disposal facility used by each LGU • Location and capacity of accredited waste disposal facilities
MMDA	<ul style="list-style-type: none"> • Daily LGU-managed waste collection • Daily waste disposal per LGU • Location, number and name of designated disposal facilities • Total and remaining capacity of the disposal facilities 	

collection. Collection also takes place at the 1,268 junkshops of Metro Manila where the monitoring of waste flow is not performed.

Although there is no data on the quantity of uncollected waste, evidence of this condition is indicated by the regular collection of plastics and residuals from the MMDA pumping stations²², the presence of plastics in the channels of the Pasig River²³ and its tributaries, as well as litter in vacant lots of LGUs and the ubiquitous occurrence of plastic waste in man-made and natural drainage systems of Metro Manila during flood events. As cited in the section on disposal, only 60 percent of the generated waste goes to the disposal facilities, based on an assumed density of 174 kg/m³. The remaining undifferentiated 40 percent includes recovered recyclables, processed biodegradables and uncollected waste, which collectively amount to an unverified 3,500 tons of waste per day.

Limited collection is aggravated by the absence of monitoring at the barangay level. Waste collection at the barangay level is performed using various modes of waste transport with unrecorded volumes. Where possible, the use of the same collection vehicles of similar capacities should be adapted. The use of pushcarts with known and fixed dimensions for barangay-level collection should also be considered. This will facilitate the uniform approximation of collected waste. The barangay eco-aide or equivalent personnel should count and record the number of trips he makes per day to arrive at the amount of collected waste. The use of portable, large weight capacity weighing scales can also be used to measure the collected waste, particularly for households and generators that use garbage bags for temporary waste storage.

The same pushcart method can be used to monitor the residuals generated at the MRS and MRFS after the second level of recovery of recyclables at the MRF and MRS systems.

Limited Number of MRFs and MRS Arrangements:

Currently, only 20 percent of the 1,710 Metro Manila barangays have their own MRFs. This number shows that the bulk of the potentially recyclable materials cannot be processed by the currently available MRFs.

There are 1,026 barangays that have MRS arrangements with junkshops. The combined MRF and MRS

arrangements amount to 1,361, still falling short of the required 355 for the rest of the Metro Manila LGUs. As the principal facilities and systems for recycling, the MRF and MRS arrangements are unable to process all the recyclables that eventually reach the collection trucks and disposal facilities.

The recycling gap is aggravated by the absence of monitoring of the MRFs and the MRS system. Recorded data on the type and quantities of waste that entered the MRFs, the classification and weight of the recyclables, biodegradables and residuals that were segregated and processed, the number of barangay personnel involved in the operation, and the number of sales of the recyclables and compost are not available. Data on the collection of the residuals is also not available.

The MRS is likewise not monitored. Records of the quantity of the collected waste, recyclables sold to the junkshop and omitted residuals are not known. The placement of these materials along the route of the LGU-managed collection system is not monitored by the barangays. If uncollected, the plastics and the rest of the residuals can potentially spread as litter and/or accumulate as unwanted deposits in canals and waterways.

Variable Quality of Recyclables Retrieved through the Four Levels of Sorting and Recovery

Sorting and recovery of recyclables is performed in limited spaces, even in MRFs and under time constraints. Under these conditions, their overriding goal is simply to recover what is deemed valuable and will be accepted by the junkshops without consideration of the quality of the materials. It is very likely that sorters under all four levels are aware of the requirements of the recyclers. This results in the presence of contaminants in the plastics that were delivered to the recyclers, as reported in the Market Study. The poor quality of the recovered recyclables is attributed to hasty sorting at collection vehicles and disposal sites, and the unsanitary condition of the sorting areas. The organic component of the waste must, at the least, be removed from the recovered plastics. Evidently, the current methods of segregation and recovery of plastics at the MRF, MRS and junkshops are not sufficient to remove the biodegradables and the poor-quality recyclables. The recovered plastics need to undergo sorting, washing and drying processes prior to baling and delivery to the recyclers. These final steps could be done in big junkshops or in a centralized facility

22 Source: MMDA disposal records as of October 2020.

23 Source: Microplastic and Plastic Field Surveys on Pasig River, Philippines, 2021.

manned by trained sorters with access to washing and drying areas.

Incomplete Plastic Waste Data from Currently Available WACS Results

WACS were performed using different methodologies and durations. Based on the WACS data presented in the 10-Year SWM plans of the LGUs, the quantities of the various plastic types have not been determined. The major plastic types that are accepted by the junkshops (PET, HDPE and PP) are reported, while the low-value and SUPs are reported as residuals. To develop a comprehensive plan for plastic waste management, all plastic types must be identified and quantified in the forthcoming WACS, which are planned for the Metro Manila LGUs. The quantities and distribution will be used to estimate the sizes of the planned recovery facilities, assess the RDF potential of the plastics, determine the effectiveness of the plans being developed to manage waste and monitor the flow of these materials through the four levels of sorting until their delivery to the junkshops, consolidators and recyclers.

4.10.2 Gaps Affecting the Overall SWM System of the LGUs

Use of Inappropriate Methods of Determining Waste Diversion

The current method used to divide the volume of waste collected by the estimated waste generation is too simplistic and yields overestimated values of diversion. It assumes that the waste that was not collected and disposed into landfills has been recycled, composted and used for other purposes. It does not consider the losses in collection and transport. While it does not relate to plastic recycling, a correct estimate of waste diversion provides a measure of the extent of recycling and composting that has been performed within the LGU, as required in RA 9003. The regulating agency, NSWMC, should create a memorandum requiring LGUs to use the quantity of diverted recyclables and biodegradables as the basis for determining diversion.

Limited Processing and Composting of Biodegradables:

Currently, the centralized MRFs of LGUs are used for processing biodegradables. These facilities can be expanded, where space permits, to accommodate more biodegradables. The small barangay MRFs can only process a limited fraction of the biodegradables.

The unprocessed waste has to be included into the LGU collection system for disposal into the landfills.

The LGUs may consider composting outside their boundaries, as practiced by Pasay and Mandaluyong. The biodegradables of these LGUs are collected by private haulers and delivered to their composting facilities in Morong, Rizal Province.

Use of the Volumetric Method and Assumed Waste Density Instead of Weigh Bridges at the Designated Disposal Site

The current method of measuring the quantity of deposited waste by counting the truck trips of vehicles of known volumes should be replaced by weighbridges, which automatically determine and record the weight of incoming waste. Based on the information provided by MMDA, weighbridges have already been installed at the NSLF and at the RPSLF. Installation of the weighbridge at the NSMSLF is ongoing²⁴. This equipment should be put into operation as soon as possible.

The SWM Plans do not have a Section on Monitoring and Evaluation— Should Contain the Agreed Upon Performance Standards

The standards could include the diversion rate based on data from MRFs and MRS, collection coverage and waste collection rate as rated against the LGUs projected waste generation. The missing section should be included in the updated version of the 10-Year plan together with the performance standards. The section on monitoring and evaluation and the use of performance standards for monitoring waste management are not included in the Implementing Rules and Regulations of RA 9003.

The Approved SWM Plans did not Evaluate the Physical and Socio-Economic Features of the LGUs with respect to the Various Components of the SWM System

These key features presented in Table 17, including the likely effect on the system, should be evaluated in future updates of the SWM plans.

²⁴ Updated information regarding the weighbridges was provided by MMDA during the World Bank sponsored presentation on May 17, 2021.

Limited SWM Data at the Barangay, LGU and Agency Levels

The gathering and updating of the SWM data should be initiated by the EMB through the LGUs. A basic checklist of the data to be gathered and updated by

the barangays and the LGUs should be generated and distributed by EMB. Regular updates of the collected data should be completed by designated personnel at the barangay, LGU and EMB levels through the use of free mobile applications such as the Google Drive Spreadsheet or the Kobo Tool Box.

Table 17.

FEATURES AFFECTING SWM SYSTEMS OF LGUS

Physical and Socio-economic Features	Effect on the SWM System
Population density and distribution of residents	This will affect the potential availability of sites for proposed SWM facilities.
Proximity to major waterways and vulnerability of low-lying areas to flooding	Waste collection in these areas should be efficient to prevent the movement of uncollected waste into the waterways.
Spatial location of major waste generators	Each income class has a different level of SWM awareness and economic need for recovery of recyclables. Planning collection systems should consider the difficult access to areas occupied by low-income residents and resulting mismanagement of uncollected waste.
Population growth and density	Increase in population translates to increased waste generation. Analyzing growth rate allows for better planning in the acquisition of equipment and facilities for SWM management. Density provides insight on the potential availability of space for future SWM facilities. These features increase annually and adjustments in collection trips should be made accordingly.
Existing road network	This should be evaluated to increase the areas reached by the waste collection vehicles of the LGU and the private haulers.
Location of MRFs and junkshops	The spatial location and sizes of the waste diversion facilities should be known. This would serve as the basis for monitoring and possible establishment of additional MRFs, where space permits.



Photo: Shutterstock / Wireless Creators.

CHAPTER 5.

COMPARATIVE ASSESSMENT OF METRO MANILA LGUs

A comparative assessment of the 17 LGUs was performed to determine their level of readiness and need to receive investments to address gaps in their respective SWM systems. The assessment utilized the following features of their respective SWM systems: (1) waste generation, (2) existing plastic waste management programs, (3) passage of relevant plastic ordinances, (4) currently available infrastructure for diversion, (5) currently available system for the recovery of recyclables, (6) potential space for infrastructure and (7) proximity to waterways that can potentially receive uncollected waste. Each criterion was assigned three equal grade levels, with 3 being the highest and 1 being the lowest.

5.1 WASTE GENERATION

The potential for a greater quantity of recyclables is directly proportional to waste generation, subject to proper collection and segregation at source, MRFs and MRS. The following ratings were used:

Rating	Waste Generation Feature
3	>1 million tpd
2	≤ 1 million, > 400,000 tpd
1	≤ 400,000 tpd

The top ranked generators included Quezon City, Manila and Caloocan—each assigned a rating of 3. The second ranked LGUs included Parañaque, Makati, Pasig, Marikina and Las Piñas—each assigned a rating of 2. The third ranked LGUs included Mandaluyong, Malabon, Pasay City, Muntinlupa, Taguig, Valenzuela, Navotas, San Juan and Pateros—each assigned a rating of 1.

5.2 PLASTIC WASTE MANAGEMENT PROGRAMS

This provides an indication of the initiative or openness of the LGU to support an investment regarding plastic waste management. It also reflects the political willingness of the LGU leaders to comply with the national policy on plastic waste management. The following ratings were used.

Rating	Plastic waste management programs
3	LGUs with extensive programs regarding plastic recovery
2	LGUs with programs covering one or several barangays
1	LGUs currently without plastic management programs

Malabon, Mandaluyong, Manila, Marikina, Muntinlupa, Parañaque, Pasig and Valenzuela were assigned a rating of 3. Las Piñas, Makati, Navotas, Pasay City and Taguig were assigned a rating of 2. Caloocan, Pateros, Quezon City and San Juan and were assigned a rating of 1.

5.3 PASSED PLASTIC MANAGEMENT ORDINANCE

This provides an indication of the LGUs' readiness to implement measures to improve plastic waste management. The following ratings were used:

Rating	Passage of plastic management ordinance
3	Passed ordinance which either regulates or bans the use of plastics
2	
1	Without any ordinance which either regulates or bans the use of plastics

San Juan, Taguig and Valenzuela were assigned a rating of 1. The remaining 14 LGUs were assigned a rating of 3.

5.4 FACILITIES FOR WASTE DIVERSION

The percentage of the number of MRFs of each LGU with respect to the number of barangays was used to rate the available facilities for diversion. This indicates the proportion of the facilities in relation to what is needed and required by law. It provides an indication of the LGUs willingness to comply with the requirements of RA 9003 notwithstanding space, financing and resources for operation limitations. The following ratings were used:

Rating	Percentage of the number of MRFs to total LGU barangays
3	> 70 percent
2	≤ 70 percent and > 40 percent
1	≤ 40 percent

Muntinlupa, Pasay City and Pasig registered > 70 percent and were assigned a rating of 3, while Quezon City, Taguig, Malabon, Parañaque, Marikina had percentages between 40 and 70 and were assigned a rating of 2. The rest of the LGUs were assigned a rating of 1.

5.5 SYSTEM FOR THE RECOVERY OF RECYCLABLES

The percentage of the number of MRS of each LGU with respect to the number of barangays was used to rate the system for the recovery of the recyclables. This provides an indication of the LGUs ability to support recycling even without a fixed waste diversion facility (MRF). The following ratings were used:

Rating	Percentage of MRS to number of barangays
3	> 70 percent
2	≤ 70 percent and > 45 percent
1	≤ 45 percent

Mandaluyong, Las Piñas, Pateros, Valenzuela, Navotas and Manila post the highest percentages of MRS over the number of barangays and were assigned a rating of 3. Caloocan, Quezon City, Parañaque, Makati and Malabon had percentages ranging from 64 to 48 and were assigned a rating of 2.

Marikina, Muntinlupa, Pasig, San Juan and Taguig do not have MRS arrangements with junkshops. Together with Pasay City, which has a percentage of 22, these LGUs were assigned a rating of 1.

5.6 POPULATION DENSITY

This provides an indication of the potentially available space for infrastructure like a centralized MRF. The following ratings were used:

Rating	Population Density/km ²
3	< 20,000/km ²
2	≥ 20,000 km ² and < 30,000km ²
1	≥ 30,000/km ²

Muntinlupa, Valenzuela, Parañaque, Quezon City and Las Piñas have the lowest densities of less than 20,000 persons per square kilometer and were assigned a rating of 3. Caloocan, Pateros, Mandaluyong and Manila have the highest density exceeding 30,000 persons per square kilometer and were assigned a rating of 1. The rest of the LGUS have a density from 20,000 and 30,000 and were assigned a rating of 2.

5.7 PROXIMITY TO WATERWAYS AND WATER BODIES

This provides an indication of the potential for disposal of plastics and uncollected waste. The higher ratings were assigned to LGUs that have the highest potential to pollute a waterway or water body due to proximity or being traversed by a major river channel. The following ratings were used:

Rating	Hydrological Feature
3	LGUs traversed by the main channel of Pasig-Marikina River
2	LGUs bounded by either the Manila Bay or Laguna de Bay
1	LGUs drained by tributaries of Pasig-Marikina River and other river systems

Makati, Mandaluyong, Manila, Marikina, Pasig and Pateros were assigned a rating of 3. Las Piñas, Muntinlupa, Parañaque, Pasay City and Taguig were given a rating of 2. Caloocan, Malabon, Navotas, Quezon City, San Juan and Valenzuela were assigned a rating of 1.

The level of implementation of the SWM plans was considered as a criterion but not used. This would require an impartial assessment that can only be obtained through comprehensive visual surveys, a review of SWM records and person-to-person interviews. This would include, among others, segregation at source, segregated waste collection, operation of the MRFs, operation of the MRS, collection coverage and compliance to ordinances on littering and use of plastics.

The institutional set-up was also considered but not used in the assessment due to the absence of clear-cut differences among the LGUs. The set-up, as presented in the SWM plans, vary but the basic functions of collection, disposal, monitoring and enforcement are present in differing degrees notwithstanding the absence of officially designated units within the organization. In some LGUs like Caloocan, Makati, Marikina and Parañaque, disposal and collection are lumped together under one unit. The rest of the LGUs have separate units for collection and disposal.

Table 18 presents the summary of the ratings of the 17 LGUs based on the cited criteria. The rankings can be grouped under four tiers. Tier 1 includes the top three LGUs obtaining the highest rating of 17: Muntinlupa, Parañaque and Pasig.

Tier 2 includes eight LGUs with ratings of 16 and 15: Manila, Quezon City, Pasay City, Las Piñas, Makati, Malabon, Mandaluyong, and Marikina. Tier 3 includes five LGUs with a rating of 13 to 11: Navotas, Pateros, Valenzuela, Caloocan and Taguig. Tier 4 includes San Juan with the lowest rating of 8.

Tier 1 corresponds to LGUs with high ratings in the implementation of plastic waste management projects, passage of necessary plastic waste ordinances and diversion facilities and a moderate rating in MRS. These ratings collectively show good SWM management compared to the rest of the Metro Manila LGUs. All three LGUs are located near major waterways and large water bodies, indicating the importance to address the plastic waste issue with urgency.

Tier 2 LGUs rank a close second in overall SWM management, but individually exhibited a wide range in ratings per evaluation criteria. Manila, Mandaluyong, Makati and Las Piñas have limited MRFs. Manila and Quezon City have large generation rates compared to the rest of the Tier 2 LGUs. Marikina does not have an MRS and was given a rating of 1 for this criteria. Mandaluyong and Manila have large population densities exceeding 20,000 persons per square kilometer. All Tier 2 LGUs passed their respective plastic ordinances. Pasay City and Quezon City do not have existing plastic waste management projects. Quezon City and Malabon are not traversed by major river systems nor proximate to large bodies of water.

Tier 3 LGUs rank significantly lower compared to Tier 2 in terms of overall SWM management, mainly on account of the absence of plastic waste management programs in Caloocan and Pateros, a non-passage of ordinances regarding plastic waste management in Taguig and Valenzuela, and the low number of MRFs in all LGUs except Taguig. The overall ranking was also affected by the low waste generation rates of these LGUs (except for Caloocan) and the wide range in population densities. All Tier 3 LGUs have moderate to high ratings with respect to the number of existing MRS.

The lone LGU under Tier 4 ranked lowest in overall SWM management as it has not passed any ordinance on plastic waste management and currently does not have any plastic-related projects. It has only three MRFs and one MRS for its 21 barangays. Notably, it had a low waste generation of just 49 tpd in 2020.

Table 18.

SUMMARIZED ASSESSMENT RATINGS OF THE METRO MANILA LGUS

LGU	Waste Generation	Plastic Waste Programs	Passed Plastic Ordinances	Diversion Facilities (MRF)	Recovery System (MRS)	Population Density	Proximity to Waterways	Total Rating	Tier	
Muntinlupa	1	3	3	3	2	3	2	17	1	
Parañaque	2	3	3	2	2	3	2	17		
Pasig	2	3	3	3	1	2	3	17		
Manila	3	3	3	1	2	1	3	16	2	
Quezon City	3	1	3	2	3	3	1	16		
Las Piñas	1	2	3	1	3	3	2	15		
Makati	2	2	3	1	2	2	3	15		
Malabon	1	3	3	2	3	2	1	15		
Mandaluyong	1	3	3	1	3	1	3	15		
Marikina	1	3	3	2	1	2	3	15		
Pasay City	1	1	3	3	3	2	2	15		
Navotas	1	2	3	1	3	2	1	13		3
Pateros	1	1	3	1	3	1	3	13		
Valenzuela	1	3	1	1	3	3	1	13		
Caloocan	3	1	3	1	2	1	1	12		
Taguig	1	2	1	2	2	2	2	12		
San Juan	1	1	1	1	1	2	1	8	4	

CHAPTER 6.

INVESTMENT OPPORTUNITIES

All LGUs of Metro Manila implement their respective SWM systems in accordance with the approved 10-Year SWM plans. The systems include the required collection and disposal together with diversion of recyclables. The systems work in varying degrees, but are hampered by gaps that limit their effectiveness and contribute to plastic pollution in waterways and water bodies within and adjacent to Metro Manila.

Investment opportunities are aimed to address the major gaps in the recovery of recyclables and inadequate collection systems.

A comparative assessment of the 17 LGUs was performed to determine their level of readiness, need to receive investments to address the identified gaps and the level of implementation of the SWM systems. The parameters used include (1) waste generation, (2) existing plastic waste management programs, (3) passage of relevant plastic ordinances, (4) currently available infrastructure for diversion, (5) currently available system for the recovery of recyclables, (6) potential space for infrastructure and (7) proximity to waterways that can potentially receive uncollected waste. Following the assessment, LGUs were ranked into four tiers, with the highest ranking in Tier 1 and the lowest ranking in Tier 4.

Tier 1 included three LGUs: Muntinlupa, Parañaque and Pasig. Tier 2 included eight LGUs: Manila, Quezon City, Pasay City, Las Piñas, Makati, Malabon, Mandaluyong, and Marikina. Tier 3 included five LGUs: Navotas, Pateros, Valenzuela, Caloocan and Taguig. Tier 4 included one LGU: San Juan.

Table 19 presents the recommended investments and the corresponding members of the Tiers that require the intervention. The investments per gap were arranged in the order of decreasing impact to the SWM systems.

The main consideration for the selection of primary and secondary targets for investments is the Tier classification of the LGUs. The selection was then based on the number of existing facilities or systems that could be enhanced and the inferred large gaps in collection and recycling.

The comparatively higher level of SWM management of LGUs under Tier 1 and Tier 2 will ensure a higher probability in the success of the proposed investments. LGUs on the upper tiers can be easily encouraged to support and implement the proposed investments.

In the case of the centralized facilities for a cluster of barangays, the assessment of the LGUs has shown that the Tier 1 LGUs are best fitted to receive the investment. The proposed centralized facilities can then serve as models for best practice in recycling which can then be replicated in the other LGUs.

All LGUs, notwithstanding the Tier levels, will benefit from comprehensive support for the respective investments they receive.

Table 19.

MATRIX OF PROPOSED INVESTMENTS AND TARGETED LGU TIERS

SWM System Gap	Proposed Investment	Primary Targets	Secondary Targets
Recycling Gap	Centralized Recovery Facility	Tier 1 LGUs	None
	Enhancement of MRFs	Pasay City and Quezon City of Tier 2	Caloocan of Tier 3
	Enhancement of MRS	Pasay City and Manila of Tier 2	Caloocan of Tier 3
	Additional plastic trading centers	Tier 2 LGUs except Manila and Mandaluyong	Tier 3 LGUs, except Valenzuela
	Segregation bins	LGUs with major CBDs: Quezon City, Manila, Makati, Mandaluyong of Tier 2; Taguig of Tier 3; Muntinlupa of Tier 1	None
Collection Gap	Pushcarts	All LGUs	Not applicable
	Skip bins	All LGUs	Not applicable
	Small collection vehicles	Quezon City, Manila of Tier 2; Caloocan of Tier 3	Rest of Tier 2

In the case of the proposed enhancement of the MRFs, Pasay City and Quezon City have the largest number of facilities among Tier 2 LGUs that could provide options for enhanced operation or consolidation into fewer but bigger processing infrastructures. Caloocan, which also has a significant number of MRFs but falls under Tier 3, was considered for enhancement, but as a secondary target.

Manila and Pasay City have the largest number of MRS in Tier 2. The same condition was determined for Caloocan in Tier 3.

Plastic trading centers are already present in Manila and Mandaluyong, which both belong to Tier 2. A trading center is also located at Valenzuela, which belongs to Tier 3.

Segregation bins for plastic waste with multiple compartments will be restricted to Tier 2 LGUs with major commercial and business districts.

Pushcarts will be provided to all LGUs subject to the results of the assessment of actual collection conditions.

Small collection vehicles could be invested in the three large LGUs of Quezon City, Manila and Caloocan as their large waste generation is subject to the results of the assessment of actual collection conditions. The rest of the Tier 2 LGUs could also be provided with small collection vehicles.

6.1 INVESTMENTS FOR RECYCLING

Based on Figure 2, recyclables are recovered at four levels before they are sold to junkshops and/or consolidators. The regular progression from Level 1 to Level 4 in all the SWM systems indicates incomplete recovery of the recyclables. Recovery at Level 1 takes place at source and is performed at households, schools and establishments. The recyclables that were not picked out at Level 1 are targeted by the ambulant waste pickers at drop off points, by barangay personnel MRFs and through the MRS arrangement with the junkshops. In terms of infrastructure, Metro Manila only has 335 barangay MRFs and 12 centralized MRFs of unknown capacities to serve the requirements of 1,710 barangays. The MRFs are complemented by 1,026 MRS arrangements with junkshops, which are present in varying numbers in all of the 17 LGUs. The absence of monitoring prevents an assessment of the quantity of recovered recyclables with respect to the generation rates of the LGUs. Notwithstanding the absence of data, the limited number of the combined MRF and MRS, and the continuing practice of sorting at collection vehicles in all LGUs and at the three disposal sites, indicate a significant gap in the recovery of recyclables.

Investments were not proposed for Level 1 since the recyclables are sold directly to junkshops or to mobile pickers. Installation of common bins outside

of residences or establishments for the placement of the recovered recyclables would not be practical for the following reasons: (1) the bins would be used by passersby and nearby residences for the placement of mixed waste and (2) the bins will likely be stolen.

Nonetheless, there are investments that could increase the recovery of recyclables, including plastics under Level 2, which will be highlighted in the next section.

6.1.1 Centralized Recyclable Recovery Facility

This could be established for a cluster of adjacent barangays of an LGU. This investment is intended to cover the recycling gap that results from the limited number and low capacity of the existing MRFs and MRS arrangements. Based on a desktop analysis of the operation of the SWM systems of Metro Manila, the three Tier 1 LGUs of Parañaque, Muntinlupa and Pasig are deemed suited and capable of successfully establishing and operating such facilities.

Features and Functions of the Facility

- **Sanitary, systematic sorting and segregation of source-segregated dry waste collected by the barangay eco-aides or equivalent under the MRS system and recyclables coming directly from MRFs.**

The output of this facility will satisfy requirements of clean plastics, which are separated according to types using the resin number and color, and without any biodegradables.

The facility will also remove or significantly reduce the unsanitary practice of sorting at collection vehicles and at the disposal sites, at least for the waste delivered from the concerned LGU where the centralized facility will be located.

- **Redemption center of SUPs recovered from the barangays served by the facility**

Partnerships with major manufacturing companies that use plastics in their products and NGOs will be established by adapting the current successful arrangements made in the following LGUs.

- Manila: Trading for goods for SUPs from Unilever and Tetra Pak Philippines in cooperation with the association of junkshops known as Linis Ganda
- Valenzuela: Trading of goods for SUPs in partnership with Nestle Philippines

- Mandaluyong: Trading plastics for goods supported by Nestle Philippines and Colgate Palmolive Philippines through Plastic Credit Exchange

- **Cleaning, drying, weighing and baling of recyclables including all types of plastics**

For plastics, segregation will be in accordance with the plastic recycling code. The output will correspond to clean, properly segregated recyclables that are free from impurities and biodegradable component.

- **Sorting and recovery of low value, poor quality and SUP waste from the collected waste**

These plastics can be utilized through one or a combination of the following options:

- Distribution to barangays engaged in brick and/or chair making.
- Storage for the eventual sale to cement factories that can use these materials as part of their fuel requirements.

- **Temporary storage of recyclables prior to their sale to the junkshops or consolidators**
- **Temporary storage of residuals for subsequent collection and disposal under the LGU system**
- **Pick-up point of the residuals by the collection trucks of the LGU and/or the waste hauler for delivery to designated sanitary landfills**

This will help improve waste collection and reduce the leaks of plastics into the waterways

- **Potential contractual engagement of informal waste pickers and personnel deployed under the MRS**

The number of personnel will be guided by the target input of the facility and the anticipated revenues to be generated by the facility.

Siting and Design of the Facility

The proposed facility will be identified on the basis of suitable foundation, proximity to waste generators, accessibility to road networks and consistency with the land-use of the LGU. A minimum buffer zone of 100 meters is used for sensitive receptors such as schools, hospitals, parks and residential areas.

Currently, there are no standards for the design of a waste recovery facility in the Philippines. Conceptually,



the facility will correspond to a warehouse-type building with a paved floor, a waste receiving area, sorting and segregation area, weighing and baling area, storage area for recyclables (metals, paper/carton, glass), high value plastics, low value/SUPs and residuals, equipment storage area, wash/toilet area and drying area. It will have enough space for the parking of pushcarts, loading/unloading area for dry waste, recyclables, residuals and processed recyclables.

The facility will have basic water and power utilities. Water will be used for regular cleaning of the facility, washing of the dirty recyclables and washing/cleaning for MRF personnel after work. Electricity can be used to light up the facility and to power equipment such as computers, printers and balers. The facility will be provided with sorting tables, scales, wheeled storage bins and balers.

The capacity of the facility should be based on the waste generation of the barangay or cluster of barangays and the results of WACS.

Facility Operation, Maintenance and Monitoring

The facility will be manned by trained personnel who will perform the sorting, weighing, baling and storage of the recyclables. Regular monitoring of incoming waste and outgoing recyclables and residuals will form part of the Operation and Maintenance procedures. This will contribute to the proper determination of the diversion rate, at least within the barangays included in the cluster. The residuals left out of the sorting process in the facility will be properly collected and disposed, thereby minimizing leaks into the environment.

6.1.2. Enhancement of Existing MRFs and MRS Arrangements

The existing MRFs and MRS arrangements with junkshops are functional, although their capacities are limited to meet the needs of Metro Manila. These can be enhanced to optimize the recovery of recyclables within the bounds of their current design. Enhancements could be done through one of or a combination of the following:

1. Expansion of existing MRFs.
2. Closure of small MRFs and consolidation of waste processing into fewer yet bigger facilities.
3. Provision of necessary equipment like sorting tables, scales and balers.
4. Provision of washing facilities.
5. Provision of additional pushcarts with scales for barangays with MRS arrangements.

The primary targets for MRF enhancements are Pasay City and Quezon City. The MRFs of Pasay are very small and serve mainly as storage areas for recyclables. The secondary target is Caloocan, which has 20 MRFs for its 188 barangays. The MRFs of these LGUs should be subjected to a thorough inspection to assess the possibility of consolidation into bigger facilities that could serve a larger cluster of barangays.

The primary targets for MRS enhancements are Pasay City, Quezon City and Manila, which have 45, 84 and 642 MRS arrangements, respectively. The secondary target is Caloocan City, which has 120 MRS.

Additional pushcarts will increase the amount of waste that can be processed for the recovery of recyclables and could facilitate the increase in MRS arrangements with junkshops. This is illustrated in the case of Pasay City, which had only 45 MRS in 2020. The LGU generated 112,420 tons of waste in 2020 or an average of 1.53 tons of waste per day per barangay. Using a density of 174 kg/m³, this amount translates to about 8 m³ of waste per barangay. Assuming a capacity of 2 m³ for a pushcart, the foregoing calculations show that each barangay needs a minimum of four pushcarts to collect the waste that will be processed for recyclables.

This analysis, combined with an assessment of the actual waste generation per barangay, can be used to determine the number of required pushcarts per MRS to enhance the recovery of recyclables.

6.1.3 Additional Barangay Trading Centers for Plastics

Currently, centers for the purchase of SUPs and trading for equivalent goods is performed in Manila, Valenzuela and Mandaluyong in cooperation with NGOs and manufacturing companies. In Parañaque, Pasig and Muntinlupa, low-value plastics are collected by LGU waste generators without equivalent cash or goods.

Given these conditions, purchasing or trading centers could still be established in barangays of 14 of the 17 LGUs of Metro Manila. Initially, these centers can replicate the arrangements made in the Tier 2 LGUs of Manila, Valenzuela and Mandaluyong with the manufacturing companies. Trading and purchase can be performed in roaming vehicles of manufacturing companies, malls, small barangay stores, existing central MRFs and participating junkshops. Each center will monitor the quantity of plastics recovered. The roaming vehicles will be similar to the Mobile MRF envisioned under the Metro Manila Flood Management Project.

The primary targets of this investment are the Tier 2 LGUs, except Manila and Mandaluyong, which have existing trading centers through Linis Ganda.

The secondary targets are the Tier 3 LGUs, except Valenzuela, which has its own trading center for plastics.

6.1.4 Segregation Bins for Plastic Waste

Multi-compartment HDPE or stainless steels bins with images of the plastic types they can hold can be installed in large malls and airport terminals. These establishments have high passage rates of transient customers who generate lightweight, plastic-based packaging waste for food items and clothing. With proper signage, strategic placement and attractive designs, these bins can encourage temporal visitors and passersby to place their waste into the proper compartments. This investment can also be implemented in large malls or establishments of LGUs with major CBDs, including the highly urbanized LGUs of Quezon City, Manila, Makati and Mandaluyong of Tier 2, Taguig of Tier 3 and Muntinlupa of Tier 1.

The manufacturing of chairs from single use plastics is currently underway in a barangay in Las Piñas through the Villar Foundation. SUPs are used as components in the production of bricks in selected barangays located in Makati, Mandaluyong, Marikina, Muntinlupa, Parañaque and Taguig. See Box 2 for a list of the equipment needed for a chair factory.

These isolated barangay activities have been given a boost by (EMB-NCR, which donated a set of equipment to each of the 14 LGUs for the manufacturing of plastic chairs for schools and to perform composting using a 1-ton capacity rotating bin. Makati, Pateros and Pasay City did not receive the equipment package due to lack of space. EMB-NCR requires the availability of a site with an area of at least 500 m². At this point, it is best

BOX 2. EQUIPMENT SET FOR CHAIR FACTORY

- | | |
|--|---|
| One unit plastic shredder | Two units hydraulic press |
| One unit biodegradable waste shredder | Two units cooling tubs with detachable mold slide |
| One unit rotating bin composter (1 ton capacity) | One set of plastic chair mold |
| One unit plastic washer | Air and water pollution control system |
| One unit plastic dryer | Accessories |
| Two units plastic extruder | |

to observe if the factories that will be established at the 14 LGUs can be operated sustainably before similar investments are made. Accordingly, the establishment of a chair factory that uses plastic waste at selected barangays was not included in the current list of proposed investments.

MMDA recently completed the construction of a granulator and brick making facility worth 41 million pesos at its Vitas Pumping Station in Tondo, Manila. It is a semi-mechanized facility, which includes a conveyor belt to facilitate the manual sorting of waste recovered from the pumping station. The sorted waste will be reduced in size by the granulator and used in the production of bricks, eco-hollow blocks, eco-concrete barriers and bio-waste compost materials. MMDA plans to install a similar facility in its pumping stations. The granulator and the brick making facility have a combined floor area of 800 m².

The facility established at Vitas will be operated by MMDA, which justified its construction to protect the pumping stations from clogging. The inputs to the facility will come regularly from the waste that clogs the pumping station and hampers its operation.

Each of the chair and brick factories donated by EMB-NCR to the 14 LGUs will occupy an area of 500 m², but will essentially perform the functions of the granulator and brick facility although on a smaller scale. As stated in the report, the sustainability of the operation must be established before investments in similar facilities are made.

In the case of the MMDA, operational aspects like manpower, cost, revenue or economic benefits must be observed for at least a year to determine viability and whether a similar, expensive facility can be sustainably operated by the LGUs.

It has also been shown in this report that LGUs are unable to monitor the operation of their small, manually operated MRFs and have difficulty in identifying and acquiring sites that can accommodate granulator and brick making facilities.

Assuming that the contracted waste haulers will be required to operate such a facility, this will entail cost on the part of the LGU as additional charges will be imposed by the private contractors to perform the additional tasks.

Accordingly, the establishment of granulator and brick making facilities at the LGUs was not included in the current list of proposed investments.

6.2 INVESTMENTS FOR COLLECTION

The gap in waste collection affects all the LGUs and their component barangays. Based on data provided by MMDA, collection in 2020 indicatively corresponds to only 60 percent of the generation estimated by NSWMC. This is below the 70 percent collection reported in similar Asian cities such as Jakarta and Bangkok.

The low collection rate is manifested by the presence of litter in vacant lots and plastics in waterways. The materials detected by the Top 10 Plastic Survey in the channel of Pasig River are presented in Table 20. Plastics amounting to 2 m³ per day need to be removed from the 50 pumping stations of MMDA along the channel of Pasig River. Sweeping operations of MMDA collect 14 m³ of litter per day.

As discussed in section 4.3.1, potential leaks in collection systems take place at the barangay MRFs, MRS routes and junkshops where collection of the residuals are not monitored.

Limited or non-collection also takes place in areas under the barangay-managed collection and LGU sections that are not reached by the large collection vehicles.

Table 20.
TOP 10 MOST COMMON WASTE IN PASIG RIVER

Waste	% Weight
PCP plastics	3.48
Candy wrappers	5.21
PET bottles	5.56
Drink wrappers	9.27
Non-plastic waste	12.05
Snack wrappers	12.26
Plastic labo bags	13.9
Sando bags	14.62
Polystyrene pieces	20.24
Noodle wrappers	3.43

Altogether, the above-cited conditions are brought about by the limited or absent interface between the LGU-managed and barangay-managed collection. The investments to improve waste collection, are as follows:

Pushcarts:

Depending on the actual collection conditions in the selected LGU, pushcarts to support the RA 9003 mandated collection by the barangay could be acquired and distributed to selected barangays. These carts were observed to be used by the mobile waste pickers in Quezon City. The use of standard size pushcarts is recommended to facilitate monitoring of waste collection at the barangay level. Each pushcart will be equipped with digital scales to determine the weight of the collected waste and the recovered recyclables.



Pushcarts for waste collection in LGU Malabon

Skip bins:

Large skip bins are proposed to be installed near MRFs, junkshops and along the route of the pushcarts of the MRS, where non-collection takes place. These skips will serve as the temporary storage of the residuals and unprocessed waste and will prevent the scattering and indiscriminate placement of waste. Unlike the smaller HDPE bins, the skips are bigger and heavier, preventing them from being stolen or moved. The location of the skip bins will be included in the designated collection routes of the private haulers.



Skip bins

Small capacity collection vehicles:

Most of the collection vehicles of the LGU-contracted haulers have capacities of 12 m³ or greater, making it difficult for them to pass through the narrow and usually occupied roadways of slum areas inhabited by low-income families and the informal sector. The use of smaller capacity trucks (≤ 5 m³) will allow the extension of regular waste collection in these areas. This investment will have to be made by the LGU-designated waste haulers.



Small dump truck

6.3 PROPOSED STUDIES FOR THE RECOMMENDED INVESTMENTS

Table 21 shows the preliminary studies and surveys that need to be conducted for the recommended investments.

Table 21.

REQUIRED SURVEYS AND STUDIES FOR THE RECOMMENDED INVESTMENTS

Recommended Investments	Required Studies/Surveys
<p>Improvement of waste collection through:</p> <ol style="list-style-type: none"> 1. Deployment of pushcarts 2. Deployment of skip bins 3. Additional small waste collection vehicles 	<ul style="list-style-type: none"> • Survey of actual coverage of LGU-managed and barangay-managed collection to determine the extent and condition of the road networks reached by the collection vehicles. The location of the MRFs, MRS routes and junkshops will be determined with respect to the existing collection routes. • Determination of actual collection rates of the barangays and the LGUs in relation to waste generation to provide a realistic estimate of the collection gap and serve as the basis for the acquisition of small trucks—in the case of the private haulers—and pushcarts in the case of barangay-managed collection. • Determination of available barangay logistics for waste collection in terms of manpower, vehicles and funds to be used to identify which barangays will receive assistance and the number of pushcarts that will be deployed.
<p>Increase in the recovery of recyclables through:</p> <ol style="list-style-type: none"> 1. Centralized recyclable recovery facility 	<ul style="list-style-type: none"> • Identification of barangay clusters that will be served by the facility. Cluster selection will give priority to contiguous barangays without MRFs or those whose MRFs and MRS have limited capacities. • Waste characterization at selected barangay clusters to determine potential amount and type of recyclables.
<ol style="list-style-type: none"> 2. Enhancement of existing MRFs and MRS arrangements 	<ul style="list-style-type: none"> • Audit of MRFs and MRS in target LGUs to determine location, physical condition, current capacity, available equipment and deployed operations personnel.
<ol style="list-style-type: none"> 3. Additional barangay trading centers for plastics 	<ul style="list-style-type: none"> • Search for NGOs and manufacturing companies that will support the program. The Philippine Alliance for Recycling and Materials Sustainability (PARMS) could be considered to start this program. • Identification of barangays where the trading centers will be established. • Search for potential market or usage.
<ol style="list-style-type: none"> 4. Segregation bins for plastic waste 	<ul style="list-style-type: none"> • Identification of commercial establishments where the bins will be deployed. These correspond to the large malls and supermarkets found in the commercial and business districts of Makati, Quezon City, Mandaluyong and Muntinlupa. LGU records of size, number of stalls, planned occupancy and sales could be used to screen the establishments where the bins will be deployed.



Photo: Shutterstock / junpinzon.

The investments will be accompanied by institutional strengthening of the concerned LGUs to ensure proper implementation as well as sustained operation and maintenance. The key areas to be addressed by capacity building include the following:

- Operation and maintenance of MRFs and new recycling facilities
- Monitoring of new recycling facilities, as well as existing MRF and MRS operations
- Monitoring of collection systems

For the new recycling facilities, MRF and MRS, the weight of the input waste and of the outputs of recyclables and residuals should be monitored. For the collection system, the capacity of the vehicles should be known, and the trips made per day should be recorded.

Aside from the operational gaps, all LGUs have limitations in the following aspects of their approved SWM plans and should be addressed when these are updated in 2024:

- **Methodology employed in the conduct of the Waste Assessment and Characterization Survey (WACS):**

The methodology and short four-day duration of the WACS used in the 2013-2014 version of the plans resulted in a wide range of per capita waste generation and densities for a group of LGUs with essentially similar socio-economic profiles. These translated into unrealistic waste generation rates and volumes that affected planning for collection, diversion and disposal.

The WACS performed for five LGUs of Metro Manila in 2021 utilized the methodology formulated by the Department of Science and Technology, which required seven (7) consecutive days of testing

and identification and quantification of the plastic components. The same methodology will be used in the planned WACS for the remaining 12 LGUs.

- **Waste component identification:**

The waste components presented in most of the SWM plans included the high-value PETs, HDPEs and PPs, while the remaining low value types were lumped together with other residual wastes. In light of the growing awareness of plastic pollution, all types should be identified and quantified so they can be used for planning and management. These include PET, HDPE, PVC, LDPE, PP, PS, and polycarbonates.

- **Section on Monitoring and Evaluation:**

10-Year SWM plans do not have a section on monitoring and evaluation, which should contain performance standards on diversion, collection and disposal. This is critical for monitoring waste management and the implementing the rules and regulations of RA 9003.

- **Analysis of socio-economic profile:**

The plans include a description of the socio-economic profile, which is simply an enumeration of the features of the LGUs. This was not analyzed and used in relation to the SWM conditions of the respective LGU. The relevant features include population growth and density, income distribution amongst the population, distribution of residential areas, proximity to major waterways and water bodies, vulnerability of low-lying areas to flooding, spatial location of major waste generators, existing road networks and the locations of MRFs, MRF routes and junkshops.



CHAPTER 7.

CONCLUSIONS AND RECOMMENDATIONS

An analysis of the SWM systems of the 17 LGUs of Metro Manila showed gaps in collection, recycling and methodologies employed in waste planning, diversion and disposal, hindering the effective implementation of RA 9003—particularly for plastic waste management. Gaps in the available SWM data at the barangay, LGU and agency levels are also present.

The gap in waste collection is attributed mainly to the limitations of both the barangay- and LGU-managed systems in reaching slum or depressed areas where the road networks are narrow and occupied by informal establishments. The extent of non-collection in these areas is not known due to the absence of monitoring by both the barangays and the LGUs. These conditions are aggravated by the absence of monitoring of the residuals generated at MRFs, MRS and junkshops, translating to collection leaks.

Metro Manila, just like the rest of the Philippines, is vulnerable to the ongoing threat of climate change. As predicted by the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the country will experience changes in the amount and frequency of rainfall, which will contribute to an overall increase in runoff—particularly in the built-up sections of Metro Manila LGUs. Accordingly, the magnitude and duration of flooding will be exacerbated by collection gaps and leaks that will fill-up and clog waterways and canals with plastic waste.

The gap in recycling is reflected by the continuing presence of four levels of the recovery of recyclables from the source until the waste reaches the disposal sites. Level 1 refers to the recovery of recyclables at source by households and workers at establishments. Level 2 corresponds to the sorting of recyclables at MRFs and MRS by barangay-designated personnel and drop-off points just outside of the waste generators by ambulant pickers. Level 3 is performed at the collection vehicles by the truck crew. Level 4 is undertaken by the informal pickers at the disposal sites.

The recycling gap is brought about by the inadequate number of efficient MRFs and MRS at Level 2 that can effectively process the waste generated in the 17 LGUs. The unprocessed waste then goes to the collection vehicles and disposal facilities. The recovery of recyclables at Level 3 and Level 4 could be reduced to a minimum if there were adequate MRFs and MRS.

The gap in the diversion of the biodegradables is attributed to the limited number of MRFs used to process these materials into compost.

Gaps in methodologies affect planning, waste diversion and disposal:

1. As currently formulated, the SWM plans do not include the analysis and correlation of the physical and socio-economic conditions with existing SWM conditions and programs of the LGUs. The per capita waste generation data of the individual LGUs and waste densities are essentially undervalued due to the procedures used to conduct the WACS. These translate to an underestimate of the waste generation of the LGUs and affect the proper accounting of disposed waste into sanitary landfills. Moreover, the current

WACS data does not identify and quantify the presence of all potential plastic types in the waste stream.

The SWM plans do not include monitoring and evaluation, which should contain the agreed upon performance standards that guide how the LGUs can effectively oversee implementation.

2. The current MMDA method of equating waste diversion to the dividend of the estimated waste collection and waste generation produces an overestimated value. Diversion should correspond to the amount of waste not disposed into the landfills due to recycling and composting. Currently, this cannot be estimated due to the absence of monitoring of recycling and composting efforts in the LGUs.
3. The use of the volumetric method and an assumed waste density at sanitary landfills is not accurate and affects proper accounting of disposed waste.

The gaps in recycling and collection were used to identify potential investments that could improve the solid waste management systems.

Investments to improve recovery of recyclables include: the establishment of centralized facilities for processing of dry and source-segregated dry waste, the enhancement of the operation of existing MRFs and MRS, the establishment of additional plastic redemption centers in all of the LGUs and deployment of plastic segregation bins in commercial establishments at LGUs with major CBDs.

Investments in collection include the combination of the following: acquisition and deployment of pushcarts to barangays, deployment of skip bins near MRFs, MRS routes and junkshops, and small collection vehicles that can pass through narrow roadways of depressed areas. The pushcarts can simultaneously be used to support the MRS of the barangays.

The 17 LGUs were assessed in terms of (1) waste generation, (2) existing plastic waste management programs, (3) passage of relevant plastic ordinances, (4) available infrastructure for diversion, (5) available system for the recovery of recyclables, (6) potential space for infrastructure and (7) proximity to waterways in order to determine their comparative readiness

and need to implement investments that will improve SWM systems.

The assessment led to a classification of the LGUs into four tiers indicating the prioritization of recipients of proposed improvements of the SWM system. Tier 1, which includes Parañaque, Pasig and Muntinlupa, will be considered for the construction of centralized facilities for the processing of dry, potentially recyclable materials. The LGUs within each of the remaining Tiers shall be considered for the implementation of the other investments based on their respective needs.

The gaps in methodologies for SWM planning could be addressed through the combined efforts of the LGUs and the NSWMC. The NSWMC could issue a memorandum order requiring the LGUs to include a section on monitoring and evaluation in their updated SWM plans. The memorandum order could contain guidelines on the parameters to be monitored and the performance guidelines to be followed by the LGUs. It should also issue another memorandum that defines waste diversion.

For their part, the LGUs should improve their plans through correlation of the physicochemical and socioeconomic conditions with existing SWM situation and use of the DOST-approved procedures in the conduct of their WACS.

Implementation of the investments will be based on actual SWM conditions at each of the selected LGUs and subject to the results of the required studies and financing arrangements.

Resolution of the disposal gap should be the responsibility of MMDA, which should require all sanitary landfill operators to use weigh bridges.

The gap in the SWM database at the barangay, LGU and EMB levels prevent effective and systematic monitoring and management—particularly for diversion and non-collection, which affect plastic waste. This can be improved through increased coordination among these three key stakeholders. EMB should establish a regional and national database based on the checklist it will issue to all barangays and LGUs. It should take an active role in the collection and management of solid waste data using appropriate and free mobile applications. The NSWMC could issue a memorandum order requiring barangays and LGUs to regularly submit updated waste management data.

Based on interviews, Information, education and communication, campaigns on proper SWM are a continuing program among all the LGUs of Metro Manila. The LGUs use social media and conventional communication methods to reach out to various stakeholders.

The following MMFMP additional IEC activities will reinforce the current efforts of the LGUs:

1. Deploy an Audio-Visual Truck to inform and educate the public on SWM.
2. Establish a Children's SWM Eco-hub in two locations to be centers for learning about SWM, intended for a large number of students.
3. Produce videos showcasing famous TV artists and well-known personalities to educate the public on proper segregation, reduction, re-use and recycling of waste.

Aside from their IEC efforts and those planned under MMFMP, the LGUs and the regulating agencies must focus and exert extra efforts on strict enforcement of local ordinances and administrative orders to improve SWM.

The proposed improvements of the SWM systems of Metro Manila through appropriate investments in recycling and collection and the establishment of a SWM database can be replicated in other parts of the Philippines where similar gaps in the implementation of RA 9003 exist. The memorandum orders to be issued by the NSWMC on SWM planning, diversion and waste data collection will apply to all LGUs of the Philippines.

REFERENCES

- Audi, Pradjita. (2019). Evaluation for The Implementation of New Presidential-Regulation on Solid Waste Management in Jakarta, Indonesia
- City Government of Marikina. (2014). Marikina City Ten Year Solid Waste Management Plan (2014-2023).
- City of Makati. (2014). Ten-Year Solid Waste Management Plan (2014-2023), City of Makati.
- City of Malabon. (2015). 10-Year Ecological Solid Waste Management Plan 2015-2014.
- City of Mandalutong. (2015). 10 Year Ecological Solid Waste Management Plan (2015-2024).
- City of Manila, Department of Public Services. (2015). 10-Year Solid Waste Management Plan (2015-2025).
- Environmental Management Bureau. (2018). National Solid Waste Management Status Report (2008-2018). Quezon City.
- Environmental Management Bureau. (2020). Annual Report fot CY 2019. Quezon City.
- Environmental Protection and Waste Management Department. (2018). Update of the 10-Year Solid Waste Management Plan of Quezon City .
- Jambeck, J. R. R. Geyer, C. Wilcox, T. R. Siegler, M. Perryman, A. Andrady, R. Narayan, K. L. Law. (2015). Plastic waste inputs from land into the ocean. *Science*, Volume 347, Issue 6223, 768-771.
- Las Piñas City, 10-Year Ecological Solid Waste Management. (2014). Las Piñas City.
- Lebreton, Lebreton, L. , A, Andrady. (2019). Future scenarios of global plastic waste generation and disposal. Palgrave Communications.
- Lungsod ng Muntinlupa. (2015). 10-Year Solid Waste Management Plan (2015-2024).
- Metro Manila Development Authority. (2020). Data on Waste Collection and Disposal as of October 2020.
- Metro Manila Development Authority and Department of Public Works and Highways. (2016). Environmental and Social Impact Assessment - Metro Manila Flood Management, Phase 1.
- Ministry of Natural Resources and Environment of Thailand. (2019). Booklet on Thailand State of Pollution, 2018.
- National Economic Development Authority, (2017), Philippine Development Plan, 2017-2022
- National Solid Waste Management Commission. (2020, November 11). NSWMC Database as of June 2020. Retrieved from Solid Waste Management Division: https://nswmc.emb.gov.ph/?page_id=50
- Navotas City. (2015). Navotas City 10--Year Solid Waste Management Plan (2015-2024).
- NEDA and National Solid Waste Management Commission. (2008). Cost Sharing Framework for Solid Waste Management.
- Parañaque City. (2015). Ten-Year Solid Waste Management Plan of the City of Parañaque (2015-2024).
- Pasay City. (2015). Pasay City 10-Year Solid Waste Management Plan (2014-2015).
- Pasig City. (2015). Pasig City Ten-Year Solid Waste Management Plan (2015-2024).
- Philippine Statistics Authority. (2021, March 5). Gross Domestic Product. Retrieved from Philippine Statistics Authority National Capital Region: <http://rssoncr.psa.gov.ph/GRDP>
- San Juan City. (2015). Solid Waste Management Plan (2015-2024).
- Taguig City. (2015). The City Government of Taguig, 10 Year Solid Waste Management Plan (2015-2024).

University of the Philippines National Engineering Center. (2021). Draft Report on the Microplastic and Plastic Field Surveys on Pasig, Philippines.

Valenzuela City. (2015). Valenzuela City Proposed 10-Year Solid Waste Management Plan (2015-2024).

World Bank (2018). Population living in slums (% urban population) - Philippines: <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=PH>

World Bank. (2018). Waht a Waste 2.0 - A Global Snapshot of Solid Waste Management to 2050. The World Bank.

World Bank Group. (2020). Market Study for the Philippines, Plastics Circularity Opportunities and Barriers. Washington DC.

ANNEX

Annex 1.

TARGET RESPONDENTS OF DATA REQUEST AND ON-LINE INTERVIEWS

Target Respondents for Data Request	Response	Target Respondents for on-line Interview	Date of Call
Caloocan	Letter request received by LGU; requested data not yet provided	CENRO Head /Designated Representative	November 23, 2020
Las Piñas	Letter request received by LGU; requested data provided on December 7	CENRO Head /Designated Representative	November 27, 2020
Makati	Letter request received by LGU; requested data provided on December 22	DES Head/ Designated Representative	November 20, 2027
Malabon	Letter request received by LGU; requested data provided on November 18	CENRO Head /Designated Representative	November 19, 2020
Mandaluyong	Letter request received by LGU; requested data provided on January 11	CEMD Head/ Designated Representative	November 23, 2020
Manila	Letter request received by LGU; requested data provided on November 25	DPS Head/ Designated Representative	December 4, 2020
Marikina	Letter request received by LGU; requested data not yet provided	CEMO Head/ Designated Representative	Target call recipient not yet available
Muntinlupa	Letter request received by LGU; requested data provided on December 7	ESC Head/Designated Representative	December 8, 2020
Navotas	Letter request received by LGU; requested data provided on January 27	CENRO Head /Designated Representative	December 7, 2020
Parañaque	Letter request received by LGU; requested data provided on November 26	CENRO Head /Designated Representative	December 3, 2020
Pasay City	Letter request received by LGU; requested data provided on December 7	CENRO Head /Designated Representative	December 7, 2020
Pasig	Letter request received by LGU; requested data not submitted but was discussed during online interview	CENRO Head /Designated Representative	December 2, 2020
Pateros	Letter request received by LGU; provided SWM plan only on November 10	MENRO Head/ Designated Representative	November 25, 2020
Quezon City	Letter request received by LGU; requested data provided on November 23	Task Force Head/Designated Representative	November 19, 2020
San Juan	Letter request received by LGU; requested data not provided	CENRO Head /Designated Representative	January 26, 2021
Taguig	Letter request received by LGU; requested data not submitted as the CENRO is undergoing reorganization	OIC CENRO, Program on recycling and plastic management discussed during online interview	December 15, 2020

Valenzuela	Letter request received by LGU; provided requested data during the online interview	CESO Head/ Designated Representative	January 25, 2021
MMDA	Letter request received by MMDA; requested data provided on November 25	SWMO Head/ Designated Representative	November 24, 2020
NCR EMB	Letter request received by NCR-EMB; requested data not submitted but was obtained thru telephone interview	Head of SWM Section	December 15, 2020
NSWMC	Letter request received by NSWMC; requested data submitted	OIC of SWM Division	December 15, 2020
Recycling Industry Representative	Letter request received by Mr. Crispian Lao, requested data not available at his office, was referred to NSWMC Secretariat	Mr. Crispian Lao	Call was not made as data requested as data requested not available at his office
SWAPP	Letter request received by MMDA; requested data not available at SWAPP	Executive Director/ Designated Representative	December 17, 2020

APRIL 2022

