FROM CITY TO SEA

Integrated Management of Litter and Plastics and Their Effects on Waterways

A Guide for Municipalities

WORLD BANK GROUP

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The guide was authored by Lila Madariaga and John Morton based on content developed by Corrie Clark, It also used information from case studies on Long Beach, developed by Save the Bay (Kirsten James) and the City of Long Beach (Suja Lowenthal); and on the District of Columbia, developed by the Alice Ferguson Foundation (Laura Chamberlain) and DC Department of Environment (Jeffrey Seltzer). Technical data analysis on costs was undertaken by Benita Thapa. It benefitted from expert review and input from Peter Kolsky, Carlos Tucci, Sergio Mora, Thierry Martin, Maria Catalina Ramirez, Farouk Banna, Van Anh Vu Hong, Lizmara Kirchner, and Clementine Maria Stip. We would also like to thank Meskerem Brhane, Maria Angelica Sotomayor, Ming Zhang and Guang Chen for supporting the various activities that led to the production of this guide.

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INTRODUCTION

1. INTRODUCTION

This Guide for Municipalities is intended for use by municipal officers and service providers concerned with (a) policies and programs that influence waste generation and management; (b) the urban environment in which litter is generated, accumulated, and transported; and (c) the waterways they affect—this includes those in charge of policy, municipal planning, urban planning, public works, and solid waste management. The guide was created to help municipal decision makers, service providers, and municipal planners understand the potentially critical consequences of litter in their cities and develop comprehensive, interdisciplinary approaches to managing litter flows.

It introduces an array of management measures and describes when they would be appropriate based on local circumstances. To strengthen the case for taking an integrated litter management approach, it provides background information on the social and environmental challenges posed by litter and how these have been tackled in some cities.

The guide includes:

- **Key facts regarding litter generation, impacts, and control options**
- **A step-by-step approach to consider local conditions to develop a strategy for litter reduction adapted to the municipality's context**
- **Case studies, including examples of different management measures that have succeeded**

Key Points We Need to Understand

What is urban litter? It is solid discarded material that is generated and deposited in the urban environment. It commonly includes domestic litter (plastics, packaging, paper, bottles, cans, and so on), construction materials, vegetative litter, and large discarded objects.

How can litter affect our city? It can affect the quality of life of communities, resulting in economic losses and damage to natural ecosystems. Adverse impacts may include—just to name a few—health hazards (including breeding grounds for disease vectors), flooding, diminished sense of security, loss of land value, atmosphere pollution, and damage to wildlife and livestock.

Who is responsible for litter? Responsibility is shared by many actors in a municipality: manufacturers and distrubutors of goods, residents, the local government, and even visitors. Thus, we should try to engage all of them in being part of the solution.

THE ROAD MAP FOR OUR MUNICIPALITY

2. THE ROAD MAP FOR OUR MUNICIPALITY

This guide will walk through the process of identifying which building blocks must be put together to manage litter effectively and then define what those blocks will look like, based on a city's unique circumstances.

Start by perusing the section on Litter Basics, which will provide background knowledge on:

- **Spatial distribution of litter in a city ("Litter in a City")**
- **Factors that influence litter quantities and distribution ("How Much and What Types of Litter Are Found in a City?")**
- **Adverse consequences of litter ("Negative Effects of Litter")**
- **Types and examples of litter management options ("How Can We Address This Issue? A Balance of Priority Measures (with Short-Term Impact) and Cost-Effective Measures (with Long-Term Impact))**

For reference, success stories and lessons learned from other cities are included in the Appendix: Case Studies. These cases include:

- **Integrated watershed litter reduction (page 46)**
- **Bans on littering items (page 48)**
- **Improvements in collection and cleaning services (page 49)**
- **Litter management information technology (page 51)**
- **Cleanup initiatives (page 52)**

LITTER BASICS

3. LITTER BASICS

Solid waste enters the urban environment at surprising levels, affecting all cities. Its accumulation in waterways and marine environments has made it an issue of global significance. Available estimates indicate that a population of a million people, even in cities with regular services to collect garbage and clean streets and drains can deposit hundreds to thousands of tons of litter in waterways each year[1], limiting their intended use for recreation and other purposes. In cities without fully developed basic services, a million people can generate hundreds of thousands of tons of garbage that go uncollected each year, a portion of which is burnt or buried by households, with the remainder inundating waterways and drainage systems or accumulating throughout the city.[2]

Litter, even in small quantities, can have significant localized effects. For example, less than 1 ton of trash accumulated in a residential area can reduce property values; and that same quantity can render a street drain unusable or clog a stormwater pipe, exacerbating flooding and reducing the value of public investments and services. It is even more impactful in parks, beaches, and recreational waterways, where the presence of small quantities of litter is a reason for many people to not make use of them. When considered citywide, these localized effects can lead to systemic degradation of the livability and functioning of an urban environment and its waterways. Photo 3.1 illustrates how litter can accumulate in various environments.

At a global level, litter reaching the ocean has accumulated to significant levels. A large proportion is from land-based waste sources composed predominantly of plastics that are more resistant to degradation than other forms of litter. This litter has accumulated in five geographic regions in the ocean where currents have created gyres that concentrate debris. The most famous one is referred to as the “Great Pacific Garbage Patch” and is estimated to be twice the size of France (1.6 million square kilometers). The others are located in the North Atlantic, South Atlantic, South Pacific, and Indian oceans. The accumulation of plastics in the oceans has been a subject of global scientific interest because of the potential effects on the ocean ecosystem health.

[1] *Four hundred forty-one tons to 4,500 tons per year per million population, based on studies that estimated trash loading to waterways considered to have impaired use due to trash, including the Los Angeles River watershed (California Regional Water Quality Control Board 2007) and Honolulu (Hawaii State Department of Transportation 2016). A study in Hong Kong based on litter found in land (rather than total loading) and water-based surveys saw similar numbers (Hong Kong Environmental Protection Department 2015).*

[2] *Seventy-three thousand tons to 440,000 tons per year per million population, based on population, waste generation, and collection coverage data from* What a Waste 2.0 *(Kaza et al. 2018) in cities near major waterways in Africa (Bamako, Mali; Bujumbura, Burundi; Cotonou, Benin; Dar Es Salaam, Tanzania; Kampala, Uganda Maputo, Mozambique; Monrovia, Liberia). When waste goes uncollected, it may be burnt, buried, or placed in an open area, or it could end up in a drainage system or waterway through direct dumping or natural means.*

PHOTO 3.1. *Litter Accumulated in Different Environments*

a. Litter on a beach

b. Litter in a city

c. Litter on a hillside

d. Litter in an open canal

Sources: *a. vaidehi shah / Wikimedia Commons; b. Bengt Nyman / Wikimedia Commons; c. © Aisha Faquir / World Bank; d. McKay Savage / Wikimedia Commons.*

LITTER IN A CITY

Presence of litter in any city is usually a shared responsibility among stakeholders: from manufacturers and distributors who introduce plastics to the market to consumers with questionable behaviors to municipalities struggling to dedicate sufficient resources to public services.

Some waste is deliberately tossed to the environment—especially on the go—whereas other waste can be dispersed from ineffective garbage receptacles (garbage bags by the sidewalk or trash bins without a lid) and spread by wind, rain, or scavenging animals. Once a piece of garbage enters the urban environment, it becomes litter. But what happens to it after that? Does it just follow the water? The answer is yes, it can, and it commonly does but not exclusively. Because litter can have varying shapes and sizes depending on the type and quantity, its mobility can vary and will also depend on the physical characteristics of the city landscape it encounters. As a result, litter accumulates in some areas and is transported through others; the exact spots and time period litter stays in a certain area can vary considerably between and among cities. Although most cities do not fully account for the path of these derelict pieces of trash even when they are able to intercept them, the main areas where litter is commonly found in urban environments can be generally characterized.

Urban Land Areas.

Among the most visible areas where litter can accumulate is the land that makes up the urban environment, including private residential, commercial, and industrial properties, largely because of ineffective or inefficient waste management by the property owners or gaps in city services—for example, in unkept or

abandoned lots or in neighborhoods that have overflowing bins and other forms of spillage without effective cleanup or city collection services. Public spaces, including parks, green areas, and areas next to roads, railways, and waterways, are also common areas for litter to be present. Litter in public and private land, if not cleaned up, can remain in place; continue to accumulate; or be transported by water, wind, animals, or human activities.

Streets and Sidewalks.

A common sight in cities is a lone plastic bottle or larger piles of litter strewn on streets and sidewalks. In these areas, the litter is commonly mobile as these hard or "impervious" surfaces (as they are referred to by drainage experts) can support a significant flow of water during a rainstorm. These surfaces also make the litter susceptible to being transported by other means, including foot and motor traffic and wind. Litter in these spaces can also accumulate in drainpipe entrances or street curbs, for example, where a physical barrier limits its mobility.

Drainage Systems.

Despite the fact they are meant to accept a large flow of water to avoid flooding, drainage systems are not designed to transport litter, even in small quantities. Commonly this results in accumulation of garbage in the drainage system of cities, as illustrated in Photo 3.2. Common areas where litter is found are at the point of entry (for example, at the drain opening or catchpits, structures that receive the water when it enters some drains); in the pipes or canals that make up the system; or at the exit point (for example, a waterway or, in systems that combine drainage with sewage systems, at a treatment plant or lagoon).

PHOTO 3.2. *Accumulation of Litter in Urban Waterways*

a. Litter in an open drainage system

b. Litter in natural waterways

Sources: *a. World Bank / Sarah Farhat; b. Bilal Kocabas / Shutterstock.com.*

Rivers, Lakes, and Bays.

Litter can be transported via drainage systems, wind, or water action or directly placed into natural water bodies and their shorelines. It is common in many cities to see litter- or garbage-filled rivers or creeks, or floating litter in bays that serve cities recreationally or as a port. Litter can sink to the bottom of the water body, whereas floatable or semibuoyant litter can accumulate in shallow areas or near or on shores, or be transported to larger bodies of water.

Oceans and Their Shorelines.

Recreational beaches commonly have garbage thrown near where tourists are active or where it washed up on shore. Once the rivers discharge into the sea, floatable litter can be transported to the open ocean. It can then either drift and accumulate in more stagnant areas or gyres, or it can be redeposited on shore. Because of the degradation of many forms of litter, the litter that gets transported or remains in ocean environments is predominantly made of plastic.

HOW MUCH AND WHAT TYPES OF LITTER ARE FOUND IN A CITY?

All cities produce litter, but the quantity, type, and distribution within the city varies significantly. Some cities seem to have trash everywhere, but others only in certain areas. What determines this? It is influenced by a variety of identifiable factors related to the generation, management, and transport of waste in a city. These include:

Urban Density and Economic Activity.

The ultimate source of garbage that, if not properly managed, can potentially become litter, is the production and consumption of products, including everything from packaging (a very common one) and bags to paper products, tires, and even furniture and construction materials. The types of garbage produced and items that become litter in a given area of a city depend on the prevailing activity, and the pattern will vary from city to city. Commercial and industrial areas tend to produce higher litter loads than residential areas, and tourism areas can commonly be hotspots of litter generation. Higher urban densities also often generate higher litter loads.

Waste and Cleaning Service Levels.

Among the most significant factors influencing the volume of waste in an individual city is the level and quality of services. On average, urban areas in high-income countries can provide waste collection for nearly 100 percent of their population, whereas low-income countries on average can provide this service to only 48 percent of their population (World Bank 2017). Because of the huge volumes of waste managed by household and business waste collection, its absence in even a portion of a city can result in significant amounts of litter through the urban environment. Likewise, the absence of cleaning services, such as street cleaning, maintenance of parks, and beaches and drain cleaning, also contributes to the accumulation of significant quantities of litter. For cities with services covering much of the population, inefficiencies in services (for example, lack of containers or a street cleaning service that sweeps litter into the drainage systems) or underresourced services (not enough collection bins or bins not emptied with the needed frequency; cleaning services that do not allocate resources to peak times or hotspots) can contribute significantly to litter generation and accumulation. Photo 3.3 illustrates how varying degrees of solid waste services influence litter accumulation. Figure 3.1 also points this out schematically.

Culture and Behavior.

In most cities, even when adequate services are in place, habits of the residents or tourists contribute to littering. Contributing factors include people's sense of stewardship and community, common or traditional practices, and even the level of cleanliness, as people get the impression they can get away with littering if it is already present. People's subjective perception of the quality of public spaces is a key driver for how much they use and how well they keep these spaces.

In neighborhoods or cities without regular services, the habits of people can affect litter generation significantly. For example, many cultures burn or bury waste in the absence of collection services; yet in other cultures the sidewalks are cleaned by residents or businesses.

Drainage System.

Different cities have a variety of drainage system configurations, which can affect the path of litter through a city significantly. The type of system—whether it is an open drainage system, separate stormwater networks, or combined stormwater and sewage systems—affects how the litter is transported. Also, having a significant dependence on natural drainage (through wetlands or groundwater) can reduce the mobility relative to that provided by concrete systems and can reduce the proximity of waterways or drainage systems to people. Additionally, the overall lack of effectiveness of a drainage system can exacerbate accumulation in and around the drainage system.

PHOTO 3.3. *Amount of Litter that Can Accumulate in Scenarios with Different Levels of Solid Waste Services Provision*

a. Significant gaps in waste collection services

b. Inefficiencies in cleaning and collection services

c. City with effective services and littering behavioral habits

Sources: *a. © Dominic Chavez / World Bank; b. Andriy Blokhin / Shutterstock.com; c. Tony Baggett / Shutterstock.com.*

FIGURE 3.1. *Relative Quantities of Litter by Source in the Spectrum of Solid Waste Services*

Note: Spectrum ranges from cities with gaps in solid waste management services (left) to existing but inefficient services (middle) to cities with efficient services (right). SWM = solid waste management

Rainfall and Climate.

The frequency and intensity of rain in a city will affect how litter accumulates and transports in cities. When there is a long dry spell, litter can accumulate on land, streets, drainage systems, and dry riverbeds, whereas intense storms commonly create a "flush" of litter. Cities with infrequent but intense storms may be subject to large sudden loads of litter to waterways or can have severely impaired drainage systems that do not function, even during strong storms.

Along its path, litter has a series of detrimental effects on society and the environment. Let us examine these more closely.

NEGATIVE EFFECTS OF LITTER

Litter can affect the quality of life of communities, entail economic losses and costs, or damage the natural ecosystem. These effects differ depending on the different media where litter is deposited, as summarized in Table 3.1.

TABLE 3.1. *Negative Effects of Litter according to Medium Where It Is Deposited*

	Land	Drainage systems	Rivers and coastal areas	Open ocean
Health	✓	✓	✓	
Aesthetics	✓	✓	✓	
Community trust, pride, and sense of security	✓		✓	
Land values	✓		✓	
Odors	✓	✓		
Infrastructure investment		✓		
Flooding		✓		
Tourism			✓	
Water quality			✓	✓
Atmospheric pollution	✓			
Interaction with wildlife and livestock	✓		✓	✓
Transport of pollutants				✓
Transport of species				✓

Litter Generates Odors and Degrades Aesthetics, Reducing the Value of Lands and the Sense of Security.

Litter often emits unpleasant odors and creates unsightly aesthetics in both natural and manmade landscapes when it accumulates in lands and drainage systems, which deteriorates the quality of life of the residents and the value of land. Ineffective services and the perception of an uncleanly, disordered environment can have a subtle but systemic impact on the functioning of the city and its individual neighborhoods, affecting their livability, property values, and attractiveness for businesses and tourism. It also can reduce a population's sense of security and confidence in their neighbors and local government and contribute to a process of community decline in the medium and long terms[3]. This can be particularly impactful in the context of the multitude of challenges faced by marginalized and informal neighborhoods.

Litter Is a Habitat for Mosquitoes and Pests.

A recent literature review (Krystosik et al. 2020) found several studies that supported an association between solid waste accumulation and urban vector-borne diseases, especially mosquito-borne diseases, and urban zoonosis. For instance, litter that builds up over time was found to provide food and burrowing sites for rodent and canine disease reservoirs.

Litter can also serve as a receptacle for rainwater, which serves as a breeding habitat for pests that carry disease. Studies have shown that common litter items, such as plastic bottles, tin cans, and Styrofoam containers, account for between 7 and 15 percent of the breeding habitats for the mosquitoes that carry Den-

[3] *Litter, lack of cleanliness, and other physical disorder creates a perception of lawlessness and lack of guardianship, which, in the case of opportunistic crime, can affect the perception of opportunity of the offender and sense of security felt by the potential victim (Cohen and Felson 1979; Cullen 2010; Wilcox et al. 2003). The impact of litter on community decline is based on the Broken Window theory (Wilson and Kelling 1982), which suggests that signs of disorderly and petty criminal behavior trigger more disorderly and petty criminal behavior, thus causing the behavior to spread. This may cause a development sequence in a neighborhood, leading in the medium and long terms to decay and deterioration of the quality of life of its inhabitants.*

gue, Chikungunya, and Zika. Because of their limited range of movement, these mosquitoes spread these diseases more effectively in densely populated areas—areas that also produce large amounts of waste (Diez et al. 2019).

Because these direct and indirect costs of these diseases affect household budgets (Winter and Kaempf 2008) and contribute to poverty in other ways, waste removal should be considered a major element of upgrading low-income communities.

Litter Impairs Drainage Systems, Contributing to Flooding and Worsening the Impact of Heavy Rainfall.

Engineered drainage systems are not designed to convey litter—only water. As a result, if litter collects in these systems, it can clog them, causing localized flooding and limiting water reuse by downstream users. For example, flooding in Kingston, Jamaica, that caused millions of dollars' worth of damage was attributed to drains clogged with plastic bottles, bags, and Styrofoam. In addition to this type of waste, paper, cardboard, tree and garden cuttings, medical and market waste, cars, appliances, and tires were also illegally dumped (Diez et al. 2019).

In some countries (for example, Nigeria and Pakistan), the links between waste accumulation and flooding have become so apparent that flood management interventions have evolved into significant solid waste management investment programs.

Litter Impacts Cause Economic Losses.

The cost of insufficient waste management has been estimated in some countries. Taking into account both direct costs and opportunity costs, estimates of economic losses resulting from inadequate provision of services have been assessed at 0.72 percent and 0.83 percent of gross domestic product (GDP), respectively, in Senegal and Burkina Faso. For example, in Burkina Faso, authorities estimate excess livestock mortality caused by ingesting plastic is 30 percent, at a cost of 0.47 percent of GDP. Also, waste accumulating in stormwater drains clogs them, leading to overflows and flooding. Recurrent flooding during the rainy season leads to human and livestock mortality and to major property damage, with accumulated costs estimated at 0.04 percent of GDP.

Litter Found along Beaches Can Harm a Country's Tourism Product.

Studies have shown that tourists are unwilling to return to areas with poor water quality and degraded beaches. For instance, a study reported that tourists in Barbados indicated strong preferences for clear water, healthy coral reefs, and high-quality beaches—all of which may suffer because of litter pollution—and were unwilling to return to the country if these conditions worsened. A study in Sweden showed that marine debris on beaches reduced tourism by between 1 and 5 percent. Although the effect that marine pollution might have on tourism is likely to be region-dependent, these studies show that even limited amounts of marine debris can significantly affect revenues, especially in the case of the Caribbean, which is so dependent on tourism.

Another study in Southern California, USA, showed that Orange County residents were losing millions of dollars each year from beachgoers avoiding littered beaches in favor of cleaner beaches that were farther away and more costly to reach. Removing all marine debris at the five beaches in Orange County with high debris levels would increase the predicted number of visits by 211 percent. Debris removal was identified as having a larger impact than eliminating parking fees, which, when applied to all 31 beaches in the study, would increase visits by only 51 percent (Diez et al. 2019).

Litter in the Marine Environment Interacts with Wildlife and Transports Pollutants and Species.

More than 600 species of wildlife—15 percent of which are considered threatened or endangered—have been entangled in or have ingested marine litter. Documented impacts for species that are in contact with plastic include death, injury, stranding themselves on beaches or shallow waters, and an increased prevalence of disease. Over time, plastics in the marine environment break down to small fragments (smaller than 5 millimeters), referred to as microplastics, the ingestion of which has been documented in multiple species within the food chain. Evidence has shown that they can become embedded in stomachs and gills, and

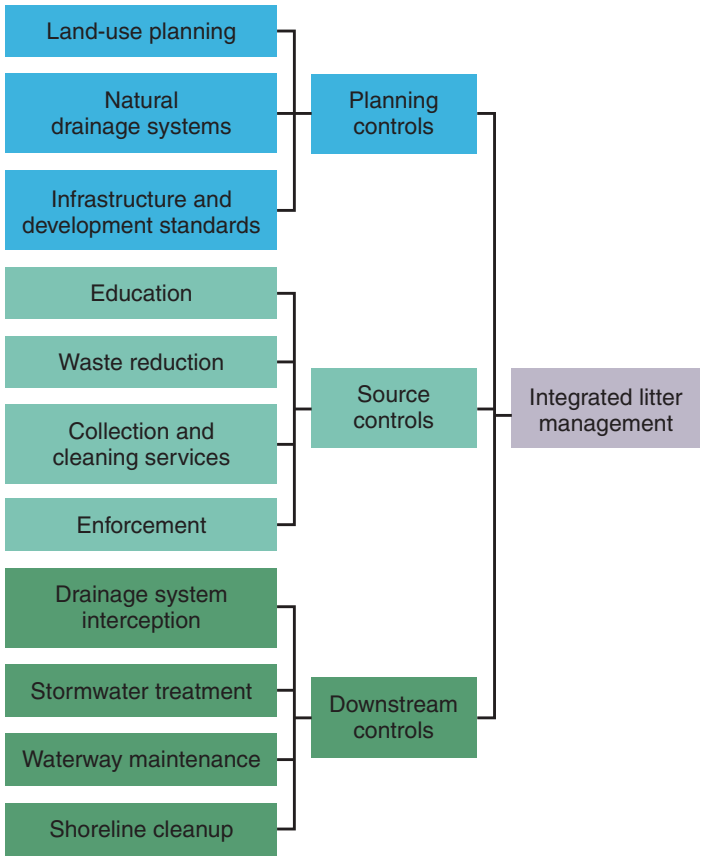
some of the effects may include false satiation and changes in buoyancy. Moreover, because of the chemical properties of plastic, substances such as pesticides and persistent organic pollutants adsorb to plastics at high concentrations and have been shown to accumulate through the food chain. Many of these have toxic and carcinogenic properties, for which the documented ingestion of microplastics has raised speculation that plastics may facilitate transport and bioaccumulation of these pollutants in marine environments. An additional concern about floating litter is that it gives eggs and organisms, such as algae, crabs, clams, and mussels, the ability to travel from their native environments to new parts of the world where they can threaten the native ecosystems. One study found that plastic litter served as a vector for the transport of a marine species that caused harmful algal blooms in the Mediterranean (Diez et al. 2019).

HOW CAN WE ADDRESS THIS ISSUE? A BALANCE OF PRIORITY MEASURES (WITH SHORT-TERM IMPACT) AND COST-EFFECTIVE MEASURES (WITH LONG-TERM IMPACT)

In an integrated approach to litter management, there are three main types of management options for drainage systems: planning controls, source controls, and downstream controls, as indicated in Figure 3.2.

If we wish to achieve effective litter management that will be sustained over time, we will likely need to integrate at least a few of each type of control, keeping in mind that our city has both a stock of litter that is already out in the environment (streets, public areas, drainage systems, and water bodies) and a continual influx of new litter that is being generated and added to the existing stock.

FIGURE 3.2. *Types of Litter Management Options*



Source: *Adapted from Marais and Armitage 2004.*

How do we tackle this? There are a range of tools that can be combined to both remove the litter that is already moving about uncontained and reducing the flow of new litter so that less makes its way to the environment. The tools can be categorized into three areas:

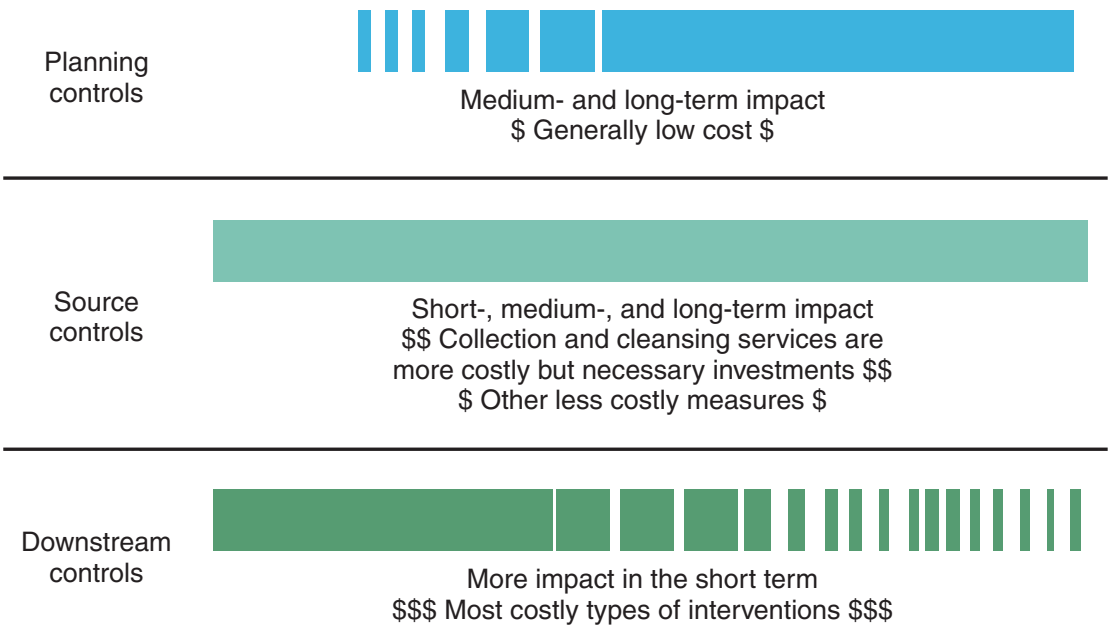
Planning controls integrate litter control into urban planning to help restrict litter-generating activities to areas where they can be effectively controlled, reduce potential impacts, and avoid transport into drainage systems and waterways. Planning controls take a long-term view of the issue, taking advantage of the tools of city planning and regulation to create a manageable urban environment for litter.

Source controls are efforts that focus on activities to directly reduce the sources of litter that can enter the urban environment and their transport to waterways or a drainage system. Source controls can be effective in both the short term and the long term and require annual expenditures on services and maintenance.

Downstream controls provide physical barriers and cleanup programs to remove litter from drainage systems and waterways. Downstream controls can be extremely effective in cleaning up a local area in the short term, and in many cases, they are the only option for removing waste that has accumulated, for example, on beaches and river shorelines. They involve high costs relative to the other types of controls and will not be effective in the long term unless there is adequate reduction of litter entering drainage systems and waterways. In cities where waste management and cleaning services do not cover entire districts or have insufficient frequency or quality, downstream controls would involve major cleanup and remediation of garbage accumulations undertaken with upgrading of services. In cities with significant service coverage, the focus would involve regular maintenance and cleanup in drainage systems, waterways, and shorelines.

Figure 3.3 depicts the relative cost and permanence of impact of the three control types.

FIGURE 3.3. *Relative Cost and Permanence of Impact of Different Types of Litter Controls*



Source: *Adapted from Marais and Armitage 2004.*

Types of Planning Controls

Zoning and Land-Use Planning.

Developments, commercial areas, and high foot-traffic areas (such as tourist sites, malls, and event venues) can be deliberately planned to avoid the litter produced in the area from entering the wider environment—for example, by locating them away from accessible drainage systems and in areas that, because of the urban design or availability of infrastructure and services, allow for easy containment and control. Directly linking waste and cleaning service expansion with the development of all new areas will also prevent service gaps that would increase litter.

Additionally, incorporation of sustainable urban drainage systems, or SUDs, designated green spaces, and natural waterways in land-use planning can reduce the potential effects of littering. By preserving the natural elements of stormwater systems (such as wetlands, creeks, and natural drainage ditches) or incorporating green areas (such as linear parks, vegetation along roads and in dense urban areas, and other green spaces), the mobility of litter is reduced as a result of a lower overall water flow and flow intensity in the streets and drainage networks during storms. The natural drainage systems may also discourage people from littering by providing a physical barrier (for example, dense riparian vegetation between roads or pedestrian areas and the waterways) or an aesthetic barrier (that is, people are psychologically dissuaded from spoiling the pleasant landscape).

Construction and Development Standards.

Implementation of municipal standards for new developments provides an effective means of ensuring litter control is incorporated into the future city development. Some key opportunities include stormwater and runoff standards for construction permits; local building codes that include explicit maintenance and service requirements; requirements for Sustainable Urban Drainage systems such as green roofs or rain gardens, or stormwater treatment; and improving legitimacy of informal settlements to ensure drainage and city services reach these areas.

Types of Source Controls

Educational Campaigns.

These can increase public awareness of urban litter (for example, informing citizens of the interconnectivity of streets, drainage systems, rivers, and oceans) and improve public response to the problem. They educate citizens on how daily activities can affect litter and its impacts. Examples of educational campaigns include advertisements on highway billboards, educational materials, antilittering messages on entrances to drains, and mass media engagement to convey litter management messages.

Waste Reduction.

Waste reduction efforts that focus on common littering items include charging deposits for plastic or glass beverage bottles; encouraging the reduction or banning the use of plastic bags or polystyrene foam (Styrofoam); encouraging the reuse of littering items; and levying pollution taxes on these items. Additional waste reduction opportunities include targeting or expanding recycling programs to common litter items—for example, programs that can provide preferential prices for the informal waste collectors for these items—and incorporating capabilities to recycle single-use items (such as containers and disposable dishware, cutlery, and cups) to an existing recycling system.

Waste Collection and Cleaning Services.

This includes introducing services that did not exist before and enhancing current services. Examples include expanding waste collection to uncovered areas, timely refuse removal, redistribution of waste collection effort resources and collection containers, and improved waste containment (introducing containers and putting lids on outdoor waste bins). Expanding street sweeping and other cleaning services to uncovered areas, improving their efficiency, and enhancing these services in litter hotspot areas or before rain events are additional, commonly employed options.

Cleanup of Accumulated Garbage and Informal Dumpsites.

In cases of significant gaps in waste collection coverage or frequency, large areas of waste accumulation or dumpsites become sources of litter that can be transported to waterways. Oftentimes, the rehabilitation efforts would include removal of the waste combined with conversion of the area to a usable space, such as a park, community center, or an otherwise aesthetic area that the population would value. To ensure the area would not revert to a garbage accumulation hotspot, these efforts would be coupled with investments in expansion of collection services and communications programs. Many municipalities also provide a service that regularly cleans up land with accumulated waste to avoid larger dumpsites from forming.

Enforcement.

Examples of common enforcement mechanisms include volunteer litter patrols for enforcing litter laws in particular neighborhoods, public reporting of litterers through "pollution hot-lines," and websites that aid in reporting of offenders.

Types of Downstream Controls

Cleanup of Accumulated Garbage in Waterways and Drainage Systems.

Similar to the informal dumpsites on land, in cases of significant gaps in waste collection services, entire canals, shorelines, and drainage tunnels can be converted to waste dumpsites saturated with water. The rehabilitation efforts would include removal of the waste combined with investments in expansion of collection service and communications programs. It also can involve redesign of the waterway or drainage channel to avoid accumulation of garbage; limiting access to the area; or conversion of the area to a waterfront park or other productive use.

Maintenance and Interception of Litter in the Drainage System

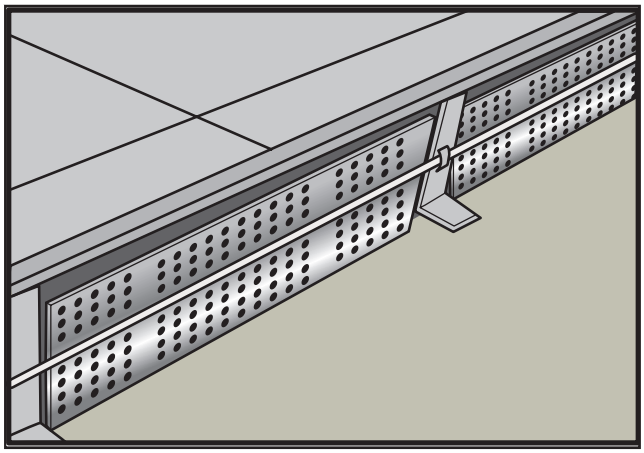
Entry of Drainage System.

Trash can be intercepted when it enters the drainage system through the installation of a grate or screen, as the ones shown in Figure 3.4. This simple structure prevents many large litter items from entering the drainage systems and keeping them on the streets, where they can be easily swept and collected by street clean-

FIGURE 3.4. *Devices that Capture Litter at Drainage System Inlets*

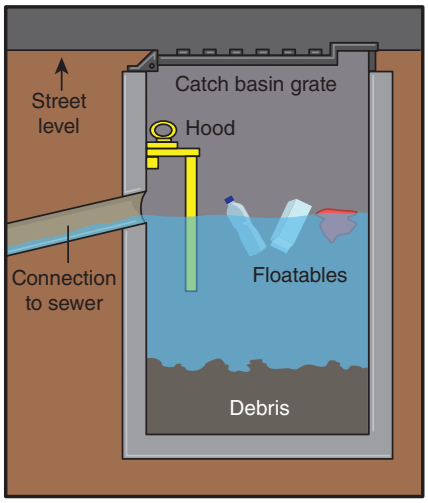
a. Catchpit grate

b. Automatic retractable screens



Sources: *a. Maria Malone / Shutterstock.com; b. World Bank.*

FIGURE 3.5. *Catch Basin Hood*



ing services. Many drainage systems have catchpits, which are chambers placed just inside the drainage entrance. The water exits through a pipe at a level that is above the bottom of the pit, allowing the catchpit to retain solids, including litter. Regularly removing the debris that accumulates in catchpits is an effective way to remove litter. Additionally, there are several options for installing inserts or specialized systems in catchpits that enhance the interception of litter, such as that depicted in Figure 3.5. These can vary from partial capture systems that filter out the trash to more sophisticated full treatment capture systems that divert the incoming flow of stormwater using a vortex to keep the litter and other solids in continuous motion (Figure 3.6), preventing them from blocking the screen so that water can pass.

In the Drainage Network.

Several methods can be used to remove accumulated litter or intercept litter as it travels through the network of drainage pipes, such as the one depicted in Figure 3.7. Regular maintenance of drainage systems can remove large quantities of litter and prevent clogging of the system. In addition, a variety of litter traps can be installed in the pipe networks that provide a means of screening the flow and, through regular maintenance, removing it from the system. More sophisticated systems designed to better handle the large flows during storms include hydrodynamic separators or swirls (Figure 3.6), or systems that allow the floatable debris to accumulate in a tank and be regularly removed.

Exit of Drainage System.

Similar systems are specialized for use in outlets of drainage systems, where they enter a waterway. Among the most common are screens and nets that affix to the outlet pipes, trapping trash that can be removed with regular maintenance. Examples of these devices are shown in Figure 3.8.

Lagoons, Retention Basins, and Treatment Plants.

Trash can be removed from stormwater in a treatment system or, if the stormwater is collected with sewage, as part of a sewage treatment plant. Stormwater treatment systems can be located at the source of runoff or at various points in the drainage system network and commonly involve a retention pond (Photo 3.4 panel

FIGURE 3.6. *Vortex Separation System that Separates Litter Hydrodinamically*

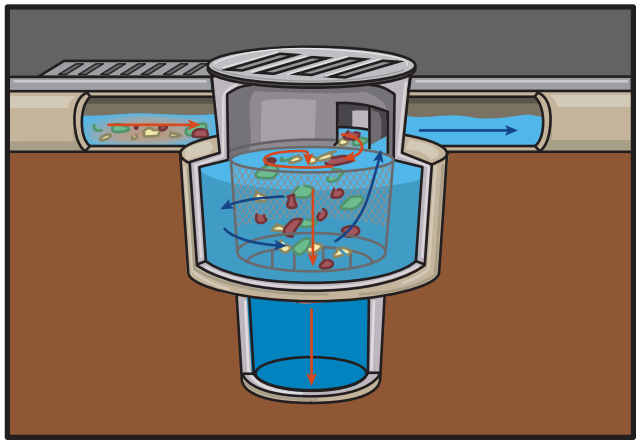


FIGURE 3.7. *Linear Radial Device that Captures Litter Inside Drainage Pipes*

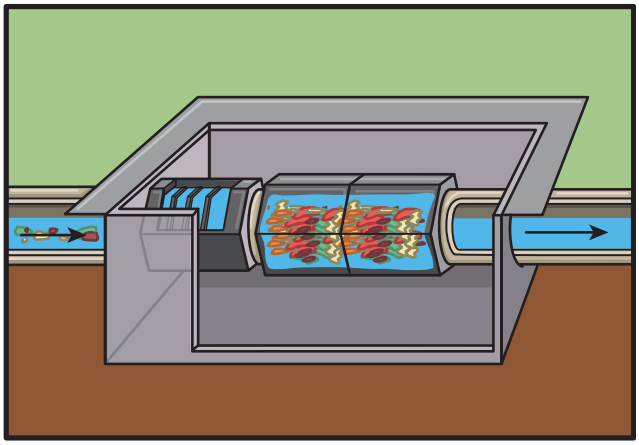
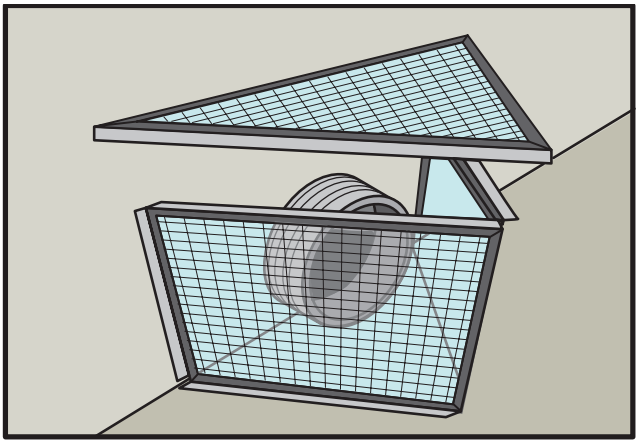
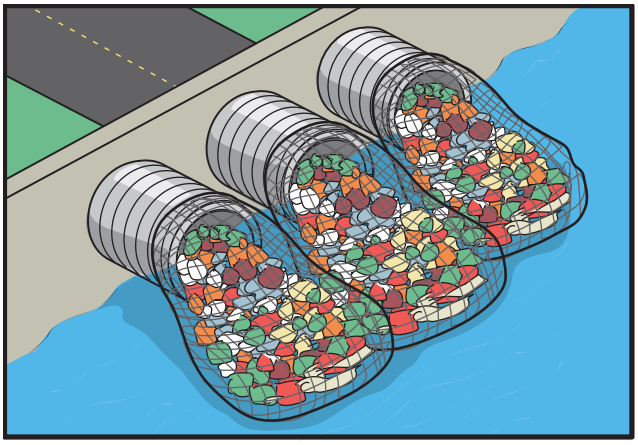


FIGURE 3.8. *Devices that Capture Litter at Drainage Pipe Outlets*

a. Connector pipe screen



b. End pipe nets



a) that allows settling of solids and interception of floatable debris, including litter, followed by an infiltration pond that allows the treated water to drain into the groundwater. Small underground tanks that function similarly can be installed to service small drainage areas. For combined stormwater-sewage collection systems, sewage treatment plants include a screening system or settling pond as primary treatment that removes trash (Photo 3.4 panel b).

Waterway and Shoreline Maintenance

Waterways.

Litter can be removed from waterways through litter traps placed in a stream or river (Photo 3.5), through boats designed to remove floating trash (Photo 3.6), and through stationary trash skimmers designed to filter trash for bays and ports. There are many designs of litter traps, but most are created to float in a flowing waterway to capture litter before it flows farther downstream by using the current to guide debris into the trap.

PHOTO 3.4. *Structures and Devices that Allow for Debris Removal at the End of Drainage Areas*

a. Stormwater retention pond

b. Primary treatment in wastewater treatment plant

Source: *a. Corey Coyle / Wikimedia Commons; b. P. Feiereisen / Flickr.*

PHOTO 3.5. *Types of Litter Traps for Waterways*

a. Bandalong litter trap

b. Litter boom

Sources: *a. LIGHTITUP / Shutterstock.com; b. Whiteaster / Shutterstock.com.*

The trash skimmer boats are designed to easily retrieve a wide variety of floating debris—including litter, old tires, leaves, timber, and logs—and enable the operator to manage all functions of the debris skimmer without coming into direct contact with the waste.

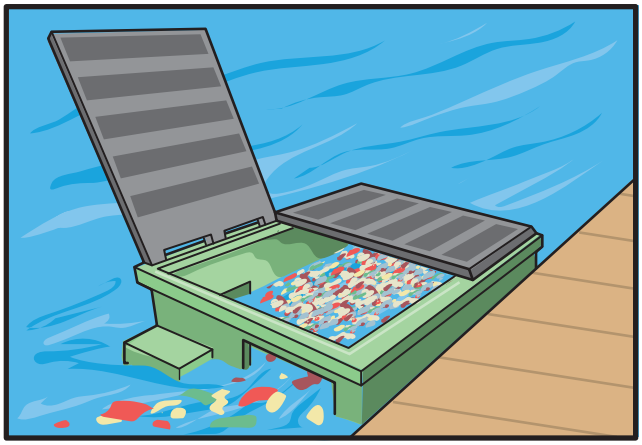
Trash skimmers are stationary units that are strategically placed at different points within marinas, harbors, and other waterways. The devices are partially submerged plastic boxes or round containers that use a pump to create a continuous surface current that draws all floating debris into its collection tank, thus catching the surface trash. Different models of trash skimmers are shown in Figure 3.9.

PHOTO 3.6. *Trash Skimmer Boat That Removes Waste from Waterways*

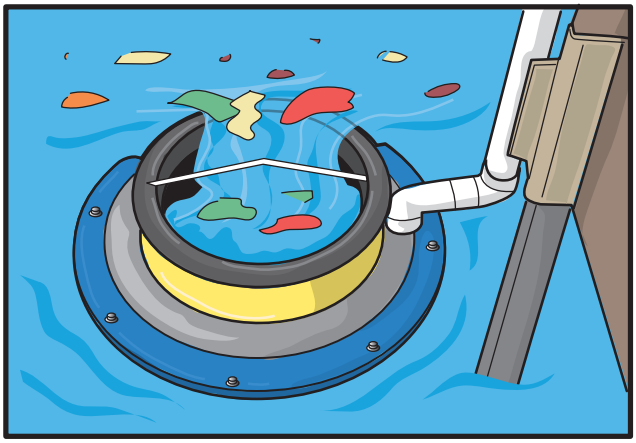
Source: *Peter Moulton / Shutterstock.com.*

FIGURE 3.9. *Trash Skimming Devices in Harbors*

a. Traditional trash skimmer



b. Seabin



Shorelines.

Beach rakes (Photo 3.7 panel a) are devices that rake surface and submerged solid wastes from the sand and lift them on a conveyor, which transports the refuse to a hopper, while residual sand falls through the perforations in the conveyor. The hopper can then be raised and tripped to dispose of its contents into a truck or container.

Manual cleanup efforts of river, lake, or coastal shorelines can be done with volunteers or city workers, as shown in Photo 3.7 panel b. Although they require a lot of effort in terms of labor, they are effective in having a short-term removal of litter from river or beach shorelines, prevent trash from accumulating to unmanageable levels, and can be an effective means of raising awareness.

Figure 3.10 helps visualize potential sources of litter our community may encounter and examples of corresponding mitigation actions.

PHOTO 3.7. *Methods for Cleaning Coastal Areas*

a. Tractor-towed beach rake

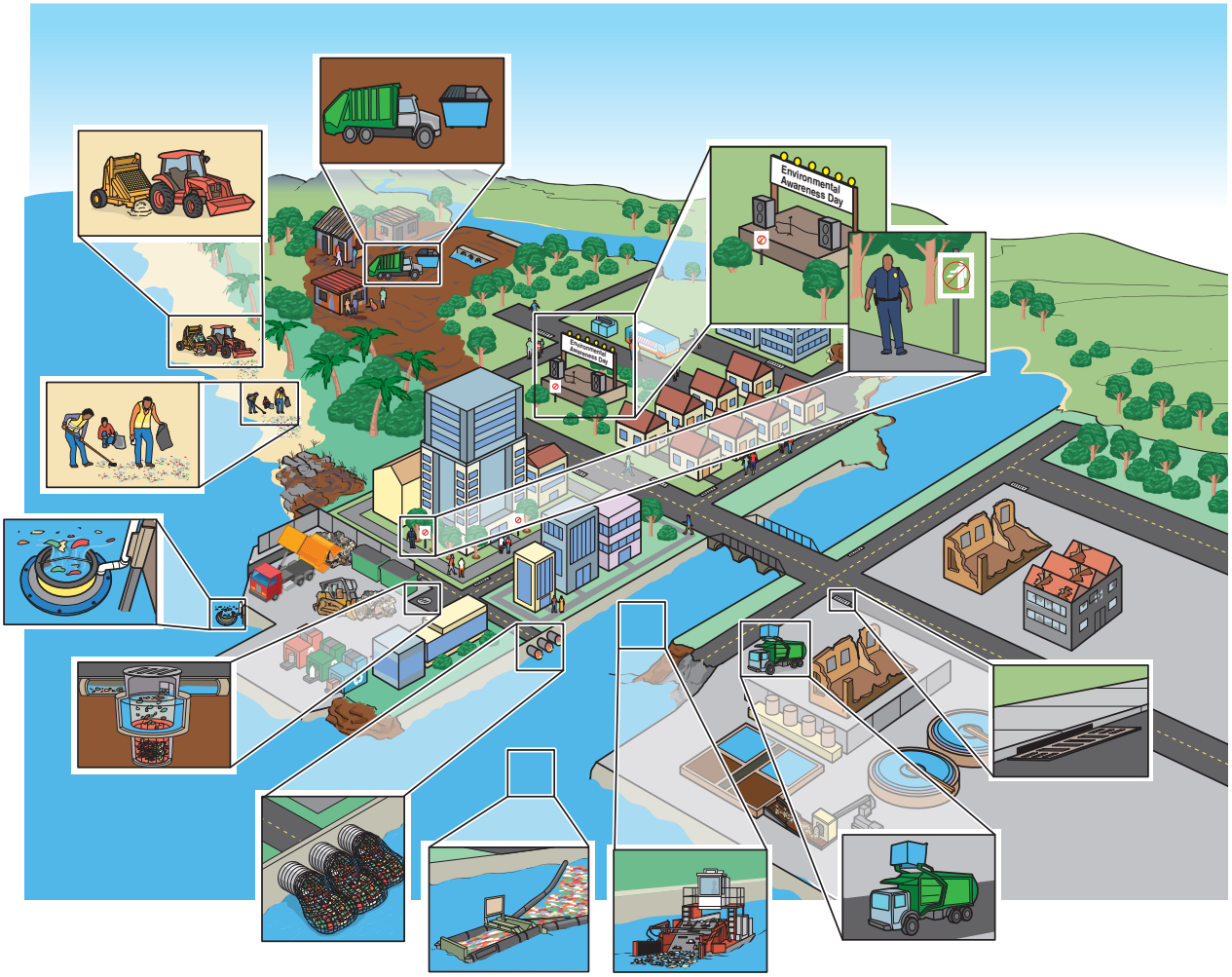
b. Beach cleanup event

Sources: *Nikolas Gregor / Shutterstock.com; b. Danil Nenashev / The World Bank.*

FIGURE 3.10. *Litter Sources and Mitigation Actions*

a. Litter sources and pathways to urban waterways

b. Actions for litter management



HOW MUCH DOES LITTER COST TO CLEAN UP?

When litter gets in an urban environment, how much does it cost to clean up? The costs of cleaning and maintaining a city and its connected waterways depend on the level of services that exist in the city. Collecting waste through a waste collection service is the cheapest, most efficient, and least damaging to health, environment, and urban aesthetics. Garbage that is not captured this way enters the environment, necessitating that the city employ other services (such as street sweeping, drainage system cleaning, or beach cleaning) and infrastructure to gather the waste. These services are both more costly and less efficient at collecting waste.

Cities or Neighborhoods with Significant Service Gaps.

In cases in which significant service gaps have resulted in large accumulations of garbage and informal dumpsites on land, drainage systems, or waterways, cleanup will involve costs related to the removal of the garbage and site rehabilitation and the introduction of new services to rectify current deficiencies. Removal costs related to clearance of the area and transport to the disposal site, as well as rehabilitation costs, can vary significantly depending on the approach, ranging from the costs of a building or park to redesigned drainage infrastructure to simple fencing. In addition, ongoing efforts are needed to promote awareness to reduce littering, introduce improved collection services to avoid continued dumping, and introduce services to regularly clean up informal dumpsites or accumulation of waste that may form. Table 3.2 presents the approximate costs of such remedial actions.

TABLE 3.2. *Range of Costs of Service Upgrading in Cities with Gaps in Solid Waste Management Services*

Incremental rehabilitation and remediation costs[a] in US$	
Clearance and rehabilitation of land	$1–$6 per ton cleared
Clearance of canals/waterways	$10–$30 per ton cleared
Repurposing or securing of land or redesign of drainage infrastructure	Varies
Communications programs	Varies
Incremental costs for maintenance	
Upgrading/expanding collection service and operation[b]	$20–$200 per ton collected
Introduction of service to regularly clear the microdumpsites[c]	$2–$10 per ton cleared
Introduction of service to regularly clear the canals[d]	$0.12 per square meter

Note: a. Based on World Bank Project experience.
b. Kaza et al. 2018.
c. Based on World Bank Project experience.
d. Drainage system is approximate number based on removal of waste from drainage structures (Narayanan and Pitt 2006).

Maintenance and Cleanup in Cities with Good Service Coverage.

Cities or neighborhoods that have reasonably high coverage of waste collection and cleaning services focus less of their litter cleanup efforts on rehabilitation of informal dumping areas and more on maintenance of the urban landscape, drainage systems, and waterways through the controls outlined earlier. The costs of cleanup in the various media are shown in Table 3.3. To be cost-effective, the city should strive to maximize the waste collected through traditional municipal collection while minimizing the waste collected from the urban environment through other programs and services, such as street sweeping, drainage system cleaning, and waterway cleanup programs.

TABLE 3.3. *Range of Costs of Litter Cleanup in a City with High Waste Collection and Cleaning Coverage*[a]

Location of litter	Collection cost per ton (US$ per ton)
Garbage can[a]	50–150
On street[b]	100–920
Entry to drainage system[c]	220–1,270
Exit of drainage system[d]	1,450–5,580
River shoreline[e]	2,650–4,550
Beach shoreline[f]	1,950–45,050
In river or bay[g]	150–29,780
In open ocean[h]	4,925–74,695

Note: Includes costs of removal and collection (but not disposal) per ton of litter-collected basis. Global review of data.
a. Kaza et al. 2018.
b. Street-sweeping costs/performance data from 15 locations.
c. Costs/performance of cleaning catchpits in five locations.
d. Costs/performance of end of pipe nets and trash traps in four locations.
e. Costs/performance of cleanup programs, with government and volunteers accounting for equivalent in labor costs in six locations.
f. Costs/performance of cleanup programs (using labor costs) for 26 states in the United States.
g. Costs/performance of skimmer boats and other trash-collecting equipment from five locations.
h. Preliminary, publicly available information on costs/performance of The Ocean Cleanup technology including development and operations costs.

WHAT CAN WE DO?

4. WHAT CAN WE DO?

Every city is unique; no community is exactly the same. Hence, let us understand better our current situation and—based on it—design a plan tailored to our circumstances and resources. For this purpose, we need to keep in mind the following concepts throughout all the design stages.

UNDERSTANDING THE KEYS TO SUCCESS

Wherever there are human agglomerations, litter management is bound to be a perpetual endeavor. Adhering to the following guidelines will help us feel a sense of control over such an endeavor.

Knowing Our Litter Situation to Guide Our Actions

Before we attempt to devise an effective plan to manage our litter, we need to learn more about the litter in our community. How much are we producing weekly or monthly? Are there large areas where litter accumulates? Where does it end up and how? What are the major types of littered items? We will need to gather data to answer these questions before we set out to determine further actions; we might find surprising facts that will be a basis to a better-targeted plan. Otherwise, we could be acting on false assumptions and thus miss opportunities to implement more effective actions.

We can develop metrics regarding litter using standard methodologies, such as cleanliness indexes. Leveraging technology—for example, smart apps and social networks—to monitor the situation in the field and the general environmental perception is becoming standard, with a more bottom-to-top approach. Some apps, particularly MapSwipe, allow for extremely accurate mapping of hotspots.

See sections *What Information Do We Need to Make Better Decisions?* for more information on litter metrics and *Litter Management Information Technology* for options on apps for bottom-to top litter monitoring.

Balance between Long-Term Solutions and Needed Short-Term Fixes

It is likely that our community currently has both a continual stream of newly deposited litter and litter that has been drifting in the urban environment for a while. At times, significant accumulated quantities can also create an informal dump. If we never stop or at least minimize the source of new litter, in the end, the issue will persist. Although all efforts to avoid littering are a more definitive solution than cleaning up, they also usually take longer to implement. In the meantime, cleanups are usually a useful action to achieve short-term impact in removing litter from the environment.

Eventually, we want to have in place the kind of regulations, services, and structures that will prevent litter from ever reaching the drainage systems and the environment. The ideal system for long-term impact is to have good planning and source controls, but until we get to that point, cleanups are typically the first step in any systematic effort to attain a litter-free environment.

Sustaining Results over Time

If we want our solutions to be effective in the long run, we must ensure that we have:

- **Commitment and consensus from key stakeholders.** Litter management alone is a multisectoral endeavor; and when watersheds are involved, it often becomes a multijurisdictional issue as well. Only coordinated efforts with the other municipalities that share our watershed—especially those upstream of us—will ensure the effectiveness of our measures. Given the scattered nature of litter, each sector and jurisdiction involved in litter generation should have shared responsibility in its management. From our local government, we need to do everything within our power to involve and elicit commitment from head executives of each institution that plays a role in our plan, encouraging them to allocate appropriate resources and to maintain the issue as a continual part of their agendas. To foster this level of commitment, think about communicating the potential benefits.

- **Outcome monitoring.** When we design our plan, think beforehand what results we anticipate, quantify such results (or at least set milestones), and set a time frame for achieving such goals (short, medium, or long term). As we start implementing our plan, follow up closely to check if we are getting close to the desired figures or milestones. If we fall short of achieving them, reroute and think of new ways to achieve reasonable goals.

- **A continual improvement mentality.** Do not settle for too little! If we achieve a small goal, do not back off but rather keep moving forward and plan the next action to improve our management of litter even more.

WHERE DO WE START?

The following questions will guide us through the process of gauging where we are coming from and identifying key actors, resources, and actions relevant to our community.

What Is the State of Litter in Our City?

This set of questions will draw attention to litter sources and presence throughout our city.

How Do Our Current Solid Waste Management Services Relate to Our Litter?

Does Our City Lack Solid Waste Management Services?

For localities with a lack of solid waste services, many of the strategies are capital-intensive, establishing or expanding collection and cleaning services while undertaking significant cleanup programs. This would be linked with planning and redevelopment of areas and redesigned drainage systems to reduce informal dumpsites and garbage-filled drainage systems. Looking more long-term, planning controls can encourage the location of new development areas away from open drainage canals to reduce dumping. In residential and tourism zones, preserving natural channels and wetlands can discourage littering.

Source controls would include implementing or improving coverage of solid waste management services and regular cleanup of informal dumpsites. Residential and tourism areas could implement community cleanups and develop education campaigns. Commercial and industrial areas could focus on waste reduction efforts depending upon typical litter composition.

Downstream controls would include implementing waterway cleanups, installing grates at catchpit entrances, and installing litter traps. Establishing a maintenance program would also be necessary to improve effectiveness of the strategies.

Does Our City Have Solid Waste Management Services That Are Incompletely Efficient?

For communities that have inefficient solid waste management services, an emphasis is likely to be placed on improving source controls. To be effective, the community would need to first understand where the deficiency in services is—for example, ineffective sweeping, bin placement, or containerization. Sweeping procedures can be altered through training to minimize sweeping into drains and through frequency to capture litter before rain events convey it into drains. Bin placement and containerization can be addressed according to surveys that improve understanding of where bins are most needed and the appropriate sizing of those systems to meet the population's needs.

Planning and downstream control options would likely be similar to those outlined for communities without solid waste management services.

Does Our City Have Efficient Solid Waste Management Services and Is Litter Primarily a Result of Littering Habits?

For localities with efficient solid waste management services, the focus would likely be on behavioral change through source controls, such as educational campaigns, enforcement efforts, and waste reduction efforts. Planning and downstream control options would likely be similar to those outlined previously, but with decreased capital expenditures (as a result of an emphasis on maintenance of existing controls rather than establishing new ones).

How Is the Weather? And How Does the Water Flow in Our City?

The frequency and intensity of rain events affect how litter is carried to drainage systems and waterways. What kind of rain pattern does our city have? Are the winds strong and frequent enough to influence litter dispersal as well? Do we experience flooding, major rainstorms, windstorms, hurricanes, tornados, or other extreme weather events that could magnify the scattering of litter? Having a better knowledge of our weather pattern can enhance our forecasting ability, which in turn can help us plan the right frequencies for catchpit cleaning and street sweeping, as highlighted in the Long Beach case study in the appendix.

Additionally, the capacity and other characteristics of our drainage system—whether it is natural or artificial, open or piped—will influence how litter is carried away from our city and into water bodies.

Are There Litter Hotspots?

What information do we have on this already? Are major informal dumpsites and garbage-filled canals mapped? Perhaps neighbors' complaints and the press have already made us aware of areas where accumulation of litter is especially problematic. We can also look at statistics from our street-sweeping service to check the weight (or volume) of debris collected over a period. If none of this information has been gathered, we could undertake a "quick and dirty" identification of the places (for example, tourism sites, events, drainage areas, densely populated neighborhoods, or commercial districts) and the times of year in which the accumulation of litter is particularly high. This can be done by asking the sweeping service provider to start keeping record of the amounts collected by zones or by asking nongovernmental organizations (NGOs) that carry out cleanup events and record the output.

What Are the Key Areas We Want to Protect?

We may want to focus our first litter-reduction efforts in a few priority areas; for example, we might be interested in preserving the tourism value of our coastline or waterfront areas, or we may want to maintain the safety and land value in our business districts. These decisions should always be informed by our city's current strategic plan for development.

What Is the Level of Environmental Awareness in Our City?

Has a household and business survey ever been carried out in our community to gauge attitudes toward littering? Do our citizens and business owners know what happens to litter? Do they talk about it? Because all citizens generate solid wastes that could become litter, a lot of effort must be put into sensitizing our people and informing them about any current or new laws and the correct ways to dispose of their waste. In addition, we can look for ways to enact policies that leverage social capital for developing pro-environmental behaviors.[4] Beyond refraining from deliberate littering, behaviors that should be encouraged include minimizing waste generation through the reduction of unnecessary packaging and single-use items, reuse or repurpose of items, and recycling.

[4] *One field experiment investigating the effects of social capital on littering behavior found evidence that social capital might be a double-edged sword: It observed that people in a context of high social capital—compared to an area with low social capital—will be less likely to litter in an already clean environment but more likely to litter when the surroundings are disarrayed (see Keuschnigg and Wolbring 2015).*

How Does Our City Work?

Some aspects of our city administration and the customs of residents and businesses will point at strengths we may already have and focal points for action. Consider and answer each of the following questions:

- What departments and services do we have that offer litter-related services? For example, Departments of Solid Waste Management, Environment, Urban Hygiene, Public Works, Transportation, Parks and Recreation, Planning, and so on.
- Do we have planning, zoning, or construction standards? For example, a planning code, a zoning map, or construction standards and specifications.
- What kind of drainage system do we have: combined stormwater and sewer, separated, or nonexistent?
- Who oversees the drainage system's maintenance?
- Who is in charge of construction and maintenance of drains adjacent to transportation infrastructure (that is, roads, bridges, and railways)?
- Who maintains the city's parks? Is it a private or a public entity?
- If we have beaches or shorelines, who maintains them?
- Are there plans for development or expansion of the city or revitalization of districts? If so, do the projects take into account improvement of services in litter control and drainage systems (for example, green roofs, rain gardens, or stormwater treatment)?
- Are there cleanups by citizens, whether government- or NGO-sponsored events?
- What do businesses or hotels do to clean up? Examples include sidewalk sweeping in front of small businesses or waste segregation programs in hotels and large businesses.

Now consider whether there is an opportunity to strengthen litter management through improved solid waste services.

Do We Need to Improve Our Solid Waste Management Services?

Cleaning operations prevent urban waste from getting into the environment. Ideally, operations should be as close to the source as possible because collection becomes more difficult and more expensive once litter enters the broader environment. Examples of improvements in cleaning operations include timely removal of waste, redistribution of collection resources and collection containers according to a need-based analysis, and proper placement of communal collection depots when door-to-door removal is not viable. Collection service is also often complemented by services that regularly clean up informal dumpsites before they begin to grow significantly. Many cities establish this as a regular service, in addition to communication and enforcement.

Another important action is street sweeping. Frequent street sweeping can remove up to 98 percent of urban litter depending upon the situation. The effectiveness may be limited because of areas that are in-accessible to sweeping, such as litter that is underneath parked cars. To be effective, street sweeping must be more frequent than significant rainfall events, which is assumed to be those events of greater than 10 millimeters. The seasonal variation may allow for altering sweeping frequency during the year with more frequent sweeping during wet seasons and less frequent sweeping during dry seasons.

A word of caution regarding street sweeping: However important it is to deal with accumulated litter, this operation does not decrease the flow of waste; thus, it could prove extremely inefficient in the absence of measures to reduce the introduction of new waste into the environment, as the situation could return to its degraded state only days after the operation. That is why providing good cleaning services should always be accompanied with promoting social norms that prioritize reduction of waste generation and more efficient collection services. Table 4.1 offers a series of questions we can ask ourselves to set up a solid waste collection service if we lack one or otherwise assess the current state of our service and spot potential deficiencies that we might need to address.

Once we answer these questions and design a new solid waste collection and cleaning service—or an improvement to an already existing service—we can keep in mind that implementation does not have to cover all the city at once but can be phased by neighborhood or some other geographic division (for example, the commercial district first). This gradual implementation may make it easier to monitor and adjust before we extend to our entire jurisdiction.

Who Should Be Involved?

As a government entity, we can act directly on four spheres, namely (a) fostering local research and knowledge on the topic of litter generation and management; (b) good governance, which includes enacting relevant laws and properly enforcing them; (c) providing or regulating solid waste management services and drainage construction and maintenance services; and (d) launching mass communication campaigns. Additionally, we can establish partnerships with other local governments and other sectors of society to involve all possible stakeholders, including the corporate sector and civil society. Generally, the more sectors and actors we can get involved, the better our outcomes will be.

Consider all the resources we currently have. Although our municipal personnel and budget are part of our available resources, they are not everything we have; other institutions may also be able to input resources and influence our litter management efforts. To make sure we are aware of everything we can count on, let us explore our community.

Do we have...? (Check all that apply.)

- ____ Hotels
- ____ Restaurants
- ____ Water recreation industry
- ____ Wholesale markets
- ____ Retail markets
- ____ Factories
- ____ Nongovernmental organizations (environmental, wildlife conservation, marine conservation, and so on)
- ____ Volunteer organizations or groups
- ____ Farmers
- ____ Universities
- ____ Community colleges
- ____ Available or convertible municipal lands
- ____ Local public figures
- ____ Media channels (TV, radio station, local YouTube channel)
- ____ Festivals and local celebrations

At first glance, it may seem odd to consider waste generators (such as markets, hotels, and restaurants) as possible resources, but in upcoming sections, we will see how they could become allies in our fight against litter.

Now, let us think what combination of strategies will help us achieve our target.

TABLE 4.1. *Basic Guidelines for Designing or Improving the Solid Waste Collection and Cleaning Service in Our Community*

Items	Aspects to consider
Waste containers	Should we use containers, bags, or both? Will the containers or bags be provided by our government (or a private contractor), or will we require users to purchase their own? If we provide containers, who will maintain them? What sort of containers are needed for different locations or users? If we use bags, can they be processed in the same treatment as the organic waste?
Collection truck size and type	What volume and weight of waste are expected? How many vehicles—and what kind—might be required given the types of containers and the expected amount to be collected?
Routes and schedule	What are the most efficient routes for collection trucks? How often should they collect waste?
Street sweeping	How frequently should we sweep, according to the frequency of our significant rainfall events? What volume of waste do we expect to collect in different locations on every sweeping operation? Are there seasonal variations in these volumes? Consider (a) leaves and twigs falling in autumn or stormy/windy season and (b) local festivals or outdoor events. What size of crew do we need to cover our needs? Can we supplement with volunteer groups or by engaging neighborhoods?
Informal dumpsite cleanup	Are there areas that are prone to accumulation of trash? Does it warrant having an established service that identifies accumulations, cleans them up, and undertakes enforcement actions and enhanced communication?
Canal or open drainage works maintenance	Are there open canals or other drainage works that accumulate garbage? Are these regularly cleaned?
Incentives	How do we incentivize at-source separation? Can we apply differential fees? How do we enforce separation? Do we use voluntary incentives?
Communication	How do we launch a mass communication campaign to explain our new solid waste management system to the community?
Implementer	Do we implement through a private contractor? If so, what should the contract terms be? Do we implement through public service? What government department should be in charge? Do we have the resources to do it?
Monitoring and surveillance	How do we make sure the service is being delivered effectively and maintains a high quality over time?

How Do We Reduce Litter?

Now that we have considered the current state of our solid waste management services, the weather and waterflow patterns in our city, as well as the areas with greatest concentrations of litter and the ones we most want to protect, let us choose a few actions we can take to start tackling the issue.

We will study Table 4.2, keeping in mind short- and long-term goals and our available resources. After exploring all the options, number a few alternatives (it does not have to be all of them—we can start with just two or three) in order of priority.

The list also indicates the relative magnitude of the direct cost for the government and of the implementation time. Keep in mind that these are just illustrative, based on other communities' previous experience, but it well may be that some particular circumstance in our government or community makes one of these parameters different for us. Table 4.1 also has several suggestions, but we do not have to limit ourselves to these; we can think of new ideas and add them to the blank space at the end of this list.

TABLE 4.2. *General Strategy Control Alternatives for Managing Litter in Our Waterways*

Alternative	Type of control	Direct cost	Implementaton time
A. Locate new residential areas away from open drainage canals and plan expansion of waste and cleaning services accordingly.	Planning	None	Long term
B. Locate new commercial developments away from open drainage canals and plan expansion of waste and cleaning services accordingly.	Planning	None	Long term
C. Locate new tourism activities away from open drainage canals and plan expansion of waste and cleaning services accordingly.	Planning	None	Long term
D. Locate new industrial activities away from open drainage canals and plan expansion of waste and cleaning services accordingly.	Planning	None	Long term
E. Require waste management plans for new developments.	Planning	Low	Long term
F. Require stormwater and runoff standards for new developments, such as green roofs, rain gardens, or stormwater treatment.	Planning	Low	Long term
G. Preserve natural channels and wetlands.	Planning	Medium to high	Medium to long term
H. Designate new green spaces, such as parks, gardens, green roadway medians, linear parks, and so on.	Planning	High	Long term
I. Improve coverage of solid waste management services.	Source	High	Medium to long term
J. Address service deficiency in solid waste management services (sweeping, bin placement, and containerization).	Source	Medium to high	Short to medium term
K. Develop education campaigns.	Source	Medium	Short to medium term
L. Encourage waste reduction by charging refundable deposits for beverage bottles (and other reusable or recyclable items) and setting up a collection and reimbursement mechanism.	Source	Medium	Medium term
M. Encourage waste reduction by levying pollution taxes on commonly littered items and using the proceeds for improving sweeping services or funding cleanup activities.	Source	Low	Medium term
N. Encourage waste reduction by banning single-use plastics, polystyrene foam, and so on.	Source	Low	Short to medium term
O. Institute reporting and enforcement efforts through technology (litter hotlines, litter reporting website or apps, and applying fines to offenders).	Source	Low to medium	Short to medium term
P. Institute reporting and enforcement efforts through volunteer litter patrols in areas of concern.	Source	Low	Short term
Q. Implement a catchpit cleaning system that incorporates storm forecasting to ensure that catchpit entrances are free of litter before major storms.	Downstream	Low to medium	Short to medium term
R. Maintain downstream control systems regularly.	Downstream	High	Short term
S. Install grates at catchpit entrances.	Downstream	High	Short term
T. Install litter interception devices inside or at the exit points of drainage networks.	Downstream	High	Short term
U. Install litter traps in natural waterways.	Downstream	High	Short term

TABLE 4.2. *General Strategy Control Alternatives for Managing Litter in Our Waterways* - *cont'd*

Alternative	Type of control	Direct cost	Implementaton time
V. Implement waterway cleaning services through skimmer devices or boats.	Downstream	High	Short term
W. Implement government-sponsored community cleanups of land areas (parks, public squares, outdoor community event venues, and so on).	Downstream	Low to medium	Short to medium term
X. Implement corporate-sponsored cleanups through corporations that have corporate social responsibility or environmental programs.	Downstream	Low	Short term
Y. Implement mandatory corporate cleanups for producers and distributors of commonly littered items (including packed beverages industries, tobacco industries, fast-food chains, gas station convenience stores, and so on).	Downstream	Low	Short to medium term
Z. Implement waterway and/or beach cleanups through conservation nongovernmental organizations.	Downstream	Low	Short term
Our own ideas:			

WHAT INFORMATION DO WE NEED TO MAKE BETTER DECISIONS?

We just selected a few actions to take. What information do we need to plan, design, and implement them properly? Do we have any data gaps we need to fill?

The information we need to gather can be divided into three steps:

1. Readily Available Data to Guide Our First Steps

Some information might be available immediately or with little effort (as we saw earlier with collecting information about litter hotspots). For example, we might review records kept by the sweeping services department or contractor to compare quantities collected in different areas of the city and have a rough idea of where the hotspots may be. Or we can ask nongovernmental organizations that already have done cleanup activities to share with us any data about the waste they collected to spot potential deficiencies in our cleaning services or identify brands with whom we can work. We can also review records kept by the drainage system maintenance crew to learn about the extent of waste collecting in our drainage system and get a sense of where new downstream controls (or higher frequency of cleaning existing ones) are needed.

2. Information We Can Gather as We Implement and Monitor Some Measures

After we launch a mass communication campaign, we can correlate this with any observable reduction in the litter collected by our sweeping service, for instance, to measure the effectiveness of our campaign and get insight for future campaigns.

Downstream controls do not have to be installed all at once but rather can be piloted in a few areas to build expertise in their operation and test their effectiveness. As we roll out these pilot experiences, we can collect data on quantities and types of litter collected, optimal cleaning frequencies, and so on; such data can inform the decision on whether to keep expanding coverage and can guide such expansion.

3. In-Depth Data We Need to Acquire before We Design Some of Our Actions

In the long run, targeting waste reduction efforts to the major sources and producers of litter can maximize benefits. Hence, if we wish to design effective solid waste services and downstream controls, we need to know more precisely the quantities and types of litter and where they come from, which we can do with a litter survey.

Litter surveys identify the various sources of litter and provide information on the types, quantities, and distribution of litter. They may also be used to assess the effectiveness of current legislation and litter management policies, thus providing insight into the problems and threats associated with litter in the area. At the same time, they may be used as a first step to increasing public awareness on litter and changing littering habits among the inhabitants of the place.

The methodology of a well-planned litter survey should at least include:

1) Site and time selection

- Determine the area to be surveyed. It can be one or a few neighborhoods, coastal or riverside areas, tourist sites, and so on.
- Global Positioning System coordinates can be recorded to plot sites, creating routing and a geographic information system map.
- Keep in mind that in order to get a sample that is representative of the normal littering conditions, surveys should not be carried out on trash collection day or immediately after a cleanup event, major storm, or big holiday.

2) Sampling

The litter should be categorized into different types specific to the area. Some of the categories might include but are not limited to the following:

- Public litter: Cigarette stubs, bottles, plastic bags, food containers and wrappers, paper bags, cartons, food cans, and so on
- Fishing: Fish boxes, fishing lines, fishing nets, and so on
- Medical: Inhalers, syringes, gauze, and so on
- Toiletries: Wet wipes, diapers, tampons, sanitary pads, condoms, and cotton buds
- E-waste: Computer and electronic device parts, mobiles, computer accessories, and so on
- Furniture: Sofas, mattresses, tables, chairs, dressers, and so on
- Construction and demolition materials: Cement, tiles, timbers, bricks, insulation, and so on

3) Recording

If done manually, a recording table with a tally of observations of different litter items should be kept. Otherwise, some apps described in the section on Litter Management Information Technology can be used to record the data with mobile devices.

4) Data Analysis

The recorded data should ultimately be analyzed to obtain a litter profile of the area—that is, identifying types, quantities, and spatial distribution of litter.

For a few examples of litter survey methodologies and more ideas, see:

- Centre for Resource Management and Environmental Studies (CERMES). 2006. *Roadside Litter in Barbados: Sources and Solutions,* by Lolita Raffoul, Robin Mahon, and Renata Goodridge. CERMES Technical Report No. 1, Barbados. https://www.cavehill.uwi.edu/cermes/docs/technical_reports/raffoul-2006-roadside-litter in-bdos.aspx.
- OSPAR Commission. 2010. Guideline for Monitoring Marine Litter on the Beaches in the OSPAR Maritime Area. https://www.ospar.org/ospar data/10 02e beachlitter%20guideline english%20only.pdf
- Abell Foundation. 2016. *Litter-Free Baltimore: A Trash Collection Policy Framework Based on Spatial Analysis and Social Media,* by Christopher Kelley and Ramya Ambikapathi. Baltimore. http://www.abell.org/sites/default/files/files/Litter%20report%20FINAL.pdf.

There are different ways in which a litter survey can be carried out. One is taking advantage of cleanup events, which naturally provide a great opportunity to do an inventory as the litter is being collected. All the volunteers can be equipped with tally tables or asked to download an app to their mobile devices. At the end of the event, a coordinator could be in charge of collecting all the tables or data stored in the apps.

Another is—over a defined time period—having a person or team do an inventory of the litter that is collected by source control devices (such as catch basin inserts, vortex separation system, end of pipe nets, and so on) as these are routinely emptied.

Lastly, a team of people can scout predefined areas looking for all the visible litter. Doing these kinds of surveys can be very time-consuming. We do not have to limit ourselves to doing it with government personnel. Here is a good time to think about partnerships with other community actors. For instance, universities and community colleges might help: We could ask one or a few such institutions to gather a group of students—guided by a professor—to administer these surveys as part of a class field project or community service. If we do not have a university or college in our community, we might look into nongovernmental organizations or civil associations that may be interested in this issue, and we could offer them government funding or pool funding from large corporations that are responsible for manufacturing or distributing the most abundant or problematic litter items or other companies with corporate social responsibility.

If we want to organize a community cleanup event, we could at the same time build our litter inventory by asking the volunteers to use one of the available mobile apps to record each item of trash they collect.

Once we have completed the survey work, we need to collect all the data and analyze it to draw some conclusions. What are the major litter items? What sector is producing the greatest volume of litter? How is that litter reaching our drainage systems and waterways? Is litter dispersed around overflowing garbage containers? Did we spot large quantities of specific brands among our litter? If so, could we work with the respective manufacturers to minimize litter from their products?

Depending on our available resources, we can do a simple analysis or a more in-depth one. If we have help from a higher education institution, we can ask them to carry out more sophisticated data analysis, including statistical analysis and developing a litter flow diagram.

This step—understanding where our litter comes from—is essential to guiding all the following steps.

Once we have a better understanding of our litter—how much there is, what different types exist, and where it comes from—we can make better-informed decisions. For example, we may realize that it would be better to start targeting

- A specific type of litter (the most abundant or the most problematic);
- One or a few specific geographic areas (those where the generation or accumulation of litter is the greatest); or
- Systematic issues that affect littering everywhere, such as waste collection inefficiencies, lack of awareness, or lack of enforcement.

How Do We Influence Effective Litter Management?

In this step, we will assess whether some of the actions we chose require us to adopt new legal instruments. Before we start talking about modifying our laws, we need to find out which of our current laws already address litter management. For instance, if we have laws on solid waste management, they will likely affect the fate of much of the waste that our community produces. We can also check our local tax laws; although this might not at first glance seem related to litter management, increases or deductions over taxes or fees can significantly change citizens' and businesses' behavior toward littering and waste management. Let us gather all the relevant laws (national, statewide, and municipal) and review them.

For this task, we might need to consult with our local government's legal advisor.

What did we find? Do we already have local solid waste management laws? If so, do they stipulate separating waste streams at the source? Is there any municipal fee for solid waste collection and treatment services? Do we charge a greater fee to generators of large volumes of solid waste? Do we require large generators to hire specialized providers licensed for that end?

Do not worry whether we are missing several of these stipulations; as we develop our plan, we will have the opportunity to incorporate them into our legal system. Now consider carefully the following list of suggested local laws in Table 4.3, looking for those that affect the top priority strategies we chose in the previous step of our plan development.

TABLE 4.3. *Regulation Options for Managing Litter*

Options	Implement with option (from Table 4.2)
Create a municipal program for the management of litter. Allocate a budget item and assimilate the issue to the mission and functions of the relevant government departments.	**Potentially all**
Update the planning code and zoning map to preserve natural drainage systems and keep new developments away from them.	**A, B, C, D, G**
Establish new requirements for building permits. Require presenting a waste management plan that includes reduction, reuse, and treatment measures.	**E**
Amend local building standards code to incorporate stormwater and runoff standards in the planning and construction of new and redevelopment projects.	**F**
Upgrade standards for construction and maintenance of road drainage systems.	**G, H, Q, R, S, T**
Introduce extended producer responsibility policies to make producers of materials commonly found in litter (for example, plastic products) responsible for the entire lifecycle of their products.	**L, M, Y**
Require commercial businesses to charge bag fees for disposable carryout bags.	**M**
Amend local tax law to include pollution taxes levied on commonly littered items.	**M**
Ban the use of disposable tableware made of materials that cannot be recycled or composted.	**N**
Create or amend a litter law that details enforcement mechanisms and fine amounts for different cases of littering (by individuals or corporations, by levels of hazard of littered items, and by quantities).	**O, P**
Ban dumping of large items on public property or vacant lots.	**O, P**

How Do We Cooperate?

As we may have noticed, several of the technical alternatives require that we work in partnership with other sectors of society. For instance, we can think of agreements with certain industries to implement reverse logistics programs for packaging items that are commonly littered (such as bottles and containers). We can also set agreements with large corporations to commit some of their corporate social responsibility resources to litter management. Within our government, the offices that work with the industrial and commercial sectors might be the most suitable to establish such agreements.

In civil society organizations, we may find excellent allies to launch communication campaigns or initiate cleanup events. How are our relationships with the private sector and the civil society? Depending on the culture of our community, it might not be necessary to impose legal instruments to attain proper management of litter, but perhaps some actors will willingly adopt voluntary measures if we encourage them.

Let us walk through some options to work with partnerships, as presented in Table 4.4.

TABLE 4.4. *Options for Cooperation with Other Sectors*

Options for cooperation with partners	Instrumentation	Implement with option (from Table 4.2)
Litter data partnerships		
Sign a treaty with the local chapters of international conservation organizations (for example, Greenpeace, International Coastal Cleanup, and so on) or with local environmental and social nongovernmental organizations to carry out litter studies (surveys or analysis of existing secondary data).	Signing treaties	—
Sign a treaty with local higher-education institutions to carry out litter studies (surveys and subsequent analysis or analysis of existing secondary data).	Signing treaties	—
Sign a treaty with a local consulting firm to carry out pro bono litter studies (surveys and subsequent analysis or analysis of existing secondary data).	Signing treaties	—
Litter prevention partnerships		
Prepare or adopt and disseminate good practice guidelines. Convene key actors within the public, private, and civil society sectors to discuss and agree on good practices to reduce litter in different activities that transpire in our communitya.	Publish and disseminate Ordinance or joint resolution from participating agencies	—-
Sign purchase agreements with manufacturers of environmentally friendly substitutes of littering items (for example, biodegradable or reusable bags, compostable bowls and utensils, and so on) so we can reliably phase out their nonbiodegradable counterparts in our public facilities (including schools and hospitals).	Signing agreements	N
Establish strategic alliances between the government and manufacturers of recyclable or reusable commonly littered items (plastic bottles, glass bottles, aluminum cans, and so on). Invite these entities to adopt a reverse logistics scheme.	Signing agreements	L
Establish strategic alliances between the government and manufacturers of commonly littered items (plastic bottles, food wrappers, cigarettes, and so on). Invite these entities to adopt voluntary measures to reach out to end users to encourage litter reduction.	Signing agreements	K
Establish strategic alliances between the government and civil associations of waterway and beach users (surfers, divers, and so on) to carry out joint education campaigns during events.	Signing agreements	K
Establish strategic alliances between the government and food service providers (restaurants, convenience stores, caterers, and so on). Invite these entities to adopt voluntary measures to actively engage customers in minimizing littering.	Signing agreements	K

TABLE 4.4. *Options for Cooperation with Other Sectors* - *cont'd*

Options for cooperation with partners	Instrumentation	Implement with option (from Table 4.2)
Establish strategic alliances between the government and food banks, soup kitchens, and other social organizations to adopt management practices to minimize litter. Invite these entities to adopt voluntary measures.	Signing agreements	K
Establish strategic alliances between the government and hotel owners to adopt management and communication practices to minimize litter. Invite these entities to adopt voluntary measures.	Signing agreements	K
Establish strategic alliances between the government and park, river, and beach concessions to adopt management and communication practices to minimize litter. Invite these entities to adopt voluntary measures.	Signing agreements	K
Establish strategic alliances between the government and owners of large event venues (arenas, theaters, concert stages, stadiums, convention centers, and so on) to adopt management and communication practices to minimize litter. Invite these entities to adopt voluntary measures.	Signing agreements	K
Establish strategic alliances between the government and private education institutions. Invite these institutions to adopt voluntary communication campaigns and waste management programs for their students and staff.	Signing agreements	K
Establish strategic alliances between the government and community or religious organizations for targeted communication initiatives.	Signing agreements	K
Establish strategic alliances between the government and large local corporations to secure part of their corporate social responsibility resources for litter mitigation.	Signing agreements	I, J, K, O, S, T, U, V, X
Sign a treaty with the local chapters of international conservation organizations (for example, Greenpeace, International Coastal Cleanup, and so on) or with local environmental and social nongovernmental organizations to carry out communication campaigns.	Signing treaties	K
Support social innovation. Encourage public-private cooperation agreements, idea contests, websites and apps that collect and publish information on cleanups, complaints about litter, and so on.	public-private partnerships	K
Litter removal partnerships		
Establish strategic alliances between the government and large corporations (tobacco and beverage industries, car manufacturers, tire manufacturers, petrochemicals, oil and gas, and so on). Invite these entities to commit resources to cleanup events.	Signing agreements	X, Y
Establish strategic alliances between the government and civil associations of waterway and beach users (surfers, divers, rowers, sailors, and so on). Invite these entities to initiate cleanup events.	Signing agreements	Z
Sign a treaty with the local chapters of international conservation organizations (for example, Greenpeace, International Coastal Cleanup, and so on) or with local environmental and social nongovernmental organizations to carry out cleanup events.	Signing treaties	Z

Note: — = Not applicable

a. Examples of good practice guidelines can be found in *The MARLISCO Guide for Reducing Marine Litter* and *Being a Good Neighbor: A Guide to Reducing Litter, Managing Trash and Encouraging Recycling* at:
- https://www.worldoceannetwork.org/wp-content/uploads/2016/04/Marlisco-guide-for-reducing-marine-litter.pdf and
- https://kab.org/wp-content/uploads/2017/10/BeingaGoodNeighor_AGuidetoReducingLitterManagingTrashandEncouragingRecycling.pdf

How Do We Raise Awareness?

We already have a few control measures that we will start with and one or a few laws to influence litter management. To be more successful in the implementation of our strategy, we need to raise awareness about the issue and communicate our plan for dealing with it.

Public Education and Outreach.

This can start by identifying target audiences and waterways of concern in order to prepare and implement an education and outreach program designed to describe to the public the effects of stormwater and discharges on the water bodies, the sources of litter, the steps they can take to decrease litter in stormwater runoff and from nonstormwater discharges, and the hazards associated with improper disposal of waste to the drains and waterways.

It could also include assessing appropriate outreach activities to ensure the reduction of trash in the stormwater discharges or promoting, publicizing, and facilitating public reporting of the presence of illicit dumping in drains and waterways.

Public Participation.

This could entail implementing a public involvement program that identifies individuals or groups who are interested in or affected by the littered lands or waterways and later identifying the types of input and ideas from them to support development and improvement. Providing program access to those who are interested in the issue could include beach cleanup activities, wetland restorations, and so on. Another option is providing the opportunity to comment on the development/improvement program by presenting the progress reports at a meeting or the Internet in advance. Lastly, a tool can be developed for the public to report litter complaints.

The following steps will guide us through the process of designing a communication plan.

Target

First, start by choosing, according to our community's characteristics, what sector(s) we want to focus on. For this, rank the items in Table 4.5.

TABLE 4.5. *Sectors to Target with Our Communication Plan*

	Local population
	Tourists and businesses in the tourism industry
	Businesses in general
	Educational institutions
	Food services (restaurants, eateries, convenience stores, catering)
	Supermarkets
	Factories
	Other:

Communication Strategy

What issue(s) do we want to focus on? Indicate with a checkmark the preferred topic area on the following list:

Social (for example, avoiding diseases or flooding, increasing safety, or beautifying our city)	
Environmental (for example, saving marine wildlife or preventing the transport of pollutants)	
Economic (for example, improving revenues from tourism or decreasing costs of health care and cleanups)	

Now, mark the purpose of our communication campaign:

	Raise awareness about health-related consequences of littering
	Raise awareness about revenue losses as a result of littering
	Raise awareness about ecosystem degradation as a result of littering
	Encourage separation of waste at the source to increase recycling
	Communicate a new ban (for example, on plastic bags, Styrofoam, dumping, and so on)
	Communicate the implementation of a new solid waste management service
	Other actions:

Do we have local subject matter experts or other influential public figures who could be our spokesperson? Write their names in the following box:

Brand Character

Think about the following details:

- **Tone and style**: The brand sets a communication style according to its personality, which can be playful, humorous, educational, informative, and so on—with a tone that can be kind, cheerful, or sobering.
- **The don'ts:** What style should our brand not have?

- **Benefits:** What benefits will the campaign actions imply for its consumers?
- **Mandatory elements:** What logos or concepts cannot be excluded?
- **Slogan or statement:** What characteristics should it have?

Communication Channels

Next, decide on the media for our campaign:

Local TV or YouTube channel		Local government's website	
Local radio station		Local government's social media (Facebook, Twitter, and so on)	
Banners, billboards, and other forms of advertising in visible places (bus stops, train stations, roads, malls, touristic sites, and so on)		Websites and social media of influential individuals and businesses (public figures, hotels and resorts, supermarkets, restaurants, and so on)	
Wrap advertising on collection trucks		Banners and speeches at festivals and local celebrations	
Utility bills (waste collection, water, electricity, and so on)		Posters at restaurants, schools, public spaces, and so on	

After having defined all these elements, we must design a campaign logo and a slogan that will be distinctive in all of our communication channels. To do this, we have several options, depending on our local resources. Here are some ideas:

- Use our government's own communication team (if we have one).
- Bid out to advertising companies.
- Launch a competition for advertising companies with a prize in cash or some other kind (for example, a temporary tax deduction or a token prize and public recognition).
- Call on a specific company or designer to provide pro bono work and recognize them in public.
- Launch a competition among advertisement or graphic design students with a prize in cash or some other kind (for example, a scholarship or a token prize and public recognition).

The *logo* will be a symbol formed by images and/or letters that will help people easily recognize our campaign. The *slogan* will be a brief sentence that summarizes the message we want to convey.

A few examples of logos and slogans against litter are in Photo 4.1.

PHOTO 4.1. *Examples of Antilittering Campaign Logo and Slogans*

a. Anti-littering campaign logo

b. Anti-littering campaign slogan

Sources: *a. MA ANDYANTO / Shutterstock.com; b. steveball / Shutterstock.com.*

WHAT SHOULD OUR INITIAL PLAN LOOK LIKE?

Let us wrap up our initial plan by asking ourselves a few questions to ensure it is complete and follows the guidelines discussed earlier. Does our plan

- **Target the greatest sources of litter, in terms of a specific type, geography, or systematic issue?** If it does not, revise our plan to ensure we tackle the greatest issues of litter generation.
- **Balance immediate impact with long-term effectiveness?** If none of the first few actions we chose will reduce litter at its source in the long term, review the strategy options to find at least one that does.
- **Count with commitment from top executives of the relevant stakeholders?** Remember that without such commitment it will be difficult to obtain the resources we need to carry out our plan.
- **Have specific resources allocated?** If we have not thought in advance where to get financial resources, personnel, volunteers, tools, lands, and so on to carry out our plan, stop and spend some time figuring this out.

If we can answer affirmatively to all these questions, then we are good to go with our initial plan! Now we just need to start working on the implementation and following up on results.

WE ARE MAKING PROGRESS. WHAT ARE THE NEXT STEPS?

5. WE ARE MAKING PROGRESS. WHAT ARE THE NEXT STEPS?

If we already implemented successfully our initial plan or if it is well under way, continue with a second iteration of the preceding methodology.

- If a long time has elapsed since the development of our first plan, we might have to review the concepts in section "*Understanding the* Keys to Success". Otherwise, we can go directly to section "*How Does Our* City Work?" to go over our available resources and possibly spot some we might not have used before. Do we have any new resources we can add to our list?

- Next, carry out new litter surveys to identify where any new major issues lie.

- Lastly, continue going through the rest of section "*Where Do We* Start?" to develop the next phase of our ongoing plan.

If we already have results from our initial plan, it would be a good time to communicate such results through a mass communication campaign. Show people what we have accomplished, and encourage them to further the cause of achieving lands, waterways, and drainage systems free of litter.

APPENDIX: CASE STUDIES–WHAT IS BEING DONE?

APPENDIX: CASE STUDIES–WHAT IS BEING DONE?

TREATING TRASH AS A POLLUTANT, INTEGRATED WATERSHED LITTER REDUCTION IN THE UNITED STATES

In the United States, trash is being regulated as a water pollutant. The Clean Water Act mandates biennial assessment of the nation's water resources, and the assessment is used to identify "impaired" waters, meaning waters in which current pollution controls are insufficient to attain water quality standards, including those for trash (also referred to as debris or floatables). States then develop and implement total maximum daily loads (TMDLs), which is a limit on how much trash can enter the watershed each day. Trash in stormwater is also regulated as a pollutant, giving a limit on what a municipality is permitted to discharge (National Pollutant Discharge Elimination System). More than 200 individual water body reaches in seven states have been listed as impaired for trash since 1996; however, it has only been since 2008 that regulatory implementation has taken effect. The following are two examples.

Mobilizing Actors to Clean up the Anacostia River

Washington, DC is within the Potomac River watershed, which flows into the Chesapeake Bay and ultimately the Atlantic Ocean. The watershed has 6 million residents, and Washington, DC alone has more than 16 million annual visitors. One of the Potomac River's tributaries that flows through Washington, DC, the Anacostia River, has been plagued by an accumulation of a large volume of highly visible trash and debris.

A plan to limit the trash entering the Anacostia was born through two concurrent actions: a civil society-led initiative and the enforcement of legislation. In 2006, the Trash Free Potomac Treaty, a treaty among the many stakeholders in the watershed, which was spearheaded by a nongovernmental organization, The Alice Ferguson Foundation, was signed. This was followed by a decision in 2008, under the Clean Water Act, that the Anacostia River was being impaired by "floatable debris," largely composed of trash.

Protecting a Downstream Beach Community in Long Beach, California

The city of Long Beach, California, is on the south coast of Los Angeles County and sits at the terminus of the Los Angeles and San Gabriel rivers. The Los Angeles River flows 82 kilometers, and the watershed encompasses 2,134 square kilometers of a highly urbanized area. The San Gabriel River runs 120 kilometers, and the watershed contains 1,784 square kilometers. Collectively, the upstream pollution from these watersheds affects litter management for the city of Long Beach.

Managing litter in its waterways and coastline is a priority of the city. Long Beach has a population of more than 470,000 and hosts approximately 5 million visitors annually to its beaches and other attractions. Long Beach port receives the most cargo tonnage on the West Coast of the United States. In 1996, the Los Angeles River was identified as impaired by trash under the Clean Water Act, and a TMDL went into effect in 2008.[5] The following is a summary of some of actions taken and the results.

[5] *Section 305(b) of United States Clean Water Act mandates biennial assessment of the nation's water resources, and the assessment is used to identify impaired waters. The Clean Water Act also requires states to establish a priority ranking for impaired waters and to develop and implement TMDLs.*

Intervention	Description
Natural drainage systems	DC government developed requirements and incentives to increase natural stormwater drainage that would reduce dependence on the city's stormwater conveyance system. This was done through transportation project standards (providing natural drainage through green medians and pocket parks on sidewalks) and providing incentives for the development of rain gardens and green roofs.
Litter awareness campaign	Marketing research was undertaken to better understand citizens' attitudes toward littering. Messages that were effective were those that focused on home, family, and personal space rather than water quality and the environment, resulting in campaign messages such as "Your litter hits close to home" and "Take control. Take care of your trash." The message was designed to help litterers feel empowered and important as caretakers for those they love. The campaign has been ongoing since 2011 and expanded throughout the city and neighboring jurisdictions.
Bag fee	In 2009, DC government required all commercial businesses to charge a $0.05 fee for each disposable paper and plastic carryout bag provided to a customer, with a portion of the fee used for watershed protection and a portion retained by the retail establishment. In 2017, more than three-fourths of businesses complied with the law, and there has been a 60 percent reduction in plastic bag use. The Alice Ferguson Foundation reported a 72 percent reduction in these types of plastic bags recovered per volunteer cleanup event. Revenues in 2016 were nearly $2.3 million, providing more than $1.6 million in activities supporting watershed management.
Bans on disposable food service containers	DC government implemented a ban on the use of disposable food service items made of expanded polystyrene (that is, foam or Styrofoam) and other products that cannot be recycled or composted. The foam ban began in 2016 and applies to all DC businesses and organizations that serve food. The requirements for recyclable and compostable materials went into effect on January 1, 2017, with enforcement beginning after one year.
Enforcement of illegal dumping	In DC, it is illegal to dump large items on public property or vacant lots. Penalties range from $75 to $8,000 and/or community service. These codes are enforced by the DC government (Department of Public Works, the Metropolitan Police Department, and the Department of Health).
Enhanced street sweeping	Through an analysis of the Anacostia watershed, trash hotspots were identified. The District's Department of Environment and Department of Public Works introduced high-efficiency sweepers and additional sweeping days to better target these hotspots. These enhancements have reduced an additional 32 tons per year of litter.
Catch basin maintenance and enhancement	DC government maintains the 27,500 catch basins found within the separate storm sewer system and combined sewer system, removing an estimated 3,629 tons of debris per year. The DC government (Department of Transportation) has also retrofitted catch basins to remove litter and improve water quality as part of roadway construction projects.
Stormwater litter removal	The DC Water and Sewer Authority maintains stormwater and combined sewer stormwater treatment systems (swirls) and vacuum screening at pumping stations.
In-stream litter traps	DC government has installed seven in-stream capture systems to capture trash. These include a trash trap designed to mimic a Japanese fishing trap and Bandalong litter traps (see Photo 3.5).
Skimmer boats	For trash that has entered local waterways, DC has skimmer boats (see Photo 3.6) managed by the DC Water and Sewer Authority. These boats collect floatable debris along nearly 25 kilometers of waterways in DC and remove an average of 435 metric tons of litter and debris.
Cleanups	The Alice Ferguson Foundation organizes the Annual Potomac River Watershed Cleanup. In 2017, the cleanup engaged more than 9,000 volunteers in collecting more than 183 metric tons of litter and debris from 270 cleanup sites. Other volunteer cleanups that occur throughout the year include those organized by the Ocean Conservancy, Anacostia Watershed Society, Rock Creek Conservancy, and DC Surfrider Foundation.

For more information on Litter Free Long Beach, visit http://www.litterfreelb.org/.

Intervention	Description
Natural drainage systems	In 2010, the Long Beach City Council adopted amendments to the local building code to incorporate standards in the planning and construction of new and redevelopment projects to include practices that would increase infiltration, capture, use, and evapotranspiration of stormwater that can mimic the natural hydrology of the system and reduce the flow of stormwater runoff in the constructed conveyance system.
Litter awareness campaign	Litter Free Long Beach is a campaign within the city's Environmental Services Bureau that organizes educational materials and provides resources for citizens to get more involved in reducing litter in Long Beach. The campaign includes education and outreach through advertisements and school programs, community cleanup events, business partnerships for clean business districts, and enforcement of litter laws.
Bag ban	In 2011, the Long Beach City Council voted to ban the distribution of plastic carryout bags and approved a $0.10 charge for qualifying recyclable paper bags. Compostable and biodegradable plastic carryout bags are considered plastic bags as these bags are littered, acting similar to plastic bags when in the environment. Although plastic bags were considered more problematic, paper bags are also part of the litter stream. The ordinance also establishes standards for recyclable paper bags and reusable bags. The city of Los Angeles followed with a similar ban in 2014, and the state of California adopted a ban on single-use carryout bags that was approved by voters in 2016.
Enhanced street sweeping	The city conducts more frequent sweeping on a weekly basis. The street-sweeping program has proven effective in reducing litter. In 2011, the city swept more than 244,200 miles and picked up more than 9,922 metric tons of material.
Enhanced litter bins and collection	To improve the convenience of proper trash disposal, Long Beach placed new litter receptacles with lids along residential streets and commercial streets, which are emptied weekly. The city also partnered with Long Beach Transit to place containers at bus stops. The Parks, Recreation, and Marine Department maintains 200 receptacles at the beach during summer and 27 in winter, which are emptied five and three times per week, respectively. The city also provides containers to businesses located in litter-free zones that are designated by the city.
Stormwater system maintenance and enhancement	Catch basin inserts, such as automatic retractable screens (see Figure 3.4), connector pipe screens (see Figure 3.8), and vortex separation (see Figure 3.6) systems, were installed at numerous catch basins in Long Beach and upstream communities along the Los Angeles River. Catch basins without these capture devices are cleaned a minimum of four times per year. The city has a rain-emergency checklist that identifies selected strategies, including catch basins, grates, culverts and ditches, and stormwater pipes that are checked immediately before a forecasted rain event to ensure they are free of litter.
Beach cleaning	Once the litter has found its way to the beach, the city employs rakes. The beach rake combs and sifts the beach sand to pick up littered trash and debris. City beaches are typically raked five to six days per week.
Cleanups	The city also conducts cleanup events. Cleanup events include community and business corridor cleanups and alley cleanups. In 2011, more than 1,100 volunteers participated in neighborhood cleanup efforts, collecting 112 metric tons of litter. Another cleanup program, the alley cleanup program, collected 1,134 metric tons of litter and involved more than 3,000 community service workers.

BAN ON THE IMPORT AND USE OF LITTERING ITEMS

Caribbean countries are part of a global movement to ban or impose taxes on some of the main items of marine debris. As of May 2021, 16 countries within the Caribbean region had in place bans on Styrofoam, plastic bags, or both (United Nations Environment Programme 2021). These efforts are designed to reduce the use of common litter items and have been implemented in many places in the world, reducing litter, improving aesthetics, and reducing the costs of cleanup.[6] Among the countries in the Caribbean with laws in effect are Haiti and Antigua and Barbuda, which banned Styrofoam and plastic bags in 2013 and 2016, respectively. Although the program in Haiti had limited results in the field, the initiative in Antigua and Barbuda has shown progress.

In Antigua and Barbuda, 90 percent of all plastic waste was bags distributed by supermarkets. Through the banning of Styrofoam, plastic bags, and other single-use food service items through a phased approach that included enforceable regulations, upfront consultations, a communication program, and incentives for alternative products, the proportion of plastic at the landfill dropped from 19.5 percent in 2006 to 4.4 percent in 2017. The ban on plastic bags occurred in two phases: The first phase banned the importation of plastic shopping bags, and this was then followed by a ban on the use of the bags. An eight-step implementation process was undertaken: (a) the announcement of phases one and two of the ban; (b) consultations with external and internal stakeholders; (c) additional consultations with supermarkets to resolve identified challenges; (d) cabinet approval; (e) drafting of regulations; (f) gazetting of regulations; (g) notifications to all stakeholders that the regulations had been gazetted; and (h) final consultations with external agencies and additional awareness initiatives. This eight-step plan was critical to the success of the ban for a variety of reasons: The two phases gave stakeholders time to prepare for the eventual removal of all plastic bags, and continual dialogue with all stakeholders improved participation and compliance (Diez et al. 2019).

IMPROVING AND EXPANDING COLLECTION AND CLEANING SERVICES

Introducing Containerized Waste Collection.

Rosario is a city of more than a million people on the Paraná River. The river and its coast are a focal point for recreation and city life. Downstream, as the river flows into the Atlantic Ocean, there is a major beach tourism industry in Argentina and in neighboring Uruguay. In Rosario, waste was placed either in ineffective, undersized plastic street containers, or in plastic bags in front of houses or at informal communal collection points throughout the city. This created disorganized piles of bags that remained on the street until collected, oftentimes spilled or opened up by animals, and was a constant source of litter and severely degraded the aesthetics of this otherwise beautiful city. As part of a reorganization of the service in 2009, the city of Rosario provided three-fourths of their population with modern communal containers placed on the side of the street. This allowed people to place their waste at any time of day and kept it neat and contained, preventing littering and improving aesthetics. This system has undergone steady improvements, introducing integrated information technology systems, more durable containers, and green areas of the city where selective collection is done, as shown in Map A.1.

Professionalizing Solid Waste Collection Contracts.

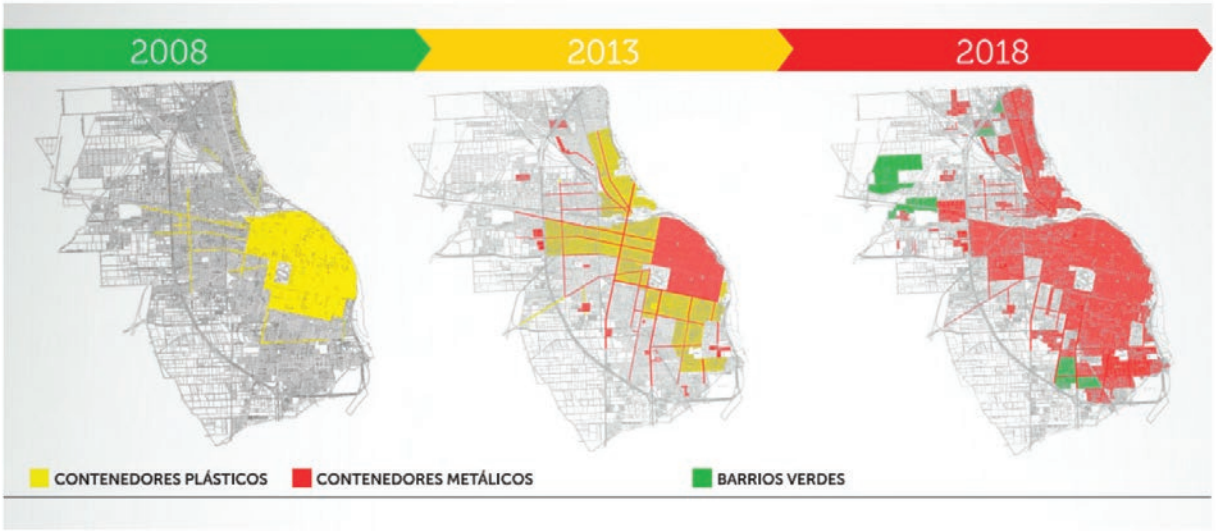
As part of implementation of a law and national strategy for solid waste that began implementation in 2008, Morocco recognized municipal solid waste collection contracts that were not being implemented or managed to provide effective collection of waste. Municipalities received support through engineering firms to improve the quality and specifications of their collection contracts. Financing of the contracts was improved through establishing municipal fees; rules for budget preparation, price revision and budget arrangements, and contract management were improved, including the establishment of a dispute-resolution mechanism between municipalities and contractors. Between 2007 and 2016, use of professionalized contracts in the country increased from 45 to 82 percent, covering 66 percent of the urban population.

Integrated Maintenance Contracts in Hotspot Areas.

Many cities have taken an integrated maintenance approach to key areas to keep business districts, city historical centers, and coastal and riverfront areas clean of litter and well-maintained. One example of this is Barcelona, Spain. The Àrea Metropolitana de Barcelona (AMB) is a regional government composed of 36

[6] *For example, in October 2015, England introduced a 5-pence charge on single-use plastic bags. An estimated 7 billion of these bags were distributed the year before the introduction of the fee. It caused distribution to plunge to only 500 million bags in the first six months. Overall, the fee is projected to reduce distribution of single-use plastic bags by about 80 percent in supermarkets and save £60 million in cleanup costs.*

MAP A.1. *Map of Rosario's Expansion of Plastic Garbage Containers, Metal Garbage Containers, and "Green Neighborhoods"*



Sources: *"Plan integral de higiene urbana", Municipalidad de Rosario. Accessed May 28, 2021. https://www.rosario.gob.ar/web/servicios/higiene-urbana/plan-integral-de-higiene-urbana. Note: Yellow = plastic garbage containers; red = metal garbage containers; green = green neighborhoods.*

municipalities surrounding Barcelona with a total population of more than 3 million people. It contains 41 regional beaches visited by more than 8.5 million people annually. AMB manages two contracts: one for furniture and facilities maintenance (playgrounds, sports facilities, showers, walkways, and benches), with the goal of ensuring they are in proper condition so that users can enjoy their time on the beaches comfortably and safely, and a beach cleaning contract. The latter covers management of the cleaning of 22,365 meters of coastline and 2,156,192 square meters of beaches in seven municipalities and provides the option to expand service to an additional three municipalities (7,328 meters of coastline with 590,445 square meters of sand).

The contract includes cleaning of sand, furniture, and other elements constructed along the beaches and covers routine cleaning and corrective maintenance that can be attributed to circumstances not covered by routine maintenance, such as storms or acts of vandalism. A cleaning operations plan that includes detailed requirements for manual cleaning, mechanical cleaning, trash removal, beach dragging (to turn over the sand), beach leveling, and adaptation of river mouths is subject to approval by the AMB. Payments are based on completion of tasks in the plan, with deductions based on the overall level of cleanliness, including detailed criteria for evaluating cleanliness of sand. As evidence of the outcome of the management approach, in 2016, 13 AMB-managed beaches were given a blue flag, a designation given by the Foundation for Environmental Education for beaches with excellent environmental performance, water quality, and installations.

Cleaning Communities and Building Better Services as Part of Community Upgrading.

The Jamaica Social Investment Fund has been implementing programs to support marginal communities that suffer from lack of basic urban infrastructure and services, crime, and unemployment. The program[7] provides an integrated package of infrastructure (roads, water supply, drainage, fencing), community employment programs, and crime and violence prevention interventions. Recognizing the extremely high level of waste and litter as a result of the lack of services and its systemic impact on flooding, community pride, sense of security, and mosquito-borne illnesses, the program includes a set of interventions for cleanups and simultaneous improvements in waste collection and cleanliness. The approach combines the overall upgrading program with investments in collection infrastructure, community cleanups and awareness activities, and enforcement through citizen environmental wardens. Financial incentives are also provided for the

[7] *Financed through two World Bank Projects: Inner City Basic Services Project and Integrated Community Development Project.*

various actors (collection companies, community-based organizations, and citizen environmental wardens) in exchange for maintaining a clean community. The most recent independent verification of targeted communities has confirmed the cleanliness of these communities, benefitting 89,000 residents.

For more information on the effect of cleaner streets on healthier and safer communities in Jamaica, visit:

- Kaza, S. L. Yao, and J. Park. 2017. "Cleaner Streets Mean Healthier Communities: The Story of the 'Zika Warriors.'" *World Bank Blogs*, April 7. https://blogs.worldbank.org/sustainablecities/cleaner-streets-mean-healthier communities-story zika-warriors.
- Yamamoto, M., C. Fevre, E. Monteiro, and S. Kaza. 2019. "New Model for Development: Tackling Urban Vulnerability and Public Safety." *World Bank Blogs*, March 22. https://blogs.worldbank.org/latinamerica/new-model-development tackling-urban-vulnerability-and-public-safety.
- The Jamaica Integrated Community Development Project on the World Bank website at https://blogs.worldbank.org/latinamerica/new-model-development tackling-urban-vulnerability-and-public-safety.

LITTER MANAGEMENT INFORMATION TECHNOLOGY

TrashOut is an environmental app that aims to eliminate illegal dumps and improve recycling. First, it enables users to report illegal dumpsites by taking and posting pictures, georeferencing, and adding a description. The report can be seen by relevant environmental organizations and municipalities, which can then take action to clean up the dump on their own or organize a cleanup event. In addition, the app has a map feature that gives directions to find the nearest disposing sites, collection centers, or the right bins to dispose of the waste correctly.

A similar app—Litter Ends Here—has been used in Greenville County, South Carolina. The citizens report litter in their neighborhood by uploading a photo, writing a description, and dropping a Global Positioning System pin to the exact location. The crew from the municipality then picks up the trash and keeps the community clean and free from litter.

An increasing number of data collection apps are reporting on the presence, location, and characteristics of litter to fill data gaps to help influence policy and invoke action on litter. Some of these include CleanSwell and Marine LitterWatch (both targeting beach litter), Litterati, and OpenLitterMap, the last being a global platform designed to empower citizens to generate high-quality, publicly available geospatial data on litter that anyone can download. It empowers people with the ability to upload geotagged photos and provide information on the type, with an accurate location and time embedded. These data are automatically mapped by space, time, and location.

Other available apps and mapping projects are not specific to litter mapping but have been used for that purpose. For instance, MapSwipe is an open-source mobile app dedicated to crowdsource mapping, which enables volunteers to swipe through satellite images; look for features such as buildings, roadways, waterways, waste, and so on; and tap once they have located them.

In Mali, the World Bank partnered with the Humanitarian OpenStreetMap Team (HOT), the Heidelberg Institute of Geoinformation Technology (HeiGIT), and MapSwipe on the Africa Cash for Digital Work Program.

This pilot project centered on creating new remote employment opportunities for individuals affected by COVID-19 lockdowns and engaging them to solve challenges relevant to their community while building relevant skills in geographic information system and technology. A total of 120 digital workers participated in the program. They were trained on how to use MapSwipe and mapped a total of 455.9 square kilometers over two weeks. They identified hotspots and correlated the data with other risks (such as malaria and flooding) to create vulnerability maps for intervention prioritization.

In Tanzania, the project Dar Ramani Huria (Swahili for Dar Open Map)—a community-based mapping project—is training teams of local university students and community members from throughout Dar Es Salaam to use OpenStreetMap to create sophisticated and highly accurate maps of the city.

In 2018, Dar Ramani Huria joined forces with Nipe Fagio—an organization in Tanzania in the sector of waste management and pollution education—to map trash sites in Dar es Salaam. In just four days of mapping, 540 students collected and uploaded a total of 20,392 trash points. The mapped data helped identify the location of the areas with poorly managed waste materials, as well as the type and size of waste, and guided methods for a major cleanup of the city on September 15, 2018. The trash hotspots were reduced to 9,452 after these activities.

Solid-waste service requests and complaints are being incorporated in 311 systems, which are unified systems established as a one-stop shop (by dialing 3-1-1 or through an online system) for citizens to take advantage of city services. Commonly 311 systems have incorporated a means of complaining about unclean streets and overflowing bins or dumpsites; requesting cleanup of a littered area or a collection of waste; and informing the city government of an event that would need additional solid waste cleanup. Open311 is an initiative that provides an open-source software to encourage adoption of these systems.

GLOBAL AND REGIONAL CLEANUP INITIATIVES

The environmental NGO Let's Do It! World promotes and organizes cleanup events, such as World Cleanup Day. This movement started from Estonia, where the first cleanup action in 2008 collected as much as 10,000 tons of illegal waste through the work of 50,000 volunteers. Inspired by this event, many countries started their own cleanup events. Let's Do It! World is now an accredited member of United Nations Environment Programme.

World Cleanup Day is a global civic movement aimed at combating the global solid waste problem. It is usually held in mid-September over the course of 24 hours. World Cleanup Day 2018 engaged 5 percent of the total world's population in a one-day cleanup program.

The International Coastal Cleanup (ICC) is a global coastal cleanup program that—since 1986— happens the third Saturday of September every year. ICC uses a map that informs the public about the cleanup events being organized all over the world, and anyone can register as a volunteer at an event near them. Volunteers from more than 100 countries come together each year and participate. ICC uses an app called CleanSwell to record the collected items and writes annual reports highlighting the goals, successes, and statistics of events.

Swachh Bharat Mission (translated as Clean India Mission) is a nationwide campaign in India held from 2014 to 2019. One of the aims was to clean up the streets, roads, and beaches in urban and rural areas of India. Cities have been evaluated based on the performance of their municipal solid waste management, including sweeping, collection, transportation, processing, and disposal of solid waste. The results have shown an improvement in awareness of litter issues, thanks to this massive nationwide campaign.

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