Santa Clara Valley
Urban Runoff
Pollution Prevention Program

MEMORANDUM

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TO: **SCVURPPP Trash AHTG**

FROM: **Paul Randall and Chris Sommers (Program Staff)**

DATE: **February 25, 2009**

SUBJECT: **Stevens Creek Pilot Trash Assessment Technical Memorandum**

Introduction

The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) Co-permittees have utilized the Urban Rapid Trash Assessment (URTA) as an assessment tool to characterize trash conditions in Santa Clara Basin watersheds since 2004. During this time, SCVURPPP Co-permittees have conducted 139 URTAs at 51 creek locations within 12 major watersheds in the Santa Clara Basin. These assessments have been primarily conducted at known trash problem areas identified by Co-permittees and documented in SCVURPPP (2004).

The URTA data has provided SCVURPPP Co-permittees with a valuable tool for identifying and prioritizing trash problem areas, as well as evaluating the potential management actions to reduce trash levels at each site. However, the URTA provides an evaluation of trash conditions only within a 100-foot section of creek for a limited number of sites within a waterbody. One limitation of this protocol is that trash conditions are highly variable and assessments conducted at one site may not be representative of longer stream segments. As a result, information gaps exist for understanding overall trash conditions at a watershed scale.

A second limitation with URTA data is that site-specific trash assessments do not provide a comprehensive evaluation of where trash comes from and how it enters the creek. Furthermore, existing assessment information does not provide insight into understanding the relative contribution from urban runoff. As a result, it is difficult for stormwater programs to identify and prioritize management actions to effectively reduce trash levels in the creek, using URTA data alone.

To address these information gaps, Program staff conducted a pilot trash assessment in Stevens Creek watershed to develop and test methodologies to better assess trash condition at the watershed scale. Objectives were to:

1) Assess the magnitude and extent of in-creek trash problem areas; and
2) Identify pathways that transport or release trash creeks, with a focus on trash contribution from Municipal Separate Storm Sewer Systems (MS4s).

This memorandum presents results of the pilot assessment that was applied to 6-mile reach of Stevens Creek. In addition, the assessment methodology was evaluated to determine if objectives were met and what if any modifications to the approach should be made for future assessments in other Santa Clara Basin watersheds.

Background

The URTA data collected by Co-permittee staff was the primary source of data used by Water Board staff to evaluate potential trash impairment of Santa Clara Basin watersheds during the 2008 303d listing process. Water Board staff applied the following criteria to evaluate potential impairment of trash: 1) score of equal to or less than 5 for URTA Parameter #1 (Qualitative Level of Trash); and/or 2) score of equal to or less than 10 for URTA Parameter #3 (Aquatic/Wildlife Condition). Water Board staff have also indicated that greater weight would be given to water bodies that had multiple assessments in the same watershed with scores $\leq$ 5.

The URTA was applied at six locations within the Stevens Creek watershed between 2004 and 2007. The lowest elevation site, La Avenida, received a score of $\leq$ 5 for URTA Parameter #1 during two assessments, including the initial evaluation[1] conducted during 2004. The two uppermost sites, McClellan Ranch and Moss Rock, received scores of 8 and 9, respectively, just below Water Board criteria of $\leq$ 10 for URTA Parameter #3. Based on these trash results, the Water Board staff listed Stevens Creek as impaired for trash.

Methods

To assess extent, magnitude, sources and pathways, trash items occurring below the high water line were enumerated over a 4.4 mile section of Steven Creek, between La Avenida Avenue (most downstream) and the southernmost Highway 85 road crossing (at the Los Altos and Sunnyvale jurisdictional boundary line). The assessment occurred between October 1 –7, 2008 when most of the channel in the study area was dry. The high water line was defined as the area in the channel subjected to high flow events, which was typically identified in the field by the presence of trash and/or debris trapped in vegetation. Trash items were tallied within 11 stream reaches, generally ranging 0.25 to 0.5 mile in length, all delineated by major road crossings. The total number of trash items below each of the road crossings was documented as well.

[1] Initial URTA assessments document trash that has accumulated within study site over a number of years, presuming no clean up events were previously conducted within the assessment area. As a result, subsequent assessments following removal of trash from initial assessments are better indicators of existing trash conditions for each site.

Trash items were categorized into three major types of pathways during the assessment, including: 1) littering or dumping directly into the channel; and 2) storm drain outfalls; and 3) accumulation from downstream transport. The first two categories represent pathways where trash is directly deposited in the creek at a given location. The accumulation category represents trash that originates from upstream sources and pathways that is then transported to an accumulation area further downstream. Trash associated with the storm drain outfalls was identified at depositional areas directly below outfalls that contributed trash to the creek. It is presumed, however, that a portion of trash identified as accumulation from downstream transport also originated from storm drain outfalls, wind and direct dumping sites upstream of the accumulation areas. Therefore, estimates of the percentage of trash entering the creek from outfalls and direct dumping are likely lower-bound estimates. Additional data are needed to estimate the relative contribution of storm drain systems to the total accumulated trash found in the creek.

Pathways for each trash item were determined by location and/or condition of trash items. For example, trash that appeared to be worn or crushed and/or located along channel margins in vegetation, upstream of flow obstructions or trapped in the substrate was identified as accumulation. In contrast, trash that was relatively clean and found in areas used by the public (e.g., road crossings, trails to creek) was identified as in-stream litter. Trash items in vegetation or substrate below outfalls were identified as originating from storm drain.

Wind transport pathway is another potential pathway for trash getting to Stevens Creek, especially at road crossings or sections of creek in close proximity to major roads and freeways. It was not possible to determine if trash at road crossings was associated with direct litter and dumping or wind. As a result, some of the trash that was identified as litter and dumping source during the assessment may be associated with wind.

Location of dumpsites was also documented during the trash assessment using GPS. Dumpsites ranged from large trash items dumped behind apartment complexes or below bridges to large trash piles near homeless camps or below bridges. These sites were generally above high water line and contained too many trash items to count. Homeless encampments visible from the stream channel were also documented. Location of major dumpsites and homeless camps were reported to municipal staff and SCVWD staff. Size and location of storm drain outfalls, as well as trash items occurring within flow line of outfall, were also documented. Photographs of trash and stream characteristics were taken for each reach.

In addition to the 4.4 mile trash assessment, a creek walk was conducted in a 1.8-mile section of Stevens Creek, between Highway 85 and Interstate 280 crossings. Trash levels appeared much lower in this section of Stevens Creek when compared to any of the 11 assessment reaches further downstream. Majority of the trash that was observed in the upper section of Stevens Creek occurred at freeway and road crossings and at the mouth of Heney Creek.

To better understand trash pathways via storm drains, a more detailed trash assessment was conducted at the Remington Drive outfall (Reach 11) located in the City of Sunnyvale. Assessments were conducted three separate time periods, including: October 14 (end of dry season), December 23 and February 20 (both following storm events). During these assessments, trash located within the flow line of the storm drain outfall was enumerated, categorized and removed from the site. Trash categories described in the Urban Rapid Trash Assessment were used in the assessment. Brand names of trash items were also noted when possible. Results of the outfall study are not provided in this memo, but will be presented at next Trash Ad Hoc Task Group meeting.

Results

Trash assessment results across the 11 reaches are shown in Table 1. A total of 9,189 trash items were counted across all reaches, with an overall average of 40 trash items per 100 feet of stream. Trash accumulation accounted for 68% of the total trash and litter/dumping and storm drain pathways accounted for 27% and 5%, respectively, of the remaining trash items. In addition, there were a total of 14 dumpsites and 7 homeless camps identified during the survey (Table 1). All but one homeless camp occurred in Reaches 8 and 9.

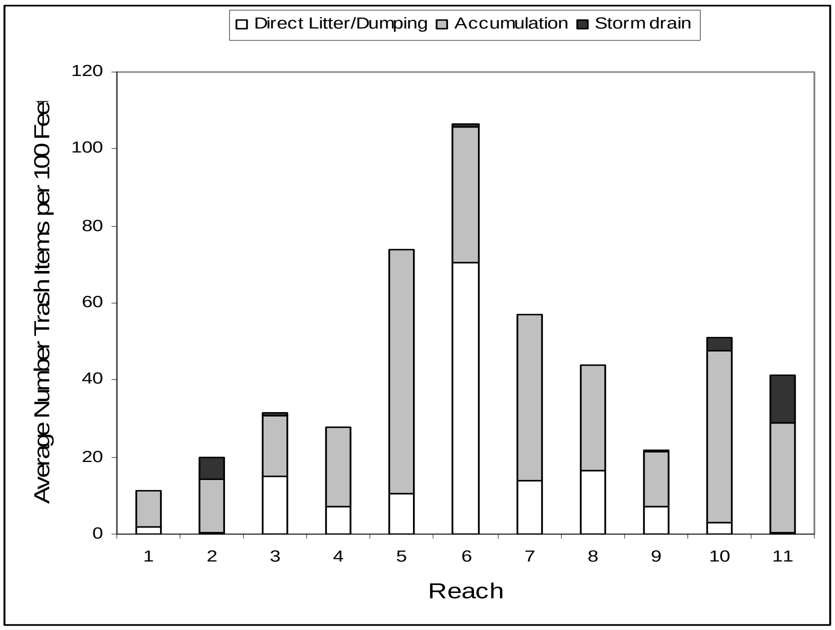
Table 1. Total number and average trash items in each reach per 100-foot length, and percentage of trash associated with pathway in 11 reaches of Stevens Creek. Only trash below high water line was tallied. Total number outfalls, dump sites and homeless camps are also shown across reaches.

Reach	Extent of Reach	Reach Length (ft)	Total Trash	Ave # Trash in Reach per 100'	Percent trash items associated with pathway			# Total Outfall	# Dump Site	# Home less Camp
					Accum-ulation[1]	Litter/ Dumping	Storm Drain			
1	La Avenida to Hwy 101	1766	201	11	85	15	-	2	-	-
2	Hwy 101 to Moffett	1774	350	20	70	1	29	6	-	-
3	Moffett to Middlefield	1643	516	31	50	48	2	7	1	-
4	Middlefield to Hwy 85	1292	360	28	75	25	-	1	1	-
5	Hwy 85 to Central Exp	1296	955	74	86	14	-	-	1	-
6	Central Exp to Dana St	1392	1481	106	33	66	1	5	2	1
7	Dana St to Highway 237	1450	829	57	75	24	-	3	2	-
8	Hwy 237 to El Camino	2052	900	44	63	37	-	2	2	3
9	El Camino to Hwy 85	4850	1046	22	66	34	1	6	4	3
10	Hwy 85 to Remington OT	3136	1595	51	88	6	6	1	1	-
11	Remington OT to Hwy 85	2558	1056	41	70	-	30	2	-	-
Total		*23309*	*9289*	*40*	*68*	*27*	*5*	*35*	*14*	*7*

[1] Accumulation represents trash that originates from upstream sources and pathways that is deposited to downstream location.
Dashed line indicates that the contribution from this pathway could not be quantified.

Differences in trash condition by reach are shown in Table 1 and Figure 1. The greatest average number of trash items for 100-foot section of creek occurred in Reaches 5 and 6, with 106 and 74 trash items respectively. Reach 5 had the greatest average number of trash items per 100 feet from accumulation (63) and Reach 6 had the greatest average number of trash items per 100 feet from direct littering/dumping (70). With the exception of Reach 6, the proportion of accumulated trash items was consistently higher than other pathways across all reaches, ranging from 50% to 85%. Reach 11 had the greatest density of trash attributed to storm drains (12).

Figure 1. Average number of trash items, categorized by pathway, per reach standardized for a 100-foot length of creek. Accumulation represents trash that originates from upstream sources and pathways that is deposited to a downstream location.



Road crossings typically had the greatest concentration of trash associated with litter. Litter at road crossings accounted for nearly 50% of the total amount of litter documented across all the reaches. It is likely that a portion of this trash was deposited by wind from adjacent roadway. This proportion would be much greater if it included stream areas immediately upstream and downstream of bridges. It is important to note that most of assessment area in Stevens Creek was dry or intermittent (i.e., Reaches 4-10 had mostly dry channel). As a result, public access along the channel from road crossings increased opportunities for littering to occur away from bridges.

Table 2 shows total number of trash items documented below 16 road crossings that occurred in the survey area. A total of 6 of the 16 road crossings had more than 100 trash items below high water line (Figure 2). For many of these bridges, the total number of trash items would have been much higher if trash on the banks and above the high water line were included.

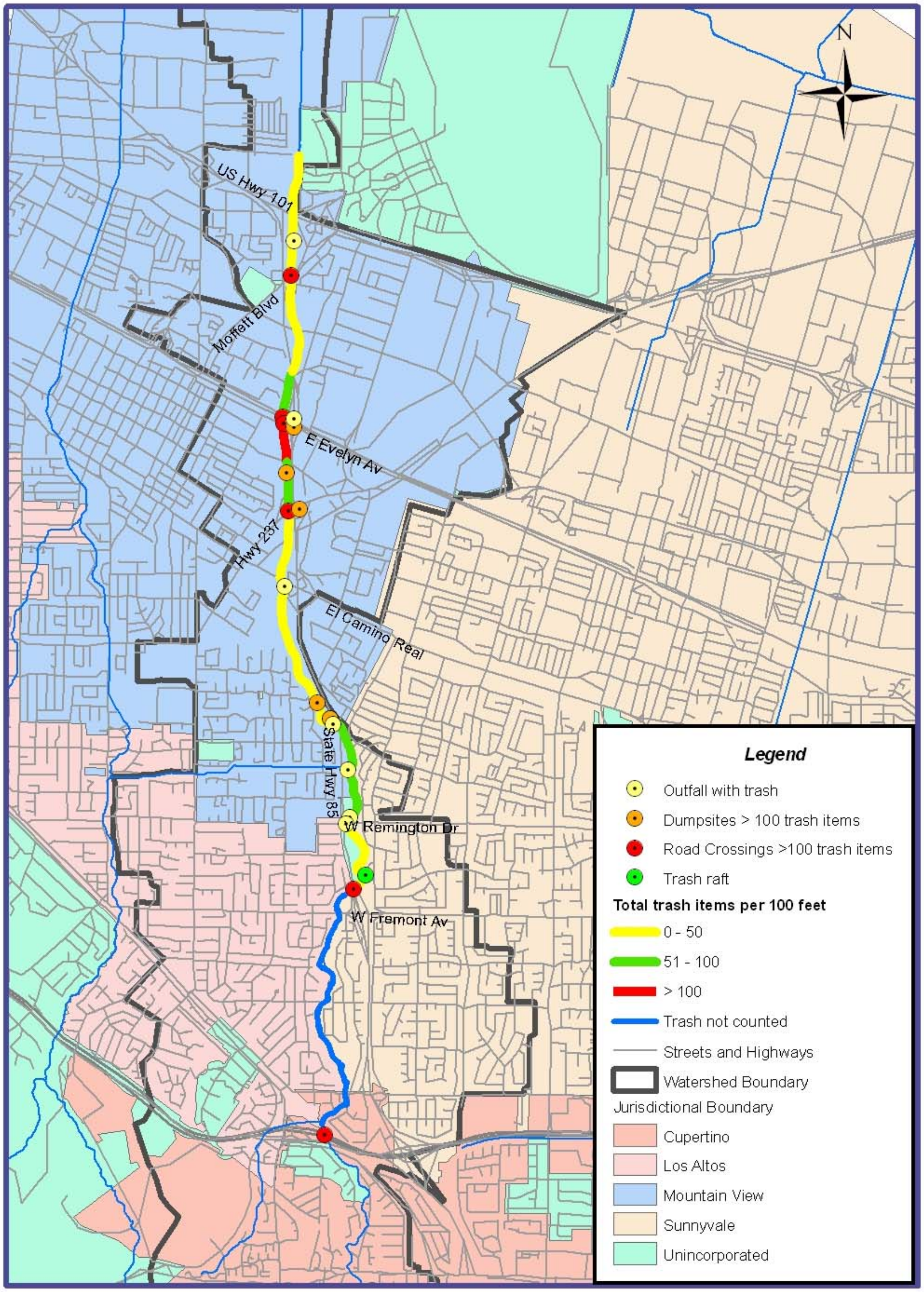


Figure 2. Stevens Creek pilot trash assessment study area showing problem areas identified at road crossings, dumpsites and outfalls.

Table 2. Trash items below high water line (HWL) at road crossings between Hwy 101 to I - 280 in Stevens Creek.

Road Crossing	Trash items tallied below high water line (HWL)			Trash sources above HWL
	Litter/ Dumping	Accum	Total	
Hwy 101	0	15	15	None
Moffett Blvd	160	0	160	None
Middlefield Rd	45	0	45	None
Hwy 85	40	20	60	None
Central Exp/Cal Train	232	70	302	Evidence of homeless activity
Evelyn Av	324	15	339	Dumping on banks
Dana St	40	2	42	Litter on banks (wind?)
85 off-ramp	21	60	81	Litter on banks (wind?)
85 onramp	14	14	28	Litter on banks (wind?)
Hwy 237	225	15	240	Homeless camp and trash pile (> 500 items)
El Camino Real	12	10	22	None
Hwy 85	45	20	65	Homeless camp and nearby dump site
Hwy 85	100	12	112	Graffiti litter (> 500 items)
Fremont Ave	38	21	59	Litter on banks (wind?)
Homestead Rd	20	18	38	Litter on banks (wind?)
Interstate 280	256	4	260	Litter on banks (wind?)

Trash was observed below the seven outfalls identified in Table 3 and Figure 2. Trash was typically observed trapped in vegetation either growing in the main or side channels directly below the outfalls. Three of the outfalls originating from Highway 85 were located on the upper banks a large distance from the main channel. As a result, trash was not tallied for the assessment since they were well above the high water line. Program staff intends to document and report trash conditions of these outfalls to the California Department of Transportation. The remaining 28 outfalls identified during the assessment had minimal or no trash deposition in close proximity to the outfall. <u>It is presumed that no trash was observed below these outfalls due to lack of vegetation and other obstructions that would promote trash deposition</u>.

Table 3. Storm drain outfalls with trash deposition observed during assessment.

Outfall dia (inch)	Reach	Location	Jurisdiction/Agency	Description
72	2	Upstream Hwy 101	Mountain View	~ 100 pieces of Styrofoam trapped in aquatic vegetation
72	6	Evelyn St	Mountain View	10 trash items observed directly below OT; >100 items in vegetation at bottom of overflow, north end of Central Exp
72	9	Upstream El Camino Real	Mountain View/ Cal Trans	93 trash items on bank and channel bed below outfall; ~25 items floating in pool directly below outfall
20	9	Hwy 85	Cal Trans	> 1000 trash items, mostly Styrofoam, in leaf litter across flood prone area; outfall is at least 100 feet from creek
20	10	Hwy 85 at Permanente Div Canal	Cal Trans	~ 100 trash items on upper bank below outfall; directly upstream of Diversion confluence with Steven Cr
72	10	Remington Dr	Sunnyvale	350 trash items trapped in vegetation along 30 feet length of side channel
40	11	Hwy 85	Cal Trans	~ 50 trash items on upper bank below outfall; outfall is about 50 feet from creek, but connected by dirt path

Although total accumulated trash was greatest in the middle and upper reaches (Figure 1), the distribution of trash within each reach was typically ubiquitous (i.e., trash was uniformly distributed in vegetation along stream margins). Additional sites with high accumulation of trash were found in areas with dense vegetation or large woody debris that was obstructing flow. In one case, a large trash raft upstream of a fallen tree was documented in Reach 11 (Figure 2). Other notable accumulation areas were at a large woody debris jam below Permanente Diversion Canal confluence in Reach 10 and the highly vegetated flood prone area below Central Expressway. Large quantities of trash were also observed in areas where the invasive plant, *Arrundo donax,* was growing in the channel.

A total of 9 of the 14 dumpsites documented during the assessment appeared to be associated with old or existing homeless encampments, with 5 of these sites containing at least 100 trash items (Figure 2). The largest dumpsite occurred in Reach 9 and consisted of three large piles of trash at the bottom of the bank behind single-family residences. There was no current public access to the site and it was not clear how the trash got to the site. Three of the 14 dumpsites were associated with apartment complexes.

Discussion

The trash assessment approach used in Stevens Creek Pilot Study met one of the project objectives to assess the extent and magnitude of trash problem areas at larger spatial scales (i.e., provide information on trash condition upstream and downstream existing URTA sites). In addition, the assessment attempted to identify trash items by source and pathway to increase understanding of how trash gets to the creek. However specific trash sources could not be identified for a majority of the trash (68% of total trash items were the result of accumulation from unknown sources further upstream). Furthermore, it is unclear from the assessment results what percentage of the accumulated trash can be attributed to storm drain outfalls in relation to other sources (e.g., littering, dumping or wind).

Additional assessment methods can be implemented to improve the understanding of contribution of trash from outfalls. A list of five methods, including anticipated advantages, disadvantages and estimated costs are shown in Table 4. These methods include:

- Repeated in-stream trash assessments;
- Monitoring trash deposition below selected outfalls;
- Land-based litter audits;
- Structural controls at catchbasins; and
- Structural controls at end of pipe

Repeated in-stream trash assessments would supplement the approach used in Stevens Creek with trash removal and subsequent re-assessment. Assessments could be conducted over time to document trash accumulation rates associated with the entire wet season or for specific peak storm events. These assessments could be conducted at selected reaches that have high trash accumulation, located downstream of large outfalls and have minimal upstream sources associated with in-stream littering and dumping. In cases where there are known high litter sites (e.g., road crossings), trash could be removed from these sites synoptically with the initial in-stream assessments. Re-assessment of trash raft site may be an optimal location to evaluate rate of accumulation following the wet season (2009).

Table 4. Potential trash assessment methods that SCVURPPP could implement to evaluate relative contribution of trash in creeks from storm drain outfalls.

Assessment Method	Description	Advantages	Disadvantages	Estimated Cost
In-stream trash evaluation	• Enumerate and remove trash during at least three seasonal time periods. • Provides rates of deposition relative to changes in hydrograph. • Conduct in areas with higher potential for trash impacts by outfalls	• Rapid and Cost effective • Assess impacts from multiple outfalls • Evaluate effectiveness	• Only trash deposited in channel is assessed • Limited application in areas with prevalent in-stream littering and dumping.	• $15,000 – $20,000 to conduct 3 assessments in 0.5 mile reach • Cost depends on access and trash volume
Outfall trash evaluation	• Enumerate and remove trash during wet season below selected outfalls with suitable characteristics for monitoring • Evaluate litter to identify specific sources in upstream catchment	• Rapid and Cost effective • Provides estimate of total trash from catchment area • Can be extrapolated to other catchment and subwatershed areas	• Only trash deposited in channel is assessed • Limited application in areas with prevalent in-stream littering and dumping.	• About $500 per outfall
Land-based litter audits	• Enumerate and remove trash at selected street locations • Site selection random or known hot spots • Represent range of land use types • Evaluate litter to identify specific sources in upstream catchment	• Rapid and Cost effective • Site information can be extrapolated to provide estimate of total trash potentially entering storm drain systems	• Assumes trash entering storm drain originates from curb and sidewalk areas of streets • High spatial and temporal variability in trash conditions	• About $250 -$500 per site
Structural controls in catchbasin (e.g., inserts)	• Monitoring trash capture provides estimate of total trash generated over given area and land use type	• Effective removal of trash at each catchbasin • Inexpensive to install • Low maintenance costs	• Multiple units necessary to treat entire catchment area • Timing of maintenance is critical, prior and following storm events	• $1,100 per unit; (assuming StormTek device)
Structural controls at end of pipe (i.e., trash nets)	• Monitoring trash capture provides estimate of total trash generated over given area and land use type	• Effective removal of all trash from entire catchment area	• Expensive to install and maintain • High maintenance requirements • Spatial constraints can make siting difficult	• $75,000 – $300,000 for Fresh Creek Netting Trash Trap

Another approach is to monitoring total amount of trash that is deposited below selected outfalls during wet season or peak storm events. This approach is only practical for outfalls with characteristics that promote trash deposition (i.e., setback from main channel and contain vegetation or other obstructions that can filter trash). This approach can provide relative estimates of trash volumes conveyed from a given catchment area. Trash can also be evaluated (e.g., documentation of business labels or brand names) to determine potential source locations. One of the major limitations of this method is lack of outfalls with suitable characteristics. In addition, high percentage of trash discharged from outfall will likely not get deposited, especially during high flow events.

Land-based litter audits are another assessment method that can be used to estimate total amount of trash that may enter storm drain system (Table 4). Existing litter audit methods (MGM 2007) enumerate and categorize trash for standardized length of curb and sidewalk area. Sites can be selected randomly or targeted at known hot spot locations. Site selection should also represent range of land use types found within catchment area. Results for litter audits may then be extrapolated to entire catchment areas. A combination of in-stream trash assessments at selected outfalls and litter audits can be implemented to study trash inputs from individual catchments.

Structural controls can be also be used to assess relative contribution of trash that is conveyed through storm drain systems to the creek (Table 4). Catch basin inserts (e.g., Storm Tek) are the least expensive, relatively easy to install and maintain. The main consideration for the use of catch basin inserts is determining the location and number of inserts needed to effectively remove trash from a catchment area. In contrast, end of pipe controls (e.g., trash nets) can treat entire catchment areas with one device. However, these controls are very expensive and difficult to site and costly to maintain.

Conclusions

- Approximately 6 continuous stream miles were assessed over a 4-day period. The assessment provided a qualitative measure of overall trash conditions averaged by reach (approximately 0.25 to 0.5 mile in length). The assessment also identified several concentrated problem areas such as road crossings, dumpsites, and accumulation sites (e.g., trash raft).

- Reaches 5-7 had the greatest number of trash items (57-106) per 100-foot section of creek compared to all other reaches. These reaches have several major transportation corridors (i.e., Highway 85, Cal Train, Central Expressway and Highway 237) that appear to contribute trash to the creek. Litter and dumping (category also includes wind generated trash) at roadways accounted for about 50% of all litter items identified during the assessment. Graffiti waste was a major contribution of litter at road crossings. Reach 6 had the largest proportion of trash from direct littering and/or dumping (66%).

- High public access to the lower reaches of Stevens Creek increases the potential for littering and dumping. Access is enhanced by the 4-mile long Stevens Creek Trail that runs parallel to the creek from Shoreline Park to El Camino Real. In addition, long sections of dry creek during summer months provide increased access to stream areas.

- About 90% (6 of 7) of the homeless camps identified during the assessment occurred in Reaches 8 and 9. These reaches also had a combined 6 dumpsites; most of them associated with existing or abandoned homeless camps. Five of the documented dumpsites had a minimum of 100 trash items.

- Reaches 10 and 11 show lower levels of trash associated with litter compared to downstream reaches, which is likely correlated with limited public access (i.e., no public trail) and no evidence of homeless camps. However, these reaches had relatively high levels of trash (average of 41-51 trash items/100') that were mostly associated with accumulation. Upstream sources of this trash may be from a combination of storm drains and littering at major road crossings (Highway 85 and Interstate 280). A large trash raft in the upper section of Reach 11 provides further evidence of downstream transport of trash from upstream sources.

- Approximately 32% of the trash identified during the assessment was associated with pathways where trash first enters a creek location (i.e., direct litter/dumping and outfalls). Trash sources (i.e., where trash first enters water body) for the remaining accumulated trash (68% of total trash) could not be identified. In addition, accumulated trash items are typically persistent and transportable (e.g., plastic) and can travel long distances before getting deposited. This trash may have accumulated over long periods of time prior to the assessment, making source identification more challenging.

- Trash associated with storm drain systems could only be documented at outfalls with vegetation or other obstructions to cause deposition of trash. The greatest amount of trash documented during the assessment occurred below the Remington outfall (n=350) where trash was deposited in about 30-foot long side channel with dense growth of blackberry vines. A much higher number of trash items associated with outfalls throughout the study area would likely be observed if more outfalls had similar characteristics as the Remington outfall. As a result, the relative contribution of trash from storm drains is likely to be much higher than the 5% estimated from this assessment.

- Specific trash sources could not be identified for a majority of the trash (68% of total trash items were the result of accumulation from unknown sources further upstream). Furthermore, it is unclear from the assessment results what percentage of the accumulated trash can be attributed to storm drain outfalls in relation to other sources (e.g., littering, dumping or wind).

Recommendations

- Repeat in-stream assessments (URTAs) at selected sites in Stevens Creek. Sites will be selected to represent high trash accumulation areas downstream of outfalls and minimal impacts from upstream sources associated with in-stream littering and dumping. One suggested location is trash raft upstream of fish ladder. Trash was removed from this site prior to rainy season and could be reassessed at end of wet season (2009).

- Recommend conducting one more trash assessment at the Remington outfall at the end of the wet season.

- Consider conducting clean up events at major road crossings prior to rainy season each year to prevent transport of litter to downstream and Baylands areas.

- Provide information on trash condition at problematic outfalls associated with Highway 85 to CalTrans.