

Trash Load Reduction Tracking Method

Assessing the Progress of San Francisco Bay Area MS4s Towards Stormwater Trash Load Reduction Goals

Technical Report (Version 1.0)

Submitted in Compliance with Provision C.10.a(ii) of Order R2-2009-0074

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February 1, 2012

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LIST OF ACRONYMS

BASMAA	Bay Area Stormwater Management Agencies Association
BID	Business Improvement District
CalRecycle	California Department of Resources Recycling and Recovery
Caltrans	California Department of Transportation
CASQA	California Stormwater Quality Association
CDS	Continuous Deflection Separator
CEQA	California Environmental Quality Act
CIWMB	California Integrated Waste Management Board
CY	Cubic Yards
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
GIS	Geographic Information System
MRP	Municipal Regional Stormwater NPDES Permit for the San Francisco Bay Area
MS4	Municipal Separate Storm Sewer System
NGO	Non-Governmental Organization
NPDES	National Pollutant Discharge Elimination System
Q	Flow
SFRWQCB	San Francisco Regional Water Quality Control Board
SWRCB	State Water Resource Control Board
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
Water Board	San Francisco Regional Water Quality Control Board
WDR	Waste Discharge Requirements

PREFACE

This Technical Report was prepared under the guidance of cities, towns, counties and flood control districts (i.e., Permittees) subject to requirements in Provision C.10.a.i of the Municipal Regional Stormwater NPDES Permit (MRP) for Phase I communities in the San Francisco Bay (Order R2-2009-0074). The tracking methods included within are intended to establish a consistent framework for Permittees to track progress towards trash load reduction goals included in the MRP. The use of this document is done so under the discretion of each Permittee. Based on the experiences of Permittees in implementing trash control measures, Permittees may chose to supplement the methods described in this Technical Report with additional credits and quantifications to account for load reductions associated with enhanced control measure implementation. Additionally, based on experiences implementing trash control measures and assessing effectiveness, methods contained herein may be modified overtime. Therefore, this document serves as Version 1.0 of the *Trash Load Reduction Tracking Method*.

TERMINOLOGY

Area-specific (with regard to control measures or reductions): Control measures or reductions which are implemented or applied within defined or limited areas within a Permittee's jurisdictional area (e.g., full-capture treatment devices or enhanced street sweeping).

Area-wide (with regard to control measures or reductions): Control measures or reductions which are implemented or applied throughout a Permittee's jurisdictional area (e.g., region-wide public education strategy).

Baseline Implementation: The level of implementation for a specific trash control measure that forms the starting point for tracking progress toward trash load reduction.

Baseline Load: the sum of the trash loads from a Permittee's effective loading area, adjusted for baseline implementation of street sweeping, storm drain inlet maintenance, and pump station maintenance.

Baseline Loading Rate: The rate (expressed as volume/acre/year) at which trash is discharged onto effective loading areas, taking into account baseline control measure implementation.

Best Management Practice (BMP): Any activity, technology, process, operational method or measure, or engineered system, which when implemented prevents, controls, removes, or reduces pollution. A BMP is also referred to as a control measure.

Bypass: The intentional diversion of water and its constituents from any portion of a treatment measure.

Conceptual Model: A model that explicitly describes and graphically represents all existing knowledge on the sources of a pollutant, its fate and transport, and/or its effects in the ecosystem.

Conveyance System Load: The volume of trash estimated to enter the stormwater conveyance system (e.g., storm drain inlets).

Conveyance System Loading Rates: The annual rates (volume/acre) at which trash enters a stormwater conveyance system (e.g., storm drain inlets) from a particular land area that is associated with a specific trash loading rate category.

Control Measure: See Best Management Practice.

Current Load: The difference between a baseline load and the load removed via existing enhanced street sweeping.

Current Loading Rate: The rate (expressed as volume/acre/year) at which trash is discharged onto effective loading areas, taking into account baseline control measure implementation.

Discharge: A release or flow of stormwater or other substance from a stormwater conveyance system.

Effectiveness (with regard to Control Measures): A measure of how well a control measure reduces trash from entering the MS4.

Enhanced (with regard to control measures): New or expanded control measures that have been implemented after the effective date of the MRP (i.e., December 1, 2009).

Existing Enhanced Street Sweeping: Street sweeping conducted by a Permittee on February 1, 2012 at a frequency greater than the baseline street sweeping ceiling.

Full-Capture Device: A single device or series of devices that can trap all particles retained by a 5 mm mesh screen, and has a treatment capacity that exceeds the peak flow rate resulting from a one-year, one-hour storm in the subdrainage area treated by the device.

Generated Load: The load (volume) of trash that is available to an MS4 under a no street sweeping, storm drain inlet and pump station maintenance scenario.

Generation Rate: The rate (expressed as volume/acre/year) for specific land areas at which trash is available to an MS4 under a no street sweeping, storm drain inlet and pump station maintenance scenario.

Geographical Information System (GIS): A system designed to capture, store, analyze, manage, and display all forms of geographically referenced data. GIS is the merging of cartography, statistical analysis, and database technology.

Interception (with regard to control measures): The process of removing trash from proceeding within an area-specific or area-wide control measure.

Litter: As defined by California Code Section 68055.1(g), litter means all improperly discarded waste material, including, but not limited to, convenience food, beverage, and other product packages or containers constructed of steel, aluminum, glass, paper, plastic, and other natural and synthetic materials, thrown or deposited on the lands and water.

Load Reduction: The estimated or quantified decrease in the amount of trash discharged from a stormwater conveyance system or removed from a receiving water.

Municipal Separate Storm Sewer System (MS4): "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created to or pursuant to state law) including special districts under state law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States. (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2." (40 CFR 122.26(b)(8))

Partial-capture Device: Treatment devices that have not been recognized as full-capture devices by the San Francisco Bay Regional Water Board, but capture trash (e.g., trash booms or retractable curb inlet screens). Partial-capture devices may be similar to full-capture devices, but do not meet the full-capture definition due to engineering challenges, or they may be completely different types of devices.

Receiving Waters: Natural water bodies (e.g., creeks, lakes, bays, estuaries)

Stormwater: Runoff from roofs, roads and other surfaces that is generated from rainfall and snow events and flows into a stormwater conveyance system.

Storm Drain Inlet: Part of the stormwater conveyance system where surface runoff enters the underground conveyance system. Includes side inlets located adjacent to curbs and grate inlets located on the surface of a street or parking lot.

Storm Drain Insert: A device (e.g., screen or basket) designed to capture trash capture within a storm drain inlet.

Stormwater Conveyance System: Any pipe, ditch or gully, or system of pipes, ditches, or gullies, that is owned or operated by a governmental entity and used for collecting and conveying stormwater.

Street Load: Volume of trash estimated to enter the environment and available for interception via on-land trash cleanups and enhanced street sweeping, following the implementation of trash generation reduction control measures.

Street Loading Rates: The annual rates (volume/acre) at which trash enters the environment within a land area and is available for interception via on-land trash cleanups and enhanced street sweeping, following the implementation of trash generation reduction control measures.

Trash: Litter (as defined by California Code Section 68055.1g), excluding sediments, sand, vegetation, oil and grease, and exotic species, that cannot pass through a 5 mm mesh screen.

Trash Generation Reduction: The implementation of control measures which prevent or greatly reduce the likelihood of trash from being deposited onto the urban landscape.

Trash Loading Rate Category: A specific combination of important trash generation factors (e.g., land use, population density, economic profile) and control measures in an applicable land area that affect a trash generation rate.

Urban Runoff: All flows within a stormwater conveyance system which consist of stormwater (wet weather flows) and non-stormwater illicit discharges (dry weather flows).

Watershed: A defined area of land that catches rain and snow; and drains or seeps into a marsh, stream, river, lake or groundwater.

Waterway: a receiving water or manmade channel.

Waterway Load: The estimated load (volume) of trash discharge to a receiving water via an MS4.

Waterway Loading Rates: The annual rates (volume/acre/year) at which trash is discharged via an MS4.

1.0 INTRODUCTION

The Municipal Regional Stormwater NPDES Permit for Phase I communities in the San Francisco Bay (Order R2-2009-0074), also known as the Municipal Regional Permit (MRP), became effective on December 1, 2009. The MRP applies to 76 large, medium and small municipalities (cities, towns and counties) and flood control agencies in the San Francisco Bay Region, collectively referred to as Permittees. Provision C.10 of the MRP (Trash Load Reduction) requires Permittees to reduce trash from their Municipal Separate Storm Sewer Systems (MS4s) by 40 percent before July 1, 2014.

Required submittals to the San Francisco Bay Regional Water Quality Control Board (Water Board) by February 1, 2012 under MRP provision C.10.a (Short-Term Plan) include:

1. A baseline trash load estimate and description of the methodology used to determine the load level; and
2. A description of the **Trash Load Reduction Tracking Method** that will be used to account for trash load reduction actions and to demonstrate progress and attainment of trash load reduction levels.
3. A Short-Term Trash Loading Reduction Plan that describes control measures and best management practices that will be implemented to attain a 40 percent trash load reduction from its MS4 by July 1, 2014;

This *Trash Load Reduction Tracking Method Technical Report* (Technical Report) was developed in compliance with submittal #2. To comply with required submittals #1 and #3, each Permittee has developed an individual *Short Term Trash Loading Reduction Plan* (Short-Term Plan) using a template developed by BASMAA to ensure consistency. Each Short-Term Plan includes the Permittee's current trash baseline load estimate and descriptions of actions that will be implemented to reach a 40% reduction in their estimated baseline trash load. Baseline trash loads were developed through the BASMAA *Baseline Trash Generation Rates Project* described in Section 1.4 (BASMAA 2011a, 2011b, 2012).

1.1 Trash Load Reduction Tracking Method Summary

The trash load reduction tracking method described in this Technical Report is intended to assist Permittees in demonstrating progress towards reaching trash load reduction goals defined in the MRP (e.g., 40 percent). The tracking method is based on information gained through an extensive literature review and Permittee experiences in implementing stormwater control measures in the San Francisco Bay Area (BASMAA 2011c). The literature review was conducted to evaluate quantification methods used by other agencies to assess control measure effectiveness or progress towards quantitative goals.

Methods to track load reductions attributable trash control measures described in this Technical Report fall into two categories: 1) trash load reduction quantification formulas; and 2) load reduction credits. Quantification formulas were developed for those trash control measures that were deemed feasible and practical to quantify load reductions overtime. Load reduction credits were developed for all other control measures included in this Technical Report. Both categories of methods assume that as new or enhanced trash control measures are implemented by Permittees, a commensurate trash load reduction will occur. Progress towards load reduction goals will be demonstrated through comparisons between load reduction credits and quantifications, and established trash baseline load estimates. Additionally,

as practicable, load reductions will also be measured empirically overtime through MS4 and/or receiving water monitoring and characterization studies (see Section 5.0).

1.2 Applicable Trash Control Measures

Permittees may choose to implement any number of trash control measures to reach MRP trash load reduction goals. Prior to conducting the literature review, BASMAA member agencies identified a list of trash control measures for which trash load reduction methods should be developed. This list was developed collaboratively through the BASMAA Trash Committee, which included participation from Permittee, stormwater program, Water Board and non-governmental organization (NGO) staff, and is based on: 1) the potential for Permittees to implement; 2) the availability of information required to populate formulas and develop credits; and 3) the expected benefit of implementation. Trash control measures for which quantification formulas and credits were developed, are described included Table 1.1.

It is important to note that in an effort to reduce trash discharged from MS4s, Permittees may choose to implement other types of control measures that are not included on this list. If a Permittee chooses to do so, methods specific to calculating trash load reductions for that control measure would need to be developed. These methods may be proposed by Permittees via their Short-Term Plans or subsequent Annual Reports. As additional methods are developed, consideration should be given to updating this Technical Report to incorporate these methods.

Table 1.1. Trash control measures for which load reduction credits or load reduction quantification formulas were developed to track progress towards trash load reduction goals.

Load Reduction Credits
Single-use Carryout Plastic Bag Ordinances
Polystyrene Foam Food Service Ware Ordinances
Public Education and Outreach Programs
Activities to Reduce Trash from Uncovered Loads
Anti-Littering and Illegal Dumping Enforcement Activities
Improved Trash Bin/Container Management Activities
Single-use Food and Beverage Ware Ordinances
Quantification Formulas
On-land Trash Cleanups (Volunteer and/or Municipal)
Enhanced Street Sweeping
Partial-Capture Treatment Devices
Enhanced Storm Drain Inlet Maintenance
Full-Capture Treatment Devices
Creek/Channel/Shoreline Cleanups (Volunteer and/or Municipal)

1.3 Baseline Trash Generation Rates Project

Through the approval of a BASMAA regional project, Permittees agreed to work collaboratively to develop a regionally consistent method to establish baseline trash loads from their MS4s. The project, also known as the *BASMAA Baseline Trash Generation Rates Project* assisted Permittees in establishing a baseline by which to demonstrate progress towards MRP trash load reduction goals (e.g., 40 percent). The project was intended to provide a scientifically-sound method for developing trash generation rates that can be adjusted, based on Permittee/site specific conditions; and used to develop baseline loading rates and loads. Baseline loads form the reference point for comparing trash load reductions achieved through control measure implementation.

Trash generation rates are estimates of trash loads (volumes) per unit area and are fully described in BASMAA (2012a). Generation rates are based on factors that significantly affect trash generation (e.g., land use) in the urbanized watersheds of the San Francisco Bay area. The method used to establish baseline trash loads for each Permittee builds off “lessons learned” from previous trash loading studies conducted in urban areas (Allison and Chiew 1995; Allison et al. 1998; Armitage et al. 1998; Armitage and Rooseboom 2000; Lippner et al. 2001; Armitage 2003; Kim et al. 2004; County of Los Angeles 2002, 2004a, 2004b; Armitage 2007). It uses the conceptual model presented in the *BASMAA Sampling and Analysis Plan* (BASMAA 2011b), which is based off of the results of the studies cited above and described by BASMAA (2011a). Baseline trash loading rates were developed through the quantification and characterization of trash captured in Water Board recognized full-capture treatment devices installed in the San Francisco Bay area.

1.4 Purpose and Scope of Technical Report

Methodologies presented in this Technical Report should be considered preliminary and are subject to revision based on additional information and implementation experiences. The primary purpose of this Technical Report is to assist Permittees in complying with Permit Provision C.10.a.ii of the MRP.

Additionally, information and methods described in this report:

- Provide a preliminary trash load reduction tracking method that is consistent with concepts incorporated into the *Trash Baseline Generation Rates Project* and avoids double-counting of water quality benefits expected from the implementation of specific control measures;
- Provide initial concepts of relative water quality benefits associated with specific trash control measures, which can assist Permittees in directing control measure implementation and be improved upon over time through Permittee experiences with implementation; and,
- Assist Permittees and other stakeholders in identifying data needs associated with load reduction quantification and crediting (i.e., identification of information needed to populate or formulas and credits).

1.5 Memorandum Organization

This Technical Report is organized into the following sections:

- Section 1: Introduction
- Section 2: Methods Overview and Tracking Process
- Section 3: Loads Reduced Credit Fact Sheets
- Section 4: Loads Reduced Quantification Fact Sheets
- Section 5: Empirical Load Reduction Measurements
- Section 6: References

2.0 METHODS OVERVIEW AND TRACKING PROCESS

This section provides an overview of the trash load reduction tracking methods described in Sections 3.0 and 4.0. The overview describes the guiding principles and key assumptions used to develop these methods. It also describes the process and steps that Permittees will take to calculate trash load reductions associated with control measures and demonstrate progress towards trash load reduction goals.

2.1. Methods Overview

The primary goal of the tracking methods development project was to assist Permittees in developing a method to demonstrate progress toward load reduction goals required by the MRP. To form a foundation based on existing knowledge base, a considerable amount of information on the demonstrated effectiveness of trash controls measures and trash load reduction tracking was reviewed and summarized by BASMAA (2011c). The results of the literature review were presented, reviewed and discussed via the BASMAA Trash Committee, which includes participation by Permittees, Water Board and NGO staff. The information gained through this review forms the foundation for tracking methods, formulas and credits described in this technical report.

As a secondary goal, the project also aimed to create a forum for dialogue among interested stakeholders to discuss their perspectives on the most effective and ineffective ways to reduce trash discharged from MS4s. To the extent possible, the methods described in Sections 3.0 and 4.0 attempts to incorporate these perspectives and prioritize the implementation of control measures that stakeholders generally feel are the most effective in reducing trash. This is most pertinent to control measures that have load reduction "credits," where effectiveness data are lacking or load reductions are difficult to quantify.

2.2. Guiding Principles and Assumptions

Based on the results of the literature review and discussions with Permittees, Water Board staff and participating NGOs, trash load reductions resulting from the implementation of specific control measures can be quantified and credited in many ways. To better understand the thought process used to develop quantification formulas and load reduction credits presented in Sections 3.0 and 4.0, the following guiding principles and assumptions were used in the development of methods described below.

- **Need for a Combination of Quantification Formulas and Credits** – Based on the results of the literature review and considerable discussions, stakeholder preference was to quantify trash load reductions associated with the enhanced implementation of specific control measures. Additionally, stakeholders agreed that the results of quantifications should ideally have a high degree of certainty that the trash load reduction actually takes place. For some control measures, preliminary quantification of load reductions is possible based on existing data collection schemes and control measure effectiveness values identified during the literature review. For other control measures, stakeholders agreed that load reduction quantification is either infeasible or impractical, and other tracking methods (i.e., credits) should be pursued. Therefore, a combination of trash load reduction quantification formulas and credits are used to demonstrate trash load reductions attributable to specific control measures. For load reduction credits, the recommended percent reductions are based on discussions among BASMAA Trash Committee members.

- **Load Reduction Quantification is Constrained by Available Data** – Only the information readily available on the degree of control measure implementation, volume of trash removed by the control measure, effectiveness, baseline loads (if available) and loads reduced can be used to develop quantification formulas and track annual load reductions. In some cases, information is very limited and assumptions have to be made. Although assumptions create uncertainties in load reduction calculations, if stated clearly and transparently, assumptions can be tested and revised accordingly as methods evolve.
- **Maximize Simplicity in Quantification Formulas** – As a general principle when creating the loads reduced formulas presented in section 4.0, the amount of information that Permittees are required to track as inputs to formulas was considered. In some cases, data that Permittees or stormwater programs will need to track and input into formulas consists of information already collected and submitted to the Water Board as part of their Annual Reports. In other cases, additional information tracked by other public agencies or private entities (e.g., volunteer groups) may need to be obtained to provide a complete picture of loads reduced from urban stormwater runoff during a given year. In limited cases, Permittees will have to begin tracking data needed to populate formulas. Specific control measures in which Permittees should begin tracking or collecting data from others are identified in fact sheets presented in Section 4.0.
- **Baseline vs. New and Enhanced Control Measures** – In most cases, Permittees may only count trash loads reduced that are associated with the implementation of new or enhanced control measures. As a general rule, control measures that were implemented prior to the MRP effective date are considered baseline and associated load reductions are included in each Permittee’s baseline load. That said, to avoid penalizing early implementers, load reductions associated with some control measures (e.g., full-capture treatment devices, polystyrene foam food ware bans, and single-use carryout plastic grocery ordinances) implemented prior to the MRP effective date¹ can be used towards trash load reduction goals. The definition of “baseline implementation” is included in the fact sheets for each control measure presented in Sections 3.0 and 4.0.
- **Permittee Jurisdictional Areas** – Consistent with the *BASMAA Baseline Trash Generation Rates Project*, Permittees will likely be responsible for reducing loads to their MS4 that originate from public or private properties that do not have or are not anticipated to have waste discharge requirements (WDRs). As such, quantification formulas and load reduction credits presented in Sections 3.0 and 4.0 include actions taken by public agencies and private entities (without WDRs) that are within their jurisdictional boundaries. In certain cases, Permittees may receive loads reduced credit for the countywide implementation of certain control measures since they directly impact trash loads across jurisdictional areas. These measures include certain public education and outreach programs. Control measures implemented directly by California Department of Transportation (Caltrans) and other state agencies are not attributable to load reduction tracking methods described in this Technical Report.
- **No Double-Counting** – In some cases, Permittees may be implementing multiple control measures within the same geographical area. In these instances, the trash loads reduced by one control measure must be accounted for in the trash loads reduction quantification/crediting method applied to the other control measure. For example, a Permittee chooses to implement enhanced street sweeping in areas also served by full-capture treatment devices. In this scenario, the volume of trash reduced from implementing enhanced street sweeping cannot also be claimed for implementing full-capture treatment devices. Safeguards to prohibit

¹ December 1, 2009.

Permittees from doing so are incorporated into the *Load Reduction Calculation Process* described in the next section. The goal is to avoid double-counting.

- **Geographical Uniformity** – Conditions vary among the various geographical areas that contribute trash to local creeks and San Francisco Bay. Thus, projecting results obtained by studies conducted at specific locations may not be representative of all areas. As a practical matter, however, one must assume that projections to the whole watershed, based on area, land use, or other important factors identified in the *BASMAA Baseline Trash Generation Rates Project* are adequate for the development of the proposed methods. As data are collected to populate formulas presented in Section 4.0, considerations should be given to the spatial representativeness of data. As a result, data should be disaggregated or aggregated, as needed.

2.3. Load Reduction Calculation Process

Using the guiding principles and assumptions described in the previous section, a stepwise process for calculating trash load reductions was developed and is presented in this section (Figure 2-1). The process takes into account the trash generation and transport process; and at what point a trash control measure prevents trash generation, intercepts trash in the environment prior to reaching a water body, or removes trash that has reached a water body. In doing so, it also avoids double-counting of load reductions.

A key component of the trash load reduction tracking method is the development of Permittee-specific baseline trash loading rates that were used to establish baseline trash loads. Baseline trash loading rates will be adjusted downward based on trash load reductions applicable to enhanced/new control measures using the following process:

- Step #1:** Existing Enhanced Street Sweeping
- Step#2:** Trash Generation Reduction
- Step #3:** On-land Interception
- Step #4:** Trash Interception in the Stormwater Conveyance System
- Step #5:** Trash Interception in Waterways
- Step #6:** Comparison to Baseline Trash Load

Reductions calculated in Steps 2 and 5 are assumed to be implemented at a constant rate on an “area-wide” basis. For example, if a new region-wide public education strategy is implemented within the San Francisco Bay area, all Permittees can apply load reduction credits associated with this control measure. These area-wide load reduction credits are not site-specific and therefore load reductions are applied to entire effective loading area within a Permittee’s jurisdictional area. In contrast, Steps 1, 3 and 4 are “area-specific” reductions that only apply to specific areas within a Permittee’s jurisdictional area. Area-specific control measures include full-capture treatment devices and enhanced street sweeping. Area-specific reductions may require the use of a Geographic Information System (GIS) to calculate.

Reductions are generally applied in the sequence as presented in Figure 2-1 and described below, although some reductions may be applied “in-parallel” and calculated during the same sub-step in the process.

Step #1: Existing Enhanced Street Sweeping

Trash load reductions due to existing enhanced street sweeping implemented prior to the effective date of the MRP and conducted at levels above baseline levels are not incorporated into each Permittee's trash baseline load. Therefore, load reductions associated with existing enhanced are accounted for first in the trash load reduction calculation process. Existing enhanced street sweeping includes street sweeping conducted at a frequency greater than **1x/week** for streets within retail land use areas or greater than **2x/month** for streets in all other land use areas. The result of adjustments made to trash baseline loads due to the implementation of existing enhanced street sweeping is a set of **current baseline loading rates** and a **current baseline load**.

Step #2: Trash Generation Reduction Control Measures

Trash generation reduction control measures prevent or greatly reduce the likelihood of trash from being deposited onto the urban landscape. They include the following area-wide control measures:

- CR-1: Single-Use Carryout Plastic Bag Ordinances
- CR-2: Polystyrene Foam Food Service Ware Ordinances
- CR-3: Public Education and Outreach Programs
- CR-4: Reduction of Trash from Uncovered Loads
- CR-5: Anti-Littering and Illegal Dumping Enforcement
- CR-6: Improved Trash Bin/Container Management
- CR-7: Single-Use Food and Beverage Ware Ordinances

Load reductions associated with trash generation reduction control measures are applied on an area-wide basis.² Therefore, reductions in current baseline loading rates are adjusted uniformly based on the implementation of the control measure and the associated credit claimed.

Baseline loading rate adjustments for all generation reduction controls measures implemented may be applied in-parallel, but should be applied prior to calculating on-land interception measures discussed in Step #3. The result of adjustments to trash baseline loading rates due to the implementation of these enhanced control measures will be a set of **street loading rates**. The **street load** is the volume of trash estimated to enter the environment and available for transport to the MS4 if not intercepted via on-land control measures described in Step #3.

Step #3: On-land Interception Control Measures

Once trash enters the environment, it may be intercepted and removed through the following control measures prior to reaching the stormwater conveyance system:

- QF-1: On-land Trash Cleanups (Volunteer and/or Municipal) (Area-wide)
- QF-2: Enhanced Street Sweeping (Area-specific)

Since on-land trash cleanups can affect the amount of trash available to street sweepers, load reductions associated with their implementation will be quantified first, followed by street sweeping enhancements. On-land trash cleanups will be applied as an area-wide reduction and all effective

² The only exception to this statement are load reductions associated with the establishment of Business Improvement Districts (BIDs) or equivalent, which are specific to geographic areas and considered "area-specific".

loading rates will be adjusted equally. Enhanced street sweeping, however, is an area-specific control measure and only those effective loading rates associated with areas receiving enhancements will be adjusted. Due to the spatial nature of enhanced street sweeping, GIS may be needed to conduct this step.

The result of adjustments to effective loading rates due to the implementation of these enhanced control measures will be a set of **conveyance system loading rates**. The **conveyance load** is the volume of trash estimated to enter the stormwater conveyance system (e.g., storm drain inlets).

Step #4: Control Measures that Intercept Trash in the MS4

Control measures that intercept trash in the stormwater conveyance system are area-specific. Therefore, they only apply to land areas and associated trash loads reduced. Conveyance system loading rates developed as a result of Step #3 should be adjusted in-parallel for the following control measures:

- QF-3a: Partial-capture Treatment Device: Curb Inlet Screens (Area-specific)
- QF-3b: Partial-capture Treatment Device: Stormwater Pump Station Trash Racks Enhancements (Area-specific)
- QF-4: Enhanced Storm Drain Inlet Maintenance (Area-specific)
- QF-5: Full-Capture Treatment Devices (Area-specific)

Load reductions for these control measures are calculated in-parallel because they are applied to independent geographical areas. Reductions from all control measures described in this step are area-specific and may require the use of GIS to calculate a set of **waterway loading rates**. Once waterway loading rates have been determined, a **waterway load** will be developed and used as a starting point for calculating load reductions associated with trash interception in waterways discussed in Step #5.

Step #5: Control Measures that Intercept Trash in Waterways

The load of trash that passes through the stormwater conveyance system without being intercepted may still be removed through interception in waterways. There are two control measures associated with interception in waterways:

- QF-3c: Partial-capture Treatment Device: Litter Booms/Curtains (Area-wide)
- QF-7: Creek/Channel/Shoreline Cleanups (Volunteer and/or Municipal) (Area-wide)

As these control measures are implemented, load reduction estimates can be calculated in-parallel for these two measures.

Step #6: Comparison to Baseline Trash Load

Applying the four steps described in the processes above will provide an estimated trash load (volume) remaining after trash control measures are implemented. As depicted in the following equation, the relative percent difference between the baseline load and the load remaining after control measures are implemented is the percent reduction that will be used to assess progress towards MRP trash load reduction goals.

$$\frac{\text{Baseline Load} - \text{Remaining Load}}{\text{Baseline Load}} \cdot 100 = \% \text{ Reduction}$$

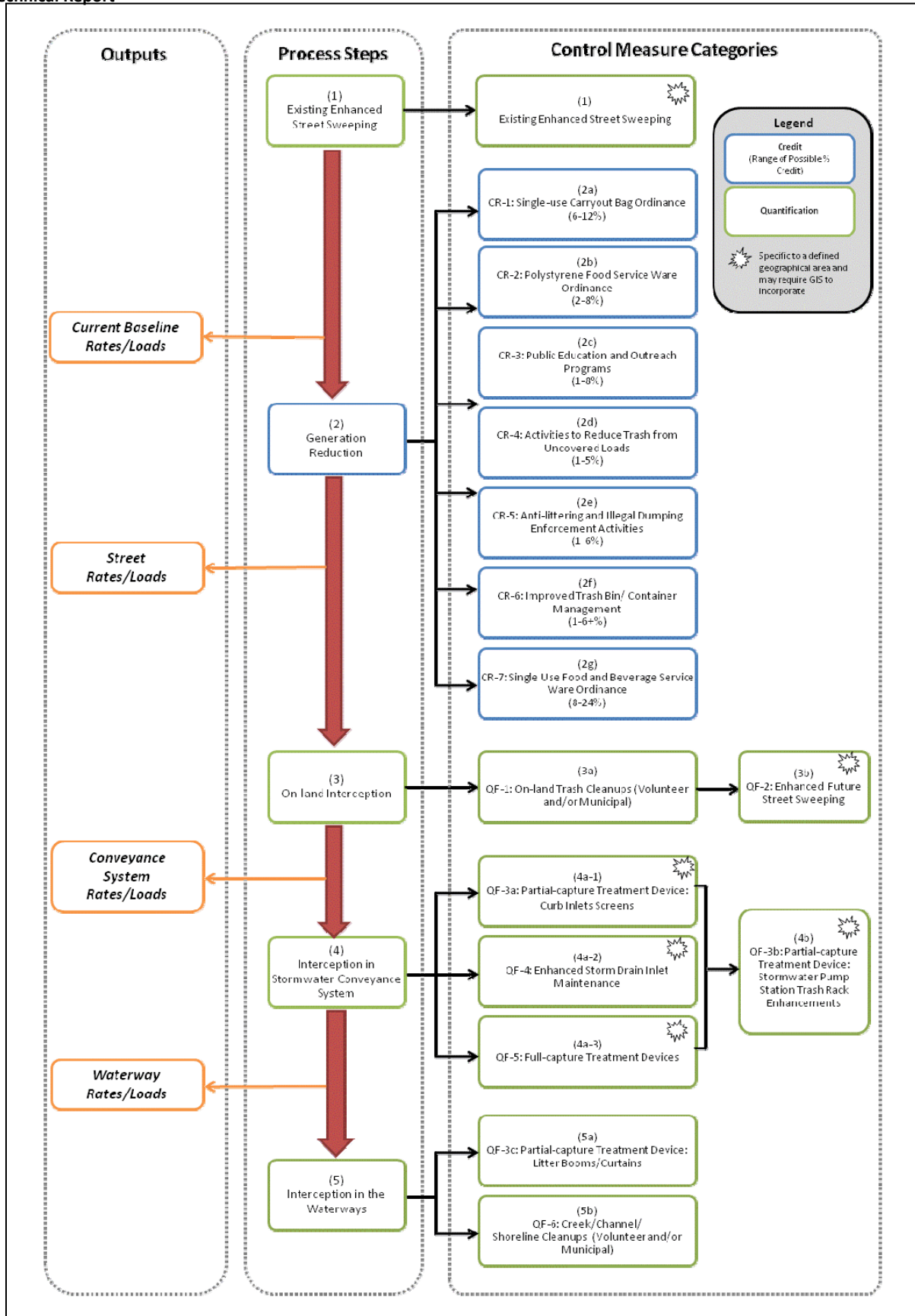


Figure 2.1. Trash Load Reduction Calculation Process and Outputs

3.0 LOADS REDUCED CREDIT FACT SHEETS

This section includes a series of fact sheets that describe trash load reduction credits for control measures that were deemed as infeasible or impractical to quantify at this time. Fact sheets presented in this section are listed in Table 3.1. Trash load reduction credits were developed based on information reviewed and summarized in BASMAA (2011c); and discussions between stakeholders at BASMAA Trash Committee meetings and Permittee meetings and communications. Each fact sheet in this section includes: 1) an introduction; 2) summary of applicable control measures; 3) load reduction crediting method; and 4) references used to develop the method.

Table 3.1. Trash control measure for which load reduction credits were developed to track progress towards trash load reduction goals.

Fact Sheet Number	Control Measure	Description
CR-1	Single-use Carryout Bag Ordinance	Area-wide credit that is based on the adoption of local, countywide ordinances or implementation of statewide actions that prohibit or significantly reduce the distribution of single-use plastic carryout bags. Additional credit is also available for the implementation of fees for all other types of single-use carryout bags (paper et al.).
CR-2	Polystyrene Foam Food Service Ware Ordinance	Area-wide credit based on the adoption of local, countywide ordinances or implementation of statewide actions that reduce the distribution of polystyrene foam food ware by vendors. Prohibitions can be implemented at two tiers: Permittee-owned properties/events and at all food service vendors. Control measures must include an active enforcement program.
CR-3	Public Education and Outreach Programs	Area-wide credit based on the implementation of advertising campaigns, outreach to school-aged children/youth, the use of media, and community outreach events, consistent with the MRP. Public education programs must include an effectiveness evaluation component to evaluate an increase in the awareness or a behavior change in the public.
CR-4	Activities to Reduce Trash from Uncovered Loads	Area-wide credit that is based on implementation of prescriptive language in Permittee trash and/or construction debris hauling contracts, and actively working with local law enforcement to establish an enhanced enforcement program for vehicles with uncovered loads.
CR-5	Anti-littering and Illegal Dumping Enforcement Activities	Area-wide credit is based on the implementation of active compliance and enforcement programs, and use of surveillance cameras and physical barriers to reduce dumping.
CR-6	Improved Trash Bins/Container Management	Area-wide credit that is based on the development and implementation of an outreach and enforcement program to identify private properties with inadequate trash service, implementation of a strategic plan for public area trash containers, and the successful establishment of business improvement districts or equivalent.
CR-7	Single-use Food and Beverage Ware Ordinance	Area-wide credit based on the adoption of local, countywide ordinances or implementation of statewide actions that reduce the distribution of single-use food and beverage ware. Prohibitions can be implemented at multiple tiers. Control measures must include an active enforcement program.

CR-1: SINGLE-USE CARRYOUT PLASTIC BAG POLICIES (AREA-WIDE)

Single-use carryout bags have been found to contribute substantially to the litter stream and to have adverse effects on marine wildlife (United Nations 2009, CIWMB 2007, County of Los Angeles 2007). The prevalence of litter from plastic bags in the urban environment also compromises the efficiency of systems designed to channel stormwater runoff. Furthermore, plastic bag litter leads to increased clean-up costs for the Permittees and other public agencies.

As a result, Permittees have adopted municipal ordinances or equivalent policies that are designed to significantly reduce environmental impacts of single use bags, while reducing cleanup costs. Ordinances can vary in scope and therefore a tiered load reduction credit system based on the anticipated magnitude of reduction was developed. For those Permittees that implement an ordinance designed to significantly reduce the use of all types of single-use carryout bags (e.g., plastic and paper) an additional load reduction credit is available.

Based on the recent experience of municipalities throughout the State, the process Permittees must undertake to enact a single-use carryout plastic bag ordinance is very challenging due to intense scrutiny and opposition from not only public interest groups and lobbyists, but also merchants and community members. In most cases, most opposition groups are pressing for the development of Environmental Impact Reports (EIRs) in accordance with the California Environmental Quality Act (CEQA). Credits presented in this fact sheet take into account the level of effort needed to enact an ordinance for single-use plastic bags.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measures implemented by Permittees at the local, countywide or regional scales. Methods described are intended to demonstrate trash load reductions resulting from implementation of one or more of these control measures within an individual Permittee's jurisdiction.

- Adoption of an ordinance (or equivalent policy) at the local, countywide, or regional level to prohibit or reduce the sale and/or distribution of single-use carryout plastic bags
- Implementation of statewide actions to prohibit or reduce the sale and/or distribution of single-use carryout plastic bags

Please Note: To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption will be credited equally to control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Load Reduction Credits

Permittees will receive trash load reduction credits for implementing the following control measures:

- **Tier 1 – Prohibit Distribution at Large Supermarkets** – Adoption of a local ordinance or implementation of a statewide or countywide action that prohibits large supermarkets from distributing single-use carryout plastic bags within their jurisdictional boundaries shall receive a trash load reduction credit of **6 percent**.
- **Tier 2 – Prohibit Distribution at Retail Establishments that Sell Packaged Foods** – Adoption of a local ordinance or implementation of a statewide or countywide action that prohibits retail

establishments that sell packaged foods from distributing single-use carryout plastic bags within their jurisdictional boundaries shall receive a trash load reduction credit of **8 percent**.

- **Tier 3 – Prohibit Distribution at All Retail Establishments (with the Exception of Restaurants)** – Adoption of a local ordinance or implementation of a statewide or countywide action that prohibits **ALL** retail establishments (with the exception of restaurants) from distributing single-use carryout plastic bags within their jurisdictional boundaries shall receive a trash load reduction credit of **10 percent**.
- **Additional Credit** – In addition to the adoption of an ordinance (or equivalent) described in Tiers 1-3, Permittees shall receive an additional load reduction credit for implementing a more far-reaching ordinance that significantly reduces the distribution and usage of ALL types of single-use carryout bags (plastic et al.). Actions may include banning the distribution of or charging a fee for, single use paper bags in retail establishments.

Please Note: To receive the trash load reduction credits described above, Permittees must implement in parallel with the ordinance/action a basic public education/outreach actions focused on reducing the distribution of single-use plastic bags, and enforcement actions designed to ensure compliance with the ordinance. Additionally, if a control measure does not fit within one of the two tiers described above, a Permittee may propose a credit commensurate with the extent of the ordinance.

A summary of trash load reductions credits available to Permittees implementing these control measures is provided in Table CR-1.1.

Table CR-1.1. Summary of single-use carryout plastic bag ordinance load reduction credits.

Control Measure	Load Reduction Credit (%)	
	Ordinance Covering Plastic Bags ONLY	Ordinance Covering ALL Types of Single-Use Bags
Tier 1 – Ordinance (or Equivalent) that Prohibits the Distribution of Single-use Bags at a Subset of Retail Establishments – Large Supermarkets	6	8
Tier 2 – Ordinance (or Equivalent) that Prohibits the Distribution of Single-use Bags at Retail Establishments that Sell Packaged Foods	8	10
Tier 3 – Ordinance (or Equivalent) that Prohibits the Distribution of Single-use Bags at all Retail Establishments (with the exception of restaurants)	10	12
Total Possible Load Reduction Credits	10	12

References

California Integrated Waste Management Board (CIWMB). 2007. Board Meeting Agenda, Resolution: Agenda Item 14. Sacramento, CA. June 12, 2007.

CalRecycle. 2010. At-Store Recycling Program: 2009 Statewide Recycling Rate for Plastic Carryout Bags. Available at <http://www.calrecycle.ca.gov/Plastics/AtStore/AnnualRate/2009Rate.htm#Rate>. Accessed June 22, 2011.

CalRecycle. 2011. Earth Day 2011: Being Green, Living Green. Available at <http://www.calrecycle.ca.gov/PublicEd/EarthDay/How.htm>. Accessed March 17, 2011.

City of San Jose. 2010. Environmental Impact Report: Single-Use Carryout Bag Ordinance File No. PP09-194 SCH #2009102095.

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County of Los Angeles, Department of Public Works, Environmental Programs Division. 2007. *An Overview of Carryout Bags in Los Angeles County: A Staff Report to the Los Angeles County Board of Supervisors*. Alhambra, CA. http://dpw.lacounty.gov/epd/PlasticBags/PDF/PlasticBagReport_08-2007.pdf. August 2007.

United Nations Environment Programme. 2009. *Marine Litter: A Global Challenge*. Nairobi, Kenya. Available at http://www.unep.org/regionalseas/marinelitter/publications/docs/Marine_Litter_A_Global_Challenge.pdf. April 2009.

CR-2: POLYSTYRENE FOAM FOOD SERVICE WARE POLICIES (AREA-WIDE)

Polystyrene foam is used as food ware in the food service industry. According to the USEPA (2002), floatable debris in waterways, such as products made of polystyrene, is persistent in the environment and has physical properties that can have serious impacts on human health, wildlife, the aquatic environment and the economy (USEPA 2002). Because of its detrimental impacts on aquatic ecosystems and difficulty in removing once in the environment, polystyrene is a material of interest to Permittees and stakeholders. Due to its properties, polystyrene foam used as food ware is typically not recycled.

Since 1990, over 100 government agencies within the United States, including over 20 within the San Francisco Bay area have enacted municipal ordinances/policies prohibiting the distribution of polystyrene foam food ware in at municipally-sponsored events and/or retail establishments. Ordinances vary in scope and therefore a tiered load reduction credit system based on the anticipated magnitude of reduction was developed. For those Permittees that demonstrate a high level of compliance with the ordinance, additional load reduction credits are available. Credits presented in this fact sheet take into account the level of effort needed to enact an ordinance prohibiting the distribution of polystyrene foam food ware.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measures implemented by Permittees at the local, countywide or regional scales. Methods described are intended to demonstrate trash load reductions resulting from implementation of one or more of these control measures within an individual Permittee's jurisdiction.

- Ordinances or policies adopted at local or countywide level which prohibits the distribution of polystyrene foam food ware; and/or
- Statewide actions that prohibit the distribution of polystyrene foam food ware.

Please Note: To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption will be credited equally to control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Load Reduction Credits

Permittees will receive trash load reduction credits for implementing the following control measures:

- **Tier 1 – Prohibit Distribution at Permittee-sponsored Events and Permittee-owned Property** – Adoption of a local ordinance or implementation of actions that prohibit food vendors from distributing polystyrene foam food ware at Permittee-sponsored events and on Permittee-owned property will receive a trash load reduction credit of **2 percent**.
- **Tier 2 –Prohibit Distribution by Food Service Vendors** – Adoption of a local ordinance or implementation of an action that prohibits food vendors from distributing polystyrene foam food ware within their jurisdictional boundaries will receive a trash load reduction credit of **8 percent**.

Please Note: To receive the trash load reduction credits described above, Permittees must implement in parallel with the ordinance or action a public education/outreach actions focused on food service

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vendors, and enforcement actions designed to ensure compliance with the ordinance/action. Additionally, if a control measure does not fit within one of the two tiers described above, a Permittee may propose a credit commensurate with the extent of the ordinance/action.

A summary of trash load reductions credits available to Permittees implementing these control measures is provided in Table CR-2.1.

Table CR-2.1. Summary of polystyrene foam food service ware ordinance load reduction credits.

Control Measure	Load Reduction Credit (%)
Tier 1 – Ordinance (or Equivalent) that Prohibits the Distribution of Polystyrene Foam Food Ware at Permittee-sponsored Events or on Permittee-owned Property	2
Tier 2 – Ordinance (or Equivalent) that Prohibits the Distribution of Polystyrene Foam Food Ware at all food service vendors	8
Total Possible Load Reduction Credits	8

References

USEPA (United States Environmental Protection Agency). 2002. Assessing and Monitoring Floatable Debris. August 2002. Available at http://water.epa.gov/type/oceb/marinedebris/upload/2006_10_6_oceans_debris_floatingdebris_debris-final.pdf.

CR-3: PUBLIC EDUCATION AND OUTREACH PROGRAMS (AREA-WIDE)

Permittees in the San Francisco Bay Area have implemented public education and outreach programs to inform residents about stormwater issues related to pollutants of concern, watershed awareness and pollution prevention. Public education and outreach efforts include developing and distributing brochures and other print media, posting messages on websites and social networking media (e.g., Facebook, Twitter, etc.), attending community events, and conducting media advertising. In recent years, some municipal agencies have implemented anti-litter campaigns to increase public awareness about the impacts of trash on their communities and water quality, and to encourage the public to stop littering. Additionally, consistent with Provision C.7 of the MRP, the main focus of current stormwater public education and outreach efforts in the Bay Area are associated with trash reduction. The effects associated with public education and outreach programs are long-term and are partially determined by long-term commitments by agencies implementing these programs.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following new or enhanced urban stormwater runoff control measures implemented by Permittees at the local, countywide or regional scales. Applicable control measures are consistent with the requirements in MRP provision C.7. Credits associated with these control measures are commensurate with the trash load reduction anticipated to occur overtime.

- **Advertising Campaigns** – Participation in or contribution to advertising campaign(s) on trash/litter in waterways with the goal of significantly increasing overall awareness of stormwater runoff pollution prevention messages and behavior changes in a target audience.³ Advertising campaigns must include the following attributes:
 - Specific anti-littering messages for reducing litter;
 - A comprehensive advertising plan designed to reach the target audience; and
 - Pre and post-campaign surveys which identify and quantify the audiences' knowledge, trends and attitudes and/or practices; and measures the overall population's awareness of the messages and behavior changes achieved by the campaign.
- **Outreach to School-age Children or Youth** – Active implementation of outreach programs (e.g., assemblies, presentations, etc.) designed to promote anti-littering behavior in school-age children (K through 12) at an implementation level listed in Table CR-3.1. Outreach programs must include an evaluation component (e.g., teacher or student feedback) to determine effectiveness.

³ A specific group of people within the target market at which the marketing message is aimed (e.g., 16-24 year old males) (Kotler 1999)

Table CR-3.1. Minimum number of school-age children/youth outreach events by Permittee population.

Permittee Population	# of Outreach Events
<10,000	2
10,001 – 40,000	3
40,001 – 100,000	4
101,001 – 175,000	5
175,001 – 250,000	6
> 250,000	8

- **Media Relations (Use of Free Media)** – Participation in or contribution to a media relations campaign which uses free media/media coverage (i.e., public service announcements and free advertising spots) focusing on litter issues (e.g., publicity of local creek/neighborhood cleanups, outreach promoting product bans, steps initiated to alleviate trash from homeless encampments, etc.). The media relations campaign must be designed to significantly increase the overall awareness of anti-litter messages and associated behavior change in target audiences.
- **Community Outreach Events** – Organization of and participation in focused outreach and education programs at an implementation level listed in Table CR-3.2 in high priority communities where litter is prevalent. Outreach programs must include an evaluation component (e.g., participant feedback) to determine effectiveness.

Table CR-3.2. Minimum number of community outreach events by Permittee population.

Permittee Population	# of Outreach Events
<10,000	2
10,001 – 40,000	3
40,001 – 100,000	4
101,001 – 175,000	5
175,001 – 250,000	6
> 250,000	8

Crediting Approach

Water quality outcomes⁴ associated with public education and outreach control measures are incredibly difficult and costly to measure with confidence. Therefore, the crediting methods used for public education and outreach control measures will be based on the documented implementation of the control measure and attempts to measure the effectiveness of such actions through assessment. For all public education and outreach control measures described in this fact sheet, with the exception of

⁴ Outcomes are the results of implementing a stormwater control measure, program element or overall program (CASQA 2007).

media relations, effectiveness assessments designed to measure increased awareness and/or behavior change must be conducted by Permittees to claim the load reduction credits described below.

Load Reduction Credits

Permittees will receive load reduction credits presented in Table CR-3.3 for the implementation of new or enhanced control measures described in this fact sheet. To receive credit, control measures must be directed at the appropriate, target audience (i.e., litterers) or potential future litterers (i.e., children). Because public education and outreach activities typically require a significant period time to achieve desired outcomes, a long-term commitment by Permittees towards implementation is assumed in the credits described in Table CR-3.3.

Please Note: To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption and continued through the term of the MRP will be credited equally to new or enhanced control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Table CR-3.3. Summary of trash load reduction credits for public education and outreach program control measures.

Control Measures	Load Reduction Credit (%)
Advertising Campaigns	3
Outreach to School-age Children or Youth	2
Media Relations (Use of free media)	1
Community Outreach Events	2
Total Possible Load Reduction Credits (%)	8

References

CASQA (California Stormwater Quality Association). 2007. Municipal Stormwater Program Effectiveness Assessment Guidance. May 2007.

Kotler, P. 1999. *Kotler on Marketing: How to Create, Win, and Dominate Markets*. New York: Free Press.

CR-4: REDUCTION OF TRASH FROM UNCOVERED LOADS (AREA-WIDE)

Although it is currently illegal to operate a vehicle that is improperly covered and which its' contents escapes⁵, vehicles remain an important trash source to MS4s and local waterways. Specifically, vehicles that do not secure or cover their loads when transporting trash and debris have a high risk of contributing trash to MS4s. Land areas that generate trash from vehicles include roads, highways (on/off ramps, shoulders or median strips) and parking lots. To help address the dispersion of trash from unsecured or uncovered vehicles destined for landfills and transfer stations, Permittees may require municipally-contracted trash haulers to cover or secure loads or work with municipal or private landfill and transfer station operators to educate waste haulers on securing loads and/or to enhance enforcement of existing regulations.

Applicable Control Measures

Load reduction tracking methods described in this fact sheet are applicable to the following urban stormwater runoff control measures implemented by Permittees at the local, countywide or regional scales. These crediting methods are intended to demonstrate trash load reductions resulting from implementation of these control measures within an individual Permittee's jurisdictional area.

- **Require Municipal Trash Haulers to Cover Loads** – development and inclusion of language in a Permittee's hauling service contract(s) that requires contracted trash and construction debris haulers to cover loads when transporting trash and debris to municipally or privately-owned landfills and transfer stations.
- **Implement an Enhanced Enforcement Program for Vehicles with Uncovered Loads** – Permittees actively working with local law enforcement to establish an enhanced enforcement program for vehicles with uncovered loads. Enhanced enforcement programs may include the following:
 - Adoption of an ordinance prohibiting the transportation of trash or debris without a cover;
 - Citations and fines for vehicles spotted on roads in an individual Permittee's jurisdictional area with uncovered loads; or,
 - Distribution of tarps for a fee to haulers or other vehicles that arrive at landfills and transfer stations with uncovered loads. Each subsequent visit without a tarp will result in an additional fee for a tarp, prompting haulers to bring their own tarp.

Load Reduction Credits

Permittees will receive load reduction credits presented in Table CR-4.1 for the implementation of control measures described in this fact sheet. Each control measure and associated credit is considered to be mutually exclusive of the other.

⁵ In accordance with the California Vehicle Code Sections 23114 and 23115, it is against the law to operate a vehicle on the highway which is improperly covered, constructed, or loaded so that any part of its contents or loads spills, drops, leaks, blows, or otherwise escapes from the vehicle. Exempted materials include hay and straw, clear water and feathers from live birds. Additionally, any vehicle transporting garbage, trash, or rubbish, used cans or bottles, waste papers, waste cardboard, etc. must have the load covered to prevent any part of the load from spilling on the highway (CVC 2011). Significant fines are possible for non-compliance.

Please Note: To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption and continued in a given year of interest will be credited equally to new or enhanced control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Table CR-4.1. Summary of trash load reduction credits for activities to reduce trash from uncovered loads.

Control Measure	Load Reduction Credit (%)
Prescriptive Language in Municipal Contracts for Trash and Debris Haulers	1
Implementation of an Enhanced Enforcement Program for Vehicles with Uncovered Loads	4
Total Possible Load Reduction Credits (%)	5

References

CVC (California Vehicle Code). 2011. California Vehicle Code Sections 23114 and 23115.

CR-5: ANTI-LITTERING AND ILLEGAL DUMPING ENFORCEMENT (AREA-WIDE)

Successful anti-littering and illegal dumping enforcement activities include laws and ordinances that prohibit littering or dumping. Laws are enforced by various municipal agency staff (e.g., police, sheriff and public works department staff) who issue citations in response to citizen complaints or other enforcement methods (e.g., surveillance cameras, signage and/or physical barriers installed at illegal dumping hot spots). In some California jurisdictions, the minimum fine for littering is \$500 and the maximum penalty for highway littering is \$1000 (City of San Francisco 2001). However, it is difficult to enforce small littering events unless they are witnessed or solid proof exists linking the offender to the litter. As a result, enforcement tends to focus on larger scale illegal dumping activities.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These crediting methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee's jurisdiction.

- **Anti-Littering and Illegal Dumping Enforcement Program** – Implementation of an active anti-littering and illegal dumping enforcement program in the year of interest that includes all of the following:
 - Thorough investigations of complaints received from an illegal dumping hotline;
 - The implementation of enforcement procedures including citations (as warranted); and,
 - The collection of evidence (e.g., names, addresses, etc.) from illegal dump sites (i.e., public and private) in an attempt to identify offenders.
- **Use of Surveillance Cameras** – Installation and use of surveillance cameras to deter and prosecute illegal dumping at high priority sites identified within a Permittee's jurisdictional area.
- **Use of Physical Barriers or Improvements** – Installation and use of physical barriers (e.g., fences, walls) or physical improvements (e.g., maintenance) which eliminate or deter illegal dumping at high priority sites identified within a Permittee's jurisdictional area.

Load Reduction Credits

Permittees will receive load reduction credits presented in Table CR-5.1 for the implementation of control measures described in this fact sheet. Each control measure and associated credit is considered to be mutually exclusive of the other.

Please Note: To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption and continued in a given year of interest will be credited equally to new or enhanced control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Table CR-5.1. Summary of trash load reduction credits for implementing anti-littering and illegal dumping enforcement activities.

Control Measure	Load Reduction Credit (%)
Anti-Littering and Illegal Dumping Investigation and Enforcement Program	2
Use of Surveillance Cameras or Other Deterrents	
<i>Tier 1 – 20-50% of identified hot spots under surveillance</i>	1
<i>Tier 2 – >50% of identified hot spots under surveillance</i>	2
Use of Physical Barriers/Improvements at a percentage of hotspots	
<i>Tier 1 – Implemented at 20-50% of identified hot spots</i>	1
<i>Tier 2 – Implemented at >50% of identified hot spots</i>	2
Total Possible Load Reduction Credit	6

References

City of San Francisco. 2001. Litter and Graffiti. Report of the 2000-2001 San Francisco Civil Grand Jury. Available at <http://www.sfsuperiorcourt.org/index.aspx?page=242>. Accessed November 12, 2010.

CR-6: IMPROVED TRASH BIN/CONTAINER MANAGEMENT (AREA-WIDE)

Receptacles used to place/store trash or recyclables prior to collection by a public agency or private waste hauler reduce the potential for littering and trash loading to stormwater conveyance systems and receiving waters (City of Los Angeles 2004). For the purposes of assigning trash load reduction credits, receptacles fall into the following two categories:

- **Private Trash/Recycling Bins**: A receptacle for placing trash or recyclables generated from a household, business, or other location that is serviced by a trash hauler. Bins are specifically-designed, heavy-duty plastic wheeled containers with hinged lids; or large multi-yard metal or plastic containers rectangular in shape.
- **Public Area Trash Containers**: A receptacle for placing incidental trash generated in public spaces that provides people with a convenient and appropriate place to dispose of trash. The design and size of public area trash containers vary widely, depending on their setting and use.

The effectiveness of bins/containers and bins in reducing trash in the environment is likely dependent upon: the location and density of the receptacles, size of the bin/container in relationship to the size needed to service users, frequency of maintenance, and the ability of the bin/container to capture and contain the trash deposited.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These crediting methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee's jurisdictional area.

- **Ensuring Adequate Private Trash Service** – Implementation of a program that identifies businesses or households that have inadequate trash service (i.e., insufficient trash collection or use of bins which are too small); and through municipal code enforcement or other authorities requiring businesses/households to sufficiently remedy the issue will receive a load reduction credit based on the extent of the program. Permittees may choose to coordinate with waste haulers to assist with the identification of subject households/businesses. Implemented programs may receive up to **3 percent** load reduction credit (if Tier 2 is implemented).
- **Implementation of Strategic Plan for Public Area Trash Containers** – Development and implementation of a strategic plan that:
 - Identifies whether public area trash containers are sufficiently located in high trash generating areas and are adequately designed to manage trash types that typically are generated from activities occurring at these areas (e.g., containers with larger openings designed to accommodate larger trash items (e.g., pizza boxes) are in locations where people dispose of these items (e.g., near schools or parks).
 - Identifies an increased level of inspection and maintenance of public area trash containers is needed at high trash generating sites.
 - Includes the installation of specialty trash bins/containers (e.g., bins for cigarette butts, sharps, etc.) in specific locations to eliminate or reduce the prevalence of these items in stormwater.
 - Includes the installation of new technologies (e.g., Big Belly Solar Trash Compactors) to reduce trash in stormwater and reduce the cost of adding public area trash containers.

The strategic plan should provide recommendations on how the system of public area trash containers within the Permittee’s jurisdictional area may be enhanced to reduce the volume of trash in streets, the stormwater conveyance system and waterways. The recommendations in the plan should begin to be implemented prior to receiving trash reduction credits associated with this control measure. Implemented plans will receive a **3 percent** load reduction credit.

- **Successful Establishment of Business Improvement Districts with Trash Reduction Control Measures** – Provide support toward the successful establishment of Business Improvement Districts (BIDs)⁶ or equivalent entity/actions that incorporates sidewalk sweeping, litter pickup and/or maintenance of public area trash containers at least once per week in retail/wholesale or commercial areas. Area-specific credit will be given for each BID successfully established within a Permittee’s jurisdictional area that has specific trash reduction language in the agreement or actions that are equivalent to establishing a BID. The successful establishment of each BID or equivalent actions that include trash reduction control measures will receive a load reduction credit of 50% of its baseline load.

Load Reduction Credits

Permittees will receive load reduction credits presented in Table CR-6.1 for the implementation of trash generation reduction⁷ control measures described in this fact sheet. **Please Note:** To avoid penalizing early implementers, applicable control measures implemented by a Permittee prior to MRP adoption and continued in a given year of interest will be credited equally to new or enhanced control measures implemented after the adoption of the MRP. Load reduction credits associated with the implementation of these control measures may be used to demonstrate progress towards trash load reduction goals.

Table CR-6.1. Summary of trash load reduction credits for improved trash bin/container management control measures

Control Measure	Load Reduction Credit (%)
Ensuring Adequate Private Trash Service and Enclosures	
<i>Tier 1 – Development and Approval of Ordinance (or equivalent) for Appropriate Trash Services (Bin/Enclosure Design) for Private Properties</i>	1
<i>Tier 2 – Development and Approval of Ordinance (or equivalent) AND Identification and Enforcement of Inadequate Trash Service for Private Trash and Recycling Bins/Containers</i>	3
Implementation of Strategic Plan for Public Area Trash Containers	3
Successful Establishment of Each Business Improvement District (BID) that Includes Trash Reduction Control Measures	50% of Baseline Load in Each BID
Total Possible Load Reduction Credit	6+

References

City of Los Angeles 2004. Technical Report: Best Management Practices for Implementing the Trash Total Maximum Daily Loads, January 2004.

Newman, T.L., W.M. Leo, J.A. Mueller, and R. Gaffoglio 1996. Effectiveness of Street Sweeping for Floatables Control. Proceedings for Urban Wet Weather Pollution: Controlling Sewer Overflows and Stormwater Pollution. Quebec. June 16-19, 1996.

⁶ BIDs are districts or areas in central cities in which the private sector delivers services for revitalization beyond what the local government can reasonably be expected to provide. The property or business owner within the BID pays a special tax or assessment to cover the cost of services. Cities provide some oversight but the BID controls its finances.

⁷ Only trash generation reduction control measures are included in this fact sheet. On-land and creek cleanups are addressed in Fact Sheets QF-1 and QF-6.

CR-7: SINGLE-USE FOOD AND BEVERAGE WARE ORDINANCES (AREA-WIDE)⁸

Single-use food and beverage ware have been found to contribute substantially to the litter stream (City of Oxnard 2004, City of San Francisco 2008, City of San Jose 2009, Clean Water Action 2011) and can cause adverse environmental impacts throughout their lifecycles (Ackerman 1997, Alliance for Environmental Innovation 2000, EPA 2009). The prevalence of litter from single-use food and beverage ware in the urban environment also compromises the efficiency of systems designed to convey stormwater runoff. Furthermore, food and beverage container litter leads to increased clean-up costs for MRP Permittees and other public agencies.

Due to the magnitude of food and beverage packaging litter emanating from commercial business districts, many California municipalities have taken action to eliminate the distribution of polystyrene foam food and beverage ware (See Fact Sheet CR-2). In addition to polystyrene, municipalities may also consider actions to reduce the quantity of all single-use disposable food and/or beverage ware through measures that promote the use of reusable containers. If enacted and enforced, such ordinances are expected to significantly reduce trash available to MS4s and local water bodies that is comprised of single-use food and beverage ware (San Francisco 2008, Clean Water Action 2011).

Based on the recent experience of municipalities throughout the State of California, a process Permittees must undertake to enact a food and/or beverage containers ordinance could be very challenging due to intense scrutiny and opposition from not only public interest groups and lobbyists, but also merchants and community members. For example, opposition groups have pressed for the development of Environmental Impact Reports (EIRs) in accordance with the California Environmental Quality Act (CEQA) when developing ordinances banning certain food related bags and ware. Load reduction credits presented in this fact sheet take into account the level of effort needed to enact an ordinance for reducing litter associated with single-use food and beverage ware.

Applicable Control Measures

Load reduction tracking methods described in this fact sheet are applicable to the following urban stormwater runoff control measures implemented by Permittees at the local, countywide or regional scales. Methods described are intended to demonstrate trash load reductions resulting from implementation of one or more of these control measures within an individual Permittee's jurisdiction.

- Adoption of an ordinance or equivalent action at the local, countywide, or regional level to reduce the use of all single-use food and/or beverage ware from food service vendors

Load Reduction Credits

Permittees shall receive trash load reduction credits that may be applied towards MRP trash reduction goals for implementing the following control measures:

- **Tier 1a – Require all food service vendors to: 1) provide consumers a discount for “bringing their own” reusable beverage ware, or 2) charge consumers a fee for using single-use beverage containers** – Adoption of a local ordinance or implementation of a statewide or countywide action that requires **ALL** food service establishments within their jurisdictional

⁸ Please note that based on the literature review conducted by BASMAA (2011c), no municipality in the United States has yet attempted to formally adopt an ordinance such as that described in this factsheet. No model/example ordinance associated with charging mandatory fees or requiring discounts currently exist. Therefore, the control measures presented in this factsheet should be considered draft and conceptual in nature. Additionally, based on municipal experience in adopting ordinances for single-use bags and polystyrene food ware, it is highly likely that considerable time and resources would be needed to respond to stakeholder comments and concerns.

boundaries that sell take-out beverages to provide a discount to consumers on the sale of beverages when a re-usable container is used, shall receive a trash load reduction credit of **8 percent**. Adoption of a local ordinance or implementation of a statewide or countywide action that requires **ALL** food service establishments within their jurisdictional boundaries that serve take-out beverages to charge the consumer a fee for each take-out beverage container used, shall receive a trash load reduction credit of **12 percent**.

- Tier 1b – Mandatory Fee for single-use disposable food and/or beverage containers –**
 Adoption of a local ordinance or implementation of a statewide or countywide action that requires **ALL** food service establishments within their jurisdictional boundaries that sell take-out beverages and/or food to provide a discount to consumers on the sale of food and beverages when a re-usable container is used, shall receive a trash load reduction credit of **20 percent**.
 Adoption of a local ordinance or implementation of a statewide or countywide action that requires **ALL** food service establishments within their jurisdictional boundaries that serve take-out food and/or beverages to charge the consumer a fee for each take-out food or beverage container used, shall receive a trash load reduction credit of **24 percent**.

Please Note: To receive the trash load reduction credits described above, Permittees must implement in parallel with the ordinance/action: 1) public education/outreach actions focused on educating consumers and food service vendors on the implementation the ordinance; and 2) an active enforcement program that includes inspections of food service vendors to ensure compliance. Additionally, if a control measure does not fit within one of the tiers described above, a Permittee may propose a credit commensurate with the nature and intent of the similar action.

A summary of trash load reductions credits available to Permittees implementing these control measures is provided in Table CR-7.1.

Table CR-7.1. Summary of trash reduction credits for adopting and enforcing single-use food and beverage ware reduction ordinances.

Control Measure	Load Reduction Credit (%)	
	Mandatory Discount	Mandatory Fee
Tier 1a – Ordinance (or Equivalent) that requires food service vendors to provide a discount for “Bring Your Own” or a fee on single use <u>beverage</u> ware	8	12
Tier 1b – Ordinance (or Equivalent) that requires food service vendors to provide a discount for “Bring Your Own” or a fee on single use <u>food and beverage</u> ware	20	24
Total Possible Load Reduction Credits	20	24

References

Ackerman, F. (1997). Environmental Impacts of Packaging in the U.S. and Mexico. Tufts University, PHIL and TECH 2.2.

Alliance for Environmental Innovation (2000). Report of the Starbucks Coffee Company / Alliance for Innovation Joint Task Force. <http://business.edf.org/sites/business.edf.org/files/starbucks-report-april2000.pdf>

City of Oxnard (2004). Storm Drain Sampling Results. Presentation at plastic debris conference. conference.plasticdebris.org/whitepapers/Mark_Pumford.doc

City of San Francisco (2008). City of San Francisco Streets Litter Re-Audit. Prepared by HDR, Brown, Vence and Associates, and MGM Management. http://www.sfenvironment.org/downloads/library/2008_litter_audit.pdf

Technical Report

City of San Jose (2009). San Jose Targeted Litter Assessment. Prepared by MGM Management.

Clean Water Action (2011). Taking Out the Trash Draft Report. <http://www.cleanwater.org/programinitiative/taking-out-trash-california-0>.

US EPA (2009). Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices. September. http://www.epa.gov/oswer/docs/ghg_land_and_materials_management.pdf.

4.0 LOADS REDUCED QUANTIFICATION FACT SHEETS

This section includes a series of fact sheets that describe trash load reduction quantification formulas for control measures that were deemed feasible and practical by the BASMAA Trash Committee to quantify load reductions at this time. Fact sheets presented in this section are listed in Table 4.1. Quantification formulas presented in the fact sheets are based on the most currently available information and will require specific data inputs to be tracked or collected by applicable Permittees. Each fact sheet in this section includes: 1) an introduction; 2) a summary of applicable control measures; 3) a loads reduced formula; 4) assumptions and data inputs needed to calculate loads reduced; and, 5) references for all citations.

Table 4.1. Trash control measure for which load reduction quantification formulas were developed to track progress towards trash load reduction goals.

Fact Sheet Number	Control Measure	Description
QF-1	On-land Trash Cleanups (Volunteer and/or Municipal)	Area-wide quantification formula that is based on the total volume of trash removed by volunteers and/or municipal and flood control agency staff conducting enhanced single-day or on-going, on-land cleanups.
QF-2	Enhanced Street Sweeping	Area-specific quantification formula that is based on the effectiveness of street sweeping during dry and wet weather, which is affected by parking enforcement, street sweeping frequency, and storm frequency.
QF-3	Partial-Capture Treatment Devices	Area-specific quantification formula that is based on the volume of trash removed by each partial-capture devices (curb inlet screens, enhanced pump station trash rack cleaning, and litter booms), which is dependent on the demonstrated effectiveness. The formula for litter booms is area-wide while the other two are area-specific.
QF-4	Enhanced Storm Drain Inlet Maintenance	Area-specific quantification formula that is based on the increased load reduced due to increased storm drain inlet maintenance, which is dependent on the number of inlets maintained at higher frequencies and the anticipated increase in load reduced due to that particular enhanced frequency.
QF-5	Full-Capture Treatment Devices	Area-specific quantification formula that is based on the volume of trash removed from full-capture devices, which is dependent on the area treated by the device.
QF-6	Creek/Channel/Shoreline Cleanups (Volunteer and/or Municipal)	Area-wide quantification formula that includes the total volume of trash removed by MRP-required and other creek, channel or shoreline cleanups.

QF-1: ON-LAND TRASH CLEANUPS (AREA-WIDE)

On-land cleanups conducted by Permittees and volunteers have been successful in removing trash from identified trash hot spots and engaging local citizenry in improving their communities. Permittees have several programs in place to address on-land trash. Municipal efforts relate to ongoing beautification of impacted areas and coordination of cleanup events. Volunteer on-land cleanups involve the meeting of individuals, creek and watershed groups, civic organizations, businesses and others at designated or adopted on-land sites to remove trash. On-land cleanups are conducted as single-day events or throughout the year.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. Quantification methods described are intended to demonstrate trash load reductions resulting from implementation of one or more of these control measures within an individual Permittee's jurisdictional area:

- **Enhanced Permittee-led On-land Cleanups** – On-land cleanup activities led by Permittees on publicly-owned property that are conducted as part of routine or regularly scheduled cleanups, homeless encampment removal and illegal dumping response and abatement, and began after the effective date of the MRP.
- **Enhanced Volunteer-led On-land Cleanups** – On-land cleanup activities led by volunteer organizations but coordinated with Permittees, including adopt-a-highway/street/park/trail programs that began after the effective date of the MRP.

Please Note: On-land cleanup activities are differentiated from creek/channel/shoreline cleanup activities, which are accounted for under fact sheet QF-6. Additionally, on-going on-land cleanup activities conducted prior to the adoption of the MRP and continued through MRP term are assumed to be accounted for in the generation rates developed through the *BASMAA Baseline Trash Generation Rates Project*. Therefore, on-land cleanup programs that were implemented prior to the adoption of the MRP and continued after MRP adoption are assumed to be baseline and cannot be used to demonstrate progress towards load reduction goals.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews and discussions with stakeholders, the following formula provides Permittees a method to estimate the volume of trash removed from all applicable on-land cleanup activities conducted in a given year. This load reduction variable is signified as **Reduction_{Cleanups}** in the following formulas. Please note that trash removed from on-land cleanups should be tracked as a volume, as opposed to mass; and only trash that has the potential of entering an MS4 should be counted towards load reductions. As a result, large items (e.g., appliances, furniture, mattresses, shopping carts, televisions, tires, lumber, etc.) removed during on-land cleanups should not be part of the volume determination since they do not have the potential of entering the MS4.

$$\text{Reduction}_{\text{Cleanups}} = \text{Baseline}_{\text{Cleanups}} - \text{Enhanced}_{\text{Cleanups}}$$

where:

- $\text{Baseline}_{\text{Cleanups}}$ = Volume of trash or removed from all applicable on-land cleanup activities prior to the effective date of the MRP
- $\text{Enhanced}_{\text{Cleanups}}$ = Volume of trash removed from all applicable on-land cleanup activities in year of interest

and;

$$\text{Baseline}_{\text{Cleanups}} = \text{Municipal}_{\text{BaselineVol}} + \text{Volunteer}_{\text{BaselineVol}}$$

$$\text{Enhanced}_{\text{Cleanups}} = \text{Municipal}_{\text{EnhancedVol}} + \text{Volunteer}_{\text{EnhancedVol}}$$

where:

- $\text{Municipal}_{\text{BaselineVol}}$ = Total volume of trash removed by municipal and flood control agency staff conducting on-going, on-land cleanups prior to the effective date of the MRP
- $\text{Volunteer}_{\text{BaselineVol}}$ = Total volume of trash removed by volunteers conducting single-day and on-going, on-land cleanups prior to the effective date of the MRP
- $\text{Municipal}_{\text{EnhancedVol}}$ = Total volume of trash removed by municipal and flood control agency staff conducting on-going, on-land cleanups in year of interest
- $\text{Volunteer}_{\text{EnhancedVol}}$ = Total volume of trash removed by volunteers conducting single-day and on-going, on-land cleanups in year of interest

Assumptions and Data Inputs

- **$\text{Municipal}_{\text{BaselineVol}}$ or $\text{Municipal}_{\text{EnhancedVol}}$** –To account for the total volume of trash removed as a result of on-land cleanups in a year of interest, Permittees may choose to track the volume of trash removed from:
 - Routine or Regularly Scheduled Litter Pickup and Removal;
 - Removal of Homeless Encampments;
 - Illegal Dump Site Responses and Abatement;
 - Interagency Cleanup Coordination and Cleanups⁹; and,
 - Litter Pickup Event Coordination and Cleanups.¹⁰

To assist Permittees in tracking trash removed via on-land cleanups, BASMAA intends to develop a standardized data collection form for use by Permittees.

- **$\text{Volunteer}_{\text{BaselineVol}}$ or $\text{Volunteer}_{\text{EnhancedVol}}$** – To account for the total volume of trash removed as a result of on-land cleanups in a year of interest, Permittees may choose to track the volume of trash removed by volunteer activities, such as:

⁹ **Interagency Cleanup Coordination and Cleanup** - On-land cleanups coordinated with other departments or programs within a municipality or countywide agency. Other department, programs or agencies include roads, streets and highways department, Department or Transportation, Anti-litter and graffiti programs, Department of Corrections and others that may conduct on-land trash cleanups.

¹⁰ **Litter Pickup Event Coordination and Cleanup** - On-land cleanups coordinated and publicized by the municipality but conducted by volunteers and/or adult/juvenile offenders. The municipality provides trash bags and disposes of collected trash. Examples include the annual Great American Pickup Event and other one-day or on-going cleanup events.

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- ***Single-day Efforts***
 - Organized Single-day Cleanup Events
- ***On-going Efforts***
 - Keep America Beautiful
 - Adopt-a-Spot, Adopt-a-Highway, Adopt-a-Trail and Other “Adoption” Programs
 - Other Organized Cleanup Events
 - Routine Cleanups of Selected On-land Hot Spots

Since quantification is viewed as unnecessary since trash is removed for aesthetic reasons, volumes of trash removed by volunteers have not been and are not currently tracked in most cases. To assist Permittees in tracking trash removed via on-land cleanups, BASMAA intends to develop a standardized data collection form for use by Permittees.

QF-2: ENHANCED STREET SWEEPING (AREA-SPECIFIC)

To some extent, street sweeping is conducted by most, if not all, Permittees. Street sweeping is either implemented by Permittees via agency staff, or through contractual agreements with private companies. The traditional purpose of street sweeping is to remove trash and debris that collect on the margins of streets and may contribute to unsightly conditions and/or reductions in the capacity of stormwater conveyance systems.

Trash removal effectiveness of street sweeping may be directly affected by sweeper operation (e.g., speed of operation), sweeping frequency, and the inability to sweep near curbs due to parked vehicles. Additionally, runoff producing storms can also impact the effectiveness of street sweepers by transporting trash to the stormwater conveyance system prior to being intercepted by street sweepers (Sartor et al 1974, Sartor and Gaboury 1984, Walker and Wong 1999, Armitage 2001). Based on the findings of the literature review conducted to support tracking method development (BASMAA 2011c), the effectiveness of a street sweeper to remove trash from streets does not appear to be heavily influenced by sweeper type (e.g., mechanical broom, regenerative air, or vacuum assisted).¹¹ Therefore, changes in sweeper type were not included as an applicable trash control measure enhancement.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These quantification methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee's jurisdiction.

- **Increased Street Sweeping Frequency** – Increases in street sweeping frequency in priority trash generating areas as determined by a Permittee.
- **Enhanced Parking Enforcement** – Actions that significantly increase the removal of vehicles from streets during street sweeping to allow sweepers to reach the curb. Actions include increases in the level of parking enforcement and introducing no-parking signage on streets.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews, the following formulas will allow Permittees to estimate the volume of trash removed annually (**Reduction_{Street}**) from conducting street sweeping during the dry season (**Reduction_{StreetDry}**) and wet season (**Reduction_{StreetWet}**) in a year of interest. Stratification of wet and dry seasons is important when calculating trash loads reduced due to the Mediterranean climate in the San Francisco Bay area where distinct wet and dry seasons create different timescales for the transport of trash to MS4s.¹²

Additionally, as illustrated in the *BASMAA Trash Baseline Generation Rates Project Technical Memorandum* and Permittee-specific *Short-Term Trash Loading Reduction Plans*, trash load reductions due to street sweeping implemented prior to the effective date of the MRP and conducted at baseline levels are incorporated into each Permittee's trash baseline load and are therefore not included in the formulas described below. Baseline implementation levels for street

¹¹ Trash defined is all manmade materials greater than 5 mm in size and the removal efficiency for particles > 2 mm in size is similar for all sweeper types (Sutherland 2008).

¹² In the Bay Area, the dry season is defined as May through October and the wet season if November through April.

sweeping are assumed to be: 1) at a sweeping frequency of **1x/week** or less for streets within retail land use areas, and **2x/month** or less for streets in all other land use areas; and 2) consistent with existing levels of parking enforcement or equivalent actions in place at the time the MRP became effective that allow a sweeper to reach the curb. Trash loads reduced associated with street sweeping frequencies that are implemented at a higher level than these baseline levels, whether implemented prior to the MRP effective date (and continued) or after the MRP effective date, are considered enhancements and included in the formulas described below.

$$\text{Reduction}_{\text{Street}} = \text{Reduction}_{\text{StreetDry}} + \text{Reduction}_{\text{StreetWet}}$$

$$\text{Reduction}_{\text{StreetDry}} = \sum \text{Enhanced}_{\text{StreetDry-i}}$$

$$\text{Reduction}_{\text{StreetWet}} = \sum \text{Enhanced}_{\text{StreetWet-i}}$$

where:

Enhanced_{StreetDry-i} = Volume of trash reduced due to enhanced street sweeping or parking enforcement during the dry season in all trash loading categories “i”.

Enhanced_{StreetWet-i} = Volume of trash reduced due to enhanced street sweeping or parking enforcement during the wet season in all trash loading categories “i”.

and:

$$\text{Enhanced}_{\text{StreetDry-i}} = \sum \text{SLoad}_{\text{StreetDry-i}} \cdot (\eta_{\text{StreetDryEnhanced-i}} - \eta_{\text{StreetDryBase-i}})$$

$$\text{Enhanced}_{\text{StreetWet-i}} = \sum \text{SLoad}_{\text{StreetWet-i}} \cdot (\eta_{\text{StreetWetEnhanced-i}} - \eta_{\text{StreetWetBase-i}})$$

where:

- SLoad_{StreetDry-i} = Dry season trash load (volume) available to the street sweepers in area “i”
- η_{StreetDryEnhanced-i} = Effectiveness (fraction) of enhanced street sweeping in area “i” during the year of interest dry season as determined by Figure QF-3.1
- η_{StreetDryBase-i} = Effectiveness (fraction) of street sweeping in area “i” during the baseline year dry season as determined by Figure QF-3.1
- SLoad_{StreetWet-i} = Wet season trash load available to the street sweepers in area “i”
- η_{StreetWetEnhanced-i} = Effectiveness (fraction) of enhanced street sweeping in area “i” during the year of interest wet season as determined by Figure QF-3.1.
- η_{StreetWetBase-i} = Effectiveness (fraction) of enhanced street sweeping in area “i” during baseline year wet season as determined by Figure QF-3.1.

Based on the findings of the literature review, the effectiveness of a street sweeping program is highly dependent upon three factors: 1) frequency of sweeping (average number of days between sweeping), 2) storm frequency (average number of days between runoff-producing storms), and 3) level of parking enforcement (Armitage 2001). As illustrated in Figure QF-2.1, effectiveness is correlated with street sweeping frequency and inversely related to storm frequency. Therefore, due to the increased frequency in storm events that transport trash to the stormwater conveyance system and make it unavailable for interception on the streets, sweeping effectiveness decreases substantially during the wet weather season.

To determine the effectiveness of street sweeping conducted by Permittees, Figure QF-2.1 was created based on Armitage (2001) and data from the City of Palo Alto’s “No Parking on Sweep Day” Program (Teresi 2008). The upper curve on the figure depicts the maximum effectiveness of street sweeping under a high level of parking enforcement (or equivalent) scenario, which includes signage and ticketing. The lower curve depicts effectiveness under a no parking enforcement (or equivalent) scenario.

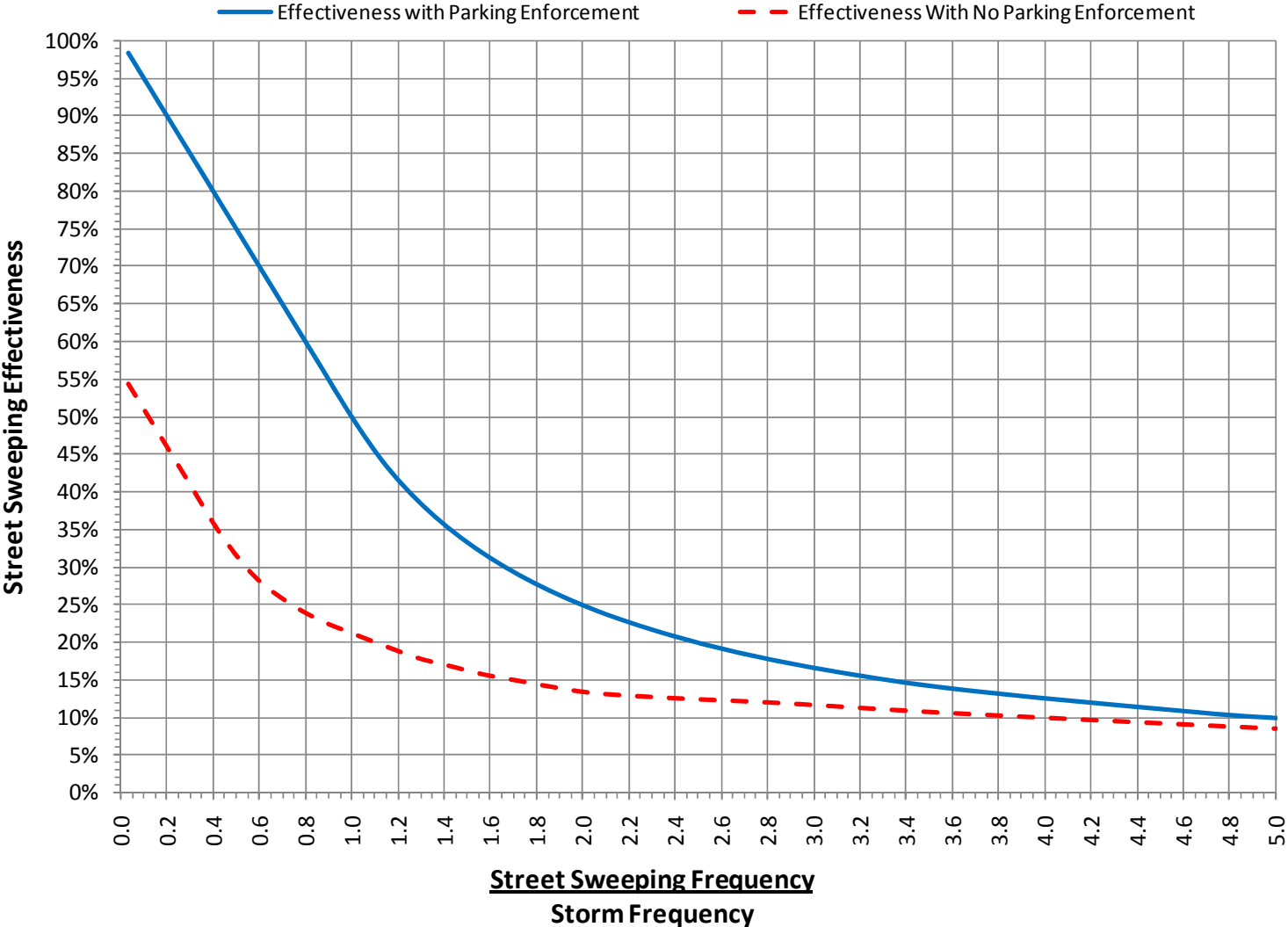


Figure QF-2.1. Street sweeping effectiveness curve based on sweeping frequency, storm frequency and level of parking enforcement (Adapted from Armitage 2001).

Figure 2-1 is provided for illustrative purposes only. Equations derived from Figure QF-2.1 are presented in Table QF-2.1. These equations should be used to calculate baseline, existing enhanced and future enhanced street sweeping effectiveness during wet and dry seasons .

Table QF-2.1. Street sweeping effectiveness (H) equations during dry and wet seasons and parking and no parking enforcement scenarios (based on Figure QF-2.1).

Season	Parking Enforcement (or Equivalent)	Average Frequency	Equation
Dry Season	Yes	> every 103 days	$H = \frac{51.5}{S}$
		≤ every 103 days	$H = 0.99 - \frac{S}{206}$
	No	> every 51.5 days	$H = 0.122 + 0.333 \cdot e^{-0.0121 \cdot S} - 0.000068 \cdot S$
		≤ every 51.5 days	$H = 0.55 - \frac{S}{206}$
Wet Season	Yes	> every 9 days	$H = \frac{4.5}{S}$
		≤ every 9 days	$H = 0.99 - \frac{S}{18}$
	No	> every 4.5 days	$H = 0.122 + 0.333 \cdot e^{-0.139 \cdot S} - 0.000778 \cdot S$
		≤ every 4.5 days	$H = 0.55 - \frac{S}{18}$

H = Street Sweeping Effectiveness (% Reduction of Street Load)
 S = Street Sweeping Frequency (Number of days between street sweeping)

Assumptions and Data Inputs

- **Load_{StreetDry}** – The street trash load available to street sweepers during the dry season is determined on an area-by-area basis.¹³ This load is derived by subtracting the trash load removed via generation reduction activities (Step #1)¹⁴ and on-land trash cleanup activities (Step #2) from the dry season baseline trash load for each area. Alternatively, Permittees may quantify the amount of trash removed in a year of interest and compare that amount to the amount collected by street sweeping activities in a baseline year during the same time period, if that data point was collected.
- **Load_{StreetWet}** – The street trash load available to street sweepers during the wet season is determined on an area-by-area basis.³ This load is derived by subtracting the trash load removed via generation reduction activities (Step #2) and on-land trash cleanup activities (Step #3) from the wet season baseline trash load for each area. Alternatively, Permittees may quantify the amount of trash removed in a year of interest and compare that amount to the amount collected by street sweeping activities in a baseline year during the same time period, if that data point was collected.

¹³ Trash baseline loading rates associated with these areas, depicted as “i” in the formula, will be partially developed through the BASMAA baseline trash generation rates development process and will be defined by those factors (e.g., land use, population density, economic profile) that most affect trash loading.

¹⁴ Single-use carryout bag ordinances, polystyrene foam food service ware ordinances, public education and outreach programs, activities to reduce trash from uncovered loads, anti-littering and illegal dumping enforcement activities, improved trash bin/container management (municipally or privately owned).

- **Dry Season Effectiveness ($\eta_{\text{StreetDryEnhanced-i}}$ and $\eta_{\text{StreetDryBase-i}}$)** – The effectiveness of baseline and enhanced street sweeping during the dry season is estimated on an area-by-area basis based on three variables: 1) average storm frequency during the dry season; 2) street sweeping frequency in the area of interest; and 3) level of parking enforcement within the area of interest. Each of these variables is further described below.
 - **Dry Season Storm Frequency** – The average number of days between runoff-generating storms in the Bay Area during the dry season was calculated using the 2000-2010 precipitation data from weather stations located at the San Francisco, Oakland, San Jose and Concord airports. Based on these data, the average number of days between storms during the dry season in the Bay Area is **103 days**.¹⁵ This average dry season storm frequency is used with the equations presented in QF 2.1 and is assumed to be relevant to all MRP Permittees.
 - **Baseline Dry Season Street Sweeping Frequency** – Baseline dry season street sweeping frequencies are those implemented during May through October by a Permittee prior to the MRP effective date. For many Permittees, baseline frequencies are area-specific, typically varying by land use category. Trash load reductions that are attributable to baseline street sweeping frequencies were incorporated into baseline load estimates and therefore are not a primary input to this formula. That said, to determine the increase in load reductions that are attributable to increases in street sweeping frequencies for particular geographical areas of interest, information on baseline sweeping frequencies for those areas is also needed. Baseline frequencies were mapped via GIS to calculate baseline rates and loads (See Section 2.3).
 - **Increased Street Sweeping Frequency in Year of Interest Dry Season** - Enhanced dry season street sweeping frequencies are those that a Permittee implemented during the year of interest in the months of May through October. Trash loads reduced associated with increased frequencies are area-specific and, similar to baseline frequencies, should be mapped in GIS. Only the increase in effectiveness associated with increased sweeping frequencies (i.e., difference between baseline and enhanced effectiveness) can be used in the formula.
 - **Enhanced Dry Season Parking Enforcement** – Enhanced parking enforcement during the dry season is defined as those enforcement activities in place during a year of interest in the months of May through October, but initiated after the effective date of the MRP. Parking enforcement may be area-specific. If so, then enhancements pertaining to different geographical areas within a Permittee’s jurisdictional area must be identified, again via GIS (See Section 2.3). Trash loads reduced that are associated with baseline enforcement were incorporated into baseline load estimates and therefore are not a necessary input to this formula. That said, to determine the loads reduced that are associated with enhanced enforcement in a particular area of interest, baseline levels of enforcement are needed.
- **Wet Season Effectiveness ($\eta_{\text{StreetWetEnhanced-i}}$ and $\eta_{\text{StreetWetBase-i}}$)** - The effectiveness of baseline and enhanced street sweeping during the wet season will be estimated on an area-by-area basis using three variables: 1) average storm frequency during the wet season; 2) street sweeping frequency in the area of interest; and 3) level of parking enforcement within the area of interest. Each of these variables is further described below.

¹⁵ Average dry season storm frequencies for the four weather stations ranged between 77 and 131 days.

- **Wet Season Storm Frequency** – The average number of days between runoff-generating storms in the Bay Area during the wet season was calculated using the 2000-2010 precipitation data from weather stations located at the San Francisco, Oakland, San Jose and Concord airports. Based on these data, the average number of days between storms during the wet season (i.e., first seasonal flush through the last storm event of the water year) in the Bay Area is **9 days**.¹⁶ This average wet season storm frequency is used with the equations presented in QF 2.1 and is assumed to be relevant to all MRP Permittees.
- **Baseline Wet Season Street Sweeping Frequency** – Baseline wet season street sweeping frequencies are those implemented during November through April by a Permittee prior to the effective date of the MRP. For many Permittees, baseline frequencies are area-specific, typically varying by land use category. Trash load reductions that are attributable to baseline street sweeping frequencies were incorporated into baseline load estimates and therefore are **not a primary input to this formula. That said, to determine** the increase in load reductions that are attributable to increases in street sweeping frequencies for particular geographical areas of interest, information on baseline sweeping frequencies for those areas is also needed. Baseline frequencies were mapped via GIS when calculating baseline rates and loads (See Section 2.3).
- **Increased Street Sweeping Frequency in Year of Interest Wet Season** - Enhanced wet season street sweeping frequencies are those that a Permittee implemented during the year of interest in the months of November through April. Trash loads reduced associated with increased frequencies are area-specific and, similar to baseline frequencies, and were mapped in GIS. Only the increase in effectiveness associated with increased sweeping frequencies (i.e., difference between baseline and enhanced effectiveness) can be used in the formula.
- **Enhanced Wet Season Parking Enforcement** – Enhanced parking enforcement during the dry season is defined as those enforcement activities in place during a year of interest in the months of November through April, but initiated after the effective date of the MRP. Parking enforcement may be area-specific. If so, then enhancements pertaining to different geographical areas within a Permittee’s jurisdictional area must be identified, again via GIS (See Section 2.3). Trash loads reduced that are associated with baseline enforcement were incorporated into baseline load estimates and therefore are not a necessary input to this formula. That said, to determine the loads reduced that are associated with enhanced enforcement in a particular area of interest, baseline levels of enforcement should be known.

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QF-3: PARTIAL-CAPTURE TREATMENT DEVICES (AREA-WIDE & AREA-SPECIFIC)

Partial-capture devices are treatment devices that have not been recognized as full-capture devices by the San Francisco Bay Regional Water Board, but capture trash at a known level of effectiveness. Partial-capture devices may be similar to full-capture devices, but do not meet the full-capture definition due to engineering challenges, or they may be completely different types of devices. For the purposes of this load reduction quantification formula, partial-capture devices include curb inlet screens (e.g., automated retractable screens), litter booms/curtains and pump station track racks. Additional treatment types such as low impact development measures are not included in this fact sheet at this time, but may also be considered partial-capture devices in the future. Based on the literature review, the design and effectiveness of partial-capture devices in intercepting trash varies among device type and application, suggesting that each device should have a separate associated effectiveness value.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These quantification methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee's jurisdiction.

- **QF-3a: Curb Inlet Screens** (Step #3; Area-specific) - devices that were installed prior to or after the MRP effective date that block trash from entering a storm drain inlet at a known effectiveness level, allow the trash to be picked up via street sweeping, and are not associated with other full-capture devices.¹⁷
- **QF-3b: Litter Booms/Curtains** (Step #3; Area-specific) – devices that were installed prior to or after the MRP effective date that block and retain trash in waterways.
- **QF-3c: Enhancement to Stormwater Pump Station Track Racks** (Step #4; Area-wide) – enhancements to existing pump station structures that were installed after the MRP effective date to increase the effectiveness of trash removal.

Loads Reduced Formulas

Based on a review of available data and information gained through literature reviews, the following formulas will allow Permittees to estimate the trash load reduced via partial-capture devices in a given year (i.e., **Reduction_{Screens}** and **Reduction_{Booms}** and **Reduction_{Racks}**). As with all control measures, the trash load reduced from partial-capture devices should be tracked as a volume, as opposed to mass.

¹⁷ Those curb inlet screens associated with full capture devices are NOT an applicable control measure to these formulas. Loads reduced associated with these curb inlets are incorporated into the formulas for full capture devices.

A. Curb Inlet Screens (e.g., Automated Retractable Screens)

$$\text{Reduction}_{\text{Screens}} = \text{Enhanced}_{\text{Screens}}$$

where:

$\text{Enhanced}_{\text{Screens}}$ = Volume of trash removed by curb inlet screen in municipality in year of interest

and;

$$\text{Enhanced}_{\text{Screens}} = \text{CLoad}_{\text{CurbInlet}} \bullet \text{Effect}_{\text{Enhanced}}$$

where:

$\text{CLoad}_{\text{Screens}}$ = Annual conveyance load¹⁸ for the land areas (i) treated by the partial-capture device

$\text{Effect}_{\text{Enhanced}}$ = percent of trash in the applicable conveyance load that is captured by the partial-capture device

Assumptions and Data Inputs

- CLoad_{Screens}** – The conveyance load applicable to the area treated by a partial-capture device will be determined through data collected via the *BASMAA Baseline Trash Generation Rates Project*; load reductions via trash generation reduction control measures, on-land trash cleanups and street sweeping; and the delineation of the area treated by the partial-capture device. Baseline loading rates are discussed in Section 1.0 and load reductions via the three categories of control measures listed above are described in other fact sheets. To delineate the drainage area served by a partial-capture device, BASMAA has developed two approaches. The first approach involves determining the inlet drainage area through GIS evaluation and field measurement for each specific device. The second approach entails calculating the average inlet drainage area by dividing the total number of Permittee-owned storm drain inlets into the total urban (developed) area within a Permittees jurisdiction. Either approach is assumed to be valid for the purposes of calculating loads reduced for curb inlet screens.
- Effect_{Enhanced}** – The City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division conducted a comprehensive Storm Drain Inlet Opening Screen Covers Study during FY 2005-2006 to assess the effectiveness and/or performance of curb inlet screens. Results suggest that the average trash capture effectiveness of curb inlet screens is between 83.2 to 84.6 percent (City of Los Angeles 2006b). Effectiveness is based on the volume of trash captured by the curb inlet screen, compared to the trash that bypassed the screen. Based on this information, BASMAA recommends that the average effectiveness rating for curb inlet screens is 84 percent.

¹⁸The “conveyance load” is defined as the baseline trash load minus the loads reduced via generation reduction control measures, on-land removal and street sweeping.

B. Stormwater Pump Station Trash Rack Enhancements

$$\text{Reduction}_{\text{Racks}} = \text{Enhanced}_{\text{Racks}} - \text{Baseline}_{\text{Racks}}$$

where:

$\text{Enhanced}_{\text{Rack}}$ = Volume of trash removed by pump station trash racks in the Permittee's jurisdictional area in year of interest

$\text{Baseline}_{\text{Rack}}$ = Volume of trash removed by pump station trash racks in the Permittee's jurisdictional area in baseline year(s)

and;

$$\text{Enhanced}_{\text{Racks}} = \text{CLoad}_{\text{Racks}} \cdot \text{Effect}_{\text{Enhanced}}$$

$$\text{Baseline}_{\text{Racks}} = \text{CLoad}_{\text{Racks}} \cdot \text{Effect}_{\text{Baseline}}$$

where:

$\text{WLoad}_{\text{Racks}}$ = Annual waterway load¹⁹ for the land areas (i) treated by pump station trash racks

$\text{Effect}_{\text{Enhanced}}$ = percent of trash in the applicable waterway load that is captured by the enhanced stormwater pump station trash rack in year of interest.

$\text{Effect}_{\text{Baseline}}$ = percent of trash in the applicable waterway load that is captured by the baseline stormwater pump station trash rack in the baseline year(s).

Assumptions and Data Inputs

- **CLoad_{Racks}** – see CLoad_{Screens}
- **Effect_{Enhanced}** –The effectiveness of pump station structure enhancements designed to remove trash will be enhancement-specific. No information is currently available regarding the “average” effectiveness of such enhancements, and therefore effectiveness ratings should be determined by Permittees that choose to implement this control measure.
- **Effect_{Baseline}**– Typical (baseline) trash racks consist of steel bars spaced 4 to 10 centimeters apart (Allison et al. 1998) and provide a physical barrier to floating and submerged pollutants. The effectiveness of baseline trash racks varies widely (5-100%) based on studies conducted to-date. For the purposes of establishing the trash removal effectiveness for baseline trash racks, a default effectiveness rating of 25% is recommended until additional information is available.

¹⁹ The “waterway load” is defined as volume of trash estimated to pass through the stormwater conveyance system without being intercepted by control measures.

C. Litter Booms/Curtains

Based on a review of available data and information gained through literature reviews, the following formula will allow MRP Permittees to estimate the volume of trash load reduced from installation and maintenance of trash booms and curtains in a Permittee’s jurisdictional area²⁰ in a given year (**Reduction_{Booms}**). Please note that trash load reductions are tracked as a volume, as opposed to mass.

$$\text{Reduction}_{\text{Booms}} = \text{Enhanced}_{\text{Booms}}$$

where:

Enhanced_{Booms} = Volume of trash removed from a trash boom or curtain within a Permittee’s jurisdictional area in the year of interest

Assumptions and Data Inputs

- **Enhanced_{Booms}** – All trash loads in a year of interest that are removed via trash booms and curtains installed prior to or after the MRP effective date may be tracked and used by Permittees to assess progress towards trash load reduction goals. Permittees will need to quantify the volume of trash removed by each boom/curtain in the year of interest.

References

Allison, R.A., T.A. Walker, F.H.S. Chiew, I.C. O’Neill and T.A McMahon 1998. From Roads to rivers: Gross pollutant removal from urban waterways. Report 98/6. Cooperative Research Centre for Catchment Hydrology. Victoria, Australia. May 1998.

City of Los Angeles. 2006b. Technical Report: Assessment of Storm drain inlet Opening Screen Covers. City of Los Angeles Department of Public Works, Watershed Protection Division. June 2006. 26 pgs

²⁰ A Permittee may take loads reduced credit for litter booms/curtains installed by other agencies within their jurisdictions.

QF-4: ENHANCED STORM DRAIN INLET MAINTENANCE (AREA-SPECIFIC)

The stormwater conveyance system refers to the constructed drainage system designed to transport water to waterways during runoff events, and includes storm drain inlets, underground pipes/drainage lines, culverts, V-ditches, pump stations and open channels. Storm drain inlets serve as the entry point to the underground stormwater conveyance system and are generally designed to reduce flood risks and convey flows. During storm flows, trash on street surfaces is washed into the stormwater conveyance system and some portion is transported to waterways. Trash can be intercepted during this transport process through routine maintenance and cleaning of the conveyance system. Currently, most Permittees maintain and clean components of their stormwater conveyance system on an annual basis in accordance with countywide *Stormwater Drainage System Operating and Maintenance Performance Standards*.

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These quantification methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee’s jurisdiction.

- **Increased Frequency of Storm Drain Inlet Maintenance** - Permittees may choose to enhance trash load reductions by increasing the cleaning frequency of storm drain inlets from baseline (i.e., annually) to semiannually, quarterly or monthly. Increases in cleanout frequencies may occur in storm drain inlets throughout a Permittees jurisdiction or within targeted areas.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews, the following formulas will allow Permittees to estimate the trash load reduced via increased frequency of storm drain inlet maintenance in a given year (i.e., **Reduction_{Drains}**). As with all control measures, the trash load reduced from this control measure should be tracked as a volume, as opposed to mass.

$$\text{Reduction}_{\text{Drain}} = \sum \text{Enhanced}_{\text{Drain-ij}}$$

where:

Enhanced_{Drain-ij} = Trash load reduction attributable to an increased frequency of storm drain inlet maintenance “j” (semi-annually, quarterly, or monthly) at a storm drain located in a trash loading category “i”.

and;

$$\text{Enhanced}_{\text{Drain-ij}} = N_{\text{Drains-ij}} \bullet \text{CLoad}_{\text{DrainBase-i}} \bullet P_{\text{Drain-j}}$$

where:

N_{Drain-ij} = Number of storm drain inlets within a Permittee’s jurisdiction where increased cleaning occurred in the year of interest and whose drainage areas are classified in the trash loading category “i” and are cleaned at an increased frequency “j”.

CLoad_{DrainBase-i} = Trash conveyance load for a storm drain inlet whose drainage area is classified in the trash loading category “i” and has a trash reduction rate “x” at a baseline (annual) cleaning frequency.

$P_{\text{Drain-j}}$ = Percent increase in volume of trash removed annually (above baseline) due to increased maintenance at frequency, “j”.

Assumptions and Data Inputs

- **$N_{\text{Drain-ij}}$** – Storm drain inlets are typically cleaned annually by Permittees and therefore an annual maintenance frequency is identified as baseline. The trash load reduced via annual cleaning is incorporated into the baseline trash load, and therefore is not included as a variable in this formula. That said, this variable is assumed the number or inlets cleaned at each frequency and their associated land use is needed.
- **$C_{\text{LoadDrainBase-ix}}$** – The trash conveyance load applicable a storm drain inlet will be determined through: 1) the trash baseline generation rate developed via the *BASMAA Baseline Trash Generation Rates Project* for loading rate category “i” and the application of this rate using the load reduction tracking process described in Section 2.3 to develop a Permittee-specific conveyance loading rate; 2) the area within a Permittee’s jurisdiction that is associated with loading rate category “i”; 3) the number of storm drain inlets in a Permittee’s jurisdiction and associated with loading rate category “i”; and 4) the percent of trash removed from an inlet under a baseline (annual) cleaning frequency.
- **$P_{\text{Drain-j}}$** – There are limited data available on the reductions of trash associated with different storm drain inlet maintenance frequencies. Through the literature review associated with this project, one Bay Area study was found that assessed the effectiveness of storm drain maintenance frequencies on debris (i.e., trash and other materials) removal. Data from the *Storm Inlet Pilot Study* in Alameda County (Woodward Clyde 1994) listed in Table QF-4.1 are recommended for use as inputs to this variable. These data are assumed to be applicable to the entire San Francisco Bay area.

Table QF-4.1 Percent increase above baseline in volume removed from storm drain inlets due to an increase in storm drain inlet maintenance.

Frequency	Percent Increase Above Baseline (by Volume)
Monthly	215
Quarterly	50
Semi-annually	22
Annually	Baseline

References

Woodward-Clyde. 1994. Storm Inlet Pilot Study. Prepared for the Alameda County Urban Runoff Clean Water Program.

QF-5: FULL-CAPTURE TREATMENT DEVICES (AREA-SPECIFIC)

As defined by the Municipal Regional Stormwater Permit (MRP), a full-capture system or device is any single device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate (Q) resulting from a one-year, one-hour, storm in the sub-drainage area. The MRP requires population-based Permittees to install and maintain a minimum number of full-capture devices by July 1, 2014 to treat runoff from an area equivalent to 30 percent of retail/wholesale land that drains to MS4s within their jurisdictions²¹. In addition, full-capture systems or devices may have been installed by Permittees or private entities prior to the adoption of the MRP, and in the future Permittees may choose to install additional devices. A list of full-capture systems and devices that are recognized by the San Francisco Bay Regional Water Quality Control Board (Water Board) is included as Table QF-5.1 (SFEP 2010).

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These quantification methods are intended to demonstrate trash load reductions resulting from implementation within an individual Permittee’s jurisdiction.

- **Trash Full-Capture Treatment Devices** – Trash capture devices recognized by the Water Board as meeting the “full-capture” definition (see Table QF-5.1 for examples) that are located in a Permittees jurisdictional area, installed prior to or after the effective date of the MRP, and are adequately maintained by the Permittee or a private entity.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews, the following formula will allow MRP Permittees to estimate the volume of trash load reduced from all full-capture devices in a Permittee’s jurisdictional area in a given year (**Reduction_{FullCap Devices}**). Please note that trash load reduced from full-capture devices is tracked as a volume, as opposed to mass.

$$\text{Reduction}_{\text{FullCap}} = \sum \text{Enhanced}_{\text{FullCap}}$$

where:

Enhanced_{FullCap} = Volume of trash removed from a full-capture device within a Permittee’s jurisdictional area in the year of interest

and;

$$\text{Enhanced}_{\text{Full Cap Devices}} = \text{CRate}_i \bullet \text{AreaTreat}_i$$

where:

CRate_i = Conveyance loading rate (volume/acre/year) for areas associated with trash loading category “i” and are being treated by a full-capture device in the year of interest

AreaTreat_i = Area (acres) associated with trash loading category “i” that are being treated by a full-capture device in the year of interest

²¹ A population-based Permittee with a population less than 12,000 and retail/wholesale land less than 40 acres, or population less than 2,000, is exempt from installing and maintaining a minimum number of full capture devices.

Table QF-5.1. Devices recognized by the San Francisco Bay Regional Water Quality Control Board as meeting the trash full-capture definition.

Storm Drain Inserts	Hydrodynamic Separators
<p>Advanced Solutions AS-1 Stormtek ST3 AS-2 Stormtek ST3-G</p> <p>Bio Clean Environmental Services, Inc. BC-1 Grate Inlet Skimmer Box (square design) BC-2 High Capacity Round Grate Inlet Skimmer Box BC-3 Modular Connector Pipe Screen BC-4 Trash Guard</p> <p>Ecology Control Industries (American Stormwater) ECI-1 Debris Dam</p> <p>G2 Construction, Inc. G2-1 Collector Pipe Screen G2-1R Collector Pipe Screen Removable</p> <p>Gentile Family Industries (Waterway Solutions) GFI-1 WAVYGRATE Trash Catcher</p> <p>KriStar Enterprises, Inc. KS-1 Flo Gard Plus Storm drain inlet Filter Insert, combination inlet style – C3 (stainless steel) KS-2 Flo Gard Plus Storm drain inlet Filter Inserts, flat grated inlet style, rectangular or round – C3 (stainless steel) KS-3 FloGard Storm drain inlet Outlet Screen Insert</p> <p>Revel Environmental Manufacturing, Inc. REM-1 Triton Bioflex Drop Inlet Trash Guard</p> <p>United Stormwater, Inc. USW-1 Connector Pipe Screen</p> <p>West Coast Storm, Inc. WCS-1 Connector Pipe Screen</p>	<p>Contech Construction Products CCP-1HF Continuous Deflective Separator (CDS)</p> <p>KriStar Enterprises, Inc. KS-6HF Downstream Defender KS-7HF FloGard Dual-Vortex Hydrodynamic Separator</p> <p>In-line Netting</p> <p>Fresh Creek Technologies, Inc. FCT-1HF Inline Netting Trash Trap</p> <p>KriStar Enterprises, Inc. KS-10HF Nettek Gross Pollutant Trap - In Line</p> <p>End-of-Pipe Netting</p> <p>Fresh Creek Technologies, Inc. FCT-2HF End of Pipe Netting Trash Trap</p> <p>KriStar Enterprises, Inc. KS-11HF Nettek Gross Pollutant Trap- End of Line</p> <p>Other In-line Devices</p> <p>Bio Clean Environmental Services, Inc. BC-5HF Nutrient Separating Baffle Box</p> <p>KriStar Enterprises, Inc. KS-5HF CleansAll KS-8HF FloGard Perk Filter KS-9HF FloGard Swirl-Flo Screen Separator</p> <p>Roscoe Moss Company RMC-1HF Storm Flo Screen</p>

Assumptions and Data Inputs

- **CRate_i** –Permittee-specific conveyance loading rates will be used to calculate load reduction credits for installation and maintenance of full-capture devices. Conveyance rates are Permittee-specific and are based on trash baseline generation rates developed via the *BASMAA Baseline Trash Generation Rates Project* and implementation of trash generation reduction activities in the year of interest, on-land trash cleanups and street sweeping programs by the Permittee. Conveyances rates will vary by loading category “i”.
- **AreaTreat_i** – To delineate the drainage area served by a full-capture device, BASMAA has developed three approaches that a Permittee may choose to use:
 1. **Field Survey and Map Review** - Applicable to all full-capture devices listed in Table QF-5.1, involves the delineation of the geographical area treated through field surveys and/or the review of maps of the stormwater conveyance network.
 2. **Permittee Average** - Only applicable to storm drain inserts listed in Table QF-5.1, entails calculating the average drainage area treated by a storm drain insert by dividing the total number of Permittee-owned storm drain inlets into the total

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urban (developed) area within a Permittee's jurisdictional area that is served by the MS4.

3. Regional Average - average drainage area (1.75 acres per inlet) for ~160 storm drain inserts calculated as part of the *BASMAA Baseline Trash Generation Rates Project* (BASMAA 2011d).

For the purposes of defining average drainage area, either approach is assumed to be valid for storm drain inserts. Regardless of the approach chosen, the geographical areas treated by full-capture devices should be mapped using GIS to allow for trash load reduction quantification to occur.

References

SFEP (San Francisco Estuary Partnership).2010. Bay Area-wide Trash Capture Demonstration Project: Vendors and Devices approved March 18, 2010. 2pgs.

QF-6: CREEK/CHANNEL/SHORELINE CLEANUPS (VOLUNTEER AND/OR MUNICIPAL)(AREA-WIDE)

Creek cleanups have been successful in removing large amounts of trash from San Francisco Bay area creeks and waterways, and increasing citizen's awareness of trash issues within their communities. Creek cleanups are conducted as single-day events or throughout the year by volunteers and Permittees. Since volunteers and municipal agencies have the common goal of clean creeks and waterways, their efforts sometimes overlap. This is apparent in Permittees coordinating with volunteers to help assess and clean designated trash hot spots during single-day volunteer events. In most cases, creek cleanups are an effort of “last resort” due to the increased expense and difficulty of removing trash in creeks, compared to long-term solutions such control measures that fall under the trash generation reduction .

Applicable Control Measures

Methods described in this fact sheet are applicable to the following urban stormwater runoff control measure enhancements implemented by Permittees. These quantification methods are intended to demonstrate trash load reductions resulting from implementation within or “downstream” of an individual Permittee’s jurisdictional area.

- **MRP-required Creek/Channel/Shoreline Cleanups** - In accordance with the Permit Provision C.10.b., Permittees are required to annually assess and clean a number of trash hot spots to a level of “no visual impact”. Through these efforts, total volumes of trash removed from this effort are estimated. MRP-required creek/channel/shoreline cleanups are mostly conducted by Permittee staff, but in some instances volunteers assist Permittees.
- **Non MRP-required Creek/Channel/Shoreline Cleanups** - In addition to MRP-required cleanups, some Permittees conduct or actively support creek/channel/shoreline cleanups as part of volunteer events, routine maintenance, homeless encampment removal and illegal dumping response and abatement.

Loads Reduced Formula

Based on a review of available data and information gained through literature reviews and personnel interviews, the following formula will allow MRP Permittees to estimate the volume of trash load reduced from all applicable creek/channel/shoreline cleanup activities in a year of interest (**Reduction_{CreekCleanups}**). Please note that trash loads removed from creek/channel/shoreline cleanups should be tracked as a volume, as opposed to mass.

$$\text{Reduction}_{\text{CreekCleanups}} = \text{Enhanced}_{\text{CreekCleanups}}$$

where:

Enhanced_{CreekCleanups} = Volume of trash removed from all applicable creek/channel/shoreline cleanup activities in year of interest

and;

$$\text{Enhanced}_{\text{CreekCleanups}} = \text{MRP-Required}_{\text{Enhanced}} + \text{Other}_{\text{Enhanced}}$$

where:

MRP-Required_{Enhanced} = Volume of trash removed by Permittee staff and volunteers conducting MRP-required creek/channel/shoreline trash hot spot cleanups in year of interest

$Other_{Enhanced} = \text{Volume of trash removed via all other (i.e., non MRP-required) creek/channel/shoreline cleanups in year of interest}$

Assumptions and Data Inputs

- **MRP-Required_{Enhanced}** – All trash loads reduced via hot spot cleanups required by MRP Provision C.10.b. during the year of interest may be tracked and used by Permittees to assess progress towards trash load reduction goals. Consistent with established tracking methods, Permittees will quantify the volume of trash removed from each trash hot spot cleanup during each annual hot spot cleanup event and identify the dominant types of trash (e.g., glass, plastics, paper) removed and their sources to the extent possible. In some instances, volunteers may assist agencies with these cleanups. This information will be reported in Permittee Annual Reports submitted to the Water Board each year by September 15.
- **Other_{Enhanced}** – Similar to MRP-required hot spot cleanups, all trash loads reduced via creek/channel/shoreline cleanups during the year of interest that are outside of those required by the MRP may be tracked and used by Permittees to assess progress towards trash load reduction goals. These cleanups include but are not limited to:
 - **Permittee & Volunteer Collaborative Activities**
 - **Single-day Efforts**
 - National River Cleanup Day (third Saturday in May)
 - Coastal Cleanup Day (third Saturday in September)
 - Other Organized Single-day Events
 - **On-going Efforts**
 - Adopt-a-Creek and Other “Adoption” Programs
 - Other Organized Cleanup Efforts
 - Individuals or Organized Groups
 - Creek/Watershed Group
 - Non-governmental Organizations (e.g., Save the Bay, etc.)
 - **Permittee-led Cleanup Activities**
 - **On-going Efforts**
 - Removal of Homeless Encampments
 - Routine or Regularly Scheduled Creek Maintenance
 - Illegal Dump Site Correction
 - Measure-funded Programs
 - Other On-going Cleanup Efforts

To determine the total volume of trash removed from all non MRP-required cleanups, volunteers and Permittees will need to track the volume of trash removed from these efforts as accurately as feasible. Data types need to calculate loads removed may include the number of cleanups conducted, number of locations cleaned and the number and size of trash bags filled.

In most cases, however, volunteer groups do not quantify the volume of trash removed since they are most interested in improving creek conditions, estimating volumes. Therefore, Permittees may not be able to track the trash loads removed from all non MRP-related cleanups conducted within their jurisdictions. It is recommended that Permittees identify which creek/channel/shoreline cleanups they conduct and want to demonstrate trash loads reduced, and track the volumes of trash removed from these efforts. In addition, it is recommended that Permittees identify which volunteer creek/channel/shoreline cleanups conducted that they want to demonstrate trash loads reduced, and establish relationships with volunteers regarding data collection and submittal of cleanup data to Permittees. To assist Permittees in tracking the volume of trash removed from all non MRP-related cleanups, BASMAA plans to develop a standardized data collection form for Permittee and volunteer use.

5.0 LOAD REDUCTION REPORTING AND VERIFICATION

5.1 Annual Reporting

Consistent with MRP Provision C.10.d (i), Permittees will report on progress towards MRP trash load reduction goals on an annual basis beginning with their Fiscal Year 2011-2012 Annual Reports.

Annual reports will include:

1. A brief summary of all enhanced trash load reduction control measures implemented to-date;
2. The dominant types of trash likely removed via these control measures;
3. Total trash loads removed (credits and quantifications) via each control measure implementation; and
4. A summary and quantification of progress towards trash load reduction goals.

Similar to other MRP provision, annual reporting formats will be consistent region-wide and each Permittee will submit a completed annual report to the Water Board by September 15 of each year. Annual reports are intended to provide a summary of control measure implementation and demonstrate progress toward MRP trash reduction goals. For more detailed information on specific control measures, Permittees will retain supporting documentation on trash load reduction control measure implementation. These records should have a level of specificity consistent with the trash load reduction tracking methods described in this Technical Report.

5.2 Verification of Trash Load Reductions

Measuring trends in stormwater runoff quality via empirical monitoring is incredibly challenging due to the inherent temporal and spatial variability in sources, transport processes and deposition rates in water bodies. These inherent challenges make it difficult to detect if differences (increases or decreases) in stormwater quality (e.g., trash loads) are due to natural variability, or as a result of changes in sources and associated loadings. Therefore, any stormwater runoff or receiving water monitoring conducted in an attempt to detect trends in trash loading to receiving waters should be well thought-out and statistically based. If Permittees choose to conduct such monitoring, the development a monitoring (verification) plan will take time and require the input of a number of stakeholders (e.g., scientists, Permittee and Water Board staff, NGOs).

Verification monitoring is not required by the MRP, but is currently under consideration by BASMAA. Due to the compliance schedules set forth in the MRP and the focus on implementation during the Permit term, a monitoring (verification) plan is not included in this version of the Technical Report. However, MRP Permittees will consider the development of a load reduction monitoring (verification) plan prior to July 1, 2014. A combination of BMP effectiveness, stormwater discharge, and receiving water monitoring, assessments and studies should be considered during the plan development. Once a plan is finalized, it should be incorporated into this Technical Report. Implementation of the plan is subject to available funding.

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