Catch Basin Opening Screen Cover Assessment: Final Report

May 12, 2015

Project No. TOS - S77

Prepared for:

City of Los Angeles
Bureau of Sanitation
Watershed Protection Division

ADvTECH Environmental, Inc.
Environmental Engineering Consultants

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CATCH BASIN OPENING SCREEN COVER ASSESSMENT
FINAL REPORT
LOS ANGELES BUREAU OF SANITATION
WESTLAKE AREA

Prepared for:

City of Los Angeles
Bureau of Sanitation
Watershed Protection Division

Prepared by:

***ADvTECH* Environmental, Inc.**
Environmental Engineering Consultants
632 S. Azusa Avenue
West Covina, California 91791

R. Derek Chung, E.I.T.
Project Engineer

Michael E. Shiang, R.G., C.Hg.
Principal Hydrogeologist
QSD No. G05794

Seal:

REGISTERED GEOLOGIST
MICHAEL E. SHIANG
NO. 5794
06/16
STATE OF CALIFORNIA

Contents

List of Figures

List of Tables

List of Appendices

Introduction

The purpose of the Catch Basin Opening Screen Cover Assessment Study (Assessment) is to objectively evaluate the performance of an alternative catch basin (CB) capture technology for product effectiveness in trash deflection and abatement. This Assessment complements other studies conducted that are intended to be used for regulatory compliance determination.

Background

To comply with the Federal Clean Water Act and a consent decree between the United States Environmental Protection Agency (USEPA) and environmental groups, the LARWQCB adopted the Ballona Creek Trash TMDL and the Los Angeles River Trash TMDL in 2001. These TMDLs have subsequently been amended in 2004 and 2007 (LARWQCB, 2004; LARWQCB, 2007a).

The Los Angeles River and Ballona Creek were the first TMDLs to be approved by the LARWQCB with a final target of zero trash. Other trash TMDLs for water bodies within the City of Los Angeles jurisdiction followed for Machado Lake, Lincoln Park Lake, Echo Park Lake, and Santa Monica Bay (LARWQCB, 2007b; USEPA, 2012; LARWQCB, 2010).

The City has utilized catch basin and partial capture devices as the first pollutant barrier to prevent trash from entering the storm water system. Catch basins are entry points to the City's storm drain system and are typically designed to intercept street flow based on street slope and drainage area. The CBs, however, by themselves are not designed for trash capture. Often, they are retrofitted with a screen as an additional treatment or pretreatment for trash. The screen design is expected to open to curb flow in order to reduce the potential for flooding during wet weather.

Partial-capture devices are treatment devices that have not been approved as full capture (i.e , 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) by the LARWQCB, but captures trash at a known level of performance (EOA, 2014). Catch basin screen covers are considered partial-capture devices that the Regional Board requires that its product performance be demonstrated prior to being used for compliance demonstration.

The City of Los Angeles must comply with the Trash TMDLs under the LARWQCB adopted Municipal Separate Storm Sewer System (MS4) Permit for the Los Angeles Region. As stated in the 2012 MS4 Permit Section VI.E.5, compliance with the Trash TMDL interim and final effluent limitations may be accomplished through a combination of full capture systems, partial capture devices, and institutional controls (LARWQCB, 2012). The City has had success in utilizing full and partial capture devices in complying with the trash TMDLs and meeting TMDL milestones by installing 38,000 tested and approved retractable CB screens and CB inserts starting in 2001.

Since 2004, alternative catch basin structural technologies for trash abatement have evolved and the City installed CB screens have or will be reaching their service life within the next coming years. Catch basin screens and inserts are considered “partial capture devices” by the LARWQCB. Should the City desire to utilize a different CB screen or insert for Trash TMDL compliance, the City must conduct a study to demonstrate the partial capture device’s effectiveness in preventing trash from entering the storm drain system. At present, the LARWQCB only oversees the certification process for a full capture system device and leaves it to the permittees to demonstrate the effectiveness of the partial capture system (Bishop 2004, 2005, 2007; Dickerson, 2003).

The State Water Resources Control Board (SWRCB) began work in 2010 on a Statewide Policy and proposed amendments to the California Ocean Plan and the forth coming Inland Surface Waters, Enclosed Bays, and Estuaries of California Plan. The objective of the proposed Trash Amendments is to provide statewide consistency for the regulatory approach to reduce trash in state waters. The policy includes a certification process similar to that established by the LARWQCB (SWRCB, 2014). The SWRCB adopted the Trash Amendments in April 2015 (SWRCB, 2015).

BMP Effectiveness

As stated earlier, the MS4 permit allows several means to meet water quality-based effluent limitation for the Trash TMDL. These include the use of “full capture” systems devices that have been certified by the LARWQCB. In addition, combined approaches, use of “partial capture” systems and “institutional control” measures, can be utilized provided certain criteria are met. The use of partial capture system devices requires a demonstration of performance of the device on trash removal efficiency.

For this reason, full and partial trash capture systems products cannot simply be purchased and installed to satisfy the trash TMDLs. These devices must be field tested. In 2004, the City, in collaboration with LARWQCB, established a process to demonstrate the effectiveness for “partial capture systems”. Since this approach was utilized in the past, acknowledged by the LARWQCB and resulted in an earlier design CB screen cover device, the City utilized the same process to calculate the new product’s performance factor in trash deflection.

BMP Effectiveness Process

Study Protocol

The study protocol (Appendix A) was developed to determine retractable CB curb opening screen covers' performance during wet weather days with an accumulation of 0.25 inch or greater of rain. The methods and approaches employed in this study are based on the City's 2004-2006 collaborative approach with LARWQCB (City of LA, 2006), and refined based on field experience, updated information, and input from City staff. The rain accumulation value was chosen to be consistent with the MS4 Permit for Storm Event Discharges. The protocol was developed to ensure the evaluation approach, selected study area, field activities and data collection met quality assurance and quality control (QA/QC) so that the determination of effectiveness factor in trash deflection would be acceptable to the LARWQCB.

The hybrid retractable CB screen cover (a.k.a. Hydra®), manufactured by BuildIt, was chosen for this study based on the selection criteria developed by the City and described in the protocol. The criteria were based on experience, observations, and lessons learned from the existing trash BMP devices that are installed and maintained throughout the City. The device selected for this study is a hybrid retractable CB curb opening screen cover and blends the positive features of the earlier versions of CB screen covers. The hybrid retractable screen design moves away from a perforated screen cover shielding the catch basin curb opening and instead, relies on a series of flat-angle wedges installed across the curb opening. The plastic wedges are held in place by a cable and slide in a longitudinal direction of the CB opening.

The protocol ensures robust data collection through a QA/QC approach which ensures collection of data is representative of the storm and performance of the hybrid device. This includes study area preparation prior to storm season, field crew training, and data collection method and documentation. The information collected will be analyzed and inserted into a formula to determine the effectiveness of the device in deflecting trash.

Study Area

This study takes place in the Ballona Creek watershed drainage area which is about 127 square miles. This watershed extends in the east from the crest of the Santa Monica Mountains southward and westward of Los Angeles Civic Center and thence to Baldwin Hills. Tributaries of Ballona Creek include: Centinela Creek, Sepulveda Canyon Channel, Benedict Canyon Channel, and numerous other storm drains. The RWQCB adopted a trash TMDL for Ballona Creek and Ballona Creek Estuary, as well as TMDLs for metals, toxic pollutants, and bacteria (LARWQCB 2005, 2006). Figure 1 provides photographs of study area and Figure 2 is a Ballona Creek watershed map.

The 31 catch basins retrofitted with the hybrid retractable CB curb opening screen covers are located west of the Los Angeles Civic Center in the Westlake area of the City in close proximity to the community of Koreatown. The drainage area is approximately 55 acres, with three-quarters commercial and the remaining multi-family residential land uses. It is important to note this is the same test area for the 2004-2006 City/LARWQCB collaborative study and that the land use definition for this area has not changed. Figure 3 shows the study area and locations of the BMPs that were evaluated.

Figure 1. Representative Photos of the Study Area

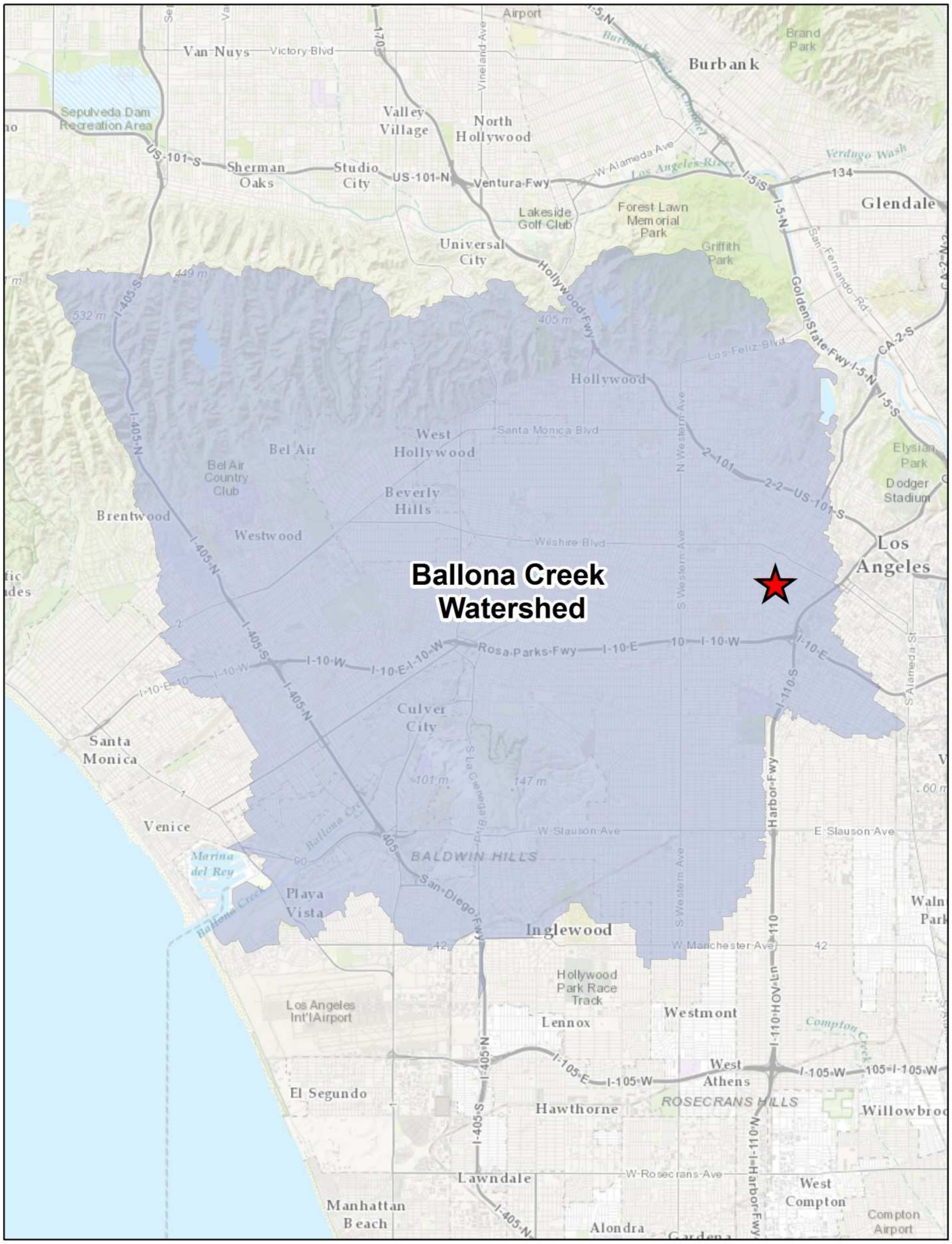


Figure 2: Ballona Creek Watershed Showing Study Area Location (adapted from www.lastormwater.org)

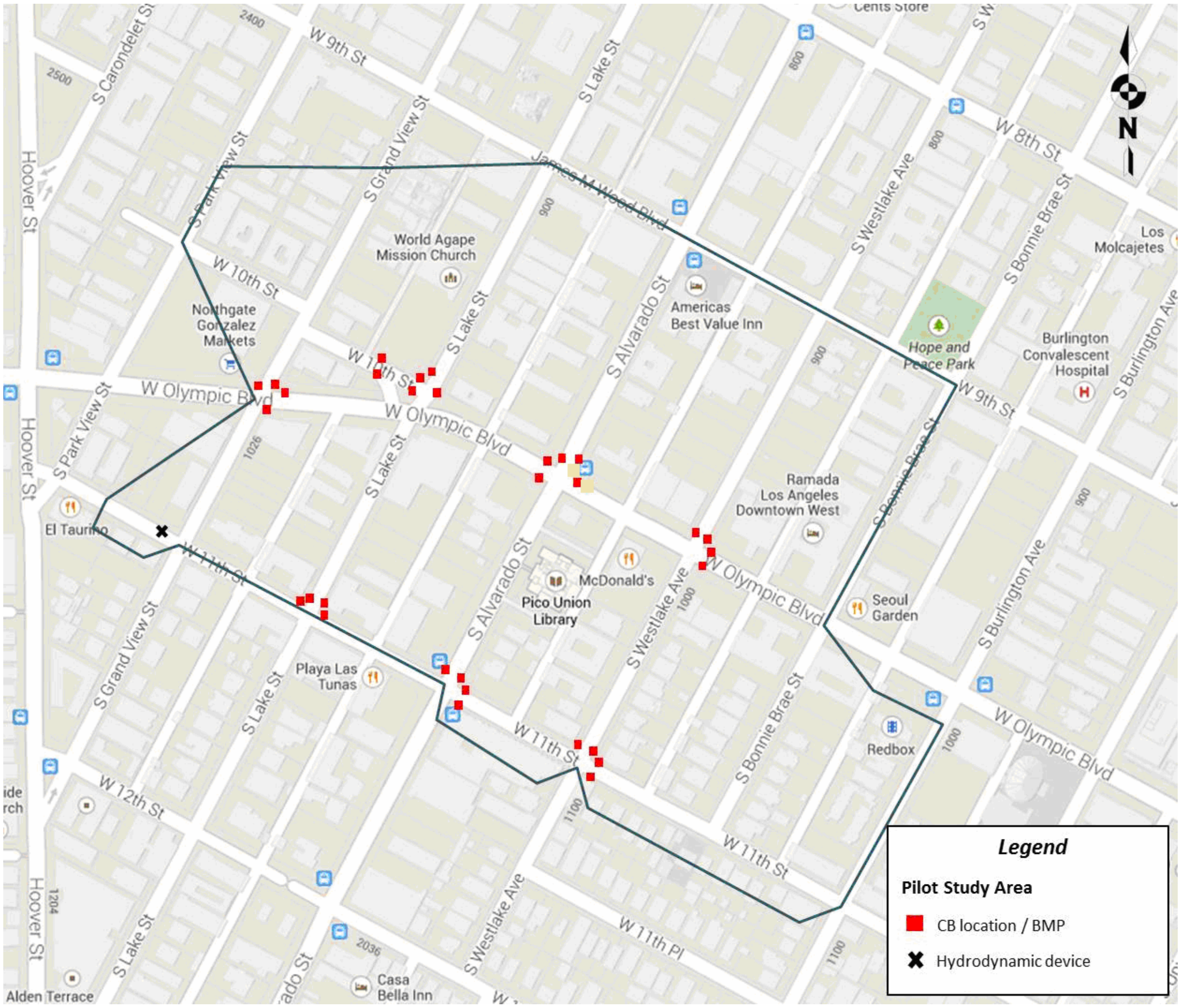


Figure 3. Study Area with Locations of BMP Devices

The entire drainage area discharges to an existing hydrodynamic device installed as an offline unit to the main line. The unit being used is a Contech Continuous Deflection Separation System (CDS®) unit Model PSW 70-70 with a treatment design flow rate of 26.5 cubic feet per second. Figure 4 shows a schematic of the CDS and a photo of the device cover on the street. The CDS unit is located below the street near the intersection of 11th Street and S. Grandview Street. The CDS are currently recognized by the LARWQCB as full capture devices to meet Trash TMDL compliance milestones. For partial capture device assessments, it is desirable to conduct the study up stream of a CDS. Should the screens fail to deflect any trash, this device will capture the trash before it enters the waterways. The offline installation ensures the design storm for trash capture is met and allows for bypass to prevent flooding when the design storm is exceeded. Partial capture systems are designed not to negatively impact the catch basins flow intercept capacity.

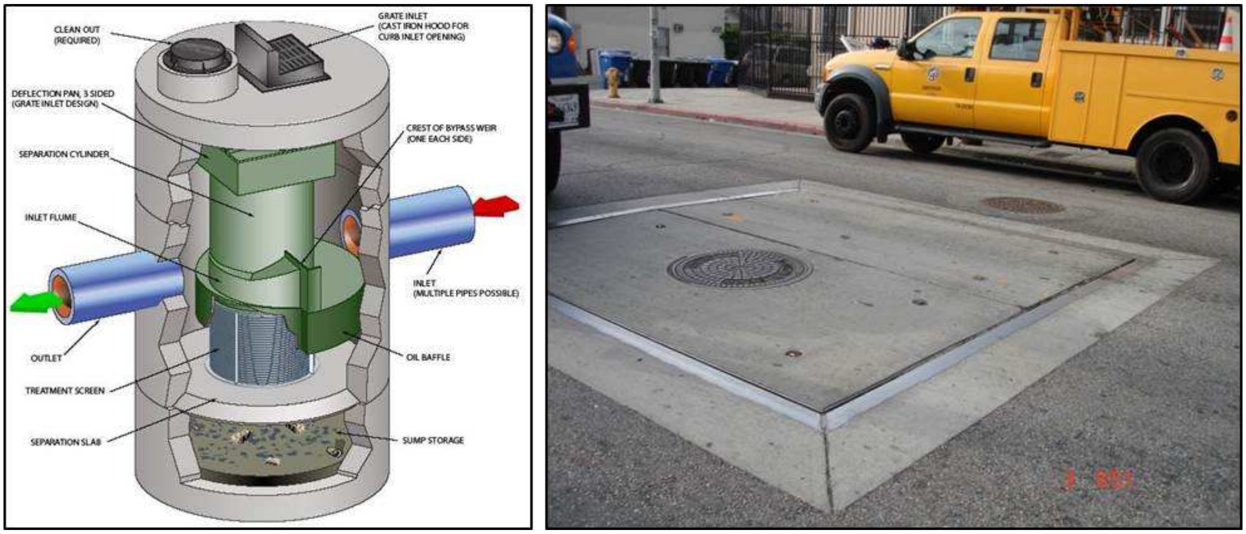


Figure 4. Schematic of ConTech Continuous Deflection Separation System (CDS)

Figure 5 shows the selected study area is regarded as a high trash generation area within the City as determined by the City's High Trash Generation Areas and Control Measures (City of LA, 2002). Selection of a high trash generation area presents the ultimate test area for CB screens. These screens should be able to deflect floatable trash mobilized by a small and moderate storm across the face of the screen and prevent it from entering the CB, yet allow enough water to drain into the CB to prevent flooding of the street area serviced by the screen.

By selecting this study area, the CB hybrid retractable screen covers were subjected to extreme conditions. The resulting calculations will be based on data reflecting these conditions, and should provide a conservative "effectiveness factor" which will be applicable in all areas of the City where these CB screens will be utilized.

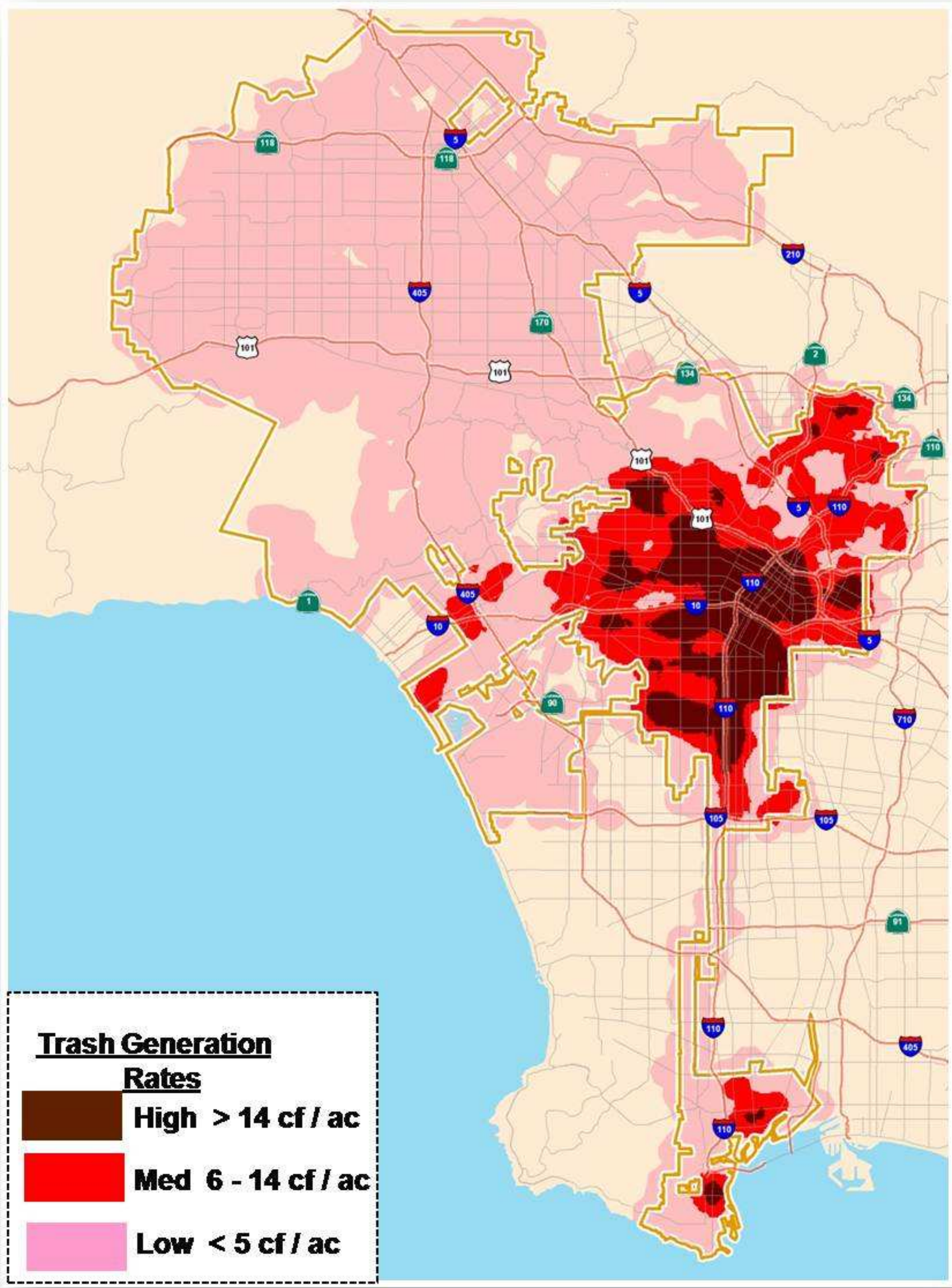


Figure 5. High Trash Generation Areas map (City of LA, 2002)

Performance Procedure

Wet Weather BMP Effectiveness

The City has provided a baseline mass (pounds) of the amount of trash collected at the hydrodynamic device and CBs prior to screen installation during the 2003 – 2004 rain season. The average 2003-2004 amount of trash collected at the hydrodynamic device and CBs was 860 pounds (City of LA, 2006). This baseline mass included the sediment captured at the CDS which was estimated by City staff to be 80% of the weight, which results in floatable trash weight of 172 pounds. Since then the City has conducted a scientific study (2012 – 2013) that quantified the effectiveness of its institutional measures in trash reduction. That study concluded that the City, based solely on it institutional measures, has reduced trash discharges by 13.5% from the baseline litter generation rates used (City of LA, 2013). Therefore, the 2006 floatable trash weight of 172 pounds was reduced by 13.5% to reflect this improvement resulting in a weight of 149 pounds, which has been used in the calculation for BMP effectiveness.

Wet weather BMP effectiveness was determined by comparing the drained wet weight of trash that was captured in the CDS and CBs in 2003-2004 prior to installation of screens on the upstream catch basins (149 pounds), to the drained wet weight collected after the hybrid CB screen devices (Hydra®) were installed.

Floatable materials are more likely to be mobilized and transported to the CB during rain events. For this assessment, field crews removed all floatable trash observed in the hydrodynamic device after each of the 2 rain events meeting the 0.25 inch accumulation criteria. Figure 6 shows before and after photos of the CDS cleaning and weighing. Trash was also collected in the 31 CBs serviced by the hybrid retractable screen covers. All collected trash was weighed, volume measured, and recorded on field sheets.

The original protocol evaluation formula was adjusted based on subsequent studies by the City (City of LA, 2006; City of LA, 2013), resulting in a corrected formula. The data was compiled and utilizing the corrected formula below, the wet weather BMP effectiveness of the tested catch basin curb opening screen cover was determined as follows:

$$[Screen\ Cover]\%_{\ wet\ weather\ effectiveness} = \frac{(([CDS+CB])_{historical} - [CDS+CB]_{current})}{(CDS+CB)_{historical}} \times 100$$

$$CDS + CB_{historical} = 149 lbs\ (average\ 2003-04\ rain\ season\ collections)$$

Dry Weather BMP Effectiveness

The assumption can be made that dry weather BMP effectiveness of a catch basin curb opening screen cover to be one hundred percent (100%) due to the absence of significant flow to push the wedges covering the hybrid CB screen aside to open and allow trash to enter the CB. This also assumes the curb opening screen has a locking mechanism that prevents the opening of the screen by the general public during this period. Currently the hybrid retractable screen cover does not have a mechanical locking mechanism; consequently a deduction of 5%, based on field observations of the devices, will be taken from the overall BMP effectiveness (See Data Analysis Section). Figure 7 and 8 show two different types of screen covers in the open and closed position.

Calculation of Overall BMP Effectiveness

The overall BMP effectiveness over an entire calendar year is calculated using a weighted average[1] based on both the wet- and dry-weather effectiveness. The use of a weighted average is appropriate in that the Trash TMDL compliance is anticipated throughout the year and not during one period of time or season. The most appropriate weighing factor to use in the calculations is that of wet and dry days experienced in the City of Los Angeles in a typical calendar year, since the BMP device being tested is activated by the presence of flow. In a typical year, the City of Los Angeles experiences twenty five (25) days of measurable rain and three hundred forty (340) days of sunshine (a ratio of 1 to 13.6, NOAA 2014). Thus, the overall BMP effectiveness will be determined as follows:

$$Screen\ \ Cover\ \%_{Overall\ \ BMP\ \ Effect} = \frac{(Screen\ \ Cover\ \%_{wet\ \ weather\ \ effectiven\ ess} \times 1) + (100\,\% \times 13.6)}{(1 + 13.6)} \times 100$$

The calculated overall BMP effectiveness results in a percentage representative of the amount of trash that will be prevented from entering the storm drain system from this particular device. Determining the BMP effectiveness is a requirement by the MS4 permit for all partial capture devices if they are to be used in determining a municipality’s compliance to the Trash TMDL.

[1] The weighted average is an average where one factor contributes more to the result than another factor.

Figure 6. Photos Showing CDS Structure Before and After Cleaning

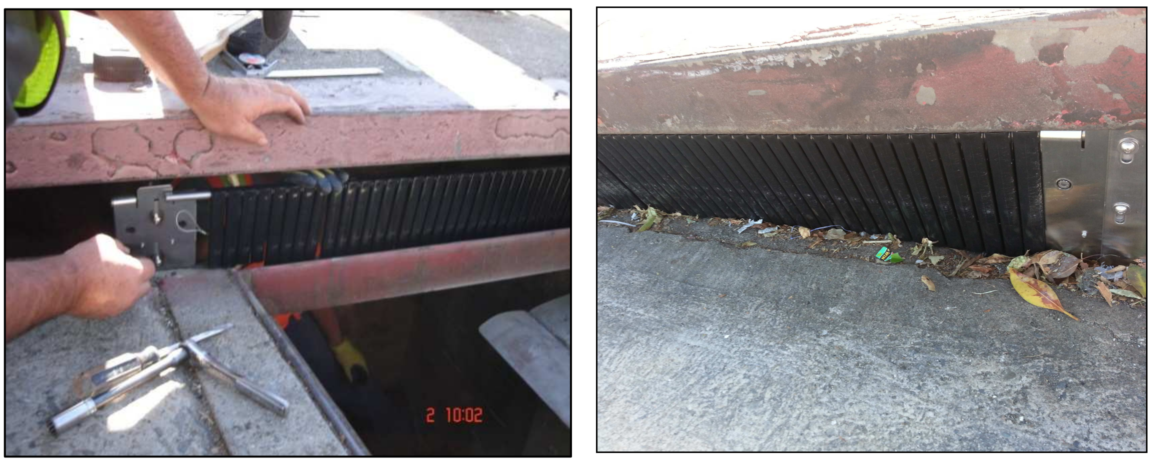


Figure 7. Curb Opening Screen Cover Shown in Open and Close Position

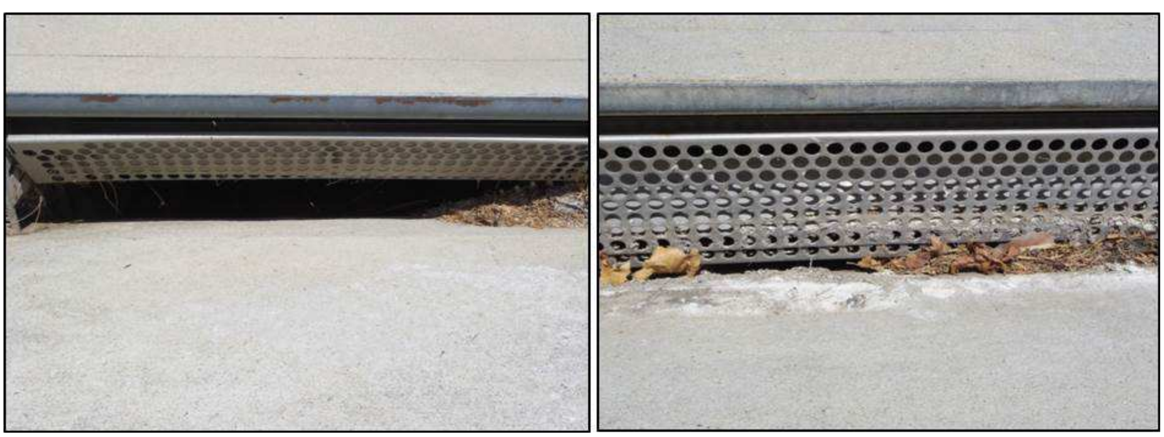


Figure 8. Curb Opening Screen Cover Shown in Open and Close Position

BMP Results and Discussion

Pre-Study Preparation

The study was conducted in accordance to the Trash TMDL rainy season, from October 15, 2014 to April 15, 2015, for the data collection to be used in the evaluation (City of LA, 2015). To ensure a consistent and robust data set, several pre-study activities were performed prior to the beginning of the rainy season. Table 1 below provides a list of those activities completed:

Table 1. Pre-Study Preparation Activities

Study Protocol	See Study Protocol (Appendix A). The protocol provided the logistical foundation as to how the study would proceed during the rain season and subsequently in the data analysis. Completed: August 2014.
Field Verification of CBs	ADvTECH Environmental, Inc. (hereinafter referred to as "consultant staff") "ground-truthed" the number of CBs as provided by City staff. During the field verification four (4) additional CBs were discovered to discharge to the CDS unit and were added to the study group. Completed: August 2014.
Field Crew Training	Consultant staff was provided in-class training in data collection and field safety; see Study Protocol (Appendix A) for Training Presentation. Completed: August 2014.
CDS & CBs Cleaned	Coordination with City staff facilitated the use of City forces to clean both 31 CBs and CDS unit in the study area. CBs and CDS in study area were then pulled from the regular cleaning schedule. Completed: August 2014.
CB Hybrid retractable screen cover Installation	BuildIt Engineering was the selected vendor to provide 31 hybrid retractable screen covers (a.k.a., Hydra®) to be evaluated by the study. American Storm water was selected to provide installation services. Completed: September 2014.
Field Crew Mobilization	Consultant field crews were placed on standby at the beginning of the rain season as to be able to respond within 24 hours when activated. Since the occurrence of a triggering rain event having a 0.25 inch accumulation was unpredictable crews were available throughout the rain season.

Consultant staff performed several field reconnaissance visits to get a "feel" of the area prior to the initiation of the study as to note any factors that may influence the study results. City staff had provided background information on the area and had stressed their concern of possible vandalism and/or tampering of the new CB screens. During one of the field visits, consultant staff observed individuals pushing trash into the CBs which could result in misrepresentation of the device's performance. In consultation with City staff, this event resulted in a decision to omit the first rain event of the season as to provide the storm drain system an opportunity to "flush out" trash that may have been introduced by other means other than runoff.

It should be noted that the study area had been retrofitted with stainless steel ARS that had to be removed for the hybrid retractable screen cover evaluation. American Storm Water, a contractor retained by BuildIt and the City to install hybrid retractable screen cover devices, averaged 20 to 30 minutes for removal of the stainless steel curb opening screen covers due to corroded anchor bolts that required grinding them off at many of the catch basins. Many of these screens had been in place for more than five years. Once the old stainless steel ARS was removed, installation of the preassembled hybrid retractable screen cover averaged 5 to 10 minutes per catch basin. Removal and installation duration is important in that if the City does proceed to use the hybrid retractable screen cover in other sites throughout the City, the removal time of the “old” screens should be considered in pricing out the overall replacement costs.

Data Collection

The first rain event occurred in early November 2014 and produced enough runoff to cause much of the trash remaining in the study area storm drain system to be transported to the CDS. Consultant staff at the conclusion of the rain event manually cleaned the CDS of all retained floatable trash which was confirmed by City staff onsite. The rain event was then followed by a triggering rainstorm (i.e., accumulation >0.25 inches) for data collection at the beginning of December 2014, resulting in a short duration between the cleaning event of the first storm and the first data collection storm event. It is anticipated that the short duration between the cleanings reduced the likelihood of the data being biased by outside factors. A summary of the data is shown in Table 2.

Data collection consistency was maintained by employing the same practice throughout the study and deploying the same trained field technicians. Collection consisted of removing all trash found within the catch basin as well as trash immediately in front of the hybrid retractable screen cover cover. Only the trash data collected from within was used in determining the product performance effectiveness. The data collection procedures and record-keeping forms are located in the protocol. Consultant field supervisors and city staff were present throughout the duration of the study for QA/QC purposes. Records also included photo-documentation. Communication for trash collection dispatch was between the same consultant contact and point person at the City. Data on accumulated rain for triggering collection was based on the Los Angeles County Department of Public Works USC and/or Ducommun rain gage (LACDPW 2014).

Street Sweeping

The City of Los Angeles still uses mechanical street sweepers for the collection of trash and debris from its streets. This type of street sweeper uses a rotating wire brush affixed to the side of the vehicle to direct the trash and debris to the collection intake. Depending on the placement of the catch basin curb opening screen cover (flush with the curb or recessed), this

Table 2. Summary of Data Collection Storm Events – December 5, 2014 & December 15, 2014

No.	CLAMMS No.	Address	Location	Catch basin									
				Curb opening parameters		Trash collection event No. 1 Dec. 5, 2014				Trash collection event No. 2 Dec. 15, 2014			
						inside		outside		inside		outside	
				length (ft)	height (in)	volume (gal)	weight (lbs)	volume (gal)	weight (lbs)	volume (gal)	weight (lbs)	volume (gal)	weight (lbs)
1	51605461111108	Westlake Ave & 11th St	NW	2	8	1.25	1.50	0.20	0.20	0.20	0.25	0.75	0.50
2	51605461111097	11th St & Westlake Ave	ES	2	8	0.20	0.20	0.00	0.00	A.	A.	A.	A.
3	51605461111093	Westlake Ave & 11th St	NE	3	6	0.20	0.25	0.00	0.00	1.00	1.50	0.20	0.20
4	51605461111095	11th St & Westlake Ave	EN	3	8	B.	B.	2.00	1.50	B.	B.	0.20	0.20
5	51605461111027	Grand View St & Olympic Blvd	NW	3.5	7	0.25	0.50	0.20	0.20	1.00	1.25	1.00	1.50
6	51605461111037	Olympic Blvd & Grand View St	ES	3.5	8	0.20	0.20	0.75	0.50	0.50	0.50	0.20	0.25
7	51605461111048	Olympic Blvd & Alvarado St	WS	3.5	8	0.50	0.75	1.00	1.50	1.50	1.50	2.00	1.75
8	51605461111054	Olympic Blvd & Westlake Ave	EN	3.5	8	2.00	2.50	0.25	0.25	0.20	0.20	0.20	0.20
9	51605461111055	Olympic Blvd & Westlake Ave	ES	3.5	8	0.75	0.50	0.75	0.50	0.50	1.50	0.50	0.50
10	51605461111063	Lake St & 11th St	NW	3.5	8	2.50	4.50	0.50	0.75	1.50	0.50	0.20	0.20
11	51605461111064	11th St & Lake St	WN	3.5	8	0.75	2.50	0.00	0.00	0.75	1.25	0.50	0.50
12	51605461111068	Lake St & 11th St	NE	3.5	8	1.50	3.00	0.25	0.25	0.75	0.50	0.20	0.20
13	51605461111069	11th St & Lake St	EN	3.5	8	0.75	1.25	2.00	3.50	1.00	1.00	1.50	0.50
14	51605461111078	Alvarado St & 11th St	NW	3.5	8	2.50	3.00	5.00	8.50	1.50	1.25	0.20	0.20
15	51605461111082	Alvarado St & 11th St	NE	3.5	7	0.20	0.20	1.00	2.00	0.75	0.50	1.00	1.50
16	51605461111084	11th St & Alvarado St	EN	3.5	8	0.20	0.20	0.25	0.25	0.20	0.20	1.50	2.50
17	51605461111086	11th St & Alvarado St	ES	3.5	7	0.75	2.00	0.00	0.00	0.50	1.25	2.00	2.50
18	51605461111031	Grand View St & Olympic Blvd	NE	3.5	6	1.00	1.50	0.20	0.20	0.75	1.00	0.20	0.20
19	51605461111040	Alvarado St & Olympic Blvd	NW	7	8	0.20	0.50	1.00	1.25	0.50	1.50	1.00	0.07
20	51605461111042	Olympic Blvd & Alvarado St	WN	7	8	0.50	1.25	0.75	0.50	1.50	2.25	1.50	2.00
21	51605461111056	Westlake Ave & Olympic Blvd	NW	7	8	3.00	5.25	1.00	1.50	0.20	0.25	0.20	0.20
22	51605461111066	Westlake Ave & Olympic Blvd	NE	7	8	2.00	3.50	0.25	0.50	4.25	3.50	5.50	7.50
23	51605461111044	Alvarado St & Olympic Blvd	NE-2	3.5	8	0.75	1.75	4.50	2.25	0.50	1.00	4.25	2.50
24	51605461111071	Olympic Blvd & Alvarado St[1.]	EN-2	7	8	0.25	0.50	0.20	0.20	0.25	1.00	0.20	0.20
25	51605461111032	Olympic Blvd & Grand View St	WN	3.5	8	0.20	0.20	0.20	0.20	1.00	0.75	0.20	0.20
26	51605461111022	2215 W 10th St	WS	3.5	8	1.00	1.50	1.50	1.75	1.75	2.50	1.00	1.50
27	51605461111018	10th St & Lake St	WN	7	8	1.50	1.00	0.20	0.20	1.00	1.50	2.00	3.00
28	51605461111029	Lake St & 10th St	NW	7	8	0.25	0.50	0.20	0.20	0.50	0.50	0.75	0.50
29	51605461111030	Lake St & 10th St	NE	7	8	0.50	0.75	0.50	0.75	1.00	2.25	0.20	0.20
30	51605461111023	10th St & Lake St	WN	3.5	8	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.20
31	51605461111028	10th St & Lake St	WS	3.5	8	0.20	0.20	0.20	0.20	0.25	0.50	0.20	0.20
					Total	**25.85**	**41.45**	**25.05**	**29.80**	**25.50**	**31.85**	**29.55**	**31.67**
32	CDS UNIT (1 Unit)	W. 11th St & S. Grand View St	Ctr			22.50	24.50			5.00	4.50		
					Grand Total	**48.35**	**65.95**	**25.05**	**29.80**	**30.50**	**36.35**	**29.35**	**31.47**

Notes:

A. Catch basin flooded, no data collected.
B. No catch basin, no data collected.
1. Structure has curb opening screen and horizontal grate.

street sweeper's ability to collect trash and debris that accumulated directly in front of the screen cover will be affected. It should be noted that the older model screen covers have a locking mechanism that prevent the screen from being pushed in and will only retract during the presence of storm flow. This is important to note that the hybrid retractable screen cover being evaluated does not have a locking mechanism like the older ARS model screen covers and is designed to slide open longitudinally to allow storm water flow into the CB. As a result, the hybrid design may allow trash and debris to be introduced into the CB by the street sweeper's brush during cleaning activities. For this reason, Consultant staff also documented City street sweeping routes, days and times for the study area (See Figure 9) should this activity have a bearing on the performance evaluation.

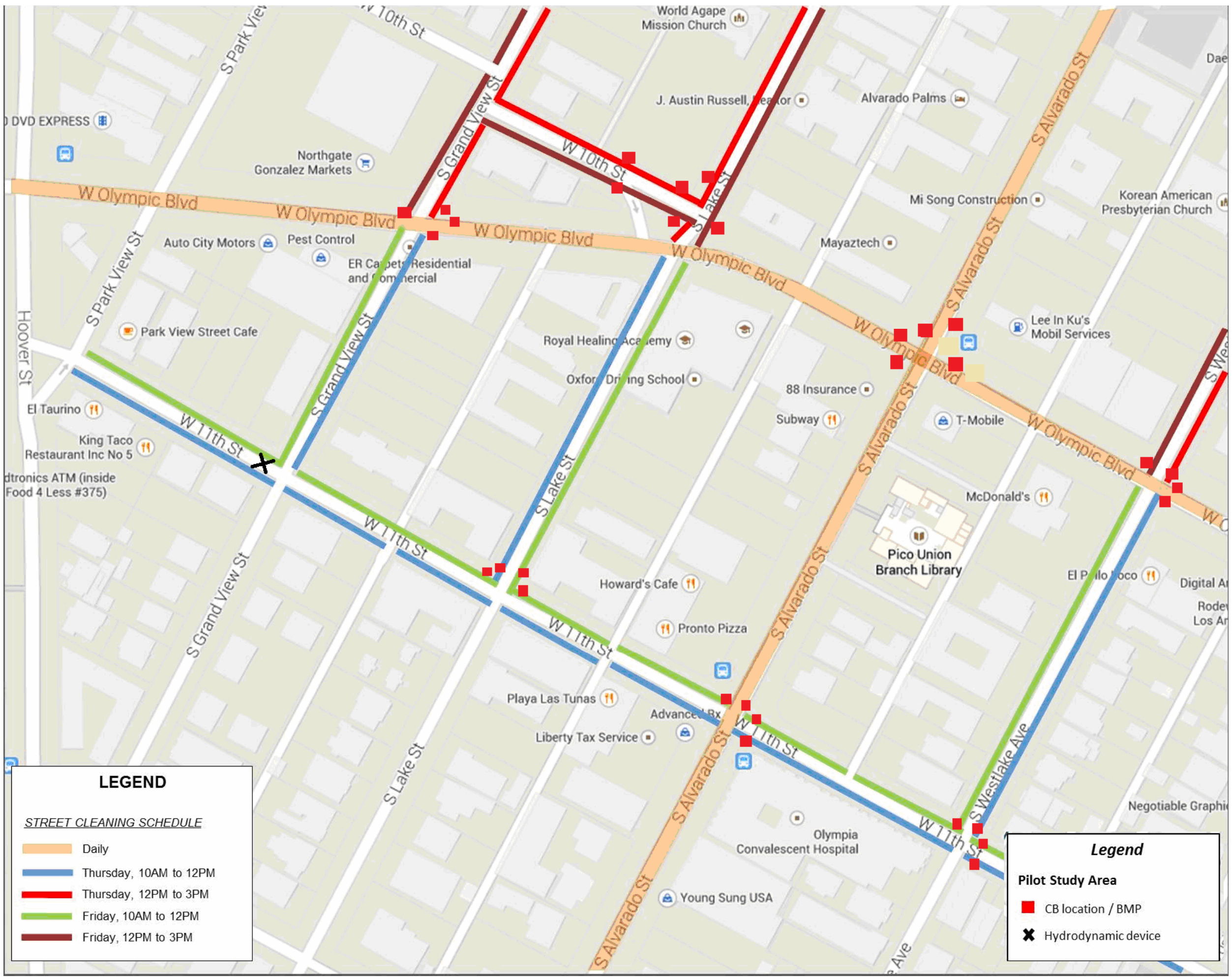


Figure 9. Street Sweeping Routes for Study Area

Data Analysis

In accordance with the approved Study Protocol by the City, data collection from the Study Area would only be initiated with a storm event having an accumulation of greater than 0.25 inches. During the month of December 2014, two rain events occurred meeting this criteria and consultant crews were dispatched to collect data (Appendix B and Appendix C). As previously noted, Table 2 provides a summary of the data collection events used in determining the screen's effectiveness.

The calculations below provide BMP Effectiveness values by storm event as well as an overall performance value calculated for the hybrid retractable screen cover. This calculation procedure was discussed in the previous section of this report, Performance Procedure.

Storm Event No. 1 - Calculation of BMP Effectiveness

A. *BMP Effectiveness wet weather only,*

$$Screen\ Cover\%_{wet\ weather\ effectiveness} = \left(\frac{[149\,lbs] - [65.95\,lbs]}{[149\,lbs]} \right) \times 100\%$$

Screen Cover $_{wet\ weather\ effectiveness}$% = 55.67%

B. *BMP Effectiveness year-round,*

$$Screen\,Cover\%_{Overall\ BMP\ Effectiveness} = \frac{(55.67\% \times 1) + (100\% \times 13.6)}{(1 + 13.6)} \times 100$$

Screen Cover% $_{Overall\ BMP\ Effectiveness}$ = 96.96%

The provided hybrid retractable screen cover, by BuildIt Engineering, does not have a locking mechanism to prevent the screen to be driven inwards by means other than storm runoff, thus the assumption made that this type of screen is 100% effective during the dry season is not valid. Based on field observations, 5% will be deducted from the overall BMP Effectiveness to account for this condition. Thus,

***BMP Effectiveness year-round* = 91.96%**

Storm Event No. 2 - Calculation of BMP Effectiveness

A. *BMP Effectiveness wet weather only,*

$$Screen\ Cover\%_{wet\ weather\ effectiveness} = \left(\frac{[149\,lbs] - [36.35\,lbs]}{[149\,lbs]} \right) \times 100\%$$

Screen Cover% $_{wet\ weather\ effectiveness}$ = 75.56%

B. BMP Effectiveness year-round,

$$Screen\,Cover\%_{Overall\ BMP\ Effectiveness} = \frac{(75.56\% \times 1) + (100\% \times 13.6)}{(1 + 13.6)} \times 100$$

Screen Cover% $_{Overall\ BMP\ Effectiveness}$ = 98.32%

Again, the provided hybrid retractable screen cover by BuildIt Engineering does not have a locking mechanism to prevent the screen to be driven inwards by means other than storm runoff, thus the assumption made that this type of screen is 100% effective during the dry season is not valid. Based on field observations, 5% will be deducted from the overall BMP Effectiveness to account for this condition. Thus,

***BMP Effectiveness year-round* = 93.32%**

Overall Calculation of BMP Effectiveness (Performance Factor)

A mathematical average of the two storm events will be used to determine the overall BMP effectiveness in preventing trash from entering the storm drain system. This method was used in determining the BMP effectiveness for the stainless steel automatic retractable screen in the 2004/05 study by City of Los Angeles (City of LA 2006) which was acknowledged by the Los Angeles Regional Water Quality Control Board.

Overall BMP Effectiveness =
(BMP Effectiveness year-round $_{Storm\ Event\ No.\ 1}$ + *BMP Effectiveness year-round* $_{Storm\ Event\ No.\ 2}$*)* / 2

Overall BMP Effectiveness = (91.96% + 93.32%) / 2

Overall BMP Effectiveness = **92.64%**

Conclusions

BMP Field Applicability

The BuildIt Engineering hybrid retractable screen cover (a.k.a., Hydra®) is a promising alternative to the typical stainless steel automatic retractable screen for trash deflection marketed for complying with the Trash TMDLs. Based on the visual observations and data collected through this study, it has been shown that the hybrid retractable screen cover is ***92.64% effective year-round*** in preventing trash from entering the storm drain system. This is a six percent (6%) improvement from the stainless steel automatic retractable screens tested by the City of Los Angeles in the 2005/06 wet season. Though the performance improvement is small, the hybrid retractable screen cover's cost for fabrication and installation is assumed to be considerably lower, when comparing stainless steel versus plastic material costs, making them financially attractive.

The application of the hybrid retractable screen cover as currently designed and tested in the City of Los Angeles' catch basins would be appropriate for use in hillside areas, low trash generation areas, and for resident requests for screens. Again, the hybrid retractable screen cover is a lower cost alternative, when comparing materials, that has shown it can prevent trash from entering the storm drain system. However, the screen still has limitations that the manufacturer should address for wider land-use applications. Furthermore, the application in hillside areas may be appropriate since these areas typically generate low volume of trash and are often considered low density residential land use (City of LA, 2013). Hillside area catch basins are built on steep slopes where the use of the automatic retractable screen is not optimal because the slope prevents the necessary 20-60% curb height and lateral storm runoff volume and force to disengage the locking mechanism, thus resulting in a screen that would remain in a fixed position most of the time and increase potential to cause flooding (SWRCB 2014). The hybrid retractable screen cover may be the appropriate alternative in the hillside areas since it does not rely on a locking mechanism being disengage for its operation, both for deterring trash from entering the catch basins and for allowing the design flow to enter the catch basin.

Hybrid retractable screen cover use in low trash generation areas of the City may be an appropriate application. As previously stated, the hybrid retractable screen cover lacks a locking mechanism that makes it prone to tampering by individuals determined in pushing trash inside the catch basin. Most of the low trash generation areas in the City are single family residential neighborhoods, which are more likely to be mindful of environmental impacts of trash and less likely to interfere with the hybrid retractable screen cover operation.

City staff has expressed that many of the residential curb opening screen requests are not only for the deterrence of trash and debris from entering the catch basin, but also for the deterrence of vermin or for property and/or personal safety. Installation of a typical automatic retractable screen for these reasons is not cost effective. On the other hand, installation of a hybrid retractable screen cover makes more sense due to its low cost, deterrence of vermin, vandalism and theft, and safety properties.

BMP Improvements

It should be noted that the hybrid retractable screen cover tested is innovative in design and may provide the impetus on how future curb opening screen covers are designed by other vendors. This section's purpose is only to provide the City of Los Angeles a brief overview (Tables 3 and 4) of the advantages and disadvantages of the hybrid retractable screen cover as observed during this short duration of the study. It is recommended further field observations be made beyond this study to ensure that such elements as provided in the tables are validated.

Table 3. Hybrid Retractable Screen Cover Product Possible Advantages

Recyclability	The use of a plastic material for the fabrication allows for the hybrid retractable screen cover to be recycled once its useful life has been reached. Its recyclability may also allow for the recovering of portion of the initial investment.
Low Fabrication Cost	The use of a plastic material for the fabrication of the screen cover significantly is thought to reduce the overall cost of the hybrid retractable screen cover.
Light Weight	The use of a plastic material allows the screen cover to be light in weight, allowing for ease of handling during fabrication as well as installation.
Tension Adjustment	Though the hybrid retractable screen cover does not have a typical locking mechanism, the use of cable tension lock to hinder movement of the screen cover allows it to be versatile since tension settings can vary depending on the location and use.
Blends in with CB Opening	Flexibility in color schemes for the curb face screen allows the user to determine the right blend for the location/neighborhood.
Print Messaging	Manufacturer has stated that the plastic material could be printed which would allow the user the option of seeking sponsors/advertisers for a print message.
Fabrication Material	Manufacturer has stated that depending on the users' specifications the hybrid retractable screen cover can be manufactured with virgin or recycled plastic material. Recycled material could increase social and environmental value of the hybrid retractable screen cover.
Theft Deterrence	Due to the use of a plastic material it is highly unlikely that vandalism and theft would occur since the resale value of plastic is very low compared to that of a stainless steel screen cover.

Table 4. Hybrid Retractable Screen Cover Product Possible Disadvantages

Limited Manufacturers	Being a patented screen cover poses the concern that only one vendor can fabricate this device. This may result in the higher pricing of the product.
Product Longevity	The duration of this study is not sufficient time to validate the manufactures claim that the plastic material will last over a decade. Continuous field observations or other tests are required to validate the longevity of the product.

CB Inlet Capacity Impact	The scope and duration of this study did not allow for a range of field observations during various rain events to firmly verify that the hybrid retractable screen cover does not impact the inlet capacity of the catch basin (SWRCB, 2014).
Screen Design Elements	The hybrid retractable screen cover design of using wedge-like elements to form the face of the screen may impact effective performance of the device due to trash/debris being snagged by wedges. Further field observations are needed to determine if this condition would be prevalent and could prevent application of the hybrid retractable screen cover.

Next Steps

In addition, the City may consider conducting a life-cycle assessment and/or a cost-benefit analysis of the hybrid retractable screen cover to evaluate further if, how, and where these devices can be placed. Furthermore, the City may consider integrating the hybrid retractable screen cover in a controlled field hydraulic study, particularly in streets with moderate to steep slopes. This hybrid retractable screen cover's unique design, versatility, and cost may be a good alternative to the ARS for hillsides. Additional study data will allow the City to scale or rank these devices in areas to obtain the most efficient use of the selected opening screen covers.

References

Bishop, J. (2004). Certification of the gross solids removal as full capture systems. Letter to Jai Paul Thakur. 7 October 2004.

Bishop, J. (2005). Certification of a best management practice (BMP) for trash control as a full capture system – Four-Cities request. Letter to Jim Valentine. 4 May 2005.

Bishop, J. (2007). Certification of catch basin insert screen devices as full capture systems for trash removal. Letter to Shahram Kharaghani. 4 April 2007.

City of Los Angeles (City of LA). (2002). High trash-generation areas and control measures. http://www.lastormwater.org

City of LA. (2006). Technical report on assessment of catch basin opening screen covers. June 2006.

City of LA. (2013). Quantification study of institutional measures for trash TMDL compliance. Prepared by Black& Veatch for City of Los Angeles. December 2013.

City of LA. (2015). Reconsideration of certain technical matters of trash TMDLs for Los Angeles River Watershed and the Ballona Creek Watershed. April 2015.

County of Los Angeles Department of Public Works (LACDPW). (2014). Precipitation map and rainfall data. http://www.ladpw.org/wrd/precip/alert_rain/index.cfm

Dickerson, D. (2003). Request for technical report pursuant to water code section 13267 to develop technical information pertaining to best management practices and other control measures suitable for implementing the trash total maximum daily loads. Letter to Don Wolfe. 22 October 2003.

EOA, Inc. (2014). Tracking california's trash (TCT) project. Literature Review. Prepared on behalf of the Bay Area Storm water Management Agencies Association (BASMAA).

Guo, J. (2000). Street storm water conveyance capacity. ASCEJ. Of irrigation and drainage engineering, Vol. 126, No. 2, March 2000.

Guo and MacKenzie. (2012). Hydraulic efficiency of grate and curb-opening inlets under clogging effect. Colorado department of transportation report No. CDOT-2012-3. April 2012.

Los Angeles Regional Water Quality Control Board (LARWQCB). (2004). Trash total maximum daily loads for the Ballona Creek and wetland. 16 January 2004.

LARWQCB. (2005). Total maximum daily loads for toxic pollutants in Ballona Creek Estuary. 7 July 2005.

LARWQCB. (2006). Total maximum daily loads for bacterial indicator densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel.8 June 2006.

LARWQCB. (2007). Trash total maximum daily loads for the Los Angeles River Watershed. 9 August 2007.

LARWQCB. (2007). Trash total maximum daily loads for Machado Lake in Dominguez Channel Watershed. 11 July 2007.

LARWQCB. (2010). Santa Monica Bay seashore and offshore debris TMDL. 25 October 2010.

LARWQCB. (2012). Order No. R4-2012-0175, NPDES Permit No. CAS004001, Waste discharge requirements for municipal separate storm sewer system (MS4) discharges within the coastal watersheds of Los Angeles County, except those discharges originating from the City of Long Beach MS4. Adopted November 2012.

National Oceanic and Atmospheric Administration (NOAA). (2014). CNRFC precipitation summary. September 2014. Retrieved from www.cnrfc.noaa.gov/rainfall_data.php

State Water Resources Control Board (SWRCB). (2014). Draft staff report for the proposed amendments to statewide water quality control plans to control trash. June 2014.

SWRCB. (2015). Proposed public meeting and consideration of adoption of proposed final amendments to the ocean plan to control trash. February 13, 2015.

United States Environmental Protection Agency (USEPA). (2012). Los Angeles area lakes TMDLs for nitrogen, phosphorus, mercury, trash, and organochlorine pesticides and PCBs. U.S. Environmental Protection Agency Region IX. March 2012.

Appendix A

Catch Basin Opening Screen Cover Effectiveness Protocol

Catch Basin Opening Screen Cover Effectiveness Protocol

September 30, 2014

Project No. TOS - S77

Prepared for:

City of Los Angeles
Bureau of Sanitation
Watershed Protection Division

ADvTECH Environmental, Inc.
Environmental Engineering Consultants

CATCH BASIN OPENING SCREEN COVER EFFECTIVENESS PROTOCOL
LOS ANGELES BUREAU OF SANITATION
WESTLAKE AREA

Prepared for:

City of Los Angeles
Bureau of Sanitation
Watershed Protection Division

Prepared by:

***ADvTECH* Environmental, Inc.**
Environmental Engineering Consultants
632 S. Azusa Avenue
West Covina, California 91791

R. Derek Chung, E.I.T.
Project Engineer

Michael E. Shiang, R.G., C.Hg.
Principal Hydrogeologist
QSD No. G05794

Seal:

Contents

List of Figures

List of Tables

List of Appendices

Introduction

This protocol is designed to objectively assess the performance of alternative catch basin (CB) technologies for trash abatement in an urban area with storm water conveyance system infrastructure. In 2004, the City of Los Angeles (City) performed a pilot study on two trash capture devices, CB retractable screens and CB inserts, and based on the results of the study, the devices obtained approval as "full capture systems" or "partial capture systems" from the Los Angeles Regional Water Quality Control Board (LARWQCB). The City subsequently installed approximately 38,000 CB of the tested retractable screens and 10,000 CB of the tested inserts to meet Trash TMDL milestones. Since 2004, alternative catch basin structural technologies for trash abatement have evolved; however, the information on the performance of trash control measures is limited. In addition, many of the installed trash deflection/retention products will be reaching their service life in the next five years and will require replacement. Therefore, it is the City's desire to perform an evaluation of alternative catch basin technologies in a pilot study to determine the effectiveness of selected device. This protocol will ensure the data collected for analysis will provide confidence in the determination of the effectiveness of the selected technology.

Background

Regulatory

In March 22, 1999, the United State Environmental Protection Agency (USEPA) and USEPA Region IX settled a lawsuit (Heal the Bay v. Browner) in the form of a Consent Decree requiring the development Total Maximum Daily Loads (TMDL) for the Los Angeles area to be completed in 13 years or by 2012. The responsibility to implement these provisions of the Clean Water Act was delegated by the USEPA to the State of California, specifically the LARWQCB. The consent decree established a schedule for the development of certain TMDLs over the 13 year period.

Trash is widely recognized as a serious water quality concern in California, impacting creeks, shorelines, rivers, and lakes. The LARWQCB further identified trash in urban runoff that is conveyed through the storm drain system as a primary source of pollution reaching the receiving waters. When trash is discarded on land, pollutants such as bacteria in animal droppings, household and toxic wastes are contained in or become entrained in paper, plastic, polystyrene, cans, and other debris which rain storms frequently wash into gutters, storm drains, and eventually into waterways, lakes, and ocean. Street and storm drain trash studies have been conducted in various California regions, including one conducted by City of Los Angeles. These studies have provided insight into the composition and quantity of trash that flows from urban streets into the storm drain system and out to adjacent waters. The LARWQCB identified many beneficial uses being impaired due to trash in these water bodies, including:

1. Contact recreation (e.g. swimming, boating) – trash causes physical injuries to swimmers, and health hazards to swimmers by carrying bacteria, viruses, and toxic substances, as well as health hazards due to consumption of fish with diseases transported by trash.
2. Non-contact recreation (e.g. fishing, hiking, jogging, and bicycling) – trash can cause alterations or degradation to waters that support non-contact recreation, safety hazards to boats, rafts, or other recreational vessels.
3. Habitat for aquatic life and wildlife – Fish or wildlife often ingest and become entangled in trash. Trash alters and degrades habitat and interferes with ecosystem function such as supporting spawning grounds and benthic communities.

The trash TMDL for Los Angeles River and Ballona Creek were the first TMDLs to be approved by the LARWQCB in 2001 with a target of zero trash. Other trash TMDLs for waterbodies within the City of Los Angeles jurisdiction followed for Machado Lake, Lincoln Park Lake, Echo Park Lake, and Santa Monica Bay. The City must comply with these trash TMDLs and have had success in utilizing full and partial capture devices in meeting TMDL milestones.

This study takes place in the Ballona Creek watershed drainage area. Compliance requirements for the Ballona Creek Trash TMDL are listed in Table 1.

Table 1.Ballona Creek Trash TMDL Compliance Milestones

Ballona Creek									
Percent Reduction	20	30	40	50	60	70	80	90	100
Compliance date	9/30/ 2006	9/30/ 2007	9/30/ 2008	9/30/ 2009	9/30/ 2010	9/30/ 2011	9/30/ 2012	9/30/ 2013	9/30/ 2014

In November 2012, the LARWQCB adopted a new Municipal Separate Storm Sewer System (MS4) Permit for the Los Angeles Region. As stated in the MS4 Permit Section VI.E.5, compliance with the Trash TMDL interim and final effluent limitations may be accomplished through a combination of full capture systems, partial capture devices, and institutional controls. The use of partial capture devices requires a demonstration of its effectiveness in the prevention of trash from entering the storm drain system. At present, the LARWQCB only oversees the certification process for a full capture system device and leaves it to the permittees to demonstrate the effectiveness of the partial capture system.

Since the adoption of the Los Angeles River and Ballona Creek Trash TMDLs, the LARWQCB has adopted more trash TMDLs, totaling 15 trash TMDLs in the Los Angeles region. Other regions of the state regulate trash through TMDLs and permits, but goals and compliance requirements vary. Beginning in 2010 the State Water Resources Control Board (SWRCB) initiated work on a Statewide Policy and proposed amendments to the California Ocean Plan and the forth coming Inland Surface Waters, Enclosed Bays, and Estuaries of California Plan. The objective of the proposed Trash Amendments is to provide statewide consistency for the regulatory approach to reduce trash in state waters. In June 2014, the SWRCB released the proposed amendments for public comment. The proposed Trash Amendments would apply to all surface waters in the state, with the exception of those waters within the jurisdiction of the LARWQCB that have trash TMDLs in effect prior to the Trash Amendments for the reason that, the fifteen trash TMDLs in the Los Angeles Region have more stringent provisions than the proposed Trash Amendments, and will not result in a degradation of water quality standards in those waters.

In addition, for statewide consistency, the SWRCB would take responsibility for the certification process for full capture systems, but those full capture systems previously certified by the LARWQCB would remain certified for use by permittees as a compliance method. The process for certification would follow a similar process established by the LARWQCB with certification approvals directed to the SWRCB. The SWRCB expects to adopt the Trash Amendments sometime in late 2014.

Project Objectives

This protocol is designed for a study to objectively assess alternative trash abatement products during a twelve month period, which will include a “dry” and “wet” season. The findings of the study will assist the City in selection and use of products to meet Trash TMDL requirements. As mentioned earlier, the use of partial capture devices requires a demonstration of performance of the device. The LARWQCB currently oversees a process for “full capture system” certification, and has not established a process for “partial capture system”. However, in 2004, City established a process in collaboration with LARWQCB for “partial capture systems” which resulted in acknowledgement by the LARWQCB, in 2006, of the City’s partial capture device of the automatic retractable screen (ARS).

This protocol follows the earlier 2004 approach and will provide the information and details necessary for the City to demonstrate to the LARWQCB the selected product’s effectiveness in trash deflection. It is anticipated the LARWQCB will be apprised of and encouraged to provide input during the study, and that the protocol and findings of the study will successfully result in acknowledgement by the LARWQCB of the partial capture system.

BMP Selection

Selection Criteria

Selection criteria were developed by the City of Los Angeles to determine the alternative BMP device to be evaluated based on considerations learned from the existing trash BMP devices installed and maintained. The proposed selection criteria (Figure 1) shown below are intended to establish guidance standards for the selection of trash BMP devices.

Selection Criteria	BMP device must keep trash out of the storm drain system
	BMP device must be economically feasible (e.g., low cost fabrication & installation)
	BMP device must be easily installed (e.g., adaptable to existing structures)
	BMP device must be easily maintained (e.g., requires minimal changes to existing operational practices)
	BMP device must be adaptable for application in varying conditions (e.g., landuses)
	BMP device must not significantly alter hydraulic parameters of the storm drain system
	BMP device must be recognized as a "partial capture" device for incorporation of the calculations for Trash TMDL compliance

Figure 1. Selection Criteria for Alternative CB curb opening BMP Devices

Evaluation of BMPs

Existing catch basin (CB) curb opening BMP devices, considered to be “partial capture” devices, can be grouped into three categories based on the operation of the device in preventing trash from entering the storm drain system. Those operational categories are: a) fixed; b) retractable – water weight; and c) retractable – water force.

Fixed CB curb opening screen covers

Fixed CB curb opening BMP devices (fixed screens, Figure 2), as the name implies, are a permanent barrier placed across the curb opening. Fixed screens are a first generation BMP device first installed in 2000 at targeted catch basins across the City of Los Angeles and other regional municipalities in anticipation of the adoption of the first Trash TMDLs by the LARWQCB. These fixed screens were

Figure 2. CB curb opening screen, fixed

fabricated out of galvanized expanded metal with diamond shape openings having a linear length of one inch (1 in) and a width of one-half inch (1/2 in). The screens extended from the bottom of the curb batter to approximately three quarters of an inch from the top of the curb opening, allowing for this gap to act as an overflow during periods of wet weather.

These fixed screens were effective during dry weather in keeping all debris greater than an inch out of the storm drain system. During periods of wet weather, it was quickly learned that during moderate to severe storms they hindered the catch basin's inlet design capacity resulting in localized ponding. Consequently, the fixed screens required their removal during the wet weather months.

Retractable CB curb opening screen covers

Retractable CB curb opening screen covers were introduced around 2005 in the Los Angeles region. These screens were developed in response to the extensive operational needs required by the fixed screens. These types of curb opening screens are now commonly referred to as automatic retractable screens (ARS) and are recognized by the LARWQCB as "partial capture" devices. Current retractable CB curb opening screen covers sold by various vendors either rely on the weight of flowing water or the force/velocity of water to disengage the locking mechanism.

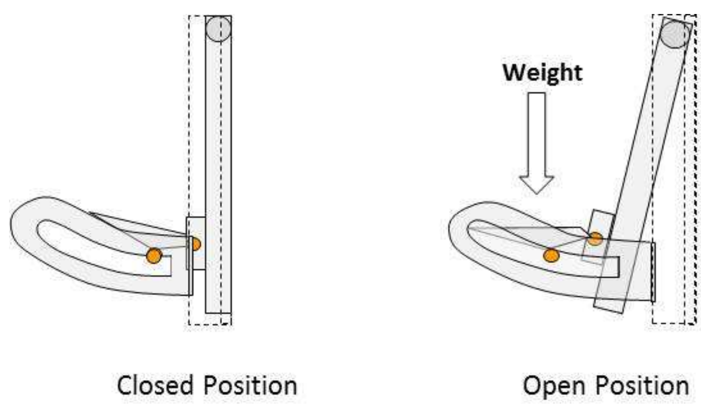


Figure 3. CB curb opening screen, retractable water weight

Figure 3 illustrates the concept of water weight activated retractable CB curb opening screen covers. The screen cover typically has a *horizontal* plate/wing running lengthwise of the screen cover allowing water to accumulate and depress the plate/wing to disengage the locking mechanism. Once the locking mechanism is disengaged, the accumulated water in front of the screen pushes the screen cover inwards not to impede the flow of water into the catch basin. This allows the catch basin inlet capacity to be maintained during storm events.

Figure 4 illustrates the concept of water force/velocity activated retractable CB curb opening screen covers. Contrary to the water weight activated curb opening screen cover, the screen cover typically has a vertical plate/wing running lengthwise of the screen cover allowing water to exert force on the plate/wing to disengage the locking mechanism. Similar to the retractable water weight screen the accumulated water in front of the screen pushes the screen cover inwards.

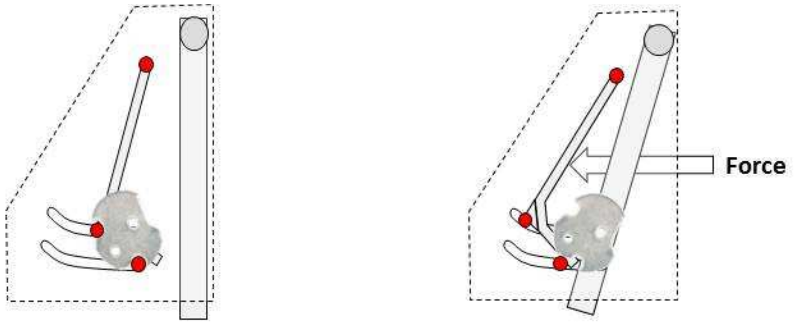


Figure 4. CB curb opening screen, retractable water force/velocity

Hybrid Retractable – CB curb opening screen covers

Due to functional needs that have been identified since the introduction of the retractable curb opening screens in 2005, a manufacturer has developed a hybrid retractable CB curb opening screen cover. One of the concerns of the current retractable screens include its tendency not to disengage the locking mechanism and open to prevent flooding by allowing trash into the storm drain system during moderate and severe storm events. This was mostly encountered in water force/velocity activated retractable CB curb opening screen covers.

The hybrid retractable CB curb opening screen cover is a blend of the positive features of the earlier version of the fixed screen and the current retractable screens (Figure 5). The hybrid retractable screen design moves away from a perforated screen cover shielding the catch basin curb opening and instead relies on a series of flat-angle wedges installed in the curb opening. In addition, the hybrid retractable screen eliminates many of the appurtenances required in earlier versions of the CB curb opening screen cover.

The hybrid retractable wedges act independently from each other, thus only those being exerted a force by flowing water retract inwards to allow flow inwards. Those wedges not being exerted a force remain in the closed position, theoretically preventing trash from entering the storm drain system during wet weather. The wedges pivot from a horizontal cable or rod positioned at the upper portion of

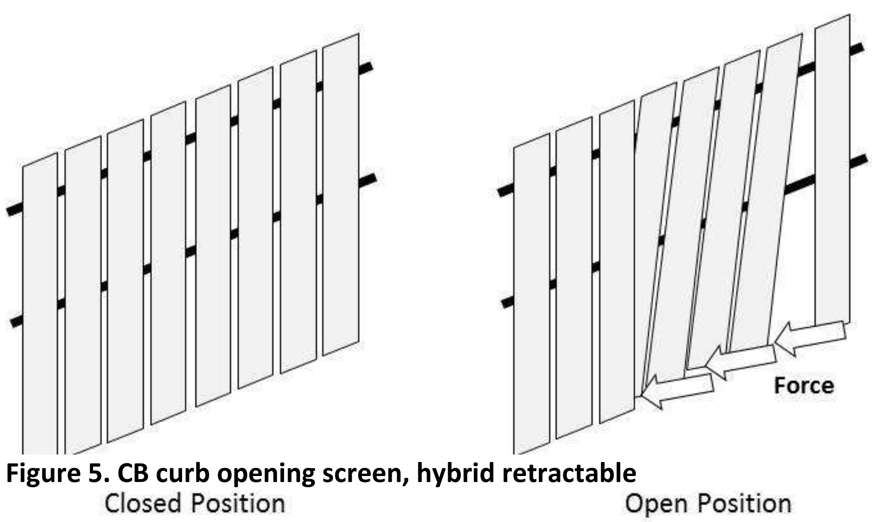


Figure 5. CB curb opening screen, hybrid retractable

the wedge, while a separate pre-tension cable is placed midway down the wedge to provide resistance.

Selected BMP

Based on the City selection, the hybrid retractable CB curb opening screen cover will be evaluated to determine its effectiveness in preventing trash from entering the storm drain system. The hybrid retractable CB curb opening screen cover's features of preventing more trash from entering the storm drain system compared to conventional retractable screens and minimizing localized ponding will be closely observed during the upcoming wet weather season. It is anticipated by the end of the study, the City of Los Angeles would have developed an effectiveness factor for the hybrid retractable CB curb opening screen cover for possible use in the future.

Protocol

Goals and Objectives

The goal of this test protocol is to determine the hybrid retractable CB curb opening screen covers' effectiveness during wet weather days with an accumulation of 0.25 inch or greater of rain. This value was chosen to be consistent with the MS4 Permit for Storm Event Discharges.

Elements

Selection of Study Area

The catch basins retrofitted with hybrid retractable CB curb opening screen covers are located west of the Los Angeles Civic Center in the Westlake area of the City in close proximity to the community of Koreatown (See Figure 6). The drainage area is approximately 55 acres, with three-quarters commercial and the remaining multi-family residential land uses (see Figure 7). The entire drainage area discharges to an existing hydrodynamic device. This area is regarded as a high trash generation area within the City as determined by the City's Trash Generation Study of 2000.

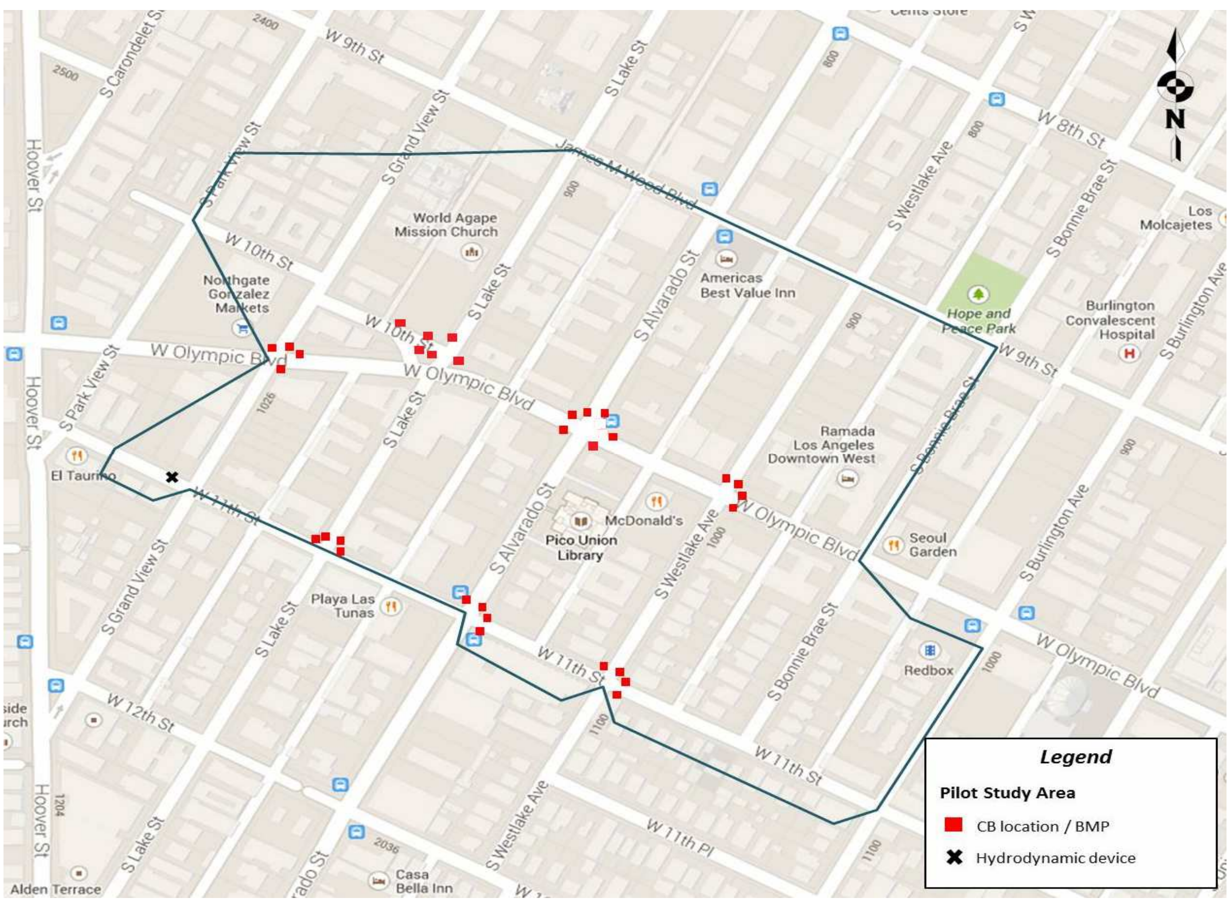


Figure 6. Study area location

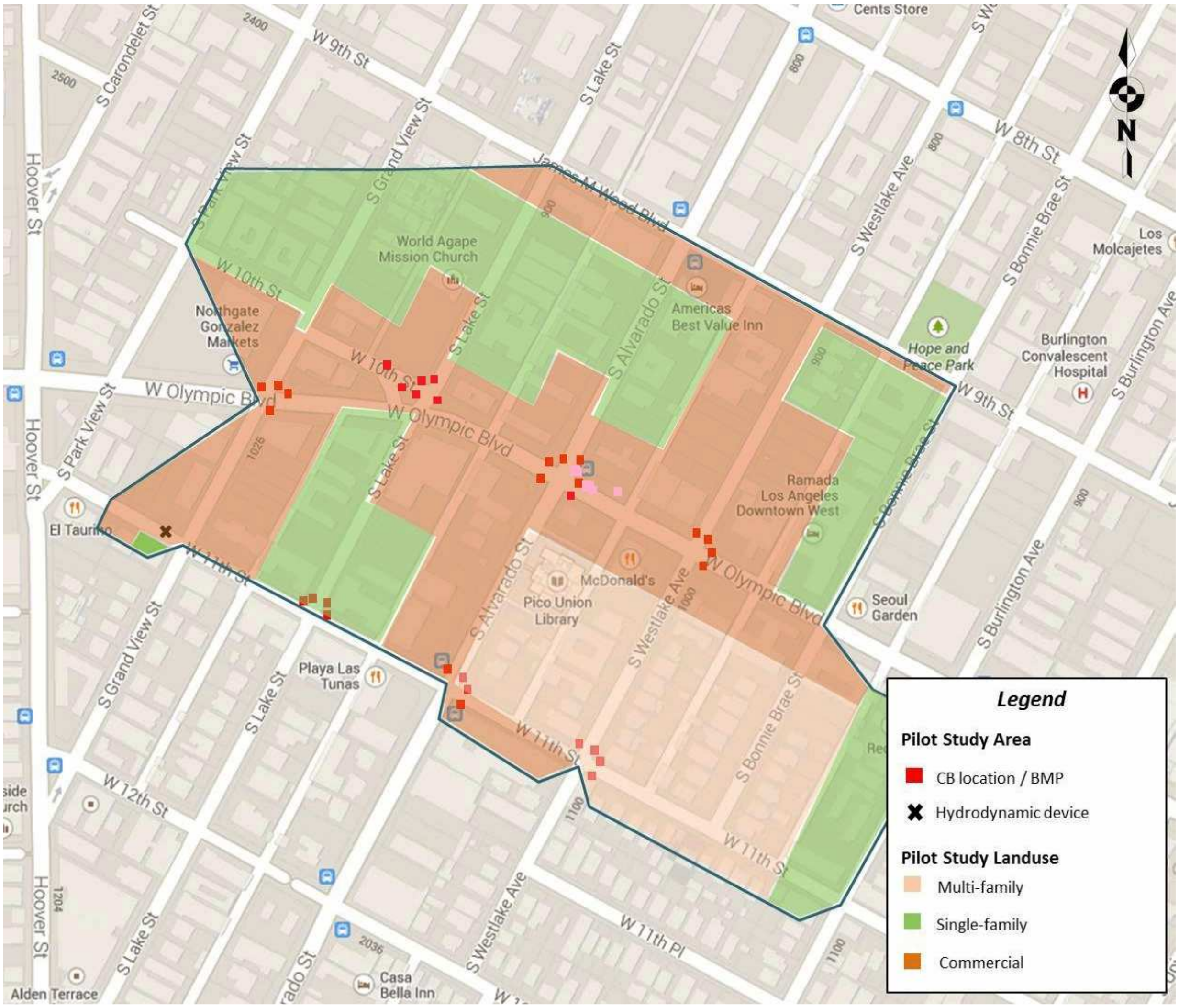


Figure 7. Study area land use

Catch basin and hydrodynamic structure details

Catch Basins

Catch basins (CBs) are the most commonly used inlet structures for a storm drain system to intercept flow from streets (See Figure 8). The study area has 33 CBs that collect flow and direct it to the hydrodynamic device at the outlet of the study area. CBs sizes vary depending on the amount of flow that is being intercepted which is a factor of the curb opening length. Typical curb opening lengths range from 3.5 feet to 28 feet. The physical parameters of the catch basins included in the study are shown in Table 2. As the Table illustrates, over two-thirds of the catch basins had a curb opening length of 3.5 feet and curb opening height of six (6) to eight (8) inches. Appendix A contains photos of all catch basins in the study area.

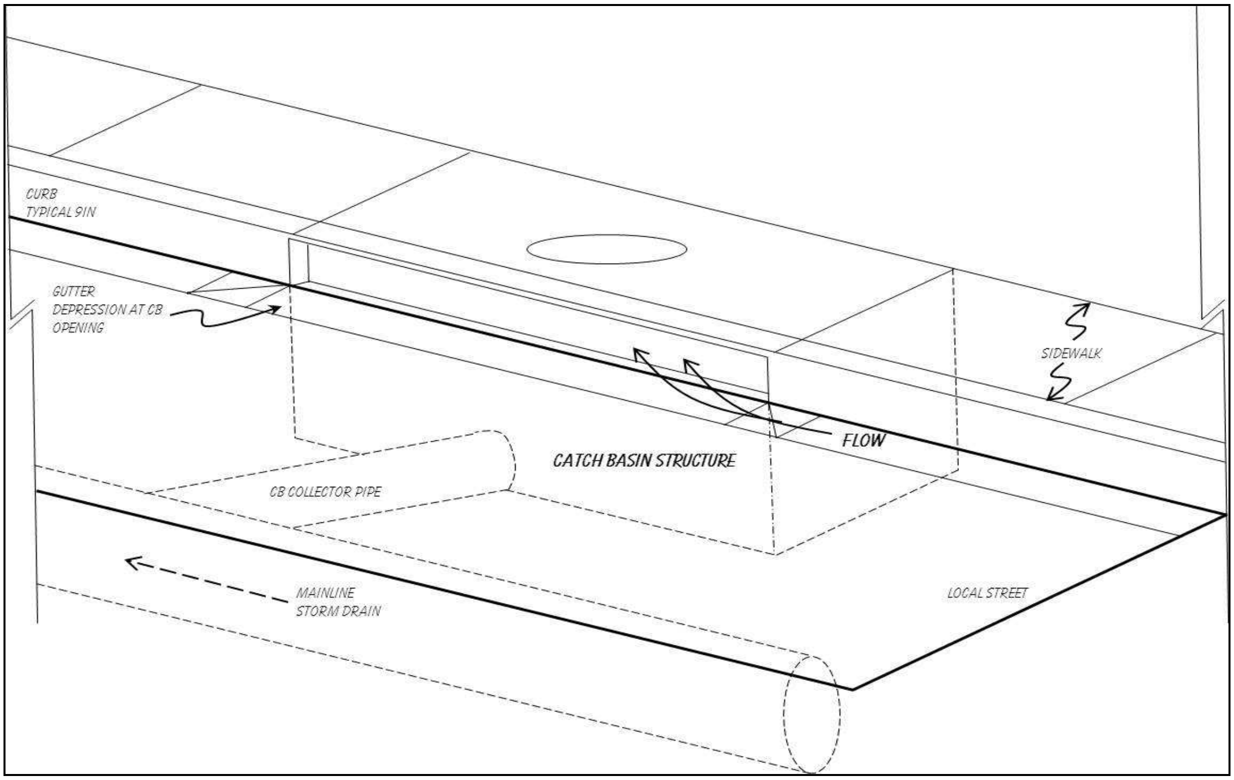


Figure 8. Typical catch basin structure layout

Table 2. Study Area Catch Basins

No.	City of Los Angeles Maintenance Management System #s (CLAMMS #s)	Address	Location	Catch basin Length (ft)	Catch basin Height (in)
1	51605461111108	Westlake Ave & 11th St	NW	2	8
2	51605461111097	11th St & Westlake Ave	ES	2	8
3	51605461111093	Westlake Ave & 11th St	NE	3	6
4	51605461111095	11th St & Westlake Ave	EN	3	8
5	51605461111027	Grand View St & Olympic Blvd	NW	3.5	7
6	51605461111037	Olympic Blvd & Grand View St	ES	3.5	8
7	51605461111048	Olympic Blvd & Alvarado St	WS	3.5	8
8	51605461111054	Olympic Blvd & Westlake Ave	EN	3.5	8
9	51605461111055	Olympic Blvd & Westlake Ave	ES	3.5	8
10	51605461111063	Lake St & 11th St	NW	3.5	8
11	51605461111064	11th St & Lake St	WN	3.5	8
12	51605461111068	Lake St & 11th St	NE	3.5	8
13	51605461111069	11th St & Lake St	EN	3.5	8
14	51605461111078	Alvarado St & 11th St	NW	3.5	8
15	51605461111082	Alvarado St & 11th St	NE	3.5	7
16	51605461111084	11th St & Alvarado St	EN	3.5	8
17	51605461111086	11th St & Alvarado St	ES	3.5	7

No.	City of Los Angeles Maintenance Management System #s (CLAMMS #s)	Address	Location	Catch basin Length (ft)	Catch basin Height (in)
18	51605461111031	Grand View St & Olympic Blvd	NE	3.5	6
19	51605461111040	Alvarado St & Olympic Blvd	NW	7	8
20	51605461111042	Olympic Blvd & Alvarado St	WN	7	8
21	51605461111056	Westlake Ave & Olympic Blvd	NW	7	8
22	51605461111066	Westlake Ave & Olympic Blvd	NE	7	8
23	51605461111044	Alvarado St & Olympic Blvd	NE-2	grate	
24	51605461111047	Olympic Blvd & Alvarado St	EN-1	grate	
25	51605461111070	Alvarado St & Olympic Blvd	NE-1	grate	
26	51605461111071	Olympic Blvd & Alvarado St	EN-2	7	8
27	51605461111032	Olympic Blvd & Grand View St	WN	3.5	8
28	51605461111022	2215 W 10th St	WS	3.5	8
29	51605461111018	10th St & Lake St	WN	7	8
30	51605461111029	Lake St & 10th St	NW	7	8
31	51605461111030	Lake St & 10th St	NE	7	8
32	51605461111023	10th St & Lake St	WN	3.5	8
33	51605461111028	10th St & Lake St	WS	3.5	8

Hydrodynamic structure

The study area has an existing hydrodynamic device located at the outlet of the drainage area that processes all upstream storm drain flow. The hydrodynamic device in use is a ConTech Continuous Deflection System (CDS, see Figure 9) installed as an offline unit from the mainline storm drain system. CDS units are currently recognized by the LARWQCB as full capture devices to meet Trash TMDL compliance milestones.

The CDS is designed as a device that acts similarly like a centrifuge that when the design flow velocity is achieved it forces trash, sediment, and other pollutants to drop into its containment chamber. Proprietary appurtenances (e.g. 5 millimeter screen, baffles, etc.) within the chamber prevent the captured pollutants from being discharged. During dry weather when the design flow velocity is not achieved, it primarily acts like a sedimentation tank, which makes it very effective in the capture of sediment. In wet weather events, the design flow velocity is

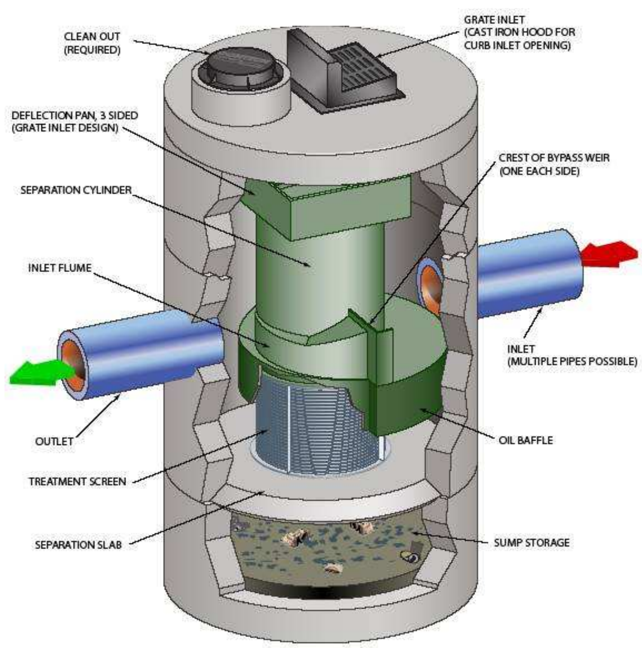


Figure 9. Typical ConTech CDS unit (Source: CONTECH Engineered Solutions)

achieved when a vortex action is created, much like a centrifuge, and contaminants are separated from the flow and contained within the chamber.

Hydrodynamic devices are structures that typically are used to treat large flows and where smaller CB BMPs may not be feasible for installation.

Preparation Prior to Fieldwork

Catch basin and hydrodynamic structure maintenance

It is important prior to the collection of data that all catch basins and the hydrodynamic structure be cleaned to ensure an appropriate baseline is established. In consultation with City staff, it has been determined that City workforces will maintain the hydrodynamic device and all catch basins upstream of the unit prior to the installation of the hybrid retractable catch basin curb opening screen.

Installation of BMP device

Consultant team will remove currently installed CB curb opening screen devices and ensure proper installation of the hybrid CB opening screen covers to be evaluated. This will occur after City workforces have cleaned the hydrodynamic device and all catch basins upstream of the unit.

Training, and Quality Assurance/Quality Control

Field staff will participate in a training session prior to start of the data collection. Field staff will be trained on the goals and objectives of the study, and collection procedures. The field staff will be provided detailed information and maps of the location of the project site, catch basins and CDS unit. They will be trained on properly completing the field data collection form and safety measures. Staff will also be instructed on handling the public should they be approached while working in the field. See Appendix B for training session module.

During the data collection events, the field supervisor and consultant team members will be present for QA/QC purposes. Field supervisor will ensure photographs taken are properly documented for future references, scales are calibrated, and extraneous materials that may affect the weight/volume are not included, and other quality control measures. The crew member's efforts will be observed and corrected immediately as necessary.

Data Collection

General

The CB curb opening screen covers being evaluated are manufactured by BuildIt Engineering from Burbank, California. The curb opening screen covers are manufactured of a composite plastic material in shapes of angle wedges. The wedges are approximately 1.5 inches in width and vary in length depending on the CB curb opening. A series of these wedges are arranged to cover the entire span of the CB curb opening.

Data collection will occur between October 15, 2014 and March 15, 2015 from storm events having an accumulation 0.25 inches or greater. However, the first storm event of the wet weather season having an accumulation greater than 0.25 inches will not be collected. It is anticipated that the first significant storm event of the season will wash out debris from the storm drain system that has accumulated during the dry weather months and give false measurements at the hydrodynamic device. The floatable materials accumulated at the hydrodynamic device, after the first storm event, will be removed but not recorded as valid data.

Field crews will be dispatched to collect data after a wet weather event having an accumulation greater than 0.25 inches as measured in the civic center of the City of Los Angeles using near real time precipitation data provided by the Los Angeles County Department of Public Works, Water Resources Division USC station.
(http://dpw.lacounty.gov/wrd/Precip/alert_rain/index.cfm)

It is anticipated that storm events occurring within short intervals will have minimal trash deposited in the study area. This is due to less outdoor activities and people will spend less time outdoors during rain periods. Thus, data collection and measurements will only be performed if the storm event occurred ten or more days after a past storm event.

Existing historical catch basin and hydrodynamic cleaning data will be obtained from City staff for the purpose of comparison with data measurements collected from the study.

A data collection form has been developed and will be provided to field staff for the collection of data. See Appendix C for sample form.

Fieldwork Procedures

The following field conditions will be recorded by staff at each structure:

Table 3. Parameters to collect during fieldwork

Parameters	Unit
Observations:	
Date	month/day/year
Start/end time at catch basin	hour am/pm
Structure	catch basin or hydrodynamic device
Street address	primary street X cross street
Geographical location	NW / SW / EN / etc.
Weather conditions	Sunny / cloudy / etc.
Street cleaning frequency	daily / weekly
Street ponding in front of catch basin	Yes / No
Amount of trash within structure – CB or hydrodynamic	None / ¼ full / ½ full / ¾ full / Full
Photo of structure before & after cleaning	Yes
Measurements:	
Amount of trash within structure – CB or hydrodynamic	gallons (gals, uncompressed)
Amount of trash within structure – CB or hydrodynamic	Pounds (lbs)

During data collection activities, field crews will be supervised by consultant staff as well as City staff to ensure the robustness of the data. Any deviation from the established protocol will be corrected immediately by the field supervisor. At the conclusion of the data collection event, field crews will return their completed field sheets to the supervisor.

Data Analysis for BMP Effectiveness

Calculation of BMP Effectiveness – wet weather

Determination of wet weather BMP effectiveness will be determined by a comparison of what was captured in the hydrodynamic devices when no BMP devices were installed on the upstream catch basins and what is now collected when BMP devices have been installed. The City has provided a baseline mass (pounds) of the amount of trash collected at the hydrodynamic device prior to BMP device installation during 2003 - 2004. The average 2003-2004 amount of trash collected at the hydrodynamic device was 200 pounds.

Field crews will remove all floatable trash observed in the hydrodynamic device after rain events meeting the 0.25 inch accumulation criteria. Collected trash will be weighed and the volume measured.

Wet weather BMP effectiveness of a catch basin curb opening screen covers will be determined as follows:

$$Screen\ Cover_{wet\ weather\ effectiveness}\% = \left(\frac{CDS_{historical} - CDS_{current}}{CDS_{historical}}\right) \times 100$$

$$CDS_{historical} = 200\ lbs\ (average\ 2003 - 04\ wet\ season\ cleanings)$$

Calculation of BMP Effectiveness – dry weather

The assumption can be made that dry weather BMP effectiveness of a catch basin curb opening screen cover to be one hundred percent (100%) due to the absence of significant flow to activate the locking mechanism and push the screen cover open.

Calculation of Overall BMP Effectiveness

The overall BMP effectiveness over an entire calendar year is calculated using a weighted average[1] based on both the wet- and dry-weather effectiveness. The use of a weighted average is proper in that the Trash TMDL compliance is anticipated throughout the year and not in one period of time or season. The most appropriate weighing factor to use in the calculations is that of wet and dry days experience in the City of Los Angeles in a typical calendar year, since the BMP device being tested is activated by the presence of flow. In a typical year, the City of Los Angeles experiences twenty five (25) days of measurable rain and three hundred forty (340) days of sunshine (a ratio of 1 to 13.6). Thus the overall BMP effectiveness will be determined as follows:

[1] The weighted average is an average where one factor contributes more to the result than another factor.

$$Screen\ Cover_{Overall\ BMP\ Effect}\% = \frac{(Screen\ Cover_{wet\ weather\ effectivenss} \times 1) + (100 \times 13.6)}{(1 + 13.6)}$$

The calculated overall BMP effectiveness results in a percentage representative of the amount of trash that will be prevented from entering the storm drain system from this particular device. Determining the BMP effectiveness is a requirement by the MS4 permit for all partial capture devices if they are to be used in determining a municipality’s compliance to the Trash TMDL.

References

City of Los Angeles. (2002). High Trash-Generation Areas and Control Measures. Available at: http://www.lastormwater.org

City of Los Angeles. (2006). Technical Report on Assessment of Catch Basin Opening Screen Covers. June 2006.

City of Los Angeles. (2013). Quantification Study of Institutional Measures for Trash TMDL Compliance. Prepared by Black& Veatch for City of Los Angeles. November 2013.

Dickerson, D. (2003). Request for Technical Report Pursuant to Water Code Section 13267 to Develop Technical Information Pertaining to Best Management Practices and Other Control Measurews Suitable for Implementing the Trash Total Maximum Daily Loads. Letter to Don Wolfe. 22 October 2003.

Heal the Bay v. Browner (N.D.Ca. 1999)

Los Angeles Regional Water Quality Control Board. (2004). Trash Total Maximum Daily Loads for the Ballona Creek and Wetland. 16 January 2004.

Los Angeles Regional Water Quality Control Board. (2012). Order No. R4-2012-0175, NPDES Permit No. CAS004001, Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges Within the Coastal Watersheds of Los Angeles County, Except those Discharges Originating from the City of Long Beach MS4. December 2012.

Sperling's Best Places. (2014). Sunny Days. Retrieved August 1, 2014, from http://www.bestplaces.net/climate/city/california/los_angeles

State Water Resources Control Board. (2014). Draft Staff Report for the Proposed Amendments to Statewide Water Quality Control Plans to Control Trash. June 2014.

Appendices

Appendix A
Photos

11th St & Westlake Ave, ES

11th St & Westlake Ave, EN

Westlake Ave & 11TH St, NE

Westlake Ave & 11TH St, NW

11th St & Alvarado St, ES

11th St & Alvarado St, EN

Alvarado St & 11th St, NE

Alvarado St & 11th St, NW

11th St & Lake St, EN

Lake Ave & 11th St, NE

Lake Ave & 11th St, NW

11th St & Lake St, WN

Olympic Blvd & Westlake St, ES

Olympic Blvd & Westlake St, EN

Westlake St & Olympic Blvd, NE

Westlake St & Olympic Blvd, NW

Olympic Blvd & Alvarado St, EN2

Olympic Blvd & Alvarado St, EN1

Alvarado St& Olympic Blvd, NE1

Alvarado St & Olympic Blvd, NE2

Alvarado St & Olympic Blvd, NW

Olympic Blvd & Alvarado, WN

Olympic Blvd & Alvarado, WS

Olympic Blvd & Grand View, ES

Olympic Blvd & Grand View, WN

Grand View St &Olympic Blvd, NE

Grand View St & Olympic Blvd, NW

2215 W 10th St, WS

10th St & Lake St, WN

Lake St & 10th St, NW

Lake St & 10th St, NE

10th St & Lake St, WN

10th St & Lake St, WS

11th St & Grandview St, Center of Street, CDS

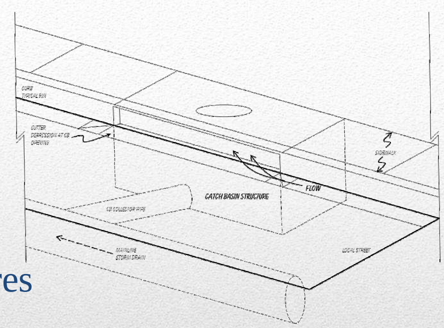
Appendix B
Training Module

CITY OF LOS ANGELES TOS – S77
Trash TMDL Special Study for the Determination of Effectiveness of Alternative Catch Basin Deflection/Retention Products

CB and CDS Trash Collection
Training Session

September 2014

BLACK & VEATCH



- Project Objective
- Field Collection
  - Location
  - Collection Procedures
- Health and Safety

Overview

- Collect all trash in each catch basin (CB) and only the floatable trash at the continuous deflective separation unit (CDS) found in the study area <u>after</u> a rain event having an accumulation of 0.25 inches.
  - Determine volume
  - Determine weight

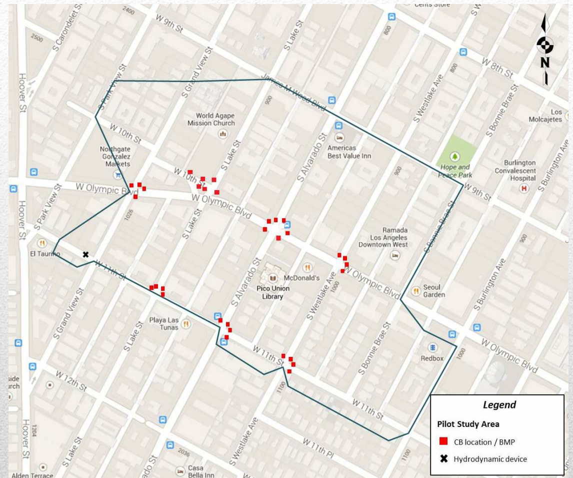
Project Objective

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products

Courtesy Watershed Protection Division, City of Los Angeles

Floatables anticipated ~15 feet

Floatable trash in CDS



- 32 Catch Basins (CB)
- 1 Continuous Deflective Separation unit (CDS)

Field Collection

- Basic Collection Goal
  - Collect data on volume and weight
- Collection Procedure
  - Photo-document trash in CB and CDS
  - Record visual observations
  - Place cones around work site
  - Install trash bag liner inside 50 gallon container

Field Collection

Collection Procedure (continued)

- Remove floatable trash from inside CB or CDS using appropriate tools and place into strainer
- After excess water is dumped, place in 5 gallon buckets for volume measurement, then dump into bag-lined container to be weighed
- Trash is measured as A or B for each catch basin
  - A: 5 foot radius from storm drain on outside of CB
  - B: Inside catch basin
- Remove bag from container, fill out tie-bag information, and place in vehicle.

Field Collection

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products

- Before leaving each site, ensure CB and CDS covers are securely placed back in position.
- Return to City solids facility, measure volume and weight
- Record Data on Trash Collection form
- Form must be signed and dated by crew members
- Dispose of trash in City provided container.
- QA/QC Efforts

Field Collection

Date:____________

Start Time:_____ **End Time:**_____

Personnel: ____________________

CLAMMS#: 51605461111097

Location: 11th St. & Westlake Ave ES

Site Description (circle all valid):

Ponding Vegetation Sediment Open

Other: ____________________

Inside CB

Volume of Trash (gallons):_________

Weight of Trash (lbs): ___________

Outside CB

Volume of Trash (gallons):_________

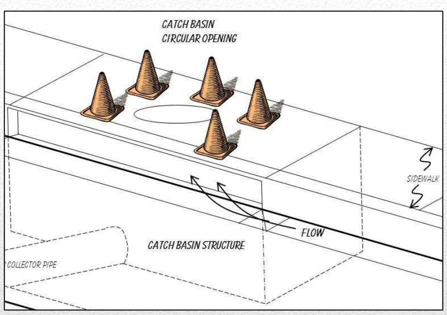
Weight of Trash (lbs): ___________

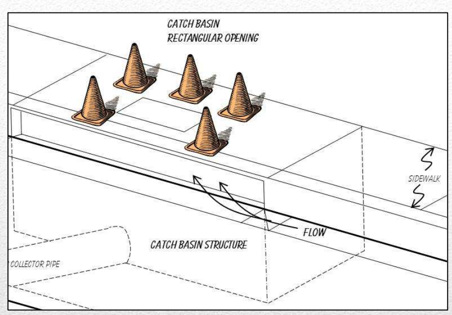
Signature: ____________________

Fill out form completely for each CB

Data Collection Form

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products





Circular Opening

- 40 to 50 lbs
- Lift, pull, & **SLIDE** lid off
- Set traffic cones around opening during cleaning operation

Rectangular Opening

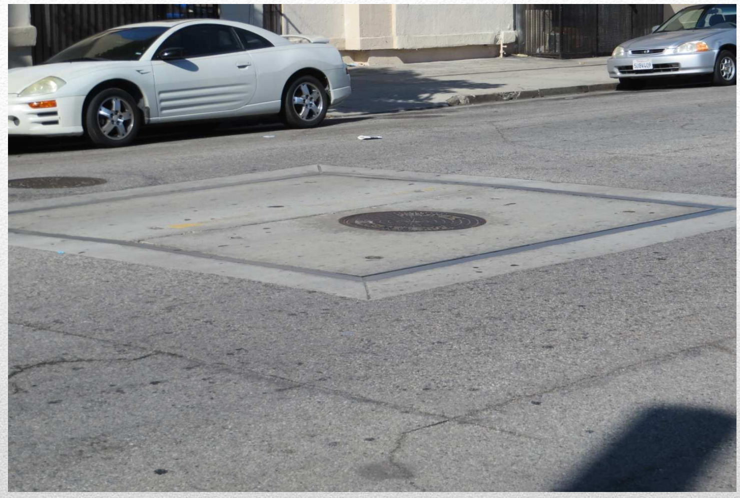
- 40 to 50 lbs
- Lift, pull, & **SLIDE** lid off
- Set traffic cones around opening during cleaning operation

Sample CB opening

CB, rectangular opening

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products

CB, circular opening



CDS circular opening

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products

- Environmental Safety
- PPE
- Hazardous Material Procedure
- Emergency Management

Health and Safety

Environmental Safety

- 4 traffic cones around working area
- 3 traffic cones around CB cover

Health and Safety

OSHA 1910.120 APP B PPE:

- Tyvek suit (optional)
- Work gloves
- Steel Toe Boots
- Safety vest
- Safety glasses
- Hard hat

Health and Safety

- Ambient air monitoring
  - Check CBs for hazardous air quality with photoionization detector (PID)

Health and Safety

- In the case of dangerous objects (knives, guns, etc.) do not touch, take a photo
- For weapons: notify police

Health and Safety

Emergency Contact information

- Site lead: Michael Shiang (626) 641-9632, Derek Chung (909) 238-8630, ADvTECH Environmental Inc.
- Emergencies or Dangerous objects: Call 911
- Local Hospital:

California Hospital Medical Center

1401 S Grand Ave

Los Angeles, CA 90015

Health and Safety

City of LA Trash TMDL Special Study for the Determination of Effectiveness of Alternative CB Deflection/Retention Products

Questions?

Appendix C
Data Collection Forms

Catch Basin BMP Effectiveness Study

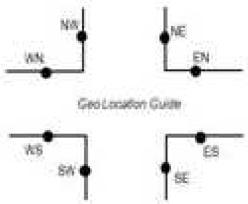
DATA MEASUREMENT FORM

DATE: ______________________ START TIME: ____________ END TIME: ____________

COLLECTION (Circle): CB CDS

CB LOCATION
ADDRESS: ______________________
Name of street where CB is located "@" Name of Cross Street

GEO LOCATION: ______________________



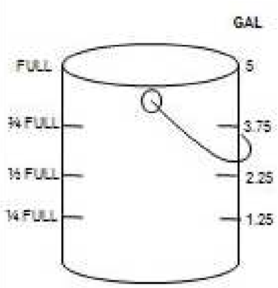
VISUAL OBSERVATIONS		
WEATHER CONDITIONS		
IS PONDING IN FRONT OF CB	YES	NO
STREET CLEANING FREQUENCY		
AMOUNT OF TRASH WITHIN STRUCTURE (circle): CB CDS	NONE	MINIMAL
	¼ FULL	½ FULL
	¾ FULL	FULL

PHOTO TAKEN (Circle): YES

COMMENTS: ____

____

VOLUME (gals)



WEIGHT (lbs)

COMPLETED BY: ______________________ DATE: ____________

APPROVED BY: ______________________ DATE: ____________

SHALL BE SIGNED AND DATED IMMEDIATELY AFTER EVENT

PAGE ________ OF ________

Parameters to collect during fieldwork

Parameters	**Unit**
<u>Observations:</u>	
Date	month/day/year
Start/end time at catch basin	hour am/pm
Structure	catch basin or hydrodynamic device
Street address	primary street X cross street
Geographical location	NW / SW / EN / etc.
Weather conditions	Sunny / cloudy / etc.
Street cleaning frequency	daily / weekly
Street ponding in front of catch basin	Yes / No
Amount of trash within structure – CB or hydrodynamic	None / ¼ full / ½ full / ¾ full / Full
Photo of structure before & after cleaning	Yes
<u>Measurements:</u>	
Amount of trash within structure – CB or hydrodynamic	gallons (gals, uncompressed)
Amount of trash within structure – CB or hydrodynamic	Pounds (lbs, wet)

Additional Data Collection Documents

Date:_______________
Start Time:_______ End Time:______
Personnel: _________________________
CLAMMS#: 51605461111108
Location: Westlake & 11th St NW
Site Description (circle all valid):
Ponding Vegetation Sediment Open
Other: ____________________________
Inside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________
Outside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________

Signature: _________________________

Date:_______________
Start Time:_______ End Time:______
Personnel: _________________________
CLAMMS #: 51605461111093
Location: Westlake & 11th St NE
Site Description (circle all valid):
Ponding Vegetation Sediment Open
Other: ____________________________
Inside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________
Outside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________

Signature: _________________________

Date:_______________
Start Time:_______ End Time:______
Personnel: _________________________
CLAMMS#: 51605461111097
Location: 11th St. & Westlake Ave ES
Site Description (circle all valid):
Ponding Vegetation Sediment Open
Other: ____________________________
Inside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________
Outside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________

Signature: _________________________

Date:_______________
Start Time:_______ End Time:______
Personnel: _________________________
CLAMMS #: 51605461111095
Location: 11th St. & Westlake Ave EN
Site Description (circle all valid):
Ponding Vegetation Sediment Open
Other: ____________________________
Inside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________
Outside CB
Volume of Trash (gallons):___________
Weight of Trash (lbs): ______________

Signature: _________________________

Appendix B

Data from USC Rain Gauge

Data from USC Rain Gage

Los Angeles County Department of Public Works - USC Rain Gage Data
(http://www.ladpw.org/wrd/precip/alert_rain/index.cfm-Accessed December 12, 2014)
(Trash collection dates: December 15 & 16, 2014)

Date / Time	Raw Count	Amount (in.)	Accumulated (in.)
2014-12-12 17:35:48.0	329	0.01	3.23
2014-12-12 16:53:34.0	328	0.02	3.22
2014-12-12 15:03:42.0	326	0.00	3.20
2014-12-12 11:10:47.0	326	0.02	3.20
2014-12-12 11:02:35.0	324	0.01	3.18
2014-12-12 11:01:44.0	323	0.01	3.17
2014-12-12 10:59:03.0	322	0.01	3.16
2014-12-12 09:23:04.0	321	0.01	3.15
2014-12-12 09:19:36.0	320	0.01	3.14
2014-12-12 09:17:42.0	319	0.01	3.13
2014-12-12 09:16:16.0	318	0.02	3.12
2014-12-12 09:14:08.0	316	0.01	3.10
2014-12-12 09:11:59.0	315	0.02	3.09
2014-12-12 09:08:12.0	313	0.01	3.07
2014-12-12 09:06:37.0	312	0.01	3.06
2014-12-12 09:05:20.0	311	0.01	3.05
2014-12-12 09:00:33.0	310	0.03	3.04
2014-12-12 08:39:44.0	307	0.01	3.01
2014-12-12 08:39:04.0	306	0.01	3.00
2014-12-12 08:38:16.0	305	0.01	2.99
2014-12-12 08:36:55.0	304	0.01	2.98
2014-12-12 08:35:46.0	303	0.02	2.97
2014-12-12 08:20:52.0	301	0.01	2.95
2014-12-12 08:17:54.0	300	0.01	2.94
2014-12-12 08:15:57.0	299	0.01	2.93
2014-12-12 07:58:24.0	298	0.01	2.92
2014-12-12 07:33:15.0	297	0.01	2.91
2014-12-12 07:26:43.0	296	0.01	2.90
2014-12-12 07:22:27.0	295	0.02	2.89
2014-12-12 07:11:35.0	293	0.01	2.87
2014-12-12 07:06:52.0	292	0.01	2.86
2014-12-12 07:03:20.0	291	0.01	2.85
2014-12-12 07:00:14.0	290	0.01	2.84
2014-12-12 06:54:46.0	289	0.01	2.83
2014-12-12 06:50:33.0	288	0.02	2.82
2014-12-12 06:40:03.0	286	0.01	2.80
2014-12-12 06:36:54.0	285	0.01	2.79
2014-12-12 06:34:04.0	284	0.01	2.78
2014-12-12 06:30:47.0	283	0.01	2.77
2014-12-12 06:27:41.0	282	0.01	2.76
2014-12-12 06:24:19.0	281	0.02	2.75
2014-12-12 06:19:32.0	279	0.01	2.73
2014-12-12 06:16:10.0	278	0.01	2.72
2014-12-12 06:12:38.0	277	0.01	2.71
2014-12-12 06:08:46.0	276	0.01	2.70

Date / Time	Raw Count	Amount (in.)	Accumulated (in.)
2014-12-12 06:05:04.0	275	0.01	2.69
2014-12-12 06:00:53.0	274	0.01	2.68
2014-12-12 05:55:40.0	273	0.01	2.67
2014-12-12 05:51:25.0	272	0.02	2.66
2014-12-12 05:44:38.0	270	0.01	2.64
2014-12-12 05:41:30.0	269	0.03	2.63
2014-12-12 05:33:16.0	266	0.05	2.60
2014-12-12 05:18:15.0	261	0.01	2.55
2014-12-12 05:14:46.0	260	0.01	2.54
2014-12-12 05:07:41.0	259	0.01	2.53
2014-12-12 05:01:32.0	258	0.01	2.52
2014-12-12 04:57:49.0	257	0.01	2.51
2014-12-12 04:55:42.0	256	0.01	2.50
2014-12-12 04:53:41.0	255	0.02	2.49
2014-12-12 04:50:25.0	253	0.02	2.47
2014-12-12 04:46:11.0	251	0.01	2.45
2014-12-12 04:44:19.0	250	0.01	2.44
2014-12-12 04:41:38.0	249	0.02	2.43
2014-12-12 04:37:02.0	247	0.05	2.41
2014-12-12 04:16:32.0	242	0.03	2.36
2014-12-12 04:01:58.0	239	0.01	2.33
2014-12-12 03:57:45.0	238	0.01	2.32
2014-12-12 03:52:31.0	237	0.03	2.31
2014-12-12 03:46:44.0	234	0.02	2.28
2014-12-12 03:43:26.0	232	0.02	2.26
2014-12-12 03:40:02.0	230	0.01	2.24
2014-12-12 03:38:07.0	229	0.01	2.23
2014-12-12 03:35:33.0	228	0.04	2.22
2014-12-12 03:32:21.0	224	0.01	2.18
2014-12-12 03:31:51.0	223	0.01	2.17
2014-12-12 03:31:21.0	222	0.01	2.16
2014-12-12 03:30:56.0	221	0.02	2.15
2014-12-12 03:30:32.0	219	0.01	2.13
2014-12-12 03:30:01.0	218	0.01	2.12
2014-12-12 03:29:38.0	217	0.02	2.11
2014-12-12 03:28:20.0	209	0.02	2.09
2014-12-12 03:28:02.0	207	0.02	2.07
2014-12-12 03:27:46.0	205	0.02	2.05
2014-12-12 03:27:31.0	203	0.02	2.03
2014-12-12 03:27:14.0	201	0.02	2.01
2014-12-12 03:26:55.0	199	0.02	1.99
2014-12-12 03:26:38.0	197	0.04	1.97
2014-12-12 03:25:52.0	193	0.01	1.93
2014-12-12 03:25:21.0	192	0.01	1.92
2014-12-12 03:24:48.0	191	0.01	1.91
2014-12-12 03:22:58.0	190	0.01	1.90
2014-12-12 03:20:23.0	189	0.01	1.89
2014-12-12 03:17:06.0	188	0.01	1.88
2014-12-12 02:52:33.0	187	0.01	1.87
2014-12-12 01:19:01.0	186	0.01	1.86
2014-12-12 01:05:28.0	185	0.01	1.85
2014-12-12 01:01:20.0	184	0.01	1.84
2014-12-12 00:53:47.0	183	0.01	1.83

Los Angeles County Department of Public Works - USC Rain Gage Data
(http://www.ladpw.org/wrd/precip/alert_rain/index.cfm-Accessed December 2, 2014)
(Trash collection dates: December 4 & 5, 2014)

Date/Time	Raw Count	Amount (in.)	Accumulation (in.)
2014-12-03 23:35:11.0	180	0.01	1.80
2014-12-03 19:36:29.0	179	0.02	1.79
2014-12-03 18:08:30.0	177	0.01	1.77
2014-12-03 17:58:25.0	176	0.01	1.76
2014-12-03 17:46:08.0	175	0.01	1.75
2014-12-03 17:42:19.0	174	0.01	1.74
2014-12-03 17:40:09.0	173	0.01	1.73
2014-12-03 17:30:54.0	172	0.01	1.72
2014-12-03 17:16:50.0	171	0.01	1.71
2014-12-03 16:37:26.0	170	0.01	1.70
2014-12-03 16:28:51.0	169	0.01	1.69
2014-12-03 16:22:42.0	168	0.01	1.68
2014-12-03 16:21:28.0	167	0.02	1.67
2014-12-03 16:20:13.0	165	0.01	1.65
2014-12-03 15:22:50.0	164	0.01	1.64
2014-12-03 14:05:19.0	163	0.01	1.63
2014-12-03 10:33:08.0	162	0.01	1.62
2014-12-03 10:16:25.0	161	0.01	1.61
2014-12-03 10:07:32.0	160	0.01	1.60
2014-12-03 10:03:11.0	159	0.01	1.59
2014-12-03 09:47:11.0	158	0.02	1.58
2014-12-03 06:18:46.0	156	0.01	1.56
2014-12-03 03:03:26.0	155	0.00	1.55
2014-12-02 23:42:21.0	155	0.01	1.55
2014-12-02 19:03:06.0	154	0.01	1.54
2014-12-02 18:38:22.0	153	0.01	1.53
2014-12-02 17:39:09.0	152	0.01	1.52
2014-12-02 16:34:36.0	151	0.01	1.51
2014-12-02 16:30:48.0	150	0.01	1.50
2014-12-02 16:28:24.0	149	0.01	1.49
2014-12-02 16:24:24.0	148	0.02	1.48
2014-12-02 16:09:19.0	146	0.01	1.46
2014-12-02 16:03:24.0	145	0.01	1.45
2014-12-02 15:55:57.0	144	0.01	1.44
2014-12-02 15:49:23.0	143	0.01	1.43
2014-12-02 15:42:09.0	142	0.01	1.42
2014-12-02 15:36:44.0	141	0.01	1.41
2014-12-02 15:30:59.0	140	0.03	1.40
2014-12-02 15:20:29.0	137	0.01	1.37
2014-12-02 15:17:05.0	136	0.01	1.36
2014-12-02 15:14:02.0	135	0.01	1.35
2014-12-02 15:11:03.0	134	0.01	1.34
2014-12-02 15:07:48.0	133	0.01	1.33
2014-12-02 15:05:19.0	132	0.01	1.32
2014-12-02 15:02:28.0	131	0.01	1.31
2014-12-02 14:53:55.0	130	0.01	1.30
2014-12-02 14:45:24.0	129	0.01	1.29

Date/Time	Raw Count	Amount (in.)	Accumulation (in.)
2014-12-02 14:38:50.0	128	0.01	1.28
2014-12-02 14:34:34.0	127	0.02	1.27
2014-12-02 14:25:16.0	125	0.01	1.25
2014-12-02 14:21:19.0	124	0.02	1.24
2014-12-02 14:15:36.0	122	0.03	1.22
2014-12-02 14:07:58.0	119	0.01	1.19
2014-12-02 14:04:28.0	118	0.01	1.18
2014-12-02 14:01:40.0	117	0.01	1.17
2014-12-02 13:57:18.0	116	0.01	1.16
2014-12-02 13:54:30.0	115	0.01	1.15
2014-12-02 13:52:03.0	114	0.01	1.14
2014-12-02 13:50:00.0	113	0.01	1.13
2014-12-02 13:46:06.0	112	0.01	1.12
2014-12-02 13:42:43.0	111	0.01	1.11
2014-12-02 13:38:28.0	110	0.01	1.10
2014-12-02 13:32:18.0	109	0.01	1.09
2014-12-02 13:24:40.0	108	0.01	1.08
2014-12-02 13:19:43.0	107	0.02	1.07
2014-12-02 13:09:19.0	105	0.01	1.05
2014-12-02 13:05:47.0	104	0.01	1.04
2014-12-02 13:01:30.0	103	0.01	1.03
2014-12-02 12:58:37.0	102	0.02	1.02
2014-12-02 12:44:15.0	100	0.01	1.00
2014-12-02 12:36:39.0	99	0.01	0.99
2014-12-02 12:28:19.0	98	0.02	0.98
2014-12-02 12:16:22.0	96	0.01	0.96
2014-12-02 12:13:13.0	95	0.02	0.95
2014-12-02 12:07:33.0	93	0.01	0.93
2014-12-02 12:02:34.0	92	0.02	0.92
2014-12-02 11:55:08.0	90	0.01	0.90
2014-12-02 11:45:00.0	89	0.01	0.89
2014-12-02 11:42:19.0	88	0.01	0.88
2014-12-02 11:40:37.0	87	0.01	0.87
2014-12-02 11:37:33.0	86	0.01	0.86
2014-12-02 11:32:56.0	85	0.01	0.85
2014-12-02 11:30:30.0	84	0.01	0.84
2014-12-02 11:28:42.0	83	0.01	0.83
2014-12-02 11:27:20.0	82	0.01	0.82
2014-12-02 11:26:18.0	81	0.01	0.81
2014-12-02 11:25:07.0	80	0.01	0.80
2014-12-02 11:23:35.0	79	0.01	0.79
2014-12-02 11:19:42.0	78	0.01	0.78
2014-12-02 11:13:46.0	77	0.01	0.77
2014-12-02 11:01:30.0	76	0.01	0.76
2014-12-02 10:57:43.0	75	0.01	0.75
2014-12-02 10:41:43.0	74	0.01	0.74
2014-12-02 10:20:17.0	73	0.01	0.73
2014-12-02 10:13:21.0	72	0.01	0.72
2014-12-02 10:05:47.0	71	0.01	0.71
2014-12-02 10:00:32.0	70	0.01	0.70
2014-12-02 09:27:35.0	69	0.01	0.69
2014-12-02 08:47:17.0	68	0.01	0.68
2014-12-02 07:06:52.0	67	0.01	0.67

Appendix C

Photos: CDS Pre-Study Cleaning and CB Data Collection

CDS Pre-study Cleaning – November 18, 2014

Catch Basin Data Collection After Rain Event - December 4, 2014

10th at Lake Street 51605461111030

10th St at Lake St 5160461111028

11th and Alvarado EN 51605461111084

11th and Alvarado EN 51605461111086

11th and Lake EN 51605461111069

11th and Lake EN 51605461111064

11th and Westlake ES 51605461111097

2215 W 10th St 51605461111022

2222 Olympic ES 516055461111037

Alvarado and 11th NE 51605461111082

Alvarado and 11th NW 51605461111078




Alvarado and Olympic NE 51605461111044

Alvarado and Olympic NW 51605461111040

Alvarado and Olympic NE 51605461111018

Grandview and Olympic NW 51605461111027

Lake and 11th NE 51605461111068

Lake and 11th NW 51605461111063

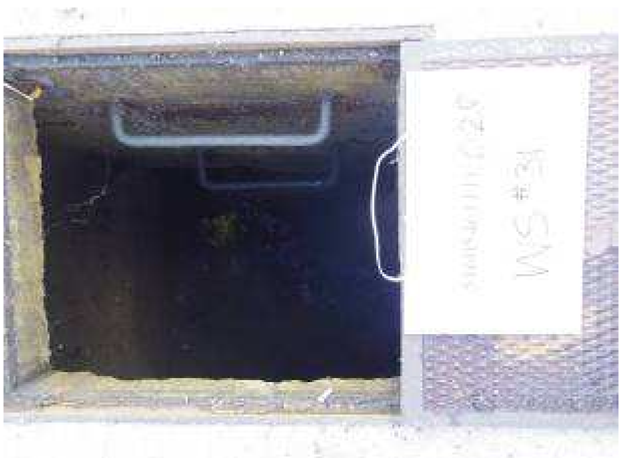
Olympic and Alvarado WN 51605461111042

Olympic and Alvarado WS 51605461111048

Westlake and 11th NE 51605461111093

Westlake and 11th NW 51605461111108

Westlake and Olympic NW51605461111056 #21



Grandview and Olympic NE 51605461111031

Olympic and Alvarado EN-2 - 51605461111071

Westlake and Olympic NE 51605461111066 #22

11th and Westlake EN 51605461111095 #4

Olympic and Alvarado St EN 51605461111071 #24

Olympic and Westlake EN 51605461111054 #8

Olympic and Westlake ES 51605461111055 #9

Catch Basin Data Collection After Rain Event - December 16, 2014

10th at Lake St 51605461111029




10th at Lake Street 51605461111030

10th St at Lake St 51605461111028

11th and Alvarado EN 51605461111084

11th and Alvarado ES 51605461111086

11th and Lake EN 51605461111069

11th and Lake WN 51605461111064

11th and Westlake EN 51605461111095

11th and Westlake ES 51605461111097

2215 W 10th St 51605461111022

2222 Olympic ES 51605461111037

Alvarado and 11th NE 51605461111082

Alvarado and 11th NW 51605461111078

Alvarado and Olympic NW 51605461111040




10th St. & Lake WN 51605461111018

Grandview and Olympic NE 51605461111032

Grandview and Olympic NW 51605461111027

Lake and 11th NE 51605461111068

Lake and 11th NW 51605461111063

Alvarado and Olympic NE 51605461111044