Baseline Trash Loading Rates from Bay Area Municipal Stormwater Systems

Sampling and Analysis Plan

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The Bay Area Stormwater Management Agencies Association

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LIST OF ABBREVIATIONS

ABAG	Association of Bay Area Governments
ADWD	Antecedent Dry Weather Days
BASMAA	Bay Area Stormwater Management Agencies Association
BMP	Best Management Practice
Caltrans	California Department of Transportation
CASQA	California Association of Stormwater Quality
CDS	Continuous Deflective Separation
cm	Centimeter
DU	Dwelling Unit
ft	Feet
ha	Hectare
HDS	Hydrodynamic Separator
HDSFR	High Density Single Family Residential
hr	Hour
in	Inch
kg	Kilogram
km	Kilometer
L	Liter
LA	Los Angeles
Lbs	pounds
LDSFR	Low Density Single Family Residential
m	Meter
m^3	Cubic Meter
MRP	Municipal Regional Stormwater NPDES Permit
MS4s	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
SAP	Sampling and Analysis Plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollutant Prevention Program
SFEP	San Francisco Estuary Partnership
SFRWQCB	San Francisco Regional Water Quality Control Board or Water Board
SOP	Standard Operating Procedure
SWRCB	State Water Resource Control Board
TMDL	Total Maximum Daily Load
µm	Micrometer (micron)
USEPA	United States Environmental Protection Agency
yr	Year

TERMINOLOGY

Baseline: A defined line or standard by which effectiveness can be measured or compared.

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 waste streams from any portion of a treatment (or pretreatment) facility.

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

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

Effectiveness (with regard to treatment BMPs): A measure of how well a BMP system meets its goals for all storm water flows reaching the BMP site, including flow bypasses.

Event Mean Concentration (EMC): the total captured pollutant mass per volume of discharged runoff

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 BMP.

Gross Solids: Gross solids are litter, trash, leaves, and large coarse sediments that travel, as either floating debris or bed loads, in stormwater conveyance systems. Sometimes referred to as gross pollutants.

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.

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))

Outfall: The discharge point of a water conveyance system (e.g. pipes) to a receiving water body

Overflow: To be filled beyond the design capacity of a BMP.

Performance (with regard to treatment BMPs): A measure of how well a treatment BMP meets its goals for storm water that flows through, or is processed by it.

Pollutant: A substance introduced into the environment that adversely affects or potentially affects the usefulness of a resource.

Pollutant Load: The mass of a pollutant discharged into or from a receiving water body.

Receiving Waters: Natural water bodies receiving discharges from municipal stormwater drainage systems.

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

Storm Drain Inlet: Part of the stormwater drainage 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 Drainage 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.

Total Load: Total amount of a given substance entering a water body during a given time (e.g., tons of trash per year).

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

Trash Dispersal: Inadvertent distribution of trash in the environment due to improper handling and transportation.

Urban Runoff: All flows in a stormwater drainage system and consists stormwater (wet weather flows) and non-storm water 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.

1. PROJECT PURPOSE

The Municipal Regional Stormwater NPDES Permit for Phase I communities (Order R2-2009-0074), also known as the Municipal Regional Permit (MRP), became effective on December 1, 2009. The MRP applies to all 76 large and medium municipalities (cities and counties) and flood control agencies in the San Francisco Bay Region (Bay Area), collectively referred to as Permittees. Section C.10 (Trash Load Reduction) requires Permittees to implement control measures to reduce trash loads from municipal separate storm sewer systems (MS4s) by 40 percent by 2014, 70 percent by 2017, and 100 percent by 2022.

To assess compliance with these load reduction requirements, each Permittee is required to determine the baseline trash load from its MS4. A baseline trash load must be submitted to the San Francisco Bay Regional Water Quality Control Board (Water Board) by February 1, 2012. A progress report is also due to the Water Board by February 1, 2011, and should identify whether Permittees are developing trash loads individually or collectively through a regional project. Through approval by the Bay Area Stormwater Management Agencies Association (BASMAA) of a regional project, Permittees have agreed to work collaboratively to develop a regionally consistent method to establish baseline trash loads from their MS4s. The purpose of this regional project is to assist Permittees in establishing a baseline for which to demonstrate progress towards MRP trash load reduction goals (i.e., 40%, 70% and 100%). The project is intended to provide scientifically-sound method for developing a (default) baseline trash loading rate that can be adjusted based on Permittee/site specific conditions, and used to compare against load reductions via control measure implementation.

2. BACKGROUND

2.1. Conceptual Model and Potentially Influential Factors

In a previous technical memorandum, BASMAA developed a conceptual model of trash loading to MS4s (EOA 2010). The conceptual model was built off of information derived from a comprehensive review of available literature regarding baseline trash loads entering stormwater conveyance systems from urban areas. Based on the conceptual model (and literature review), it is apparent that trash loads from MS4s in urbanized areas are dependent upon:

- **Trash Generation** - the rate at which trash is generated (i.e., deposited onto the urban landscape); and,
- **Trash Interception** - The degree to which trash is intercepted through control measures (e.g., street sweeping) prior to entering MS4s.

The conceptual model is shown in Figure 2-1, and identifies the following seven factors, both anthropogenic and natural, that most likely influence the amount of trash entering MS4s: (1) Land Use; (2) Population Density; (3) Economic Profile; (4) Street Sweeping Effectiveness; (5)

Manual Pickup Effectiveness; (6) Antecedent Dry Weather Days; and (7) Rainfall (Totals and Intensity)

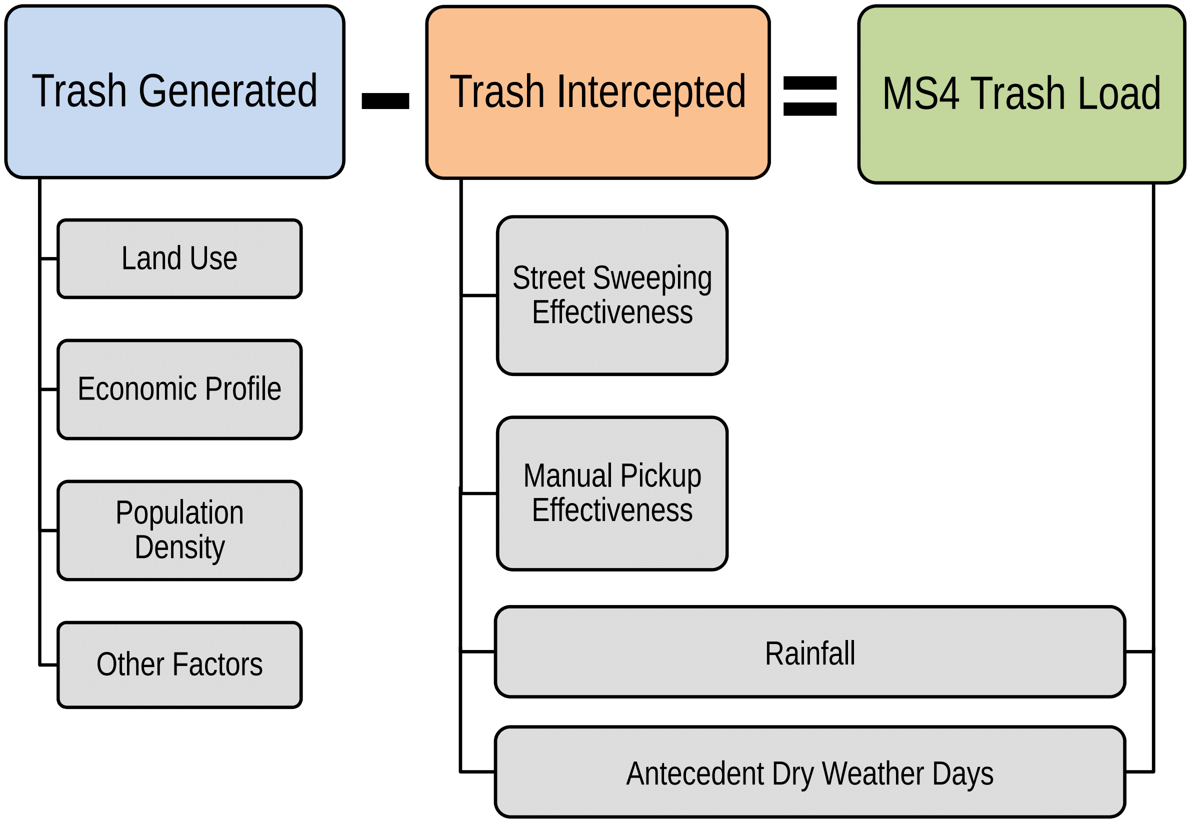

Figure 2-1. Conceptual model of trash loads to Municipal Stormwater Conveyances

2.2. Hypothesis

From the conceptual model, the following two draft overarching hypotheses were created to test the influence that the seven factors have on trash loads from MS4s:

> ***H_1*** *= A combination of factors, including land use, economic profile, population density, street sweeping and rainfall can sufficiently explain the variability in trash loading rates from MS4s.*
>
> ***H_0*** *= Variability in trash loading rates from MS4s are not sufficiently explained by testable factors and are therefore assumed to be natural and unexplainable.*

These hypotheses allow for the testing of whether specific factors influence trash loading from MS4s. Based on the literature review, it is expected that individually or a combination of these factors will explain the differences in trash loads observed.

2.3. Baseline Trash Loading Equation

Based on the MS4 trash loads equation presented in Armitage and Rooseboom (2000), the equation below was developed to establish the total annual trash loads (excluding vegetation, sand and sediments) from MS4s based on the factors describe in the previous section and the collection of trash data described in this sampling and analysis plan.

$$T_{Load} = \sum_{ij=1}^{n} (R_{ij} A_{ij} S_{ij} H_{ij})$$

where:

T_{Load}	=	total annual trash load from an MS4 (m^3/yr)
i	=	land use category
j	=	economic profile category
n	=	total number of land use and economic profile category combinations
R_{ij}	=	default trash generation rate for a land use and economic profile category combination ($m^3/ha \cdot yr$)

where:

$$R_{ij} = \sum_{ij=1}^{n} \left[\frac{L_{ij}}{(1 - T_{ij})(1 - M_{ij})} \right]$$

L_{ij} = observed trash loading rate for a land use and economic profile category combination ($m^3/ha \cdot yr$)

T_{ij} = the efficiency of street cleaning for the monitored land use and economic profile category combination (fraction)

M_{ij} = the efficiency of manual pickup for the monitored land use and economic profile category combination (fraction)

S_{ij}	=	street sweeping efficiency factor for each area (dimensionless)
H_{ij}	=	manual pickup efficiency factor for each area (dimensionless)
A_{ij}	=	area of land use and economic profile category combination (ha)

3. PROJECT ORGANIZATION

3.1. Project Location and Area

Baseline trash loading rates will be developed through the quantification of trash captured in Water Board approved trash full capture devices in four (4) Bay Area counties (Alameda, Contra Costa, San Mateo, and Santa Clara) and three (3) cities (Fairfield, Suisun City and Vallejo), all of which are MRP Permittees. Trash captured in monitored devices will be periodically removed and characterized using standard operating and quality assurance procedures. A map of the included geographical areas is shown in Figure 3-1. These areas comprise the "Project Area".

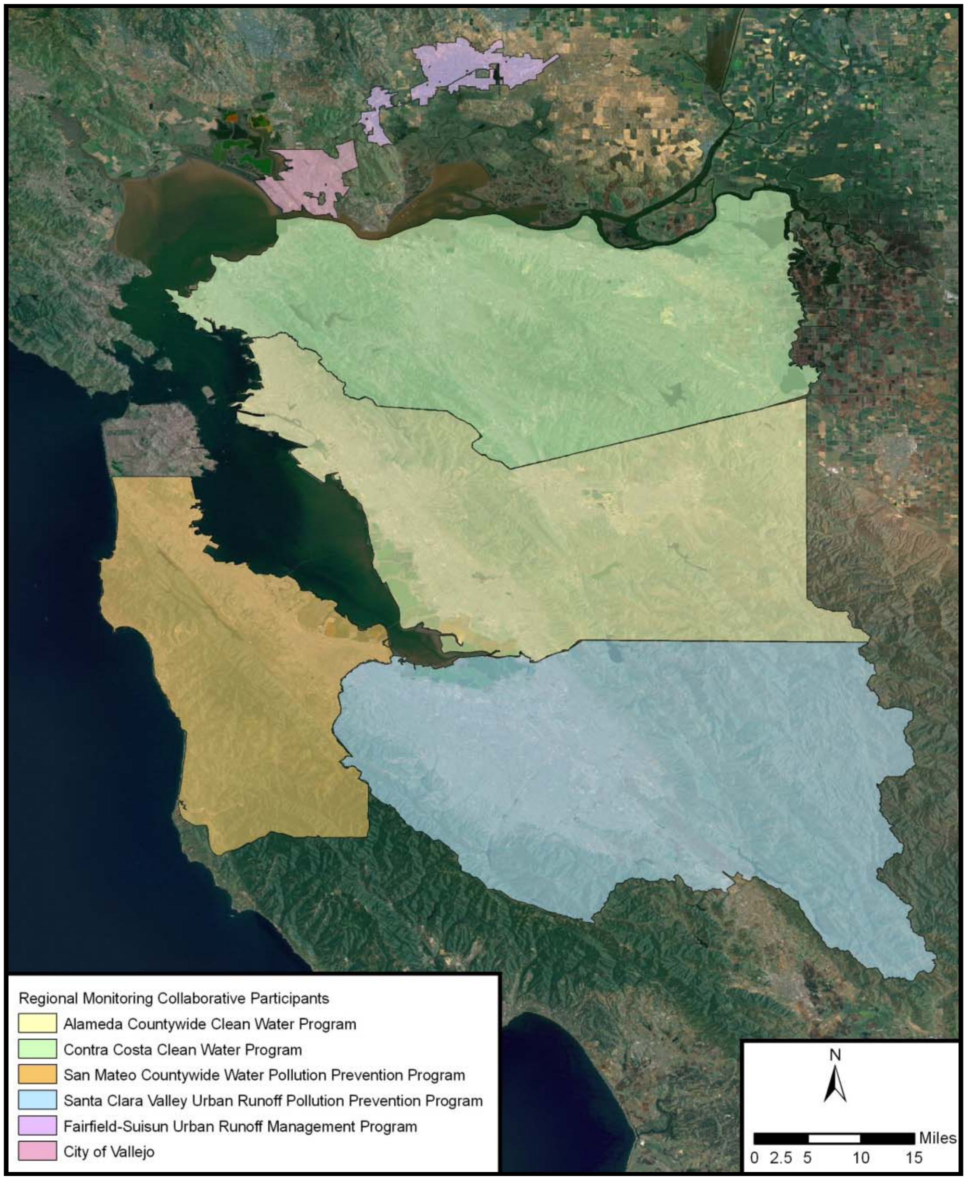

Figure 3-1. Trash baseline loads project area.

3.2. Project Equipment

Full capture storm drain inserts and hydrodynamic separator (HDS) devices installed within the stormwater conveyance system provide the data collection points where trash loads will be monitored. Types of storm drain inserts that may be monitored during this project include:

- Advanced Solutions - Stormtek ST3
- G2 Construction, Inc. - Collector Pipe Screen
- KriStar Enterprises, Inc. - FloGard Catch Basin Outlet Screen Insert
- West Coast Storm, Inc. - Connector Pipe Screen
- Bio Clean Environmental Services, Inc. – Trash Guard

Hydrodynamic separators, also known as vortex separators or swirl concentrators, use tangential forces created by the incoming flow of water to separate trash and other pollutants from stormwater. HDS devices that may be monitored include:

- Bay Saver, Inc. - Bay Saver Separation System
- CDS Technologies, Inc. - Continuous Deflective Separation (CDS™)
- Kristar Enterprises, Inc. - Flo-Gard ® Dual Vortex

3.3. Project Management and Responsibilities

This project will utilize the cooperative efforts of several parties involved in the design and implementation of various components of the project. The main roles and responsibilities are defined below.

3.3.1. Project Manager

Staff from the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) will serve as the project manager. In particular, Chris Sommers (SCVURPPP staff person and BASMAA Trash Committee Chairperson) will be responsible for coordination of all efforts performed by participating parties and the oversight of contractor efforts.

3.3.2. Installation and Cleanout of Devices

MRP Permittees will be responsible for the installation and maintenance of full capture devices within their jurisdiction. Additionally, MRP Permittees whose devices meet site criteria and choose to participate in the project will be responsible for device cleanout, transport and storage until characterization can occur.

3.3.3. Characterization of Trash/Debris

A contractor selected by BASMAA is anticipated to be responsible for the characterization of trash and other debris removed from full capture device cleanouts using standard operating and quality assurance procedures. The Project Officer will provide oversight of the contractor.

3.3.4. Analysis and Data Management

The Project Officer (SCVURPPP staff) will be responsible for the analysis and interpretation of baseline monitoring data, calculation of default trash generation rates, identification of data gaps, and development of tools for agencies to utilize when applying generation rates to their applicable land areas.

4. Information Sources

To test stated hypotheses, several information sources must be accessed to gather information pertaining to these factors in the San Francisco Bay Area. The following information will be obtained to assist in the development of baseline trash loads.

4.1. Land Use and Population Density (ABAG 2005)

The Association of Bay Area Governments (ABAG) has developed a Geographic Information System (GIS) land use layer for the Bay Area. The 2005 version of the land use layer will be obtained for the projects geographical area and used to determine the land use category(s) within the drainage area for each device monitored through this project. As described in section 5, population density is also included in the residential land use categories in the ABAG dataset.

4.2. Economic Profile (U.S. Census 2000)

The United States Census is conducted every 10 years and provides a wealth of information such as household income and population density by Census tract, city, county or metropolitan area. The most current Census was conducted in 2010, but is still being compiled and not currently available. This project will utilize the most readily available data from the Census Bureau for all counties at the time information is needed. Census data will be used to identify economic profiles of populations within drainage areas of devices monitored through this project.

4.3. Rainfall and Antecedent Dry Weather Days Data

A variety of sources may provide precipitation data for this project. Water and flood control districts and airports are just a few of the agencies that will be asked to provide precipitation data. Data from rainfall gauges located as close to each monitoring site as possible will be sought. Rainfall totals and intensity as well as antecedent dry weather days for each site and sampling period will be determined from these records.

4.4. Street Sweeping and Manual Pickup Data (Participating Permittees)

The individual municipalities participating in the project will need assist in chronicling street sweeping and manual pickup activities within the drainage areas serviced by monitored full capture devices. Additionally, street sweeper type and efficiency, if known, will be collected as well as the existence and degree of parking enforcement applied during the study period.

4.5. Full Capture Device Data (SFEP)

It is expected that many trash full capture devices will be installed during the project. The purchasing and installation of many of these devices will occur through the San Francisco Estuary Partnership's (SFEPs) pilot demonstration project. Through this task, the installation of devices will be tracked using the online data management system developed by SFEP.

5. MONITORING DESIGN

The following section describes the monitoring design selected by the Project Team to provide a reasonable estimate of trash loading rates needed to establish baseline loads from Bay Area MS4s. The design will establish loading rates based on factors identified as important by other studies. That said, not all factors that may influence trash loading rates can be assessed, and therefore loading rates developed through this project are expected to be have a moderate level of confidence. Ideally, trash loading rates and associated loads would be developed with a high level of confidence/certainty based on monitoring conducted at numerous sites (500-1000) equipped with full capture devices over a number of years (5-10) that represent varying climatic conditions due to inherent temporal and spatial variability. However, due to the limited resources Permittees have available conduct this level of monitoring, and the fact that resources are likely better spent on implementing measures to reduce trash in water bodies, establishing loading rates with a high level of confidence and certainty is currently not feasible.

5.1. Monitoring Strata

Devices monitored during this project will be selected to test factors listed in Section 2.1 that may sufficiently explain variability in observed trash loads. Combinations of factors, or monitoring strata, are presented in this section and form the basis of the sampling design. Land use, economic profile, and population density are all factors that are considered *apriori* into the monitoring design through appropriate site selection. Rainfall and antecedent dry weather days are also incorporated into the design via optimal sampling frequency and timing. Although likely important factors, the effects of street sweeping and manual pickup efficiencies on loading rates will be assessed for each monitoring strata during data analysis (i.e., *post-priori*). The data related to street sweeping and manual pickup will be recorded for each of the monitoring sites during the monitoring period along with rainfall and antecedent dry weather days. Factors used to develop monitoring strata are further described in the following sections.

5.1.1. Land Use and Population Density

The Association of Bay Area Governments (ABAG) categorizes land use at several scales. At the broadest scale is the “Urban and Built-Up” category, which serves as the sampling frame for this project. This broad category can be broken into the following categories:

- Residential
- Commercial and Services
- Industrial
- Transportation, Communications and Utilities
- Mixed Commercial and Industrial Complexes
- Mixed Residential and Commercial Use
- Other Urban and Built-Up Land

For the purposes of this project, these categories were reclassified to best allow the testing of potentially influencing factors based on our knowledge of important land uses associated with trash generation. Land use categories based on this reclassification that will be utilized in this project are presented in Table 5-1. The defined land use categories in Table 5-1 cover 88 percent of the developed land use area in the Bay Area. The remaining 12 percent of the developed land area is included in the “other” land use category. Additional information of ABAG land use classifications is presented in Appendix A.

Table 5-1. Reclassified ABAG land use categories that will be utilized during the project.

Reclassified Land Use Category	ABAG Land Use Category Description
High Density Residential	Less than 0.333 acre lots (~9 to 20 DUs* per hectare)
Low Density Residential	0.334 to 5 acre lots (~ 1 to 8 DUs per hectare)
Commercial and Services	Combines 30 ABAG land use categories that include local government, education, research centers, offices, churches, hospitals, and military.
Retail and Wholesale	Retail and Wholesale (may include post offices and hotels)
Light and Other Industrial	Combines 4 ABAG land use categories, including light and unspecified industrial, warehousing and food processing
Heavy Industrial	Heavy Industrial - activities are devoted to heavy fabrication, making and assembling parts which are, in themselves, large and heavy, or to the processing of basic raw materials. Most industries in this category involve mechanical, chemical or heat processing.
Urban Parks	Urban parks - all leisure, ornamental, zoological and botanical parks. Cemeteries, golf courses, and regional parks are not included.
K-12 Schools	Elementary and secondary schools
Other	All land use categories not included above
*DU = dwelling unit	

Similarly, the County of Los Angeles's Trash Baseline Monitoring Study for the Los Angeles River and Ballona Creek Watersheds considered land use categories that are very similar to the proposed categories above (See Appendix B). Los Angeles County combined commercial, service, retail and wholesale into one category, and all industrial land uses into one category as well.

5.1.2. Economic Profile

The reclassified land use categories discussed in the previous section can be further stratified based on economic profile data provided via the U.S. Census. For the purposes of this project, median household income, will serve as the main indicator of economic profile, based on previous studies identified in the literature review for this project.

To establish median household income categories, reported household incomes for participating counties (Alameda, Contra Costa, San Mateo, and Santa Clara) and cities (Fairfield and Vallejo) were combined and a cumulative frequency distribution was developed (Figure 5-1). Based on the need to create a limited number of categories, tri-tiles of the distribution were calculated by identifying the income levels at the 33rd ($50,000) and 66th ($110,000) percentiles.

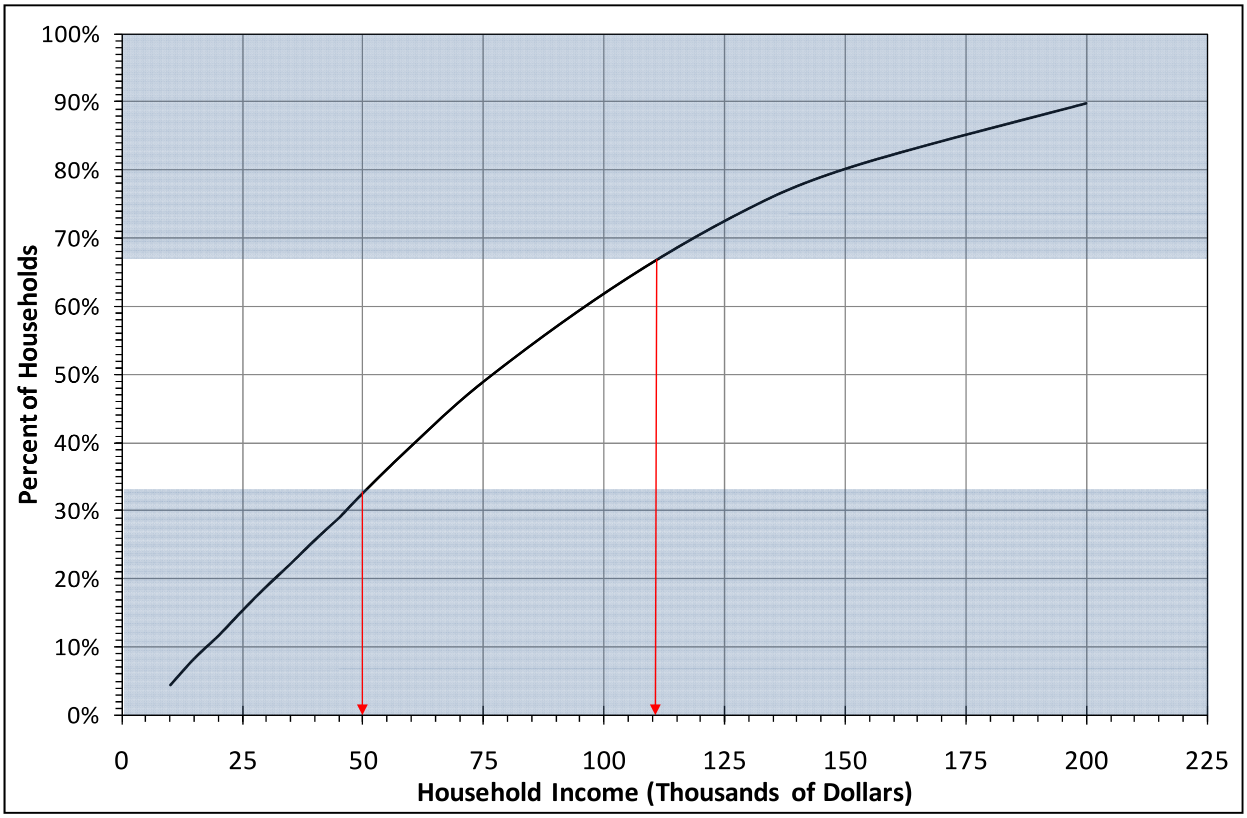

Figure 5-1. Cumulative frequency distribution of household income in the project area.

Based on this analysis, three median household income categories will be utilized for this project:

- **Low income**: areas with an annual household income less than $50,000
- **Medium income:** areas with an annual household income between $50,000 and $100,000 (rounded $110,000 to $100,000 for ease of interpretation); and
- **High income**: areas with an annual household income greater than $100,000.

5.1.3. Final Monitoring Strata

Combining the land use and median household income categories identified yields 24 categories. However, median household income only pertains to residential land uses and those associated with residential areas, such as commercial and retail areas. Therefore, only land use applicable to income categories were further categorized based on income. This resulted in 16 final monitoring site categories based on a combination of land use and income (Table 5-2).

Table 5-2. Final monitoring strata and IDs based on median household income and land use.

Land Use Category	Median Household Income		
	Low (<$50K)	Medium ($50-100K)	High (>$100K)
High Density Residential	*HRL*	*HRM*	*HRH*
Low Density Residential	*LDL*	*LDM*	*LDH*
Commercial and Public	*CPL*	*CPM*	*CPH*
Retail and Wholesale	*RWL*	*RWM*	*RWH*
Light and Other Industrial	*LI*		
Heavy Industrial	*HI*		
Urban Parks	*UP*		
K-12 Schools	*KS*		

5.2. Types of Full Capture Devices

Storm drain inserts and HDS devices provide optimal sampling locations to establish trash loading rates and have been used extensively in previous trash loading studies, as summarized in the preceding Technical Memorandum (EOA 2010). To establish loading rates from Bay Area MS4s, storm drain inserts will be the primary device utilized because they generally drain a relatively small drainage area and have a higher likelihood of draining a single land use/income stratum. HDS devices typically drain larger heterogeneous land uses and income categories. Therefore, these devices are more suitable to assist in calibrating and validating model inputs derived via storm drain inserts. Additional information on the use of full capture devices is provided in Section 8.

5.3. Criteria for Site Selection

To assist the Project Team in identifying monitoring sites that fit within the 19 categories presented in Table 5-2 and work towards meeting project goals, the following monitoring site criteria were developed:

- All devices selected for monitoring must meet the full capture devices or systems definition (i.e., a full capture system or device has the ability to trap all particles retained by a 5 mm mesh screen and has a design treatment capacity of at least the peak flow rate resulting from a one-year, one-hour, storm in the sub-drainage area);
- For storm drain inserts, a minimum of 70 percent of the area treated by the device should fit within one of the land use and income categories in Table 5-2. Additionally, storm drain inserts cannot be equipped by curb inlet screens that block trash from entering the storm drain;
- For HDS devices, the area treated by the device should be heterogeneous and include multiple land use/income categories.

- The municipality that owns or operates a device must be willing to clean out the device according to the schedule described in Section 5.4.1 and must have the ability to transport the material collected to a centralized facility (exact location to be determined).

5.4. Monitoring Sites

5.4.1. Storm Drain Inserts

Existing and newly installed storm drain inserts in the project area will be identified as potential monitoring sites using land use and household income information, and criteria presented in Section 5.2. A minimum of 150 sites (i.e., storm drain inserts) will be selected based on the monitoring strata presented in Table 5-2. Of these 150 sites, data have already been collected from 37 sites between 2008 and 2010 by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), the City of San Jose and City of Sunnyvale.

Site Selection and Strata Weighting

Monitoring sites will be distributed among the 16 strata, to ensure that each is adequately represented. There are a variety of ways to distribute sites and criteria that can be used to do so. For example, the proportion of acreage attributed to each land use and income strata in the project area could be used. However, this site distribution method does not take into account the predicted variability within each stratum, which could complicate data analyses and testing of hypotheses. The magnitude of variability in trash data between land uses is evident in the results of the Los Angeles County's Trash Baseline Monitoring Study (Los Angeles County 2004).

Figure 5-2 was developed from catch basin insert data for that study, and compares the annual trash loading rates by land use. While highest variability was observed in the 28 commercial (public, retail and wholesale) sites monitored, the 35 low density single family residential (LDSFR) areas had the lowest variability. One extreme outlier for the industrial land use sites, whose loading rate was two orders of magnitude greater than the other sites, was excluded from the plot. This site was identified as a heavy industrial site, demonstrating the need to separate industrial land use into two categories.

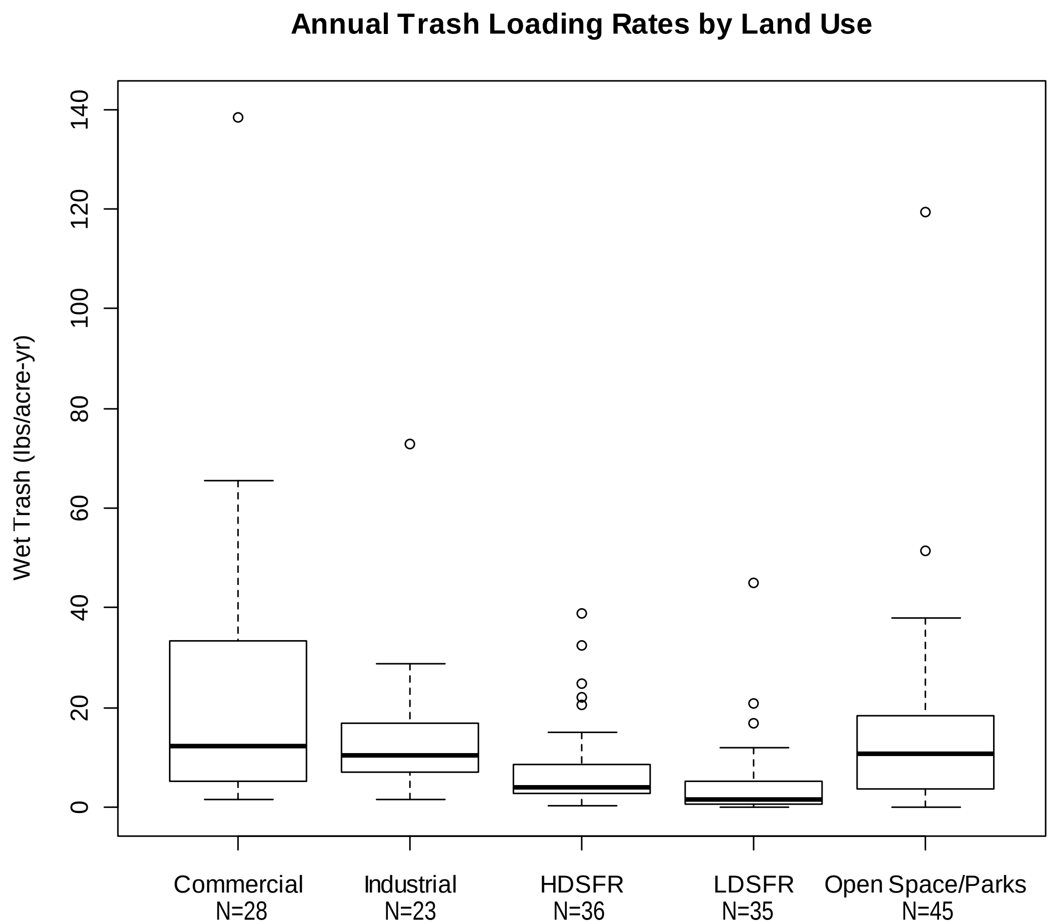

Figure 5-2. Trash loading rates by land use in Los Angeles County based on data collected in 2002-2003 from catch basin inserts (HDSFR is high density single family residential and LDSFR is low density single family residential) (Los Angeles County 2004).

To take into account both the proportional area within each stratum and the anticipated variability in trash loading rates within each stratum, the following method was selected:

1. Develop weighting factors for each monitoring stratum based on the predicted variability of loading rates among sites within that stratum;
2. Apply weighting factors to each stratum and distribute monitoring sites based on these factors;
3. Adjust site distribution based on weighting factors using the proportional areas within each stratum; and,
4. Adjust site distributions to ensure that no less than 3 sites are selected for each stratum.

The optimal distribution of monitoring sites based on the method described above is presented in Table 5-3. It is based on the proportion of land area in the Project Area and predicted variability in land use categories. As the project progresses and storm drain inserts are installed, achieving the desired number of sites for each stratum may not be feasible. Should this situation arise, the site distribution will be adjusted accordingly.

Table 5-3. Ideal percentages of monitoring sites for each land and income strata.

Land Use Category	Area (acre)	% of Project Area	Median Household Income			% of Sites
			Low	Medium	High	
High Density Residential	217,133	42.9	6.0%	6.0%	6.0%	18%
Low Density Residential	109,560	21.6	4.0%	4.0%	4.0%	12%
Commercial and Public	67,126	13.3	3.0%	3.0%	3.0%	9%
Retail and Wholesale	20,970	4.1	13.0%	13.0%	13.0%	39%
Light and Other Industrial	29,550	5.8	6.5%			7%
Heavy Industrial	15,731	3.1	6.5%			7%
Urban Parks	31,865	6.3	4.0%			4%
K-12 Schools	14,232	2.8	4.0%			4%
Totals	506,167	100%				100%

Though the Retail and Wholesale land use comprises only 4.1 percent of the project area, the number of sites required for this land use is high due to the predicted variability, as seen in Los Angeles County (see Figure 5-2). Additionally, monitoring sites will be located within as many Bay Area municipalities as feasible to account for geographical differences in trash loadings.

5.4.2. Hydrodynamic Separators

Existing hydrodynamic separators located in the project area will be evaluated using the criteria described in Section 5.3 (bullet 3). Based on this evaluation, two (2) monitoring sites will be selected. The spatial distribution of sites will also be considered during the sites selection process.

5.5. Monitoring Schedule

Monitoring will be coordinated by the Project Manager, as described in Section 3.3.1, who will inform participating permittees when to sample storm drain inserts and hydrodynamic separators.

5.5.1. Storm Drain Inserts

Monitoring is scheduled to begin in the 2010 wet weather season (October – April) and continue through the 2011 dry weather season (May – September). Additional monitoring may be conducted in 2012 if deemed necessary by BASMAA participants.

From the literature review it was found that there can be high inter-annual variability at the same site (Marais et al. 2004), and it is therefore ideal to sample multiple times, with priority given to the wet season due to highly likelihood of precipitation runoff as the main mode of transport of trash from streets to storm drains. Based on this recommendation, two sampling events will occur during the wet season, and one will occur during the dry season at each of these sites.

For all selected storm drain inserts, if cleanouts occur during the project at times other than those identified as project sampling event (either due to flooding issues or other unforeseen events) a record of the cleanout will need to be taken, including the date of cleanout and the estimated amount of material removed.

5.5.2. Hydrodynamic Separators Cleanouts

Two hydrodynamic separators will be used to verify trash loading rates established via storm drain insert monitoring. Cleanout frequency will be based upon typical maintenance schedules of hydrodynamic separators selected.

5.6. Contingency Monitoring

Once the initial monitoring described in this section is complete and preliminary analyses are conducted, data gaps may be identified. Permittees may choose to conduct additional monitoring at full capture devices to fill these gaps. This determination will be made through BASMAA.

5.7. Summary of the Monitoring Design

A summary of the monitoring design, including the number of devices, purpose, and frequency of monitoring and cleanout occurrence is shown in Figure 5-3.

Purpose	Development of Rate for Individual Strata	Rate Verification
Device	Storm Drain Inserts	Hydrodynamic Separators
Number	150	2
Frequency	3 Times	At least once at the end of the wet weather season

Figure 5-3. Trash baseline loading monitoring design

6. Device Cleanouts

As stated in Section 3.3.2, Permittees will be responsible for cleaning out storm drain insert devices and hydrodynamic separators monitored during the project. Removal of trash and debris should follow procedures described by the Standard Operating Procedures (SOP) summarized below and included in Appendix C for storm drain inserts and Appendix D for hydrodynamic separators.

6.1. Sample Identification

In order to standardize the cleanout reporting, field staff should identify the cleanout and site/device using the following code MMDDYY-XX-NN-#, where MMDDYY is the month, date and year; XX is the city, NN is the device number, and # is the cleanout number. For example, if device number three (3) is cleaned out for the second time on February 15, 2011, its code would be 021511-SJ-03-2. Each party responsible for cleanouts should maintain a list of device numbers and corresponding locations. Example city codes are listed in Table 6-1.

Table 6-1. Example codes for sample identification

City	Code
San Jose	SJ
Dublin	DL
Oakland	OK
Mountain View	MV
Sunnyvale	SV

6.2. Storm Drain Insert Cleanouts

Prior to the start of the project, each of the storm drain inserts will be cleaned out to provide an accurate start date for the first accumulation period. The date of clean out should be recorded and reported. If the date of the most recent cleanout is known (with certainty), then this cleanout may be used as the start date for the first accumulation period. Project cleanouts should follow the procedures in the *Standard Operating Procedure for Storm Drain Insert Trash Removal* (Appendix C).

6.3. Hydrodynamic Separator Cleanouts

Similarly, prior to the start of the project, each of the hydrodynamic separators will be cleaned out to provide an accurate start date for the first accumulation period, unless the date of the last cleanout is known (with certainty). The date of clean out should be recorded and reported. Any additional, non-project related cleanouts should also be reported and, if possible, the volume should be estimated.

Cleanouts of hydrodynamic separators should be completed during dry weather conditions, to ensure that no/low flow in the unit. Project cleanouts should follow the procedures in the *Standard Operating Procedure for Hydrodynamic Separator Trash Removal* (Appendix D).

6.4. Documentation

6.4.1. Field Forms

For device cleanouts, the field form in Appendix E should be completed at the time of the cleanout. Specifically, the date, location and personnel responsible should be noted.

6.4.2. Photographic Documentation

If possible field staff should photograph the storm drain insert or HDS unit prior to and after cleaning.

7. Trash and Debris Characterization

All trash characterization will be consistent with the *Standard Operating Procedure* for *Trash and Debris Evaluation* included Appendix F.

There are two trash and debris evaluation steps. They include:

1) Sorting of trash and debris, and
2) Measuring the volume and weight of stored trash and debris.

For this Project, debris pertains to all material not man-made, such as sediment and vegetation.

7.1.1. Documentation

Staff will use the Program's *Trash and Debris Evaluation Data Collection Form* (Appendix G) to record the total number of recyclable beverage contains, plastic grocery bags and Polystyrene, the total volume and weight of trash in each category.

8. Data Analysis

As stated in Section 3.2, SCURPPPP staff through a BASMAA regional project will manage and analyze data collected. All existing data and associated information on trash captured via monitored full capture treatment devices will be compiled into a simple Microsoft Access database. The following sections briefly describe the preliminary data analysis and interpretation methods that are expected to be used in developing trash generation and loading rates.

8.1. Analysis of Los Angeles County Baseline Trash Study

Data available from the Los Angeles County Baseline Trash Study will be used to examine and quantify the relationship between trash loading rates in different land use areas and total rainfall, maximum hourly rainfall intensity and antecedent dry weather days. The results from the analysis will be extrapolated to the Project Area where practical.

8.2. Storm Drain Insert, Street Sweeping and Manual Pickup Effectiveness

Based on the documentation of existing street sweeping and manual pickup practices in place during the course of the project, and the demonstrated effectiveness of storm drain inserts to capture trash, default trash load generation rates will be developed for each area draining to a storm drain insert. Literature values of the efficiencies of storm drain inserts, street sweeping and manual pickup activities, or efficiencies based on data generated during this project, will be utilized to establish trash load generation rates.

8.3. Hypothesis Testing of Factors Affecting Generation Rates

The potential influence that land use, income and other factors (e.g., traffic patterns, litter generating events, road density, road type, and drainage area size) have on trash generation and loading rates will be tested using multiple statistical tests. Nonmetric Multidimensional Scaling (NMS) ordination, significance tests and other multivariate statistical approaches may be utilized. Based on the results of the hypothesis testing, trash generation rates will be developed for each stratum that appears to be unique. For each municipality, trash loading rates can then be derived from applicable trash generation rates and the application of street sweeping and manual pickup efficiency factors. Trash generation rates will be verified through the procedures described below.

8.4. Verification of Rates

Because of their high level of effectiveness in capturing trash, hydrodynamic separators (HDS) in two drainage areas will likely be monitored to verify calculated trash loading rates. HDS devices drain a much larger areas (than the storm drain inserts) that cover many different monitoring strata. Using trash generation rates established through the process described above, trash loads will be calculated for the drainage areas served by HDSs. The resulting trash loads will be compared to the actual material collected from each HDS to verify baseline loading rates. To the extent possible, loading rates will be adjusted based on empirical data collected from the HDSs.

8.5. Tool to Develop Baseline Trash Loading Rates

During monitoring, information will be collected on extent and predicted effectiveness of existing control measures that are implemented in the area draining to full capture devices. As described previously, default trash generation rates will be developed that assume that no control measures are currently being implemented. These generation rates provide a starting point for “adjusting” generation rates based on the current implementation of control measures within a particular area. The tool will be in the form of an excel spreadsheet and include a guidance document for its application by Permittees.

9. REFERENCES

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BASMAA. (2010). *Trash Baseline Loads Technical Memorandum #1.* Technical Memorandum, Oakland.

Marais, M., Armitage, N., & Wise, C. (2004). The measurement and reduction of urban litter entering stromwater drainage systems: Paper 1- Quantifying the problem using the City of Cape Town as a case study. *Water SA , 30* (4), 469-482.

APPENDIX A

Association of Bay Area Governments
Land Use Categories

DESCRIPTION OF LAND USE CLASSIFICATION CATEGORIES

CATEGORY 1 -- URBAN AND BUILT-UP

NOTE: ***In the five counties of Contra Costa, Marin, Napa, San Francisco, and San Mateo, as well as in the unincorporated portions of Solano and Sonoma counties, the urban land areas do not include local streets and should be considered a basis for net urban acres. However, in the two counties of Alameda and Santa Clara, as well as the incorporated cities of Solano and Sonoma counties, the urban land areas do include streets, and should be considered a basis for gross, rather than net, residential acres.***

CATEGORY 11 – RESIDENTIAL

Residential areas are delineated to include houses, apartments, garages, sheds, and lawns. Streets are included only in limited areas as noted above[1].

In the nine county Bay Area, ABAG has subdivided the residential areas into categories based on density or use as follows:

111 – 1-plus to 5 acre lots (approx. one dwelling unit (DU) per metric hectare (2.47 acres)
112 – 0.334 to 1 acre lots (approx. 2 - 8 DUs per hectare
113 – 0.126 to 0.333 acre lots (approx. 9 - 19 DUs per hectare)
114 – Mobile homes and mobile home parks (technically a part of 113 but listed separately)
115 – Less than 0.126 acre lots (> 8 DUs per acre or 20 DUs per hectare) (no data to allow use in Alameda, Santa Clara, Solano, and Sonoma counties)
118 – Group quarters residential
119 – Recreation and common facilities associated with multifamily residential when available

CATEGORY 12 – COMMERCIAL AND SERVICES

There are a number of types of these facilities, ranging from retail commercial, to military, to educational.

121 – Retail and wholesale

[1] ***When creating a value for "total" residential hectares, or acres, it is useful to view:***
• category 111 as 10% residential and 90% category 17 (urban open)
• category 112 as 50% residential and 50% category 17 (urban open)
• categories 113 - 119 as residential
• category 1234 (university housing) as residential
• category 1251 (military housing) as residential
• category 16 and 161 as 50% residential and 50% commercial
• category 162 as 67% residential and 33% commercial

This category includes central business districts, as well as shopping centers, commercial strip development, and auto salvage operations. It ***may*** also include motels and post offices.

1221 – Recreational vehicle (RV) parks (currently not used)

122 – Commercial intensive outdoor recreation

This category includes intensive areas of recreation which cover a minimum of one acre, such as golf course club houses, tennis courts, amusement parks, swim clubs, drive-in theaters, and the structures in large public (county and state) parks (such as meeting rooms, visitor centers, rental cabins, etc.). These "intensive" recreational uses are mapped separately from the "extensive" outdoor uses shown in Subcategory 171.

123 – Education

This category includes all public and private schools, including pre-schools and subsidiary land (such as parking, administrative structures, recreation areas and dormitories). Seminaries and novitiates are also included. The category is subdivided, when the information is available, into:

1231 – Elementary and secondary schools
1232 – Colleges and universities
1233 – Stadiums
1234 – University housing
1235 – Day care facilities

124 – Hospitals, rehabilitation, health, and State prison facilities

Included in this category are most major hospitals, medical centers, mental health centers, sanitariums, convalescent centers, and State prison facilities.

1241 – Hospitals - designated trauma centers
1242 – Community hospitals (not designated trauma centers)
1243 – Medical long-term care facilities
1244 – Medical clinics
1245 – Home health care facilities (currently not used)
1246 – Out-patient surgery centers
1247 – State prisons (local jails are 1267)
1248 – State mental health and developmentally disabled facilities
1249 – State psychiatric facilities

125 – Military installations[2]

All areas which reflect military use such as armories, National Guard centers, firing ranges, barracks and arsenals have been mapped in this category. Subdivisions of these areas are:

1251 – Military residential
1252 – Military commercial/services (currently not used)
1253 – General military use

[2] ***Both categories 1257 (military open) and 1255 (military communications) can be included with category 17 (urban open) when generalizing these data. Category 1251 (military residential) can be included with category 11 (residential).***

1254 – Military hospital
1255 – Military communications
1256 – Military airport
1257 – Military open areas
1258 – Military port
1259 – Closed military facilities (including airports, ports, and hospitals)

126 – Local government and other public facilities

This category includes major government facilities, typically at least two acres (one hectare) in size. Such facilities may include libraries, post offices, police and fire stations, city and county government complexes, and state and federal facilities. Eight subcategories of facilities have been included:

1261 – Stadium (when not associated with a college or university)
1262 – Churches, synagogues, and mosques (if associated school, entire area tends to be 1231 or 1232)
1263 – Fire station
1264 – Police station
1265 – City halls, and county, state, and federal government centers
1266 – Government Emergency Operations Centers (EOCs)
1267 – Local government jails and rehabilitation centers (State prisons are 1247)
1268 – Convention centers
1269 – Museums, libraries, and community centers

127 – Research centers

Major research centers (including both offices and laboratories) have been included in this subcategory.

128 – Offices

Some major areas of offices or professional centers have been identified and mapped in this subcategory.

129 – Hotels and motels

In certain parts of the Bay Area, particularly in San Francisco, areas predominately composed of hotels or motels have been mapped.

CATEGORY 13 – INDUSTRIAL

This category includes the subcategories of heavy and light industrial, and metal salvage or recycling.

In the nine-county Bay Area, industrial use has been separated into these uses based both on the type of production and the product manufactured. For example, the manufacturing of locomotives would be considered heavy industrial, whereas the manufacturing of model trains would be considered light industrial.

131 – Heavy industrial

These industrial activities are devoted to heavy fabrication, making and assembling parts which are, in themselves, large and heavy, or to the processing of basic raw materials. Most industries in this category involve mechanical, chemical or heat processing. Although salt evaporation ponds along San Francisco Bay might be considered part of this category, they are considered a part of "63 – Salt Evaporation Ponds" for purposes of this mapping effort.

132 – Light industrial

These industrial activities include the design, assembly, finishing and packaging of products, rather than with processing basic raw materials. Typical industries in this category include electronics firms, small textile mills, warehousing, and assembly plants. These facilities have been mapped along with associated parking lots and grounds.

133 – Metal salvage and recycling

The large-scale recycling of metal in salvage yards is a form of industrial operation that does not fit the standard definitions of heavy or light industrial operations. Thus, it is given its own category rather than being placed in the general 13-Industry category.

134 – Food processing

Some portions of the region have areas designated for the processing of food, such as wineries and canneries. These areas are distinct from areas of agriculture used for food production.

135 – Warehousing

Some portions of the Bay Area are staging areas for the storage or transportation of goods. Warehousing areas have been mapped where information was sufficient to define specific areas.

139 – Industrial common areas (currently not used)

CATEGORY 14 – TRANSPORTATION, COMMUNICATION AND UTILITIES

This category includes eight infrastructure systems as subcategories. A great deal of effort has been made to place many of these facilities in the appropriate four-digit subcategory. However, due to the sporadic availability of road and freeway information, there are some inconsistencies, as indicated below.

141 – Road transportation facilities
1411 – Freeways and interchanges (both paved areas and adjacent rights-of-way are included; some local roads in Solano County are also included this category)
1412 – Bus transit centers (currently not used)
1413 – Park and Ride lots (for car pools)
1414 – Truck or bus maintenance yard
1415 – City, county or utility corporation yard (for the maintenance of their vehicles)

1416 – Parking garages and some parking lots (most parking lots associated with a building are assigned the use of that building)
1417 – Inspection and weighing stations
1418 – Local streets and roads (includes some highways in San Mateo, Napa, and Marin counties, and the unincorporated portion of Sonoma County)
1419 – Walkways and bicycle paths (currently not used)

142 – Rail transportation facilities
1421 – Rail passenger stations (including Amtrak, BART and CalTrain)
1422 – Rail yards (included are switching, classification and maintenance yards, as well as terminals)
1423 – Light rail stations (currently not used)
1424 – Light rail yards (currently not used)

143 – Airports
This subcategory is broken down into commercial airports (with 6 groups), public (general aviation), and private airfield. In the Bay Area, the three commercial airports of San Francisco, Oakland and San Jose are shown.
1431 – Commercial airport passenger terminal
1432 – Commercial airport air cargo facility
1433 – Commercial airport airline maintenance
1434 – Commercial airport runway
1435 – Commercial airport utilities (water, communications, power)
1436 – Commercial airport - other (including parking, buffers, and other land related to airport operations)
1437 – General aviation (public) airfield
1438 – Private airfield (note - not all private airfields are identified)

144 – Marine transportation facilities
This category is characterized by port or dock facilities and associated warehouses and storage areas. This category also includes passenger terminals, slips and associated parking areas. The five commercial ports in the Bay Area (Oakland, San Francisco, Richmond, Benicia and Redwood City) are subdivided. The tug, marina, and ferry facility locations are shown.
1441 – Commercial port passenger terminal
1442 – Commercial port container terminal
1443 – Commercial port oil and liquid bulk terminal
1444 – Commercial port - other terminal and ship repair
1445 – Commercial port storage and warehousing
1446 – Tow boat (tug) facility
1447 – Ferry terminal (including associated open areas and parking)
1448 – Marina

145 – Power facilities

1451 – Electricity – Power plant

1452 – Electricity – Substation (not associated with industrial activities and covering the minimum mapping size requirement of 2 acres or 1 hectare)

1453 – Electricity – Other (including power transmission lines meeting a 55-yard (50 meter) minimum mapping specification)

1454 – Service center (currently not used)

1455 – Building (currently not used)

1456 – Natural gas facility (currently not used)

146 – Municipal wastewater facilities

1461 – Wastewater treatment plant

1462 – Wastewater pumping station

1463 – Wastewater storage

147 – Municipal water supply facilities

1471 – Water treatment (filtration) plant

1472 – Water pumping station

1473 – Water storage (covered)

1474 – Water storage (open)

148 – Communication facilities

1481 – Communications – Network tower (currently not used)

1482 – Communications – Tower (currently not used)

1483 – Media broadcast tower and communications facilities

1484 – Telephone company "offices" (currently not used)

CATEGORY 15 – MIXED COMMERCIAL AND INDUSTRIAL COMPLEXES

Areas of mixed commercial and industrial use, as well as areas of multiple commercial and industrial uses within a single structure, have been placed in this category. Areas of predominately commercial use or predominately industrial use are ***not*** included, whenever feasible. Mixed residential and commercial areas have been included as part of Category 16. Note that areas of scrap metal recycling are included in Subcategory 133.

CATEGORY 16 – MIXED RESIDENTIAL AND COMMERCIAL USE

Mixed residential and commercial uses, whether in an area or within a single structure, have been placed in this category. Mixed land use is common in areas converting from residential to commercial. Also, rural centers often are too small to map separately as commercial or residential.

161 – Transitional (mixed use of land areas)

162 – Mixed use in buildings

163 – Mixed agriculture and food processing (with residential at times)

CATEGORY 17 – OTHER URBAN AND BUILT-UP LAND

Areas that have been affected by urban development but with minimal paving and buildings are included in this category.[3]

171 – Extensive recreation

Included in this category are athletic fields and playgrounds. When available, two subdivisions are shown:

- 1711 – Golf courses (the extensive, not the intensive, portion – thus, the golf clubhouse is usually shown as Category 122)
- 1712 – Racetracks
- 1713 – Camps and campgrounds

172 – Cemeteries

Public, private and military cemeteries are included.

173 – Urban parks

All leisure, ornamental, zoological and botanical parks are included when the use is apparent. However, areas of extensive tree cover may be classified as forest. Thus, city parks are included in this category, but large parks (such as those operated by the East Bay Regional Park District or county park districts) are subdivided into forest, grassland, etc. and noted as "protected").

174 – Open space – slated for redevelopment

This category includes land that ***has been developed*** as an urban use but is currently open waiting for redevelopment.

175 – Urban vacant undeveloped land

Undeveloped open areas and vacant lots slated for urban development, as well as open areas on the urban/rural boundary are shown in this category. Typically, these lots are small in size and have had some clearing or other activity occur in preparation for construction. When know, the following subdivisions are also included:

- 1751 – Vacant residential
- 1752 – Vacant commercial or services
- 1753 – Vacant industrial
- 1754 – Vacant infrastructure (currently not used)

[3] ***Note: for purposes of obtaining a general "urban open" total area, Subdivisions 1255 (Military Communications), 1257 (Military Open), 90% of 111 (Rural Residential), and 50% of 112 (Low-Density Residential) can be included in this category.***

APPENDIX B

Los Angeles County Land Use Categories
for Trash Baseline Monitoring

Los Angeles County Land Use Categories for Trash Baseline Monitoring (Los Angeles County 2002)

Land Use Category	Los Angeles County Descriptions
High Density Single Family Residential (HDSFR)	Single family residential units with a unit density greater than 2 units per acre (5 per hectare) – typically found in modern urban and suburban subdivisions – and multi-family residential (apartments, condominiums, townhomes, etc.).
Low Density Single Family Residential (LDSFR)	Single family residential units with a unit density less than 2 units per acre. Includes urban ranch homes and estates and urban areas where single family lots have been established but house have not been built on all of them and are not likely to be built in the near future.
Commercial and Service	Includes areas which are used predominantly for business or the sale of products and their associated services. Also, some non-commercial uses such as government and public service office. Skyscrapers, retail stores and commercial services such as shopping malls, commercial storage, commercial recreation, hotels, motels, attended pay public parking facilities
Open Space/Parks	Developed open areas with urban settings, and urban and non-urban areas developed for recreational activities, including golf courses, local parks and recreation, regional parks and recreation, cemeteries, wildlife preserves and sanctuaries, specimen gardens and arboreta, and beach parks.
Industrial	Areas where manufacturing, assembly, processing, or packaging of products takes places including light industrial (manufacturing, motion picture, packing houses and grain elevators, research and development, winery) heavy industrial (manufacturing, petroleum refining and processing, open storage, major metal processing, chemical processing), wholesale and warehousing.

APPENDIX C

Standard Operating Procedure for
Storm Drain Insert Trash Removal

DRAFT
Standard Operating Procedures
Storm Drain Insert Trash Removal

Prepared for

Bay Area Stormwater Management Agencies Association

January 2010

Prepared by

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1.0 Purpose and Applicability

The purpose of this Standard Operating Procedure is to detail all steps for removing trash and debris from storm drains sited with storm drain inserts. Trash and debris removed from cleanout activities will be transported to a designated facility for evaluation. The evaluation process is an important step in the development of baseline trash loading rates in accordance with Permit Provision C.10.a.ii of the Municipal Regional Permit.

2.0 Definitions and Acronyms

2.1 Acronyms

BASMAA: Bay Area Stormwater Management Agencies Association

SOP: Standard Operating Procedures

2.2 Definitions

Debris: Natural, not man-made, material, including vegetation and sediment. This does not include trash.

Hydrodynamic Separator: Devices which use the tangential forces created by the incoming flow of water to separate trash, debris, oil and other pollutants from stormwater. Hydrodynamic Separators (HDSs) are also known as vortex separators or swirl concentrators.

Litter: According to the California Government 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 waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling, or manufacturing" (CA State 2011).

Storm Drain Insert: A full capture treatment device sited in a storm drain to prevent trash and debris from entering receiving waters.

Trash: Man-made litter (see Litter).

3.0 Health and Safety Warnings

3.1 Health

3.1.1 Heavy Lifting

Acute back injuries can be the immediate result of improper lifting techniques and/or lifting loads that are too heavy for the back to support. When lifting a heavy storm drain grate, avoid lifting the grate alone, if possible. Lift with the legs, not the back, by bending at the knees, not at the waist. Avoid twisting while carrying the grate and instead turn the entire body. If necessary, ensure that proper back support is worn during the lifting process.

3.1.2 Pathogens and Toxic Chemicals

Because pathogens and toxic chemicals in stormwater pose a health risk, gloves should be worn at all times. Avoid contact with skin, mouth, eyes and nose. After completion of work, immediately wash hands with soap and hot water.

3.1.3 Sharps

There is a risk of injury due to sharp objects that may have been collected by storm drain inserts. Pay close attention and handle trash and debris carefully to prevent accidental cuts and scrapes. If accidental cuts and scrapes do occur, ensure that tetanus shots are up-to-date to prevent infection.

The negligent handling of trash and debris could lead to infection or other serious ailments.

3.2 Safety

Because storm drain inserts may be sited in heavily trafficked areas, ensure that a traffic control program is in place during cleanouts. At a minimum, orange safety cones should be placed around the cleanout site.

4.0 Personnel Qualifications/Responsibilities

At least one person who has prior experience cleaning a storm drain insert should be present during the cleanout. Inexperienced field staff may assist experienced staff, but may not clean the device without supervision.

5.0 Equipment and Supplies

To remove trash and debris from storm drains sited with storm drain inserts, the following equipment and supplies will be required:

- Grate tool to remove storm drain grate;
- Digging tool (e.g., clam shell or flathead shovel);

- Heavy duty garbage bags to transport collected trash and debris;
- Tags or labels to identify bags;
- Permanent marker to mark tags or labels; and
- Device Cleanout Field Form;

6.0 PROCEDURES

Storm drain insert cleanouts should be performed during periods of low flow through the storm drain, ideally during dry weather days. The following steps should be conducted:

1) Remove the storm drain grate and place it out of the way.
2) If not affixed, remove the storm drain insert from the storm drain. If affixed, keep storm drain insert in place.
3) Remove all trash and debris from the storm drain using a digging tool.
4) Place all trash and debris into garbage bag(s).
5) Ensure that all trash and debris is removed from the storm drain insert (e.g. removed from the screen of the device).
6) Label or tag heavy duty garbage bag(s) with device ID# and cleanout date. Use a permanent marker when labeling or tagging bag(s).
7) If the storm drain insert was removed, place it back in storm drain.
8) Replace the storm drain grate.
9) Prior to departing cleanout site, prepare Device Cleanout Field Form with required information.
10) Transport bag(s) to designated facility for storage and evaluation. The location of the designated facility will be provided to participating jurisdictions.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE

As a quality control measure, take photographs prior and immediately following cleanouts.

To accurately determine the volumes of trash and debris collected by storm drain inserts for cleanouts not part of this project, collect trash and debris in accordance with this SOP, if possible. If collection is not possible in accordance with this SOP, at a minimum, record the date of the cleanout.

8.0 REFERENCES

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Occupational Safety & Health Administration (1999). Section VII: Chapter 1, Back Disorders and Injuries. *OSHA Technical Manual*. TED 01-00-015

APPENDIX D

Standard Operating Procedure for
Hydrodynamic Separator Trash Removal

In development

APPENDIX E

Device Cleanout Field Form

In development

APPENDIX F

Standard Operating Procedure
for Trash and Debris Evaluation

DRAFT
Standard Operating Procedures
Evaluation of Trash and Debris Removed from Full Capture Trash Devices

Prepared for
Bay Area Stormwater Management Agencies Association

January 2010

Prepared by

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1.0 PURPOSE AND APPLICABILITY

The purpose of this Standard Operating Procedure is to detail all steps for evaluating trash and debris collected from full-capture trash devices, including storm drain inserts and hydrodynamic separators. Trash and debris evaluation is an important step in the development of baseline trash loading rates in accordance with Permit Provision C.10.a.ii of the Municipal Regional Permit.

2.0 SUMMARY OF METHODS

A summary of the methods involved in the evaluation of trash and debris removed from full-capture devices is shown in Figure 2-1.

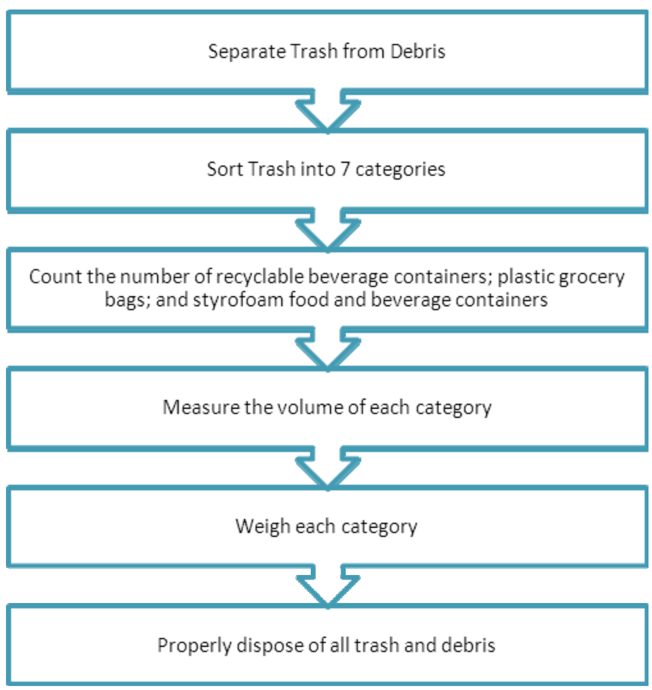

Figure 2-1: Summary of Methods for Evaluating Trash and Debris Removed from Full-Capture Devices

3.0 ACRONYMS AND DEFINITIONS

3.1 ACRONYMS

BASMAA: Bay Area Stormwater Management Agencies Association

SOP: Standard Operating Procedures

3.2 DEFINITIONS

Debris: Natural, not man-made, material, including vegetation and sediment. This does not include trash.

Hydrodynamic Separator: Devices which use the tangential forces created by the incoming flow of water to separate trash, debris, oil and other pollutants from stormwater. Hydrodynamic Separators (HDSs) are also known as vortex separators or swirl concentrators.

Litter: According to the California Government 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 waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling, or manufacturing" (CA State 2011).

Storm Drain Insert: A full capture treatment device sited in a storm drain to prevent trash and debris from entering receiving waters.

Trash: Man-made litter (see Litter).

4.0 HEALTH AND SAFETY WARNINGS

Because pathogens and toxic chemicals in stormwater pose a health risk, gloves should be worn at all times. Avoid contact with skin, mouth, eyes and nose. After completion of work, immediately wash hands with soap and hot water.

There is a risk of injury due to sharp objects that may have been collected by full-capture devices, including storm drain inserts and hydrodynamic separators. Pay close attention and handle trash and debris carefully to prevent accidental cuts and scrapes. If accidental cuts and scrapes do occur, ensure that tetanus shots are up-to-date to prevent infection.

The negligent handling of trash and debris could lead to infection or other serious ailments.

5.0 PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

A field supervisor will be present to ensure standardization. Additionally, pay close attention to details to avoid errors.

6.0 EQUIPMENT AND SUPPLIES

Sorting and evaluating trash and debris will require a large workspace in an area with little wind and the following equipment:

- At least seven buckets or containers with known volumes (e.g. 1-5 gallons);

- Tape measure, ruler, or yardstick;
- Scale;
- *Trash and Debris Evaluation Data Collection Form;* and
- Pen

7.0 PROCEDURES

Sorting and evaluation of trash and debris should be done on a large worktable in areas and periods of the day that are not susceptible to wind.

7.1 SORT TRASH AND DEBRIS

Separate all trash items from debris and place all debris in a large box or container of known volume (e.g., preferably a box or container no smaller than 12 gallons).

Sort trash into the following seven categories:

1) Recyclable Beverage Containers (CRV labeled),
2) Plastic grocery bags;
3) Styrofoam (i.e., food and beverage containers);
4) Other Plastic (all others excluding plastic grocery bags)
5) Paper
6) Metal;
7) Miscellaneous.

Examples of items that fall into each category are described in the *Trash Category/Type* Worksheet provided within Appendix G. If an observed trash item is not on the list, use best professional judgment in determining which trash category the item may be described as.

While sorting, place the seven trash categories and/or types in separate buckets (1-5 gallons) and other containers (smaller than one gallon, variable sizes) for volume determination. Use plastic bags inside the box or container to facilitate removal and disposal of debris during the sorting process.

7.2 ITEM COUNTS

After sorting is completed, individually count the **total number** of recyclable beverage containers (CRV labeled), plastic grocery bags and Styrofoam (i.e., food and beverage containers). Use the *Trash and Debris Evaluation Data Collection Form* (Appendix G) to record the total number of these three trash types.

Once these trash items are counted, place recyclable beverage containers (CRV labeled), plastic grocery bags and Styrofoam (i.e., food and beverage containers into separate sorting buckets or containers.

7.3 VOLUME AND WEIGHT MEASUREMENTS

When measuring total volume of trash, ensure that it is un-compacted. Measure the total volume of each trash category using buckets and containers of known volume. Since all buckets and containers will not be full, in most cases, use a tape measure, ruler or yard stick to estimate total volume.

Example: A two-gallon bucket is determined to be one-thirds full when measuring with a ruler, the estimation of the total volume of trash within the bucket would be 0.33 X 2 gallons = 0.666 gallons.

Record the total volume of each trash category on the *Trash and Debris Evaluation Data Collection Form* (Appendix G).

On the same form, record the total number of boxes and/or containers of debris sorted. To determine the total volume of debris sorted, multiply the total number of boxes and/or containers with the known volume of the box and/or container. For example, if you filled five 12-gallon boxes and two five gallon buckets with debris, the total volume of debris sorted would be 70 gallons.

Properly dispose of all trash and debris.

8.0 QUALITY CONTROL AND QUALITY ASSURANCE

To be developed.

9.0 REFERENCES

California State (2011). California codes. Government Code Section 68055-68055.9. Available at http://www.leginfo.ca.gov/ (Accessed January 2011).

APPENDIX G

Trash and Debris Evaluation Data Collection Form
and Trash Categories/Types Worksheet

Debris and Trash Evaluation Data Collection Form

Device ID #: ____________ **Date:** ________________ **Time:** __________ **Staff:** ________________________________

Debris

Moisture Content[1]			Number of Bucket(s)[2]						Total Volume (gallons)	Total Weight (pounds)
Dry	Damp	Wet	5 gal	2 gal	1 gal	64 oz	32 oz	16 oz		

Trash

Trash Category/Type[3]	Number of Bucket(s)[2]						Total Number (pieces)	Total Volume (gallons)	Total Weight (pounds)
	5 gal	2 gal	1 gal	64 oz	32 oz	16 oz			
I. Recyclable Beverage Containers (CRV-labeled)									
II. Plastic Grocery Bags									
III. Styrofoam Food and Beverage Ware									
IV. Other Plastic							**N/A**		
V. Paper							**N/A**		
VI. Metal							**N/A**		
VII. Miscellaneous							**N/A**		

[1] A description of moisture content is provided on the next page.
[2] The number of buckets used to determine total weight of debris and trash.
[3] A description of each trash category/type is provided on the next page.

Moisture Content Definitions and Trash Categories/Types Worksheet

Moisture Content

Dry
Material that is free of liquid or water.

Damp
Material that appears slightly wet, damp or humid.

Wet
Material that is covered or soaked with liquid or water.

Trash Category/Type

I. Recyclable Beverage Containers (CRV labeled)

II. Plastic Grocery Bags

III. Styrofoam Food and Beverage Ware
Styrofoam Take Out Food Containers
Styrofoam Beverage Containers (e.g., cups)
Syrofoam Bowls
Styrofoam Plates

IV. Other Plastic
Plastic Bags (Other)
Snack Food Wrappers
Cigarette packaging
Plastic Cap
Plastic Cup/Lid/Straw
Plastic Utensils
Styrofoam Packaging
Styrofoam Pieces
Plastic Band, 6-pack ring
Plastic Pieces
Phone Card
Other Plastic Products

V. Paper
Food Container
Paper Cup/Plate
Paper Napkin
Receipt, Bus/Train Card
Newspaper, Magazine, Flyer
Cardboard
Lottery/Scratcher Card
Other Paper Products

VI. Metal
Aluminum/Steel Can
Bottle Cap
Pipe, Rebar
Wire
Machine part
Nail, Bolt, Screw
Other Metal

VII. Miscellaneous
Glass Bottle (non-CRV labeled)
Glass Jar or Container
Glass Pieces
Other Glass
Rubber
Foam
Toy, Balloon
Foil Wrapper
Cigarette Butt
Golf Ball
Tennis Ball
Synthetic Fabric
Natural Fabric (cotton, wool)
Wood Debris
Other Wood
Other Miscellaneous

Draft Sampling and Analysis Plan Comments

Commenter: **Jamison Crosby**

Report Section and/or Page #	Comment	BASMAA Response
General Comment	Need to see the overall matrix of possible combinations of income levels with land uses and the plan to fill those boxes with various sites. Need to see an overall breakdown of the number of samples that should be taken from each county with the intent of making them proportional to population. Then populate the matrix with the sites already done in Santa Clara and see what other opportunities we have. Sampling should not commence until we have a good idea of how the locations will be distributed among the counties.	At the December 2010 BASMAA Trash Committee meeting, tables were distributed showing existing sites that will be used to develop trash baseline loads and sites needed, based on overall goals of distributing sites. These tables provide the general geographic distribution of sites in the Bay Area.
Section 2.1, Page 5, Second Sentence	Top of the page, second sentence. Include the word "small" when referring to cities. "The MRP applies to all 76 small, medium and large municipalities…."	The requested change was made.
Section 2.1, Page 5, Last Paragraph	The paragraph at the bottom lists a number of factors. Each factor should be preceded with a number. So, "The conceptual model is shown in Figure 2-1, and identifies the following seven factors, both anthropogenic and natural, that most likely influence the amount of trash entering MS4s: 1) Land use; 2) Population Density, 3) Socio-Economic Profile…etc.	The requested change was made.
Section 3.3.1, Page 9	Heading should refer to Project Officer, not Project Manager. Technically, BASMAA rules say the PO can't be the same person as the PM and I think here you're referring to the PM.	The requested change was made.
Section 5.1.1, Page 11	7th bullet list should include "traffic volume/total vehicle count" as 8th bullet	We are unsure how we would obtain vehicle traffic volumes for all sites. If the commenter can provide us the source of this information, then we will evaluate this characteristic with the others described in the SAP.
Section 5.4.2, Page 16	Section 5.4.2 refers to evaluating 6 hydrodynamic separators. Project profile says 4. Is it 6 or 4?	Based on all comments received, the total number of HDS units that will be included in the study is two.
Section 5.7, Figure 5-2, Page 17	Figure 5-2, is Traffic count included in "Land Use and Income Loads" bubble? If not, it should be. Also, "income load" is a very strange terminology.	See response above re: traffic count. Land use & Income Loads changed to "Trash Loads for all Applicable Strata"
Section 7.1, Page 20	Section 7.1, Says 20 gallons of material will be removed from the storm drains and sorted and characterized. Assuming there is more than 20 gallons in a drain, this is essentially like taking an aliquot. What measures will be taken to assure that this 20 gals is representative of all the material in the drain?	Based on the comments received and data from previous evaluations trash in full capture devices, all material collected from storm drain inserts will be characterized (no subsampling). For HDSs, all material from the screening device (i.e., floatables) will be characterized, and a representative sub sample will be characterized from the wet well. Sub sampling will be conducted with a high level of quality assurance.

Commenter: **Paula White**

Report Section and/or Page #	Comment	BASMAA Response
Section 5.1.3, Table 5-2, Page 14 Section 5.4.1, Table 5-3, Page 16	It is unclear how median household income is associated with commercial and public and retail and wholesale land uses. Does the drainage area include both residential and these non-residential land uses? Also, transit stops, particularly BART/Train stations are often high trash generation areas. They might skew data if they're present near some tcd's with a given land use and not another. Are primary schools high trash generation areas? Why are they included, but not middle/high schools? Spatial distribution?	The US Census data provides median household incomes for all census tracts, residential and non-residential land uses. This datalayer was used to assess the income of non-residential areas. We agree. The proximity of sites to public transit stations will be tracked as sites are identified. The term "primary schools" include all K through 12 schools. To make this more explicit, we have change the name to K-12 schools.
Section 6.3, Page 19	Steps for cleaning hydrodynamic separators. Typo in step 2 and garbled text in step 3.	The requested change was made.
Section 7.1, Page 20	How was 20 gallon ceiling determined? Related to capacity of storm drain inserts?	Based on the comments received and data from previous evaluations trash in full capture devices, all material collected from storm drain inserts will be characterized (no subsampling). For HDSs, all material from the screening device (i.e., floatables) will be characterized, and a representative sub sample will be characterized from the wet well. Sub sampling will be conducted with a high level of quality assurance.
Appendix E—Trash Category/Type Worksheet	Question about trash categories and types (appendix E—Trash Category/Type Worksheet). These appear similar to URTA categories but missing biohazards and toxics. Also, more detailed characterization of paper, metal. What is rationale for categories? Predominance? Key question: Since item counts will only be performed for categories I-III, what is the purpose for calling out the items in categories IV-VII? Why not count them if they're going to be sorted anyway?	The rationale for counting some types of trash and not others is that some types of materials are being considered for bans or prohibitions by some municipalities and item counts may be the best information for these efforts. The other categories are based on material type, which is the easiest way to classify trash types. Counting all types would be resource intensive and outside of the need of this project. That said, we are more than willing to provide the sorted trash to individuals who would like to do further characterization.
Appendix E—Trash Category/Type Worksheet	Category II. Plastic. Plastic grocery bags. Does this include smaller non-labeled/branded plastic bags dispensed at convenience/liquor stores (often black or pink) or by other retailers? Cigarette packaging appears under Cat IV, Plastic while cigarette butt is in Cat. VII, miscellaneous.	Yes. It includes all plastic bags distributed at convenience or grocery stores. Correct.

Commenter: **Paula White**

Report Section and/or Page #	Comment	BASMAA Response
	Suggest separate category for smoking-related, as on Coastal Cleanup Day data card, which categorizes trash by activity. Or, have more general category called tobacco products under miscellaneous. Paper V. Should have paper bag listed; presumed replacement for plastic bags ergo could be useful data point to measure product substitution as a result of plastic bag ban. Separate receipt from bus/train card (put on two lines—they are dissimilar). VII. Miscellaneous. "Bottle" problematic because could be plastic or glass. Also, presumably not recyclable, since category I is for recyclable beverage containers. Foil wrapper—Is this the same as aluminum foil? Since it's recyclable could again be a useful data point for tracking product substitution (foil instead of Styrofoam or plastic wrap). Put under metal? Golf/tennis ball, each have separate line, whereas toy/balloon together on one line. Why not just have a category for balls? Glass piece/other glass—delete glass piece Wood debris/other wood—delete one (other wood?) Add batteries (fairly commonly found and they are regulated under state law.) Add item called "composite" or "mixed material" or something similar. This would cover metal lined paper/cardboard containers and plastic/metal blends.	See response above related to types. See response above related to types. Example was changed to make clearer. Now under metal. Comment pertains to all remaining: These are only provided as examples. We do not intend for these items to be characterized separately.
Section 7.2.1, Page 21 and Appendix B	Standard Operating Procedure for Storm Drain Insert Trash Removal and Evaluation. Individual counting of items in first 3 categories, recyclable beverage containers, plastic grocery bags, Styrofoam. I'm guessing 2 and 3 because of proposed/enacted bans, and 1 because of existing container laws. Will analysis be performed on efficacy of source reduction legislation? Also, instructions for placing recyclable containers into four material-based trash categories (plastic, paper, metal and miscellaneous) for volume measurements should specify that these recyclable materials be put into plastic bags for ease of removal later in accordance with step 7.3, disposal, where separation of trash is	The requested change was made.

Commenter: **Paula White**

Report Section and/or Page #	Comment	BASMAA Response
	encouraged. Otherwise, it probably won't happen.	
Section 8.1.1, Page 22	"Literature values of street sweeping…efficiencies based on data generated during this project will… establish trash load generation rates." Does this mean that an equation published in literature review will have empirical data plugged into it? If so, will trash categorization of street sweeping/manual pick up also occur? Where is efficiency data coming from?	Data needs associated with determining the efficiencies of street sweeping and manual pickup will be discussed by the Committee to determine next steps. Decisions on which efficiencies to use have not yet been made.

Commenter: **Peter Mangarella**

Report Section and/or Page #	Comment	BASMAA Response
General Comment	**Controlling Effects of Rainfall:** I think we would all agree that rainfall is one of several important factors affecting trash delivery into drainage system. Ideally to isolate this effect, you would sample all inlets at the same time so that all inlets are subject to the same rainfall events. However, in the December 16th meeting we discussed the possible need to stagger the sampling because of the delay in setting up inserts in the various cooperating agencies. The effect of this is to allow your sampling plan to actually add to the variability in this factor and I think that will compromise the data and the data analysis	It is highly likely that all inlets will be cleaned in roughly the same timeframe (2 weeks) to reduce variability.
General Comment	**Controlling Effects of Street Sweeping:** On a similar note the divergence of street sweeping practices in catchments being sampled will introduce additional variability in the data set. Ideally you would have some control over this effect by specifying a sweeping schedule that is uniform across the sampling catchments. I can imagine that this might be difficult to impose, and perhaps as an alternative could you request that no street sweeping be conducted? (I know the SAP calls for incorporating this effect with the completion of forms documenting street sweeping practices, but documentation is quite different from control)..	We very much appreciate the suggestion of how to reduce the inherent variability. The project has resources to target roughly 140-175 sites and sample each three times. The ideal sampling timeframe under this frequency is to allow accumulation to occur for a number of weeks/months. Therefore, discontinuing street sweeping for this period of time is not feasible.

Commenter: **Peter Mangarella**

Report Section and/or Page #	Comment	BASMAA Response
General Comment	**Controlling Effects of Insert Selection:** We are all concerned that inserts are not full capture, and effectiveness will be function of insert design. Also we have no means of measuring insert effectiveness and the hope that we could somehow do this in a verification step using the CDS data is unclear. Would it be possible to decide on only one type of insert, and ideally one that was tested for effectiveness in the LA county study?	All devices being used are vertical storm drain inserts that screen debris from entering the outflow pipe. These designs are what municipalities in LA County have settled on after piloting many designs over the last 8 years. Although each device in the Bay Area will be manufactured to meet the specifications of each storm drain inlet, the designs of devices being installed in the Bay Area are very similar. These similar designs will likely reduce the inherent variability typical between different types of devices. Unfortunately, based on our review of the literature, the effectiveness of these vertical storm drain inserts have not been studied in LA or elsewhere. That said, these devices are assumed to be more effective than those previously studied. Over the next few months, BASMAA will continue to discuss options for determining the effectiveness of these devices.
Section 2.2 Page 6	**Comment on Null Hypothesis:** Rather than natural and unexplainable, would random be a better term???	The suggested change was made.
Section 2.3 Page 7	**Comment on T_{Load} Provided in Formula:** Focus seems to be volume, but is mass important, if not justify rationale for volume - eg, is volume the measure called for in MRP??	The MRP allows volume or mass to be used as the basis for load estimates. Both will be measured during the study.
Section 3.2, Page 8	**Comment on Full-capture Drain Inserts:** Given that drain inserts are not technically full capture devices, how do you plan to correct data for trash that has bypassed units?? I know Chris mentioned this issue in last trash meeting, but maybe it should be addressed here or somewhere in the SAP.	In part, the analysis of trash in hydrodynamic units will be used to assess the estimated proportion of trash that bypasses storm drain inserts. Additionally, over the next few months BASMAA will continue to discuss options for determining the effectiveness of these devices.
Section 4.4, Page 10	**Comment on Street Sweeping and Manual Pickup Data:** But amount (volume or mass) of trash removed by street sweeping is also key, so is there any way such data could be included?? or at least an estimate within given ranges??	We agree that the amount of trash collected by street sweepers is an important part of understanding baseline loads. Over the next few months BASMAA will continue to discuss options for assessing the proportion of trash collected by street sweepers.
Section 5, page 10	**Comment on Goal of Monitoring Design:** I would say that the goal is to develop reliable predictive equations for estimating loading (or do you mean generation?) rates based on factors....	Generation is the correct term.
Section 5.1.2, page 12	**Comment on Socio-economic Profile (Income Levels):** Is consideration of percent of population contained within each range an issue, or do we have any insight from literature review on how best to make these distinctions. Do we have any data on % of	Yes. The 2000 Census data provides this information and was incorporated into the design.

Commenter: **Peter Mangarella**

Report Section and/or Page #	Comment	BASMAA Response
	Bay Area population by income?	
Section 5.2, page 14	**Comment on the following statement:** "Storm drain inserts and HDS devices provide optimal sampling locations to establish trash loading rates and have been used extensively in previous trash loading studies." --Not locations, but rather methods	Locations is the correct term.
Section 5.3, page 14	**Comment on Second Bullet:** Seems to somewhat contradict first bullet point, without curb inlet screens would inserts still have 1 yr design treatment capacity??	Yes. Inserts are designed to meet the full capture definition. Adding curb inlet screens would only likely increase the effectiveness of these devices.
Section 5.4, page 15	**Comment on Methodology used by SCVURPPP:** Was methodology consistent with this SAP?? If so, state so…. if not, discuss if this will in any way affect quality of these data…	Yes, the methods were the same. Text was changed to indicate so.
Section 5.4.1, Table 5-3, page 16	**Comments on Optimal number of monitoring sites per land and income strata described in Table 5-3:** Are you comfortable with emphasis on residential in contrast to industrial and commercial??? I presume there is no bias here stemming from San Jose data?? Also number of samples per strata is obviously too small to allow for statistical analysis to yield significant results, so we may not be able to really address hypotheses defensibly??	The number of sites is based on the predicted variability as seen in Los Angeles County – high variability in commercial areas and low variability in loading rates in residential areas. Figure 5-2 added to show variability in LA data. The commenter may be correct. The total number of samples is purely a result of resource availability. To increase our ability to detect differences between strata, the number of samples per strata was based on observed variability in land use strata in LA County, the most robust dataset readily available.
Section 5.5.1, page 16	**Comment on Catch Basin Insert Cleaning Frequency:** Could you consider varying cleaning frequency based on loading?? I am wondering if inserts can only collect so much before bypassing and if insert is filled, then additional trash is bypassed…	All catch basins will likely be cleaned during the same timeframe. However, we will take commenter's suggestion under consideration.
Section 8.1, page 22	**Comment on Hypothesis Testing:** Again, concerned that number of samples may be too low to yield significant statistical confidence. For example, if you wanted to compare loads amongst land uses, you would want to estimate 95% confidence band about the median, and that decreases with inverse of square root of n (sample size) if distribution normal.	See response above.
Section 8.1.1, page 22	**Comment on Street Sweeping and Manual Pickup Documentation:** Do you somewhere explain what specific documentation you will be requesting; this seems a bit vague…	Clarification was added to the SAP.

Commenter: **Peter Mangarella**

Report Section and/or Page #	Comment	BASMAA Response
Section 8.2.1, page 22	**Comment on Calibration and Verification of Modeled Rates:** Again, I don't think you have enough HDS units to make this feasible, and moreover, their catchments may not be comparable. Consider deleting validation step??	After further consideration. The validation step was eliminated.

Commenter: **Elisa Wilfong**

Report Section and/or Page #	Comment	BASMAA Response
General Comment	Plan is incomplete. A SAP should include all the guidance a consultant or sampling team needs to tell them where and how to sample. As written, the SAP contains too many factors/calculations that 'may' happen and the only things that appear to be very clear are how to label a sample and how to clean out and identify trash. It is unclear where the samples are going to be taken and where in the matrix of the conceptual model on page 6 that factors are going to be distributed throughout the counties who are going to be sampled.	SOPs for all sampling were added as Appendices. At the December 2010 BASMAA Trash Committee meeting, tables were distributed showing existing sites that will be used to develop trash baseline loads and sites needed, based on overall goals of distributing sites. These tables provide the general geographic distribution of sites in the Bay Area. These tables are not intended to be included in the SAP.
Section 2.1,Page 5	Freeways and traffic should be listed in the factors on the bottom of Page 5.	Requested change was made.
Section 2.1,Figure 2-1,Page 6	Need to know where the samples are intended to be taken and who gets what in the distribution of how trash is generated (see figure 2-1 on page 6).	See response above.
Section 4.2, Page 10	Page 10 - I assume the U.S. Census data from 2000 (or the most recent study available) will be used for all the counties and not a different one for each region.	"for all counties" was added
Section 5.1, Page 11	On page 11, section 5-1, it would be nice to have an appendix listed as a street sweeping data log sheet to help the cities log what is being swept and with what frequency at the monitoring sites (just a suggestion).	Thank you for the suggestion. Frequencies and dates of street sweeping will be tracked throughout the project.
Section 5.1.1, Page 11	Second Rinta's suggestion - add traffic (and freeways) to the bullet list on page 11.	See response above.
Section 5.4.1.,Page 15	Page 15 is confusing. Under the paragraph 'Site Selection and	Numbers of sites are now consistent throughout the document.

Draft Sampling and Analysis Plan Comments

Commenter: **Elisa Wilfong**

Report Section and/or Page #	Comment	BASMAA Response
	Strata Weighting' 150 sites are mentioned in bullet #2, I think he means 100 since he wants to use the 50 that are already done. Then he lists 165 sites in the last paragraph and then on page 16 the table total of sites adds up to 151 sites.	
Section 8, Page 22	Section 8 is confusing. On page 22, meaning of text in section 8.1.1 about literature values of street sweeping is confusing. Which and what? The three sections that follow are also very unclear. I don't know what all will be done in the equation for baselines with that information.	We are unsure what is unclear in this section. No change was made.
Section 8.2.1, Figure 8.1, Page 23	The illustration on page 23 is very hard to read.	Requested change made.

Commenter: **Roger James**

Report Section and/or Page #	Comment	BASMAA Response
General Comments	The sampling plan must include a health and safety element addressing all elements of the project including the permittees' employees that will be removing material from the devices and the contractor's employees that will be sub sampling and characterizing the material…….The health and safety plan should also contain a confined space entry program including the necessary training and certifications…….The Project should ensure that permittees implement traffic control programs during the cleanout of the devices to protect workers performing the cleanout operations.	SOPs for all sampling and health and safety were added. Thank you for the suggestion.
General Comments	The Project should consider additional sampling and analysis of the sediments removed from the devices for other pollutants of concern. The Project will undertake a significant effort and expense to obtain samples and this may be an opportunity to obtain samples in coordination with monitoring programs that address other regulatory requirements thus avoiding the pollutant by pollutant approach.	Sediment sampling and analysis for contaminants is beyond the scope of this project. A large number of samples (>700) from streets and storm drains in the Bay Area have been collected over the last 9 years. These samples have been focused on pollutants of concern (PCBs, Hg, trace metals, chlorinated pesticides, etc.) and have provided a wealth of information to local municipalities.
Section 2.1, Page 5	Section 2.1 indicates that a comprehensive review has been made of other available literature; however, the Literature review does not contain an analysis of the data generated by the Trash	Information added to the literature review

Commenter: **Roger James**

Report Section and/or Page #	Comment	BASMAA Response
	TMDL baseline monitoring (ref 1). A thorough review of this data is needed to determine if loading rates can be applied to land uses in the Bay Area before incurring the expense of developing and validating the conceptual model and undertaking the Project's proposed level of monitoring.	
Section 3.1, Page 7	Section 3.1 incorrectly states that the Water Board approved trash full capture devices. See my comments on Table 2-1 in the document Trash Load Reduction Tracking Method – Literature Review for the status of the Regional Board's approval of full capture devices.	Your commented is being forwarded to the appropriate Water Board staff. This comment is not pertinent to this project.
Section 4.3, Page 10	Rainfall stations selected by the Project referenced in section 4.3. must have the capability of recording instantaneous intensities in 0.01 inch increments in order to develop the short duration (2-3 minute) intensities necessary to calculate the peak flows to catch basin inserts because of their Tc . Allison (ref 5) has reported that gross pollutant concentrations peak before the peak of the hydrograph, but most of the gross pollutant load is transported during peak discharges.	The most readily available rainfall data from stations that are geographically close to monitoring sites will be used in this study. To the extent possible, we intend to use data from those stations that provide the most robust datasets to meet project needs.
Section 5.1, Page 11	The monitoring program (section 5.1) must include a "know your watershed" element that documents these additional factors that can affect not only trash loads, but other gross pollutants that affect sample collection and performance and maintenance requirements of the devices.	We agree. Through communication with municipal staff, we plan to track additional factors that may affect trash loads.
Section 5.1.2, Pages 12 and 13	My introductory comments questioned the applicability of using a socio-economic profile in the Bay Area. Section 5.1.2. must address these issues.	Economic profile is being tested as a factor that may affect trash loads. We have not presupposed that data will show that this factor is more or less important than any other.
Section 5.3, Pages 14 and 15	Three studies (ref 1 and 5) and the City of Los Angeles have incorporated a combination of catch basin inserts and HDS devices (CDS device) at the base of the catchment to determine the effectiveness of the catch basin inserts and to determine the catchments trash loading. The Los Angeles County study (ref 1) monitored five catchments, four of which had single land uses. With over 600 CDS units installed in the Bay Area it should be possible to identify enough catchments where single land uses could be monitored. Section 5.3 should be modified to specify that each site monitored must have a minimum of 5 storm drain inlets, that catch basin inserts will be placed on each inlet and a	We agree that this design would be ideal. However, project resources are limited and therefore a different deign is being used. That said, we intend to mine the LA data to help determine variability in trash loading rates, the effects of factors such as the extent of antecedent dry weather periods, storm size and intensity, and street sweeping frequency. We anticipate that these data will be highly valuable and assist Bay Area municipalities in estimating trash loads.

Commenter: **Roger James**

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	HDS device will be located at the downstream terminus of the catchment. This will allow determination of efficiencies of the catch basin inserts as well as trash loadings from the land use as done by ref 1.	
Section 5.3, Page 15	The responsibilities of the permittees described in section 5.3. – fourth bullet must include inspection of the unit before and after each storm event ≥ 0.25-inch of rainfall to determine whether the screens are blocked and the catch basin inserts have bypassed or in need of maintenance.	At a minimum, inspections will be conducted at the time of cleanouts. Evidence of bypass will be documented at that time.
Section 5.4.1, Pages 15 and 16	Section 5.4.1. needs to clarify whether a single catch basin insert is considered to be a monitoring site or is a site a catchment with multiple inlets and catch basin inserts. If it is the former then 150 catch basin inserts to monitor nine different land uses and for only two storm events pales in comparison to what has been accomplished in the Trash TMDL's baseline program. The project needs to better explain that this level of monitoring can produce sufficient data calibrate and validate the conceptual model.	Text was revised to indicate that a site is a single catch basin. As described above, additional insight is expected from mining and analyzing the LA data.
Table 5-3, Page 16	Table 5-3 needs a much better explanation – what is the Area? Why does the % of the project Area exceed 100%, what is meant by Predicted Variability and what is the Total column.	Table 5-3 was revised and text was added to better explain "area" and predicted variability.
Section 5.4.2, Page 16	Section 5.4.2. refers to section5.2.2 yet there is no section 5.2.2. Is it 5.5.2?	Changed to "Section **Error! Reference source not found.** (bullet 3)"
Section 5.5 and 5.5.1, Pages 16 and 17	The monitoring schedule in sections 5.5 and 5.5.1 is questioned unless the additional 100 sites meeting the selection criteria have already been identified and permittee commitments have been obtained to perform the monitoring. If this hasn't been achieved then the schedule needs to be revised with realistic dates expectations of obtaining meaningful data lowered because the season's initial "first flush" of gross pollutants was not monitored.	It is highly likely that monitoring will be extended into the 2011-12 wet weather season in order to obtain data from the first significant runoff event of a season.
Section 5.5, Page 16	A section needs to be added to Section 5.5 to explain how sampling events will be coordinated between multiple permittees. Can meaningful data be obtained if permittees monitoring the same land use category use different storm events?	To the extent possible, monitoring will be coordinated to sample the same set of storms for all sites.

Draft Sampling and Analysis Plan Comments

Commenter: **Roger James**

Report Section and/or Page #	Comment	BASMAA Response
Section 5.5.2, Page 17	Section 5.5.2 needs to explain how data from the hydrodynamic separators can be used to calibrate and validate loading rates established through the catch basin insert monitoring when the separators will monitor multiple land uses while the inserts will only monitor single land use categories.	Additional text was added to clarify how the HDS units will be used to assist BASMAA in determining the uncertainty of loading estimates developed through the storm drain inlets.
Section 6.2.1 and 6.2.2, Page 18	Section 6.2.1) and 6.2.2) should specify that catch basin inserts be "broom" cleaned. This section should specify that all "material' – trash vegetation and sediments is to be removed and not refer to debris that hasn't been defined.	The applicable SOPs were revised to ensure that all debris is removed from screens. The term debris, which refers to all material collected from a device, was added to the terminology section.

Draft Sampling and Analysis Plan Comments

Commenter: **Roger James**

Report Section and/or Page #	Comment	BASMAA Response
Section 6.3, Page 18 General Comments	A lot of experience has been gained on the cleanout of hydrodynamic separators through routine maintenance and performance elevation studies… The following comments are just a few issues that need to be considered: • The Project should anticipate that there will be base flows in storm drain systems that will need to be managed during cleanouts of hydrodynamic separators. Infiltration, nuisance water and water from building sump pumps will likely be encountered requiring installation of plugs or diversion weirs in the storm drain. • The floatables will be on the water surface and not in the sump and volumes can widely vary. • A pool skimmer does not have the strength to remove the floatables and removal is best accomplished with a vacuum truck. • A phase separator or fibre glass bin (8'x4'x3') has been used to store the floatables. • The water overlying the solids can best be removed with a sump pump discharging to a sanitary sewer system which may require a permit from the agency. • The volume of solids (trash, sediment and vegetation) in the sump can be removed using a vacuum truck; however, decanting the load will result in the significant loss of solids. • Solids removed can be placed in fibre glass bins or phase separators. Sounding of solids in a device and estimating the volume is not accurate. Cleanouts of larger CDS units have required use of 10 cuyd separators or lined large drop boxes. Ramps or recess of the separator will likely be required because of the limited clearance of the vactor trucks storage chamber. • Subsamples can be taken of the larger volumes in bins or separators by sectioning the container and sampling each section.	We very much appreciate the commenter's knowledge on the subject of HDS cleanouts. Based on these and other comments, we intend to develop SOPs specific to each HDS we plan to monitor. The commenter's considerations will be taken into account as these SOPs are developed.

Commenter: **Roger James**

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	It is absolutely essential for permittees to photograph the cleanout operations to provide the quality control unless project staff is going to be on site for all the sampling events. The photos are also helpful in documenting the types of blockage of catch basin screens.	Photo documentation was added to the cleanout SOPs.
Section 7, Page 19	Throughout section 7 there is reference to debris and this needs to be changed to vegetation and sediments because everything else would be trash.	See comment above.
Sections 7 and 7.2.1,Pages 20 and 21	The Project (section 7, 7.2.1.) should also determine the mass or weight of trash, vegetation and sediment so that data can be compared to what other programs have measured and reported. It is simple to do and inexpensive.	We agree. Both volume and weight will be measured
Section 7.1., Page 20	The volume of material removed from catch basin inserts is likely to be rather small so all material should be sorted and characterized rather than just 20 gallons. The time required to obtain subsamples could be better spent just characterizing the entire sample.	The SOP was revised to indicate that all debris from catch basins will be characterized.
Section 7.1.2, Page 21	Cigarette butts should be included in the items to be characterized (section 7.1.2) since studies (ref 5 and 17) and coastal cleanup programs have identified them as being the top marine debris items.	Specific items to be characterized are included due to the potential for municipalities to ban/prohibit these products. Due to resource constraints, only those items will be characterized
Section 8.1, Page 22	Section 8.1 indicates that the data will be analyzed using statistical techniques to test the conceptual model. The Project should determine now whether sufficient data points will be obtained through the sampling plan to justify use of the model. It certainly doesn't appear that the limited data points for the various land uses justifies this approach.	The commenter is correct to state that resource constraints are a challenge for this project. Text will be added to not overstate our ability to assess statistical differences between populations of data. Based on our understanding of the variability in the LA TMDL data, we are confident that the sampling plan will generate useful information to base loading estimates for MRP Permittees.
Section 8.1.1, Page 22	The Project has not presented data on "trash" removed by street sweeping and manual pickup. Much of the available data I have seen is for sediments and vegetation, but not trash.	A separate project is assessing current knowledge on the effectiveness of street sweeping and manual pickup. We direct the commenter to the "Trash Load Reduction Tracking Method Technical Memorandum #1 - Literature Review".
Section 8.1.2, Page 22	The rainfall analysis of section 8.1.2 must also include the short duration intensities discussed earlier under section 4.3.	To the extent possible, short duration intensities will be included in the analyses.

Commenter: **Roger James**

Report Section and/or Page #	Comment	BASMAA Response
Section 8.1.4, Page 22	The other factors discussed under sections 2.2 and 2.3. on page 13 must also be included in section 8.1.4.	Requested change was made.
Section 8.2.1, Pages 22 and 23	The proposal to use of data from the hydrodynamic separators to calibrate and verify calculated trash loading rates discussed in section 8.2.1. is problematic at best unless the catch basin inserts and separators are collocated within the same catchment. The Project should co-locate the hydrodynamic separators and catch basin inserts in the same catchment to determine the efficiencies.	We are confident that the application of loading rates to a drainage area served by a hydrodynamic separator will provide valuable information regarding the uncertainty associated with the loading rates developed through the process described. Installing storm drain inserts in areas served by a HDS would not be an efficient use of limited resources for this project and would not be consistent with the MRP goals of trash reduction or full capture installation. Therefore, the recommendation of collocating devices was not accepted at this time.
Section 8.3, Page 23	Concerns about the project's proposal in development of baseline loading rates were express at the beginning of my comments and are reiterated for section 8.3.	See response above.
Section 9, Page 24	The many references I have cited in my comments should be added to section 9.	Requested change was made.
Appendices B and C	Earlier comments made on the standard operating procedures apply to Appendices B and C.	Consistent with the responses above, changes to the SOPs were made.
Appendix D	Appendix D needs to include a form for the pre and post storm event inspections of catch basin inserts and hydrodynamic separators to determine if they are blocked or have bypassed and require maintenance. The Device Cleanout Form needs to explain how to determine or contain criteria on whether the material is dry, damp or wet.	See response above.